Updraft 1.0

User manual

Content

1 Introduction

Updraft 1.0 is a students' software project, developed at the Faculty of Mathematics and Physics at the Charles University in Prague.
The main aim of the project is to create a user-friendly open-source desktop application for glider flight planning and visualization.

The web pages of the project are http://updraft.github.com .
Repository with the program source code is at https://github.com/updraft/updraft .

The application is focused on smart flight visualizations, displayed over free yet quality map sources. Everything can be displayed in one map window at once, but there are panels belonging to each opened file and at a single moment there is only one “active file”.

2 System requirements

Updraft is designed as a multi-platform application. It runs on Windows, Mac and potentially also on Linux.

For correct application functionality on Windows, it requires Windows 7, Windows Vista, or Windows XP with all available service packs. Graphics is rendered with the OpenGL library, so it is necessary to have proper OpenGL drivers installed.

On Mac, following OS X versions are supported: Leopard (10.5), Snow Leopard (10.6) and Lion (10.7).

The Linux operating system is not actively supported by our program. However it is possible to run Updraft on Linux without any limitations. As it is not our target platform, it is intended mainly for Linux enthusiasts who are able to compile applications themselves.

3 Installation

Program installation is platform-dependent.

3.1 Windows

A simple wizard will guide you through the installation. You can read the license and change the folder, where the application will be installed.

3.2 Mac

For OS X, a compressed disk image (dmg) with an application bundle is prepared. To install the application, open the disk image and drag-and-drop the Updraft bundle to destination directory (for example Applications folder).

3.3 Linux

As was mentioned in the previous chapter, Linux is not primary target platform of our application. There is no installer. However, if all dependencies are met, it is fairly easy to compile the application on Linux using CMake. The source code can be downloaded from our

repository[1].

4 Application Window

After the applications starts, the main application window appears.

It consists of four logical parts:

- **Application menu:** Provides basic high-level functions for file opening/saving, accessing application settings, view manipulation, and opening application help (this manual).
- **Map view:** Main part of the application window. The view contains a map and its overlaying layers.
- **Left pane:** Contains tree view with map layers. Allows the user to show or hide them. The left pane can be resized or completely hidden by dragging it's right border (horizontal splitter).
- **Bottom pane:** This pane adds the multiple document interface to the application. It contains several tabs, each tab corresponding to an opened file. The bottom pane can be resized or hidden in the same way as the left pane using the vertical splitter.

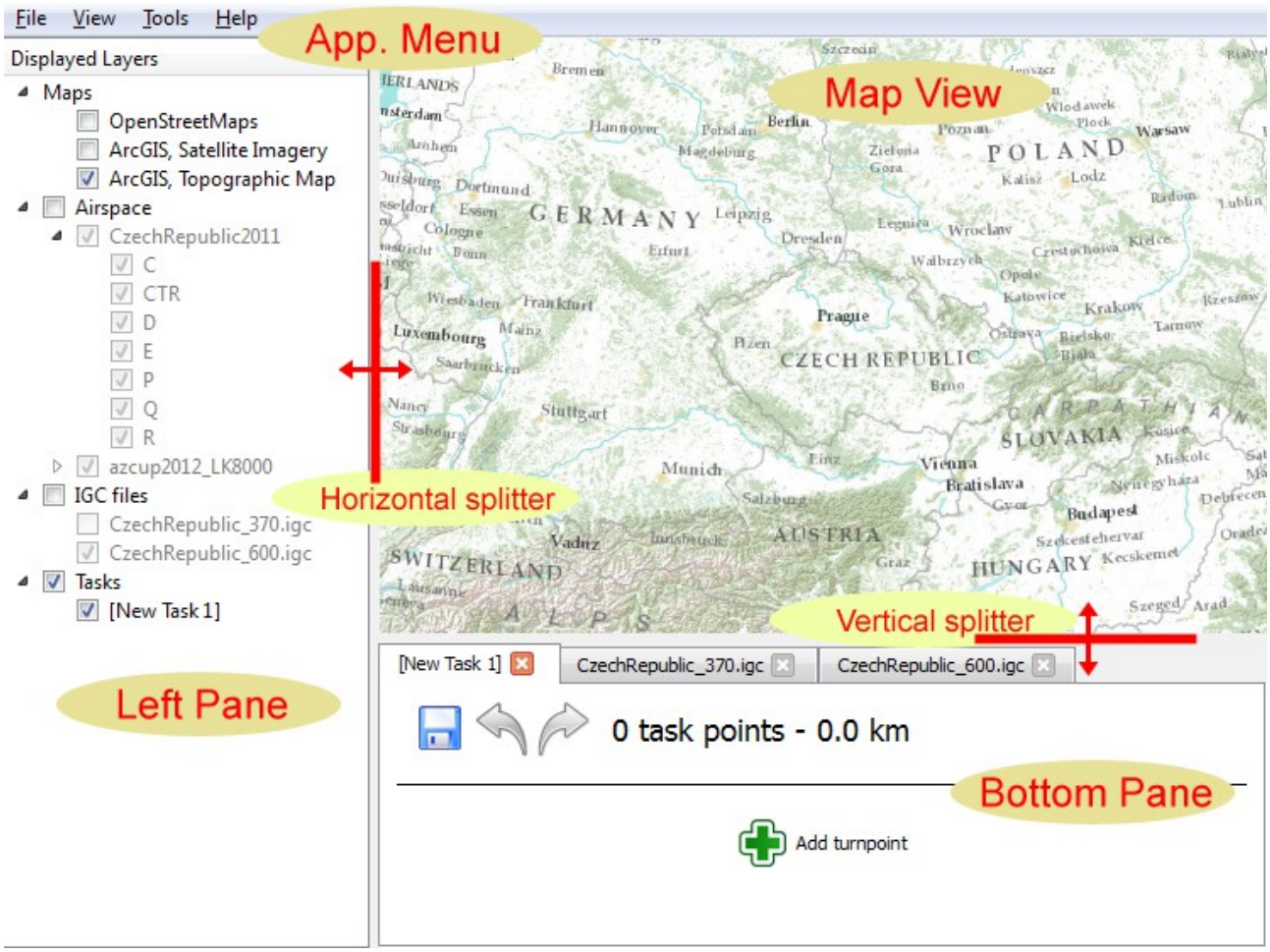

Figure 1: Application Window layout

1 Link to git repository web front-end: https://github.com/updraft/updraft

5 Map view[2]

5.1 Visualization

The map is rendered as a 3D textured globe. Any place on the globe can be visualized in detail by zooming to it.

Besides the map itself, the map view can display another layers – all of them are rendered at once (turn-points, flight trajectory, airspace divisions, …).

Which layers are currently displayed can be controlled by the check boxes in the left pane. On the first start of the application, only the Maps layer is present.

User can choose from the following maps:

- **OpenStreetMaps:** This is the default map. It is very useful for its simplicity, and level of detail in high zoom level. However, on the big zoom only the most important data is drawn, so the map remains readable even with complicated overlaying layers.

- **ArcGIS Topographic Map:** In contrast to OpenStreetMaps, this map contains topography information. The map is also quite clean and suitable for displaying overlays, so it provides an alternative to OpenStreetMaps.

- **ArcGIS Satellite Imagery:** This is not a map, but a set of photos rendered on the ground. It is intended especially for 3D visualization of the recorded flight. The impression of flying in mountains is amplified by rendering of terrain elevation.

- **Offline map:** Low resolution satellite map, that is available even without internet connection and without caches.

2 Map rendering and manipulation is performed by osgEarth toolkit. For more information about osgEarth visit http://osgearth.org

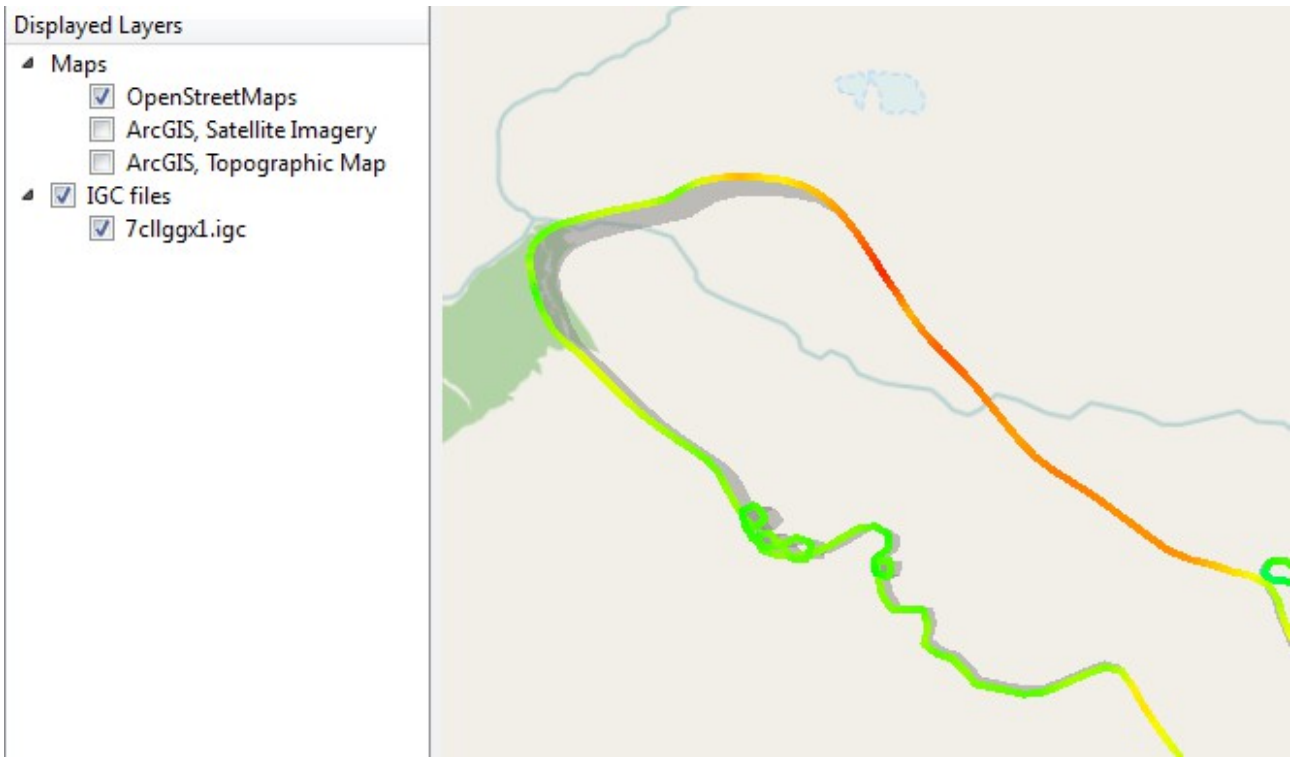

Figure 2: Flight trajectory drawn on OpenStreetMaps

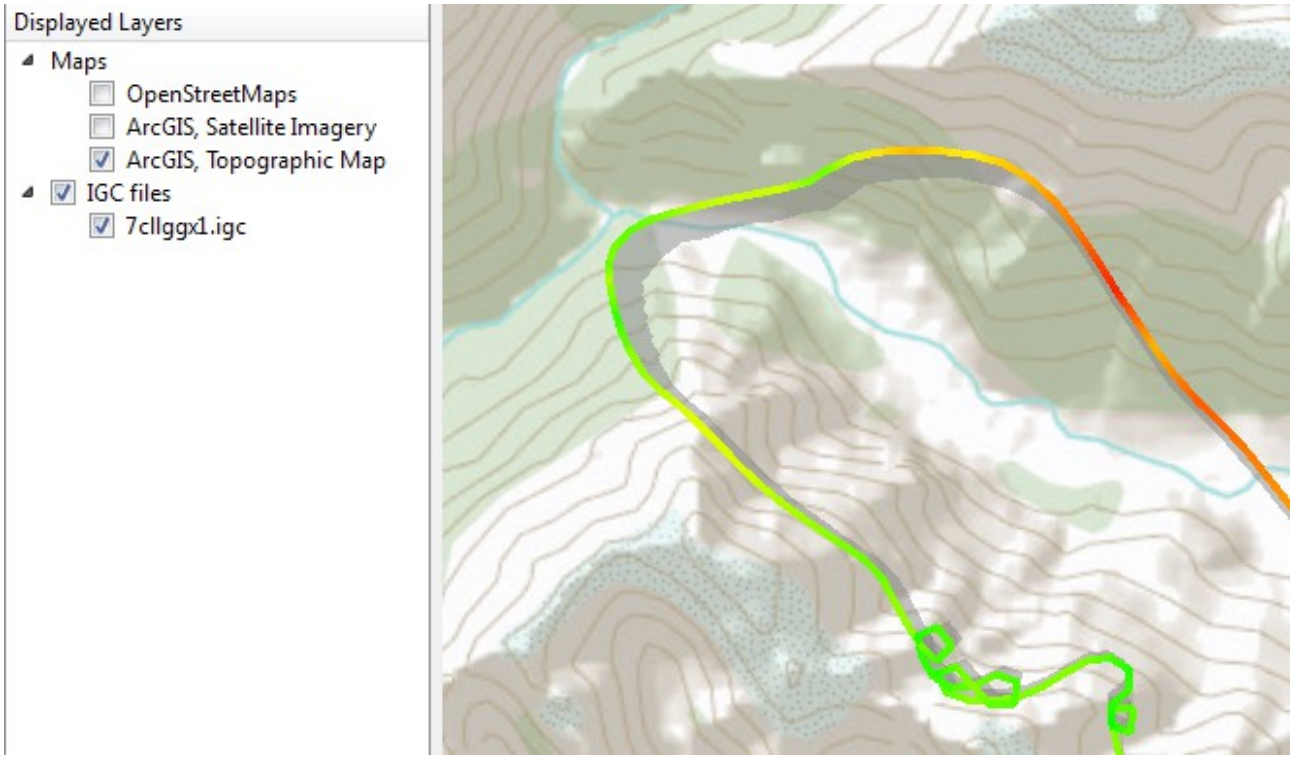

Figure 3: Flight trajectory drawn on ArcGIS Topographic Map

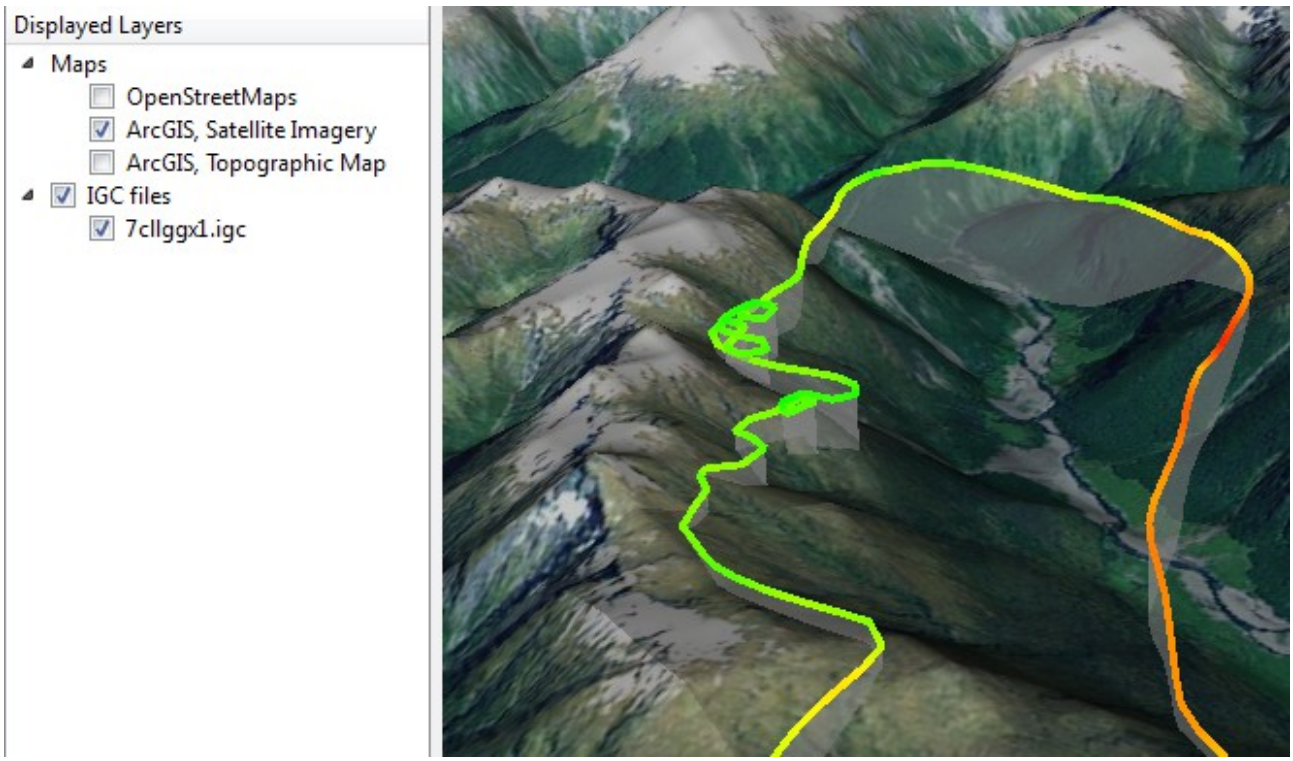

Figure 4: Flight trajectory drawn on ArcGIS Satellite Imagery with terrain elevation

5.2 Camera manipulation

The camera can be rotated and moved in order to change the point of view.

In our application there are several ways to manipulate the camera. The user can perform the following interactions:

Interaction	Basic control	Alternative controls
Pan	Drag map with pressed left mouse button	Arrow keys
Continuous Pan	Press left+right buttons and drag mouse	
Zoom	Scroll mouse wheel	Shift+up/down arrow keys A,Z keys
Continuous Zoom	Press middle mouse button and drag mouse up/down	
Zoom to/from target	Double left click to zoom in Double right click to zoom out	
Rotate	Press right button and move mouse left/right	Shift+mouse wheel Ctrl[3]+left/right arrow keys
Tilt	Press right button and move mouse up/down	Ctrl[3]+mouse wheel Ctrl[3]+up/down arrow keys

3 On Mac computers, the Command key is used instead of Ctrl.

Go to home position	Space-bar	

One-button mouse alternatives[4]:

Ctrl[3] + left button is an alternative to the right button.

Alt + left button is an alternative to the middle button.

Shift + left button is an alternative to pressing both buttons at once.

For your convenience, you can easily revert to the standard camera position. By selecting "Restore 2D View" in the View menu, you get back to 2D (nadir) position. You can also align the view to the north by selecting "Rotate to north" in View menu.

A useful feature is also the so-called "Home position". The camera view can be restored by pressing the space-bar. To change the home position, manipulate the camera to the desired position and select the "Set home position" action from the "View" menu.

5.3 Maps downloading

If you are connected to the Internet, maps are downloaded automatically as you move around the globe. When you disconnect from the network, maps are loaded from the cache, which was created (during downloading) in the Updraft data directory.

If you never were connected to the Internet, you can display only very rough offline map included in the installation.

6 Application components

Apart from map viewing, our application contains several plug-ins that serve for task planning and flight analyses.

There are four plug-ins:

- Airspace visualization
- Turn-points visualization
- Task declaration
- Igc analysis

All plug-ins are loaded automatically during the application start-up.

7 Airspace database

This plug-in provides visualization of airspace divisions. It is useful especially for flight planning when the pilot wants to avoid prohibited areas.

7.1 Importing files

Airspace data is loaded from external files. OpenAir file format is supported.

4 This is intended for one-button mice which are common for Macs.

To get new airspace files, see chapter Airspace and turn-point sources.

To import a new file into the application, select Open from the application menu.

When the Open dialog appears, select a file with airspaces and click Open. OpenAir file format has extension ".txt".

When you click Open, the file is imported into the application. It means that the selected file is copied into the Data directory.

All airspace files stored in the Data directory are automatically loaded during the start-up of the application. Loaded files are listed in the left pane in the Airspace group.

7.2 Removing files

To remove the airspace file, press the right mouse button on the associated item in the left pane and choose Delete.

7.3 Visualization

The airspaces are represented as 3D geometric primitives. They are defined by their shape, consisting of lines and arches, and have a starting and ending height.

In the map window, they are displayed with semi-transparent side faces. Used color is specified in the airspace file. When the 2D view is active, only the line boundaries are visible.

7.4 Hiding airspaces

Each loaded airspace file has an associated item in the left pane and also sub-items for every contained airspace class. Naming of the items depends on naming used in the file. Each particular class can be individually displayed/hidden by pressing the check-box beside its label in the tree. You can also show/hide the whole file or even all airspace files by pressing check-boxes next to the appropriate labels.

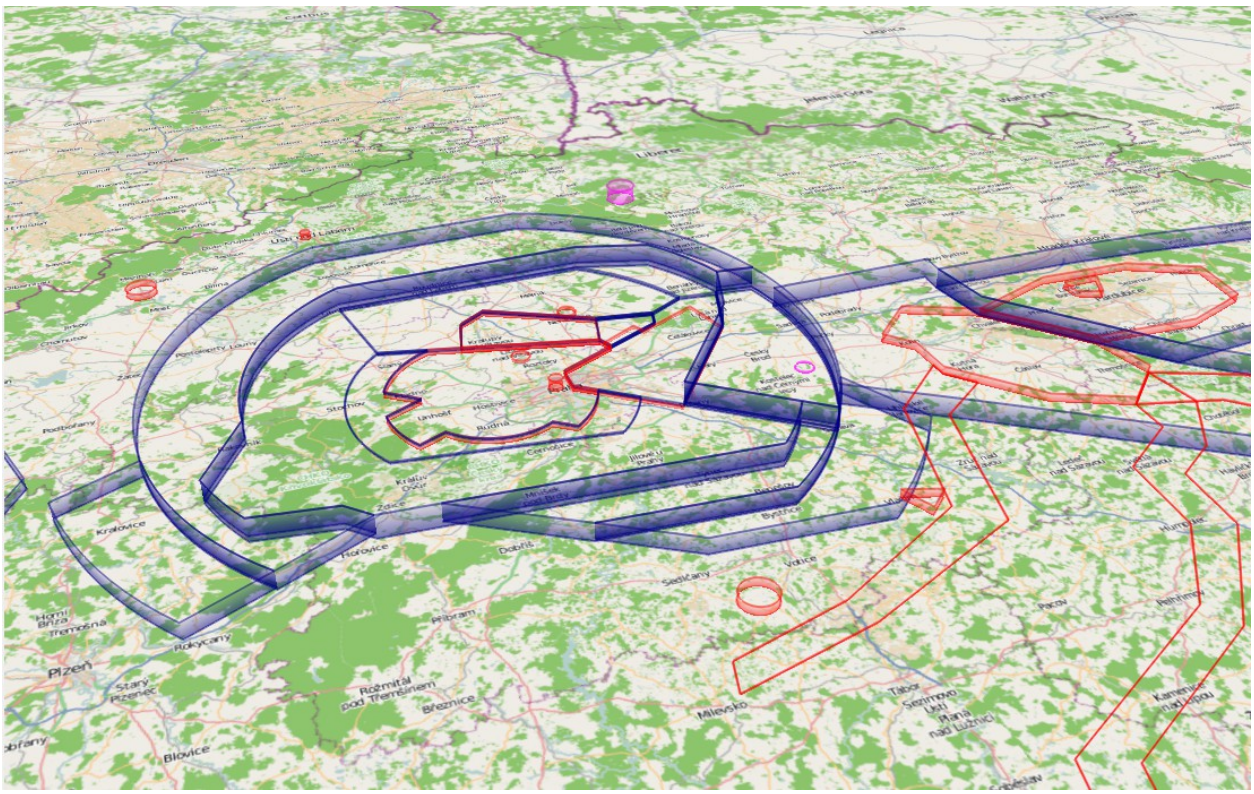

Figure 5: Airspace division visualization. (Prague, Caslav and Pardubice (M)CTRs, (M)TMAs)

8 Turn-points database

If the pilot declares a task in his on-board device, he chooses a few turn-points from a file stored in this device.

These files are usually published by some authority in the region, by the jury of a competition or e.g. by some enthusiast in the air club.

Updraft application gives you the opportunity to use such files for planning tasks on the PC.

8.1 Importing files

You can import pre-declared turn-point sets and display them in the map.

To get new turn-points files see chapter Airspace and turn-points sources.

SeeYou *.cup files are supported.

To import a new file into the application, select Open from the application menu.

When the Open dialog appears, select a *.cup file with turn-points and click Open.

When you click Open, the selected file is imported into the application. It means that the selected file is copied into the Data directory.

All turn-point files stored in the Data directory are automatically loaded during the application start-up. Loaded files are listed in the left pane in the Turn-points group.

8.2 Removing files

To remove a turn-point file, press the right mouse button on the associated item in the left pane and choose Delete from the context menu.

8.3 Visualization

Turn-point can be either an airfield or a general turn-point. The turn-point's type is read from the turn-point file. If it is an airfield, it has a defined runway direction.

A general turn-point is visualized as a blue disk on the ground, whereas an airfield is displayed as a blue circle, crossed by a thick line in the direction of the runway.

Depending on the camera distance, labels with turn-point names are displayed.

Figure 6: Turn-point visualization. Airfields have icon with runway direction.

9 Task Declaration

This module helps the user declare a task. The task consists of a few points which the pilot should reach during his flight. Declaring a goal in advance and trying to reach it is the basis of the glider cross-country flying. There are many circumstances, which must be considered in flight planning.

Namely weather conditions, active airspaces (e.g. military), pilot experience, glider performance, etc. According to these circumstances, the pilot declares a task. Basic parameters of the task are distance and shape. It is easier to achieve a goal when you fly from the home airfield to a near turn-point four times back and forth than a situation when you fly a triangle of the same length.

Plugin Task Declaration allows to draw any polygonal task and computes the total distance, length of each leg and its azimuth. It is also able to detect a FAI triangle (according to the FAI sporting code).

9.1 New Task

To create an empty task, select the New Task item from the application menu. New task panel appears in the bottom pane.

9.2 Task Drawing

To add a new task-point, click on the "Add turn-point" button in the task panel. Now the button is pressed/checked and a task-point will be added when you click on the map.

Add button remains pressed until you uncheck it. Before you do so, you can append any number of points to the task.

If you click near a pre-declared turn-point, the task-point can be snapped to it. When this is done, a new task-point widget, labeled with the name of the turn-point, appears in the task panel. If you pick an arbitrary map point (not a turn-point), the label contains geographical coordinates instead.

Inserting points in the middle of a track is possible after clicking the "+" button between the desired task-points.

9.3 Undoing changes

All changes done to the task are logged and can be undone. For undo/redo actions there are two buttons with arrows in the task panel.

Note: If you press undo and then make any changes to the task, it is impossible to perform a redo.

9.4 Task Opening

You can open previously declared task by selecting the "Open..." item from the application menu. Tasks are stored in xml formatted text files and have ".tsk" extension. To open more tasks at once, select more files while holding Ctrl or select a range of files using Shift.

9.5 Task Saving

Tasks can be stored on the file system. To do this, press the save button with an image of a floppy-disk or select "Save" or "Save as..." from the application menu. The Save dialog always appears on the first save. If the file has already been saved, the Save dialog appears only when you select "Save as..." from the menu, otherwise the file is stored under its original filename.

9.6 Task Panel

Each opened task has a panel assigned to it in the bottom pane. Apart from the aforementioned buttons for saving, undo/redo and adding new points, there are two text fields containing task parameters.

The first text field (right next to the undo/redo buttons) contains the shape of the task, the official and total distance.

Task shape can be either: Out and return, Triangle, FAI Triangle, N-point task, N-point closed task.

Total distance (written in round brackets) is the sum of lengths of all the task legs. It is calculated using the ellipsoid model, which is by default WGS84.

Official distance equals to the total distance minus 1km for each middle task-point and 0,5km for the first and last task-point. (This is because, according to FAI rules for usual tasks, there is a 500m tolerance for reaching each task-point.)

Second text field contains the lengths and azimuths of each of the legs. The label of each leg is decorated by arrows pointing to the surrounding task-points.

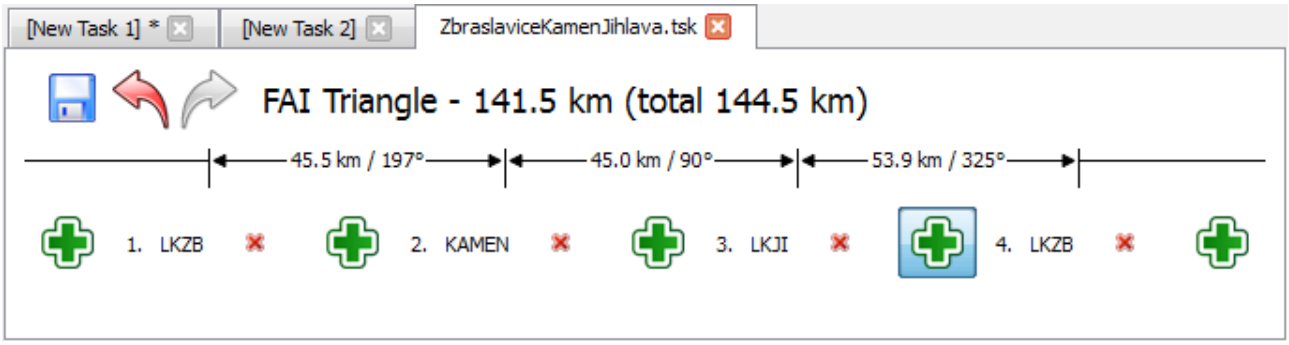

Figure 7: Task declaration panel. Green "+" buttons allow for insertion of new task-points at any point of the task. Red "x" buttons delete the corresponding task-points.

10 IGC Analysis

Updraft application contains the Igc Viewer plug-in, which is designed to analyze flight logs.

For a better understanding, a brief description of the flight log recording procedure follows.

Flight log is created by the on-board device called flight recorder or logger. This instrument is equipped with a GPS receiver and also a barometric altimeter. It makes records in regular intervals (e.g. once per 10 seconds) and stores them in the inner memory. These records are called fixes. Each fix can contain GPS coordinates and barometric height. After landing, the flight is saved into one file with the extension ".igc". Some loggers have a memory card, which can be removed and used to copy the igc files to the computer. Some loggers have serial interface that can be used to connect to the computer and download the igc files.

Updraft Igc viewer is able to load and visualize such igc files.

10.1 Igc Opening

One or multiple igc files can be opened and inspected at once. To load an igc file, select the Open item from the application menu.

10.2 Igc Visualization

The flight is rendered in the map view. It looks like a thick colored polygonal line. The line is drawn in 3D, so it hangs above the terrain. In order to be able to relate the route to the terrain, a semi-transparent curtain is drawn under the line that connects it to the ground. That way, the exact projection of the flight path onto the ground can be seen.

If multiple flights are displayed, each has its own color. Trajectory coloring can also visualize the dynamic values that are computed for every single fix (e.g. ground speed). All such possible values are listed in the chapter Igc Panel.

The values are visualized as rainbow colors. Blue color corresponds to the lowest values (e.g. lowest speed) and red color corresponds to the highest values. If multiple flights are open, they share the coloring and also its scale, which means that the values can be compared across the opened trajectories.

In such situation, red parts of any displayed trajectory correspond to the highest values among all of the open igcs.

Coloring according to the vertical speed is specific, because it can also be positive or negative. Zero vertical speed is always rendered with green color. Blue then means negative values, whereas red color represents positive ones.

Each trajectory can be hidden/shown by clicking the appropriate check-box in the left pane.

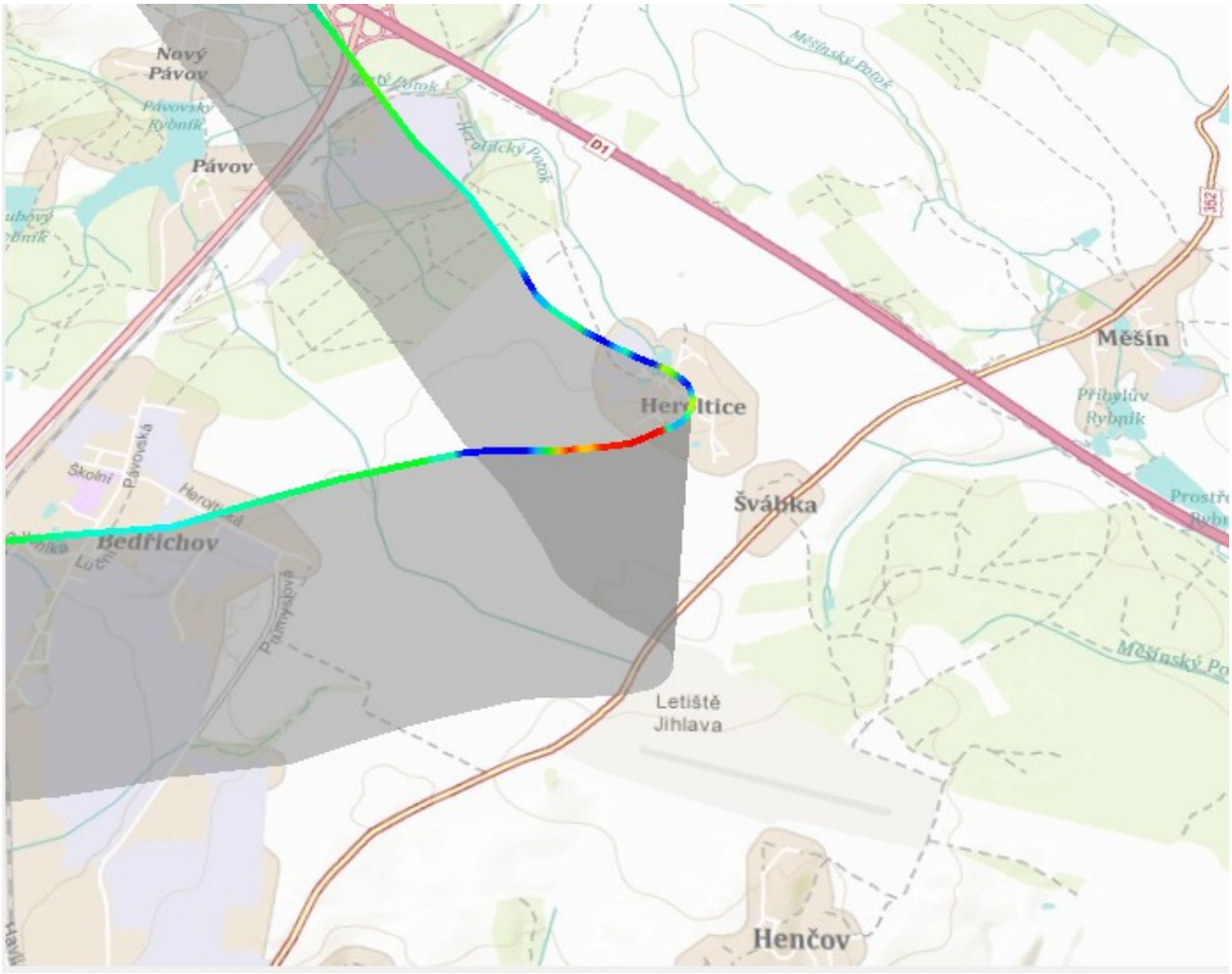

Figure 8: Igc curtain connecting flight trajectory with the ground. Trajectory is colored by vertical speed. Green parts – constant height, red parts – climbing, blue parts – sinking.

10.3 Igc Panel

The bottom pane contains a tab for each of the opened igc files. It consists of three plots, a combo-box for selection of the trajectory coloring and also an auxiliary statistics window. The plots share the time (horizontal) axis. First plot shows the altitude in meters, the second one shows ground speed (km/h) and the third one shows vertical speed (m/s).

For better plot inspection, it is possible to enlarge them by dragging the upper border of

bottom panel.

Trajectory coloring mentioned in the chapter Igc Visualization can be changed using a combo-box to one of the following values:

- Automatic: The default value. Assign each igc file one color that is then used to render the whole trajectory. If more igcs are opened than the number of available colors, they get the same colors again.
- Altitude
- Ground Speed
- Vertical Speed
- Time: The beginning of the flight is colored with blue color, end of the flight is colored with red color.

10.4 Plot statistics

The igc plots can be enriched with simple statistics. These are shown in the plots' auxiliary window (left of the plots) and some of them also directly in the plots. Statistics are computed for an arbitrary point in the plot and also for intermediate segments between the neighboring points.

User can add new points to the plot by clicking on it. The point is represented by a gray vertical line shared among all of the plots. Small icon is also drawn in the map view to visualize the point in the flight trajectory itself.

All added points can be removed by right-clicking on the plots.

Insertion of points is also possible by clicking directly on the trajectory in the map view.

For each point, the actual plot values are printed out (altitude, GS, VS) together with the time (UTC). For intermediate segments, following values are computed:

- dT: Time difference between the neighboring points.
- dS: Direct distance between points (in km, computed on the ellipsoid surface)
- dH: Gained height (altitude difference in meters)
- GS: Average ground speed = dS/dT (km/h)
- VS: Average vertical speed = dH/dT (m/s)

If there is enough space, segment statistics are drawn under the plots. All statistics are displayed in the aforementioned small window next to the plots.

First and last fix of the igc form implicit plot points that cannot be removed. To give an example, if the user places one point into the middle of the plots, the trajectory is divided into two segments defined by three points.

When the mouse cursor is moved over the plots, a temporary gray line is shown for the point under the cursor and its statistics are shown in the upper part of text window. A marker for this point is also rendered in the map view.

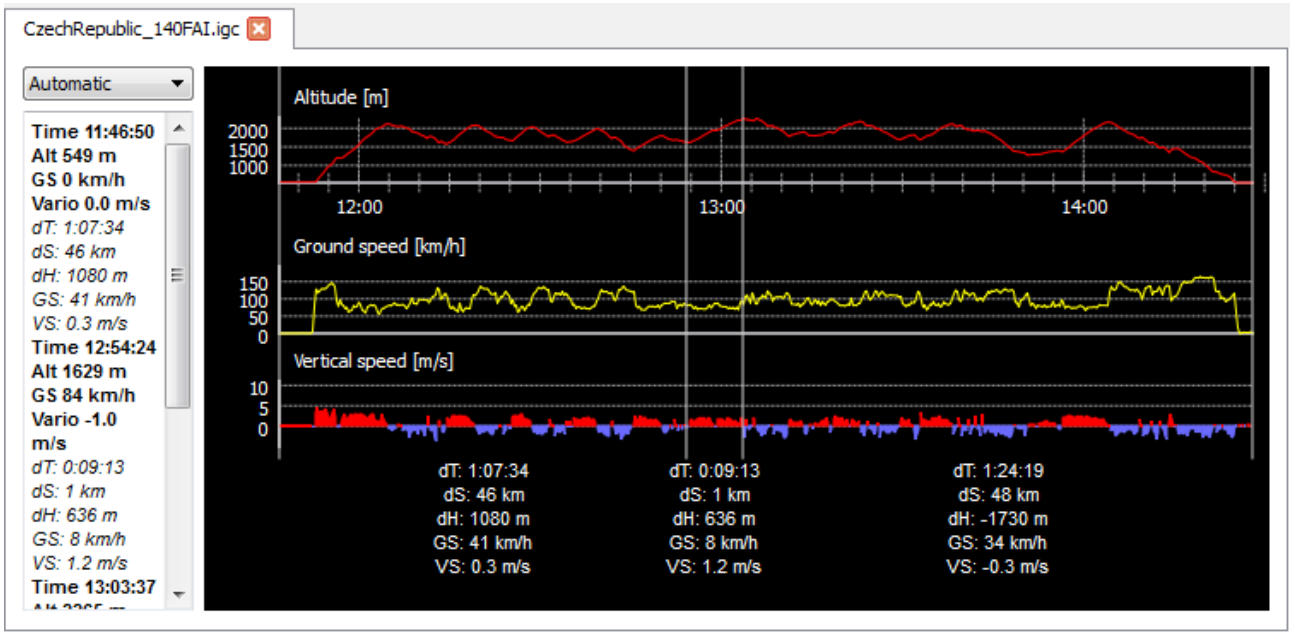

Figure 9: Igc graph with statistics for three segments. Left of the graph is the text window with statistics for all of the marked points and intermediate segments. Drop-down (combo-box) above the text window serves for igc trajectory coloring selection.

11 Options

Options dialog is accessible through the application menu. It allows the user to change some application variables. There are two option types (actually three, but the third type is not user-editable): basic and advanced.

The advanced settings are intended for more skilled users. They are displayed by switching on the „Advanced settings“ check-box in the Options dialog.

Changes to some settings will be visible only after the application restarts. These are marked with an asterisk.

If you make some changes in the Options dialog and want to undo them, click the “Reset” button and all the editors' values will be reset to their original values. The “Apply” button applies the options without closing the dialog, which can sometimes be useful.

11.1 General Options

- **Language:** Changes the localization language of the Application. English (default) and Czech localizations are supported.
- **Data directory:** Selects the directory where the temporary Updraft data will be stored. Application stores the map cache in this directory as well as imported files (turn-points and airspace files). When the value of this option is changed, Updraft attempts to move the data directory to the new location. When the data directory cannot be found in this location during the application start-up (e.g. because it was manually deleted), the location is reset to a default value and the data directory is reinitialized.
- **Ellipsoid model:** Selects the ellipsoid model of Earth used for distance computing. Supported options are WGS84 and FAI Sphere. This selection affects all the measurements (igc statistics and task declaration), but not the 3D display.

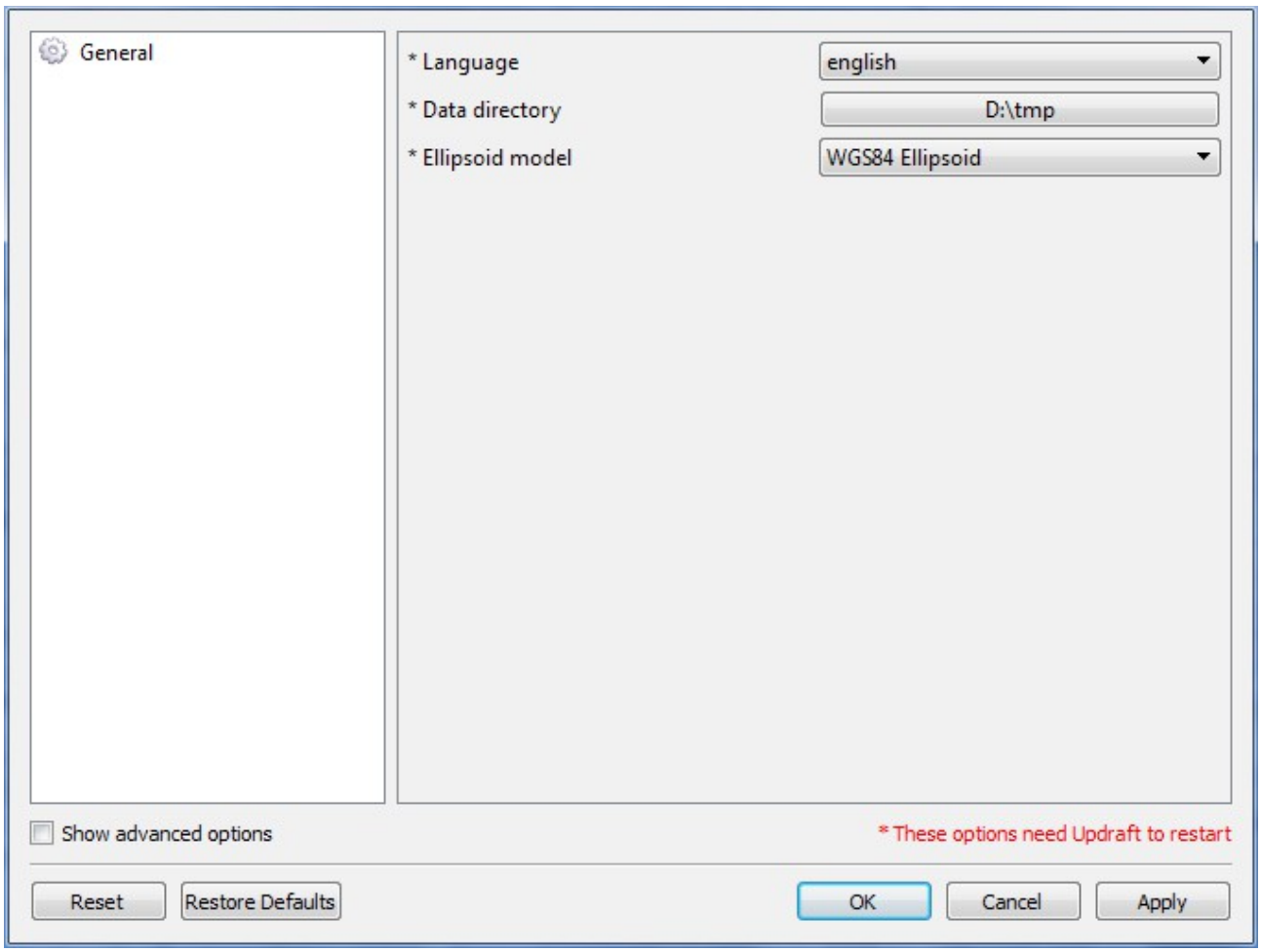

Figure 10: Options dialog

11.2 Map Options (hidden)

- **Mouse zoom sensitivity:** Adjusts speed of zooming with mouse scroll.
- **Mouse click tolerance:** Adjusts distance between mouse button press and release. If this value is large, even clicks with long movements between the press and release will be counted as a single click and not a click-move-release (this is to distinguish between map object clicking and map manipulation).

12 Airspace and turn-point sources

Turn-point and airspace files can be obtained from various sources. Here is a list of some basic Internet sources:

- http://soaringweb.org/Airspace Web for free airspace data exchange
- http://soaringweb.org/TP/HomePage.html Web for free turn-point exchange
- http://www.lkka.cz/sport/files/Points.zip Current set of Czech turn-points published by the Czech glider committee.
- http://gliding.cz Page containing links to webs of Czech glider competitions. Such webs contain downloads of both turn-point and airspace files intended for that competition.