

# RS41 Tracker V1.15 User manual

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# 1 Introduction

*RS41 Tracker* is a software running on Windows that it's able to decode telemetries generated by the Vaisala RS41 radiosondes.

Used in conjunction with a FM radio receiver it allows operators to display radiosonde positions on a map and to control other meaningful parameters like temperature, wind speed/direction and burst killer related information. All in real time.

Main features are:

- Directly decoding of GFSK signal received by the FM radio receiver (the use of a Software Defined Radio is recommended).
- Capability to connect and command SDRSharp software by mean of Net Remote Control plugin.
- Advanced frequencies scan, decode and rescan: *RS41 Tracker* is able to look for RS41 radiosonde signal in a given list of frequencies, starting the radiosonde decoding when a valid signal is detected. Software is also able to restart the scanning activity when the previously received sonde is no more available.
- Real time showing radiosonde position on map (online/offline mode are available)
- Real time showing user position on map (connection to an external GPS required)
- Tracking position (Elevation, bearing, Range, Slant Range). Parameters are calculated using the presetted home position or current user location /see GPS IN).
- Map auto centered on radiosonde position (selectable option)
- burst killer detailed information and launch time estimation.
- Integration with **APRS** network: *RS41 Tracker* is able to connect to APRS-IS servers in order to provide information on locally received radiosonde, and to receive and show on map radiosonde information received from APRS users (bidirectional connection - **Internet connection required**). In addition software is also able to transmit current user location to APRS servers (igate mode - Optional).
- Radiosonde RAW data save
- post processing of RS41 RAW data file (flight replay).
- Support to kml ghost-track. Software is able to load a GPS track file in kml format. This feature was introduced to allow real time comparison between the current radiosonde track and the forecast track provided by site <http://alerteselectroniques.fr>. Of course any "well formatted" kml file can be loaded.
- Radiosonde track can be saved in kml/gpx format.
- Shortcut for google-maps in browser. This command show the radiosonde latest position using google map on your favorite browser.
- Measurement units of Vertical speed and wind speed can be chosen between:
  - meters per second
  - kilometers per hour
  - knots
- Auxiliary sensors detection  
Software is able to detect presence of single/multiple auxiliary sensors connected to radiosonde.
- Auxiliary sensors telemetries decoding  
Telemetries of auxiliary sensors are decoded and shown on a dedicated window, The following sensors are supported: Ozone (OIF411), Cobald, CFH, SKYDEW. Unsupported sensors are not decoded but identified and reported with their own raw data.  
*In case of unknown sensor detection, please send the RAW file to [escursioni@altervista.org](mailto:escursioni@altervista.org): this could help new software releases to support additional sensors.*
- Automatic software updates check (at startup and on demand).  
The software now it's able to verify if a new software version is available
- Introduction of PTU parameters (Pressure, Humidity, dew point)  
Due to lack of information related to PTUs, in SG model, these parameters have to be considered as an estimation.

Please see "Telemetries accuracy" chapter.

- Precise pressure calculation for RS41-SGP model.
- Antenna Rotor Handler  
Software can handle an AZ/EL antenna rotor in order to track RS41 Radiosonde.  
Supported protocols are:
  - Yaesu GS232a/GS232b
  - EasyComm
  - Raw
  - Window Registry (position provided by means of two windows registry keys to support customizations)
- RS41 Telemetry export in csv format
- Advanced audio signal monitor.
- Full screen mode available.
- Diagrams window with Stüve Diagram (preliminary release)
- Map downloader tool
- User can choose as map type one of the following:
  - OpenStreetMap
  - OpenOrthoMap

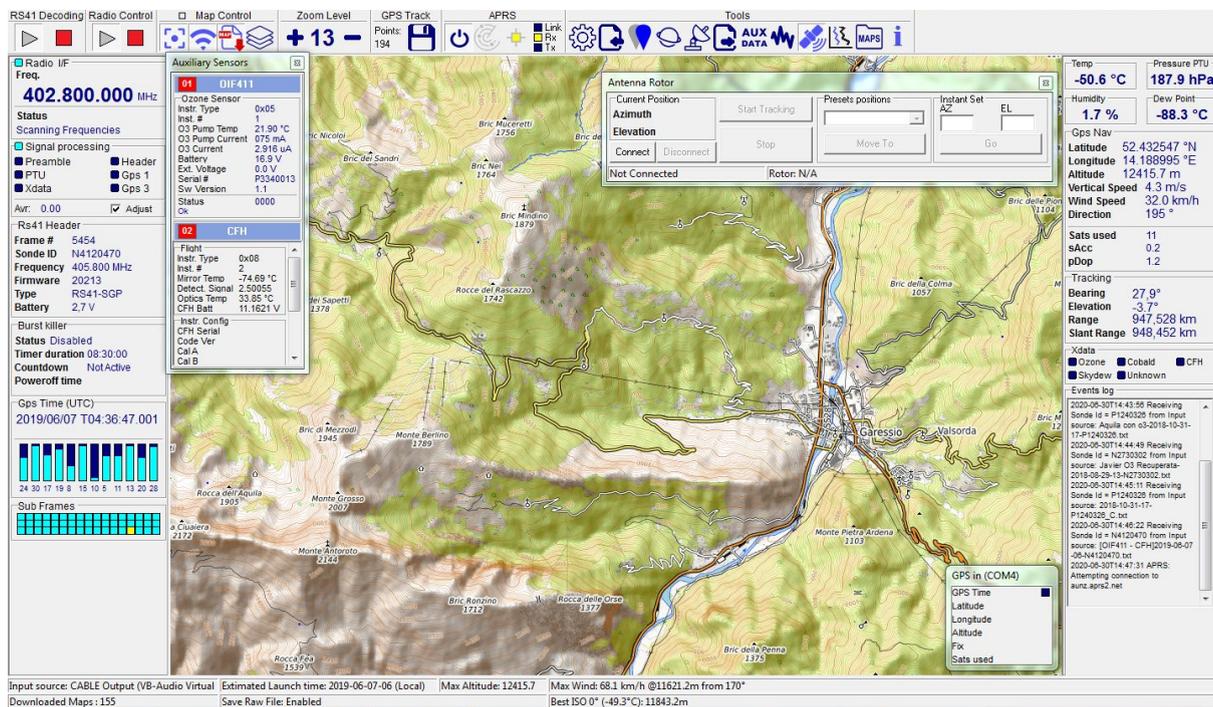


Figure 1 - RS41 Tracker - main window

## 1.1 Software installation

*RS41 Tracker* is distributed using a zip file without any installation file.

To install the software simply uncompress the zip file in a directory of your choice.

**Note: with introduction of TopoMap , two additional libraries are now added to the zip file: libeay32.dll and ssleay32.dll. It's mandatory to left these libraries in the same directory where the *RS41 Tracker.exe* file is located.**

## 2 Configurations

In order to work with *RS41 Tracker* some configuration parameters related to working environment must be defined.

These parameters are accessible pressing the Settings button  located into tools section. Hereafter a brief description of the available setting parameters.

## 2.1 Audio

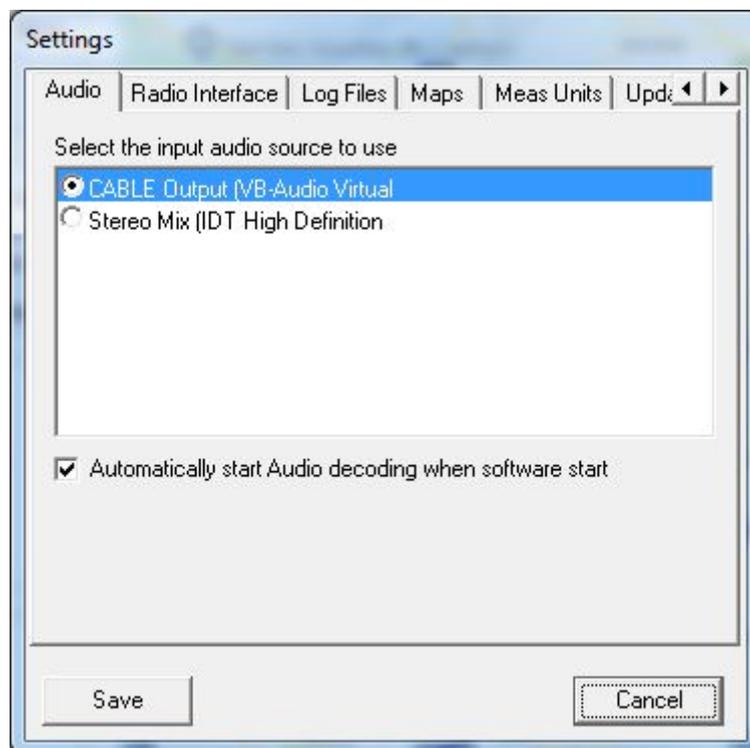


Figure 2 - Settings - audio

In this section is mandatory to specify the audio input interface used to connect the radio receiver to PC.

In case your radio receiver is a SDR USB device, consider to use a virtual cable software.

It's also possible to automatically enable audio decoding at software startup selecting the related checkbox.

To verify the current audio setting it's possible to use the *Audio signal monitor* functionality (see para 3.7).

## 2.2 Radio interface

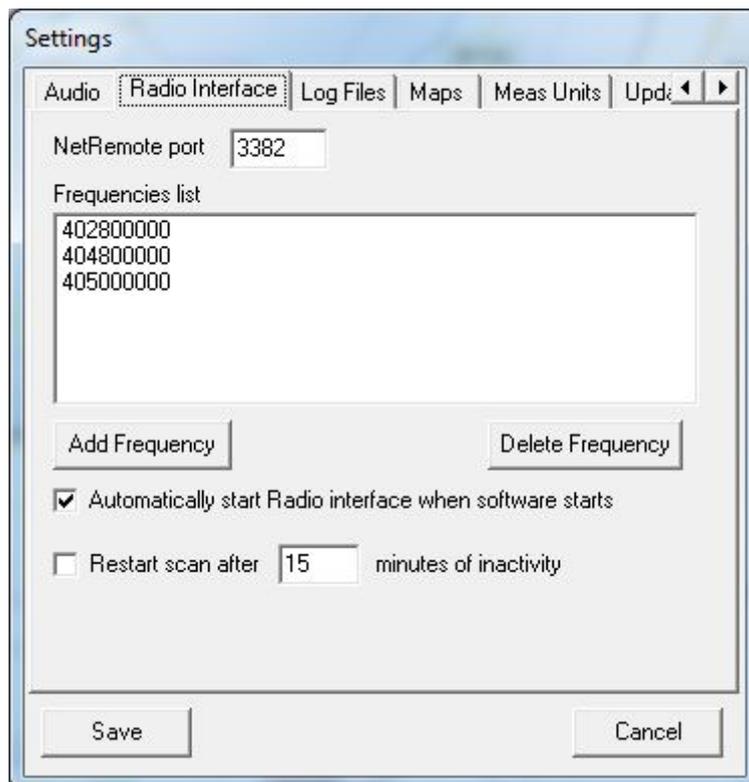


Figure 3 - Settings - Radio interface

*RS41 Tracker* is able to drive a SDR USB radio receiver operated with SDRSharp software by means of Net Remote Control plugin.

Instruction on how to install the plugin can be found on SDRSharp web page ([airspy](http://airspy.com)).

To allow communications between *RS41 Tracker* and the SDRSharp plugin it's necessary to set the same communication port number on both.

Default port number is 3382.

Hereafter a screenshot of the Net Remote Control plug in showing the configuration used.

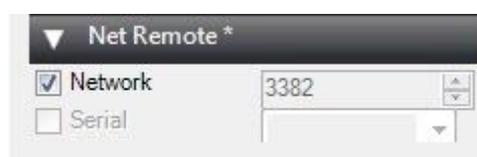


Figure 4 - Net Remote plug in configuration

Remember to check the network flag as shown in the previous picture.

The commanding activities performed on radio interface are intentionally limited to set the tuning frequency: no changes are executed on other radio parameters (radio on-off, bandwidth... and so on): this will allow operator to set its preferred settings into SDRSharp.  
For these reason, remember to turn on radio receiver in SDRSharp, or SR41 Tracker will scan frequencies without receive any sound.

In this tab is also mandatory to set the list of frequencies that will be used by *RS41 Tracker* for radiosonde signal detection.

#### Scan behaviour

Each frequency is monitored for 5 seconds then the radio receiver move to the next one in list.  
Once a valid RS41 radiosonde signal is received the frequency scan stops (in main page, the Radio interface status become "Sondeld locked.")

Note: Only frequencies between 400.000.000 Hz and 407.000.000 Hz are allowed.

Also in this case It's possible to perform SDRSharp commanding at software startup selecting the related checkbutton.

*RS41 Tracker* is also able to restart scanning when a previously received sonde become not available (signal lost).

This feature is useful to receive more than a sonde in the same working session (one sonde after another...) or when the operator want to run *RS41 Tracker* without supervise operations.

Restart scanning can be enabled using the "restart scan" checkbox and the related time parameter.  
Allowed values are from 2 minutes to 1440 (a day).

### Few words about SDRSharp settings

The RS41 radiosonde uses GFSK 4800 modulation with 5KHz bandwidth.

For this reason it's **recommended** to set a NFM demodulation with a bandwidth closer to 5k (6500 Hz in the example).

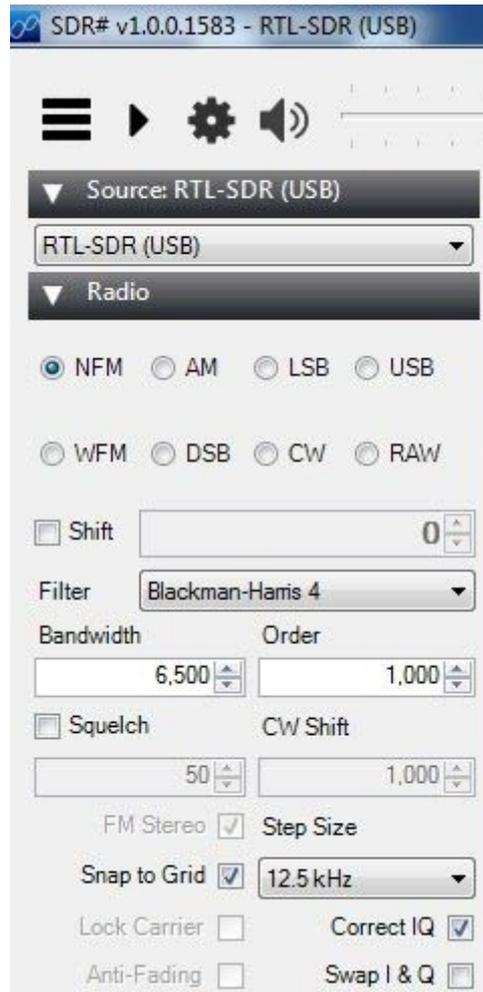


Figure 5 - SDRsharp configuration example

Also avoid any signal filter that could lead to audio modification (e.g. in audio section avoid filter audio, in AGC settings avoid the AGC use, .....

At last verify that the received signal is centered respect to the expected frequency: if necessary trim the receiver ppm setting.

## 2.3 Log Files

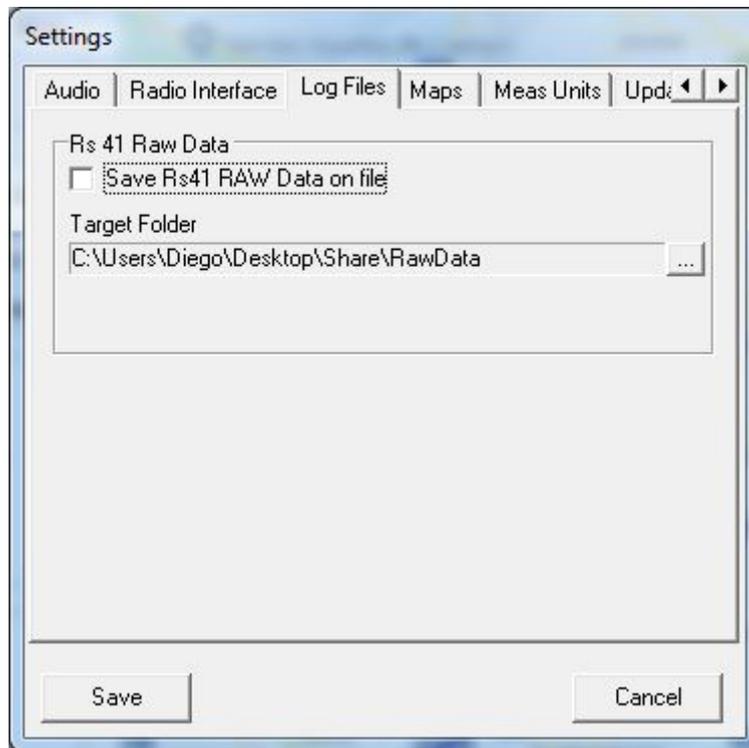


Figure 6 - Settings - Log files

*RS41 Tracker* is able to save on file the raw data received from radiosonde. This will allow to perform post analysis on saved files.

To avoid data flooding only raw data that contains at least some valid data will be saved.

Default saving folder (RawData) is located where *RS41 Tracker* runs.

It's recommended to update the saving folder in accordance to the working environment and personal preferences.

Saving raw data feature can be disabled using the related checkbox.

## 2.4 Maps

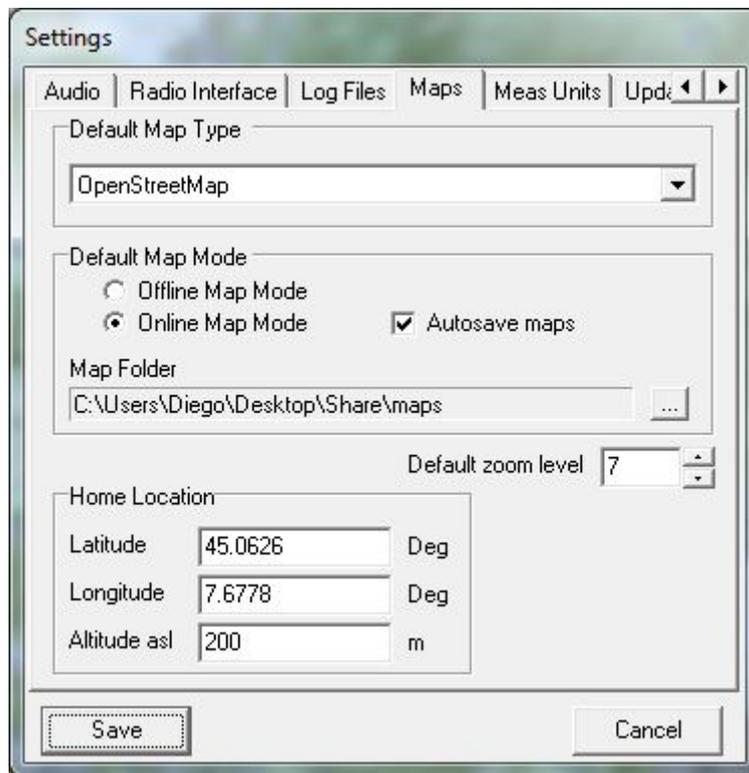


Figure 7 - Settings - Maps

In this tab it's possible to set configuration parameters related to map.

Currently two types of maps are supported: OpenStreetMap and OpenOrthoMap: a drop-down menu allows the user to select which kind of map has to be used at startup. Map type can be dynamically changed using a command button on the toolbar of the main window (See Para 3 for further information).

With introduction of new map engine it's now possible to set map working mode at startup.

Allowed working mode are Offline and Online. These parameters can be temporary overridden using the related buttons in the command bar of the main screen.

Once the online mode is activated it's also possible to save new downloaded map on local disk selecting the "Autosave maps" checkbox.

Default Map folder (maps) is located where *RS41 Tracker* runs.

It's recommended to update the saving folder in accordance to the working environment and personal preferences.

Zoom level at startup can also be set, while data related to home location have to be entered in order to allow *RS41 Tracker* to calculate tracking data and set a home marker on map.

## 2.5 Meas Units

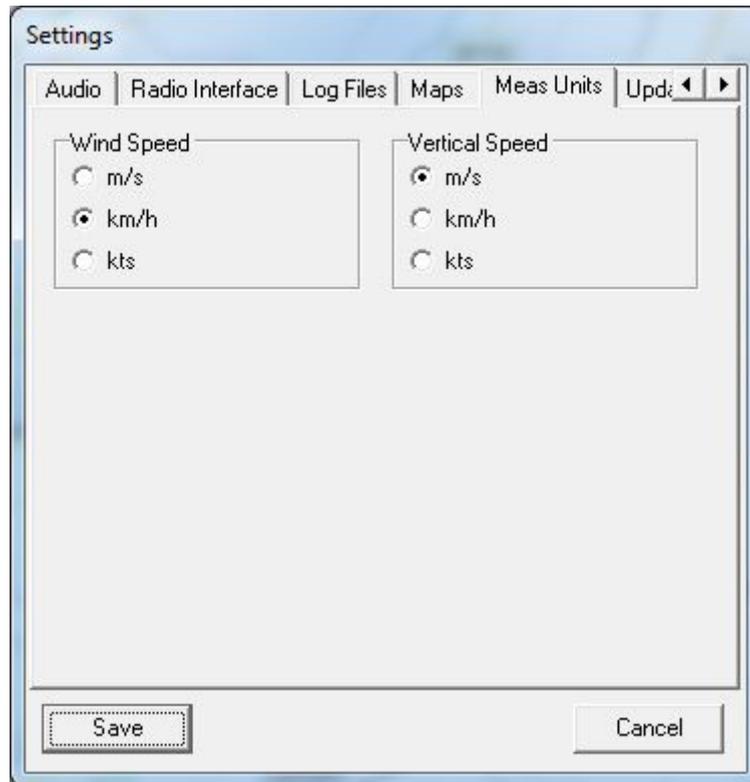


Figure 8 - Settings - Meas Units

In this tab it's possible to set the measurement unit used to display *wind speed* and *vertical speed* parameters

It's possible to set:

- meters per second,
- kilometers per hour
- knots

## 2.6 Updates

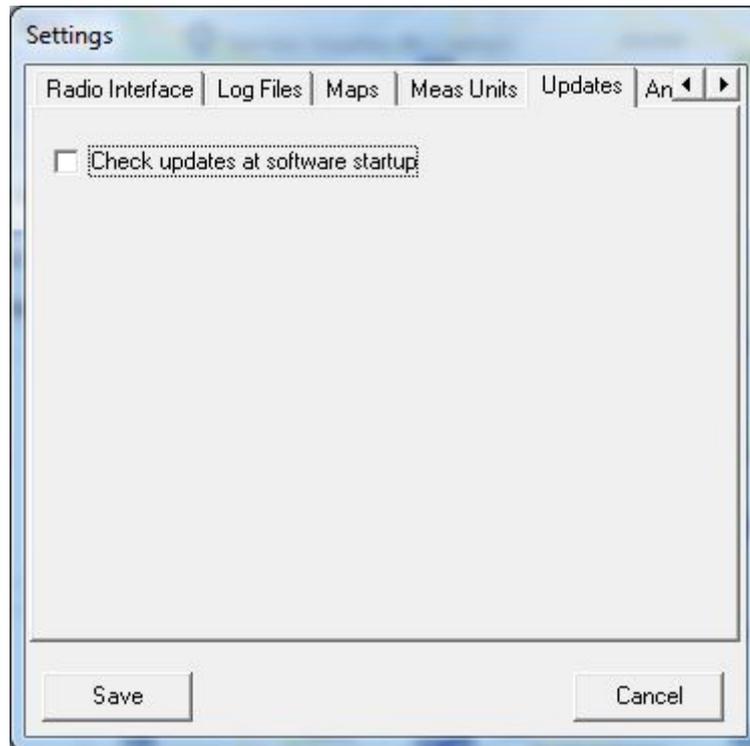


Figure 9 - Settings - Updates

Software is able to verify if a new release of *RS41 Tracker* is available for download.

If "Check updated at software startup" is checked, the software will look for updates 10 seconds after startup.

If an update is found the software shows a message window reporting info related to the new version.

Note:

- 1) To avoid interference with normal operation the message window will auto-close within 5 seconds.
- 2) No software is downloaded. The window just report information.

Manual check of software updates can also be performed using the "check for update" button located in "About" window.

In this case the info window will not auto close.

## 2.7 Antenna Rotor

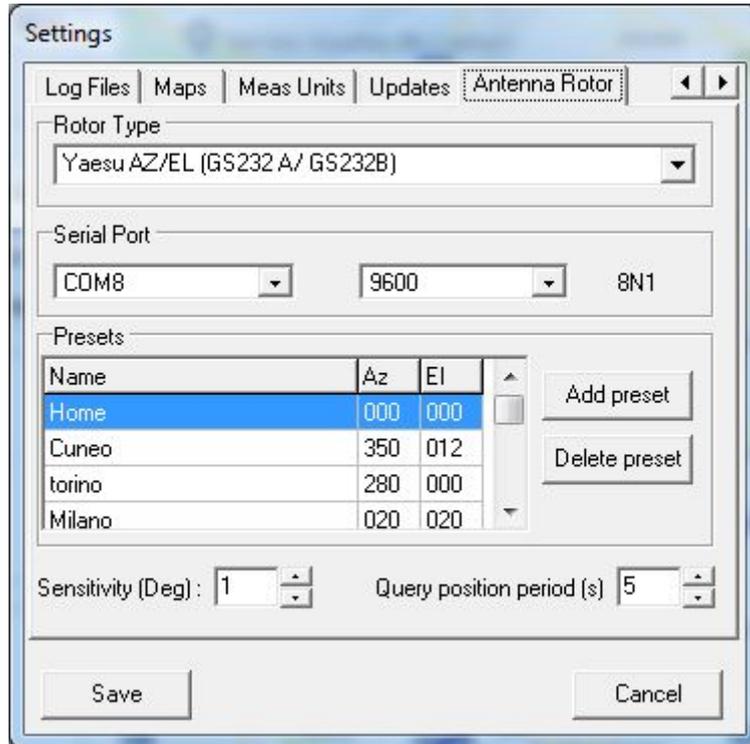


Figure 10 - Settings - Antenna Rotor

*RS41 Tracker* software supports the handling of two axis antenna rotor.

Currently two models (communication protocols) are supported:

- Yaesu AZ/EL (with protocol GS232A/GS232B)
- EasyComm
- Raw: a 9 chars string on serial port with the following format:  
<AAA><blank><EEE><CR><LF>  
where <AAA> is the azimuth angle, <EEE> is the elevation angle, both in degrees.  
Each string is terminated with <CR><LF> characters (#13 + #10) while a <blank> (#32) is used as separator between angles.
- Windows registry keys (for custom protocol antenna rotor).  
Used keys are:
  - HKEY\_CURRENT\_USER\Software\IW1GIS\Rs41Tracker\Rotor\AZ
  - HKEY\_CURRENT\_USER\Software\IW1GIS\Rs41Tracker\Rotor\ELboth keys are strings, always three characters long and with range az(0..359) el(0..180)

In “*Serial Port*” section it’s possible to set serial port and speed used to communicate with the antenna rotor. Please consider that to work with serial port greater than 9 (COM10, COM11,...) it’s necessary to execute *RS41 Tracker* as administrator.

Port/speed parameters are ignored in case of Registry rotor type.

In “*Presets*” section the operator can insert up to ten predefined positions that can be quickly set during operation with antenna rotor. Add and delete operations are intuitive.

The *Sensitivity* parameter controls how new target positions are sent to the antenna rotor. During radiosonde tracking a new target position is calculated every second (see bearing and elevation parameters in main screen).

Only when difference between current antenna position and new target position is greater/equal the sensitivity parameter then a new target position is sent to the antenna rotor.

Sensitivity = 1 deg means continuous tracking.

You can think *Sensitivity* parameter as the max allowed error in antenna positioning (expressed in degrees).

The Yaesu protocol foresees a command (W2) that is able to return the current antenna position.

This command is used by software to periodically update data located into the antenna rotor window. The parameter "Query position period" represent how often the query command has to be sent to the antenna rotor.

This parameter is ignored in case of Registry rotor type; where the current antenna position is set with the same value of the last provided command.

## 2.8 APRS

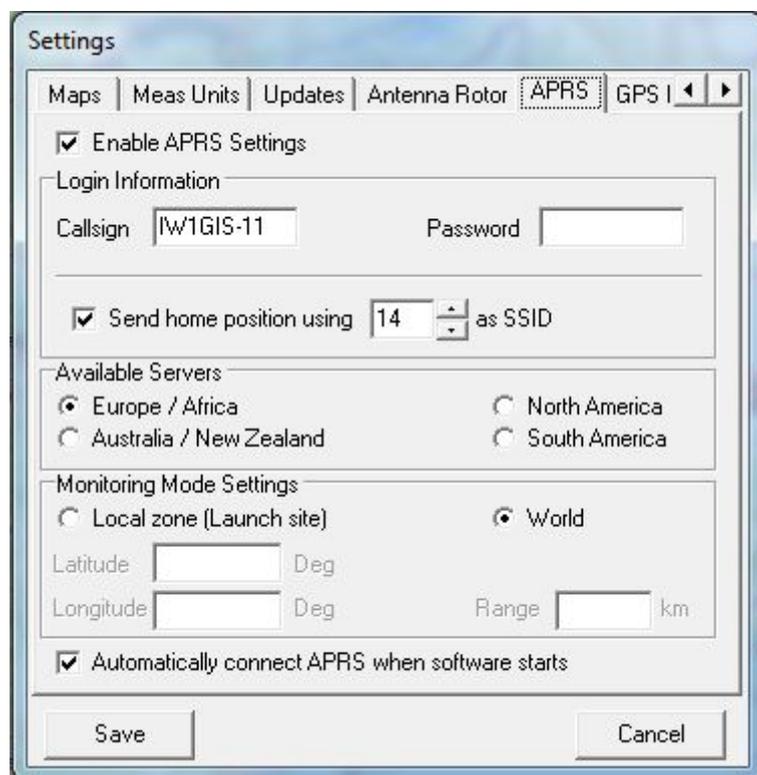


Figure 11 - Settings - APRS

RS41 Tracker supports the connection with APRS-IS server.

**Please consider that use of APRS-IS is restricted to amateur radio only.**

Once activated with "Enable APRS settings" in this tab it's possible to set the following parameters:

<Callsign> is your OM Callsign. It's mandatory to use the secondary station Identifier

<callsign>-<SSID>

The value <callsign>-11 (balloon) is suggested.

<Password> is the numerical password needed to access APRS server. In case you have already used APRS-IS you know what your password is. If this is not the case and you are an amateur radio you can send me a password request by email (please remember to clearly specify your complete callsign).

It's also possible to send current home position to APRS-IS server specifying an additional SSID number and selecting the "send home position.." checkbox. On APRS system the home position is represented as IGATE node and each sonde positions are sent through this IGATE. For further info please read para 3.4.

**Note:** *RS41 Tracker* policy about APRS is to share data: if you want to receive data from APRS you have to provide yours. For this reason the read only password access (-1) is not allowed.

<Available servers> you have to select a server to connect to, basing the choice on your geographical position. Please consider that all servers provide the same data but you have to choose the nearest to your position (servers load optimization).

<Monitoring mode> *RS41 Tracker* is able retrieve radiosondes data from APRS server and to show on map sonde positions. Two different settings are foreseen:

- World  
If set the software will shown on map in real time the positions of all APRS tracked sonde (worldwide).
- Local zone  
If set the software will shown on map in real time the positions of all APRS tracked sonde located in a restricted geographical area.  
To identify this area it's necessary to set the center coordinates (latitude and longitude) and a radius (distance from center in km).  
A good way to operate this mode could be to center the local zone on the launch site of interest and to set a meaningful range value (based on your working conditions).

The last checkbox allows to autostart APRS connection when software starts. Additional info on how operate with APRS can be found in para 3.4 APRS Operations

## 2.9 GPS IN

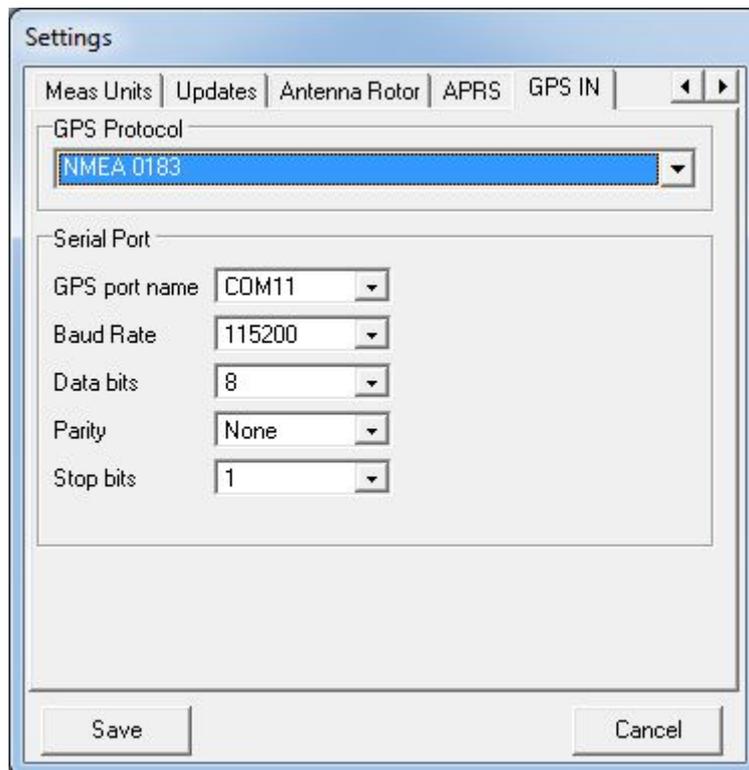


Figure 12 - Settings - GPS IN

*RS41 Tracker* supports the connection with an external GPS unit in order to update in realtime:

- current user position on map
- telemetries relates to user position like bearing, range, slant range and elevation.

The following information are needed:

- *<Gps Protocol>* is the communication protocol used by GPS. Currently only NMEA 0183 is supported.
- *<Gps port name>* identify the serial port used for GPS connection.
- *<Baud rate>* serial port speed
- *<Data bits>* serial port data bits, typically "8"
- *<Parity>* serial port parity bit, typically "none"
- *<Stop bits>* serial port stop bits, typically "1"

Note: if the computer running *RS41 Tracker* supports a bluetooth connection it' also possible to use and android smartphone as external GPS. See Para 3.5 for further information.

### 3 Operating the software

Command buttons are located on the top part of the main window and are enough intuitive.



Figure 13 - Commanding bar

RS41 Tracker window can be scaled or set in full screen mode. In case the complete command bar is not visible a scroll button will appears.(The same behaviour occur on left and right panel).

Hereafter a short description.

	<p>Start and stop radiosonde decoding</p>
	<p>Start and stop frequency scanning (using SDRSharp+Net Remote Control plugin) Three different scenarios can occur:</p> <p>1) Scan not active</p> <p>2) Scan active</p> <p>3) Scan paused (see para 2.2)</p> <p>When scan is paused the <i>minutes left</i> to scan restarting are reported in the radio I/F panel on the left side of the screen.</p> <p>They decreases only in case of radiosonde signal lost. When sonde signal is present, <i>minutes left</i> are set to maximum value.</p>
	<p>Map working mode. The first three buttons set the map working mode.</p> <ul style="list-style-type: none"> <li>- First button: map autocenter mode.</li> <li>- Second button: online/offline map mode setting</li> <li>- Third button: allow to locally save each downloaded maps (available in Online mode only).</li> </ul> <p>Top left indicator is on when autocenter function is temporary disabled. Latest button open a drop down menu that allows to dynamically</p>

	<p>select the type of map used in main window.</p> <p>Currently this kind of map are available:</p> <ul style="list-style-type: none"> <li>- OpenStreetMap</li> <li>- OpenTopoMap</li> </ul> <p>For additional information on map mode please see chapter 3.3</p>
	<p>Map zoom level increase and decrease.</p> <p>Valid range is between 3 and 19.</p>
	<p>Save current GPS track.</p> <p>This command allows to save on file the current radiosonde track. Supported file format are</p> <ul style="list-style-type: none"> <li>• kml (keyhole markup language).</li> <li>• gpx</li> </ul> <p>It's possible to save track during radiosonde receiving or to save the track generated by a loaded RAW file</p>
	<p>APRS Controller.</p> <p>These buttons are available only if enabled in APRS settings</p> <ul style="list-style-type: none"> <li>- First button: Connect/Disconnect from APRS server.</li> <li>- Second button: Monitoring mode: When enabled all available APRS sondes (world/local zone) are shown on map.</li> <li>- Third button: Tracking mode: only selected sonde will be shown on map. In addition a panel reporting all available APRS sonde data will be shown.</li> </ul> <p>In case of connection error the connection button become red</p>  <p>and software retry to connect to APRS server</p> <p>Additional information can be found in para 3.4 Aprs operations.</p>
	<p>Settings</p>
	<p>Load a RS41 radiosonde RAW file (.txt)</p>
	<p>Ghost track load/unload</p> <p>See Para. 3.1</p>
	<p>Sonde position on google map.</p> <p>This command show the radiosonde latest position using google map on your favorite browser.</p> <p>The same symbol is also reported into APRS panel and works in the same way but using the APRS data.</p>
	<p>Show Antenna rotor control panel.</p> <p>See Para 3.2</p>

	<p>save radiosonde telemetry on file. Supported file format is</p> <ul style="list-style-type: none"> <li>• csv (comma separated values).</li> </ul>
	<p>If a configuration with auxiliary sensors is detected, the software automatically open the auxiliary sensors window reporting the sensors telemetries. This auxiliary sensors windows can be closed using the x button on the upper right side of the window and can be reopen using this button.</p> <p>This button is disabled when auxiliary sensors are not present. See Para 3.6</p>
	<p>Audio signal monitor. See Para 3.7</p>
	<p>Connection to an external GPS connected to the platform where <i>RS41 Tracker</i> is running. See Para 3.5</p>
	<p>Diagrams Window See Para 3.8</p>
	<p>Map downloader tool See Para 3.9</p>
	<p>Info Box.</p>

### 3.1 Ghost track functionality

Using this command it's possible to load/unload a GPS track file in kml format. This feature was introduced to allow real time comparison between the current radiosonde track and the forecast track provided by site <http://alerteselectroniques.fr>. Any "well formatted" kml file can be loaded anyway.

A representation of ghost track functionality is depicted in the following image.

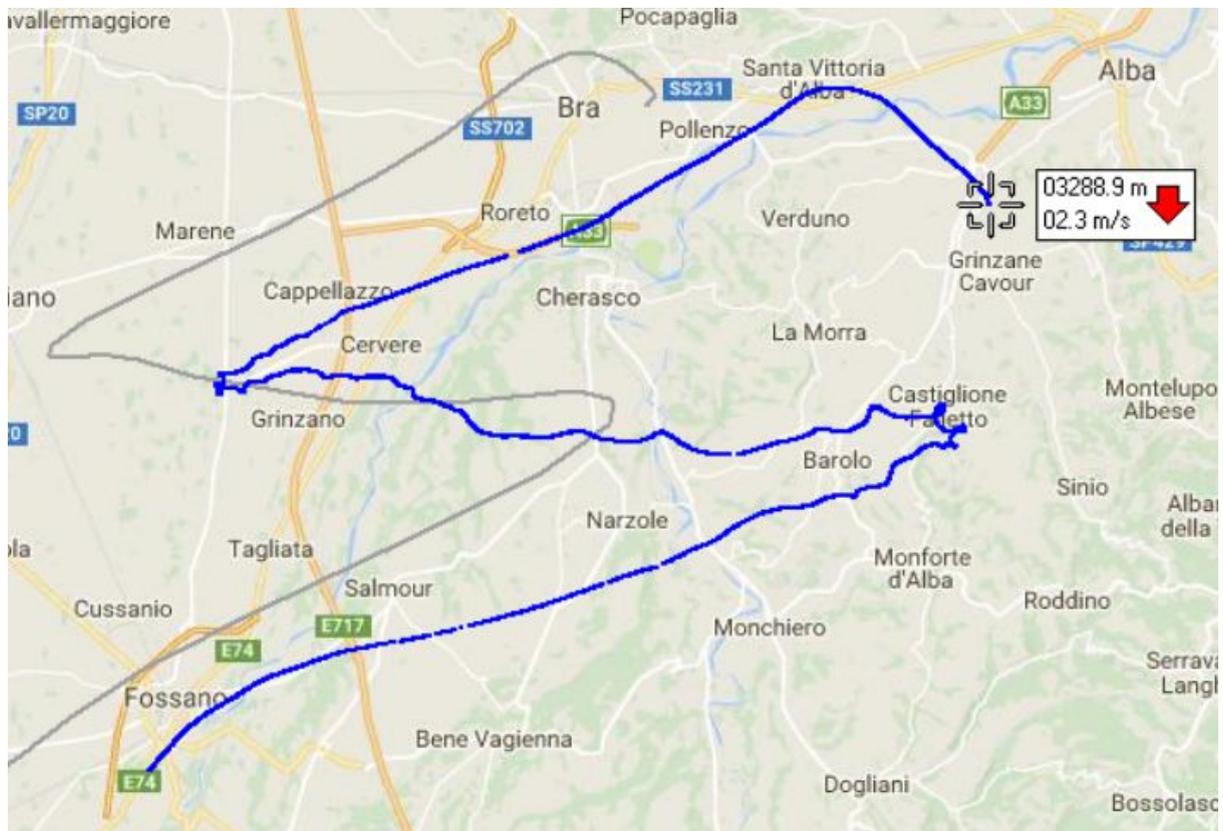


Figure 14 - ghost track example

As you can see, near the radiosonde track (blue in color) it's possible to see the ghost track (gray in color) reporting the forecast track provided by site <http://alerteselectroniques.fr>.

## 3.2 Operating an antenna rotor

During reception of a radiosonde signal (for testing purpose also during a processing of a RAW data file) the operator can connect *RS41 Tracker* to an antenna rotor using the functionalities located into a dedicated window. Supported protocols are reported in Para 2.7

This window can be activated using the button located in the tool section of the main window.

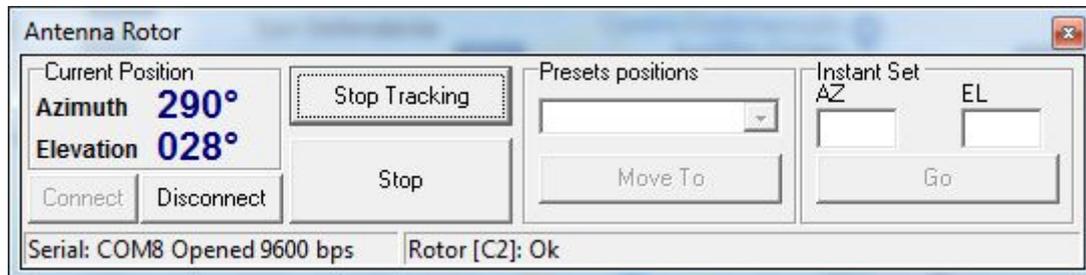


Figure 15 - Antenna rotor control window

On the left side of the window are located two software pushbuttons that are used to connect/disconnect software to the antenna rotor.

Once the antenna rotor is connected there are three different way to operate it:

- Automatic tracking (Start/stop Tracking button)  
In this mode rs41 directly handles the rotor in order to follow the radiosonde movements.
- Move to Preset position  
In this mode the operator can choose a presetted position (see settings) from the dropdown list and quick sent it to the rotor by means of “Move To” button. This function is not available when automatic tracking is active.
- Instant set position  
In this mode the operator can directly send custom Azimuth and Elevation values to the rotor by means of “Go” button. This function is not available when automatic tracking is active.

Stop button sends a stop command to the antenna rotor and terminate the automatic tracking functionality if active.

rotor window can be closed and reopened without stopping the antenna rotor commanding.

### **Warning**

Currently the antenna rotor handler (Yaesu protocol) was tested only with a self made antenna rotor. For this reason it's recommend to pay attention using this functionality.

Out of curiosity the self made antenna rotor was intended to be used in outdoor tracking activity. Requirements are: portability, lightweight, wireless connection (Bluetooth), 12V power supply (battery/solar panel).

The first working prototype was created using a 3D printer and it's currently used for radiosonde tracking.

Once stabilized I will provide documentations on Radiosonde site.

A short demonstration video can be found here.

<https://youtu.be/hkrhcggVkSc>

## 3.3 Maps operations

From release 1.9 the old map visualization based on Google map service was updated with a new map engine based on OpenStreetMap.

New engine allows the operator to work in two different operating mode. These are:

### Offline mode

In this mode the software handles map visualization using map files located on local computer storages only and without performing any access to internet network.

This mode could be useful when portable stations are used and internet connection is not available.

Maps files can be previously saved on local drive using the online mode (see below) or copied from another station that previously have downloaded maps files.

### Online mode

Also in this mode the software handles map visualisation using map files located on local computer storage: in case a map file is not found it will be downloaded from Internet (if connection is available) and saved locally only if the option "Autosave map" is enabled. Latest mentioned option allow user to limitate the amount of map files locally saved.

### Map dragging function

With introduction of new map engine the operator can uses the mouse to drag map to the desired position.

During dragging operation the sonde position continues to be updated as well as the radiosonde full track.

**Autocenter:** when this function is activated the software automatically update map in order to keep radiosonde position on screen.

Map dragging by mouse temporary suspends the autocenter function (10 seconds from the last drag action). During autocenter suspended period the indicator located in the map control panel become red (as hereafter reported).



If autocenter function is not active the map doesn't automatically follow the radiosonde position and user can drag map in the preferred position.

### Map type selection:

user can dynamically select which type of map use.

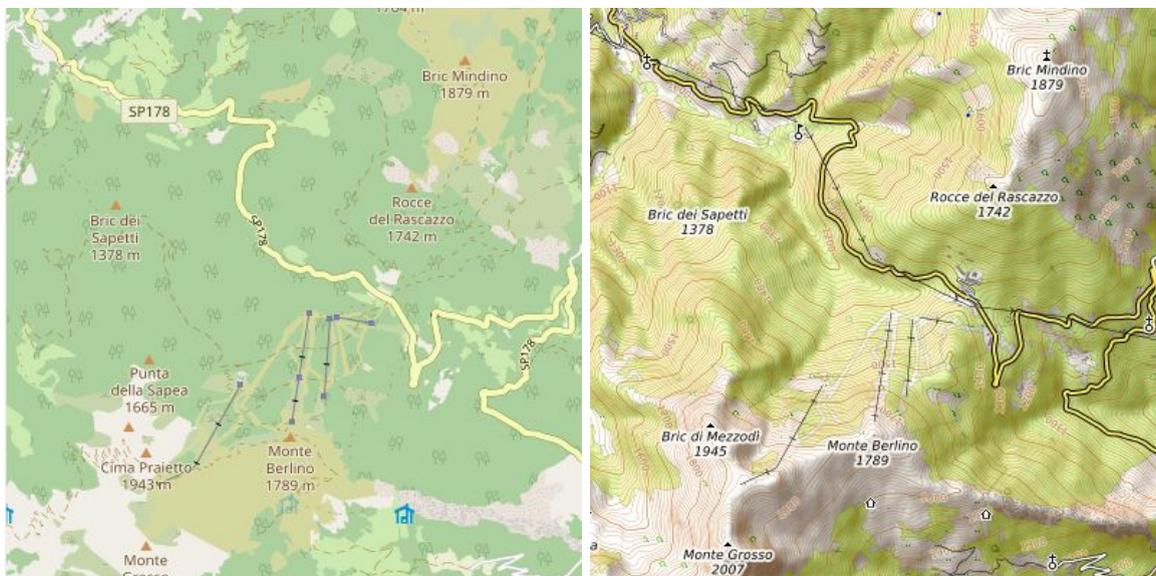


Figure 16 - OpenStreetMap vs OpenTopoMap

### Zoom

Operator can perform zoom in and zoom out operations using the zoom level command button on main windows. The same can be obtained using the mouse wheel forward and backward.

## 3.4 APRS operations

*RS41 Tracker* is able to connect to APRS in order to provide/receive data to/from APRS network. Link with APRS allows the user to integrate its own radiosonde local tracking data with data provided by other users and at the same time to share its own data on the APRS network.

**For default, connection with APRS is disabled.** Para 2.8 explains the settings needed to enable it.

After enabled, to activate connection with APRS press the  button on the command bar of the main screen.

Once button pressed the software will try to connect to APRS server. If everything went fine an information of "connection successfully" will be reported into events log. Hereafter an example:

*2018-12-09T13:55:37 APRS: Connected to euro.aprs2.net as IW1GIS-11*

In case of connection error the aprs button become red  and software periodically will try to restore connection.

*RS41 Tracker* is able to provide data to APRS in two different ways:

- Simple mode (default). In this mode your station ID directly provides radiosonde telemetries as APRS object. No information on your station ID is sent to APRS system.



Figure 17 - APRS Simple mode

- IGate mode. When this mode is set, *RS41 Tracker* provides to APRS servers also the home position of the user (see home position settings in para 2.4). This mode needs to define an additional secondary station ID (eg. -15) that works as Gateway.

Taking as reference the picture hereafter reported you have:

Station IW1GIS-11 (not visible in map) provides the telemetries of the object R1850818 (our radiosonde) via the Gateway IW1GIS-15.



• Figure 18 - APRS IGate mode explanation

Note: Gateway position will be updated in realtime whenever a GPS is connected to your receiving station and the “GPS-IN” interface is activated.

Software can handles the received data in two different working mode, Monitoring Mode and Tracking mode that are freely selectable/identifiable by means of the following buttons:



### **Monitoring Mode (default)**

In this mode all radiosondes received by APRS server are decoded and shown on map by means of a yellow marker



Multiple sondes can be shown at the same time.

The amount of available radiosondes (if any) is reported in the APRS command bar (Avail parameter) as hereafter reported.



The same panel also report three “led” with the following meaning:

- Link: reports the connection status to APRS server. It blinks once every 20-30 seconds.
- Rx: reports a radiosonde position is received. It blinks once every packet received.
- Tx: reports a (locally received) radiosonde position is sent to APRS server. It blinks once every packet sent.

Additional info can be found below in this chapter.

It's possible to monitoring all the radiosondes available in APRS (worldwide) or to reduce the monitoring to a restricted geographical area. More info on how to set these modes can be found in Para 2.8 APRS.

### **Behaviour**

*RS41 Tracker* is able to update the position on map of a received radiosonde in real time, anyway APRS server will not provide updates faster than 5 seconds and typically an APRS user send an update every 20.. 30 seconds.

So summarizing, the APRS marker will update slower than the local tracking sonde: typically once every 30 seconds (also depends on how many stations will provide data for the same sonde).

Marker not updated for a period equal to 4 minutes is highlighted as hold (gray and crossed).



Marker not updated for a period greater or equal than 5 minutes is removed from map.

Sondes received via APRS do not generate any track on map: the scope is to avoid confusion with the regular symbology used for the local tracking activity.

## Tracking Mode



This mode can be set pressing the button  in command bar.

If a single APRS sonde is available the mode is immediately activated when button is pressed, if not a dialog box will invites user to select the ID of the radiosonde to track.

Once activated only the selected APRS sonde will be shown on map while the APRS command bar will report the locked state.



The marker used to show APRS sonde position on map decrease its size to reduce interferences with locally sonde symbology.

When tracking mode is enabled the APRS tracking panel is shown.



Figure 19 - APRS Tracking panel

In this panel all meaningful APRS data are shown.

Basically sonde identifier, geographical position, altitude , speed, course,climb speed and so on.

In addition also Bearing, Elevation and Slant Range are calculated: these data can be useful in case of antenna rotor use.

### **Note:**

*APRS system use the course information (sonde travel direction) while sonde tracking use the wind direction (which direction the wind is coming from).*

*This two data provide the same info but using different point of view.*

*Example: for a wind blowing from West you will have*

*Wind direction 270 deg (west)*

*Sonde course 90 deg (east).*

Last section of panel reports the payload of the APRS message. The APRS communication protocol doesn't define all possible data provided by a sonde (e.g. burst killer information), so every software developer working on radiosonde software will provide its own custom data using the comment field of APRS packet.

User can read the payload content in order to retrieve additional information: usually payload is in human readable format.



In APRS panel is also present an additional command button that have the same aspect of the one present in tools section of the command bar.

This command show the latest position of tracked APRS sonde using google map on your favorite browser.

### Behaviour

Marker not updated for a period equal or greater than 4 minutes is highlighted as hold (gray and crossed)



but it will be never removed from map. This allow user to retrieve position, zoom on map ,etc, without time limits.

### Provide data to APRS server.

*RS41 Tracker* is able to send data related to locally received radiosonde to the APRS server in order to share them with other users (data transmission).

This functionality is not related to any of the receiving activities that user can operate (monitoring mode/ tracking mode): data transmission works in standalone mode.

For example user can track an APRS sonde while automatically *RS41 Tracker* send data related to a different one.

To transmit data to APRS server the following conditions have to be meet:

- *RS41 Tracker* is connected with APRS server
- Software is locally receiving and decoding a rs41 signal
- All subframes are already received (see subframe indication in the bottom-left side of the *RS41 Tracker* window).

### Behaviour

Software send data to APRS server with a minimum (typical) period of 20 seconds.

This value can increase if case of bad radiosonde reception (only full validated packets are used for APRS transmisson).

When transmission occurs the following events occur:

- Tx “led” reported into APRS command bar blinks
- The number of packets sent to APRS server and reported on the top left side of the APRS command bar as reported in the following image will increase (tx 16).



- The yellow marker used for report a sonde position received from APRS server become green. In other words:



**Position Received from APRS Server**



**Position sent to APRS Server**

In these ways also if APRS server will not provide back any of the packets sent from a client it's possible to have a direct feedback of the transmitted data to APRS.

An additional verification can be obtained using the APRS website ([www.aprs.fi](http://www.aprs.fi)) where it's possible to verify that our local data are shared with other APRS users.

In the following picture an example is reported: please note that “from” data match with our callsign. It's also possible to check the additional parameters provided into APRS comment field (e.g. burst killer).

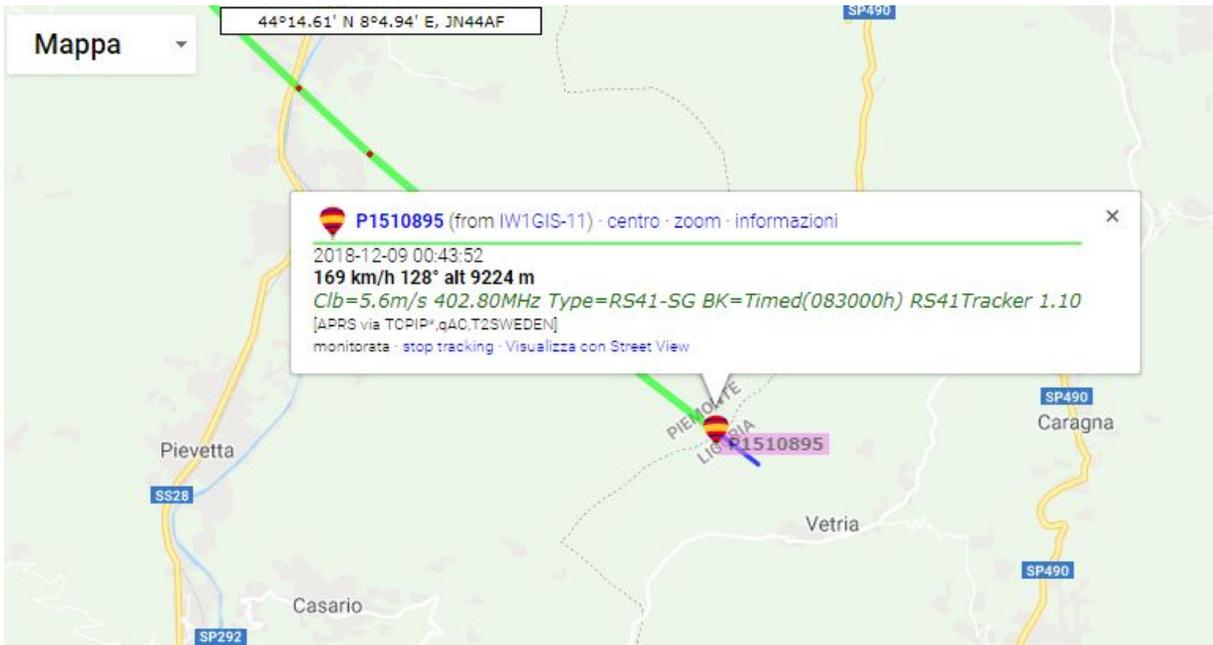


Figure 20 - www.aprs.fi website showing data

## 3.5 GPS-IN operations

Rs41 Tracker is able to operate an external GPS connected to the hardware platform where software is running.

This means that on map, user location will be updated in accordance with the input received from GPS.

In the same way also information related to user position (distance from sonde, elevation, bearing and so on) will be updated.

By default, the GPS IN button  is disabled. Para 2.9 explains the settings needed to enable it.

Once pressed the software show the GPS IN interface



GPS in (COM11)	
GPS Time	19:55:27 <span style="color: green;">■</span>
Latitude	44.533953N
Longitude	7.723319E
Altitude	416.2m
Fix	GPS
Sats used	6

Figure 21 - GPS IN interface

This window is kept “minimal” to avoid clutter on screen.

Coloured indicator located on top right of the window provides information on how the GPS works:

- ■ no blink: Software doesn't receive any NMEA data from GPS. If this condition occurs verify connection cable and if GPS supports the NMEA protocol.
- ■ Yellow blink: Communication with GPS is established but GPS is not able to provide a position(Fix). This condition happens when no enough satellites are received by GPS. In case this condition persists, move your GPS in a “clear sky view” zone.
- ■ Green Link: Communication with GPS is established and current position is provided from GPS to software. This is the nominal condition.

GPS window provide the following information:

- GPS Time (UTC based)
- Latitude in degrees
- Longitude in degrees
- Altitude in meters
- Fix type ( No Fix, Invalid, GPS, DGPS, ....)
- Sats # used to calculate current position.

Once connected, to terminate communication with external GPS, press the  button.

## Set an Android Smartphone as external GPS

If your computer has a bluetooth interface and you also own an android smartphone a different solution can be adopted to connect a GPS to your system.  
it's possible to configure your smartphone to operate as an external Bluetooth GPS.

Hereafter the instructions to configure your system.

### ON smartphone

- 1) From Google Play Store download and install GPS 2 Bluetooth software

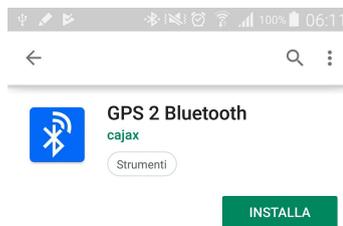


Figure 22 - GPS 2 Bluetooth installation from Play Store

- 2) Once installed open the software and press the start button.  
**Note:** This step has to be performed before the configurations on windows platform or you will be no able to enable the serial port interface.

### ON Windows platform where RS41 Tracker is installed

- 1) Perform bluetooth pairing with the smartphone.
- 2) Open the windows containing your bluetooth devices (On the right side of the windows bar, right click on the bluetooth icon, then select to show your bluetooth devices).



Figure 23 - Windows - Paired Bluetooth devices

- 3) Right click on your phone and select properties, then select services and from the list enable “serial port (SPP) ‘GPS2BT2’”.

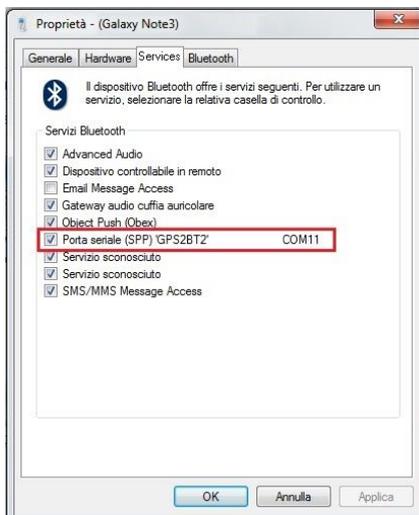


Figure 24 - Windows - Bluetooth device services

- 4) If everything went fine , in the hardware list of your PC is now possible to see a new COM interface associated to the GPS BT services of your phone.

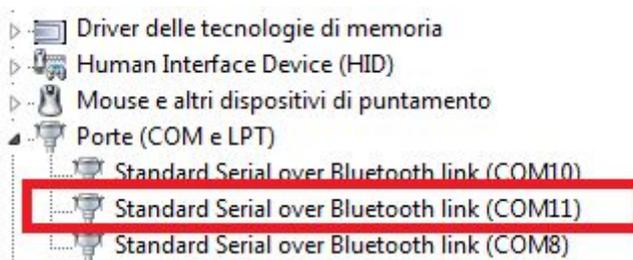


Figure 25 - Windows devices

In *RS41 Tracker* is now possible to set the new COM port into settings windows in order to use the GPS of your smartphone.

### 3.6 Auxiliary sensors

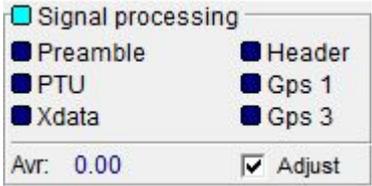
The RS41 sondes by Vaisala are equipped with a standard XData interface that is used to connect additional sensors.

The most part of the RS41 flights are without any aux sensors, but sometimes when special measurements are needed, one or more auxiliary sensors are used.

#### Detection

RS41 Tracker is able to detect and decode aux sensors presence providing detailed information to user.

This is performed by means of dedicated panels located into main screen.

	<p>Signal processing panel provides the Xdata indicator.</p> <p>Xdata blinks when at least one auxiliary sensor is present in sonde configuration.</p>
---	--

	<p>Indicators located into Xdata panel specifies which sensor is present.</p> <p>Currently the following are identified:</p> <ul style="list-style-type: none"><li>• Ozone,</li><li>• Cobald,</li><li>• CFH</li><li>• Skydew.</li></ul> <p>Different kind of sensors not present in the previous list are anyway detected and highlighted by means of an "Unknown" indicator.</p>
---	---

**In case you detect presence of unknown sensor, please provide me the RAW file: this will help RS41 Tracker to support new sensors.**

## Telemetry

RS41 Tracker is also able to decode aux sensor telemetries

These telemetries are shown in an additional window automatically opened by software when the Xdata flow is detected.

If you are not interested in auxiliary sensor telemetries you can simply close the auxiliary sensor windows.



Once closed you can reopen it using the **AUX DATA** button. This button is only enabled if aux sensors are present.

For each sensor a dedicated panel is used. The following sensor telemetry panels are defined

<p style="text-align: center;"><b>MW41 Ozone Interface Board (OIF411, Vaisala)</b></p>  <p style="text-align: center;">Figure 26 - OIF411 panel</p>	<p style="text-align: center;"><b>Compact Optical Backscatter Aerosol Detector (Cobald, ETH Zurich)</b></p>  <p style="text-align: center;">Figure 27 - Cobald panel</p>
<p style="text-align: center;"><b>Cryogenic Frostpoint Hygrometer (CFH, EN-SCI)</b></p>  <p style="text-align: center;">Figure 28 - CFH panel</p>	<p style="text-align: center;"><b>Peltier-based chilled-mirror hygrometer (SKYDEW, Meisei)</b></p>  <p style="text-align: center;">Figure 29 - Skydew telemetries</p>

### 3.7 Audio signal monitor

The Audio signal monitor functionality allow user to verify quality of audio signal provided as input to *RS41 Tracker*.

It's an advanced scope that is able to synchronize its graphical output with the received radiosonde signal in order to show meaningful signal part and to allow a better signal trim (in term of volume/bandwidth).

User can open the audio signal monitor using the  button.

When a sonde is not received the monitor works as a normal scope: in this condition is possible to verify only signal level(typically noise).

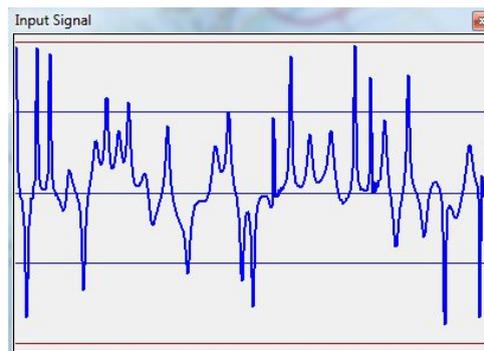


Figure 30 - Audio signal monitor (Noise)

When a sonde is received the monitor will shown two meaningful part of received signal(alternated): the Preamble and the first bytes of the Rs41 data packet (valid data).

This will allow the user to verify signal level but also signal quality in term of bandwidth and waveform.

An example of good signal (level and bandwidth) is shown in the following examples

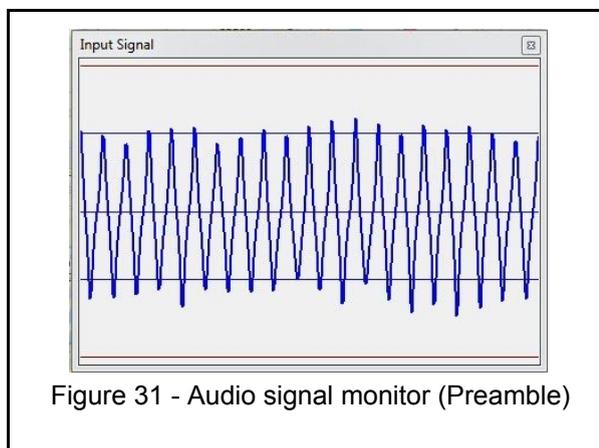


Figure 31 - Audio signal monitor (Preamble)

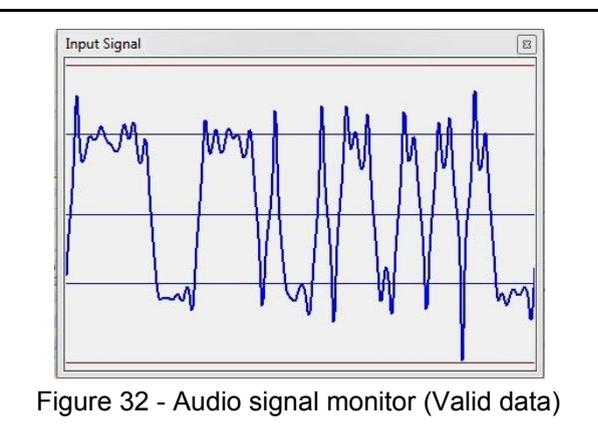


Figure 32 - Audio signal monitor (Valid data)

Maximum level of signal are highlighted with red lines.

### 3.8 Diagrams window

This window is intended to show several diagrams related to rs41 sonde. Currently a preliminary version of Stüve diagram is supported (work in progress....)

User can open the diagrams window using the  button.

Each diagram is updated in real time while a radiosonde is received (or a RAW file is played). Please bear in mind that, as reported in chapter 5, telemetries have to be considered as estimation: the same concept is applicable to diagrams. The following picture reports an example of Stüve diagram generated by *RS41 Tracker*.

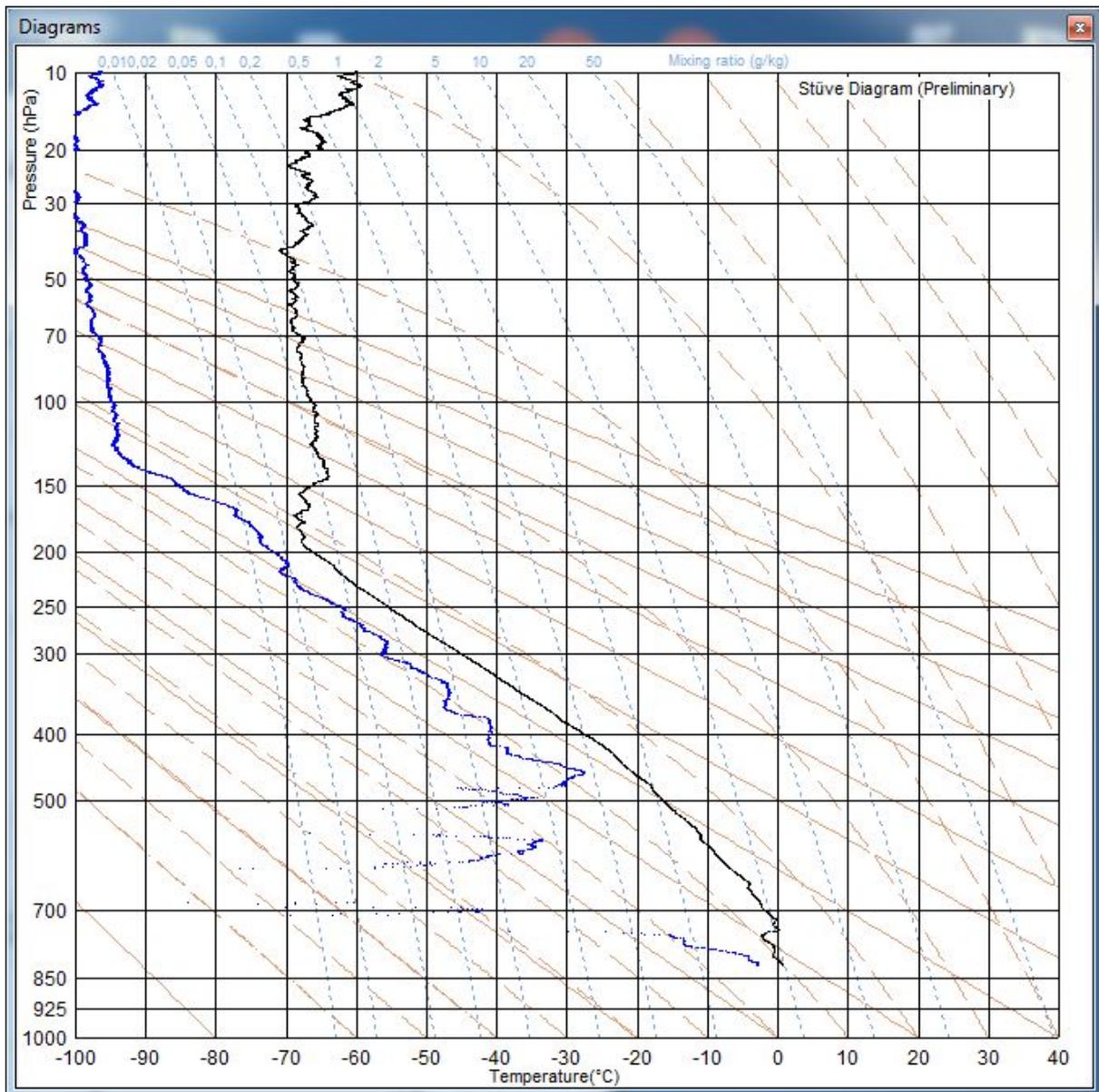


Figure 33 - Stüve diagram example

## 3.9 Map downloader tool

The map engine of RS41 Tracker is able to operate using map tiles located on your local hard drive or downloaded from internet.

In portable stations running software, the internet connection may be not available: this tool allows to pre download maps (when internet connection is available) in order to operate portable station in stand alone mode.

### Important considerations on map tile

As previously mentioned in this manual, maps are not monolithic files but they consist of several tiles. Tiles are png images 256x256 pixel and **each file is about 20-40 Kbytes in size.**

An important role is played by the zoom level: to each zoom level is associated a different map.

This means that tiles composing map at zoom level <n> doesn't belong to any other map at different zoom level.

Moreover the number of tiles composing a single map increasing with zoom level (they twice for each axes).

To clarify this concept please look at the following pictures

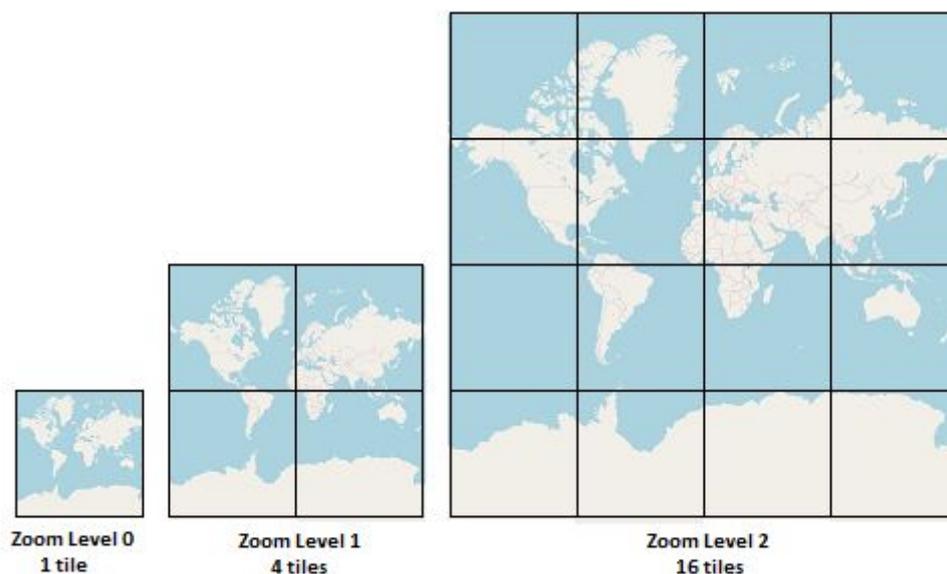


Figure 34 - Map tile decomposition

High zoom level means high number of tiles -> high disk space required to save map.

Map downloader tool can be activated pressing the  button on the menu toolbar of the main window.

Once opened the following window appears:



Figure 35 - Map downloader window (1/2)

Instructions are directly reported into window: to download a map it's necessary to perform the following steps:

- Into the main windows, where the map is shown, select the map region you want to download.
- You also have to choose which kind of map you want to download (currently OpenStreetMap or OpenTopoMap)
- The starting zoom level is the one reported into the main window (current zoom level of the map). It's necessary to specify which level of zoom you want to reach in download.
- It's recommended to take care of the statistics part of the window where the "tile to download" parameter is reported. Remember that each tile can be 20-40 KBytes
- The "Overwrite old files" flag allows to overwrite the existing tiles. This is useful for update old map or to download big map using different download section (uncheck means to download missing tile only).

Once pressed the download button and confirmed the operation it's possible to verify the progress in the status bar of the window

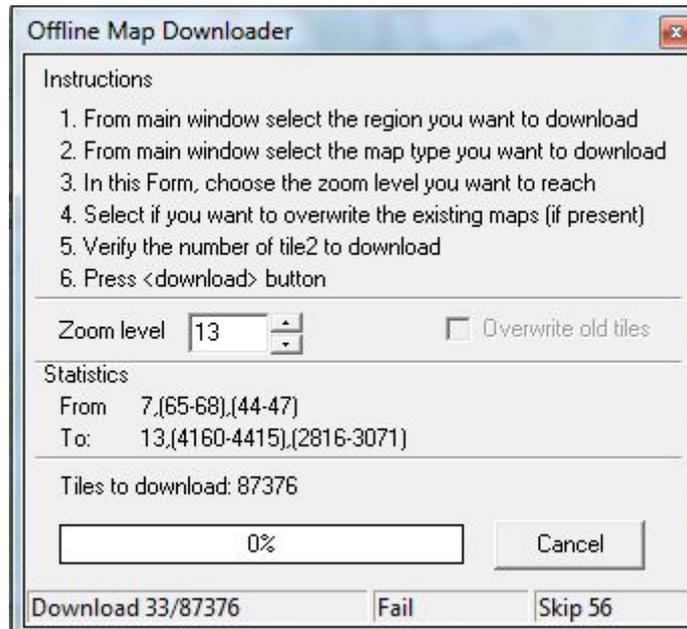


Figure 36 - Map downloader window (2/2)

It's possible to see the download percentage, the number of downloaded files over the total. In the end, skip are the number of tiles not downloaded because already present on disk while Fail are the number of tiles not downloaded due to connection error.

## 4 Time Expiration

This is an engineering software and for this reason a lots of releases are foreseen. The intent of time expiration is to reduce the number of different software versions running at the same time, simplifying the maintenance activities. The software version you're using is expired? Simply download and run the latest updated release.

## 5 Telemetries accuracy

Due to lack of information of Rs41 radiosonde, not all telemetries reported by *RS41 Tracker* are accurate: the following parameters have to be considered as estimation:

- GPS Signal level
- Temperature
- Pressure
- Humidity
- Dew Point

Remain parameters have to be considered accurate.

## 6 Software license

The software provided under this license is provided as Freely Available Copyrighted Software ("Freeware"), which means:

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## 7 Support

*RS41 Tracker* is provided free of charge but if you want you can support my software development activity in a very unusual way: go to your amazon account and donate me an e-gift. Values start from 0,15 euro. (15 cent).

If possible please directly use the amazon italian site (amazon account works worldwide) and choose delivery by mail: [escursioni@altervista.org](mailto:escursioni@altervista.org).

You can find the step by step procedure that can be used to donate a gift card using the Amazon italian site in the Support section of the webpage

<http://escursioni.altervista.org/Radiosonde/>

Feedback,suggestions and bugs reports are also welcome.

Thanks.

IW1GIS - Diego