XCSoar 7

the open-source glide computer

Podręcznik

30 lipca 2021
For XCSoar version 7.11
http://www.xcsoar.org

Spis treści

1 Introduction **4**
1.1 Organization of this manual 4
1.2 Notes 6
1.3 Platforms 6
1.4 Technical support 6
1.5 Training 7
1.6 Using XCSoar safely 8

2 Installation **9**
2.1 To run XCSoar 9
2.2 ! Before you go out flying the first time with XCSoar ! 9
2.3 How to get the most from XCSoar 9
2.4 XCSoar Checklist 10
2.5 Compatibility 11
2.6 Software installation 12
2.7 Data files 14
2.8 Running XCSoar 15

3 User Interface **18**
3.1 Display elements 19
3.2 Interaction 20
3.3 The main button menu 20
3.4 Menu item overview 21
3.5 Default menu buttons 23
3.6 InfoBoxes and screen pages 24
3.7 Status messages 26
3.8 Dialogue windows 27
3.9 Acoustic alert and sound feedback 29
3.10 Screen visuals 29
3.11 Help system 30
3.12 Interfacing with gestures 30

4 Navigation **32**
4.1 Map display elements 32
4.2 Glider symbol, map orientation 33
4.3 Zoom and map scale 33
4.4 Panning the map 34
4.5 Waypoints 35
4.6 Active task 36

4.7 Terrain and Topography 37
4.8 Trail 38
4.9 Markers 40
4.10 Pilot Event 40
4.11 Thermals 40
4.12 Glide range line 40
4.13 Status tabs '*Flight*' and '*Time*' 42
4.14 Route 42

5 Cross Country Tasks 45
5.1 Goto tasks 45
5.2 Editing tasks 46
5.3 Waypoint Information 46
5.4 Waypoint selector dialogue 49
5.5 Task manager 50
5.6 Task types 53
5.7 Turn Points' task rules 54
5.8 Start a task 56
5.9 Advancing and restarting tasks 56
5.10 Alternate starts 58
5.11 Abort/resume the task and Alternates 58
5.12 Task status 59
5.13 Assigned Area Tasks 60
5.14 Contest 65
5.15 Logger 65
5.16 Flight analysis 67
5.17 Sunlight and time 69

6 Glide Computer 70
6.1 Flight modes 70
6.2 MacCready setting 72
6.3 Glide polar 72
6.4 Flight setup dialogue 74
6.5 Speed command display 75
6.6 Speed to fly 75
6.7 Speed to fly with risk 76
6.8 Safety heights 77
6.9 Final glide calculator 79
6.10 Display of required altitude difference 80
6.11 Task speed estimation 81
6.12 Optimal cruise track 82
6.13 Auto MacCready 83
6.14 Analysis dialogue 85
6.15 Flight notifications 87

7 Atmosphere and Instruments 88
7.1 Variometer 88
7.2 Audio Variometer 89
7.3 Air data inputs 89

7.4 Wind display . . . 89
7.5 Wind estimation . . . 90
7.6 Wind settings dialogue . . . 91
7.7 Thermal profile . . . 92
7.8 Thermal locator . . . 92
7.9 Thermal assistant . . . 93
7.10 Convection forecast . . . 94
7.11 Analysis dialogue . . . 95
7.12 Weather, METAR / TAF . . . 96
7.13 Weather forecast, RASP . . . 96
7.14 pc_met, Deutscher Wetterdienst . . . 100

8 Airspace, Traffic and Team Flying 102
8.1 Airspace display . . . 102
8.2 Airspace warnings . . . 103
8.3 Airspace query and details . . . 105
8.4 Analysis dialogue . . . 106
8.5 FLARM traffic . . . 107
8.6 Team flying . . . 109

9 Avionics and Airframe 111
9.1 Battery life . . . 111
9.2 GPS connection . . . 111
9.3 Switch inputs . . . 112
9.4 Vega switch dialogue . . . 113
9.5 Slave mode . . . 113
9.6 System status . . . 114
9.7 Multiple devices . . . 114
9.8 Managing external devices . . . 114

10 Quickstart 115
10.1 Local flight . . . 115
10.2 FAI Task . . . 116
10.3 AAT Task, Manual Arm . . . 117

11 InfoBox Reference 121
11.1 Altitude . . . 121
11.2 Aircraft state . . . 122
11.3 Glide ratio . . . 123
11.4 Variometer . . . 123
11.5 Atmosphere . . . 124
11.6 MacCready . . . 125
11.7 Navigation . . . 126
11.8 Competition and assigned area tasks . . . 127
11.9 Waypoint . . . 128
11.10 Team code . . . 129
11.11 Device status . . . 129
11.12 Alternates . . . 129
11.13 Obstacles . . . 130

11.14 Radio 130

12 Configuration **131**
12.1 Scope of configuration 131
12.2 Modifying settings 131
12.3 Configure System 132
12.4 Site Files / Site Files 132
12.5 Map Display / Orientation 133
12.6 Map Display / Elements 134
12.7 Map Display / Waypoints 135
12.8 Map Display / Terrain 136
12.9 Map Display / Airspace 137
12.10 Glide Computer / Safety Factors 139
12.11 Glide Computer / Glide Computer 139
12.12 Glide Computer / Wind 140
12.13 Glide Computer / Route 140
12.14 Gauges / FLARM, Other 141
12.15 Gauges / Vario 141
12.16 Gauges / Audio Vario 142
12.17 Task Defaults / Task Rules 142
12.18 Task Defaults / Turnpoint Types 144
12.19 Look / Language, Input 144
12.20 Look / Screen Layout 145
12.21 Look / InfoBox Pages (or just Pages) 145
12.22 Look / InfoBox Modes (or InfoBox Sets) 146
12.23 Setup / Logger 146
12.24 Setup / Units 147
12.25 Setup / Time 147
12.26 Setup / Tracking 148
12.27 Configure Plane 149
12.28 Configure Devices 149

13 Data Files **151**
13.1 File management 151
13.2 Map Database 152
13.3 Waypoints 152
13.4 Airspace 153
13.5 Airfield details 153
13.6 Glide polar 154
13.7 Profiles 155
13.8 Checklist 155
13.9 Tasks 156
13.10 Flight logs 156
13.11 FLARM Identification 156
13.12 Input events 157
13.13 Status 157

14 History and Development **159**
14.1 Product history 159

14.2 Get involved 160
14.3 Open source philosophy 161
14.4 Development process 162
14.5 User base 162
14.6 Credits 163

A GNU General Public License **167**

Preface

Warnings and precautions

IT IS THE USER'S RESPONSIBILITY TO USE THIS SOFTWARE PRUDENTLY. THIS SOFTWARE IS INTENDED TO BE USED ONLY AS A NAVIGATION AID AND MUST NOT BE USED FOR ANY PURPOSE REQUIRING PRECISE MEASUREMENT OF DIRECTION, DISTANCE, LOCATION, OR TOPOGRAPHY. THIS SOFTWARE SHOULD NOT BE USED AS AN AID TO DETERMINE GROUND PROXIMITY FOR AIRCRAFT NAVIGATION. THIS SOFTWARE SHOULD NOT BE USED AS A TRAFFIC COLLISION AVOIDANCE SYSTEM.

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1 Introduction

This document is a pilot's manual for XCSoar, an open-source glide computer originally developed for Pocket PC devices. The audience is assumed to have a sound knowledge of the fundamental theory of flight for gliders, and at least a basic working knowledge of cross-country soaring.

Updates to the XCSoar software may result in some of this manual being out of date. You should read the release notes distributed with the software to keep track of changes. Updates to the manual and software are available from

http://www.xcsoar.org

1.1 Organization of this manual

This manual most notably is written in order to get the XCSoar user started quickly *as well as* support his deep understanding of all the features, concepts and tactics introduced. At all times, the authors made their effort for doing this from a pilot's perspective (and honestly hope for having succeeded).

The authors highly encourage you to take your time reading the entire manual chapter by chapter (with exception of the reference chapters Infoboxes and Configuration). Feel assured, the time you will have spent will pay off as a manifold in understanding. On your way reading you might feel blue once in a while. That is why the authors introduced some blueish things: links and icons.

Rysunek 1.1: Icons configuration, reminder, gesture, warning

Warning. The icon warning is used, whenever things shall be followed strictly. Not following will cause unexpected results, total dysfunction, or even danger to life. Proceed only, if warning understood.

DU

Gesture. A swipe gesture input is available using devices with a touch screen to invoke a menu or function amongst others. In this example, DU stands for moving your fingertip down, then up, (in straight lines) on the screen.

Specific Gesture. Whenever the manual's authors kept up with XCSoar's

rapid development process in writing, a specific icon is provided, depicting the movements.

Reminder. This icon tags a tip, trick, things you might remind after having read corresponding sections and so on.

12.5

Configuration see... The icon depicting two craftsman's tools refers to an in-depth description of items being mentioned and how to configure them. The numbers beside the icon refer to a specific chapter / section of this manual's reference chapters 11 and 12, in this case referring to section 12.5.

Stop from reading manuals whilst flying inverted!

Read at home, *configure* on the ground, safely. Having perceived this (inverted) warning as an example, you are ready to proceed.

1.6

Referring to the second exemplary case of the icon "configuration" to the left, the icon points towards chapter 1, (this chapter), section 1.6, "Using XCSoar safely" underneath, which could be understood as a "how to configure yourself". It is up to you whether to jump to an in depth discussion and go back or just proceed. If reading this manual electronically, clicking the number will let you jump to the requested cross -reference. Use the go-to "back" (or similar) function of your particular browser to proceed with the chapter you jumped from.

The numbers are printed in blue as are the icons introduced, signalling "help available". And so are other Universal Resource Locators, underlying blue text. Clicking on text like `http://www.xcsoar.org/contact` will open your world wide web browser or mailer to get in touch with other resources or knowledgeable people respectively.

The remainder of this chapter "Introduction" is about getting you prepared for XCSoar, how to raise your level of understanding and maintain your skills. Chapter 10 "Quickstart" might be the next waypoint after 2 "Installation" for the urgent user. Feel free to cut short, but do not resume too sadly when reading chapter by chapter, following:

Chapter 3 introduces the user interface concepts and gives an overview of the display .

Chapter 4 describes the moving map part of the display in greater detail and describes how the software can assist in general navigation. Chapter 5 describes how cross-country tasks are specified and flown, and presents some of the analysis tools available to pilots to help improve their performance. Chapter 6 goes into further detail on the glide computer functions as it is important for pilots to be aware of how the computer performs its calculations.

Chapter 7 describes how the computer can interface to variometers and other air data sensors, and how it uses these measurements to provide various models of the atmosphere, in particular on winds and thermal convection. Chapter 8 describes how XCSoar can assist in

managing flight in special use airspace and the FLARM collision awareness system. Chapter 9 deals with systems integration and systems diagnostics, the integration of XCSoar with communications devices and with airframe switches.

The remainder of the manual contains mainly reference material. Chapter 11 lists the types of information that can be displayed in the grid of InfoBoxes next to the map display. The configuration of the software is described in detail in Chapter 12. The formats of the various data files that program uses, as well as where to obtain them from and how to edit them, is described in Chapter 13.

Finally, a short history and discussion of XCSoar's development process is presented in Chapter 14.

1.2 Notes

Screenshots

Throughout this manual are several screenshots of XCSoar. These are taken from the program running on a variety of hardware platforms and possibly even different versions. Each platform and version may have different screen resolutions, layouts and fonts, and so there may be slight differences in the appearance of the display. Most of the screenshots in this manual are taken of XCSoar running in landscape orientation.

1.3 Platforms

Android Devices : XCSoar runs on Android 1.6 or newer.

eBookreader : XCSoar runs on several Kobo eReader devices.

Windows PC : It is possible to run XCSoar on an ordinary computer with the Windows operating system (Vista and above). This setup can be used for training yourself in using XCSoar. A simulation mode is included in XCSoar as well as a IGC replay function, that can be used when not connected to a valid GPS source.

Unix/Linux PC : XCSoar runs on Unix/Linux.

1.4 Technical support

Troubleshooting

A small team of dedicated developers produces XCSoar. Although we are happy to help with the use of our software, we cannot teach you about basics of modern information technology. If you have a question about XCSoar in particular not found in this manual please get in touch. You will find all of the following links summarized at:

http://www.xcsoar.org/contact

To begin with communication, join the XCSoar forum at:

http://forum.xcsoar.org

If your concern appears not already addressed, post it or email us:

xcsoar-user@lists.sourceforge.net

Any frequent questions will be added to this document. You may also find it useful to subscribe to the XCSoar users mailing list so you will be kept up to date with latest developments.

If all of this does not help, you probably discovered a bug.

Feedback

Like any complex software program, XCSoar may be subject to software bugs, so if you find any, please report them to the XCSoar developers by using our bug tracker portal at:

http://www.xcsoar.org/develop/new_ticket.html

or by sending an email to

xcsoar-devel@lists.sourceforge.net

XCSoar logs many valuable things in a logfile `xcsoar.log` in the `XCSoarData` directory. The logfile can be appended to the bug ticket in order to help XCSoar developers determine the cause of possible problems. If you like the idea of doing some more, get involved:

http://www.xcsoar.org/develop

Updates

You should periodically visit the XCSoar website to check for program updates. The installation procedure in the following chapter can typically be repeated in order to upgrade the software. All user configuration settings and data files will be preserved during the reinstallation/upgrade.

It is also recommended to periodically check for updates to data files, particularly Special Use Airspace, which may be subject to change by the national civil aviation authority.

1.5 Training

For the safety of yourself and others, pilots using XCSoar are advised to train themselves in using XCSoar on the ground and become familiar with its interface and features prior to flight.

Using XCSoar on the PC

The PC versions of XCSoar may be used to become familiar with XCSoar's interface and functionality in the comfort of one's home.

All files and configuration used by this version are identical to the embedded versions, so it can be helpful to try out customisations on the PC version before using them in flight.

The PC versions can also be connected to external devices and operate just as the embedded versions do. Suggested uses include:

- Connect the PC to a FLARM device to use XCSoar as a ground station display of FLARM-equipped traffic.
- Connect the PC to an intelligent variometer such as Vega to test configuration settings of the variometer.

Using XCSoar with a flight simulator

A good way to learn how to use XCSoar is to connect the smartphone device to a PC running a flight simulator that can output NMEA sentences to the serial port. Suitable simulators include Condor and X-Plane.

The benefit of this form of training is that XCSoar can be used in FLY mode, so it behaves exactly as if you were really flying, and you can get a good feel for how the program works while you are flying the simulator.

1.6 Using XCSoar safely

The use of an interactive system like XCSoar in flight carries with it certain risks due to the potential distraction of the pilot from maintaining situational awareness and eyes outside the cockpit.

The philosophy guiding the design and development of the software is to try to reduce this distraction by minimising the need for user interactions as much as possible, and by presenting information in a clear fashion able to be interpreted at a glance.

Pilots using XCSoar must take responsibility for using the system safely. Good practice in the use of XCSoar includes:

- Becoming familiar with the system thoroughly through training on the ground.
- Performing clearing turns before interacting with XCSoar in flight in order to ensure there is no collision risk with other traffic.
- Setting up the system to take advantage of automatic functions and input events so that user interactions can be minimised. If you find yourself mechanically performing certain interactions frequently, ask yourself (or other XCSoar users) if the software can be made to do these interactions for you.

2 Installation

2.1 To run XCSoar

you need to obtain the following:

- a device to run XCSoar on
- XCSoar
- a GPS receiver
- a waypoint file
- an airspace file (optional)
- a map file (optional)

2.2 ! Before you go out flying the first time with XCSoar !

After having installed XCSoar successfully, you might use it instantly. XCSoar will launch with a ready-to-use pre-configuration. But be aware, that up to this point your new toy will give you a moving map display only. *Don't trust the computations.* You have to tell XCSoar which plane you are flying in advance. This is done by specifying your plane's data as are polar, weight and some other data. However it's always a good idea to study the manual and become familiar with XCSoar at home.

2.3 How to get the most from XCSoar

In order to achieve your maximum benefit from XCSoar, you are kindly asked to do some more after having installed the software and downloaded some data files. "Some more" includes personal and plane data as well as configuration of just a few features. Unless you are willing to tweak everything XCSoar provides, this could be done in a rather short time. Necessary steps are summarized in an *XCSoar Checklist*, given in the next section.

If you are planning to arrange a system with several components engaged in, this manual will give you valuable advice on both, how to set up things and how to use them.

If you are a pilot in a hurry, the authors suggest to change to the short form manual `XCSoar-in-a-Flash` going through the *XCSoar Checklist* step by step. The short form manual is available on http://www.xcsoar.org/discover/manual.html.

2.4 XCSoar Checklist

Bring XCSoar into play

- get hardware and install XCSoar
- get appropriate data files of your flight district
- tell XCSoar which data files to use
- tell XCSoar about the glider's polar & weight
- possibly connect to instruments
- finish setup and familiarize
- mount hardware
- add items listed underneath to your checklists
- make "home"

Conduct preflight check, including

- setup polar and weight
- setup wind and flight parameters (MC, bugs, QNH)
- possibly setup a task

Conduct start check, including

- Check wind and flight setup once more

Fly, enjoy

Conduct after flight check

- Download flight logs from logger, upload to skylines and OLC
- Gather statistical data of flight.

2.5 Compatibility

Devices for running XCSoar

XCSoar runs on the following platforms:

- Android mobile phones and tablets with Android 1.6 or newer Example: Dell Streak, Samsung Galaxy S II, HTC Desire HD, Motorola Xoom
- eReader Kobo
- Windows 2000 or newer
- Linux
- Mac OS X (outdated)

GPS, Logger, Vario

XCSoar is compatible with any GPS emitting NMEA data. Most modern Android devices have a built-in GPS, but for several reasons it is favorable to connect to one or more external devices:

- a specialized GPS receiver gains much better reception providing much better data for measures and calculations
- an airspeed indicator allows quick and exact wind estimates without circling
- a vario improves the thermal assistant
- a task can be declared to an IGC logger, and after landing, the flight log can be downloaded
- some varios allow synchronising the MacCready setting with XCSoar
- FLARM (and even ADS-B input) provide informations and states of others around you (and of course FLARM gives you collision detection)

Supported external devices and features

Supported:	-Features			-Stream Data				
NMEA Device	Declaration	Remote ctrl.	Download	Airspeed	Vario	Baro. altitude	Wind	G-Sensor
Borgelt B50		√		√	√	√		
CAI 302	√	√	√	√	√	√	√	√
CAI GPS Nav								
Condor				√	√	√	√	
Digifly Leonardo				√	√	√	√	
EW Logger	√					√		
EW microRecorder	√					√		
FLARM	√		√			√		
Flymaster F1					√	√		
Flytec 5030				√	√			
ILEC SN10					√	√	√	
IMI ERIXX	√		√					
LX20, Colibri	√		√			√		
LXNAV Nano	√		√					
LXNAV V7		√		√	√			
PosiGraph	√					√		
Triadis Altair (pro)	√					√		
Triadis Vega		√		√	√	√		√
Vaulter		√		√	√	√	√	√
Volkslogger	√		√			√		
Westerboer VW1150		√		√	√	√		
XCVario		√		√	√	√	√	√
Zander / SDI		√		√	√	√	√	

While most Windows CE based devices have a serial port, such legacy hardware is not present in modern Android devices. Those can either use Bluetooth or the Android IOIO board. To use Bluetooth, you need to connect the external device to a Bluetooth-to-Serial adapter, such as the K6-Bt or the SoarTronic-BT1/2.

2.6 Software installation

The software is available as a free download from the XCSoar website http://www.xcsoar.org. This section describes which file should be downloaded, and how to install it.

On Android

Obtain XCSoar from Google's Android market, or install the `apk` file manually. Copy the data files on the SD card in the directory `XCSoarData`.

On a Kobo Mini

The Kobo Mini is a cheap e-book reader. It has a black and white e-paper screen with excellent sunlight readability.

Before you begin: back up the internal SD card. The XCSoar installer may break the Kobo, though unlikely. You can always recover the Kobo from a software failure, but only if you have access to a backup.

To install XCSoar, connect the Kobo to your PC via USB. The Kobo exposes a mass storage device to your PC; open it and create a directory called `.kobo` (note the leading dot). Download the file `KoboRoot.tgz` from the XCSoar website into that directory (http://www.xcsoar.org/hardware/). Unplug the Kobo and reboot it (switch it off completely, and switch it on again). You will see the message "Updating", and after a few minutes, the Kobo shows a menu that allows you to launch XCSoar or the Kobo e-book reader software.

To copy data files (maps, waypoints, ...) to the Kobo, launch the original Kobo software ("Nickel") and connect the Kobo to your PC again. Copy the files into a directory called `XCSoarData` at the top level.

Alternatively data files may be downloaded via XCSoar's file manager, after having invoked a WLAN connection just before launching XCSoar.

Hacking the Kobo

After installing XCSoar on the Kobo, the new boot script checks for a script called `XCSoarData/kobo/init.sh` and executes it. If you know what you're doing, you can use this script to do things at boot time, for example launch `inetd` (for `telnet` access).

When you launch `Nickel` (the original e-book firmware), the new boot script also checks for a script in `XCSoarData/kobo/` named `init_nickel.sh` and executes it. Again, if you know what you're doing, you can use this script to do things before `Nickel` is fully started, for example send commands to your attached vario (to shut it down, to cut the volume, etc...).

On a Windows PC

Download the program file `XCSoar.exe` (target "PC") to your hard disk.

On Unix/Linux

The file downloaded is `xcsoar_XXX.deb`, where `XXX` includes the version number and platform, e.g. `xcsoar_6.0.4_i386.deb`. This is a Debian package and can be installed using

```
sudo dpkg -i xcsoar_XXX.deb.
```

Use `dpkg-query -L xcsoar` to see where the executable and other files are installed, Additional data files must be placed in the directory `~/.xcsoar`. If `~/.xcsoar` does not exist, it will be created the first time that `xcsoar` is run.

On Raspberry Pi and Cubieboard

Install the Debian package as described above. However, unlike on "regular" Linux, XCSoar will not use X11. Instead, it runs full-screen on the Linux console.

On the Raspberry Pi 4, you need to enable the VC4 display driver by adding the following line to `/boot/config.txt`:

```
dtoverlay=vc4-fkms-v3d
```

XCSoar requires access to your input devices (`/dev/input/event*`). By default, only `root` is granted access. To override this, create a udev configuration file, e.g. `/etc/udev/rules.d/99-input.rules`:

```
KERNEL=="event*", NAME="input/%k", MODE="660", GROUP="input"
```

Create the group `input` and make your user a member:

```
groupadd input
adduser pi input
```

2.7 Data files

To be able to use XCSoar's advanced features, additional data files, such as terrain, topography, special use airspace, waypoints etc. are needed. The files that can be used with XCSoar are described in Chapter 13.

All data files should be copied into the directory `XCSoarData`. This directory must be in a specific place so that XCSoar knows where to look for data files:

Windows PC : `XCSoarData` is in your personal folder ("`My Documents`")

Windows Mobile PDA/PNA : If there is a directory named `XCSoarData` in the same directory as `XCSoar.exe`, then this one will be used. `XCSoarData` is on the SD card. If there is no SD card, then XCSoar looks for it in `My Documents`.

Unix/Linux : The directory is called `.xcsoar` in the user's home directory.

Android Devices : `XCSoarData` is on the SD card.

XCSoar will generate a number of additional files at run time. These will be placed in the `XCSoarData` directory (Windows PC, Windows and Android mobile devices), or the `.xcsoar` directory (Unix/Linux PC). From the first run, XCSoar will create and maintain the files `user.cup` (user-edited waypoints), `Default.tsk` (Default Task),

`default.prf` (configuration settings), `xcsoar.log`, plus three directories: `cache`, `config` and `logs`. Additional files may be created/modified while XCSoar is running, such as task files (`*.tsk`) and flight logs.

2.8 Running XCSoar

Two modes are available inside the XCSoar application:

FLY : This mode is used when actually flying. The simulator is disabled and serial communications are active.

SIM : This starts XCSoar in simulator mode, no serial communications are attempted.

XCSoar PC version

The program can be run by opening the explorer window, finding the directory that has the XCSoar.exe executable, and double clicking on that program file.

The program command line options allows the screen orientation of the display to be defined:

-portrait : The screen is 480 pixels wide, 640 pixels high.

-square : The screen is 480 pixels wide, 480 pixels high.

-landscape : The screen is 640 pixels wide, 480 pixels high. This is the usual setting. If you don't specify this parameter the landscape version will be loaded automatically.

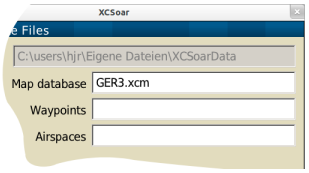
-small : Draws the screen at half size. This is useful for using XCSoar in conjunction with flight simulators e.g. Condor.

To change the screen orientation, it is convenient to create a shortcut to the program, then right click on the shortcut icon and click on "Shortcut". In the field "Target" add one of the desired options listed above.

XCSoar Unix/Linux PC version

Run `xcsoar` from a command line, or create a shortcut on the desktop. The location of the executable file may be found using `which xcsoar`. Only landscape mode is supported for now.

Loading data files



The first time that XCSoar is run, it does not automatically load the data files that you placed in the `XCSoarData` directory. To tell XCSoar which files to load, double click/tap the map (the large, blank white part with the glider symbol in the center), choose the menu Config 2 (click/tap it twice), then select the item System . The Configuration screen should be displayed: The first page allows you

to choose the map, waypoint and airspace files, by clicking/tapping on the text boxes. Many other features of XCSoar may be configured here. These are described in detail in Chapter 12. Once completed, XCSoar reloads those files; from now on, the data files will be loaded automatically at run time.

Start-up and user profiles

When XCSoar starts up, it will check for existing profiles. If multiple profiles are detected it will display a small window asking you which profile to load. To proceed, choose the desired profile and press Enter. If no profile is chosen the settings from the last session are loaded again. Profiles can be useful for example in the following cases:

- Different pilots
- Competition versus casual flying
- Flying in different locations
- Different planes (with different polars)

Profiles also might be understood as preserving a backup of a certain configuration. Virtually every of XCSoar's settings is stored in a profile file with extension `.prf`. Once you are happy with all your settings, make two copies of your profile file. One carrying extension `.prf`, the second copy carrying extension `.bak`. Whereas the `.prf` file will show up on startup and reflect all of your changes made whilst XCSoar is running for the next startup, the file `.bak` will keep the settings, you judged being worth it to preserve. As an example you might create a set of files as is:

- `buddiesinArcus.prf`
- `buddiesinArcus.bak`
- `johninKa6atwonderland.prf`
- `johninKa6atwonderland.bak`

SIM mode

XCSoar comes with a simple interface allowing for conducting a simulated flight. Depending on the hardware platform, there are different methods for altering values of bearing, speed, and height. Simulation is intended for your first familiarization with XCSoar in action. If you like the idea simulating a more realistic thing at home, you should acquire a "true" soaring simulator, to be connected to XCSoar.

On the map screen, clicking/touching the glider symbol with touchscreen or mouse and dragging causes the glider to move in the direction of the drag, the speed being proportional to the length of the drag.

With buttons, the aircraft speed, altitude and direction may be changed using the Infoboxes. The following may not be available in total

on every hardware platform, but on any of the platforms XCSoar supports, a full set of inputs needed for simulation purposes is possible.

By pushing an Infobox, you select a value to be altered by buttons, either hardware or menu buttons. The aircraft altitude can be adjusted by selecting the GPS altitude InfoBox Alt GPS , and touching the up or down key or buttons on the touchscreen. The airspeed can be adjusted by selecting the Infobox ground speed V Gnd , touching up or down key or menu buttons. The glider's track can be adjusted by selecting the track InfoBox Track , and touching up/down buttons.

With either of the Alt GPS or V Gnd selected, the glider's direction may be changed using the left/right keys.

Other controls, buttons and menus work the same as in FLY mode.

Splash screen

When XCSoar starts up, shuts down, or loads large files, such as airspace, waypoints, terrain, etc., a progress screen is presented while the data is being loaded. This screen has a progress bar which indicates the data loading activity, and a short line of text describing the action that is being performed.

This screen also displays the software version information.

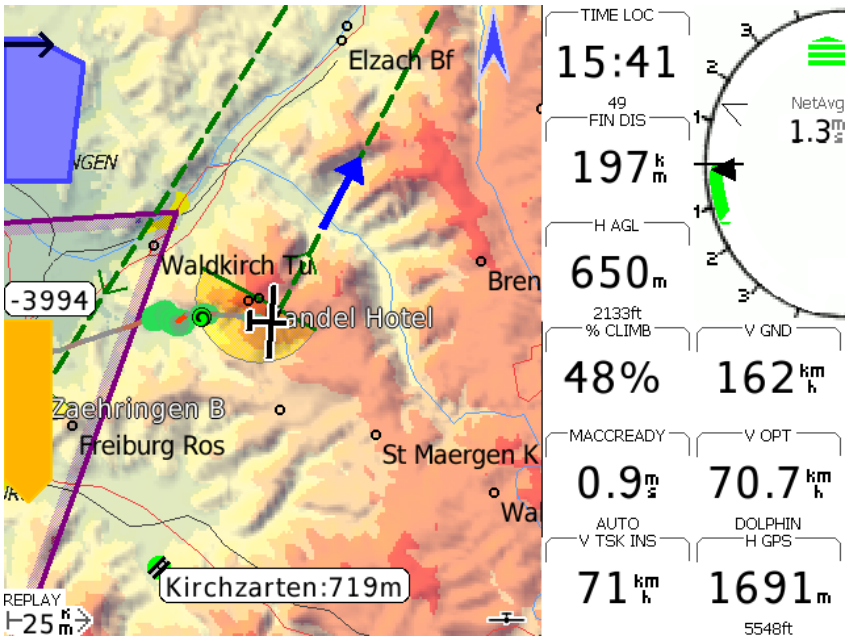
Exiting the program

For PDA and PC versions, XCSoar is shut down from the menu. The menu can be opened by double-clicking on the map or the InfoBoxes.

QUIT

For PC versions, XCSoar can also be shut down by clicking the close icon on the XCSoar window.

3 User Interface



Rysunek 3.1: Typical XCSoar main screen layout

This chapter describes the fundamental user interface concepts used by XCSoar, and is intended as an overview. The *main screen* covers much of the information needed during normal flight. Typically, the main screen is composed of the moving map and infoboxes. For several reasons - not being the scope of an introduction - you have a choice of using several main screens in-flight, named *screen pages*.

Screen pages are easily accessed by a horizontal swipe gesture just like turning pages of a book or button push, depending on the hardware you use. With screen pages you are enabled to compose several main screens to be used advantageously in different situations in-flight. Simply speaking, you are enabled to use appropriate information in different *use cases*, to be accessed quite simply and fast.

Whenever actual situations are worthy of grabbing the pilot's attention, an *overlay* is put in front of the main screen. This happens especially when urgent reaction by the pilot is required as are the situation of a possible collision or an entering of a restricted airspace expected to happen soon.

Evidently, menu buttons and menu screens are overlays too, and there are many more. As a result, the elements put on each other form a display stack with the main screen representing the base of it. More detailed descriptions are given in following chapters.

3.1 Display elements

Main screen and screen pages

Every screen page out of XCSoar's screen pages' ensemble is composed of several parts:

Main area : The bulk of the screen typically is dedicated to the GPS moving map display. Various symbols relating to glide computer information are overlaid the map area. Icons and text may appear along the lower edge of the screen to indicate status of connected devices, flight modes etc. Following the development process of XCSoar there is an increasing number of items that may be chosen for display in the main area, which are gauges, FLARM Radar, Thermal Assistant and Horizon.

InfoBoxes : A grid of data values is displayed usually either along the top and bottom of the screen (portrait display) or to the left and right of the screen (landscape display). These so-called InfoBoxes display data from the GPS and other input devices as well as data calculated by XCSoar. Further, InfoBoxes can even display gauges and certain graphs.

Bottom area : At the bottom of the screen, XCSoar is able to draw a cross-section of terrain and airspaces in the direction of your heading.

Overlays

Gauges : Gauges provide instrumentation displays. All gauges are optional and some may only have meaningful information displayed when XCSoar is connected to a supported instrument. A gauge overlay is either permanently drawn or is invoked by several conditions. E.g. the thermal assistant is shown, when XCSoar enters circling mode. The FLARM radar is invoked, whenever a probable collision is detected. Permanently overlaid gauges are the final glide bar as well as the vario bar amongst others.

Button labels and menus : Hardware buttons on the device running XCSoar can be used to bring up and navigate smaller on-screen menus that are typically laid out such that menu items can be selected by pressing the button adjacent to the item. If the device has a touch screen, the menu items can be selected by touching them. These buttons are drawn in black text on a grey background.

Status messages : Text is displayed over the screen in status message boxes. This text is used to present detailed information to the pilot when certain events occur.

Dialogue windows : Larger dialogue windows, usually containing graphics and buttons, are used to present detailed data to the pilot regarding waypoint details, statistics and analysis etc.

Main menu : The main menu is accessible by double tapping the map area or InfoBoxes as well as through gesture. If the menu buttons are not pressed after a specified time, they disappear again so as to not obscure the map area.

Classic vario gauge

As said above, gauges might be displayed in different ways, either as an infobox, overlay, or even in the main area. The traditional variometer gauge is different. This needle-style gauge is invoked permanently by choosing an infobox layout including the variometer on the right side of the other infoboxes.

3.2 Interaction

There are several ways to interact with XCSoar:

- Touching certain map elements
- Touching InfoBoxes and on-screen menu buttons
- 'Gesturing', by e.g. drawing a dash from the left to the right on the screen (see Section 3.12 below).
- 'Dragging' the screen (touching the screen and moving before releasing).
- Pressing application buttons on the device.
- Pressing the cursor keys on the device.
- Pressing keys or switches on an instrument connected to XCSoar.

Depending on the particular hardware used with XCSoar, not all of these methods of interaction are possible and there may be different numbers or assignments of buttons.

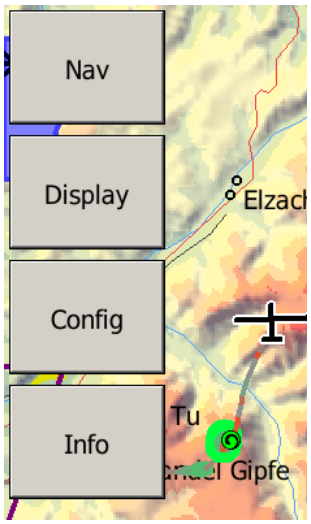
For the PC version of XCSoar, clicking the mouse over an item is equivalent to touching it.

3.3 The main button menu

The button menu is a set of buttons drawn on the screen and activated by touch or hardware button presses. Using buttons and the button menu is the primary way the user interacts with XCSoar.

Interface basics

The menu is organised into four different groups of functions, usually in the form of a hierarchy. The specific menu layout depends on the hardware button configurations and platform, and may also be customised by the user.



XCSoar can also accept input from external keyboards, game-pads, joysticks, stick grip switches etc. A wide variety of functions can be assigned to these inputs.

On the PC version, these mode buttons are activated by the 1, 2, 3 and 4 keys. The 6, 7, 8, 9 and 0 keys correspond to the horizontal strip of buttons.

If the user doesn't interact with the computer for some time, the menu will close automatically. This menu time-out is configurable. The escape key on PC can also be used to close the current menu.

Menu buttons appear greyed out if the corresponding function is not available. For example, the "Waypoint list" function will appear grey if there are no waypoints loaded.

Several menu button labels have dynamic text based on context, in order to make it clearer as to what happens when the button is pressed. The convention is used that a button's label describes what will happen when the button is pressed. For example, if the button says MC Auto , then pressing the button will turn on 'Auto MacCready', and the button label will then change to MC Manual . In the menu list described below, generic labels are used.

Menu function groups

This section describes the default layout of the menu system on all platforms. The functions performed by each button are explained more fully in following chapters.

For the PC version, the keys 1, 2, 3 and 4 activate the corresponding menu. The following menu item list has on the left side of most of the menu buttons links to the respective section. Follow them to get to all related details.

3.4 Menu item overview

Navigation menu

Nav 1/2	Task	Previous Turnpoint	Next Turnpoint	Waypoint List	Alternates
see	5	5.9	5.9	5.4	5.11
Nav 2/2	Task Abort	Mark Drop	Pilot Event	Target	
see	5.11	4.9	4.9	5.3	

You should not start using XCSoar without knowing about the 'Alternates' feature. Any 'Task' related item in the navigation menu is used for planned cross country flight and certainly the second step.

Display menu

Display 1/2	Zoom In	Zoom Out	Zoom Auto	Info Cruise/...	Pan On
see	4.3	4.3	4.3	3.6	4.4
Display 2/2	Labels All/...	Trail Full/...	Terrain On/Off	Topo. On/Off	Airspace On/Off
see	4.7	4.8	4.7	4.7	4.7

Most of the display menu items are available on gestures, or special key short-cuts of your device. Once you are familiar with XCSoar you probably will use those menu items less frequently.

Configuration menu

Config 1/3	MacCready +	MacCready −	MacCready Auto	Flight	Wind
see	6.6	6.6	6.13	6.4	7.6
Config 2/3	System	Plane	Devices	File Manager	Replay
see	12	6.3	12.28		5.15
Config 3/3	Logger Start	Raw Logger	Airspace	Vega	Profiles
see	5.15	5.15	8.3		

The configuration menu is typically part of the ground interaction with XCSoar. You are not expected to spend much time in-flight with tweaking the configuration, except you manually adjust wind or MacCready settings. The 'Vega' item gives control over the Vega intelligent variometer. This comprises a sub-menu.

Information menu

Info 1/3	FLARM Radar	METAR TAF	What's here?	Check list	Analysis
see	8.5	7.12		3.8	5.16
Info 2/3	Status	Weather	Team Code	FLARM Details	Thermal Assistant
see	4.13	7.13	8.6		7.9
Info 3/3	Credits	Airspaces	Message Repeat		
see	14.6				

The information menu is always a good address, when not only a clue on how to set MacCready is requested, but rather more elaborate help on a larger scope tactical decision on your flight is requested.

The Vega variometer sub-menu of the configuration menu

Vega 1	Airframe Switches	Setup Audio	Manual Demo	Setup Stall	Accel
Vega 2	ASI Zero	Accel Zero	Store	Cruise Demo	Climb Demo

The functions in this sub-menu require the Vega intelligent variometer. The menu can only be accessed if 'Vega' is selected as the connected device.

The pan mode sub-menu of the Display menu

Pan	Pan Off	Zoom in	Zoom out	What's here?
see	4.4			

This sub-menu unfortunately overlays the full-screen map view of the pan mode. Its functions are quite evident, although the menu could be replaced by multi-touch technology or knobs. Besides the essential 'exit pan mode' function the 'What's here?' button offers brilliant access to the variety of information of the map.

3.5 Default menu buttons

When no menu is active, (so-called default mode), the horizontal row of buttons perform the following functions (from left to right):

PC:	6	7	8	9	0
	Flight	Task Manager		Target	Drop Mark

For all other versions in the default mode, the cursor keys perform the following functions:

Up key :	Zoom in
Down key :	Zoom out
Left key :	Drop marker
Right key :	Toggle through normal/aux. InfoBoxes and full-screen
Enter :	Clear status message or suppress FLARM gauge if open and no warning active

Dynamic menu labels

Certain menu items have dynamic labels to make it clearer what happens when the menu item is selected. Furthermore, items that are not available are greyed out to indicate that selecting the menu item will not do anything.

The convention used for dynamic menu labels is for the labels to display the action that will be performed once the menu item is selected. For example "Lights On" will turn the lights on, and the menu will be updated to display "Lights Off", which would then if pressed turn the lights off. This convention is used throughout XCSoar.

A selection of key dynamic menu items is presented below:

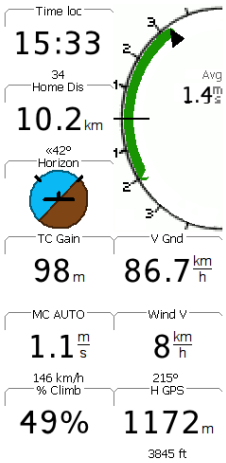
Next Turnpoint : Greyed out if the task is cleared, or if the active turnpoint is the finish. If the currently active turnpoint is the turnpoint prior to the finish, this displays "Waypoint finish".

Previous Turnpoint : Greyed out if the task is cleared, or if the active turnpoint is the start and there are no multiple start points. If there are multiple start points and the active turnpoint is the start, then this displays "Cycle start" to allow selection between the various start points. If the active turnpoint is the first turnpoint after the start, this displays "Waypoint Start".

Labels All : This will turn on all labels available on the map. There are more options to only show a reduced set of labels like "Labels Task", thus not cluttering the screen too much.

Target : Greyed out if the task is cleared or in task abort.

3.6 InfoBoxes and screen pages



The information displayed in the InfoBox fields can be selected from a wide variety of options (listed in Chapter 11). These fields can also be used to change for example the MacCready setting.

The specific number and layout of the InfoBox grid depends on the screen orientation and the device's display size.

For a 320x240 display Pocket PC in portrait mode, there are four InfoBoxes above and four InfoBoxes below the map display.

A typical landscape layout has 9 InfoBoxes and the variometer gauge to the right of the map display. For larger displays up to 24 InfoBoxes may be displayed simultaneously.

In order to gain clarity, the less infoboxes you choose to be displayed at once, the faster your reading will be. On the other hand, there are much too many InfoBox options a pilot would hardly reject. The number of possible InfoBox options already exceeded one hundred. That is why XCSoar offers two ways of managing even more options than Info*boxes* count.

Depending on your flight's state, whether you are circling or cruising, you can let XCSoar change the content of each single InfoBox. As an example you might change the display of the actual average climb whilst circling to speed to fly when cruising. The switch is derived automatically by entering different *flight modes* (see section 6.1) executing a switch to another *InfoBox set*.

Further, you can use screen pages to change InfoBox content manually, by assigning different Infobox sets to different pages (see following section).

To gain access to automatic switching InfoBoxes dependent on the flight mode, just let XCSoar run with its pre-configured setup from installation. To set up your personal version of Infoboxes go through the following procedure.

InfoBox geometry : Choose a basic Infobox geometry or layout. This basic layout is maintained through any changes in-flight, affecting InfoBox content only.

12.20

Choose Infobox set "Auto" : Configure at least one screen page with the choice of Infoboxes "Auto". As can be seen on the corresponding configuration screen, there are more screen pages pre-defined. These others are not needed to gain automatic switches by flight mode. They are for *manually* turning through the screens defined by pages.

12.21

Define InfoBox sets : Put together the Infobox content you want to be displayed in three Infobox sets called "Circling", "Cruise", and "FinalGlide" respectively.

12.22

Screen pages with different InfoBox sets

XCSoar allows the pilot to define various sets of InfoBoxes that are appropriate for "normal" states of flight. Assuming circling, cruising, or final glide as normal, XCSoar can switch corresponding Infobox sets automatically.

As you might imagine, there are countless cases, you wished you had another ensemble of information displayed at once. For all of these more or less special situations you can define up to eight screen pages, reflecting the actual *use case*. Just to draw a brief sketch of the possibilities introduced by the concept of screen pages, a few use cases are given.

Familiarisation : Especially if you are a beginner, you might study computed values in-flight in advance of placing them in your "normal" InfoBox ensemble - just to get familiar with the reading. To do so, create a new Infobox named "test" to be placed on an additional screen page brought in. In any case you can go back to the screen you know by "turning a page"

Competition : If you are a pilot scratching the edge, you might want to gain benefit of XCSoar's numerous task- and competition-related com-

putations. In order to get them related to the competition's phases, you might like the idea of defining two special use cases with pages for the phase before start, another one for whilst racing. If you are in search of a specific value to be displayed, give it a try in chapter 11 "InfoBox Reference". There is a big chance you will find it.

On the ground : As a manager on duty you might use a screen page, showing the "FLARM Radar" solely. This might happen on a PC screen running XCSoar being connected to a FLARM receiver.

Whatever you would like to display, take into account the use case and screen pages concept.

To go through the various screen pages, use gesture left/right (touch-screen), or via menu button in menu Display 1/2 , showing a dynamic label, changing accordingly to the screenpage's content to show up next:

Display 1/2 ▷ Info Circling ▷ Info Cruise ▷ Info FinalGlide ▷ Info ...

Modifying InfoBox content

(This section applies only when a touch-screen or mouse is present.)

Some InfoBox values can be changed by the user by selecting (i.e. long-pressing) the InfoBox with the touch-screen or mouse. This brings up a small tabular dialogue:

Edit : Allows the pilot to adjust the InfoBox setting (e.g. raise or lower the MacCready setting)

Setup : Allows you to change the behaviour of the setting related to the InfoBox (for example, changing from auto to manual MacCready mode); or to change the InfoBox itself by pressing '*Switch InfoBox*', then choosing from a list of all available InfoBoxes.

Examples of InfoBoxes that can be adjusted include MacCready setting, wind speed, and altitude (QNH).

Changing InfoBox sets

An entire set of InfoBox can be composed by the '*Setup System*' configuration dialogues on the '*Look / InfoBox Modes*' and '*Look / InfoBox Pages*' 12.22 setup page. The dialogues give a wide variety to set up the look and feel of the XCSoar pages.

3.7 Status messages

Status messages appear over the map area to present text for a short period of time. The message disappears after the time period has

elapsed, and different types of message have different periods. Additionally, status messages can be made to disappear by acknowledging the message. Acknowledgement is achieved by either pressing the enter key, touching the status message (on touch-screen devices) or clicking the screen (mouse enabled devices).

Takeoff

Additional user buttons may be assigned to a status message repeat function, which brings up the last message again.

Typical status messages include:

- Airspace queries
- Airspace warnings
- User interface events (e.g. changing display modes)
- Glide computer events (e.g. take-off, turning waypoints)

Note that status messages do not appear while a dialogue is on screen, the messages are buffered and displayed as soon as the dialogue is exited.

3.8 Dialogue windows

XCSoar contains several dialogue windows that can be activated to bring up additional information and are also used for more complex interactions with the user, such as editing tasks and configuring settings.

Some dialogues simply display information, and require no user input. Other dialogues contain data fields that can be modified or buttons that can be pressed.

A cursor appears over the active button or data field. Pressing the up/down arrow keys, the cursor will cycle through the next or previous items. For list items and scrollable text, the up/down arrow key moves the cursor up or down the list or text, and the left/right arrow keys move the cursor up or down by one page in long lists.

For PDAs and PC versions, list items can be selected by touching the item (or left-clicking with the mouse). Once a list item is selected, another touch (left click) is equivalent to pressing the enter key.

Pressing the right/left arrow keys, the data field value under the cursor can be modified. Pressing the enter key activates the button or makes a selection from a list.

Dialogues are typically started from the button menu.

Many of the dialogue windows have multiple pages of information and are controlled in a consistent fashion. Press the < or > buttons to select the next or previous page of the dialogue and the Close button to make the dialogue disappear.

The escape key on a PC can also be used to close dialogues.

The user must close the dialogue to return to the map view. When a dialogue has been opened, the main button menu is disabled until the dialogue is closed.

In some dialogues, items that are not relevant or valid (such as AAT details when flying a non-AAT task) are not displayed.

A summary of the major dialogues is presented below.

Flight setup : Used to modify the polar of the glider both before and during flight, as well as to set the QNH pressure

Wind : Used to modify or adjust the estimated wind magnitude and direction

Waypoint details : Describes a waypoint in detail and has navigation functions such as 'GoTo' and 'Insert in Task'

Waypoint list : Used to select a waypoint from the waypoint database

Task manager : Used to create, modify and view cross country tasks

Analysis : Shows several pages of analysis and statistics about the flight

Status : The status dialogues give summaries of the situation of the aircraft, system, task, start and times

Configuration : Allows XCSoar and certain connected devices to be configured

Airspace filter : Controls enabling and disabling the display and warnings of each airspace class

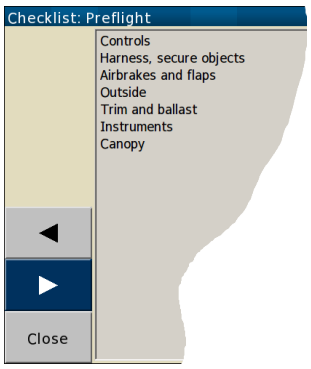
Team code : Allows transfer of coordinates between FLARM team mates via a code

Devices : Selection of various external devices (e.g. smart variometers, FLARM, etc.).

Setup Plane : Easy reconfiguration of the plane-dependent settings (e.g. polar, competition ID, etc.) by choosing from a list of previously-created plane profiles.

These dialogues are described in later chapters, with the exception of the check-list, status and text entry dialogues, which are described below.

Check-list (dialogue example)



The checklist dialogue can display several pages of user-defined free text. Typically this is used for check-lists. It can be accessed via the menu.

Info 1/3	▷	Check List

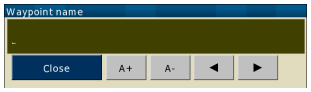
These check-lists may include: daily inspection, preflight, out-landing, pre-landing, radio procedures, and aircraft rigging and de-rigging in-

structions. Since the check-lists may be long, the up/down keys may be used to scroll through the text. Clicking the < and > buttons selects the previous/next checklist.

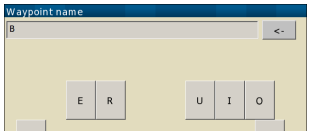
Text entry

A text entry dialogue is used for entering text. This is used for team code entry, setting file names, waypoint editing, as well as entering other configuration options, such as pilot name for the logger.

Two ways of entering text are provided.



To enter text in 'high score style', use the A+/A- buttons to adjust the character under the cursor (underlined character). Clicking the < and > buttons move the cursor left/right.



To enter text with the touch screen keyboard, press the letters of choice one after the other. In some dialogues (e.g. waypoint editing) only the next letters matching to an entry in the database will be shown. For deleting the last letter use the < − button. The Clear button deletes all input.

Press Ok to validate, or Cancel to exit.

3.9 Acoustic alert and sound feedback

XCSoar generates sounds for different events, and can be configured to have custom sounds for any event. See Section 13.13 for details on customisation.

When XCSoar is connected to the Vega intelligent variometer, it sends commands to Vega's speech system, to give verbal clues and warnings such as:

- Final glide through terrain
- Approaching/passing a task waypoint
- Airspace warnings

The XCSoar user interface also can connect sound feedback to the completion of any command like:

- Marker dropped

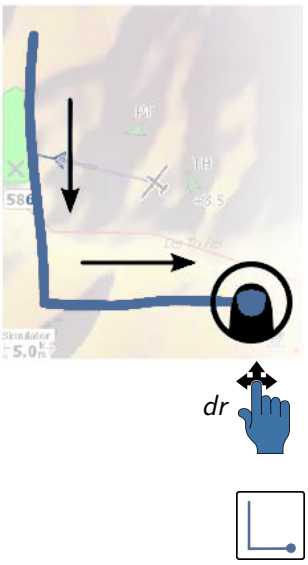
3.10 Screen visuals

Certain aspects of the look of items on the screen can be adjusted. The most noticeable of these is whether to display InfoBoxes and gauges in white on black (called inverse colours) or black on white.

3.11 Help system

A help system provides descriptive text for properties in most dialogues.

3.12 Interfacing with gestures



As of version 6.0, XCSoar supports so-called 'gestures'.

To use this feature hold down the finger on the touch-screen (or mouse button at the PC), draw a certain figure and release the touch-screen / mouse button. Depending on the figure that was drawn a certain function is activated.

A specific gesture is defined by movements of the finger or the cursor in the four directions Up, Down, Left and Right. This means if you drag your finger down and afterwards to the right over the screen, the gesture "DR" is detected, which stands for "Down-Right". It will bring up the waypoint list. The manual indicates an available gesture as shown here on the left side of the text body. Both the blue hand and pictogram of the movement are used to indicate a specific gesture, in this case move down then to the right. A list of generally available gestures is shown below.

Most common or basic gestures:

DU, denoting a check mark: Show main menu

U: Zoom in

D: Zoom out

L: Turn screen page pro-grade (Normal, Aux., Full-screen...)

R: Turn screen page retrograde (Normal, Full-screen...)

URDL, denoting a P: **P**an-mode. Might also be invoked by moving two fingers apart on the screen.

More gestures available:

DR, denoting an L: Show the Select Waypoint dialogue similar to menu item Waypoint **L**ist

RD, denoting a T: opens the **T**ask Manager

DL: show the Alternates List

UD: enables Auto-Zoom

Sophisticated dialogues:

LDR, denoting a C: Show the **C**hecklist.

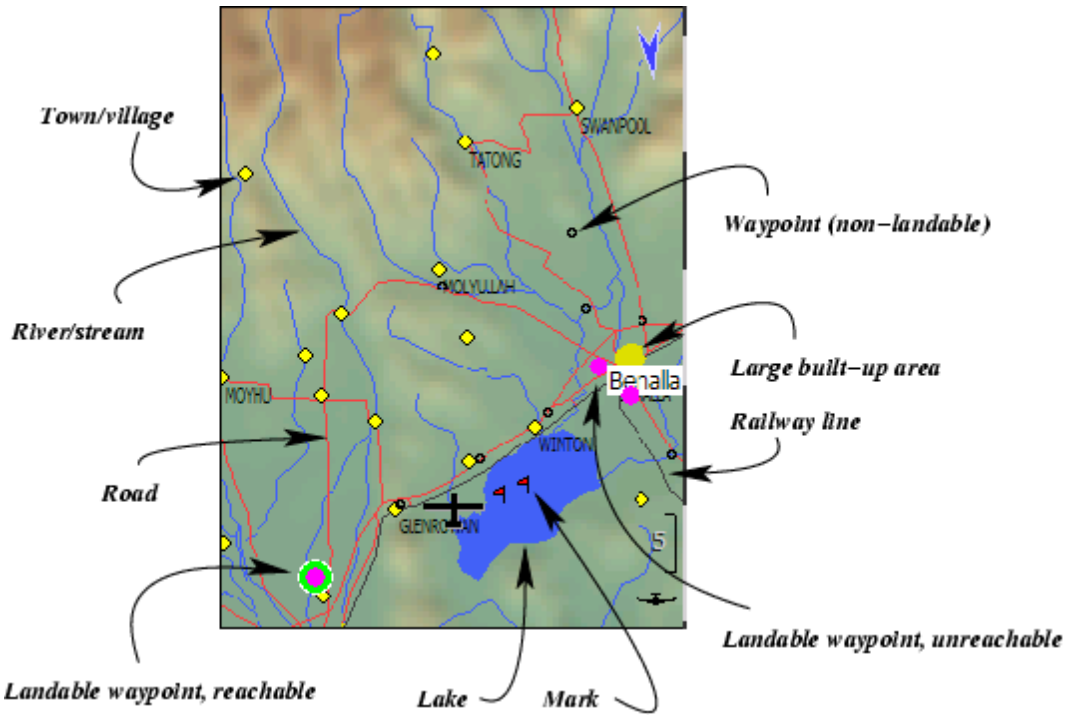
URD, denoting an A: Show the **A**nalysis dialogue.

LDRDL, denoting an S: Open the **S**tatus dialogue

4 Navigation

This chapter describes the moving map display as an aid to navigation, and also describes some of the task and glide related overlays on the map display.

4.1 Map display elements



The moving map shows:

1. Glider, wind indicator, thermal profile, final glide indicator
2. Terrain, relief and hight of the terrain
3. Topography, rivers, roads, towns
4. Waypoints, airports, landables
5. The active task, observation zones, turnpoints
6. The bearing (or route[1]) to the next waypoint, heading
7. Airspaces
8. Markers, thermals history, snail trail

[1] The line to the next waypoint may be a *route*, as described in Section 4.14.

9. Glide range[2]

The map is drawn in a projected coordinate system (not latitude and longitude), and the scale can be changed (zooming in and out), as well as panned. All navigation functions take the curvature of the Earth into account.

4.2 Glider symbol, map orientation

The glider symbol shows the position of the glider on the map. The orientation of the glider indicates the estimated heading of the glider.

12.5

The map is oriented in one of three ways: North up, Track up, or Target up. Configuration settings can be used to specify a different map orientation when in circling mode. This is useful to prevent disorientation when looking at the map while circling. Target-up when circling makes it easy to determine which direction to exit the thermal.

When Track or Target-up is used in circling mode, the glider symbol is centred on the screen, even if the symbol position is configured differently. In cruise mode the Track and the Target-up orientation allows the glider symbol to be positioned (e.g.) 20% from the bottom of the screen, giving a good view of the map ahead of the glider. This position is adjustable in the configuration settings.

12.5

4.3 Zoom and map scale

To change the scale of the map, depending on the hardware you use:

1. Tap/click on a blank part of the map to highlight the map if it is not already selected. Then use mouse wheel, or the Pocket PC up/down key to either zoom in or out.
2. Android devices have the +/- rocker that let you change the zoom (it usually allows for adjusting the sound volume). It may be difficult to access during a flight, when the device in on a generic mount.

3. You can also gesture to change the zoom level. Gesture Up (see left) zooms in, Down zooms out.
4. Or select the function from the menu.

   Display 1 ▷ Zoom In and Zoom Out

The map scale is displayed in the lower left corner of the moving map display. The indicated distance is measured from the left to the right border of the map display.

Compaq Aero Users. If you enable the Compaq Aero Game Keys (On the Q-menu) the centre two front buttons become the up/down keys.

[2] The glide range is also referred to as the *reach*, as described in Section 4.12.

Circling Zoom

12.5

There is a facility to have two zoom settings; one when the glider is in circling mode, and one in the cruise or final mode. This is the '*Circling zoom*' option in the configuration settings. By default, the circling zoom is set to about 2.5 km - 5.0 km, depending on the display size. When the user zooms in or out, it affects the current mode's zoom setting only, so when leaving the mode the previous mode's zoom setting is used. If '*Circling Zoom*' is not enabled, there is only a single zoom level. This leads to different zoom levels being preserved to be managed manually, independent of the following Auto Zoom settings.

Auto Zoom

Display 1 ▷ Zoom Auto

Auto Zoom automatically zooms in when approaching a waypoint to keep the waypoint at a reasonable screen distance. When *Auto Zoom* is active, 'AUTO' appears next to the map scale.

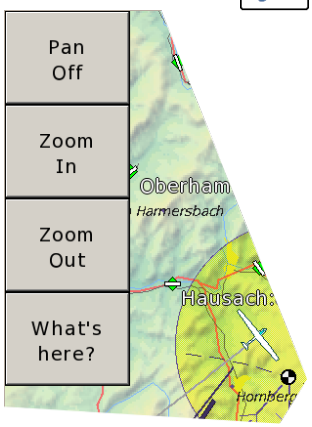
To invoke Auto Zoom use the gesture or menu path depicted to the left. Switching back to manual zoom is simply done by using the same menu path or just zooming manually, no matter whether done via menu or gesture.

When a waypoint changes (automatically, via the task selector, or by manually switching waypoints), *Auto Zoom* adjusts the zoom level automatically so that the next waypoint is visible on the map.

During circling, if a thermal has been detected, then the map is centred about the thermal or part-way such that the glider is still visible.

4.4 Panning the map

Display 1 ▷ Pan On



A pan mode allows the user to explore areas beyond the glider. This is particularly useful when task planning.

1. Enable pan mode by button menu or by gesture. The gesture for this is moving your fingertip up, right, down, left, supposed to form a "P".
2. The map can then be panned by dragging the screen or using the cursor keys.
3. When done, pan mode has to be disabled manually, by pressing '*Pan Off*' from the special sub-menu of buttons in pan mode.

When pan is active, the letters 'PAN' appears next to the map scale. While panning the location of the focus stays in the middle of the display under the cross hairs.

Despite the focus under the cross-hairs the map still offers the '*What's here?*' feature just by touching any position on the map (presuming a touch-screen).

4.5 Waypoints

Waypoints are displayed with different symbols depending on the waypoint type; the major distinction being landable and non-landable waypoints.

Landables

12.7

The waypoint symbols are drawn as shown below. There are three icon sets for landable waypoints.

Icon set	Landable field	Marginal	Reachable	Airfield	Marginal	Reachable
Purple Circle						
B/W						
Traffic lights						

The *marginal* icons are drawn for those waypoints which are principally in the reach, but it is not possible to approach them directly. E.g. a mountain prohibits a direct approach.

12.7

Waypoints are optionally labelled according to one of several abbreviation schemes and visibility.

On top of this landable waypoints can be displayed in more detail. If '*Detailed landables*' is switched on you get additional information encoded in the appearance of it's icon.

1. Landable fields get a square-shaped icon despite what is shown in the table. The square is drawn like a diamond standing on one corner. Airfields stay with the circle shape, so that they become easy to distinguish.
2. All icon sets, including the 'Purple Circle' icon set, get the runway turned into their actual direction. The runway direction has to be available in the waypoint data. E.g. the SeeYou waypoint file format (`.cup`) does include this information.

Landables in Reach

Next to landables an estimated arrival height *above the arrival safety height of reachable landable* points is displayed next to the waypoint. This feature is one of the most powerful out of XCSoar's capabilities. The arrival height is calculated highly configurable by XCSoar's *glide computer* with parameters taken into account being glider performance (polar), MacCready setting, wind, terrain clearance, and —

obviously — safety heights' values. With all of it being configurable, there is enough room for failure, so please: Unless you will have fully understood the glide computer's concepts, you better stay with XCSoar's pre-configuration (and in no way judge readings as heavenly approved). It is up to the pilot to always interpret readings and watch values trending over time.

12.7

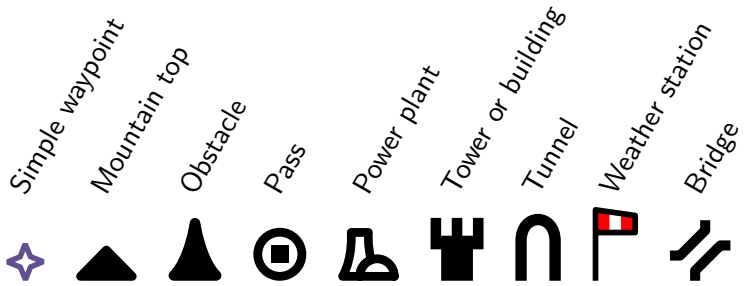
However, having set up the glide computer following Chapter 6 the *display* of estimated reach heights, drawn beside landables in reach may take into account terrain or not or display both.

Another option is to display the required glide ratio next to a landable in reach. This calculation is simply derived by the glider's actual distance to landables divided by the height difference between actual altitude and landable's altitude. Again, the safety height is added to the landable's height, but nothing else taken into account: no wind, no polar, no MacCready settings, just geometry. The concept of required glide ratios is a widely discussed concept, said as to be a very robust one.

Keep in mind a strong relationship of displays of *reach* and settings in the glide computer.

Non-Landables

As far as your waypoint file contains information on the nature of the non-landable waypoints, the map will then display specific icons accordingly. Figure 4.1 contains a collection of the currently supported map icons.



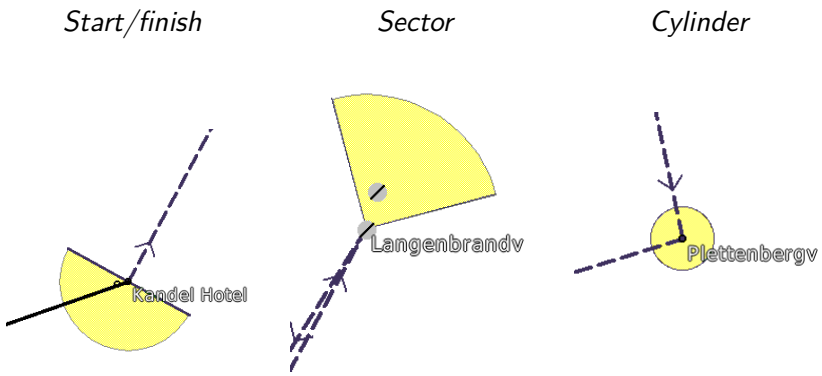
Rysunek 4.1: non-landables

4.6 Active task

The active task course is drawn on the map as a blue (dashed) line.

Assigned area tasks also show the turn point sectors or areas as a yellow shaded region. Circles are always drawn around start and finish points, lines are only drawn if the start/finish points are of line type. Task observation sectors are drawn as circle segments.

At all times a thick black line is drawn from the glider to the next waypoint in the task. This line may be the direct path to the waypoint, or may be a *route* path clearing terrain and airspace obstacles, described in further detail in Section 4.14.



4.7 Terrain and Topography

The following topographical features are drawn on the map:

- Major roads, shown as red lines
- Rivers, shown as blue lines
- Large water bodies (lakes), shown as blue areas
- Large cities, shown as yellow areas
- Small population areas, shown as yellow diamonds

Cities and small population areas are labeled in italics.

Display 2 ▷ Terrain On/Off

Terrain is coloured according to elevation, and optionally shaded by sun, or wind direction. Invalid terrain, or terrain below sea level is coloured blue.

Display 2 ▷ Topo. On/Off

12.8

Terrain is shaded to improve visibility. The default shading is set up so that the virtual lighting position is the wind bearing, thus brighter areas are on the upwind side of hills and dark areas in the lee of the hill. Support for a sun ephemeris is also implemented. If the slope shading is set to 'Sun', the brightness of a slope follows the day time in a very natural way. The amount of shading and overall terrain brightness is configurable.

Both terrain and topography display can be switched on or off from the menu.

Topography

Terrain

If the terrain data is not available (or terrain display is turned off), the background colour of the map window is white. All terrain below mean sea level is coloured blue. If you are flying outside the terrain region, the background colour will be white.

Map labels

Display 2 ▷ Labels None

The screen can be de-cluttered, turning off the display of all waypoint labels by toggling the '*Labels*' menu.

Other options for display decluttering include:

Labels Task & Airfields

Shows labels for the waypoints in the active task and any airfields (based on the waypoint attributes in the waypoints file). Other waypoints are shown but not labeled.

Labels All

Shows labels for all waypoints.

Labels Task & Landables

Shows labels for the waypoints in the active task and any landable fields (based on the waypoint attributes in the waypoints file). Other waypoints are shown but not labeled.

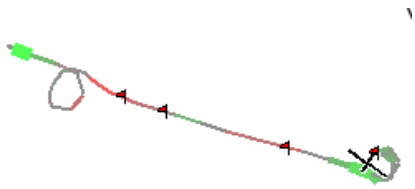
Labels Task

Shows labels only for waypoints in the active task

12.7 Note that in all cases, the label format is configurable in the '*Waypoint Display*' configuration menu.

4.8 Trail

An optional 'snail trail' is drawn on the map showing the glider's path history. The colour and thickness of the trail depends on the altitude or on the variometer value.



If Vega or an intelligent variometer is connected with Netto output, the Netto vario value is used; hence the colours and thickness of the trail indicates the air-mass vertical movement rather than the glider's vertical movement.

12.6

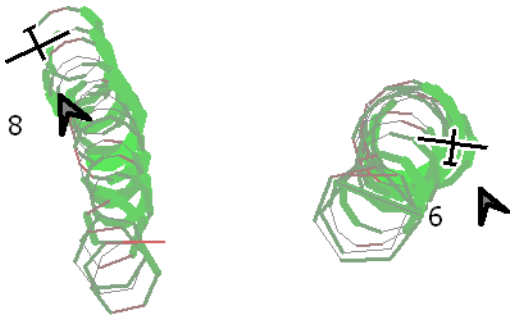
Display 2 ▷ Trail Full

The snail trail display can be toggled between *Off*, a *Short* trail (about ten minutes), a *Long* trail (about one hour) or a *Full* trail which displays the entire flight. This can be performed permanently through the configuration settings or temporarily by the menu.

Note that for all of these modes, the snail trail is short in circling mode in order to reduce screen clutter.

In order to assist centring thermals in the presence of wind, the snail trail can be artificially drifted with the wind as it is displayed (this is drift compensation). In this way, the snail trail is referenced to the prevailing wind rather than referenced to the ground. Since thermals drift with the wind also, the drifted trails give a better indication of where the glider has been relative to the thermals.

An example of this is illustrated below. Note that when trail drift compensation is active (right picture), the glider appears to be circling in a column rather than an elongated spiral (left picture).



12.6

Config 1 ▷ Wind

Enabling trail drift compensation is performed through the configuration settings. The compensation is only performed whilst in circling mode; the display of the trail in cruise mode is unaffected. This can also be performed from the wind settings dialogue.

The trail drift display is useful also to show more clearly when thermals are cranked due to wind shear.

12.6

The trail width can optionally be scaled according to the variometer display.

4.9 Markers

Nav 2 ▷ Mark Drop

Markers are shown as small flags (a) on the map. The markers can be dropped manually, by pressing a button, or automatically. An example use of automatic markers is to drop markers when entering circling mode, as a simple way of showing all thermals encountered.

Markers are not preserved after XCSoar is exited, however the location of all marks are appended to the file `xcsoar-marks.txt`.

4.10 Pilot Event

Nav 2 ▷ Pilot Event

12.17

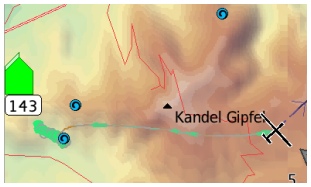
A Pilot Event (PEV) system allows pilots to mark particular times during a flight, such when inside a Turn Point Observation Zone (TP OZ). Also, when configured, it allows to initiate a special *Pilot Event* task start protocol[3].

When pressed, the task start window will be automatically set according to configuration defined in Task Rules (See 5.6): start window will open after *PEV start wait time* minutes and will be open for *PEV start window* minutes. Also, *Pilot Event* will be announced to connected devices, allowing loggers to register it without pilot pressing the physical button on the logger device itself. This might be useful when logger is located outside of pilot reach (e.g. behind the panel).

In order to start a task when *Pilot Event Start* is used, press the *Pilot Event* button, wait for *PEV start wait time* and then cross the start line within *PEV start window* minutes.

It may be useful to have *Start open* and/or *Start reach* infoboxes visible to effectively use the *PEV Start* procedure.

4.11 Thermals



While climbing in thermals, a marker is automatically generated showing the thermal location on screen. The positions of the last 20 thermals are stored until the end of the flight. This thermal history is accessible through the map element functions in the same way as markers or waypoints.

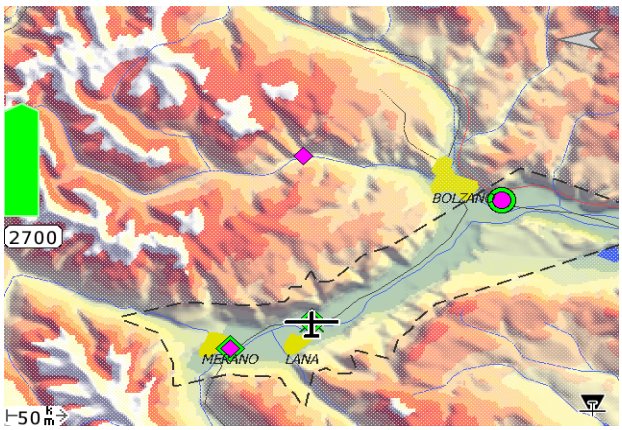
4.12 Glide range line

A reachable glide 'footprint' is displayed on the map display as a black and white dashed line, indicating where the glider would descend through the terrain clearance height. The reach shows clearance tracks extending in all directions, optionally including paths around terrain obstructions. This feature is useful in assessing range with respect to topography when searching low for lift, and when flying in mountainous areas.

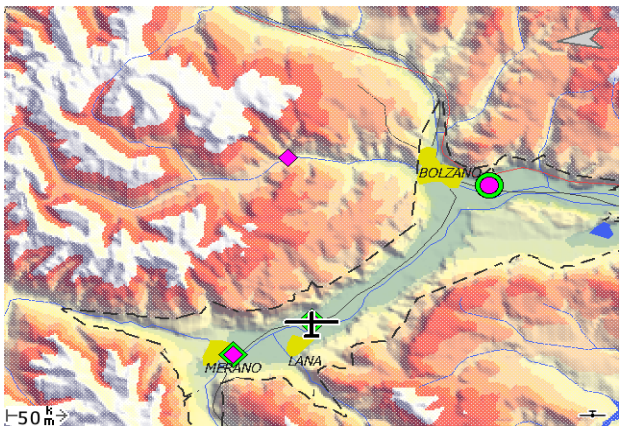
[3] PEV start procedure may be used in competitions to reduce mass starts, gaggles and following.

12.13 Reach calculations may be configured to two levels of detail:

Straight line : If turning reach is disabled, then the reach shows the furthest distance the glider can fly in final glide in all directions without turning. This reach appears as a closed ring around the glider.



Turning : If turning reach is enabled, then the reach shows the greatest area the glider can reach in all directions, even allowing turns around obstructions.[4] The reach area appears as a closed ring around the glider but may also include holes indicating mountain peaks that the glider cannot reach without further climb.



12.13 The display can be configured to additionally blur the unreachable area outside the glide range. The final glide path is checked for whether the glider clears terrain along the path by the terrain clearance height (see Section 6.8). If clearance is not attained, a red cross appears on the map at the point where the violation occurs. If a target is defined the calculation is done along the straight path to the target. If no target is defined the calculation is done along the current heading.

If reach is enabled, then the reachability of landable waypoints is used by the abort task mode, alternate landable option lists and display of landable waypoints on the map.

[4] The maximum number of turns is set to three, and no turns may be greater than 90 degrees.

Note that task calculations are otherwise unaffected by reach calculations — for example, altitudes required as shown in the final glide bar or task data as displayed in infoboxes do not take reach into account.

Furthermore, the reach calculations are used for footprint, landable waypoint arrival heights, abort mode and the alternates dialogue. The glider performance and MacCready setting used in these calculations are configurable:

12.13

Task : The MC value is that used in the task.

Safety MC : A configurable, typically low MC value is set by the user to set performance near, but slightly degraded, to best glide performance. The amount of safety in the reach calculation is then the gap between best glide performance and the glide performance following the safety MC speed to fly.

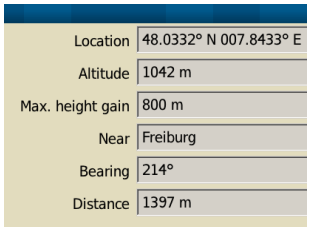
4.13 Status tabs '*Flight*' and '*Time*'

The status dialogue is a multi-tabular dialogue giving overview information on the flight, system, task, rules and times. These are information, and hence cannot be modified by the user. It is accessed via the gesture "S", or with the button menu.

Left - Down - Right - Down - Left

Info 2 ▷ Status

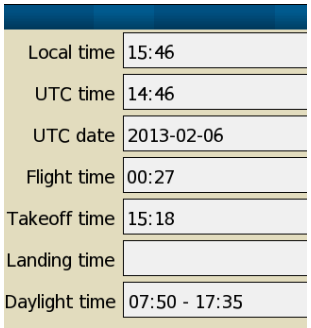
Flight



Select the tabular page '*Flight*'. The flight status dialogue shows the status of the aircraft's locality. It shows the location of the aircraft, the maximum height gain, and nearest waypoint it's bearing and distance.

You may find this function useful when you need to report your location to others.

Times



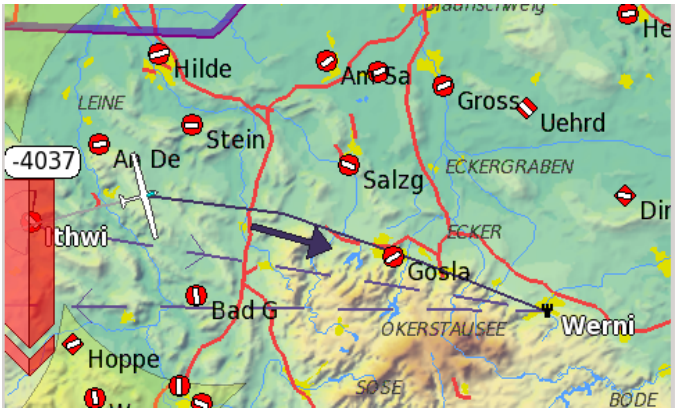
Select the tabular page '*Times*'. It shows the local time, UTC time and date, flight duration, takeoff and landing time, and the local sunrise and sunset times.

Note that the values in the Status dialogue are static once the particular dialogue page is displayed. That is, position, times, etc. do not update while the page is displayed. To see the updated values, it is necessary to select a different tabular, then return to the previous dialogue to see the new values.

4.14 Route

XCSoar can plan paths around terrain and airspace obstacles in three dimensions from the aircraft to the destination. Such a path is known

as a route. The height of the destination is the arrival height for final waypoints, or may be higher for intermediate waypoints, as dictated by the task system as required to complete the task. Route planning functions in normal ordered task mode, abort mode and goto mode.



Routes take into account the glider polar performance and are calculated to be optimal in the sense of minimum time. By default, route calculation is disabled, and can be enabled for terrain only or terrain and airspace avoidance.

12.13

12.10

Terrain is avoided vertically by the terrain safety height,with no additional lateral clearance imposed. Valid routes may result in the aircraft arriving at the destination higher than the minimum height — such as can occur when the destination is just beyond a steep mountain.

Airspace is avoided horizontally by a buffer of approximately 250 m, with no additional vertical clearance imposed. Valid routes may fly below or above airspace.

12.13

If MacCready is positive, then climbs are optionally allowed in the computed routes. The top of the climb may be limited to 500 m above the higher of the start and destination ceiling, or increased to the ceiling defined by the thermal ceiling. Climbs above the higher of the start and destination altitude are penalised by a slower climb rate than the actual MacCready value.

Some approximations and limitations of the route planning system are as follows:

- Where climbs are necessary (and permitted) to reach the destination, the climbs are assumed to occur at the start of the route.
- Climb-cruise segments are assumed to occur at constant altitude, equivalent to many small climbs distributed along the path.
- Individual turns between path segments greater than 90 degrees are not permitted.

- Failures of the solver result in the route reverting to direct flight from the aircraft location to the destination.

5 Cross Country Tasks

XCSoar provides a full task management system, in which tasks can be edited prior to flight and, when undertaking casual cross-country flying, modified during flight. Waypoints are advanced automatically or may be cycled through manually. Many of XCSoar's computations relate to either turnpoints or the finish waypoint. Unless a "true" task is defined, XCSoar will provide a "go home" function, with many of the task related functions referring to the location of takeoff. This chapter also describes the use of IGC loggers with XCSoar.

There are three task modes available:

Ordered task : This is the natural cross-country task type, in which the task consists of a start point, zero or more waypoints, and a finish point. The task points are to be flown in order.

Goto task : Flight to a single destination.

Abort task : Provides options to fly to the nearest landing points.

Note that in goto and abort modes, the ordered task is retained and may be resumed later, preserving any statistics about achievement in the task.

Automatic goto

If no ordered task is defined, then on takeoff, a goto task is automatically established with the takeoff point as the destination, or the nearest airfield if it was close to the takeoff point.

Whether or not a task is defined, the takeoff point is always generated and appears in the waypoint list for later reference or use.

After having defined an ordered task for the very first time, the automatic "goto takeoff" function is skipped. To resume a simple task, use goto.

5.1 Goto tasks

Goto tasks may be established by selecting a waypoint from the map, the waypoint list, or any other mechanism e.g. the alternates dialogue, and select GoTo . In goto task mode, selecting Nav 2 ▷ Task Resume resumes the ordered task (if any).

5.2 Editing tasks

You can edit tasks in several ways. Some methods are more useful for editing prior to flight, and others allow tasks to be modified whilst in flight for casual cross-country touring. Tasks can be saved to files and reloaded later, and can be transferred between any XCSoar platform (Android, Windows, Linux...).

It is also possible to save a 'default' task and have this task loaded automatically upon start-up of XCSoar. One application of this is to set up a default task with one waypoint being the home — this means that XCSoar is then programmed for final glide back to home, which is useful for casual cross-country touring.

The main ways of setting tasks are the following:

- Using the task editor dialogue
- Selecting waypoints from the map and adding them to the task from the waypoint details dialogue
- Loading the task from a file

Loading a task from file may be useful in competition or casual cross-country flying in groups, as one person can distribute the task file to others, thereby saving effort on editing the task severalfold. If no task is present at startup, a task is created automatically, containing one waypoint takeoff as "goto home".

XCSoar saves the current task when shutting down and loads it at startup, thereby allowing the task to be entered early in the day, then the device running XCSoar can be turned off until flight time.

Task waypoints are preserved even if the waypoint file is changed. This means, if you save a task, then change the waypoint file, then load the task again, new waypoints are generated for any waypoints that are missing in the new waypoint file.

5.3 Waypoint Information

The waypoint info dialogue describes a waypoint in detail and has navigation functions such as GoTo, insert, append to the task, or set the waypoint as the new home. This may be accessed in several ways:

or menu Nav 1/2 ▷ Task , highlight a waypoint, then tap the highlighted waypoint again to display the task point dialogue, then push Details .

or menu Nav 1/2 ▷ Alternates to show the details of the landables nearest to the aircraft.

or menu Nav 1/2 ▷ Waypoint List , highlight and select a waypoint to show its details.

or menu Display 1/2 ▷ Pan On to put the map into pan mode, pan

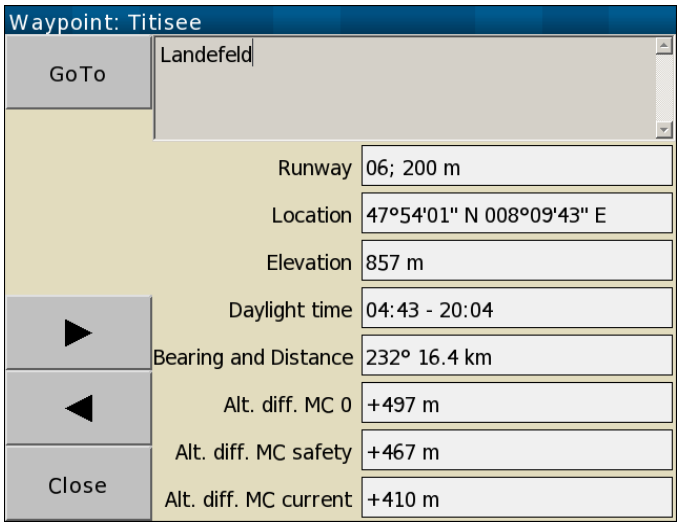
to the desired waypoint, touch its name or the waypoint symbol.

Info 1/3 ▷ What's here? to show the item list under the cross-hair, or your index finger on the map.

The waypoint details dialogue contains two major pages (accessed via the > and < buttons). Depending on the availability of further details of the waypoint they will by shown on extra pages.

Waypoint details

This page contains text giving the name of the waypoint, the waypoint's GPS coordinates, elevation, radio frequency and runway information (if this information is in the waypoint file), local daylight time, bearing and distance to the waypoint, and the altitude differences required to reach the waypoint as described below. In addition, there is a button GoTo to directly initiate navigating to this waypoint. The button cancels the current task.



As mentioned above, the Waypoint info dialogue also shows three forms of altitude difference (additional altitude required to reach the waypoint at the safety height) for the corresponding waypoint:

Alt diff MC 0 : Altitude difference at MC setting of 0

Alt diff MC safety : Altitude difference at the abort/safety MacCready setting (see 6.7)

Alt diff MC current : Altitude difference at the current MacCready setting

From the main Waypoint Info screen, you can access the second page by using the > and < buttons in the bottom left corner of the page. Depending of the type and number of details available for a waypoint, other pages could be available.

Task actions menu

This page contains a column of buttons allowing various actions to be performed:

Replace in task : replaces the active waypoint in the task with the selected waypoint.

Insert in task : inserts the selected waypoint before the active waypoint in the task.

Append to task : adds the selected waypoint to the end of the task.

Remove from task : removes the selected waypoint from the task. Note that this option is only visible if the selected waypoint is included in the active task.

Set as new home : sets the waypoint as the home airfield.

Pan to waypoint : switches to pan mode and pans to that waypoint.

Set Active Frequency :

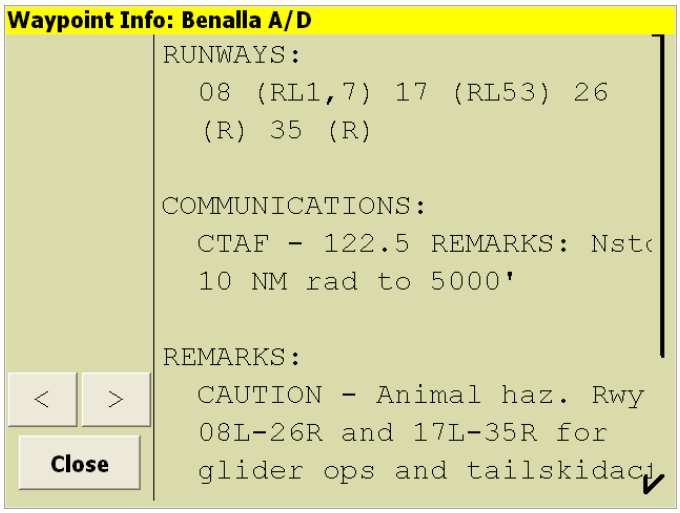
Set Standby Frequency :

Edit : allows to change the various attributes of the selected waypoint

It is a good idea to set your home waypoint from the waypoint details dialogue. This causes XCSoar to start up at the home location regardless of whether a GPS fix is received. If no home is set, then XCSoar starts in the centre of the terrain map.

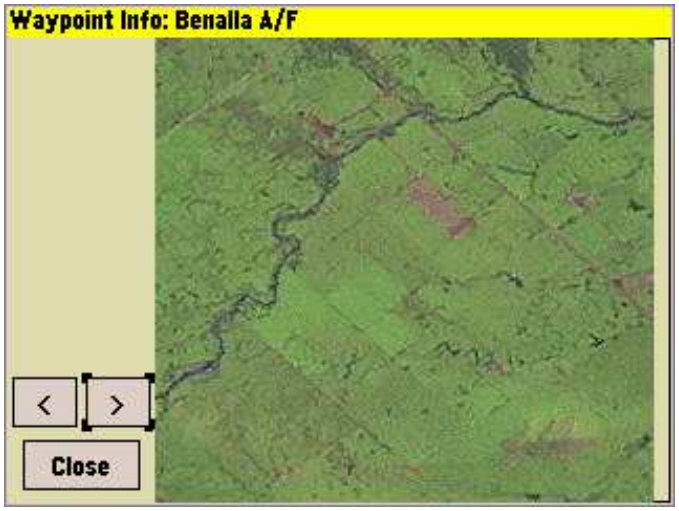
Airfield information

This page may contain relevant text from the en-route supplement about the airfield, including runways, radio frequencies, traffic patterns, contacts. See Section 13.5.



Waypoint details image

This page shows a satellite image of the waypoint.



How to set up the detailed waypoint information read Section 13.5.

5.4 Waypoint selector dialogue

Nav 1/2 ▷ Waypoint List

The waypoint selector is a dialogue that allows waypoints to be easily selected from a potentially large database.

Invoking the selector brings up a filtering dialogue screen with a set of optional filters on the left side of the page, and a list of waypoints on the right, matching all of the filtering conditions set. There are several filters available, which may be used together, individually or not at all.

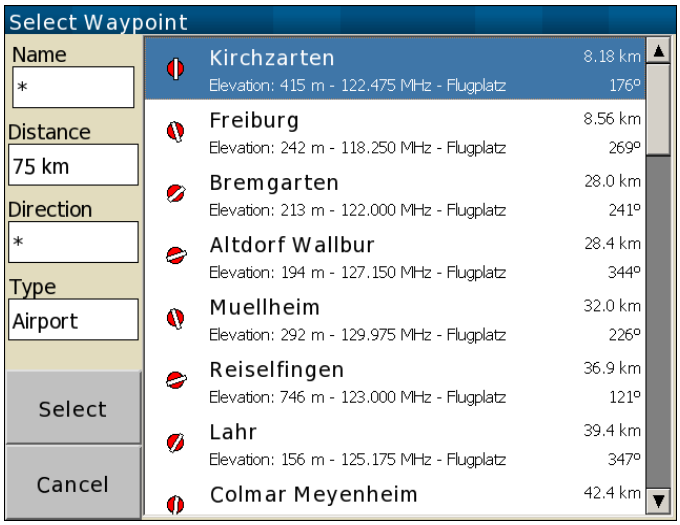
Name : Selects waypoints, starting with the string typed.

Distance : Filters out waypoints farther than a specified distance from the aircraft.

Direction : Filters out waypoints that are not in a specified direction from the aircraft. An additional special direction "HDG(xx°)" ("HDG" stands for "heading") filters waypoints within 30 degrees to either side of the heading of the glider. This allows the pilot to point the glider at a group of waypoints and quickly find them.

Type : Filters out waypoints that are not of the specified type (Landable point, Airport, Turnpoint, etc.) or that appear in the specified File 1 or File 2 (primary or secondary waypoint file respectively), or in recently-used files.

When filtering by name and type, the list of matching waypoints is sorted by name. When (in addition) filtering by distance or direction, the list of matching waypoints is sorted by distance.



The list can be scrolled if there is more than one screen full of matching waypoints. To scroll through the list, simply drag with the finger, or move to the bottom (or top) of the list with the cursor.

Selecting an item will result in different behaviour depending on what function opened the waypoint selector. In typical use it brings up the waypoint details dialogue for the selected waypoint.

5.5 Task manager

Nav 1/2 ▷ Task

The task manager is used to edit, view, load, save to file, and declare cross country tasks.

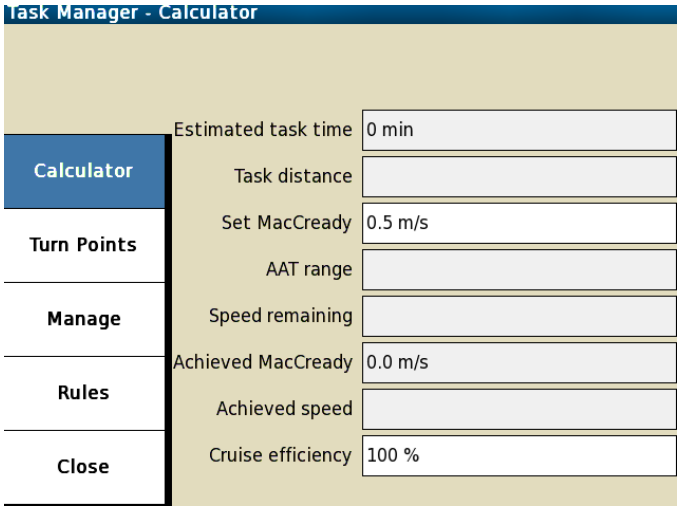
The primary page is a calculator. It shows various calculations related to the active task, as described in detail below. In addition, there are buttons for invoking dialogues Turn Points , Manage , and Rules , as well as a button to Close the task manager.

Task calculator dialog

Calculator

The task calculator dialogue allows the pilot to see the effect of various changes to the task on final performance.

In flight the Task Calculator might also be accessed from the Analysis pages. With pages Task, Climb, and Task Speed a button Task Calc comes up, that directly changes to the Task Calculator screen.



Estimated task time : This field displays the estimated total time on task to complete the task at the provided MacCready setting.

Remaining task time : This field displays the time remaining to complete the task.

Task distance : This field displays the total task distance.

Remaining distance : This field displays the remaining distance to complete the task.

Speed estimated : This field displays the estimated speed for the remaining of the task considering the provided MacCready setting.

Speed average :

Set MacCready : Allows the user to adjust the MacCready value and see the effect it has on the estimated task time.

AAT range : Allows the user to adjust the targets within the remaining AAT areas, to see the effect it has on estimated task time and task distance.

Speed remaining : This field displays the estimated speed for the remainder of the task at the provided MacCready setting.

Achieved MacCready : This field displays the achieved MacCready value.

Achieved speed : This field displays the achieved speed

Cruise efficiency : 100 % indicates perfect MacCready performance, greater than 100 % indicates better than MacCready performance is achieved through flying in streets. Less than 100 % is appropriate if you fly considerably off-track. This value estimates your cruise efficiency according to the current flight history with the set MC value. Calculation begins after task is started.

See Section 6.11 for more details on task speed and achieved MacCready calculations.

On closing the dialogue the entered MacCready value is used as the MacCready setting. If the Cancel button is pushed, the MacCready setting is unaffected.

The Target button, for AAT tasks, adjusts the range (increases or decreases) so that the estimated task time exceeds the assigned task time by less than five minutes. The range is adjusted target-wise. In typical use, all targets are set to "auto" that means the pilot does not have to manually adjust the range to find the course for arrival at the assigned task time, thereby reducing pilot workload.

Turn Points

Turn Points

This page displays an ordered list of the points in the current active task. If there are no waypoints in the active task, there will be only an option to "Add Turnpoint." By highlighting (tapping) the "Add Turnpoint" function, then tapping in the highlighted region, the waypoint selector is displayed, as described above. Highlighting a waypoint from the list and then tapping on the highlighted region adds the waypoint to the task.

Manage

Manage

This page allows for invoking all operations needed to create new or manage already defined tasks.

New Task Clears the current task and resets the task rules to the default values.

Declare If an external logger is connected, this will allow uploading the active task to the logger and declaring it.

Browse Displays a list of all the saved tasks, allowing the pilot to load a previously saved task. Note that this option will overwrite the current active task.

Save Saves the current active task. Upon tapping the Save button the pilot will be prompted to enter a file name for the task to be saved.

Rules

Rules

The values in the menu depend on the task type selected. Clicking any existing value will bring up another menu allowing the pilot to select a different value for this rule. Task types are discussed in more detail below.

Also, tapping on the Rules button again after it is highlighted allows toggling between a "thumbnail" view of the task map and a larger view of the task.

5.6 Task types

XCSoar currently defines three different task types: Racing, AAT, and FAI badges/records.

A brief description of the task types is included below, but this manual does not intend to rephrase FAI rules or contest task types. The reader is encouraged to become thoroughly familiar with each task type by referring to contest rules or FAI rules, which are available at http://www.fai.org.

Racing

(also known as an "assigned task"). The racing task involves flight around each specified turnpoint in the specified order. Selecting the racing task type allows the pilot to enter the following parameters (note that if the option "FAI start/arrival tasks" is "On", only part of these options is available) :

Arm start manually : If set to "On", some extra buttons are presented in order to let you [Arm start] as well as [Disarm start] in menu [Nav 1/2], controlling the detection of the start condition.

Start open time : This is the time when the start zone opens.

Start close time : This is the time when the start zone closes.

Start max. speed : This is the maximum speed allowed in the start observation zone. This should be set to 0 if there is no limit.

Start max. height : This is the maximum height above the start height reference (AGL or MSL) at which a task can be started. This should be set to 0 for no limit.

Start height ref. : This specifies whether the maximum start height is referenced to ground level of the start point ("AGL") or Mean Sea Level ("MSL")

Finish min. height : This is the minimum height based on the finish reference (AGL or MSL) at which a task can be finished. This should be set to 0 for no limit.

Finish height ref. : This specifies whether the minimum finish height is referenced to ground level of the finish point ("AGL") or Mean Sea Level ("MSL")

PEV start wait time : This specifies an interval in minutes between pilot presses the *Pilot Event* (see 4.10) button is pressed and start window opens. If set to 0, the start will open immediately after *Pilot Event* button is pressed.

PEV start window : This specifies an interval in minutes during which the start window remains open when *Pilot Event* (see 4.10) start procedure is used. If set to 0, the start window, once opened, remains open forever.

Assigned area task (AAT) and Modified area task (MAT)

(also known as "Turn Area Task", or TAT). This is a task through assigned areas (restricted to cylinder or sector observation zones). A minimum task time applies. Rules options for this task type include:

AAT min. time : This is the required minimum time for the task. Refer to contest rules or consult an expert for penalties associated with finishing prior to the minimum time.

Other rules : All other rules stay the same as in case of task type "racing".

FAI badges/records

The selection of this type of task allows to define the value of the following field:

FAI start/finish rules : If set to "On", only the type of start, and the start and end times might be set. If set to "Off", all other racing task rules might be altered from the FAI standard.

Once the appropriate task type has been selected and start and finish rules have been defined as described above, it is necessary to define the properties of each waypoint in the task.

Once selected, waypoints can be moved with the Up and Down arrows. The first waypoing is automatically set as a start point, and the last as an arrival point.

5.7 Turn Points' task rules

Turn Points

The Turn Points dialogue brings up the list of waypoints in the task. If no waypoint is already defined, this screen will show an empty list. With (add Turnpoint) , up and down arrows, and Make Finish an ordered list of waypoints is created. Waypoints can be start point, turnpoint, or finish point. Highlighting any waypoint on the list and either tapping it again or touching the Edit Point button brings up the waypoint definition. Touching Change type will bring up a menu of the various task point types available. Definitions of each point type are given below.

A variety of task rules may be used when specifying tasks, including the common FAI triangles and Assigned Area Tasks (AAT). Many aspects of the rules can also be customised.

Starting and finishing lines are centred on their associated waypoint and aligned perpendicular to the next and previous waypoints respectively.

Sector turn-points are 90-degree segments aligned to the bisection of the previous and next waypoints, as commonly used in FAI tasks. There is also support for British BGA, and German DAeC sectors.

Start point types

The conditions to be met for a valid start depend on the type of start:

Start Cylinder : When the glider leaves the cylinder area.

Start Line : When the glider crosses the start line.

Turnpoint types

The conditions to be met for a valid turnpoint pass depend on its type:

FAI Sector : When the glider has entered the observation zone (OZ), defined by a segment and radial distance from the waypoint. The segment is defined by a 90-degree arc centred about the bisector of inbound and outbound legs, with a distance of 20 km.

Keyhole Sector (DAeC 0.5/10 sector) : When the glider has entered the observation zone, defined by a segment and radial distance from the waypoint. The segment is defined by a 90 degree arc centred about the bisector of inbound and outbound legs, with a distance of 10 km. The observation zone also includes a cylinder of 500 m.

BGA Fixed Course Sector : When the glider has entered the observation zone defined by a segment and radial distance from the waypoint. The segment is defined by a 90-degree arc centred about the bisector of inbound and outbound legs, with a distance of 20 km. The observation zone also includes a cylinder of 500 m (British rules).

BGA Enhanced Option Fixed Course Sector : When the glider has entered the observation zone defined by a segment and radial distance from the waypoint. The segment is defined by a 180-degree arc centred about the bisector of inbound and outbound legs, with a distance of 10 km. The observation zone also includes a cylinder of 500 m (British rules).

Turnpoint Cylinder : When the glider has entered the observation zone defined by a radial distance from the waypoint.

Symmetric quadrant : A symmetric quadrant with a custom radius.

Area Cylinder (AAT) :

Area Sector (AAT) : When the glider has entered the observation zone defined by the radial distance from the waypoint, and segment for sector areas.

Finish point types

Task completion depends on the finish type:

FAI finish quadrant : A 90 degree sector with a radius of one kilometer. Cross edge to finish.

Finish line : When the glider crosses the finish line.

Finish cylinder : When the glider enters the cylinder area.

Automatic advancement is triggered whenever a condition is met. To start an AAT, mixed task, or Racing task the start has to be armed before.

Competition rules may be defined in a profile file for distribution to a group of pilots or task-setters, so all competitors are playing by the same rules!

Additional task rules for valid starts and finishes may also be specified. Starts may have a defined maximum altitude above ground, and a maximum speed. Finishes may have a minimum altitude above ground. These parameters are defined in the page "Default Task Rules" in the configuration settings in Config. 1/3 ▷ System in the panels "Task Defaults/Task Rules" and "Task Defaults/Turnpoint Types". For non-AAT tasks, an option is available to set the minimum finish altitude according to the FAI rule, whereby the minimum finish altitude is above 1000 meters below the start altitude.

12.17

5.8 Start a task

One the waypoints (start, turn points with their special features, finish) and task rules defined, there are two things to do:

- In the panel "Manage", press on Save to save the task by giving it a name. If you have just modified an existing task, you can either give it the same or give it another name (to create a new task based on an already-existing one).
- Press on the item Close of the task manager. After the creations and changes done, the displayed windows may differ. You can choose between Close to use the task you have just modified or created. The button Revert Changes allows to discard the changes and continue with the task that was previously loaded. If you have created and saved a new task, it will not be most: you could find it later on in you list of saved tasks. However, the activated task would have been erased from the working memory. You will have to reload the task that you wish to do.

Si you push on Close , the task is started (activated).

5.9 Advancing and restarting tasks

At all times one waypoint in the task is designated as the active waypoint. The active waypoint is used for calculation and display of navigation information, that is, the pilot is directed to fly towards the active waypoint (also referred to as the "next waypoint" in the description of InfoBoxes as in Chapter 11).

During flight a continuous display of the bearing to the next waypoint is shown.

The altitude required to complete the task is calculated for the route starting from the glider's actual position going through the task's turnpoints to the final waypoint.

Changing the active waypoint is performed automatically, or may be performed manually. The start point of racing tasks, and AAT task points, are special cases that require the task point to be "armed" before the system will automatically advance to the next task point once that point is reached. All other task points will automatically advance to the next point as soon as the last point was reached.

For non-racing tasks, no user interaction is required to advance through the task — the system will automatically advance as each task point is achieved. The user may still manually advance or retreat the active task point by selecting the menu items Nav ▷ Previous turnpoint and Nav ▷ Next turnpoint respectively.

The menu items Previous turnpoint and Next turnpoint show dynamic labels that indicate the action that will be performed upon selecting the item.

For task points requiring arming, Next Turnpoint becomes Arm turn if the turn is not armed; if it is armed, then it becomes Next Turnpoint allowing for manual advance. Previous Turnpoint changes to Disarm turn if the turn is armed and vice versa. Similarly, for racing tasks these menu items update for arming start points. If the Next Turnpoint is the Finish Turnpoint , the menu label changes accordingly.

Status messages are given for task points requiring arming, when inside the observation sector, as reminders to arm the turn when the pilot is ready to advance to the next waypoint. For starting, a warning is given that the glider is in the start cylinder or behind the start line, as a reminder to "arm" if necessary.

For PC with touchscreen, the user may manually cycle through the waypoints by highlighting the waypoint and by pushing the up or down cursor key.

See Section 5.7 for details on observation rules.

If a user has cycled through the waypoint manually, this does not mean that the glider has successfully passed the waypoint! However, this facility is useful to force a task restart or to skip a waypoint when flying a casual cross-country task.

Tasks can be restarted simply by manually cycling back through the waypoints to the start.

In all modes, if the glider re-enters the start zone or crosses the start of the previous start, the task will be automatically restarted.

When selecting Previous turnpoint , the trigger that detects auto-advance for that waypoint is cleared; meaning that the task manager expects the aircraft to fly to that observation zone (OZ) again before continuing the task. The pilot may still select Next turnpoint to advance to the next task waypoint.

A system beep and message is given on task/waypoint advance. The messages are given when the system advances the task waypoint automatically or, in manually arm mode, when the system is armed and the aircraft is in sector:

Task start : appears when the aircraft has crossed the start line or exited the start sector. This can be repeated any time.

Next turnpoint : appears when the aircraft has entered the observation sector for turnpoints. Turns with variable target advance as soon as Arm Turn is pushed. For the manual arm mode, if the aircraft has already entered the observation sector and left, pushing arm will cause the task manager to expect, that the turn is intended to approach another time.

Task finish : appears when the aircraft has crossed the finish line or entered the finish cylinder. This occurs in both advance modes.

5.10 Alternate starts

The task system allows alternate start sectors to be defined:

Nav 1/2 ▷ Task ▷ Turn Points select start point, Edit Point ▷ Enable Alternate Starts

On the start point edit page of the Task Manager turn on the Enable Alternate Starts property. Another screen is brought up for defining an alternate start point. If alternate start points have been defined before, label Enable Alternate Starts changes to Edit Alternates . After selecting "Add Alternate Start" and touching Relocate the "Select Waypoint" filtering dialogue is invoked.

Having set up several alternate start points, the "next waypoint" scheme again will be extended. Before detection of a valid start and having armed start manually, the menu buttons stepping through all the waypoints will show label Next Start .

Summarizing, all dynamic menu labels in menu Nav 1/2 show commands to be executed for selecting waypoints and conditions either consecutively or in reverse order.

5.11 Abort/resume the task and Alternates

If atmospheric conditions change for the worse, you may make the judgement that it will be impossible to complete the task. In this situation, XCSoar can be instructed to "abort" the task, and it will then help you reach a safe landing site. An ordered task can be aborted in different ways. Either it is done by selecting a waypoint and execute

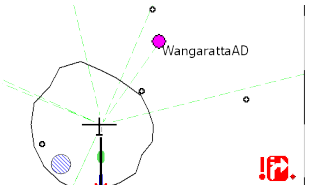
the goto command or by invoking the abort mode. In either case, the ordered task might be resumed.

Task Abort

Nav 2/2 ▷ Task Abort

12.13

Invoking the abort mode forces XCSoar to enter a special case of the final glide mode. For a discussion on flight modes refer to Section 6.1. In this flight mode the configuration option 'reach polar' determines whether waypoint arrival heights in abort mode uses the MacCready value prior to aborting the task, or if the safety MacCready value is used. Default is to use the safety MacCready value. When switching to abort mode, the MacCready setting is set to the safety value if it is lower than the current setting.

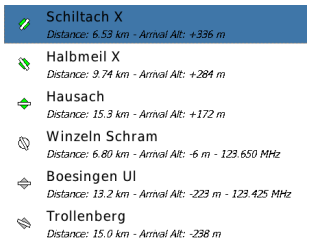


With invoking abort mode the cross-country task is disabled. On the map radials are drawn pointing to the nearest landables to instantly support the pilot's decision. As is during the whole flight, the group of nearby landables is maintained permanently. Radials and nearest landables may change dynamically when in abort mode, so that at any time several landing options are presented and any of these may be selected as the active waypoint. Even if no landable is in reach, the radials are drawn. If conditions improve, the task can be resumed by selecting the same menu button that aborted the task, now denoting Resume Task . The active waypoint, prior to aborting the task, is then restored along with all the other task details.

Alternates

Nav 1/2 ▷ Alternates

12.10



Alternates are maintained throughout the flight, reflecting good airmenship by always keeping an eye on possible alternates. Six landing options are maintained. They are filtered by the configured "alternates mode" criteria (Simple, Task, or Home). Choosing Task or Home puts some bias on the presentation of alternates to the heading, you were taking whilst still task oriented.

As is with every waypoint list, additional information might be called by tapping Details before deciding which final to go. Select a waypoint from the list and push Goto .

Although the items on the alternate list obey different rules they interact in the same way with the current task. Choosing a target from the alternates list aborts the task; once the conditions get better the resuming of the task is doable by the already mentioned button.

5.12 Task status

Info 2 ▷ Status

The status dialogue gives a summary of important task information. It can be useful to give a good overview of the task status while freeing up InfoBoxes for other purposes. The status dialogue can be referred to in order to confirm that a valid start was detected, as well as the progress against the task. The status dialogue can be invoked by menu

or gesture left down right down left, denoting an S. The status tabs 'Task' and 'Rules' are of interest.

The task tab shows the AAT times, distances achieved and remaining and the task speeds. The rules tab shows the validity of start/finish according to the task rules.

Task

Estimated task time	04:16
Remaining time	04:13
Task distance	197 km
Remaining distance	200 km
Speed estimated	46.1 km/h
Speed average	59.3 km/h

Rules

Valid start	Yes
Start time	15:42
Start alt.	1661 m
Start point	Kandel Hotel
Start speed	152 km/h
Finish min. alt.	759 m
Valid finish	No

5.13 Assigned Area Tasks

AAT targets

A *target* is a point within an AAT area that the pilot intends to fly to. These targets can be moved within the AAT areas so the pilot can adjust the effective distance of the task. Targets may be set on the ground, during task planning, and modified during flight.

When flying an AAT task, the navigation system directs the glider to the target, and statistics like distance to waypoint are also relative to the target rather than the waypoint of the AAT area itself.

Automatic task waypoint advancement does not trigger when entering an AAT area solely. The pilot has to arm the turn manually to advance to the next turn. When arming the AAT turn while flying through the OZ also the task optimiser is triggered to capture the realized AAT target and bring the target optimisation for the rest of the task up to date. See Section 5.9 for details.

Manually moving targets

In order to make the specification of targets more straightforward, their location is defined by a range parameter that determines how far from the minimum to maximum possible distance the target is. This is expressed as a percentage. For example, with range set to 100%, the target is located to give the maximum overall task distance. With range set to -100%, the target is located to give the minimum overall task distance.

Zero range yields a nominal task distance: for sectors the target is half way along the bisector radial; for cylinders the target is in the center of the cylinder.

The task calculator dialogue (see Section 5.5), shows the average percentage over all turns in the AAT Range field. The targets can be individually modified from the target dialogue of the task calculator.

AAT targets and the Task Calculator

Config. 1/3 ▷ Flight
Config. 1/3 ▷ Wind

The typical use of targets in flying AAT is as follows:

- Set the expected MacCready, bugs/ballast and wind settings for the flight using the dialogues and .
- Define the task as normal from the task editor.
- Based on the pilot's judgement of how good the weather is, and whether some areas are likely to be more or less difficult than others, targets may be set individually for each turn-point in the target view. The ETE field in the target view compared to the assigned minimum time is shown as Delta T to check if the planned task is efficient and long enough.
- During flight, if situations change, such as changed MacCready setting or wind, the task calculator can be brought up to show the estimated task time, again allowing comparison to the assigned minimum time.
- If the pilot decides to extend or shorten the flight, all the remaining targets can be modified from the task calculator.

The task calculator therefore allows the pilot to make (and help to answer) 'what if?' questions, for example:

- What will happen if the conditions improve? The MacCready setting can be increased and the pilot can see if there is sufficient adjustment to targets in order to be able to extend the planned task.
- What will happen if the conditions deteriorate? The MacCready setting can be decreased and the pilot can see how much the task can be shortened and still finish the task later than the assigned minimum time.
- What will happen if I leave the AAT area now? By pressing Arm turn the take over of the current position into the optimization can be forced. The repositioning of subsequent turns can be reviewed in the task calculation dialogue.

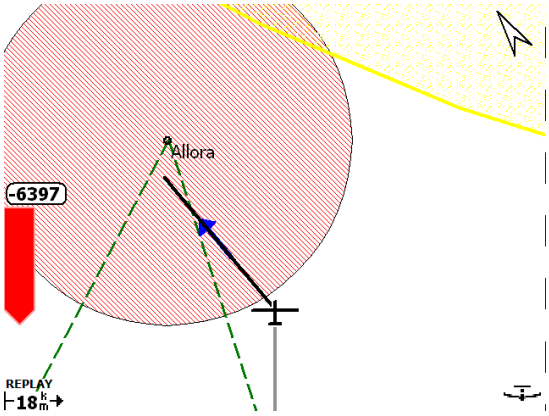
Target projection

XCSoar continually analyses the path of the glider through AAT sectors to find the points in previous AAT sectors through which the achieved scoreable distance will be greatest. Internally, the program moves the targets for previous AAT sectors, which are then the optimal targets.

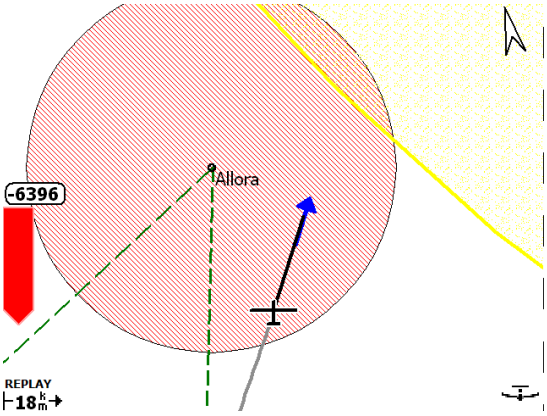
In certain conditions, targets for the current AAT sector may be moved automatically:

- When inside an AAT sector, the target in that sector is moved to a line projecting from the previous sector's target through the aircraft, at the same distance from the previous sector's target to the target prior to entering the sector. The effect of this is to allow pilots to choose to enter an AAT sector in a different direction or offset from the direct line from the previous target to the current target.
- While the aircraft is in the AAT sector and the distance from the previous target to the aircraft is greater than the distance from the previous target to the current target, the target is moved further along the projected line from the previous target to the aircraft, just beyond the aircraft. Hence, the black track line will not be visible but the blue optimal track arrow will point along this projected direction.

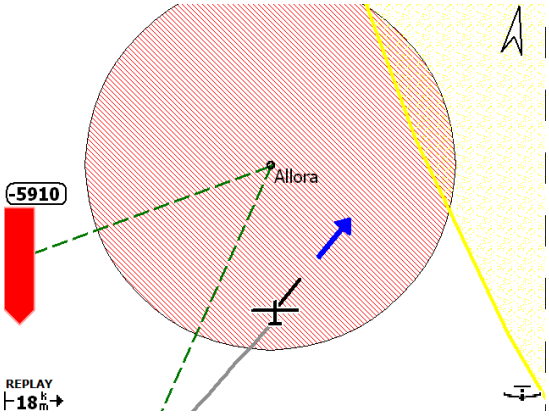
A worked example is provided in the following figures to illustrate how targets move during a flight and to show how XCSoar determines the maximum scored path.



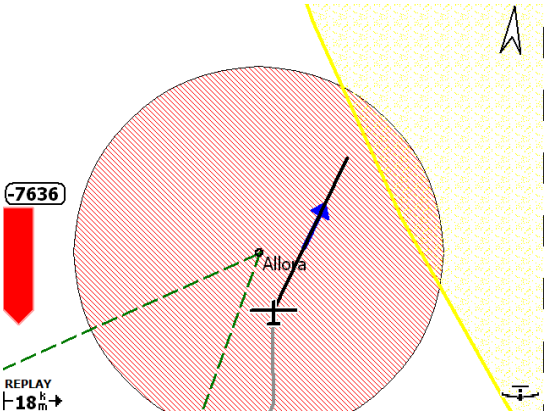
Outside sector
Target (-20%) is on bisector



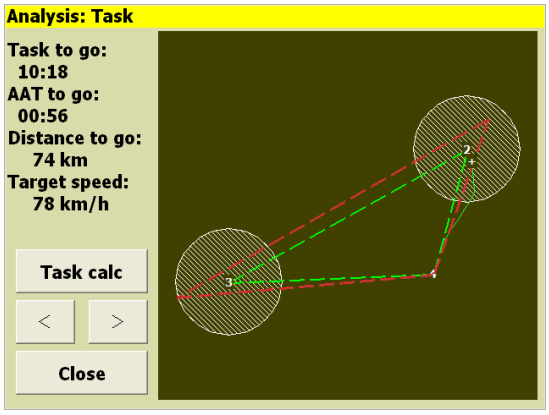
Inside sector
Target moved along track line



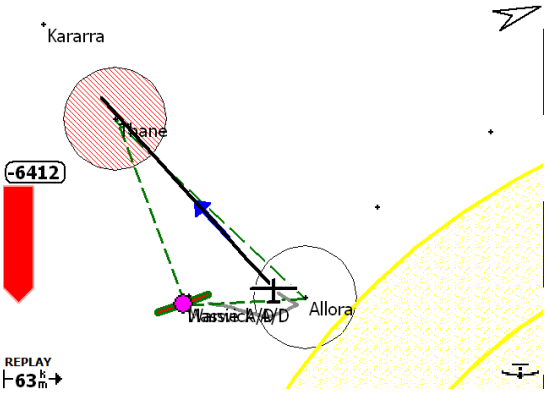
User decreased range
Target (-80%) moved along track line



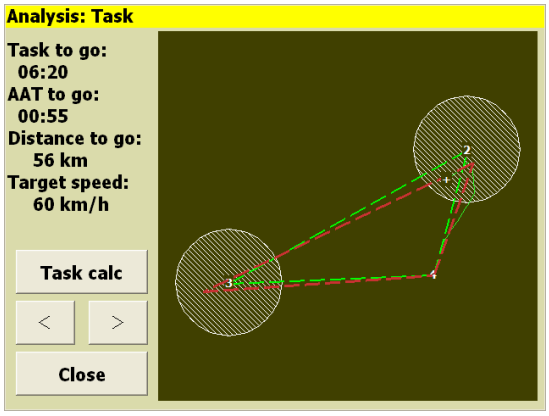
User increased range
Target (80%) moved along track



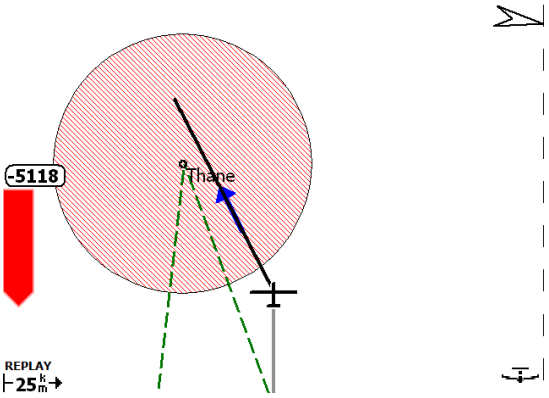
Analysis (task page)
Path around active target



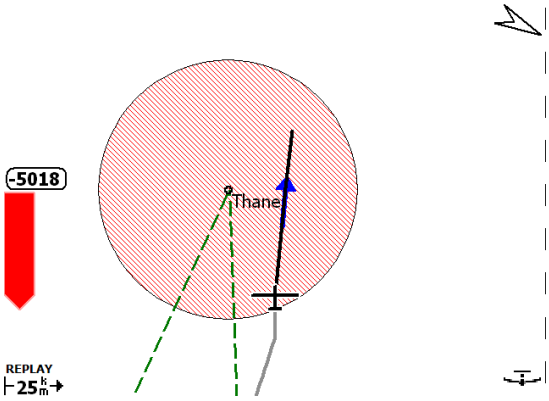
Next waypoint
"Arm Turn" pressed



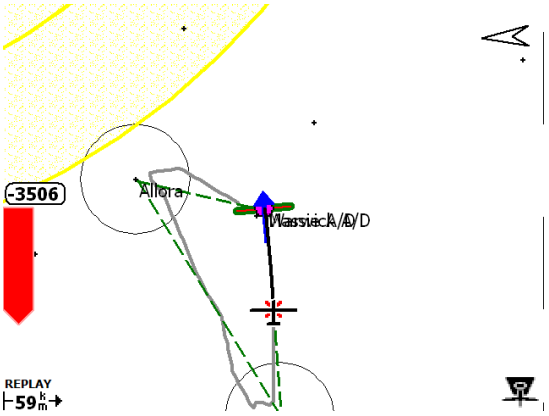
Analysis (task page)
Best scored target found



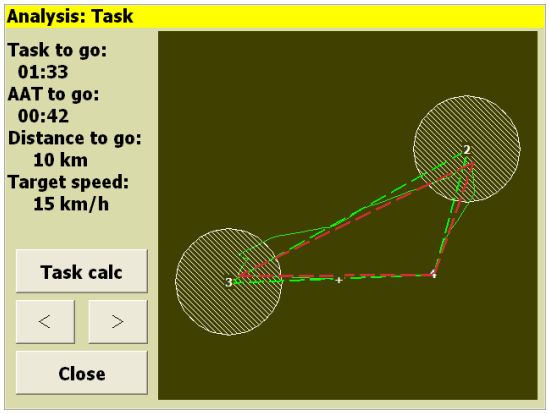
Approaching next area
Target (60%) is on bisector



Inside sector
Target (60%) moved along track line



Next waypoint
"Arm Turn" pressed



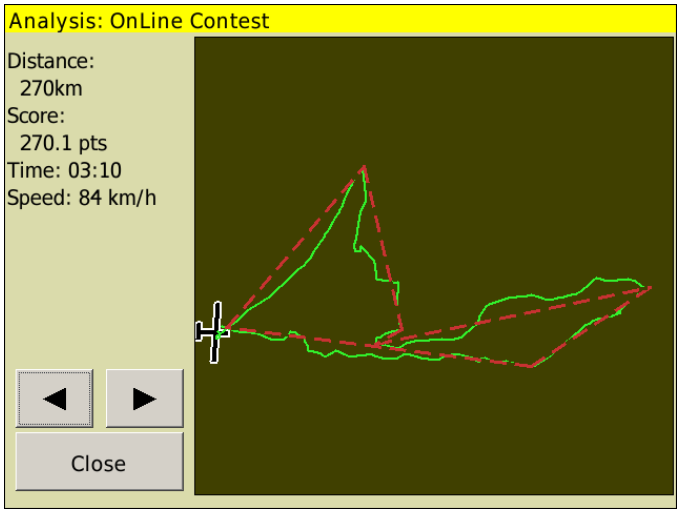
Analysis (task page)
Best scored targets found

5.14 Contest

12.17

The analysis dialogue contains a page "Contest" which can be used to show the optimal path and estimated score. The configuration settings (task rules page) allows the selection of which set of rules to be used for the selected contest (like OLC or WeGlide) optimisation.

The optimization is done continuously in the background and can be retrieved at any time. The analysis page shows a graphical overview of the optimisation result besides distance and score. An InfoBox is available which gives the instant selected contest distance and score as well.



When flying for contests, either AAT or non-AAT tasks may still be used to manage the flight navigation. During flight, the computer will optimise the current flight with respect to the selected contest rules.

In the contest analysis page, the aircraft track is shown as a thin green line, the optimal path is shown as a thick red line.

The score and computed optimal distance is approximate.

When the aircraft has landed, the displayed result is not updated anymore.

5.15 Logger

A flight logger conforming to the IGC file specification can be used to record flights.

Several flight loggers are accessible via XCSoar:

- A software-based logger. All versions of XCSoar have this functionality. The logger conforms to the IGC standard but is not certified.

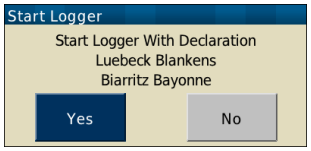
12.28

- XCSoar can also send declarations to some external logger devices. For this to work, the device must be specified in the 'Devices' section of the configuration settings.
- For some of the numerous logger devices XCSoar can download IGC files. This is convenient especially for logger devices which are not that easily removable from the glider.

Setup

For a complete matrix of the supported logger features see Section 2.5. The configuration is described in detail in Section 12.23. Details to the log files can be found in Section 13.10.

Logger activation



The logger can be turned on and off automatically or manually. For para-glider XCSoar provides the option to only start the logger automatically. Thus a very slow and close to the terrain flight won't automatically stop logging the flight. If you choose the auto start only logger you have to stop the logger manually. To turn the logger on (or off) manually, select from the menu:

Config 3 ▷ Logger Start

When the internal software logger is active, a small 'green status led' in the lower right corner of the map area flashes once per second.

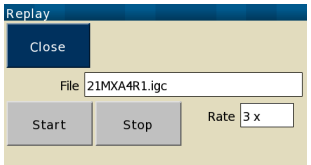
By default, XCSoar is set up to automatically start and stop the internal software flight logger when it detects the aircraft is flying and when it has landed, respectively. Only when the logger is manually started does it ask if the flight is to be declared; when automatically starting it automatically declares the current task. In simulation mode the logger does not get activated automatically.

If a task has been declared, then subsequent attempts at modifying the task result in a warning message asking to confirm whether the action is to be taken and invalidate the declaration. This is intended to make it harder to accidentally modify the task resulting in a failed declared task.

The XCSoar software logger, when started, checks for 500 kB of free space on the file storage. If there is insufficient space, it will automatically delete IGC files, oldest first, in order to free up 500kB. It does not ask the user for confirmation before performing this operation.

The internal software logger buffers data so that when it starts (automatically or manually) up to 60 seconds of data prior to starting is recorded. This means that the software logger now adequately captures the full take-off.

Logger replay



Flight logs in the IGC format generated by XCSoar or other loggers can be replayed. The logger replay dialogue can be accessed via the menu:

Config 2 ▷ Replay

During replay, the word 'REPLAY' appears at the lower left corner of the screen. During replay, the program behaves as if real GPS updates are being received by a GPS.The logger replay dialogue does not need to be open during replay.

To start a log replay, first select the file to load, and then select the Start button. The replay can be performed in accelerated time by changing the time scale from 1x to a higher number, and paused by setting the time scale to zero. High time scales can result in degraded performance of the wind estimation and other statistics/analysis routines.

Stop the log by pressing Stop . Once a log is started, further presses of the Start has the effect of restarting the replay.

After a log file has been replayed, it is recommended to reset the device before flight, in order to ensure that XCSoar's internal statistics are properly reset.

When operating XCSoar in FLY mode, the replay is disabled (stopped) if the real GPS receiver detects that the aircraft is moving.

The logger replay works best with high sampling rate log files; a 6 second interval or less works fine.

Error analysis logger

For the pure reason of tracking down error prone behaviour of XCSoar there is a 'Raw Logger'. In case you are able to reproduce an error you can activate the raw log file creation by:

Config 3 ▷ Raw Logger

Developers will appreciate very much any detailed error description including a log file like this. It really facilitates the root cause analysis and saves time to fix an error.

5.16 Flight analysis

Up - Right - Down

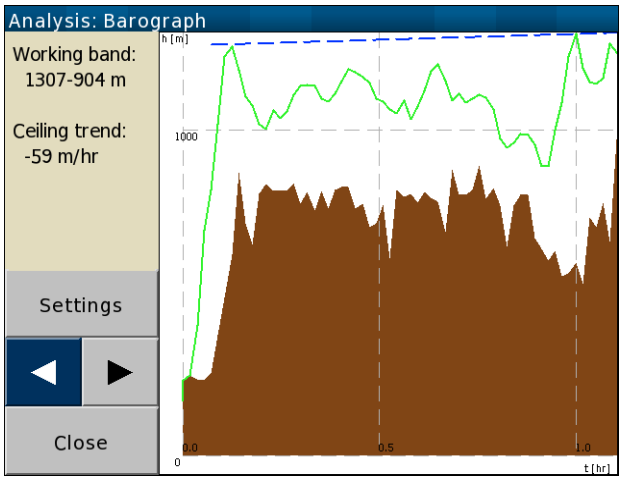
The analysis dialogue is very useful in planning and conducting cross-country flights. It is accessed via the menu:

Info 1 ▷ Analysis

Several pages are of interest:

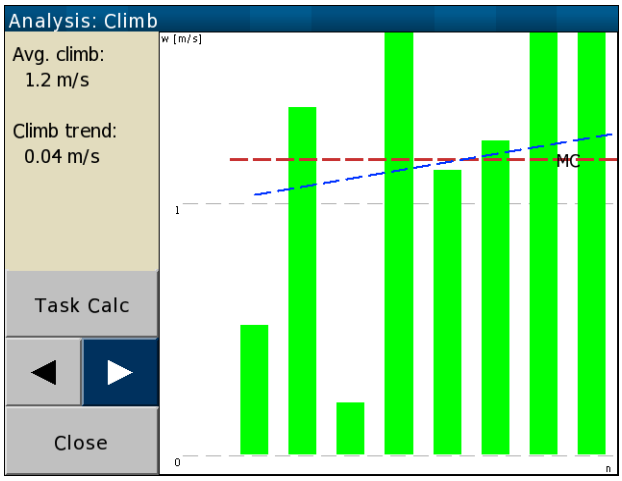
Barograph : Shows a graph of the history of the altitude of the glider. Statistics are used to estimate the thermal working band (average base and ceiling of climbs) and to estimate how the ceiling is changing over time. The base and ceiling lines are drawn on the barograph.

The 'Settings' button opens the flight settings dialogue, allowing to alter the values of ballast, bugs, QNH and maximum temperature.



Climb history : Shows a bar chart of the average climb rate achieved during each climb. Statistics are used to estimate the overall average climb rate, and to estimate how this average is changing over time. The current MacCready setting is drawn on the bar chart as a thick red dashed line, and the climb rate trend is drawn on the chart as a blue line.

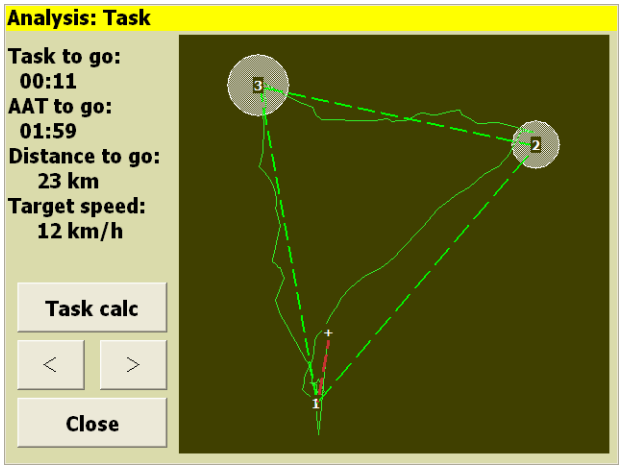
The "Task Calc" button opens the task calculator, (e.g. to adjust the MC value).



Task : This page shows an overview of the entire task. The main task line is drawn in thick dashed green, AAT areas are shaded. For

AAT tasks, the path from the aircraft around the remaining targets within AAT areas is shown in red. The aircraft track is shown as a thin green line.

The 'Task Calc' button opens the task calculator, (e.g. to adjust the AAT task range or MC value).



5.17 Sunlight and time

A sun ephemeris computes the time of sunrise and sunset, which is displayed in the Aircraft Status dialogue (see Section 4.13). Note that local terrain and atmospheric conditions may result in poor visibility before the displayed sunset time.

For PDA systems, the clock is adjusted for daylight saving time according to the settings in the operating system.

If the expected arrival time at the final waypoint in the task is past sunset, a status message warning is issued.

6 Glide Computer

This chapter focuses on how XCSoar's glide computer works and is recommended reading so you understand the specific details of calculations being performed and how to use the software properly. It assumes a basic knowledge of cross-country soaring, but is suitable reading for competition pilots as well as pilots engaging in casual cross-country touring.

6.1 Flight modes

In order to reduce the pilot's workload, XCSoar is enabled to do different things depending on the actual flight's state. XCSoar can do this without in-flight interaction of the pilot. The differences are reflected by different displays, calculations, and flight information amongst others. The four states used by XCSoar are called *flight modes*, which are

- Cruise mode
- Circling mode
- Final glide mode
- Abort mode

XCSoar automatically detects the difference between circling flight and cruising flight. Circling is enabled when the glider turns (typically three quarters of a turn). After about 30 seconds of straight line flight the software will switch from circling to cruise mode. Hence, the switch is based on a simple condition.

It is also possible to have circling mode switched based on an external input (e.g. from a pilot-operated switch).

Final glide becomes active when the glider is above final glide path with respect to the given navigational task and safety margins. The required altitude depends most importantly on the adjusted MC value, but also the ground clearance is considered. On entering a thermal while in final glide mode for gaining some extra safety margin XCSoar will switch to the circling mode and back to the final glide mode, once the thermal is left again and the final glide condition is still met (i.e. the glider is still above the final glide path, considering MC setting and terrain).

As an example, a powerful feature to be driven by flight modes is the switch between different MacCready settings strategies. If you decided to let XCSoar manage the setting automatically it will maintain a

12.11 value based on past thermals worked out successfully until final glide. Instantly MacCready is set to achieve minimal arrival time or what you set up for final glide (see Section 6.13). Hence the switch to final glide mode is based on a set of sophisticated computed tactical conditions.

You might force XCSoar to enter final glide mode by skipping all remaining turnpoints, if for example conditions get worse and you decided to just go home.

12.10 Abort mode is invoked manually to give you full control in case of emergency via menu. No automatics — you decide. The abort mode might be understood technically as a special final glide mode with concurrent support for multiple optional targets. However, in practice the abort mode simply supports your urgent decision where and how to go finally (see Section 5.11). In this case, a safety MacCready value is set. Hence the switch to abort mode is based on the pilot's cognition.

Due to the fact that the different flight modes typically are reflected in differing things being displayed, the frequent XCSoar user might get used to some kind of watching a 'display mode'. This is just the default *perceived* after having installed XCSoar without having done some advanced configuration. As holds true for almost everything within XCSoar, the display's behavior might be changed, adding value for the advanced user. But altering things in XCSoar does not influence the conditions for entering a flight mode, they do not change.

In order to take full advantage of the flight modes concept, XCSoar will *always* show you, which mode is active. A small symbol is drawn on the lower right corner of the map area to indicate which flight mode the computer is in:

(a) (b) (c) (d)

Cruise (a) : The glider is not circling and there is either no task active, or the task waypoint is not the finish point.

Circling (b) : The glider is circling (though it may not be climbing).

Final glide (c) : The glider is not circling and the active waypoint is the final one in the task.

Abort (d) : This manually-triggered mode indicates the immediate landing options to the user. (See Section 5.11)

The concept of different flight modes enables much more to be automated:

12.21
- The InfoBoxes may be set up differently for each flight mode. (See Section 3.6)

12.5
- Change zoom level between circling and other flight modes (this

is called 'circling zoom', see Section 4.3).

12.15

- Switch the vario gauge's reading between Vario (gross climb rate) whilst thermalling and airmass lift around you (net) whilst cruising (see Section 7.1).

12.14

- When in circling mode, invoke the 'thermal assistant', a small polar diagram depicting the updraft over circular course (see Section 7.9).

12.6

- Switch to a so-called drift compensation, drawing a wind-compensated trail of the circles you fly to better depict wind shear (see Section 4.8).

Take notice, that this list is just an excerpt from an entirety of switchable items. You will find numerous dependencies conducted by the actual flight mode, whilst further reading this manual. Please pay attention to it, because the flight mode concept is one of XCSoar's fundamental basics. Another very basic scheme deals with how to structure information to be displayed together. This information is grouped in *screen pages*. Further details are given in Section 3.6 "Infoboxes and screen pages".

12.21

6.2 MacCready setting

The MacCready setting may be adjusted several ways:

- For touchscreen/mouse devices, select the MacCready InfoBox field, then use the up and down arrow keys.
- When connected to a supported intelligent variometer, adjusting the MacCready setting on the variometer will change the setting in XCSoar according to the devices synchronisation configuration (see Section 12.28)

In addition, an automatic MacCready mode is available as described in Section 6.13.

6.3 Glide polar

Config 2/3 ▷ Plane

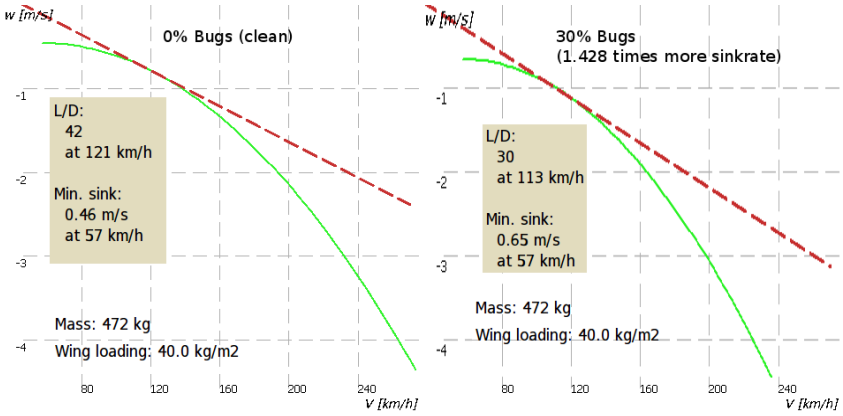
12.27

The glide polar specifications of a wide selection of glider types, representing major classes of gliders, are built into XCSoar. If your glider type is not listed, these may be used as an approximation if no better glide polar can be found. However, for most accurate results, it is advisable to use the correct glide polar for your particular aircraft type. Besides the aircraft type, the correct overall mass of the glider is important for accurate results. The preflight check of your tactical glide computer certainly includes a check of the correct settings for water ballast, with regard to the configured dry mass. Because XCSoar does not offer a setting for the pilots weight you are free to include the latter to the dry mass setting, or the water ballast setting.

On top of the polar and mass configuration the glide polar is adjustable in flight to take into account performance degradation due to bugs or rain droplets.

The build-up of bugs on the wing's leading edge, as well as rain droplets on the wing, affect the aerodynamic performance. It is the pilot's responsibility to judge and update the bugs value during flight. The bugs value is expressed as a percentage of degradation compared to the clean glider's performance. For example, at 0% bugs value, the glider performs as a clean glider, and at 50% bugs value, the glider's sink rate is doubled when compared to a clean glider. The calculation scales linearly in-between.

Info 1 ▷ Analysis



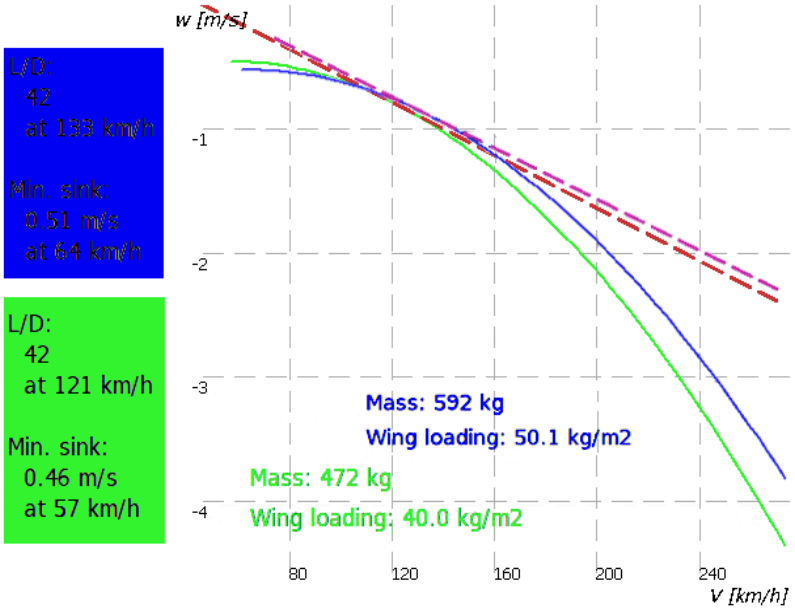
Knowing all this, a meaningful setting for a worst-case bug polluted wing could scale down the polar by 30%. Some experimentation may be required to determine appropriate settings for bugs, because the performance degradation experienced by different glider types may be different.

Alternatively, you can enable the "Auto bugs" feature which adds 1% to the bugs setting after each full hour of flying. This feature is set via

Config 1 ▷ System ▷ Glide Computer ▷ Safety Factors ▷ Auto bugs

The ballast is set in litres of water. Depending on the specifically set dry mass of the glider, this may optionally include a weight margin to provide for different pilot weights. When flying with no ballast, a heavy pilot may set a ballast value of perhaps 15 l so that the polar is appropriately adjusted for the increased cockpit weight.

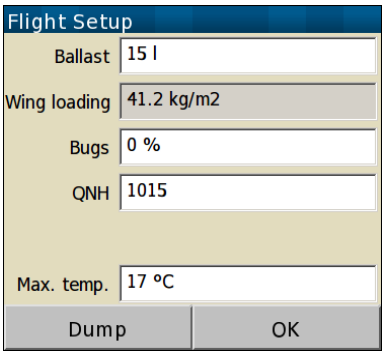
Info 1 ▷ Analysis



6.4 Flight setup dialogue

Config 1 ▷ Flight

Use the flight settings dialogue to modify the all up weight of the glider both before and during flight, as well as to set the QNH pressure.



The 'bugs' setting determines the amount the polar is degraded due to contamination during a long flight. A 'bugs' setting of 0% will cause the software to use the clean polar. A 'bugs' setting of 50% will degrade the polar and effectively double the sink rate for a given airspeed.

The ballast setting is used to modify the polar to account for any water ballast carried during the flight. Ballast is shown in litres, and should be set to correspond to the correct water ballast added before flight. The ballast setting modifies the polar to account for the indicated load of water ballast.

Use this dialogue both before and during the flight to record the mean sea level atmospheric pressure, also known as QNH pressure. The software uses the values entered to convert airspace flight levels into altitudes. If connected to a supported intelligent variometer with an

altimeter, the altitude is updated on this dialogue as the QNH pressure is adjusted. This makes it easy to set the QNH pressure if the airfield elevation is known.

The maximum forecast ground temperature is used by the convection forecast algorithm (see Section 7.10) in its determination of estimated convection height and cloud base.

It is possible to configure XCSoar to display the basic settings dialogue when it starts up.

On system startup, after the GPS has acquired lock, and if a barometric altitude source is connected (e.g. Vega, AltairPro, FLARM), the QNH is automatically adjusted. This adjustment sets the QNH such that the barometric altitude equals the terrain altitude.

The QNH is only updated if the aircraft is on the ground for more than 10 seconds, so that if XCSoar is restarted during flight, QNH will not be adjusted. The update also only occurs if the terrain database is valid at the current aircraft location.

6.5 Speed command display

When used in conjunction with an intelligent variometer that produces indicated airspeed measurements, a speed command chevron is drawn on the right side of the map display. If the glider is flying slower than the optimal speed, the chevrons are red and point downwards. If the glider is flying faster than the optimal speed, the chevrons are green and point upwards. If the speed is approximately optimal, no chevrons are drawn.

Depending on the configuration, speed command chevrons can be displayed on the right side of the map area, or on the variometer gauge.

6.6 Speed to fly

XCSoar continuously calculates two types of speed to fly:

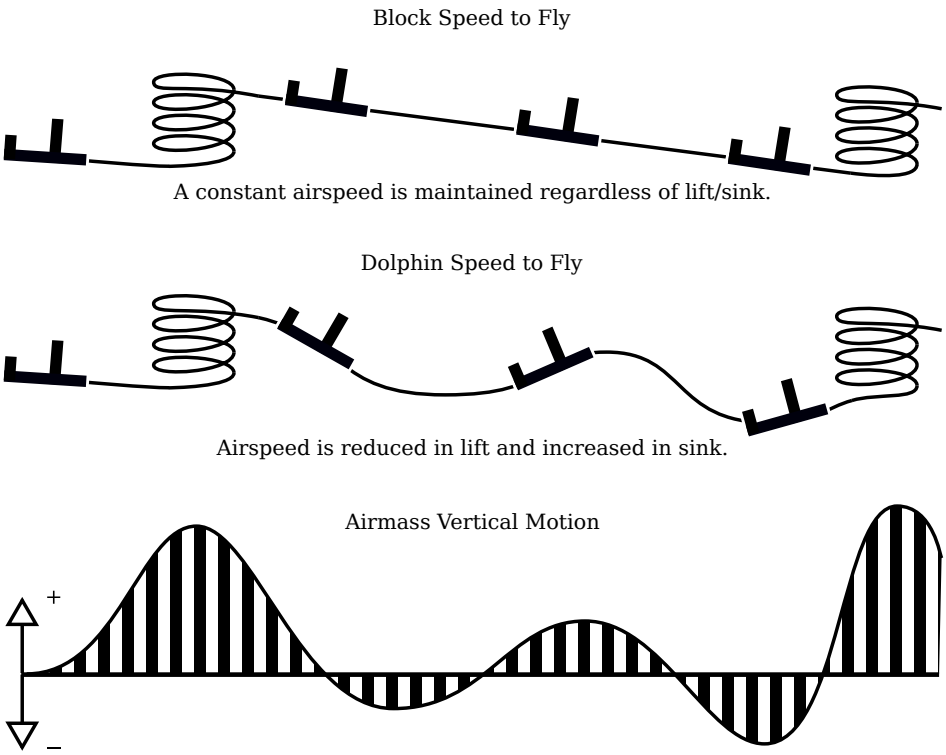
MacCready speed : This is the best speed to fly during cruise in still air, adjusted for wind if in final glide mode.

Dolphin speed : This is the instantaneous, best speed to fly in rising or descending air, adjusted for wind if in final glide mode.

The user can specify a maximum maneuvering speed in the configuration settings, which limits the speed-to-fly in MacCready calculations to realistic values.

Different pilots have personal preferences as to whether they prefer to fly in so-called 'block MacCready' style, in which they fly constant speed between thermals according to the MacCready speed; or to fly

in 'dolphin' style, in which they fly at varying speeds according to the continuously changing Dolphin speed value.



A configuration option 'Block speed to fly' (see Section 12.11) can be used to specify whether dolphin or block speed to fly is used. The infobox 'V Opt' shows the optimum speed according to whichever mode is selected. When connected to the Vega intelligent variometer, the speed command sounds are based on this optimum speed value.

6.7 Speed to fly with risk

The speed to fly system can be compensated for risk, in which the MacCready setting used for calculating the speed to fly (in both Block or Dolphin modes) is reduced as the glider gets low.

Many pilots typically wind down the MC as they get low — this feature performs this automatically. The theory governing how this is implemented in XCSoar is based loosely on the paper by John Cochrane, "MacCready Theory with Uncertain Lift and Limited Altitude", *Technical Soaring*, 23 (3) (July 1999) 88–96.

faculty.chicagobooth.edu/john.cochrane/soaring/docs/newmcred.pdf

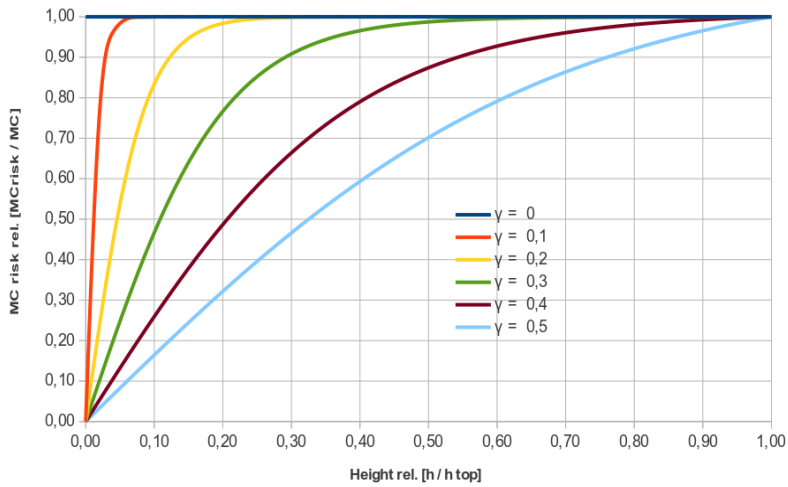
A configuration parameter γ ('STF risk factor', in the configuration settings under page 'Glide Computer') controls how the risk MC value is calculated. The γ factor determines the fraction of the current

MacCready setting as a function of the height fraction. The height fraction used in this calculation is the ratio of the height above terrain (h) to the height of the maximum climb above the terrain (h_{top}, this will usually be close to cloudbase). The γ setting thus represents the fraction of the total available climb (cloudbase minus terrain) at which you would wish to abandon the task and begin to prepare for a landout. Thus, low γ values indicate a higher tolerance for landout risk than higher values of γ.

For the default value, $\gamma = 0.0$, there is no compensation — the risk MC is the same as the MC setting. For $\gamma = 1.0$, the risk MC is scaled linearly with the height fraction h/h_{top}. For intermediate values of γ, the risk MC varies smoothly with the height fraction, such that the risk MC is small only when low.

Low values of γ are best when pilots do not want to slow down as they get low (but risk out-landing); high values of γ can be used for very cautious pilots but will result in lower average speeds.

A value of $\gamma = 0.3$ is recommended.



6.8 Safety heights

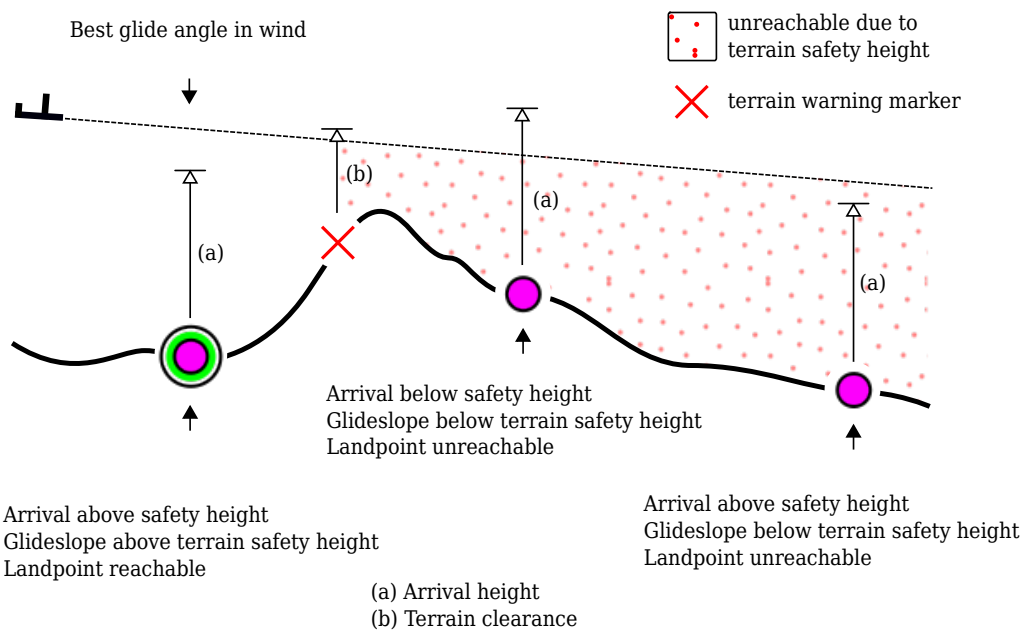
Three safety heights are defined to provide a degree of safety margin in glide computer calculations.

The safety heights are:

Arrival height (a) : This is the elevation above ground at which the glider is required to arrive at least. Typically, you want to include height for a safe landing circuit, plus some safety margin for hazardous vertical/horizontal air movements and resulting errors of computed route and speed. This value is used in final glide calculations as well as the determination and display of reachable landable fields.

Terrain clearance (b) : This is the elevation above ground, below which any computed glide path is considered to provide inadequate clearance to the terrain. The terrain clearance value affects the glide range display, and if the final glide at any point dips below the terrain clearance elevation above ground, a warning marker (large red cross) is drawn on the screen. If the terrain elevation model is invalid or out of range, then the glide range display and the terrain warning marker is disabled.

Break-off height (c) : This is the elevation above ground, below which it is recommended for pilots to consider the cross-country task failed and to concentrate on finding a suitable field to land in. Currently, this break-off height does not affect XCSoar in any way but it is referenced in the manual.



These may be set to zero but this is highly discouraged since all glide computers, instruments and data sources (such as terrain elevation models) are subject to some degree of error and the atmosphere through which the glider flies is also unpredictable.

XCSoar determines the elevation above sea level of any turn point or landing point either from the waypoint file, or if no height is specified in the waypoint file, from the terrain file.

The estimated arrival altitude displayed next to landable waypoints is by default calculated for best glide angle at zero MacCready ring setting (MC$= 0$), adjusted for wind. However, a safety MacCready setting may be configured to modify the MacCready setting used in this calculation, as described below.

Landable fields are only marked as reachable if the estimated arrival elevation above ground is above the arrival altitude safety height, and the glide path does not intersect the terrain clearance safety elevation.

At all times, if the final glide through terrain marker (a red cross) is displayed on the screen, then the glider must climb in order to safely reach the destination.

When calculating the arrival heights of landable fields (for map display purposes and in abort mode), a safety MacCready value can be specified in the configuration settings. This safety value is set to zero by default. Larger values make the arrival height calculation more conservative.

6.9 Final glide calculator

The final glide calculator uses many sources of information when determining the altitude required to reach your goal or the next waypoint. These are:

- The glider's polar data;
- The wind speed and direction;
- The distance and bearing of the goal or waypoint;
- The MacCready setting;
- The altitude of the waypoint or goal;
- A user specified safety margin (arrival height and terrain clearance).
- The glider's total energy if XCSoar is connected to an instrument with an air speed indicator.

From the parameters shown above, two altitudes are derived.

Altitude required : This calculation is the total altitude required for the glider to reach the goal plus any user safety margin.

Altitude difference : This calculation is the altitude required to glide to the goal plus any safety arrival altitude plus the altitude of the goal, minus the altitude above mean sea level of the glider. The result represents either your height above glide slope, or your arrival height at goal. If no goal altitude is provided in the turn-point file, XCSoar will use the terrain file altitude at the goal.

The final glide calculation is extended to calculate the altitudes required and difference to complete the entire task. This capability is sometimes referred to as final glide around multiple turn points. The altitude difference to complete the task is displayed continuously as an arrow and in numeric form on the left-hand side of the map area of the screen.

The altitude required is adjusted for energy, compensating for the fact that the kinetic energy of the glider can be converted to height (potential energy). The kinetic energy that is convertible to height is calculated from the difference in the true airspeed to the true airspeed for best glide. This compensation is most accurate when airspeed data is available to XCSoar, otherwise the true airspeed is estimated from the wind speed and ground speed.

6.10 Display of required altitude difference

On the left side of the map display, a box displays the calculated altitude difference required for the glider to complete the task, or reach the final waypoint. If the glider is above the minimum altitude required, a green arrow bar is drawn above the box indicating the amount of excess height.

If the glider is below the minimum altitude required, a red arrow bar is drawn below the box indicating the amount of height deficit. If, however, there are landable waypoints within glide range, but the glider is below the minimum altitude required to complete the task, the bar is coloured amber.

The scale of the final glide bar is +/− 500 meters.
A bar beyond this scale is indicated by a chopped-off tip.

At this point it must also be mentioned, that the indicated height below the glide path is not just a plain difference of glide path and current altitude. Depending on the setting 'predict wind drift' (On) the 'Below' indicator shows the required height to gain by thermalling. The required height might be quite a bit more with headwind, as well as a bit less with tailwind. Otherwise ('predict wind drift' set to Off), it is just the plain altitude difference.

12.11

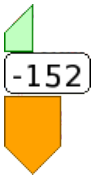
Dual altitude required bars

The final glide bar has been extended to show the effect of MacCready setting on the altitude difference to complete the task. The display shows with a brighter split arrow the *altitude difference calculated at zero MacCready*, as well as the usual arrow that displays the altitude difference calculated at the current MacCready setting.

The number shown in the box next to the final glide bar still shows the altitude difference at the current MacCready setting.

Examples of the appearance in various configurations with the additional *MC*= 0 bar display is shown below:

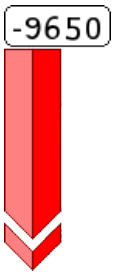
Above final glide : (current MC= 0.7) Here the display shows that at the current MacCready setting, the aircraft is above final glide (filled arrow). The split arrow shows the additional excess height.



Below/above final glide : (e.g. MC= 1.8) Here the display shows that at the current MacCready setting, the aircraft is below final glide (filled amber arrow). The split green arrow shows that at MC= 0, the aircraft is above final glide.

In this situation, if the glider is climbing, the pilot can assess whether to leave the thermal early and commence a final glide descent at a reduced MacCready setting; or continue to climb. It is useful to switch on the auto MacCready setting as this will automatically adjust the MacCready value to the optimal value — and then it is simple for the pilot to compare the achieved lift rate with the MacCready value. When the achieved lift rate drops below the MacCready value, the thermal should be left.

Below final glide : (e.g. MC= 2.5 and with less height) Here the display shows that at the current MacCready setting, the aircraft is below final glide (filled red arrow). The tip of the red arrow is chopped off to show that the altitude undercut the 500 meter limit the arrow can scale on. The split slightly brighter red arrow shows that by reducing the MacCready setting to zero, the aircraft still is far from final glide.



Below final glide : Here the display shows that at the current MacCready setting, the aircraft is below final glide (red arrow). The split brighter red arrow shows that even at MC= 0 the aircraft is well below final glide.

6.11 Task speed estimation

Some of XCSoar's internal calculations make use of estimates of the time required to reach each waypoint in the task. This information is used in some InfoBox displays, Assigned Area Task calculations, and sunset warnings.

The glide computer assumes the glider's average cross-country speed is equal to that achievable under classic MacCready theory taking wind into account, with the current MacCready setting. This method is used for estimating arrival times and task finish time.

The following task speed measures are defined:

Task speed achieved : This is the task speed to date, compensated for altitude differences from the task start altitude.

Task speed average : This is the task speed to date compensated for altitude required to complete the task.

Task speed remaining : This is the task speed estimated for the remainder of the task according to MacCready theory.

Task speed instantaneous : This is the instantaneous estimated speed along the task. When climbing at the MacCready setting, this number will be similar to the estimated task speed. When climbing slowly or flying off-course, this number will be lower than the estimated task speed. In cruise at the optimum speed in zero lift, this number will be similar to the estimated task speed.

This measure, available as an InfoBox is useful as a continuous indicator of the cross-country performance. It is not used in any internal calculations.

For assigned area tasks at the same time a new task time estimation is calculated the target position is optimised. the AAT will be completed not more than five minutes after the given task time.

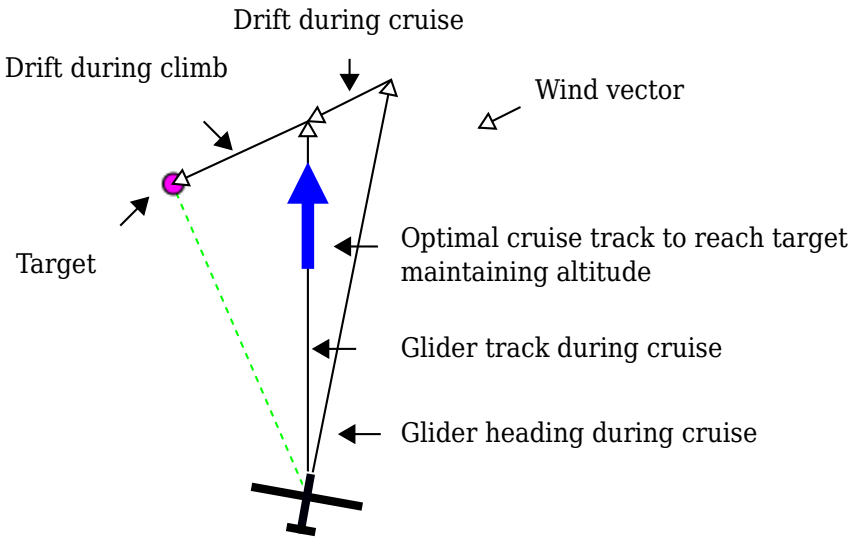
In addition, a measure called *achieved MacCready* is calculated. This is computed by finding the MacCready setting that under classical MacCready flight would produce the same task speed as has been achieved. This value is higher than the actual MacCready setting when the glider has climbed faster than the MacCready setting or when the glider has flown in cloud streets etc. The achieved MacCready is used in the task calculator dialogue.

Task speed estimates for achieved speed are compensated for altitude variations, such that the effects of climbs are taken into account in calculating the average task speed. Considering two gliders A and B flying the same task. Glider A has cruised faster, trading off altitude for speed. Glider B is behind A but higher and will save time later since it has less climbing to do to complete the task.

While flying AAT tasks, the task speed measures may change when the glider is inside an AAT area or when the AAT range or targets are adjusted by the pilot. This is due to the task distance achieved and remaining when such events occur.

6.12 Optimal cruise track

In order to help reduce the cross-track error when flying between non-final waypoints, XCSoar calculates an adjustment to the cruise track, called the 'optimal cruise track'. This track is adjusted so that it compensates for the wind drift incurred when circling, and as such it needs to estimate the proportion of time spent circling according to classical MacCready theory.



The optimal cruise track is displayed on the map area as a large blue arrow, and it recommends the glider steers so that the glider's track is lined up with the blue arrow during cruise. For example, if the display is oriented 'Track-Up', then steer so the blue arrow points directly up.

The glide computer accounts for wind drift during circling to provide an 'optimal cruise track' vector, which indicates the track the glider should follow during cruise such that it will arrive at the waypoint in minimum time. This vector is displayed on the map as a blue arrow. When the wind is negligible, or when the computer is in final glide mode, this arrow will point along the black line that indicates the track to the next waypoint.

The calculation and display of optimal cruise track is a unique feature of XCSoar. Commonly, when cruising between thermals, glide navigation systems direct the glider to steer so that the glider's track points directly at the target. Ideally, the glider's track is collinear with the line from the previous to next waypoint, such that the cross-track error is small and hence the glider travels the minimum distance between waypoints.

However, because the glider usually has to stop cruising in order to climb in lift, whilst circling the glider drifts downwind and therefore the cross track error can increase. After several cycles of cruise-climb, the overall track becomes curved.

For the case where the final waypoint is active and one is above final glide, circling is not necessary so this simple scheme is optimal.

6.13 Auto MacCready

XCSoar can adjust the MacCready ring setting automatically to relieve the workload on the pilot. Two methods of updating the MacCready

ring setting are available:

Final glide : During final glide, MacCready is adjusted in order to arrive at the finishing point in minimum time. For OLC Sprint tasks, the MacCready is adjusted in order to cover the greatest distance in the remaining time and reach the finish height.

Trending average climb : When not in final glide, MacCready is adjusted to the trending average climb rate based on all thermals.

Additionally, both methods may be used, so that before reaching final glide, the MacCready setting is adjusted to the average climb rate, and during final glide it adjusts the setting to give minimum time to arrival.

The method that is used is defined in the configuration settings dialogue as the field "Auto MC Mode". The default setting is "Both".

When Auto MacCready is enabled, the MacCready infobox displays 'MC auto' instead of 'MC manual'; and the MacCready indicator in the variometer gauge displays 'AutoMC' instead of 'MC'. To benefit the most from the automatic MC adjustment XCSoar propagates the MC value to the connected intelligent variometer (if it supports).

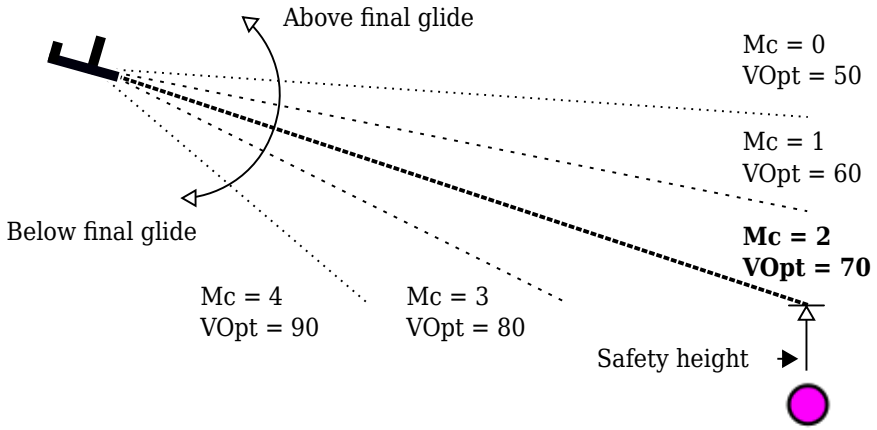
The Auto MacCready methods are described in further detail below.

Final glide

When above final glide altitude, the MacCready ring setting may be increased, resulting in a higher speed to be commanded. Because the ring setting has increased, this also increases the minimum strength of the thermal that would be efficient to stop and circle in.

Similarly, when below final glide altitude, the MacCready ring setting may be decreased, resulting in a lower speed to be commanded. Because the ring setting has decreased, the pilot may be prepared to stop and circle in weaker thermals.

Auto MacCready performs this adjustment automatically and continuously. Typically, it is meaningless to enable this mode before reaching final glide altitude, or nearly so, because early in the flight the glider will be very much below the final glide altitude and the Auto MacCready function would then drive the MacCready ring setting to zero.



Average climb

This method sets the MacCready to the average climb rate achieved across all thermals in the current flight. As such, it takes into account the time spent centering the thermal. The value is updated after leaving a thermal.

Since MacCready theory is optimal if the MacCready setting is the average climb rate of the next expected climb, this method may give sub-optimal performance (commanding speed too slow) if the conditions are improving; and similarly may be non-conservative if the conditions are deteriorating (commanding speed too high). Similarly, if the pilot continues to climb in weak thermals, this will reduce the average and may therefore encourage the pilot to continue to select weak thermals.

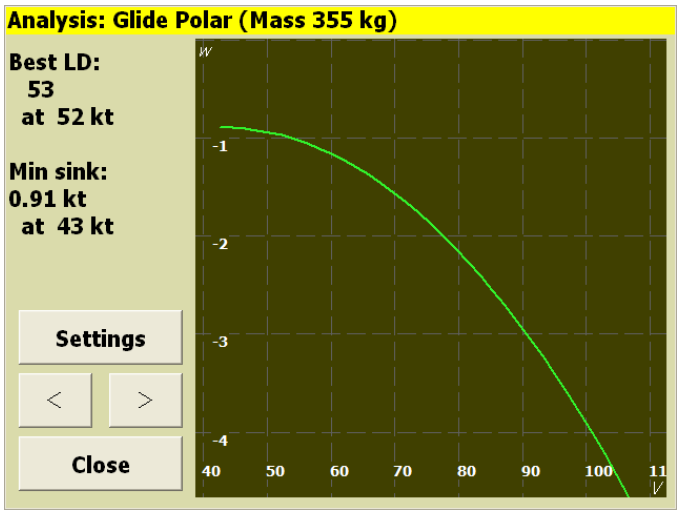
As a result of these limitations, the pilot should be aware of how the system operates and adjust his decision-making accordingly.

6.14 Analysis dialogue

Info 1 ▷ Analysis

The analysis dialogue can be used to check the glide polar.

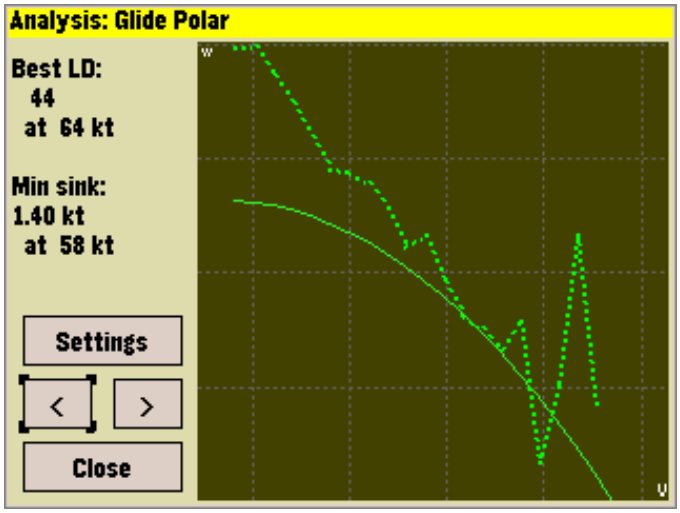
The polar page shows a graph of the glide polar at the current bugs and ballast setting. It also shows the calculated best L/D and the speed at which it occurs, and the minimum sink and the speed at which it occurs. The current aircraft all up weight is displayed in the title.



In this dialogue page, the 'Settings' button opens the flight settings dialogue (e.g. to adjust the bugs/ballast).

The glide polar page of the analysis dialogue shows the average total energy sink rate at each speed achieved in flight, when connected to a supported intelligent variometer (e.g. Vega). This facility allows pilots to perform test flights in stable atmospheric conditions, such as on calm days with no wind, and inspect the measured glide polar. By comparing the measured glide polar with the model glide polar, this enables investigation of whether the glider is being flown optimally with respect to flap settings and also to investigate the benefits of performance optimisation such as sealing control surfaces, etc.

Data is collected only when in cruise mode and at G loading between 0.9 and 1.1; so pilots performing test flights should attempt to fly smoothly with wings level.



6.15 Flight notifications

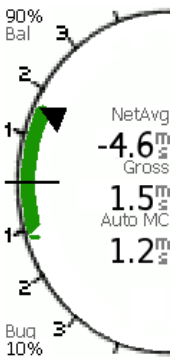
Notifications, appearing as status messages, appear when the following conditions are detected:

- Estimated task time too early for AAT
- Estimated arrival at finish past sunset
- Significant wind change
- Transition to above/below final glide

7 Atmosphere and Instruments

XCSoar maintains an internal model of the atmosphere based on statistics gathered from the flight path and other connected devices. These statistics and measurements are approximate and the weather can on some days change rapidly. The pilot should at all times keep observing the weather. In particular, when out-landing in fields, the pilot should look for indicators on the ground to confirm wind strength and direction.

7.1 Variometer



A needle-dial style display shows the variometer measurements. The gross variometer reading drives the main arrow on the dial, and in the centre of the dial the instantaneous measurement is shown as text. Additionally, speed command arrows (chevrons) appear above or below the gross variometer measurement. Chevrons pointing up indicate slowing down is recommended. Chevrons pointing down indicates that speeding up is recommended.

When the averager value is displayed, the value shown is the average gross climb rate over the previous 30 seconds when in circling mode, and the netto (airmass) vertical speed over the previous 30 seconds when in cruise mode.

12.15

The average value can also be displayed as an optional additional needle (caret). The vario gauge is customisable as to what is displayed along with the gross value etc.

When an intelligent variometer is connected to XCSoar, the needle displays data from the instrument; otherwise it produces variometer estimates based on GPS vertical speed, which is slow and uncompensated for aircraft total energy.

The MacCready value, bugs and ballast, optimum speed to fly and wind data are transferred between XCSoar and supported external intelligent variometers. In the ideal setup, both XCSoar and the variometer have a consistent perspective on the flight at all times; and that by adjusting the MacCready setting on one device should be kept in sync with the other, by the software and to not require additional input from the pilot.

Pilots abuse the device synchronisation (see Section 12.28) for various reasons. You may have different MacCready settings on PDA and intelligent vario to cross-check the results. You may do computations with different ballast settings and cross-check the results. You may

choose on one of the devices manually a different wind setting and cross-check the results, etc.

A list of supported variometers is maintained in Section 2.5.

For Vega: A small icon displaying a circling glider is displayed when the variometer is in climb audio mode.

7.2 Audio Variometer

In addition to the variometer display XCSoar provides an acoustic variometer which transfers the variometer measurements into sounds. The audio variometer is for now only available on Android devices. For proper performance connect your device to a barometric sensor or use the internal one of your Android device if provided. The audio vario is enabled/disabled via the gauges configuration in the configuration.

7.3 Air data inputs

Where additional aircraft dynamics or air mass data are provided by an intelligent variometer, XCSoar can often make use of it or display it in a separate InfoBox. Key sensor measurements that XCSoar uses include:

Gross total energy variometer : (rate of change of the total energy of the aircraft) Used for display, and for calculation of netto variometer.

Netto variometer : (estimated vertical velocity of the air mass at the aircraft) Used to for display, and to colour the snail trail so that it may effectively show areas of lift and sink.

Aircraft acceleration : (load factor) Used for netto variometer calculations where an external netto variometer is not provided.

Barometric altitude : Used for display

Indicated airspeed : Used for display, in compensating final glide calculations for aircraft kinetic energy, and in netto variometer calculation where an external netto variometer is not provided.

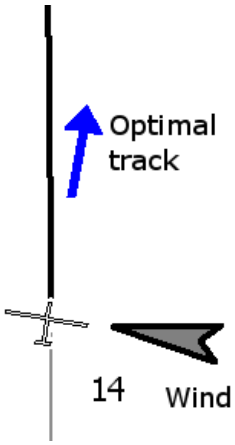
Air density : Used for calculating true airspeed from indicated airspeed.

7.4 Wind display

A continuous display of wind strength and direction is provided on the map. The wind information is derived from the gliders wind drift during thermal flight (climb mode).

The wind direction and speed are displayed as a wind vector on the moving map display and optionally in numeric form in the data display fields. The length of the vector indicates the wind magnitude, and this magnitude is also displayed near the wind vector.

The wind data is one of many data sources used to calculate final glide information. It is possible to manually adjust the wind used in all calculations.



7.5 Wind estimation

XCSoar offers two ways of estimating wind during flight.

Circling : This method uses GPS position fixes to estimate the wind based on drift, typically while thermalling; and is available on all XCSoar installations.

Zigzag : This method uses GPS position fixes and true airspeed measurements to estimate the wind, typically during cruise. It is only available where XCSoar is connected to an intelligent variometer that outputs true airspeed.

The wind magnitude and direction can also be adjusted manually from the wind settings dialogue (see below).

Statistics are gathered so that winds are recorded at different altitudes and times. When the glider's altitude changes significantly, the statistics are consulted to determine the best estimate of the wind based on previous measurements.

For PC with touchscreens, you can also do this by highlighting the wind InfoBox and using the cursor keys (up and down increase and decrease the magnitude, left and right rotate the wind direction).

12.12 The configuration settings dialogue allows control of which estimation method is used for wind updates, via the field 'Auto Wind':

- Manual
- Circling
- Zigzag
- Both (Zigzag and Circling)

When wind estimates change significantly, a status message notification of this is issued.

Circling wind algorithm

XCSoar estimates the wind magnitude and direction when circling. It does this using a sophisticated algorithm that incrementally improves the wind estimate from completed turns. Poor quality turns, where the bank angle changes significantly, are rejected or have minimal impact on the overall wind estimate. The best turns are those with constant bank angle.

Estimates are only obtained if the average GPS fix rate is better than one every two seconds. This results in improved fidelity of estimates in the presence of GPS dropouts.

Zigzag algorithm

For aircraft fitted with intelligent variometers connected to XCSoar, a so-called 'zigzag' wind estimation algorithm is available. With this algorithm, the wind estimate can be updated continuously during long glides without circling.

This allows the wind estimate to be updated during cruise while the aircraft performs a zigzag manoeuvre. No specific manoeuvre is required, in many cases the estimate will be updated as the aircraft's heading changes naturally as the pilot hunts for lift. In general, however, the technique requires the aircraft heading to change over 40 degrees.

If the wind changes significantly while in straight flight, the zigzag algorithm is used to update the wind estimate even if the aircraft's heading does not change much. This provides greater accuracy in long final glides.

Wind estimates are updated when a large difference between the estimated ground speed and the true ground speed are detected even without much zigzag manoeuvring.

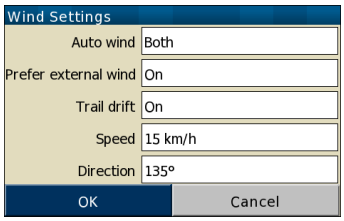
Compass algorithm

For aircraft fitted with intelligent variometers and digital compasses connected to XCSoar, a wind estimation algorithm making use of magnetic heading and airspeed is being developed. This provides another method of updating the wind estimate during cruise and does not require zigzag manoeuvres.

7.6 Wind settings dialogue

Config 1 ▷ Wind

The wind dialogue allows the initial estimate of the wind speed and direction to be entered, usually prior to flight.



At any time during flight, the pilot can make corrections to the wind estimate by entering the correction in the wind settings dialogue. Once the dialogue gets closed, the internal estimate is ignored until a new internal estimate is obtained from the circling or zigzag algorithm.

The automatic wind algorithm may also be switched on or off (or between modes) in this dialogue. See Section 7.5 for details on these algorithms.

The compensation of wind drift of the snail trail can also be switched on or off in this dialogue. See Section 4.8 for details on how this affects the display of the snail trail.

7.7 Thermal profile

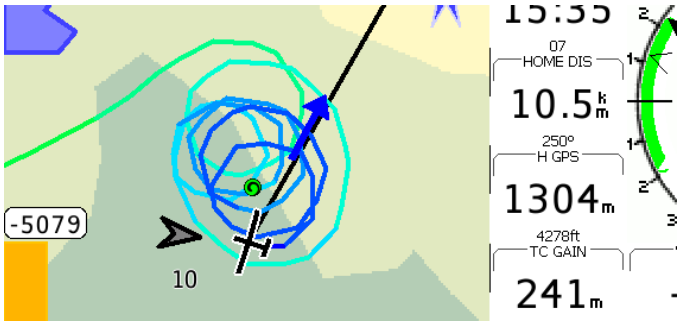
Statistics on climb rates in thermals are collected and displayed in a thermal band meter. This is shown above the final glide difference bar on the left side of the map display. It is not shown when the glider is above final glide.

The thermal band meter shows a graph, where the vertical axis is height above the break-off height (Section 6.8), and is scaled according to the maximum altitude achieved. The horizontal axis is the average climb rate achieved at a particular altitude band. The horizontal axis is scaled according to the MacCready setting, and an arrow indicating this setting, and the glider's current altitude is overlaid on the shaded area. This scaling and arrow makes it easy to see how the pilot's MacCready setting compares with achieved thermals and to plan the desired working height band.

When cruising between thermals, the vertical position of the arrow, indicating the glider's height relative to the thermal band, can be used as a reference to suggest how urgent it is to find the next thermal. As the arrow approaches the bottom of the band, then the glider is nearing the break-off height and the pilot should consider taking even a weak thermal.

7.8 Thermal locator

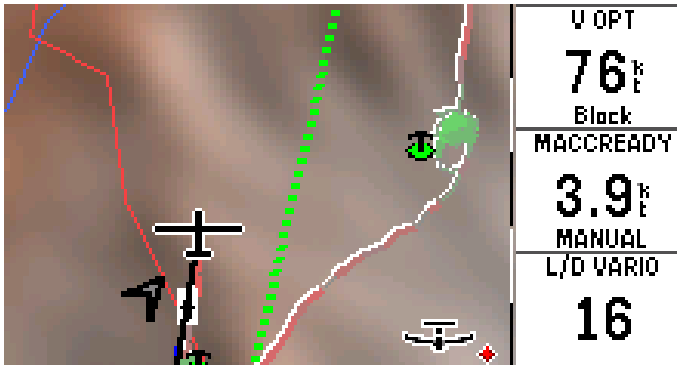
An algorithm estimates the centre of the lift when circling. The thermal marker symbol is a green circle with a spiral.



The thermal locator marks the location of the last 20 thermals on the map with the thermal symbol during cruise.

This location is calculated to compensate for the thermal drift at the glider's altitude. This means that internally XCSoar remembers the location of the thermal source on the ground. In other words, if you leave a thermal at the top and later return at low altitude, the position on the map shows the predicted location of the thermal at that low altitude (which is further upwind than the top).

If the wind changes and the thermal source is still active, its position on the map reflects the wind change; that is, the thermal at altitude will be projected downwind at the new wind estimate.

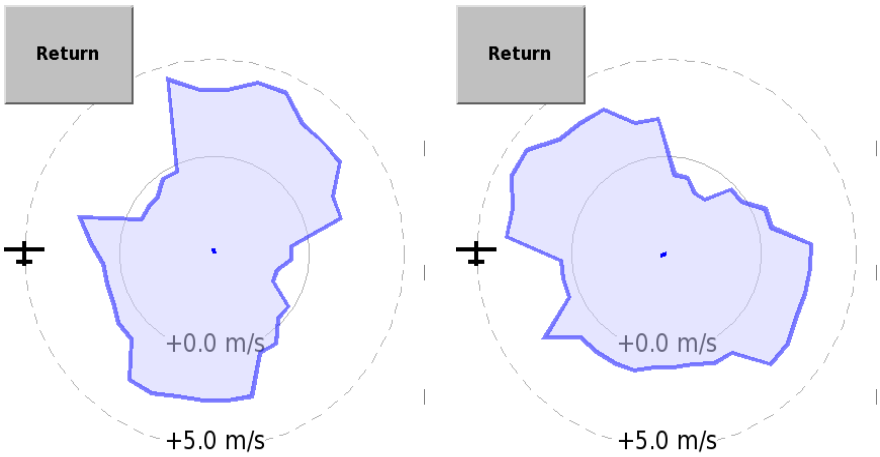


7.9 Thermal assistant

12.14

The thermal assistant is a graphical aid to maximise the exploitation of the given thermal updraft. If it is configured "On" the small polar diagram is mapped to the lower left corner of the screen. A single tap on the small diagram enlarges it to a full-screen view.

The polar diagram shows the climb rate over the circular course of the glider. The screen-shots show a right circle, where the glider position is fixed to the left side, and the polar distribution of the climb rate is shown relatively to the current glider position.



The two screen-shots are taken in a few seconds sequence to demonstrate the practical usage of the rotating climb diagram. A simple recipe to optimise the climb rate according to the assistant would be to follow these two steps repeatedly:

1. : At the moment, the maximum peak on the polar diagram passes the top of the display; that is a quarter of the circle before you reach that part again: Open the circle a bit to displace the circle centre in the direction of the strongest climb rate.

2. : At the moment, the maximum peak on the polar diagram passes the gliders position; the vario should show the maximal climb rate: Narrow the circle as much as possible to centre the thermal updraft at its maximum.

It must be said, that the interpretation of the thermal assistant always relays on the specific lag of the connected sensor and PDA itself. A successful updraft optimisation will thus depend on a bit of training to take the lag into account.

7.10 Convection forecast

If the glider is equipped with an outside temperature and humidity probe, a simple convection forecast system estimates the convection ceiling and the cloud base. The humidity probe is optional and is mainly required for estimating cloud base.

Prior to takeoff or during flight the pilot can modify the maximum forecast temperature on the ground, by adjusting the value in the "Forecast Temperature" InfoBox.

The forecast convection ceiling is determined by the altitude at which the atmospheric temperature equals the maximum forecast temperature on the ground, cooled adiabatically as it rises according to the dry adiabatic lapse rate. Typically, the glider will not climb as far as the convection ceiling and so the measured values are extrapolated to

find the ceiling. If the atmosphere is stable, the convection ceiling is reported as zero altitude.

The maximum forecast temperature on the ground is entered using the flight settings dialogue described in Section 6.4.

The forecast cloud base is determined by the altitude at which the dew point intersects the maximum forecast temperature on the ground, cooled adiabatically as it rises according to the dry adiabatic lapse rate. If no clouds are forecast, the cloud base is reported as zero.

7.11 Analysis dialogue

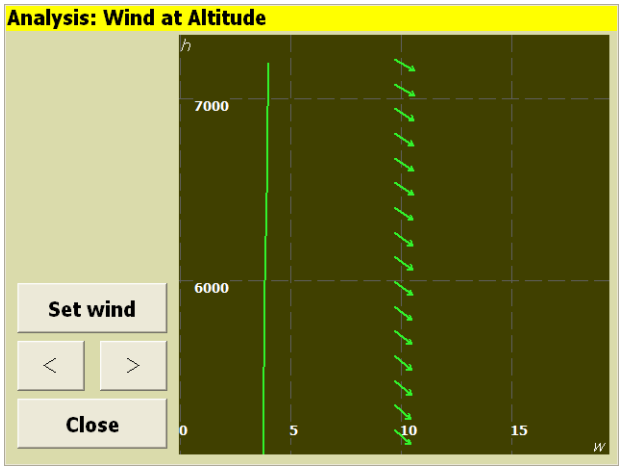
Info 1 ▷ Analysis

The analysis dialogue is used to see several aspects of the atmosphere.

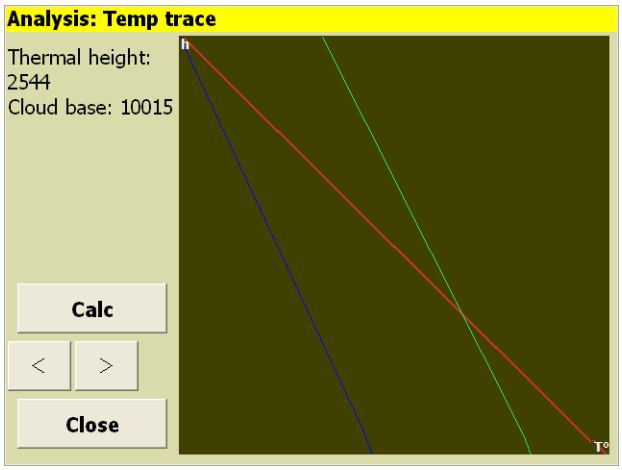
Several pages of interest:

Wind at altitude : This shows a graph of the wind speed versus altitude, and shows the wind vector at several altitudes.

The 'Set wind' button opens the wind settings dialogue (e.g. to manually set the wind).



Temperature trace : This page is only available if a supported instrument is connected to XCSoar that produces outside air temperature and humidity. The chart shows the variation of dry air temperature, dew point temperature and outside air temperature with altitude. The convection forecast is summarised as the estimated thermal convection altitude and estimated cloud base.



The climb history and barograph pages, described in Section 5.16, are also useful to determine trends in the soaring conditions.

7.12 Weather, METAR / TAF

Info ▷ Weather

If the hardware hosting XCSoar is able to connect to the internet, weather reports and forecasts can be downloaded. Present actual informations available are depicted by a little flag, pinned to the waypoint of the reporting station. To set up reports and forecasts, invoke the METAR and TAF dialogue. With Add a filtering screen for ICAO codes comes up. After typing and pushing OK another station is added to the list. Accessing the information is either possible via selecting an airport and pushing Details on the same screen or by touching the map invoking the "Map elements at this location" dialogue. The dialogue will show airports, airspaces……and weather data. If the flags are missing on the map, no actual information is available. Invoke the info dialogue and touch Update .

7.13 Weather forecast, RASP

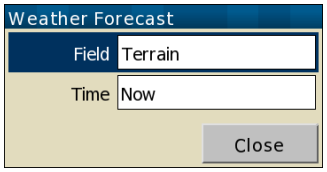
Regional Atmospheric Soaring Prediction (RASP) is intended to provide detailed graphical weather forecasts for soaring purposes. For further details the keen pilot is invited to consult http://www.drjack.info on how RASP forecasts work, from where they are available, and their use and limitations. At http://www.drjack.info/RASP, a list gives the coverage of available RASP forecasts worldwide, provided by many soaring and paragliding enthusiasts. Please note, that some of these links provide data in-season only and only some of these providers make data available in XCSoar format.

For use within XCSoar, an `xcsoar-rasp.dat` file has to be installed into the XCSoarData directory. As of February 2014, download of `xcsoar.rasp.dat` files is not (yet) supported by XCSoar's file manager. The RASP forecasts are displayed as colour-coded terrain overlays on the map.

Make sure, terrain display is set to on.

Info ▷ Weather

The RASP-forecast overlays are invoked via menu Info .



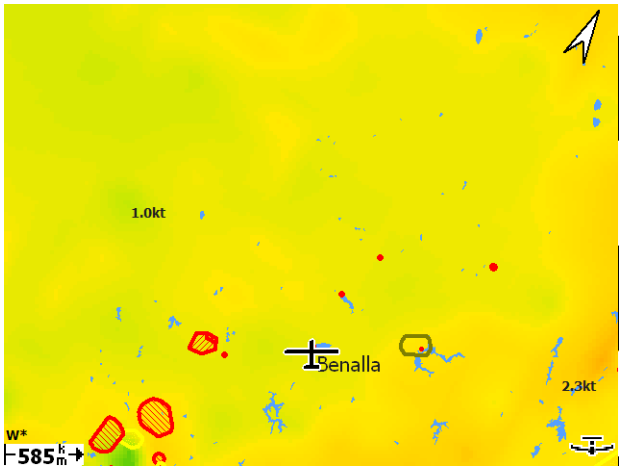
The Field setting determines which data field is displayed on the map. The Time setting determines at which forecast time the data field will be displayed. Upon entering the weather dialogue, the Time setting is advanced to the next nearest forecast time available in the RASP file. When a field is not available in the RASP file, the background is left blank.

The maximum and minimum values of the field in the map area are drawn at their respective locations on the map. The field name is displayed on the lower left of the screen.

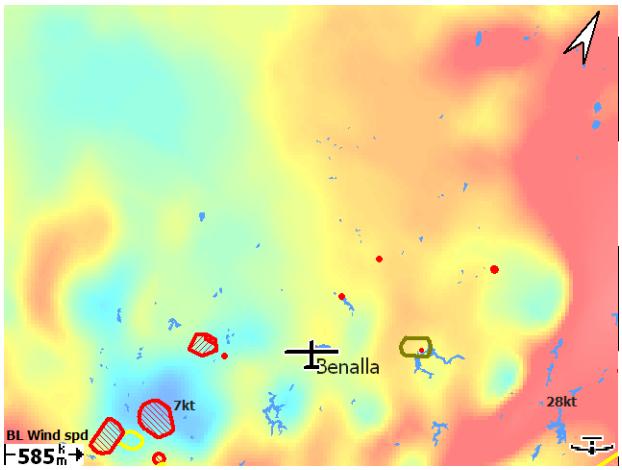
The fields available to display are as follows:

Terrain : Display terrain on map, no weather data displayed.

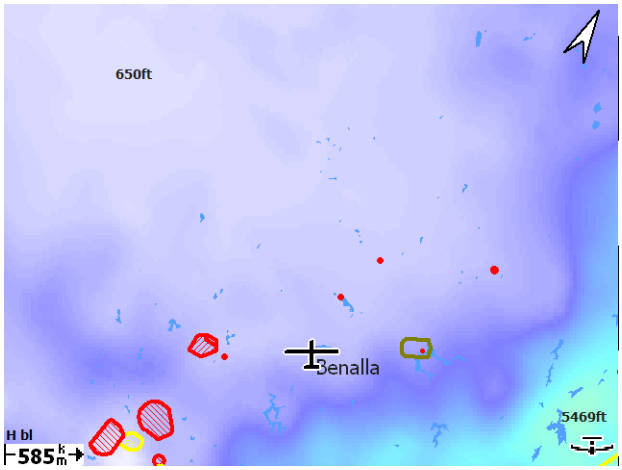
W* : Average dry thermal updraft strength near mid-BL height. Subtract glider descent rate to get average vario reading for cloudless thermals. Updraft strengths will be stronger than this forecast if convective clouds are present, since cloud condensation adds buoyancy aloft (i.e. this neglects "cloudsuck"). This value depends upon both the surface heating and the BL depth.



BL wind spd : The speed and direction of the vector-averaged wind in the BL.This prediction can be misleading if there is a large change in wind direction through the BL.



H bl : Altitude of the top of the mixing layer, which for thermal convection is the average top of a dry thermal. Over flat terrain, maximum thermalling heights will be lower due to the glider descent rate and other factors. In the presence of clouds (which release additional buoyancy aloft, creating "cloudsuck") the updraft top will be above this forecast, but the maximum thermalling height will then be limited by the cloud base. Further, when the mixing results from shear turbulence rather than thermal mixing this parameter is not useful for glider flying.

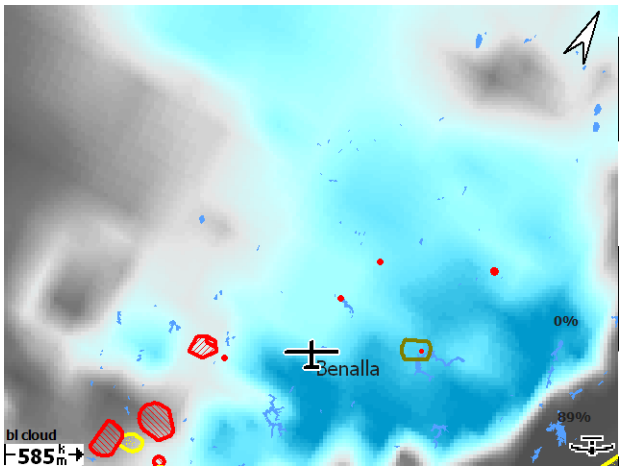


dwcrit : This parameter estimates the height above ground at which the average dry updraft strength drops below 225 fpm (1.1 m/s) and is expected to give better quantitative numbers for the maximum cloudless thermalling height than the BL Top altitude, especially when mixing results from vertical wind shear rather than thermals. (Note: the present assumptions tend to underpredict the max. thermalling height for dry conditions.) In the presence of clouds the maximum thermalling height may instead be limited by the cloud base. Being for "dry" thermals, this parameter omits the effect of "cloudsuck".

hwcrit : Same as *dwcrit*, but giving the altitude instead of the height at

which the average dry updraft strength drops below 225 fpm.

bl cloud : This parameter provides an additional means of evaluating the formation of clouds within the BL and might be used either in conjunction with or instead of the other cloud prediction parameters. It assumes a very simple relationship between cloud cover percentage and the maximum relative humidity within the BL.The cloud base altitude is not predicted, but is expected to be below the BL Top altitude.

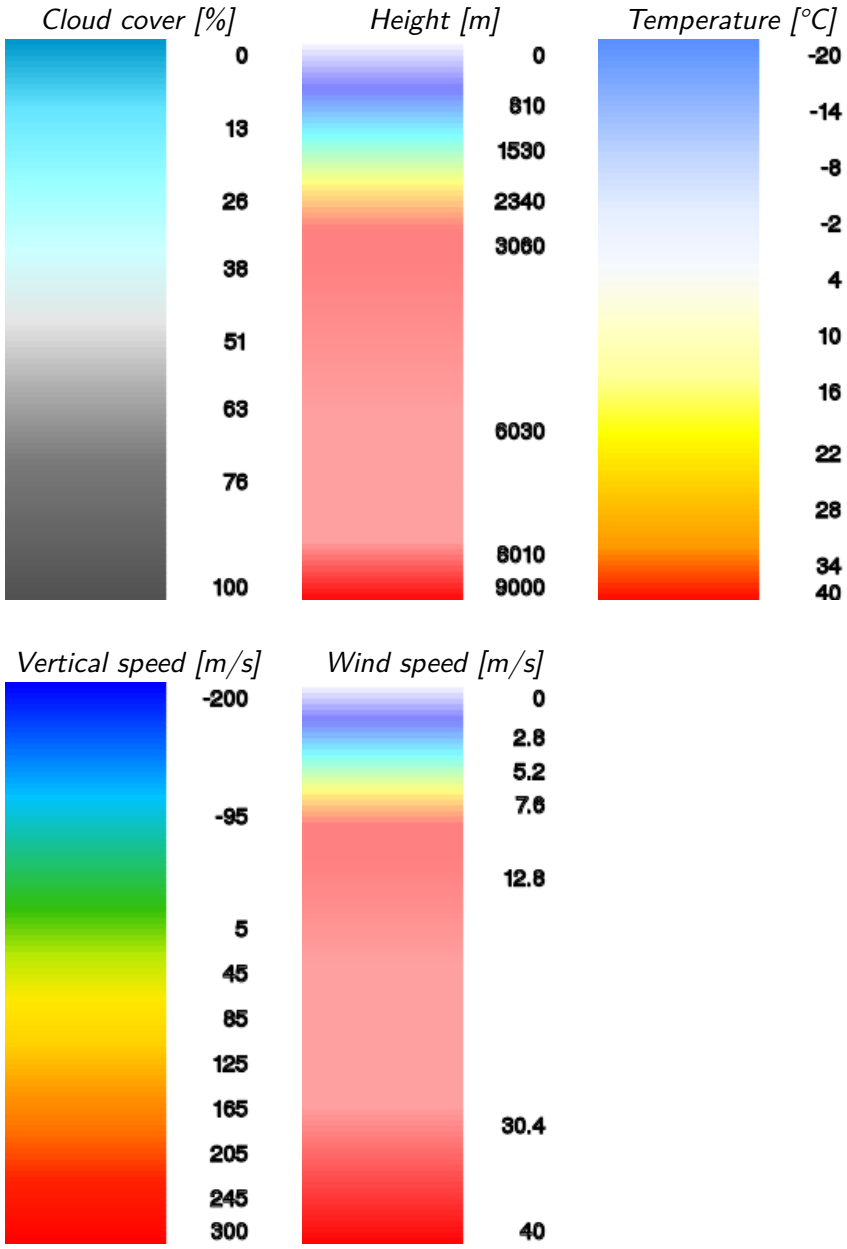


Sfc temp : The temperature at a height of 2 m above ground level. This can be compared to observed surface temperatures as an indication of model simulation accuracy; e.g. if observed surface temperatures are significantly below those forecast, then soaring conditions will be poorer than forecast.

wblmaxmin : Maximum grid-area-averaged extensive upward or downward motion within the BL as created by horizontal wind convergence. Positive convergence is associated with local small-scale convergence lines. Negative convergence (divergence) produces subsiding vertical motion, creating low-level inversions which limit thermalling heights.

blcwbase : This parameter estimates the altitude of the cumulus cloud base.

The colour schemes used in rendering the RASP contours are illustrated in the table below.



7.14 pc_met, Deutscher Wetterdienst

German weather service "Deutscher Wetterdienst" provides several useful meteorological images for XCSoar users. To use it, you need a (paid) account with their *pc_met* product.

Note that this feature requires and uses an internet connection. This may be expensive, depending on your mobile data plan.

To enable the feature, enter your *pc_met* credentials in XCSoar's system configuration. There are two username/password pairs: the first is for DWD's web services (on `www.flugwetter.de`), and the other is the FTP password (on `ftp.pcmet.de`).

Info ▷ Weather

During preflight check and during the flight, you can check weather forecasts and live weather data in the Info menu. Below "Overlay", you can choose layers for the map window. "pc_met" is a collection of live images which are usually displayed on the DWD web site `www.flugwetter.de`.

8 Airspace, Traffic and Team Flying

A database of Special Use Airspace (SUA) can be loaded into XCSoar and used for both display of the airspace regions as well as detecting when the glider enters and leaves the regions.

Two airspace files can be set in the configuration settings. The first of these is intended for use as the primary SUA database, the second is intended for use with short-term or changing airspace such as the airspace defined in NOTAMs.

It is the user's responsibility to ensure that the SUA database (airspace file) is up-to-date.

Through a connected FLARM device, the glide computer can also display information relating to FLARM-equipped nearby traffic and obstacle threats.

A team code function allows teams of pilots to exchange their positions via radio in a short code, encoded and decoded by the computer.

8.1 Airspace display

Local special use airspace regions are drawn on the map as shaded areas with thick borders. The colour and pattern of the areas are specific to different airspace categories and may be configured by the user. Depending on the settings, the user may choose to display all airspaces, only airspaces below a certain altitude, only airspace within a particular height separation, or only airspace below the glider.

The patterns used to display airspace areas include opaque, transparent (hollow) and several hatched and stippled patterns. The non-opaque patterns are partially transparent with respect to terrain and topography but are *not* transparent with respect to overlapping airspace. However, where overlapping airspace occurs, all borders are visible. That is, even though airspace patterns are not mutually transparent, all airspace borders are drawn on top of the airspace areas.

Both the display and warning of airspace classes can be individually enabled or disabled by the user as described in Section 8.3.

The default colouring of Class C, D, E and F airspace is consistent with ICAO charts.

Incursion events

Three types of events are detected by XCSoar in relation to SUA:

Predicted incursion : This event is detected when the glider is estimated to be on a track that will result in entering the airspace at a set time in the future. The time is the airspace 'warning time' configuration setting.

The use of a long term average track in these calculations means that the system can still predict incursion even when drifting in the wind when circling.

Entering : This event occurs when the glider enters an airspace region.

Leaving : This event occurs when the glider leaves an airspace region.

In all cases, the boundary of the region is defined by maximum and minimum altitudes or flight levels, as specified in the airspace file.

Airspace warnings are still issued even if the incursion region is off-screen.

Where a barometric altitude source is available, it is used preferentially to GPS altitude in detecting airspace incursions. This makes the system conform to normal conventions of having airspace violations based on QNH-adjusted altitude.

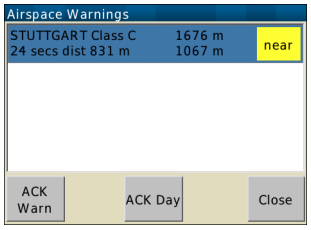
8.2 Airspace warnings

The concept of airspace warnings in gradual levels is introduced:

None : Aircraft is outside and distant from airspace.

Near : Aircraft is predicted to penetrate the airspace and is close to doing so.

Inside : Aircraft is inside airspace.



At all times XCSoar monitors the aircraft relative to all airspace and maintains warning levels for each. The airspace warnings are still filtered according to the airspace filter preferences; such that certain categories of airspace may be effectively disabled. The sequence of events when entering an airspace results typically in two warnings: when near (level 1), and when inside (level 2).

Whenever the warning level increases (above level 0) for any airspace, the airspace warning dialogue appears, accompanied by a system beep. When there are no more airspace regions at warning levels above 0, the dialogue disappears automatically.

Airspace warning dialogue

The airspace warning dialogue contains a list of up to 4 individual warnings. The list items status background is coloured red if the glider is inside, and yellow if near. If the warning is acknowledged, the text is greyed out.

Each list item occupies two rows, and includes the following details:

```
<NAME and Class>                <TOP>   <Position>
<Time and distance if outside> <BASE>
```

The values in the list are continuously updated. An example follows:

```
Bern TMA Class D                FL100      near
35 sec horizontal dist 1300     1750m
```

This means that the aircraft is 1300 m horizontally separated from the Class D airspace 'Bern TMA', with a base of 1750 m and ceiling at FL100.

Another example:

```
Bern CTRgld Class C             1350m      inside
                                SFC
```

This means that the aircraft is inside the Class C airspace 'Bern CTRgld', with base of terrain surface and ceiling at 1350 m.

If there are airspace warnings any time the airspace warning dialogue is shown you get the details to an airspace by touching it.

Airspace warning acknowledgement

When the warning dialogue is visible and an airspace warning is active, it is possible to close the warning dialogue without acknowledging the warning. Depending on the hardware used you may press ESC (on PC) or the Close button.

When one or more warnings are visible in the airspace warning dialogue, a warning can be acknowledged by pressing one of the buttons along the bottom of the dialogue.

The meanings of the acknowledgement buttons are as follows:

ACK Warn : Acknowledge the current warning level. A new warning will appear only if the warning level increases.

ACK Space : Acknowledge all current and future warning levels from this particular airspace region while the aircraft is within 2.5 km horizontal separation and 500 m vertical separation.

ACK Day : Acknowledge all current and future warning levels from this particular airspace region for the rest of the flight (specifically, until XCSoar is restarted).

Enable : Cancels an acknowledgement of the airspace, to reactivate all warnings from this space.

Close : Closes the airspace warning dialogue, without acknowledging airspace. The dialogue will re-open automatically if the airspace warning level increases.

Note that not all acknowledgement buttons may be visible for all warning levels. In particular, if inside SUA, you do not have the option

to Acknowledge the Warning (ACK Warn), since it is at this point no longer warning of an impending airspace incursion, but in fact stating that you are currently inside the airspace.

The general guidelines for using the dialogue are:

- Don't acknowledge a warning if you intend to or must avoid the airspace
- The warning system beep only occurs when the warning level increases.
- The warning system is designed to allow circling near an airspace without over-stressing the pilot with extraneous warnings.

When an airspace region is acknowledged, the region is drawn on the screen without a pattern.

When the aircraft is predicted to enter an SUA region, or it actually enters an SUA region, a warning is raised, presented as an audio alert and a status message describing the type of airspace warning, and some SUA details (including class of airspace, base and ceiling altitude or flight level).

Acknowledged warnings will repeat after a certain time specified as the 'Acknowledge time' in the configuration settings.

Airspace warning acknowledgements apply to individual SUA regions. If, for example, a glider enters airspace A and the pilot acknowledges the warning, and shortly thereafter is predicted to enter airspace B, an airspace warning for SUA region B will be raised.

If you want acknowledged airspace warnings to not be repeated, set a very large value for the configuration setting 'Acknowledge time'.

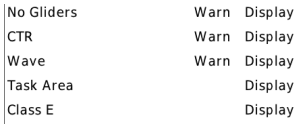
Airspace warnings are automatically cleared when both the current glider's position as well as the estimated future track are clear of the airspace.

Simultaneous airspace warnings can occur if the aircraft (or its estimated future track) penetrates multiple airspace regions.

8.3 Airspace query and details

For touchscreen/mouse devices, when an airspace region is visible on the map area, it may be queried by touching the region on the map. The map item list will appear and give you an overview of the waypoints, airspaces, etc. below your finger tip, or mouse pointer. SUAs are listed with similar details as provided when an actual warning is raised. The query returns all airspace regions when overlapping airspace is visible at the query location. Selecting the SUA on the list and pressing Details or the enter key displays all airspace details.

Airspace filter dialogue



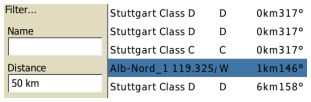
The Airspace Filter dialogue allows warnings and display to be enabled or disabled for each class of airspace.

This may be accessed several ways:

- From the main menu Info. 3 ▷ Airspace .
- Or at the system configuration page for airspaces, press the Filter button.

To use the dialogue, move up or down the list and the enter key will cycle between the various warning and display options.

Airspace selection dialogue



Pressing the Lookup button brings up the airspace select dialogue. This functions similarly to the waypoint lookup dialogue, and allows search based on name, distance, direction, and type (class).

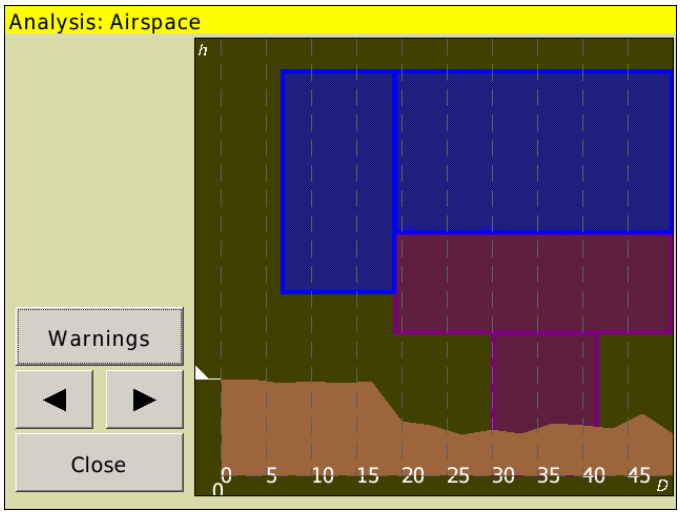
Once an airspace item has been located, you have the chance to acknowledge it for the day. From the airspace management dialogue it is possible to re-enable it again.

8.4 Analysis dialogue

Info 1 ▷ Analysis

The analysis dialogue contains a page showing a cross-section of the airspace.

The display shows along the horizontal direction, the distance from the glider out to 50 km in the direction of the glider's track; along the vertical direction is altitude. The altitude of the glider is indicated by a white arrow. This page is useful to help visualise complex layering of airspace.



The "Warnings" button opens the airspace warning dialogue if close to airspace.

8.5 FLARM traffic

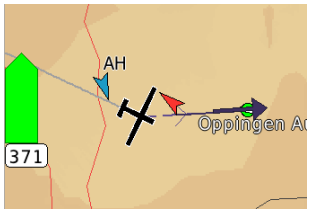
If connected to a FLARM device, FLARM traffic is displayed on the map area. Each FLARM aircraft received is drawn as a dashed red disk.

Do not use XCSoar for collision avoidance, as FLARM audio devices are much more suitable in assisting the pilot to be aware of traffic.

Note that unless one is circling, the usual zoom level is such that FLARM traffic will not be easily distinguished. When one is circling, the zoom level might be appropriate, but continuous direction change and the typical latency of a PDA makes the map display a poor aid at helping to locate the traffic.

FLARM map display

12.6

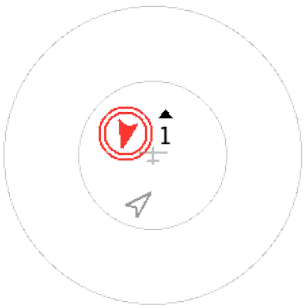


The FLARM targets on the map are drawn as red coloured arrow heads to indicate the direction the FLARM target is heading, as well as the collision risk. Note that these arrow heads are oriented according to the display orientation. For example, if the orientation is track-up, then the arrows show the relative track bearing of the target to the aircraft. If the orientation is north-up, then the arrows show the absolute track bearing of the target.

Display on the map FLARM of aircraft registration or pilot name is made possible via a look-up of the ICAO aircraft ID of FLARM traffic in a file. See Section 13.11 for details on this file format. Aircraft with the FLARM privacy flag set will not have any identification displayed.

FLARM radar

12.20



To remedy this situation, when FLARM traffic is received, XCSoar shows a small radar-style view of the FLARM traffic from the perspective of the aircraft. The FLARM traffic is displayed in identical style, except that the threatening traffic is emphasized with one or two red circles around the arrow head icon. The display corner used for the small radar view can be configured.

This FLARM display is oriented track-up and a small glider icon clearly shows that the display is oriented as such. The scale of the display is linear up to maximum distance of 2000 m. On the background there are two rings; the first is a 1000 m radius and the second is 2000 m. Traffic further away than 2000 m is drawn at the 2000 m ring.

All the FLARM displays shows FLARM traffic in colours according to the threat level, or team and dialogue status. The traffic is coloured:

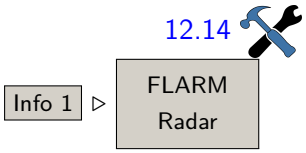
- No color for level 0, no threat.
- Yellow for level 1, warning.
- Red for level 2 and 3, alert.

- Green for the team mate.
- Blue is the selected target.

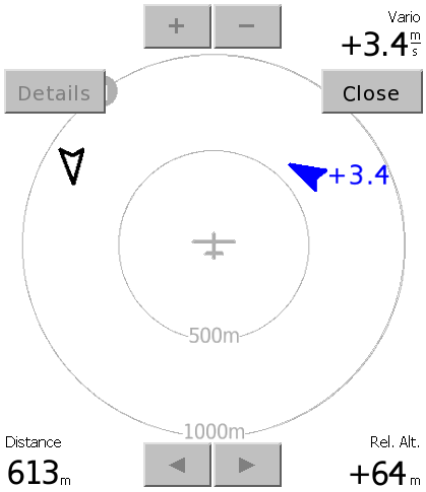
For every target above threat level 1 the rough relative height is shown. The supplied figure is the absolute height difference rounded by 100. A small triangle indicates that the target is higher or lower than you. The example radar shows a target approximately 100 m (for metric altitude) higher.

The FLARM radar-like display, when enabled, can be suppressed when visible by pressing the enter button. If the FLARM radar is suppressed, pressing the enter button again cancels the suppression and the radar is shown again. When new traffic appears in the radar, or if the FLARM issues a collision warning, the suppression is canceled.

FLARM Traffic dialogue



Once FLARM has reported traffic and the small radar-style view of the FLARM traffic gets activated you can tap on the FLARM radar to enlarge the view to fullscreen size. The fullscreen FLARM display offers all available information about the FLARM traffic and depending on the setup it closes by itself, when all traffic has gone.



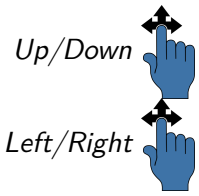
Only a few controls are on the dialogue, from top down:

North up : If checked the radar screen is oriented North up, if not the orientation is Track up.

Up - Down A. Zoom : Automatic zoom scales the radar screen so that the targets are perfectly visible. If not checked, the screen must be zoomed manually. The Up-Down gesture activates the automatic zoom.

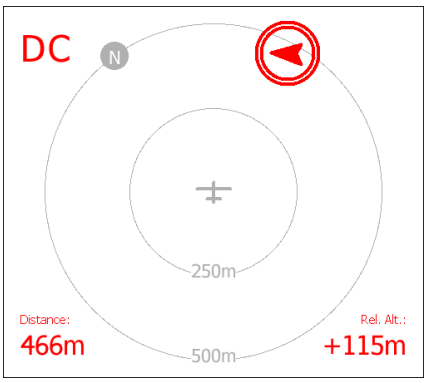
Right - Left Avg/Alt : The button toggles in-between average vario and altitude displayed next to the target.

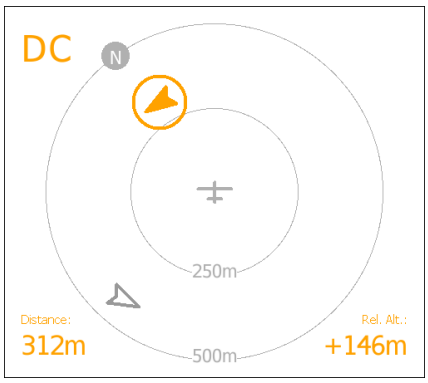
Down - Right Details : Through the button a separate dialogue with all details to the selected target is accessed.



+/- : Manually change the zoom from 500 m to 10 km radar range. The zoom gestures also apply here.

◁/▷ : Select the previous or next target on the radar, gestures work in the same manner.





The three screenshots are taken in a sequence and demonstrate a typical near pass of e.g. two FLARM equipped gliders. The extra information is colour-coded in the already mentioned way. In the four corners of the radar screen is additional info to the selected target displayed:

Top left : If available the FLARM ID of the selected target.

Top right : Vario of the target, derived from the consecutive altitude messages.

Bottom left : The distance to the target.

Bottom right : The relative height of the target.

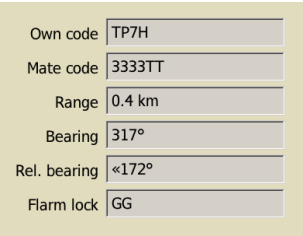
From the first to the second FLARM snapshot about 15 seconds elapsed. The selected blue target was climbing at 3.4 m/s and did not have a relative course recognised as a threat. Then in the meantime the 'DC' has turned more to the left, became an alerting threat and is now displayed red. The FLARM radar switched the zoom from 1000 m to 500 m. In snapshot three the continuously climbing target becomes classified to threat level 1, gets coloured yellow and seems to no longer be a threat.

8.6 Team flying

Team code is a system to allow pilots flying within a team to communicate their position to each other in a concise and accurate manner. The principle of the system is that each pilot uses their computer to determine a 5 digit code which describes their position relative to a common waypoint. The pilots call each other reporting these codes, and entering the codes into the computer allows their mates to be located accurately by the computer.

Info 2 ▷ Team Code

To use the team code, all pilots in the team should select a waypoint to be used as the reference. This is all done on the team code dialogue. The reference waypoint is set via the Set WP button. Select a waypoint from the lookup dialogue and it will be the team reference.



During flight, the pilot can read out his 'Own code' from the team code dialogue to his team mate, in order to report his position. When the pilot hears a code report from a team mate, he presses the Set Code button to open the text entry dialogue to allow entry of the mate's code.

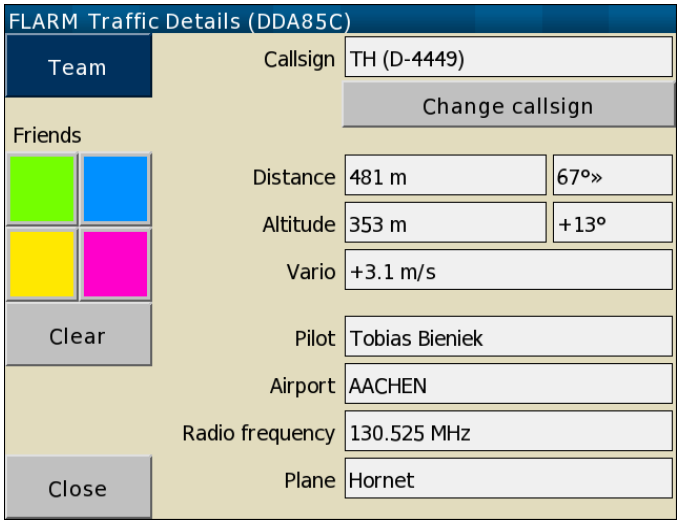
After entering the mate's code, the relative distance and bearing to the mate is calculated and updated in the dialogue.

FLARM ID lookup

Info 2 ▷ FLARM Details

XCSoar also supports the encrypted team codes from the FlarmNet initiative. The Flarm Lock button allows you to access the FlarmNet database as well as XCSoar's database for FLARM to find a team mate. A simple lookup for a competition ID delivers potentially the desired FLARM identity. Selecting the desired data base entry from the found items allows you to 'lock' your buddy from afar. See Section 13.11 for where to find the FlarmNet database etc. explained in detail.

Similar functionality provides the FLARM details dialogue. It also lets you search through the competition ID's in the data base and shows the details on it.



Click your buddy

Even if XCSoar can 'lock' only one team mate by reference waypoint, it handles any number of 'friends' with a known FLARM ID. Chances are high your buddy is not registered in any database. But in any case you get closer to your flying colleague, just pick the details from the FLARM radar screen, choose a colour and XCSoar will identify this FLARM response in the future as your buddy.

9 Avionics and Airframe

This chapter discusses XCSoar as a subsystem of the aircraft. It covers the integration of XCSoar with external devices, including GPS, switches and sensors, and aircraft radio transceivers and other devices. Integration with FLARM is covered in Chapter 8, and integration with variometers is covered in Chapter 7.

9.1 Battery life

Most modern PDAs are designed for short sporadic use and so do not have a very good battery capacity when considering the duration of cross-country soaring flights. It is recommended that the PDA be powered externally, via an appropriate voltage converter connected to the glider battery. This installation should be performed by appropriately qualified personnel, and should contain a fuse and a manual isolation switch.

The greatest cause of power drain by the PDA is the LCD back-light, however domestic PDAs are not particularly bright so they may need to have the back-light up full. However, for EFIS systems, it is recommended to use the lowest back-light settings that are comfortable.

When operating PDAs under internal battery, XCSoar detects a low battery condition and allows the operating system to shut down and preserve the memory. In addition, it can be set up to blank the screen after a period of inactivity, so that it can reduce the power consumption. When the screen is blanked, pressing one of the hardware buttons on the PDA activates the screen again. When a status message is issued by the system, the screen becomes activated.

Another way to help conserve battery power is to reduce the computational load by turning off certain features. Drawing terrain and long snail trails contribute significantly to the CPU load.

For other embedded platforms, a Battery InfoBox is available that displays the available battery life remaining, as well as the charge state (AC on–charging, or AC Off–operating off internal battery power).

9.2 GPS connection

XCSoar requires a 3D GPS fix for its navigation functions.

GPS status

GPS status icons and text may appear on the bottom edge of the map display to indicate:

(a) (b)

Waiting for GPS fix (a) : Better reception or additional time to search for satellites is required. The GPS may have a 2D fix. The aircraft symbol disappears while there is no 3D fix.

GPS not connected (b) : No communication with the GPS is received. This indicates an error in the comm port settings or the GPS device may be disconnected or switched off.

When the GPS is not connected for more than one minute, XCSoar automatically attempts to restart communication with the device and will then resume waiting. This method has shown to provide the most reliable way of recovering from communication errors.

XCSoar can handle multiple GPS sources and it uses them to provide redundancy. The sources are configured on the System Configuration screen, on the page entitled "Devices". Device A is the primary GPS data source and Device B is the secondary source.

During operation, if the primary GPS source drops out, XCSoar will use the GPS data from the secondary source. If both sources have valid fixes, the secondary source is ignored. For this reason, it is recommended to have the GPS source with the best antenna or most reliable operation as the primary source (i.e. Device A).

GPS altitude

Some older GPS units (and some new ones) do not output altitude relative to mean sea level, rather they output elevation with respect to the WGS84 ellipsoid. XCSoar detects when this occurs and applies the ellipsoid to geoid offset according to an internal tabulated data at two degree spacing. This is not required for FLARM units, which correctly output MSL altitude.

9.3 Switch inputs

XCSoar supports monitoring of switches and sensors connected to the host computer, for the purpose of providing situational awareness feedback, alerts, or as general-purpose user-interface input devices. Several mechanisms are available for interfacing to switches and sensors:

Serial device : Certain intelligent variometers such as Triadis Engineering's Vega have multiple airframe switches and pass this information on to the PDA or EFIS as special NMEA sentences.

Bluetooth device : Many Pocket PC devices support wireless connection to a Bluetooth Game-Pad device that has several buttons. This is more suited to user-interface input devices than airframe monitoring.

A custom 'input events' file determines how switch and sensor inputs are processed.

A standard set of airframe inputs are defined as:

- Airbrake
- Flap position (positive/landing flap, neutral, negative/reflex)
- Landing gear

This set is expected to expand to include engine and fuel monitoring.

Other logical inputs from Vega include computed quantities relating to specific airframe alerts and aircraft operating envelope warnings, for example "airbrake extended and gear retracted".

Refer to the Vega documentation for more details on switch inputs and how they may be used.

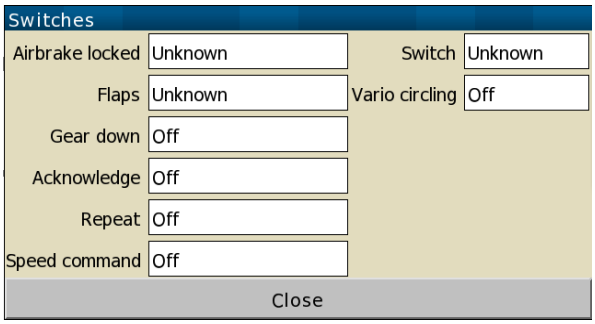
9.4 Vega switch dialogue

Config 3 ▷ Vega

Airframe Switches

A dialogue displaying switch states for the Vega variometer is available from the menu.

This dialogue is updated in real-time, allowing the pilot to check the correct functioning of switches during daily inspection tests or before takeoff.



9.5 Slave mode

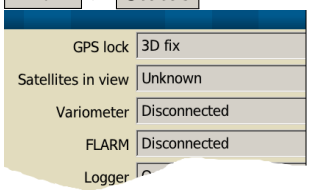
A device type in the configuration settings, "NMEA Out" is defined for use in joining two systems in a master-slave mode. In the master, the second com device can be set to NMEA Out, and all data received in the first com device (as well as outgoing data) will be sent to the slave.

As an example where two devices are being connected together, in the slave, the first com device can then be set to "Vega" and this system

receives all data as if it came from the Master's GPS and connected instruments (Vega, FLARM etc).

9.6 System status

Info 2 ▷ Status



The system status dialogue is used primarily as a systems check, to see how the glide computer and the connected devices are performing. This is accessed via the menu and then selecting the tabular **System**.

All dynamic values (e.g. battery voltage, number of satellites in view) are updated continuously.

9.7 Multiple devices

You can configure multiple external devices, connected at the same time (few PDAs have two serial ports, but Bluetooth can handle any number of concurrent connections).

When both provide a valid GPS fix, the first one (i.e. Device A) is chosen by XCSoar, and the second GPS fix is ignored. As soon as the first device fails, XCSoar switches to the second one automatically, until the first one recovers.

The same is true for all values (barometric altitude, vario, airspeed, traffic, ...): XCSoar prefers the first device, and uses the second device only for values that are not received from the first one.

Example: Device A is a CAI 302, and Device B is a FLARM. That gives you the best of both: XCSoar has airspeed, vario and traffic data.

9.8 Managing external devices

Config 1 ▷ Devices

The device management dialogue can be accessed from the configuration menu. It shows a list of configured external devices, and it lists what information they provide.

12.28

The button "Reconnect" attempts to reconnect to the selected device. XCSoar reconnects to a failed device periodically, but sometimes, it might be desirable to trigger that manually.

The button "Flight download" is only available with supported IGC loggers (see Section 2.5 for a list). Upon clicking, XCSoar retrieves a list of flights, and asks you to select one. The IGC file will be downloaded to the "`logs`" directory inside `XCSoarData`.

The button "Manage" is enabled when a Vega or a CAI 302 is connected. It provides access to special features of these devices, such as clearing the CAI 302 flight memory, which is needed sometimes to work around a Cambridge firmware bug.

10 Quickstart

This chapter provides instructions for using XCSoar in typical cross-country tasks. It is separated into simple scenarios to demonstrate how to use key features. It assumes the configuration options have already been set up to the user's preferences.

These instructions are intended to provide a simple step-by-step guide to flying tasks of varying levels of complexity but are not intended to demonstrate all the features of XCSoar. Furthermore, the system can be used productively in ways other than as described here.

10.1 Local flight

In this scenario, the pilot intends to fly locally or a casual cross-country task where navigation to pre-determined waypoints is not required.

Prior to takeoff

1. Turn on the device.
2. Open the Flight Setup dialogue and adjust the bugs and ballast as required. Set the maximum forecast temperature. Close the dialogue.
3. Open the Task Edit dialogue, and create a blank task by pressing New .
4. Select "Touring" as task type.
5. Once the task is created, move the cursor to the "add waypoint" item and press enter. Select the start waypoint from the list, e.g. first item is the home base, and press enter. Press close or escape.
6. Select another one "add waypoint", and enter the same waypoint as finish point.
7. Now the task contains one waypoint to home.

In-flight

1. At the appropriate times, set the MacCready manually from the menu, task calculator or from the variometer.
2. Change the bugs/ballast settings as required.
3. At any time, the glider can reach home when the altitude difference bar is a green arrow pointing upwards.

4. Optionally, activate MC Auto when ready to return home. If the MacCready mode was set to "Final Glide" or "Both", then the system will command the optimal speed to return home.

After landing

1. The Status dialogue shows the elapsed flight time.
2. The analysis dialogue can be used to analyse or review the flight.
3. The IGC logger replay can be used to replay the flight.
4. These actions may be performed after turning the device off and on again.

10.2 FAI Task

In this scenario, the pilot intends to fly a triangle FAI task with a single start sector and automatic waypoint advance.

Prior to takeoff

1. Turn on the device.
2. Open the Flight Setup dialogue and adjust the bugs and ballast as required. Set the maximum forecast temperature. Close the dialogue.
3. Open the Task Edit dialogue, and create a blank task by pressing New . Select "FAI triangle" as task type.
4. Move the cursor to the "add waypoint" item and press enter. Set the start and sector type and select the desired waypoint from the list and press enter. Once finished, press close.
5. Move the cursor to the "add waypoint" item again and press enter. Select the waypoint from the list and press enter. This will add the first waypoint to the task.
6. Repeat the procedure for the second waypoint. A good idea to find the right second turn is to filter the waypoint list by bearing ($+120°$) and the proper distance of the triangles edge. The filter references to the first waypoint of our triangle.
7. Repeat the last step as required for an additional waypoint. The last waypoint is the finish waypoint.
8. The task is now entered. You may declare it and send the task to a connected logger device.

In-flight

1. The current waypoint will advance automatically as the pilot flies through the observation zones.

2. After the task is started, the Status dialogue can be opened to verify a valid start was detected. "Valid Start" should be tagged as true, The start time can be reviewed, the start height is saved and the min. finish hight according given rules is shown.
3. At all times the black track arrow will point at the next waypoint. The blue arrow will point at the direction the glider should track when in cruise.
4. If Zoom Auto is activated, the map will automatically zoom in as task waypoints are approached.
5. At the appropriate times, adjust the MacCready by the menu, the task calculator or the connected variometer; or activate MC Auto . If the MacCready mode was set to 'Final Glide' or 'Both', then the system will command the optimal speed to return home; and the MacCready value will be set to the minimum climb rate at which it is beneficial to continue to climb.
6. Change the bugs/ballast settings as required.
7. Refer to the Analysis dialogue as required.
8. Refer to the Status dialogue as required. This shows the start time, elapsed time on task, estimated arrival time, average task speed etc.
9. At any time, when the altitude difference bar is a green arrow pointing upwards the glider can finish the task.

After landing

As described in Section 10.1.

10.3 AAT Task, Manual Arm

In this scenario, the pilot intends to fly a triangle AAT task, and will manually arm the waypoint advance system.

Prior to takeoff

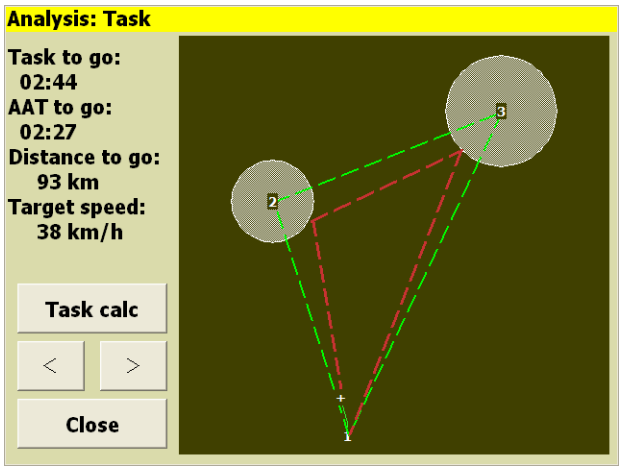
1. Turn on the device.
2. Open the Flight Setup dialogue and adjust the bugs and ballast as required. Set the maximum forecast temperature. Close the dialogue.
3. Open the Task Edit dialogue, and create a blank task by pressing New . Select "AAT" as task type.
4. Once the task is created, move the cursor to the 'add waypoint' item and press enter. Add waypoints in the already described way.

5. The AAT requires additional input to the kind and size of the observation zone. Adjust AAT sector parameters for this waypoint and press close or escape.
6. Repeat the last two steps as required for additional waypoints. The last waypoint is the finish waypoint.
7. The AAT task is now entered. Open the Properties dialogue and set the given task time.
8. The estimated elapsed time to complete the task with different MacCready settings can be explored from the Task Calc dialogue. Adjusting the MacCready value and see what "AAT Range" setting is suggested by XCSoar.

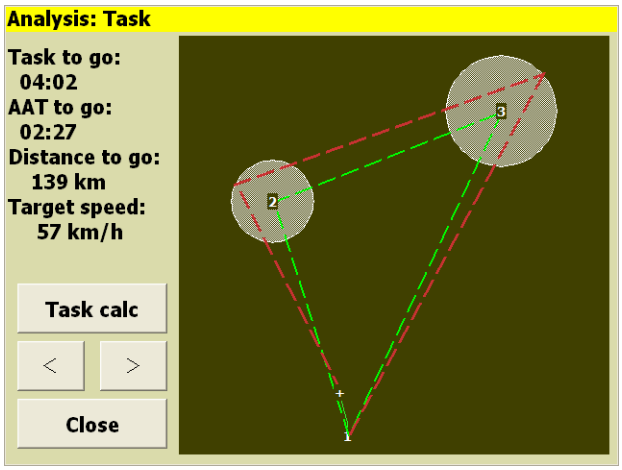
In-flight

1. When the pilot is ready to start the task, press the Arm Start button. The current waypoint will then advance automatically once, as the pilot flies through the start sector. After this occurs, the advance trigger is disarmed.
2. In order to re-start, the pilot needs to manually revert to the Start Turnpoint and again press the Arm Start button prior to flying through the start sector again.
3. After the task is started, the Status dialogue can be opened to verify a valid start was detected. If the start time is given, the start was detected and legal according to the task start rules specified in the configuration. Otherwise it will display "INVALID".
4. During flight, the estimated elapsed time to complete the task with different MacCready settings can be explored from the Task Calc dialogue. Once a decision is made to extend or reduce the AAT range this can be done by manually manipulating the Target . This allows the pilot to effectively increase or decrease the task distance and estimate the effect on AAT time.

   The figure below shows the course around the targets at range set to -100%.



The figure below shows the course around the targets at range set to 100%.



5. At all times the black track arrow will point at the next target. The target is the location within the AAT sector at the range specified in the Task Calc dialogue. The blue arrow will point at the direction the glider should track when in cruise.

6. When the pilot is within or approaching an AAT sector and is ready to advance to the next waypoint, press the Arm Turn button. The current waypoint will then advance automatically once, if the pilot is inside the observation zone. After this occurs, the advance trigger is disarmed.

7. If Auto Zoom is activated, the map will automatically zoom in as task waypoints are approached.

8. At the appropriate times, adjust the MacCready by the menu, the task calculator or the connected variometer; or activate MC Auto . If the MacCready mode was set to 'Final Glide' or 'Both', then the system will command the optimal speed to return home; and the MacCready value will be set to the minimum climb rate at which it is beneficial to continue to climb.

9. Change the bugs/ballast settings as required.
10. Refer to the Analysis dialogue as required.
11. Refer to the Status dialogue as required. This shows the start time, elapsed time on task, estimated arrival time, average task speed etc.

After landing

As described in Section 10.1.

11 InfoBox Reference

InfoBox data types are grouped into logical categories.

All InfoBoxes display their data in user-specified units. Whenever the content is invalid, the displayed value will be '– – –' and the content is greyed out. This happens, for example, when no terrain elevation is found for the 'Terrain Elevation' InfoBox, or in the same way for a derived InfoBox like 'Height AGL'.

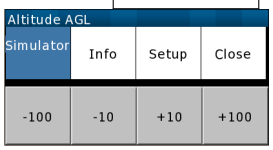
Some of the InfoBox contents are modifiable complex values like 'MC setting', or 'Wind'. Most of those values are now accessible through an InfoBox dialogue. It is a short cut to quickly change the most often accessed items. An InfoBox dialogue is opened by long press to the InfoBox (Touchscreen devices), or 'Select' and 'Enter' (PC).

In the following description of the InfoBox types, the first title is as it appears in the InfoBox configuration dialogue box, the second title is the label used in the InfoBox title.

11.1 Altitude

Altitude GPS

Alt GPS



This is the altitude above mean sea level reported by the GPS. (Touch-screen/PC only) In simulation mode this value is adjustable with the up/down arrow keys. The right/left arrow keys also cause the glider to turn.[1]

Barometric altitude

Alt Baro

This is the barometric altitude obtained from a device equipped with pressure sensor.[1]

Altitude (Auto)

Alt <auto>

This is the barometric altitude obtained from a device equipped with a pressure sensor or the GPS altitude if the barometric altitude is not available.

Height AGL

H AGL

This is the navigation altitude minus the terrain elevation obtained from the terrain file. The value is coloured red when the glider is below the terrain safety clearance height.[1]

Terrain elevation

Terr Elev

This is the elevation of the terrain above mean sea level obtained from the terrain file at the current GPS location.

Height above take-off

H T/O

Height based on an automatic take-off reference elevation (like a QFE reference).[1]

Flight level

Flight Level

Pressure Altitude given as Flight Level. If barometric altitude is not available, FL is calculated from GPS altitude, given that the correct QNH is set. In case the FL is calculated from the GPS altitude, the FL label is coloured red.[1]

Barogram

Barogram

Trace of altitude during flight.

11.2 Aircraft state

Speed ground

V GND

Ground speed measured by the GPS. If this InfoBox is active in simulation mode, pressing the up and down arrows adjusts the speed, left and right turns the glider.

Track

Track

Magnetic track reported by the GPS. (Touch-screen/PC only) If this InfoBox is active in simulation mode, pressing the up and down arrows adjusts the track.

Airspeed IAS

V IAS

Indicated Airspeed reported by a supported external intelligent vario.

G load

G

Magnitude of G loading reported by a supported external intelligent vario. This value is negative for pitch-down manoeuvres.

Bearing Difference

Brng. D

The difference between the glider's track bearing, to the bearing of the next waypoint, or for AAT tasks, to the bearing to the target within the AAT sector. GPS navigation is based on the track bearing across the ground, and this track bearing may differ from the glider's heading when there is wind present. Chevrons point to the direction the glider needs to alter course to correct the bearing difference, that is, so that the glider's course made good is pointing directly at the next waypoint. This bearing takes into account the curvature of the Earth.

Airspeed TAS

V TAS

True Airspeed reported by a supported external intelligent vario.

Attitude indicator

Horizon

Attitude indicator (artificial horizon) display calculated from flightpath, supplemented with acceleration and variometer data if available.

[1] In simulator mode an additional dialogue is available to change the value of the InfoBox.

11.3 Glide ratio

GR instantaneous

GR Inst

Instantaneous glide ratio over ground, given by the ground speed divided by the vertical speed (GPS speed) over the last 20 seconds. Negative values indicate climbing cruise. If the vertical speed is close to zero, the displayed value is '- - -'.

GR cruise

GR Cruise

The distance from the top of the last thermal, divided by the altitude lost since the top of the last thermal. Negative values indicate climbing cruise (height gain since leaving the last thermal). If the vertical speed is close to zero, the displayed value is '- - -'.

Final GR

Fin GR

The required glide ratio over ground to finish the task, given by the distance to go divided by the height required to arrive at the safety arrival height. This is no adjusted total energy possible.

Next GR

WP GR

The required glide ratio over ground to reach the next waypoint, given by the distance to next waypoint divided by the height required to arrive at the safety arrival height. Negative values indicate a climb is necessary to reach the waypoint. If the height required is close to zero, the displayed value is '- - -'.

L/D vario

L/D Vario

Instantaneous lift/drag ratio, given by the indicated airspeed divided by the total energy vertical speed, when connected to an intelligent variometer. Negative values indicate climbing cruise. If the total energy vario speed is close to zero, the displayed value is '- - -'.

GR average

GR Avg

The distance made in the configured period of time , divided by the altitude lost since then. Negative values are shown as '^^^' and indicate climbing cruise (height gain). Over 200 of GR the value is shown as '+++'. You can configure the period of averaging. Suggested values are 60, 90 or 120. Lower values will be closer to GR inst., and higher values will be closer to GR cruise. Notice that the distance is *not* the straight line between your old and current position, it's exactly the distance you have made even in a zigzag glide. This value is not calculated while circling.

11.4 Variometer

Last Thermal Average

TL Avg

Total altitude gain/loss in the last thermal divided by the time spent circling.

Last thermal gain

TL Gain

Total altitude gain/loss in the last thermal.

Last thermal time

TL Time

Time spent circling in the last thermal.

Thermal climb, last 30 s

TC 30s

A 30 second rolling average climb rate based of the reported GPS altitude, or vario if available.

Thermal average

TC Avg

Altitude gained/lost in the current thermal, divided by time spent thermalling.

Thermal gain

TC Gain

The altitude gained/lost in the current thermal.

Vario

Vario

Instantaneous vertical speed, as reported by the GPS, or the intelligent vario total energy vario value if connected to one.

Netto vario

Netto

Instantaneous vertical speed of air-mass, equal to vario value less the glider's estimated sink rate. Best used if airspeed, accelerometers and vario are connected, otherwise calculations are based on GPS measurements and wind estimates.

Vario trace

Vario Trace

Trace of vertical speed, as reported by the GPS, or the intelligent vario total energy vario value if connected to one.

Netto vario trace

Netto Trace

Trace of vertical speed of air-mass, equal to vario value less the glider's estimated sink rate.

Thermal climb trace

TC Trace

Trace of average climb rate each turn in circling, based of the reported GPS altitude, or vario if available.

Thermal average over all

T Avg

Time-average climb rate in all thermals.

Climb band

Climb Band

Graph of average circling climb rate (horizontal axis) as a function of altitude (vertical axis).

Thermal assistant

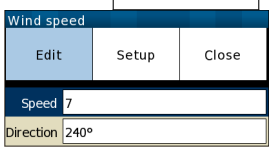
Thermal

A circular thermal assistant that shows the lift distribution over each part of the circle.

11.5 Atmosphere

Wind arrow

Wind



Wind vector estimated by XCSoar. Manual adjustment is possible with the connected InfoBox dialogue. Pressing the up/down cursor keys to cycle through settings, adjust the values with left/right cursor keys.

Wind bearing

Wind Brng

Wind bearing estimated by XCSoar. Adjustable in the same manner as Wind arrow.

Wind speed

Wind V

Wind speed estimated by XCSoar. Adjustable in the same manner as Wind arrow.

Head wind component

Head Wind

The current head wind component. Head wind is calculated from TAS and GPS ground speed if airspeed is available from external device. Otherwise the estimated wind is used for the calculation.

Head wind component (simplified)

Head Wind *

The current head wind component. The simplified head wind is calculated by subtracting GPS ground speed from the TAS if airspeed is available from external device.

Outside air temperature

OAT

Outside air temperature measured by a probe if supported by a connected intelligent variometer.

Relative humidity

Rel Hum

Relative humidity of the air in percent as measured by a probe if supported by a connected intelligent variometer.

Forecast temperature

Max Temp

Forecast temperature of the ground at the home airfield, used in estimating convection height and cloud base in conjunction with outside air temperature and relative humidity probe. (Touchscreen/PC only) Pressing the up/down cursor keys adjusts this forecast temperature.

11.6 MacCready

MacCready Setting

MC <mode>

The current MacCready setting, the current MacCready mode (manual or auto), and the recommended speed-to-fly. (Touchscreen/PC only) Also used to adjust the MacCready setting if the InfoBox is active, by using the up/down cursor keys. Pressing the enter cursor key toggles 'Auto MacCready' mode. An InfoBox dialogue is available

Speed MacCready

V MC

The MacCready speed-to-fly for optimal flight to the next waypoint. In cruise flight mode, this speed-to-fly is calculated for maintaining altitude. In final glide mode, this speed-to-fly is calculated for descent.

Percentage climb

% Climb

Percentage of time spent in climb mode. These statistics are reset upon starting the task.

Speed dolphin

V opt.

The instantaneous MacCready speed-to-fly, making use of netto vario calculations to determine dolphin cruise speed on the glider's current bearing. In cruise flight mode, this speed-to-fly is calculated for maintaining altitude. In final glide mode, this speed-to-fly is calculated for descent. In climb mode, this switches to the speed for minimum sink at the current load factor (if an accelerometer is connected). When 'Block' mode speed to fly is selected, this InfoBox displays the MacCready speed.

Thermal next leg equivalent

T Next Leg

The thermal rate of climb on next leg which is equivalent to a thermal equal to the MacCready setting on current leg.

Task cruise efficiency

Cruise Eff

Efficiency of cruise. 100 indicates perfect MacCready performance. This value estimates your cruise efficiency according to the current flight history with the set MC value. Calculation begins after task is started.

11.7 Navigation

Next Bearing

Bearing

True bearing of the next waypoint. For AAT tasks, this is the true bearing to the target within the AAT sector.

Next radial

Radial

True bearing from the next waypoint to your position.

Next distance

WP Dist

The distance to the currently selected waypoint. For AAT tasks, this is the distance to the target within the AAT sector.

Next altitude difference

WP AltD

Arrival altitude at the next waypoint relative to the safety arrival height. For AAT tasks, the target within the AAT sector is used.

Next MC0 altitude difference

WP MC0 AltD

Arrival altitude at the next waypoint with MC 0 setting relative to the safety arrival height. For AAT tasks, the target within the AAT sector is used.

Next altitude arrival

WP AltA

Absolute arrival altitude at the next waypoint in final glide. For AAT tasks, the target within the AAT sector is used.

Next altitude required

WP AltR

Altitude required to reach the next turn point. For AAT tasks, the target within the AAT sector is used.

Final altitude difference

Fin AltD

Arrival altitude at the final task turn point relative to the safety arrival height.

Final altitude required

Fin AltR

Additional altitude required to finish the task.

Final distance
Final Dist

Distance to finish around remaining turn points.

Distance home
Home Dist

Distance to the home waypoint (if defined).

11.8 Competition and assigned area tasks

Speed task average
V Task Avg

Average cross country speed while on current task, not compensated for altitude.

Speed task instantaneous
V Task Inst

Instantaneous cross country speed while on current task, compensated for altitude. Equivalent to instantaneous Pirker cross-country speed.

Speed task achieved
V Task Ach

Achieved cross country speed while on current task, compensated for altitude. Equivalent to Pirker cross-country speed remaining.

AAT time
AAT Time

'Assigned Area Task' time remaining. Goes red when time remaining has expired.

AAT delta time
AAT dT

Difference between estimated task time and AAT minimum time. Coloured red if negative (expected arrival too early), or blue if in sector and can turn now with estimated arrival time greater than AAT time plus 5 minutes.

AAT max. distance
AAT Dmax

'Assigned Area Task' maximum distance possible for remainder of task.

AAT min. distance
AA Dmin

'Assigned Area Task' minimum distance possible for remainder of task.

AAT speed max. distance
AAT Vmax

'Assigned Area Task' average speed achievable if flying maximum possible distance remaining in minimum AAT time.

AAT speed min. distance
AAT Vmin

'Assigned Area Task' average speed achievable if flying minimum possible distance remaining in minimum AAT time.

AAT distance around target
AAT Dtgt

'Assigned Area Task' distance around target points for remainder of task.

AAT speed around target
AAT Vtgt

'Assigned Area Task' average speed achievable around target points remaining in minimum AAT time.

Contest distance
Cont Dist

Instantaneous evaluation of the flown distance according to the configured contest rule set.

Task progress
Progress

Clock-like display of distance remaining along task, showing achieved task points.

Start open/close countdown
Start open

Shows the time left until the start point opens or closes.

Start open/close countdown at reaching
Start reach

Shows the time left until the start point opens or closes, compared to the calculated time to reach it.

11.9 Waypoint

Next waypoint
Next WP

The name of the currently selected turn point. When this InfoBox is active, using the up/down cursor keys selects the next/previous waypoint in the task. (Touch-screen/PC only) Pressing the enter cursor key brings up the waypoint details.

Flight Duration
Flt Duration

Time elapsed since take-off was detected.

Time local
Time loc

GPS time expressed in local time zone.

Time UTC
Time UTC

GPS time expressed in UTC.

Task time to go
Fin ETE

Estimated time required to complete task, assuming performance of ideal MacCready cruise/climb cycle.

Task time to go (ground speed)
Fin ETE VMG

Estimated time required to complete task, assuming current ground speed is maintained.

Next time to go
WP ETE

Estimated time required to reach next waypoint, assuming performance of ideal MacCready cruise/climb cycle.

Next time to go (ground speed)
WP ETE VMG

Estimated time required to reach next waypoint, assuming current ground speed is maintained.

Task arrival time
Fin ETA

Estimated arrival local time at task completion, assuming performance of ideal MacCready cruise/climb cycle.

Next arrival time
WP ETA

Estimated arrival local time at next waypoint, assuming performance of ideal MacCready cruise/climb cycle.

Task req. total height trend
RH Trend

Trend (or neg. of the variation) of the total required height to complete the task.

Time under max. start height

Start Height

The contiguous period the ship has been below the task start max. height.

11.10 Team code

Team code

Team Code

The current Team code for this aircraft. Use this to report to other team members. The last team aircraft code entered is displayed underneath.

Team bearing

Team Brng

The bearing to the team aircraft location at the last team code report.

Team bearing difference

Team BrngD

The relative bearing to the team aircraft location at the last reported team code.

Team range

Team Dist

The range to the team aircraft location at the last reported team code.

11.11 Device status

Battery voltage/percent

Battery

Displays percentage of device battery remaining (where applicable) and status/voltage of external power supply.

CPU load

CPU

CPU load consumed by XCSoar averaged over 5 seconds.

Free RAM

Free RAM

Free RAM as reported by the operating system.

11.12 Alternates

Alternate 1

Altn 1

Displays name and bearing to the best alternate landing location.

Alternate 2

Altn 2

Displays name and bearing to the second alternate landing location.

Alternate 1 GR

Altn1 GR

Geometric gradient to the arrival height above the best alternate. This is not adjusted for total energy.

Alternate 2 GR

Altn2 GR

Geometric gradient to the arrival height above the second alternate. This is not adjusted for total energy.

11.13 Obstacles

Nearest airspace horizontal

Near AS H

The horizontal distance to the nearest airspace.

Nearest airspace vertical

Near AS V

The vertical distance to the nearest airspace. A positive value means the airspace is above you, and negative means the airspace is below you.

Terrain collision

Terr Coll

The distance to the next terrain collision along the current task leg. At this location, the altitude will be below the configured terrain clearance altitude.

11.14 Radio

Active radio frequency

Act Freq

The currently active radio frequency.

Standby radio frequency

Stby Freq

The currently standby radio frequency.

12 Configuration

XCSoar is a highly configurable glide computer and can be customised to suit a wide variety of preferences and user requirements. The entire configuration is saved in a so-called profile file, reflecting all configuration settings. Whenever a configuration is judged being worthy, a backup of the profile file is advisable (see Section 2.8. This chapter describes the configuration settings and options.

12.1 Scope of configuration

There are several ways XCSoar can be customised:

- Modifying configuration settings. This is the sort of configuration most likely to be performed by users; and this is given the greatest attention in this document.
- Changing the language, or even just to change the wording of text in the user interface.
- Changing the button assignments and button menus. This allows the content and structure of the button menu to be changed.
- Changing or adding actions performed when glide computer events take place.
- Defining how long status messages appear and sounds play when those messages occur.

12.2 Modifying settings

There is a large set of configuration settings that may be customised from the settings dialogues accessible from the menu:

Config 2/3 ▷ System : Invokes the main configuration dialogue for rather static settings. It is in no way intended to be accessed during flight.

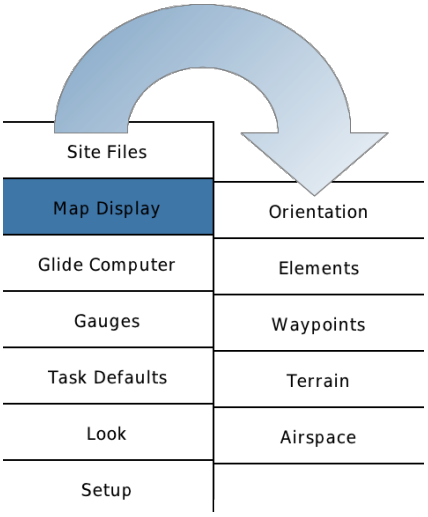
Config 2/3 ▷ Plane : Dialogue for specifying the plane's data, with polar and wing loading representing the most important ones. This dialogue is to be included in the preflight check if the XCSoar base system is used in different planes.

Config 2/3 ▷ Devices : Configuration of devices connected to XCSoar. Although being a system setup dialogue, there might be rare occasions where this dialogue is required in-flight. Whenever connections to devices are lost, this dialogue might be used to reconnect. This dialogue neither was nor will be intended for use in-flight. Unfortunately, buggy operating systems of host hardware create a demand for it occasionally.

12.3 Configure System

Config 2/3 ▷ System

The system configuration can be accessed through a two layer structured menu or just sequentially through the back and forward buttons.

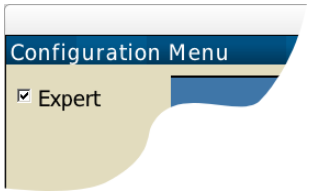


You are strongly discouraged from changing these settings during flight. All changes to the settings should be performed on the ground so that their desired effect on the programs behaviour can be verified.

The settings dialogue contains several pages. Once changes have been made, click Close on the screen to close the dialogue and return to the configuration menu. Another button press leads back to the normal map mode.

Once you are happy with your configuration settings, save the profile file and make a backup so that you can later restore the settings if your PDA's memory is accidentally erased.

See Chapter 13 for a description of the data formats of files referred to in the settings. Where no file is to be used, the field can be left blank. File name fields in forms show files that match a file extension filter. This makes it much easier to find and select the correct file.



The main configuration dialogue (Setup System) can be run in Basic or Expert user level, via a selectable field on the left of the dialogue. When in Basic mode, many of the less commonly used and advanced configuration settings are hidden. In the descriptions below, all of the parameters marked with an asterisk are only visible in expert user level.

12.4 Site Files / Site Files

The dialogue specifies most of the important files that must be configured when flying at a new site.

XCSoar data path : The location for all of your XCSoar data on your hard drive, SD card, or the PDA's static memory.

Map Database : The name of the map file (XCM) containing digital elevation terrain data, topography, and optionally waypoints, airspace etc. A good prepared database file covers all the needs for this page.

Waypoints : Primary waypoints file. If left blank, waypoints are loaded from the map file (if available).

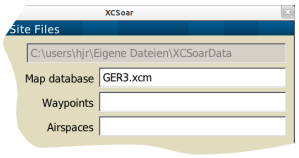
More waypoints* : Secondary waypoints file. This may be used to add waypoints for a competition.

Watched waypoints* : Waypoint file containing special waypoints for which additional computations like calculation of arrival height in map display always takes place. Useful for waypoints like known reliable thermal sources (e.g. powerplants) or mountain passes.

Airspaces : The file name of the primary airspace file. If left blank, airspaces are loaded from the map file (if available).

More airspaces* : The file name of the secondary airspace file.

Waypoint details* : The airfields file may contain extracts from Enroute Supplements or other contributed information about individual airfields.



Airspace files define Special Use Airspace. Up to two files may be specified, the first for the main SUA file, and the second is intended for use with NOTAM airspace, and is referred to as the additional airspace file.

The XCM map database concept is the current way to setup a site to fly. XCSoar releases prior to v6.4 required each to be separate files and to be specified separately (as the '*Terrain file*' and '*Topography file*' respectively). This option has been dropped in favor to the XCM map database with XCSoar release v6.4.

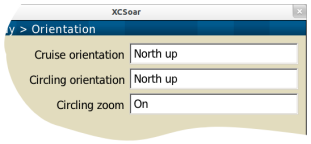
The XCM map file, however, contains all these files: Terrain, topography and optionally waypoints and airspaces. If the latter are contained, the e.g. '*Primary waypoint file*' may be left blank and the system will load waypoints from the map file. However, the user can still specify other files and they will be used instead of the data in the map file.

See Section 13.2 for more details on map files.

12.5 Map Display / Orientation

This page let you specify the favoured map orientation and view.

Cruise/Circling orientation : This determines how the screen is rotated with the glider, depending on it's current display mode.
Track up: The moving map display will be rotated so the glider's track is oriented up. The north arrow symbol points to true north. The glider symbol may be shown rotated according to the computed heading of the glider taking wind into account.
Heading up: The moving map display will be rotated so the



glider's heading is oriented up.
North up: The moving map display will always be orientated true north to south and the glider icon will be rotated to show its course (corrected for wind).
Target up: The moving map display will be rotated so the current target direction is oriented up.
Wind up The moving map display will be rotated so the wind is always oriented top-down (might be useful for wave flying).

Circling zoom : This determines whether separate zoom levels will be maintained for circling and cruise modes. If enabled, then the map will zoom in automatically when entering circling mode and zoom out automatically when leaving circling mode.

Map shift reference : The direction according to the map will be displaced in order to present a meaningful map section.
None: Disable any adjustment.
Track: Use a recent average of the ground track as basis.
Target: Use the current target waypoint as basis.

Glider position offset : Defines the location of the glider drawn on the screen in percent from the screen edge.

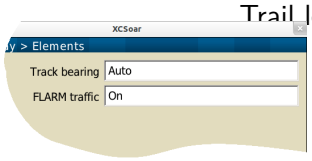
Max. auto zoom distance : The upper limit for auto zoom distance.

12.6 Map Display / Elements

This page provides options relating to screen elements overlayed to the map display.

Ground track : Display the ground track (ground track projection) on the map. The setting "Auto" displays the ground track only if there is a significant difference to plane heading.

FLARM traffic : This enables the display of FLARM traffic on the map.



Trail length* : Determines whether and how long a snail trail is drawn behind the glider.
Off: No trail is drawn.
Long: A long trail is drawn (approx 60 minutes).
Short: A short trail is drawn (approx 10 minutes).
Full: A trail for the entire flight is drawn.

Trail drift* : Determines whether the snail trail is drifted with the wind when displayed in circling mode. Switched Off, the snail trail stays uncompensated for wind drift.

Trail type* : Sets the type of the snail trail display.
Vario #1: Within lift areas lines get displayed green and thicker, while sinking lines are shown brown and thin. Zero lift is presented as a grey line.
Vario #1 (with dots): The same colour scheme as the previous, but with dotted lines while sinking.

Vario #2: The climb colour for this scheme is orange to red, sinking is displayed as light blue to dark blue. Zero lift is presented as a yellow line.
Vario #2 (with dots): The same colour scheme as the previous, but with dotted lines while sinking.
Altitude: The colour scheme corresponds to the altitude.

Trail scaled* : If set to ON the snail trail width is scaled according to the vario signal.

Detour cost markers* : If enabled this displays in cruise flight some figures projected in front of the nose of the glider icon. This is the additional distance in percent if you fly up the position of the figure and after that again straight towards the target, compared to the straight distance to target.

Aircraft symbol* : Sets the symbol used for the aircraft.
Simple: Simplified line graphics, a black glider shape with white contours.
Simple (large): Enlarged simple graphics for better visibility on a small display.
Detailed: Rendered aircraft graphics.
HangGlider: Simplified hang glider as line graphics, white with black contours.
ParaGlider: Simplified para glider as line graphics, white with black contours.

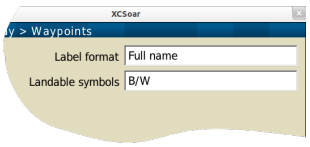
Wind arrow* : Determines the way the wind arrow is drawn on the map.
Off: No wind arrow is drawn.
Arrow head: Draws an arrow head only.
Full arrow: Draws an arrow head with a dashed arrow line.

FAI triangle areas : Whether to show FAI triangle areas on the map.

12.7 Map Display / Waypoints

This page provides options relating to the map display.

Label format : This setting determines the label format displayed with each waypoint. There are four different format options.



Full name: The full name of each waypoint is displayed.
First word of name: Only the first word (up to the first space) of the waypoint name is displayed.
First 3 letters: The first 3 letters of the waypoint name are displayed.
First 5 letters: The first 5 letters of the waypoint name are displayed.
None: No name is displayed with the waypoint.

Arrival height* : This enables the arrival height info shown additionally for landables.
None: No arrival height is displayed.

Straight glide: Straight glide arrival height (no terrain is considered).
Terrain avoidance glide: Arrival height considering terrain avoidance.
Straight & terrain glide: Both arrival heights are displayed.
Required glide ratio: Show the glide ratio over ground that is required to reach the waypoint.

Label style* : Labels for landables can be shown on a rounded rectangle with white background, or with outlined letters.

Waypoint label visibility* : Controls which waypoints are displayed with names and arrival altitudes on the map:
All: All waypoint labels will be displayed.
Task waypoints and landables: All waypoints part of a task and all landables will be displayed.
Task waypoints: All waypoints part of a task will be displayed.
None: No waypoint labels will be displayed.

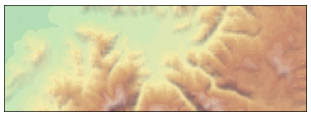
Landable symbols : Three styles are available: Purple circles (WinPilot style), a high contrast style with icons, and icons with a traffic light colour scheme. See Section 4.5 for details.

Detailed landables* : Enabling details on landables displays instead of fixed icons variable information like runway length and heading.

Landable size* : A percentage to select the size landables are displayed on the map.

Scale runway length* : Enabling this option will display for detailed landables additionally a scaled runway length based on real length.

12.8 Map Display / Terrain



This page sets how terrain and topography is drawn on the map window. The effect of the changed terrain settings are directly visible at the small preview below.

Terrain display : Draws digital elevation terrain on the map.

Topography display : Draws topographical features (roads, rivers, lakes etc.) on the map.

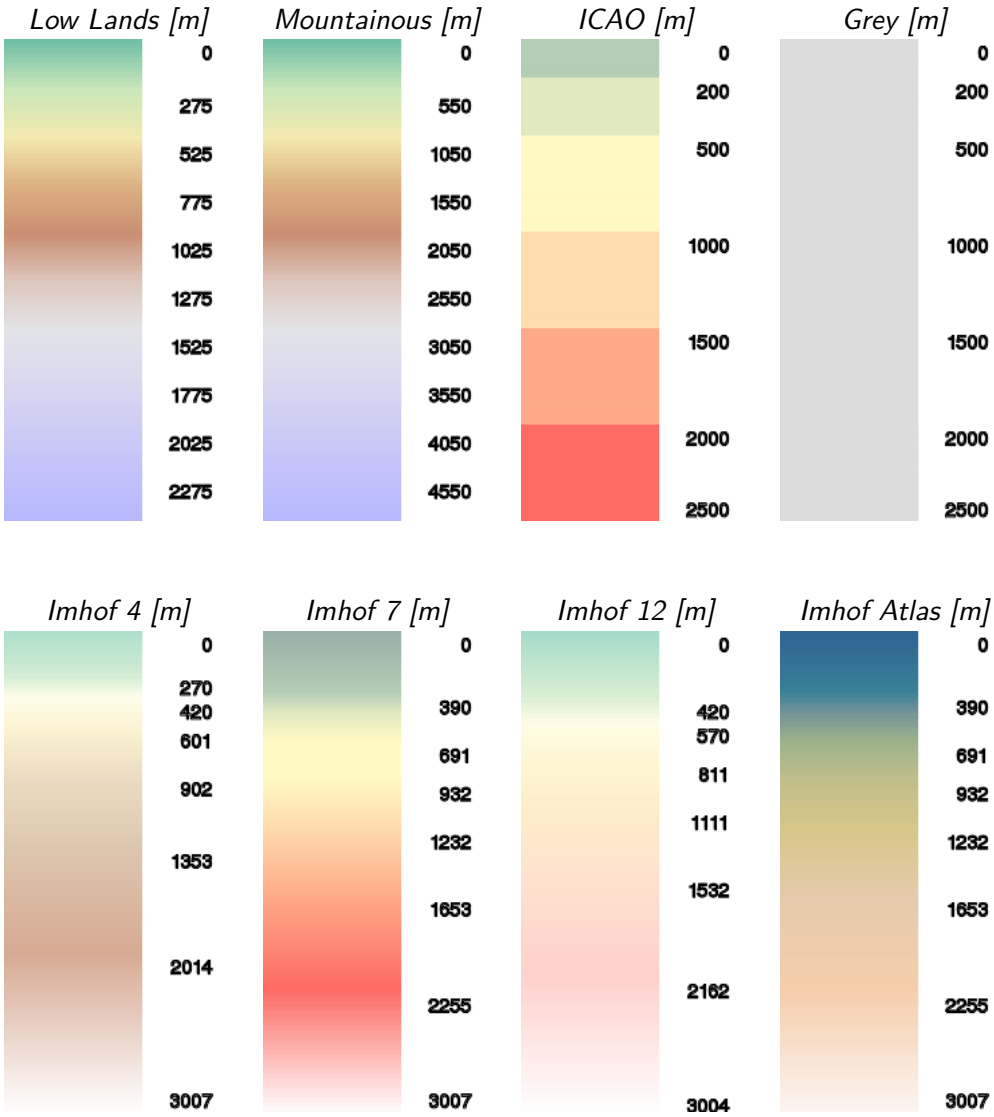
Terrain colours : Defines the colour ramp used in terrain rendering. Various schemes are available, which works best for you will depend on how mountainous your region is.

Slope shading* : The terrain can be shaded among slopes to indicate either wind direction, sun position or a fixed shading from North-West. Slopes faced to the wind (or sun) get displayed brighter and the averted slopes get darker.

Terrain contrast* : Defines the amount of Phong shading in the terrain rendering. Use large values to emphasise terrain slope, smaller values if flying in steep mountains.

Terrain brightness* : Defines the brightness (whiteness) of the terrain rendering. This controls the average illumination of the terrain.

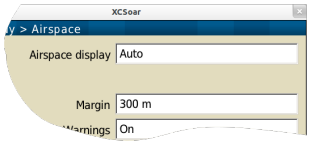
The available terrain colour schemes are illustrated in the table below.



12.9 Map Display / Airspace

This page is used to determine how the airspace information is displayed and how warnings are issued.

Airspace display : Controls how airspace display and warnings are filtered based on altitude. The airspace filter dialogue also allows filtering of display and warnings independently for each airspace class.
All on: All the airspace information is displayed at the same



time.
Clip: Only airspace below a user determined altitude is shown.
Auto: Only airspace at the current altitude plus or minus a user definable margin is shown.
All below: Like auto plus every airspace below the glider is shown.

Clip altitude : For clip mode, this is the altitude below which airspace is displayed.

Margin : For auto and all below airspace mode, this is the height above/below which airspace is included.

Warnings : Determines whether warnings are enabled or disabled.

Warning time* : This is the time before an incursion is estimated at which the system will warn the pilot.

Acknowledge time* : This is the time period in which an acknowledged airspace warning will not be repeated.

Use black outline* : Draws a black outline around each airspace.

Airspace fill mode* : Specifies the mode for filling the airspace area.
Fill all: Transparently fills the airspace colour over the whole area.
Fill padding: Draws a solid outline with a half transparent border around the airspace.
Default: This selects the best performing option for your hardware. In fact it favours '*Fill padding*'.

Airspace transparency* : If enabled, then airspaces are filled transparently.

This page also has Colours and Filter buttons which can be used to review or change the colours/patterns used by each airspace class, and whether each airspace class will be filtered out of warnings and/or display. Depending on the airspace transparency setting it is no longer needed to define patterns. The availability of transparency relies on the capabilities of the used hardware and may differ.

Colours

This function is used to determine the colours used to draw each class of airspaces.

First select the airspace class you wish to change. Then select the colour and pattern you wish the selected airspace class to be drawn in.

Filters

The filter function is described in Section 8.3.

12.10 Glide Computer / Safety Factors

This page allows the safety heights and behaviour for the alternates mode to be defined.

Arrival height : The height above terrain that the glider should arrive at for a safe landing.

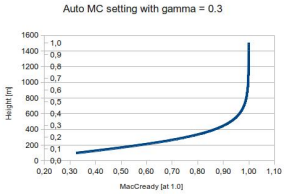
Terrain height : The height above terrain that the glider must clear during final glide.
See Section 6.8 for more details on the meanings of the safety heights.

Alternates mode : Determines sorting of alternates in the alternates dialogue.
Simple: The alternates will only be sorted by arrival height. The first waypoint in the list is therefore the most reachable waypoint.
Task: The sorting will also take the current task direction into account, such that the sort order is according to minimum extra distance travelled to the respective field and onwards to the task.
Home: The sorting will try to find landing options in the current direction to the configured home waypoint. Similar to 'task' but with the home field as the desired destination.

Polar degradation* : A permanent polar degradation. 0% means no degradation, 50% indicates the glider's sink rate is doubled.

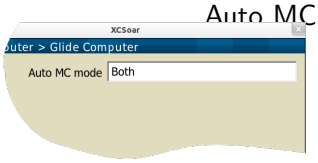
Safety MC* : When safety MC is enabled, this MacCready setting is used for reach calculations, task abort, alternates and for determining arrival altitude at airfields.

STF risk factor* : The STF risk factor reduces the MacCready setting used to calculate speed to fly as the glider gets low, in order to compensate for risk. Set to 0.0 for no compensation, 1.0 scales MC linearly with height (with reference to height of the maximum climb). If considered, 0.3 is recommended. See Section 6.7 for more details.



12.11 Glide Computer / Glide Computer

This page allows glide computer algorithms to be configured.



Auto MC mode : This option defines which auto MacCready algorithm is used. For more details see Section 6.13.
Final glide: Final glide adjusts MC for fastest arrival.
Trending average climb: Sets MC to the trending average climb rate based on all climbs.
Both: Uses trending average during task, then fastest arrival when in final glide mode.

Block speed to fly* : If enabled, the command speed in cruise is set to the MacCready speed to fly in no vertical air-mass movement. If disabled,

the command speed in cruise is set to the dolphin speed to fly, equivalent to the MacCready speed with vertical air-mass movement.

Nav. by baro altitude* : When enabled and if connected to a barometric altimeter, barometric altitude is used for all navigation functions. Otherwise GPS altitude is used.

Flap forces cruise* : When this option is enabled, causes the flap switches in Vega to force cruise mode when the flap is not positive. This means that when departing a thermal, switching to neutral or negative flap will immediately switch XCSoar's mode to cruise mode. Similarly, for Borgelt B50 systems, the speed command switch forces XCSoar's climb or cruise mode.

GR Average period* : Average efficiency is always calculated in real-time. Here you can decide on how many seconds of flight this calculation must be done. The real distance covered second by second in this period is divided by the final difference of altitude. So if for example you go and return back to the same point after 2 minutes, and you have set 2 minutes as period, average GR will consider the total distance covered in those two minutes, and not the distance between your position 2 minutes before and your current position, that in this case could be almost zero! Normally for gliders a good value is 90-120 seconds, and for paragliders 15 seconds. Lower values will give as a result pretty much the same as GR Instant, while higher values will look like GR Cruise. Other commercial instruments and software use 2 minutes.

Predict wind drift* : Account for wind drift for the predicted circling duration. This reduces the arrival height for legs with head wind (on by default).

12.12 Glide Computer / Wind

This page sets the base for wind computations.

Auto wind : This allows switching on or off the automatic wind algorithm.
Manual: When the algorithm is switched off, the pilot is responsible for setting the wind estimate.
Circling: Circling mode requires only a GPS source.
ZigZag: ZigZag requires an intelligent vario with airspeed output.
Both: Uses Circling and ZigZag.

Prefere external wind : If enabled, the wind vector received from external devices overrides XCSoar's internal wind calculation.

12.13 Glide Computer / Route

This page allows control over glide reach calculations and route optimisations.

Route mode : This controls which types of obstacles are used in route planning. Please have a look at Section 4.14 for a detailed description.

Route climb* : When enabled and MC is positive, route planning allows climbs between the aircraft location and destination.

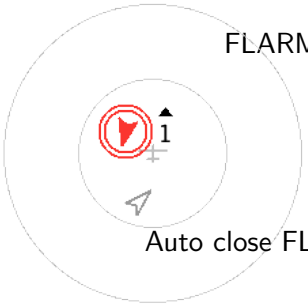
Route ceiling* : When enabled, route planning climbs are limited to ceiling defined by greater of current aircraft altitude plus 500 m and the thermal ceiling. If disabled, climbs are unlimited.

Reach mode : How calculations are performed of the reach of the glider with respect to terrain.
Off: Reach calculations disabled.
Straight: The reach is from straight line paths from the glider.
Turning: The reach is calculated allowing turns around terrain obstacles.

Reach display : This determines whether the glide reach is drawn as a line resp. a shade on the map area.

Reach polar* : This determines the glide performance used in reach, landable arrival, abort and alternate calculations.
Task: Uses task MacCready value;
Safety MC: Uses safety MacCready value.

12.14 Gauges / FLARM, Other



FLARM radar : This enables the display of the FLARM radar gauge. The track bearing of the target relative to the track bearing of the aircraft is displayed as an arrow head, and a triangle pointing up or down shows the relative altitude of the target relative to you.

Auto close FLARM* : This will close the FLARM radar view when all FLARM traffic has gone.

Thermal assistant : Enables the display of the ThermalAssistant gauge.

Thermal band : Enables the display of the thermal profile (climb band) overlay on the map.

Final glide bar MC0* : If set to ON the final glide bar will show a second arrow indicating the required altitude to reach the final waypoint at MC zero.

In all FLARM environments, the colour of the target indicates the threat level.

12.15 Gauges / Vario

This page bundles all details to the vario-gauge and is entirely classified as expert setup.

Speed arrows* : Whether to show speed command arrows on the vario gauge. When shown, in cruise mode, arrows point up to command slow down; arrows point down to command speed up.

Show average* : Whether to show the average climb rate. In cruise mode, this switches to showing the average net airmass rate.

Show MacCready* : Whether to show the MacCready setting.

Show bugs* : Whether to show the bugs percentage.

Show ballast* : Whether to show the ballast percentage.

Show gross* : Whether to show the gross vario value.

Averager needle* : If true, the vario gauge will display a hollow averager needle. During cruise, this needle displays the average net value. During circling, this needle displays the average gross value.

12.16 Gauges / Audio Vario

This page bundles all details to the audio vario-gauge.

Audio Vario : Enable/Disable the audio variometer.

Volume : Set the volume of the variometer sounds.

Enable Deadband : Enable/Disable the mute for audio output when the current lift is in a certain range around zero.

Min. Frequency* : The tone frequency that is played at maximum sink rate.

Zero Frequency* : The tone frequency that is played at zero climb rate.

Max. Frequency* : The tone frequency that is played at maximum climb rate.

Deadband min. lift* : If the deadband feature is enabled the vario will play sounds when the climb rate is below this threshold.

Deadband max. lift* : If the deadband feature is enabled the vario will play sounds when the climb rate is above this threshold.

12.17 Task Defaults / Task Rules

Task rules may be defined to limit valid starts according to competition rules.

Start max. speed* : Maximum speed allowed in start observation zone. Set to 0 for no limit.

Start max. speed margin* : Maximum speed above maximum start speed to tolerate. Set to 0 for no tolerance.

Start max. height* : Maximum height above ground while starting the task. Set to 0 for no limit.

Start max. height margin* : Maximum height above maximum start height to tolerate. Set to 0 for no tolerance.

Start height ref.* : Reference used for start max. height rule.
MSL: Reference is altitude above mean sea level.
AGL: Reference is the height above the start point.

Finish min. height* : Minimum height based on finish height reference (AGL or MSL) while finishing the task. Set to 0 for no limit.

Finish height ref.* : Reference used for finish min. height rule, correspondingly to the start rule height reference.

PEV start wait time* : The default interval in minutes between pilot presses the *Pilot Event* (see 4.10) button is pressed and start window opens. If set to 0, the start will open immediately after *Pilot Event* button is pressed.

PEV start window* : The default interval in minutes during which the start window remains open when *Pilot Event* (see 4.10) start procedure is used. If set to 0, the start window, once opened, remains open forever.

Contest : Determines the rules used to optimise for the selected contest paths.
OLC FAI: Conforms to FAI triangle rule. Three turns and common start and finish. For tasks longer than 500 km, no leg less than 25% or larger than 45%; otherwise no leg less than 28% of total. Finish height must not be lower than start height less 1000 m.
OLC Classic: Up to seven points including start and finish, finish height must not be lower than start height less 1000 m.
OLC League: A contest on top of the classic task optimisation, cutting a 2.5 hours segment over max. 3 of the turns. Finish height must not be below start height.
OLC Plus: A combination of Classic and FAI rules. 30% of the FAI score are added to the Classic score.
DMSt: Deutsche Meisterschaft im Streckensegelflug.
XContest:
DHV-XC:
SIS-AT:
FFVV NetCoupe: The FFVV NetCoupe '*libre*' competition.
WeGlide FREE: WeGlide combines multiple scoring systems in the WeGlide Free contest. The free score is a combination of the free distance score and the area bonus. For the area bonus, the scoring program determines the largest FAI triangle and the largest Out I& Return distance that can be fitted into the flight route.
WeGlide O&R: A start point, one turn point and a finish point are chosen from the flight path such that the distance between the start point and the turn point is maximized.

Predict Contest : If enabled, then the next task point is included in the score calculation, assuming that you will reach it.

12.18 Task Defaults / Turnpoint Types

This page allows to set default turnpoint types used by the task editor. All options are well described for the task manager in Chapter 5.

12.19 Look / Language, Input

This page allows to customise the way the user controls and interacts with XCSoar.

Events* : The Input Events file defines the menu system and how XCSoar responds to button presses and events from external devices.

Language : The language options selects translations for English texts to other languages. Select **English** for a native interface, **Automatic** to localise XCSoar according to the system settings; or you may select one of the two character language short cuts directly.

Status message* : The status message file can be used to define sounds to be played when certain events occur, and how long various status messages will appear on screen.

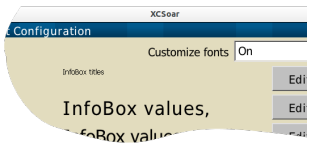
Menu timeout* : This determines how long menus will appear on screen if the user does not make any button presses or interacts with the computer.

Text Input Style* : Determines which style for text entries is used. See Section 3.8 for further information on textual input.
HighScore Style: For entering text you have to change the underlined character to the relevant letter.
Keyboard: Uses the on-screen keyboard for entering text.
Default: Uses the default input style for your platform.

Haptic feedback* : (Android devices only) Let you switch on or off the '*brrt*' when the device accepts your finger press as valid input on the touchscreen.

Press the Fonts button to adjust the fonts XCSoar uses.

Font Configuration



This page enables customisation of fonts in various fields of the program.

Once the customisation is enabled, the Edit buttons allow to change some parameters (font face, height, bold and italic) of the chosen font.

If customisation is disabled, default fonts will be used.

12.20 Look / Screen Layout

This page once more details the appearance of the graphical user interface of XCSoar.

InfoBox geometry : A list of possible InfoBox layouts. Do some trials to find the best for your screen size. The preceding number refer to the total number of InfoBoxes of this geometry.

FLARM display* : In case you enabled the FLARM display this is to configure the place on the screen, where the tiny radar window appears. As a default an 'Auto' setup is possible, which means that the radar window will overlay the InfoBoxes, and not the map part of the screen.

Tab dialogue style : Determines whether tabbed dialogues use text or icons.

Message display* : Defines the alignment of the status message box, either **Center** or in the **TopLeft** corner.

Dialogue size* : Determines the display size of dialogues.

Inverse InfoBoxes* : If **On**, the InfoBoxes are white on black, otherwise black on white.

Colour InfoBoxes* : If **On**, certain InfoBoxes will have coloured text. For example, the active waypoint InfoBox will turn blue when the glider is above final glide.

InfoBox border* : Two styles for InfoBox borders are available.
Box: Draws boxes around each InfoBox.
Tab: Draws a tab at the top of the InfoBox across the title.

Cursor size : Control the size of the cursor. Default is 1. Only available if cursor is drawn by XCSoar.

Black cursor : Use black instead of white cursor. Default is **Off** (white cursor). Only available if cursor is drawn by XCSoar.

12.21 Look / InfoBox Pages (or just Pages)

This page allows the definition of the screen page ensemble. A typical setup will contain three pages, the expert can pile up to eight possible pages.

A page is more or less a composition of map and InfoBox set. There are five predefined pages for circling, cruise, final glide, a map only page and a page with automatic InfoBox set activation depending on your flight mode.

Additionally you can choose from up to five more pages that are composed from map and your custom InfoBox sets.

Page 1..3 : Select what you feel is appropriate for you to appear on page 1,2,3 etc. Selecting "- - -" will make the page inactive.

Page 4..8* : Experts can configure up to eight pages in the already described manner.

12.22 Look / InfoBox Modes (or InfoBox Sets)

This page shows and let you customise the available InfoBox sets.

Circling, Cruise, ... : There are three predefined InfoBox sets (Circling, Cruise, Final Glide). Additionally you can define up to five more InfoBox sets and name them as you want. By default they are named AUX-1, AUX-2, and so on.
Selecting one of the sets starts a dialogue which provides all means to name and compose an InfoBox set up to your needs.

Use final glide mode : Controls whether the "final glide" InfoBox mode should be used on "auto" pages.

InfoBox Set Customisation

Name : Sets the name of the currently customized InfoBox set. The button starts the text input dialogue of XCSoar.

InfoBox : The number identifying the current box.

Content : Select the information you want to see in the current box.

The right side of the dialogue always gives the overview on the composed set. When composing at the PC you can use the mouse to select the individual boxes right from the overview.

See Section 11 for a description of the InfoBox types and their meanings.

To change a set press on one of the InfoBoxes labeled with it's current content. The InfoBoxes are numbered; the location of the InfoBoxes depends on the screen layout. The tables below show the InfoBox enumeration scheme for the landscape and portrait screen layout.

1	7
2	8
3	9
4	10
5	11
6	12

1	2	3	4
5	6	7	8

12.23 Setup / Logger

The internal software logger has adjustable time steps, separate for cruise and circling modes. Typically the circling time step is set to a

smaller value than cruise in order to give good quality flight logs for replay purposes.

Pilot name : This is the pilot name used in the internal software logger declaration.

Time step cruise* : This is the time interval between logged points when not circling.

Time step circling* : This is the time interval between logged points when circling.

Auto logger* : Enables the automatic starting and stopping of the logger on takeoff and landing respectively. Disable when flying paragliders to prevent the low ground speeds from triggering the automatic logger.

NMEA logger* : Enable the NMEA logger on startup? If this option is disabled, the NMEA logger can still be started manually.

Log book* : Logs each start and landing.

Logger ID : This is the logger registration.

12.24 Setup / Units

This page allows you to set the units preferences used in all displays, InfoBoxes, dialogues and input fields. For most users hopefully one of the presets will match the needs. The presets include unit sets for **American**, **Australian**, **British**, and **European**.

Separate selections are available for all items. Once you changed a given preset it will be referenced as 'Custom' set and will also be stored in your profile.

Aircraft/Wind speed* : Units used for airspeed and ground speed: mph, knots, km/h. A separate unit is available for task speeds.

Distance* : Units used for horizontal distances e.g. range to waypoint, distance to go: sm, nm, km.

Lift* : Units used for vertical speeds (variometer): knots, m/s, ft/min.

Altitude* : Units used for altitude and heights: ft, m.

Temperature* : Units used for temperature: °C, °F.

Task speed* : Units used for task speed: mph, knots, km/h.

Pressure* : Units used for pressures: hPa, mb, inHg.

Lat./Lon.* : Units, or better formats used for latitude and longitude. Supported are several 'degree/minutes/seconds' formats, respectively their decimal fraction, and the UTM WGS 84 format.

12.25 Setup / Time

Set the local time offset with respect to UTC.

UTC offset : The field allows the UTC local time offset to be specified.

Local time : The local time is displayed below in order to make it easier to verify the correct offset has been entered. Offsets to the half-hour may be set.

Use GPS time* : This option, if enabled sets the clock of the computer to the GPS time once a fix is set. This is only necessary if your computer does not have a real-time clock with battery backup or your computer frequently runs out of battery power or otherwise loses time.

12.26 Setup / Tracking

'*Live*'-Tracking means using a GPS to determine your position and a mobile network to send this position in real-time to a server, other people can see your exact position and track presented in a map just in time. The tracking option needs the capability to connect to mobile networking as offered by your glide computer.

Currently there are two tracking protocols implemented. '*SkyLines*' as a spin off project from XCSoar itself; for details on this service have a look at http://skylines.xcsoar.org. And also the '*LiveTrack24*' protocol used e.g. by the tracking portal on http://www.livetrack24.com. Please consult the web pages of the service provider listed under 'Server' for details on this setup.

SkyLines : Switch this **On** to enable the live stream of your position to '*SkyLines*'.

Tracking Interval : The time interval for which one position is sent to the tracking service. '*SkyLines*' implements a very lean protocol, so that even a 30 sec. interval does not exhaust a plain GPRS connection (ca. 12 kbit/sec).

Key : Create a key on the page http://skylines.xcsoar.org/tracking/info and enter it here, to identify your positions at the tracking service.

LiveTrack24 : Switch this **On** to enable the live stream of your position to '*LiveTrack24*'.

Tracking Interval : The time interval for which one position is sent to the tracking service.

Vehicle Type : Type of vehicle used.

Server : The service's web address to stream your position to. There is currently a choice of some predefined.

Username : If you created an account you can enter those credentials here. Otherwise the track will be logged as '*guest*' and thus be anonymous.

Password : The password to your tracking account.

12.27 Configure Plane

Config 2/3 ▷ Plane

This dialogue allows the glide polar to be defined. For a large variety of glider types XCSoar provides a predefined glide polar, they could be modified if needed, or you can load your own polar from a file. The file format is based on the WinPilot polar file format (see Section 13.6).

To configure the glide computer to the performance of a glider type start with the selection of a type from the List . Choose Import when you want to load an external polar file. Customise the three V/W points defining the parabola curve and the reference weight to your needs. Be aware that namely those four items are of crucial importance for every glide performance relevant computation of XCSoar. Export your efforts to a file: always a good idea.

Polar V/W : Three pairs of corresponding horizontal and vertical speed of the glider. A good choice for the point triplet is one at the top most area of the polar, the second at a still very curved area and the third far out where the curvature seems to disappear.

Reference mass : Reference weight at which the given polar is valid.

Dry mass : The complete weight of the rigged glider including the pilots weight except the loaded water ballast. In the absence of a configurable pilot weight XCSoar expects you to include your own weight to the dry mass.

Wing area : Optional specification of the wing area of the glider type.

V rough air : Optionally the maximum manoeuvring speed can be entered on this page to prevent the glide computer from commanding unrealistic cruise speeds.

Handicap : The handicap factor used for the On-Line Contest scoring.

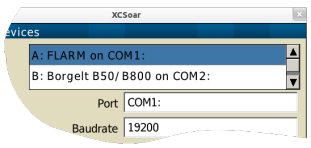
Max. ballast : Optional the amount of water ballast XCSoar refers to as 100% ballast. Set to zero if it does not apply.

Dump time : The time in seconds needed for dumping full ballast.

12.28 Configure Devices

Config 2/3 ▷ Devices

The Devices page is used to specify the ports used to communicate with the GPS and other serial devices. The default settings are COM1 and 4800 bits per second. When connected to the Vega intelligent variometer, the settings should be COM1 and 38400.



Four devices can be configured (device A through D). One, for example, can be connected to a GPS and another to a second device such as a variometer. If there is no further device, set the unused ports to 'Disabled'. XCSoar will then ignore those ports.

COM ports 0 to 10 may be used, including a TCP/IP connection. Which COM port is appropriate for you depends on what brand of PDA you use, and the communications medium (serial cable, Bluetooth, virtual COM port, SD card or CF based GPS, internal GPS). Detailing the various options for different devices is beyond the scope of this document. If you have trouble identifying which COM port to set, please refer to the XCSoar website and mailing lists.

Port : This setting maps an existing interface (port) of your glide computer to one of the available slots A to D.

Baudrate : Set this to the communication speed of the connected device.

TCP Port : This setting is useful to e.g. connect to the Condor flight simulator and do some XCSoar training in winter time.

Bulk baud rate : The baud rate used for bulk transfers, such as task declaration or flight download. The item is visible for those devices that support the feature.

Driver : The specific type of device can be selected from a list in order to enable support for devices with proprietary protocols or special functions.

Sync. from device* : This option lets you configure if XCSoar should use settings like the MacCready value, bugs and ballast from the device.

Sync. to device* : This option lets you configure if XCSoar should send settings like the MacCready value, bugs and ballast to the device.

Ignore checksum* : If your GPS device outputs invalid NMEA checksums, this will allow it's data to be used anyway.

13 Data Files

Data files used by XCSoar fall into two categories:

Flight data files : These files contain data relating to the aircraft type, airspace and maps, waypoints etc. These are the files that are most likely to be modified or set by normal users.

Program data files : These files contain data relating to the 'look and feel' of the program, button assignments, input events.

This chapter focuses on flight data files; see the *XCSoar Advanced Configuration Guide* for details on program data files.

13.1 File management

File names must correspond to the name extensions specified below. It is good practice to make sure that the file names are recognisable so that when making configuration changes there is less risk of confusion between different files and different file types.

Regarding older Pocket PC devices it is a good idea to have data files located in nonvolatile memory, the use of SD cards and other removable media in PDAs can cause performance issues; for smaller files, and files that are only accessed at start-up (waypoints, airspace, glide polars, configuration files), this is acceptable. However, terrain and topography files are accessed continuously while XCSoar is running, so these should be located in faster storage memory. For newer Windows Mobile or Android devices this is not an issue any more. The access to modern memory cards usually meets the required performance.

Many PDAs provide a 'file store' which is nonvolatile; the same arguments above apply regarding their use and performance.

All data files should be copied into the directory:

`My Documents/XCSoarData`

On PDAs data can also be stored on the operating system file store, on Compact Flash cards or SD cards under the directory `XCSoarData`.

For example:

```
SD Card/XCSoarData
IPAQ File Store/XCSoarData
```

If unsure, just start the newly installed XCSoar and it creates the `XCSoarData` directory at the right place.

13.2 Map Database

A map database (extension `.xcm`) contains terrain, topography and optional contents like waypoints and airspaces.

Terrain is a raster digital elevation model represented as an array of elevations in meters on a latitude/longitude grid. The internal file format is GeoJPEG2000.

The topography is vector data such as roads, railway lines, large built-up areas (cities), miscellaneous populated areas (towns and villages), lakes and rivers. The topography is stored in ESRI Shape files which are generated from OpenStreetMap.

Map files can be downloaded from the XCSoar web site:

http://www.xcsoar.org/download/maps/

To generate a custom map database with different settings and bounds, you may use the map generator:

http://mapgen.xcsoar.org/

As far as waypoints or airspaces are included in the map database XCSoar defaults to them. An e.g. separately configured waypoint file will replace all the waypoints given by the map database.

13.3 Waypoints

XCSoar understands the following waypoint file formats:

- WinPilot/Cambridge (`.dat`)
- SeeYou (`.cup`)
- Zander (`.wpz`)
- OziExplorer (`.wpt`)
- GPSDump/FS, GEO and UTM (`.wpt`)

Files are available from the Soaring Turn-points section of the Soaring Server[1]: http://soaringweb.org/TP

Several commercial and freely distributable programs exist for converting between different waypoint formats.

Elevation field of a waypoint shouldn't be empty. If so, import of such a waypoint is skipped. But if the elevation of any waypoints is set to zero in the waypoint file, then XCSoar estimates the waypoint elevation from the terrain database if available.

[1] Mirrors to this website exist, google search for "worldwide soaring turnpoint exchange" if the main server is inaccessible.

13.4 Airspace

XCSoar supports airspace files (extension `.txt`) using a sub set of the widely distributed OpenAir format, as well as the Tim Newport-Pearce file format (extension `.sua`). Files are available from the Special Use Airspace section of the soaring web site:

http://soaringweb.org/Airspace

The following is the list of supported airspace types: Class A-G, Prohibited, Danger Areas, Restricted, Task Area, CTR, No Gliders, Wave, Transponder Mandatory, and Other. All other airspace types will be drawn as type "Other". In addition to the OpenAir standard the AR command is recognized as the airspace radio frequency.

13.5 Airfield details

The airfield details file (extension `.txt`) is a simple text format file containing entries for each airfield, marked in square brackets, followed by the text to be displayed on the Waypoint Details Dialogue for that particular waypoint. The text should have a narrow margin because the waypoint details dialogue cannot currently handle word wrapping.

The text may also specify images for airfields or waypoints. To show an image directly in XCSoar use `image=` followed by the file name (this is currently not supported on PC/Windows). Be sure to avoid any additional whitespaces around the equal sign or in front of the keyword. Which files are supported depends on your operating system and the applications that are installed. Android supports JPEG files and other file types, others mostly BMP images.

The names of airfields used in the file must correspond exactly to the names in the waypoints file, with the exception that converting to uppercase is allowed.

The XCSoar website provides airfield details files for several countries and includes tools to convert from various Enroute Supplement sources to this file format.

Users are free to edit these files to add their own notes for airfields that may not otherwise be included in the Enroute Supplement sources.

An example (extract from the Australian airfields file):

```
[BENALLA]
RUNWAYS:
  08 (RL1,7) 17 (RL53) 26
  (R) 35 (R)

COMMUNICATIONS:
  CTAF - 122.5 REMARKS: Nstd
  10 NM rad to 5000'
```

```
REMARKS:
  CAUTION - Animal haz. Rwy
  08L-26R and 17L-35R for
  glider ops and tailskidacft
  only, SR-SS. TFC PAT - Rgt
  circuits Rwy 08R-26L. NS
  ABTMT - Rwy 17R-35L fly wide

ICAO: YBLA

image=Benalla_sat.bmp

[GROOTE EYLANDT]
Blah blah blah blah
...
```

13.6 Glide polar

Many polars of common gliders are built into XCSoar. If your glider model is not listed, you can use a polar file in the WinPilot polar format (extension `.plr`).

The WinPilot and XCSoar websites provide several glide polar files. Files for other gliders may be created upon request to the XCSoar team.

The format of the file is simple. Lines beginning with * are ignored and so may be used to document how the polar was calculated or if there are restrictions on its use. Other than comments, the file must contain a single row of numbers separated with commas:

- Mass dry gross weight in kg: this is the weight of the glider plus a 'standard' pilot without ballast.
- Max water ballast in liters (kg).
- Speed in km/h for first measurement point, (usually minimum sink speed).
- Sink rate in m/s for first measurement point.
- Speed in km/h for second measurement point, (usually best glide speed).
- Sink rate in m/s for second measurement point.
- Speed in km/h for third measurement point, (usually max manoeuvring speed).
- Sink rate in m/s for third measurement point.

The following is an extension to the existing polar file format and thus optional.

- The wing area in m^2 to allow the wing load computation (could be zero if unknown).
- The max. manoeuvring speed in km/h to enable simple checks for the cruise speed command.

An example, for the LS-3 glider, is given below:

```
*LS-3 WinPilot POLAR file: MassDryGross[kg],
*  MaxWaterBallast[liters], Speed1[km/h], Sink1[m/s],
*  Speed2, Sink2, Speed3, Sink3
373,121,74.1,-0.65,102.0,-0.67,167.0,-1.85
```

Don't be too optimistic when entering your polar data. It is all too easy to set your LD too high and you will rapidly see yourself undershooting on final glide.

13.7 Profiles

Profile files (extension `.prf`) can be used to store configuration settings used by XCSoar. The format is a simple text file containing `<label>=<value>` pairs. Certain values are text strings delimited by double quotes, for example:

```
PilotName="Baron Richtoffen"
```

All other values are numeric, including ones that represent boolean values (true= 1, false= 0), for example:

```
StartDistance=1000
```

All values that have physical dimensions are expressed in SI units (meters, meters/second, seconds etc).

When a profile file is saved, it contains all configuration settings. Profile files may be edited with a text editor to produce a smaller set of configuration settings that can be given to other pilots to load.

When a profile file is loaded, only the settings present in that file overwrite the configuration settings in XCSoar; all other settings are unaffected.

The default profile file is generated automatically when configuration settings are changed or when the program exits; this has the file name `default.prf`.

The easiest way to create a new profile is to copy a previous one, such as the default profile. Copy the file, give it a logical name, and then when XCSoar starts next time the new profile can be selected and customised through the configuration settings dialogues.

13.8 Checklist

The checklist file (`xcsoar-checklist.txt`) uses a similar format to the airfield details file. Each page in the checklist is preceded by the

name of the list in square brackets. Multiple pages can be defined (up to 20).

An example (extract):

```
[Preflight]
Controls
Harness, secure objects
Airbrakes and flaps
Outside
Trim and ballast
Instruments
Canopy

[Derigging]
Remove tape from wings and tail
...
```

13.9 Tasks

Task files (extension `.tsk`) are stored in XCSoar's own XML format, whereas SeeYou tasks can also be loaded from file (extension `.cup`).

13.10 Flight logs

The software flight logger generates IGC files (extension `.igc`) according to the long naming convention described in the FAI document *Technical Specification for IGC-Approved GNSS Flight Recorders*.

Log-files are stored in the 'logs' subdirectory of the XCSoarData directory. These files can be imported into other programs for analysis after flight.

13.11 FLARM Identification

The FLARM identification file `xcsoar-flarm.txt` defines a table of aircraft registrations or pilot names against the ICAO IDs that are optionally broadcast by FLARM equipped aircraft. These names are displayed on the map next to FLARM traffic symbols, for matching ICAO IDs.

The format of this file is a list of entries, one for each aircraft, of the form *icao id=name*, where *icao id* is the six-digit hex value of the ICAO aircraft ID, and *name* is free text (limited to 20 characters), describing the aircraft and/or pilot name. Short names are preferred in order to reduce clutter on the map display.

Example:

```
DD8F12=WUS
DA8B06=Chuck Yeager
```

Currently this file is limited to a maximum of 200 entries.

Additionally the FlarmNet file `data.fln` is supported. It contains all the FLARM identifications distributed by the FlarmNet community. The file can be downloaded from the web site:

http://www.flarmnet.org

The file must reside in the XCSoarData directory.

13.12 Input events

The input event file (extension `.xci`) is a plain text file designed to control the input and events in your glide computer.

You do not require access to the source code or understanding of programming to write your own input event files but you do require some advanced understanding of XCSoar and of gliding.

Some reasons why you might like to use xci:

- Modify the layout of button labels
- Support a new set or layout of buttons (organiser hardware buttons)
- Support an external device such as a Bluetooth keyboard or gamepad
- Customise any button/key event
- Do multiple events from one key or glide computer triggered process

For more information on editing or writing your own input event file the *XCSoar Developer Manual* is a good starting point.

13.13 Status

Status files are text of the form *label=value*, arranged in blocks of text where each block corresponds to an individual status message. These are delimited by double spaces. Each block can contain the following fields:

key : This is the text of the status message.

sound : Location of a WAV audio file to play when the status message appears. This is optional.

delay : Duration in milliseconds the status message is to be displayed. This is optional.

hide : A boolean (yes/no) that dictates whether the message is to be hidden (that is, not displayed).

Example:

```
key=Simulation\r\nNothing is real!
sound=\My Documents\XCSoarData\Start_Real.wav
delay=1500

key=Task started
delay=1500
hide=yes
```

14 History and Development

14.1 Product history

XCSoar started as a commercial product developed by Mike Roberts (UK), where it enjoyed a successful share of the market for several years and going though several releases, the last being **Version 2**. Personal reasons prevented him from being able to continue supporting the product and so in late 2004 he announced the licensing of the source code to the GNU public license, as XCSoar **Version 3**. A support website on Yahoo Groups was set up and the open source project started to gain interest and input by developers.

In March 2005 the program was substantially enhanced and this resulted in **Version 4.0** being released. By this time, coordination of the various development efforts on the source code became difficult and time-consuming, so it was decided to move the project to SourceForge, whereby all the software work could be managed by a concurrent version management system.

In July 2005, **Version 4.2** was released which addressed some compatibility issues that were experienced with certain PDA and GPS hardware configurations.

In September 2005, **Version 4.5** was released. This contained major enhancements to the user interface including the introduction of the 'input event' system and language translation files.

In April 2006, **Version 4.7** was released to Altair customers. This contained stability and performance enhancements as well as many bug fixes; and a new method for handling dialogues based on XML files.

In September 2006, **Version 5.0** was released on all platforms, Altair, PC, PDA. This version contains many improvements and new features and is based on extensive testing in flight and in simulation.

In September 2007, **Version 5.1.2** was released on all platforms, Altair, PC, PDA. This version contains many improvements and new features and is based on extensive testing in flight and in simulation. Major improvements include a new map file format incorporating JPG2000 compression, online contest support, additional supported devices, FLARM radar screen, and overall improved stability, reliability and accuracy of task calculations. Many feature requests from users have been incorporated into this release.

In February 2008, **Version 5.1.6** was released. This contained numerous bugfixes and user interface enhancements, notably expanding the RASP and AAT functionality.

In March 2009, **Version 5.2.2** was released. As well as user interface improvements, several major features were introduced: IGC files were digitally signed for validation in online contests such as OLC. Windows CE-based PNA navigation devices were supported for the first time. FLARM was integrated with the map display with support for the FlarmNet ID database. Developers could now easily compile XCSoar from Linux desktop computers.

In August 2009, **Version 5.2.4** was released with internal fixes and enhancements.

In December 2010, **Version 6.0** was released. Following an extensive rewrite of much of the program, many stability and performance enhancements were made and startup times were dramatically reduced. A great many features were added including a vastly expanded task engine and editor, AAT support, new FLARM and thermal-assistant displays. Many new languages were introduced, and new translations could now be easily generated by users.

Significantly, the rewrite allowed XCSoar to run on UNIX-like systems and Android devices, and the use of modern compiling tools enhanced the performance of the program on the current generation of devices.

In March 2011, **Version 6.0.7b** was released, the first release to officially support Android.

Early 2013: With **Version 6.4.5.** first results of a German and French manual translation got published on the XCSoarhome page.

February 2012: XCSoar**is world champion** in Argentina! Tobias did a interview with Santi on IRC (the modern way), read on here: http://www.xcsoar.org/discover/2013/02/05/WGC_Argentina.html.

April 2013: **Version 6.6** was released. Six years after starting the version 6 rework of the XCSoarengine the final outcome becomes visible on user interface level. A remarkable pile of usability convenience condensed the XCSoarvalue, including the cross section map view.

May 2013: The Android XCSoarinstallation counter for the stable release crossed the 30,000 mark.

14.2 Get involved

The success of the project is the result of many kinds of contributions. You do not have to be a software developer to help.

In general, there are perhaps five major ways of contributing, other than working on the software itself:

Give feedback : Ideas, suggestions, bug reports, encouragement and constructive criticism are all very welcome and helpful.

Setup suggestions : Because XCSoar is so configurable, we rely to some extent on users to think about how they would like the program to be set up. Selection of infobox layouts, button menus and button assignments require some design thought, and making these available to the developers and other users will help us provide good default settings.

Data integrity : Airspace and waypoint files need to be kept up to date, and it often takes people with local knowledge to do this.

Promotion : The more users the software has, the better the product will be. As more people use the software and give feedback, bugs are found more easily and improvements can occur at a greater pace. You can help here, for example, by showing the software to others and by conducting demonstration and training sessions in your club.

Documentation : Naturally, the manual is always outdated, and we need help with maintaining it.

14.3 Open source philosophy

There are several benefits to having software like XCSoar open source.

- Firstly, it is free so pilots can try out the software at no cost and decide if it is suitable for their needs; and pilots are free to copy the program onto whatever Pocket PC device, PC or EFIS they like without charge.
- You have access to the source code so you are free to change the software or use pieces of it in new free programs.
- Having the source code available on the Internet means that it is subject to wide scrutiny and therefore bugs are easily and quickly fixed.
- A large group of developers are available to help in troubleshooting and quickly implement new features upon request.
- Open source software under the GNU public license cannot at a later date be made closed-source; so by using this software you will not be locked in to unspecified software costs in the future.

The full terms of the licensing agreement for XCSoar is given in Appendix A.

The development of XCSoar since its open source release has been entirely a volunteer effort. This does not preclude individual developers or organisations from offering commercial support services. The spirit of the project however suggests that in such cases the commercial

services are encouraged to produce some flow-on benefit back to the wider community of users.

14.4 Development process

We try to incorporate new features as quickly as possible. This has to be balanced by the needs to not change substantially the interface without appropriate warnings so users that upgrade do not get a shock. This means that when we introduced the new button menu system in version 4.5, it was necessary to also distribute a file that allowed users to have the buttons assigned to their 'legacy' function.

XCSoar, being used in flight, is a special kind of software because it can be regarded as 'mission-critical', and is a real-time system. This has placed a very high emphasis on developers to perform a great deal of testing before releasing changes to the public.

Flight testing is certainly the best sort of test, but we have also been able to conduct the bulk of testing by using XCSoar in a car, and more recently, by replaying IGC flight logs.

In general, we don't want the program to crash or hang, ever, and if it does so during testing, then whatever bug caused the problem has to be fixed as top priority.

The software developers all keep in contact with each other through the SourceForge developer's mailing list

`xcsoar-devel@lists.sourceforge.net`

We try to coordinate our activities to avoid conflict and duplicated effort, and to work together as a team. If you would like to get involved in the software development, send the developers an email.

14.5 User base

Who is using XCSoar? Good question, and hard to answer. Since no-one pays for the product — most people download the program anonymously — it is hard for anyone to keep track of how many users are out there.

Statistics from the main website indicate there has been an average of approximately twenty downloads per day between June 2005 and June 2006, and eighty downloads per day between June 2006 and September 2007. Looking at how many people download the terrain and topography data packs from the website indicates that it is used in many countries and in nearly every continent.

XCSoar is used by a wide cross section of pilots, including early post-solo through to experienced competition pilots. There are many 'arm-chair' pilots who use XCSoar with gliding simulators, such as Condor.

14.6 Credits

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