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# **MARSIS/SHARAD viewer plug-in for QGIS**

***Release 0.9***

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## ABOUT THE PLUG-IN

*MARSIS/SHARAD viewer* is a plug-in for the QGIS software (<http://www.qgis.org/>). It's aim is to provide an easy way to visualize radargrams from MARSIS (<http://sci.esa.int/mars-express/34826-design/?fbodylongid=1601>) and SHARAD (<http://mars.nasa.gov/mro/mission/instruments/sharad/>) ground penetrating radars.

It is written in Python and uses the PyQtGraph (<http://www.pyqtgraph.org/>) library for 2D and 3D plots rendering.

The plug-in is made to work together with the MARSIS and SHARAD tracks DB as provided by EPFL-eSpace (see tracks DB documentation for details).

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## INSTALLATION

### 2.1 Install dependencies

#### 2.1.1 GNU/Linux

##### Debian 8 (Jessie)

###### Enable backports repository

Enabling the official *debian backports repository* allows to install a more recent version of QGIS. You can skip this step if you are happy with the version provided in the main repository.

Add the following line to the file */etc/apt/sources.list* (root privileges required):

```
deb http://ftp.debian.org/debian wheezy-backports main
```

Run repos update (as root):

```
# apt-get update
```

More information about *Debian backports* can be found here

<http://backports.debian.org/>

Official **QGIS** repositories providing newer versions of the software can be added following the instruction in

<http://qgis.org/en/site/forusers/alldownloads.html#debian-ubuntu>

###### Install QGIS and dependencies

Install python and python packages:

```
# apt-get install python-numpy python-qt4 python-pil
```

Check the available QGIS versions:

```
# apt-cache showpkg qgis
```

The output should begin like this:

```
Package: qgis
Versions:
2.14.5+dfsg-1~bpo8+1 (/var/lib/apt/lists/ftp.ch.debian.org_debian_dists_jessie-...
Description Language:
    File: /var/lib/apt/lists/ftp.ch.debian.org_debian_dists_jessie-...
    MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language: en
    File: /var/lib/apt/lists/ftp.ch.debian.org_debian_dists_jessie-...
    MD5: 49f76973cc4c2bd4a16872b7a79659ad
2.4.0-1+b1 (/var/lib/apt/lists/ftp.ch.debian.org_debian_dists_jessie_main_bina...
Description Language:
```

```
File: /var/lib/apt/lists/ftp.ch.debian.org_debian_dists_jessie...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language: en
File: /var/lib/apt/lists/ftp.ch.debian.org_debian_dists_jessie...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
```

To install the most recent version:

```
# apt-get install qgis=2.14.5+dfsg-1~bpo8+1
```

*Take care of replacing the version with the actual version available in the repository at the installation time.*

### Ubuntu 16 LTS (Xenial Xerus)

#### Enable Ubuntu GIS repository

Enabling the *Ubuntu GIS unstable repository* allows to install a more recent version of QGIS. You can skip this step if you are happy with the version provided in the main repository.

Add the following line to the file */etc/apt/sources.list* (root privileges required):

```
deb http://ppa.launchpad.net/ubuntugis/ubuntugis-unstable/ubuntu xenial main
deb-src http://ppa.launchpad.net/ubuntugis/ubuntugis-unstable/ubuntu xenial main
```

Run repos update:

```
# sudo apt-get update
```

More information about *Ubuntu GIS* can be found here

<http://wiki.ubuntu.com/UbuntuGIS>

<http://trac.osgeo.org/ubuntugis/wiki/UbuntuGISRepository>

Official **QGIS** repositories providing newer versions of the software can be added following the instruction in

<http://qgis.org/en/site/forusers/alldownloads.html#debian-ubuntu>

#### Install QGIS and dependencies

Install python and python packages:

```
# apt-get install python-numpy python-qt4 python-pil
```

Check the available QGIS versions:

```
# apt-cache showpkg qgis
```

The output should begin like this:

```
Package: qgis
Versions:
2.14.1+dfsg-3~xenial0 (/var/lib/apt/lists/ppa.launchpad.net_ubuntugis_ubuntugis-...
Description Language:
File: /var/lib/apt/lists/ch.archive.ubuntu.com_ubuntu_dists_xen...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language:
File: /var/lib/apt/lists/ch.archive.ubuntu.com_ubuntu_dists_xen...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language: en
File: /var/lib/apt/lists/ch.archive.ubuntu.com_ubuntu_dists_xen...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language:
File: /var/lib/apt/lists/ppa.launchpad.net_ubuntugis_ubuntugis-...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language:
```



```

File: /var/lib/apt/lists/ppa.launchpad.net_ubuntu_gis_ubuntu_gis...
MD5: 49f76973cc4c2bd4a16872b7a79659ad

2.8.6+dfsg-1build1 (/var/lib/apt/lists/ch.archive.ubuntu.com_ubuntu_dists_xenial...
Description Language:
File: /var/lib/apt/lists/ch.archive.ubuntu.com_ubuntu_dists_xeni...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language:
File: /var/lib/apt/lists/ch.archive.ubuntu.com_ubuntu_dists_xeni...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language: en
File: /var/lib/apt/lists/ch.archive.ubuntu.com_ubuntu_dists_xeni...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language:
File: /var/lib/apt/lists/ppa.launchpad.net_ubuntu_gis_ubuntu_gis-u...
MD5: 49f76973cc4c2bd4a16872b7a79659ad
Description Language:
File: /var/lib/apt/lists/ppa.launchpad.net_ubuntu_gis_ubuntu_gis-u...
MD5: 49f76973cc4c2bd4a16872b7a79659ad

```

To install the most recent version:

```
# apt-get install qgis=2.14.1+dfsg-3~xenial0
```

*Take care of replacing the version with the actual version available in the repository at the installation time.*

## CentOS 7

### Enable EPEL repository

Install the proper package and update the system:

```
# sudo yum install epel-release
# sudo yum update
```

### Install QGIS and dependencies

```
# sudo yum install numpy python-pillow PyQt4 qgis
```

## 2.1.2 Apple OSX

### Download and install QGIS

Download and install *QGIS* from <https://www.qgis.org/en/site/forusers/download.html#mac> or directly from <http://www.kyngchaos.com/software/qgis>

### Download and install dependencies

From <http://www.kyngchaos.com/software/python> install the following packages:

- NumPy
- PIL

## 2.1.3 Microsoft Windows

### Download and install QGIS

Download and install the *QGIS standalone installer* of your choice from

<http://www.qgis.org/en/site/forusers/download.html>

The package contains all the required libraries .

## 2.2 Install MARSIS/SHARAD plug-in

### 2.2.1 Download MARSIS/SHARAD viewer

You can alternatively do one of the following

- Download the latest release version (or any other version at your choice) from

<https://github.com/eSpaceEPFL/marsissharadviewer/releases>

and uncompress the archive.

- Get the development version from

<https://github.com/eSpaceEPFL/marsissharadviewer>

by clicking on the green button ‘clone or download’.

Uncompress the archive if you downloaded the *zip* file.

Cloning the repository requires you have [Git](#) installed on your machine.

### 2.2.2 Installing the plug-in

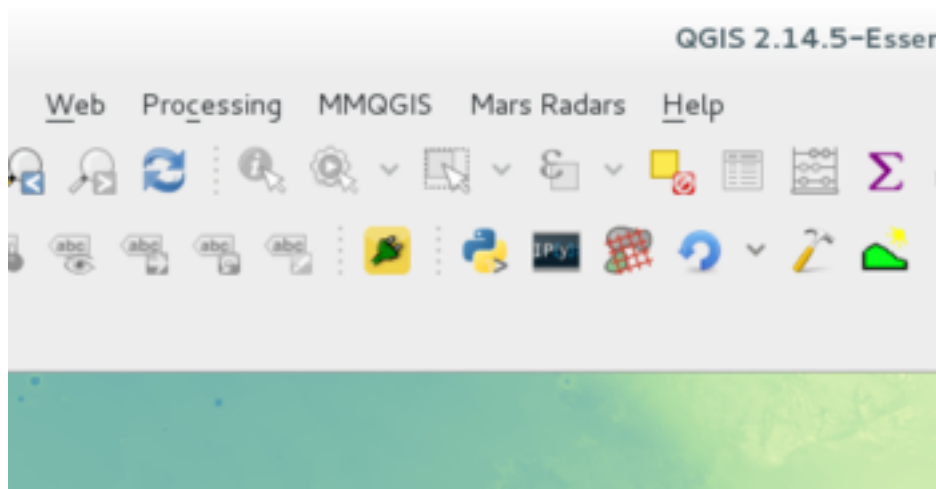
Copy the folder *marsissharadviewer* containing the plug-in files in the QGIS plug-ins folder.

**The folder may be named *marsissharadviewer-`<branch_name>`*. Rename it to *marsissharadviewer*.**

**Location of the QGIS plug-ins folder**

Operating system	Folder location
GNU/Linux	/home/{username}/.qgis2/python/plugins
OSX	/Users/{username}/.qgis2/python/plugins
Windows	C:\users\{username}\.qgis2\python\plugins

Launch QGIS, the ‘*Mars Radars*’ menu should appear in the menu bar as show in the figure below.



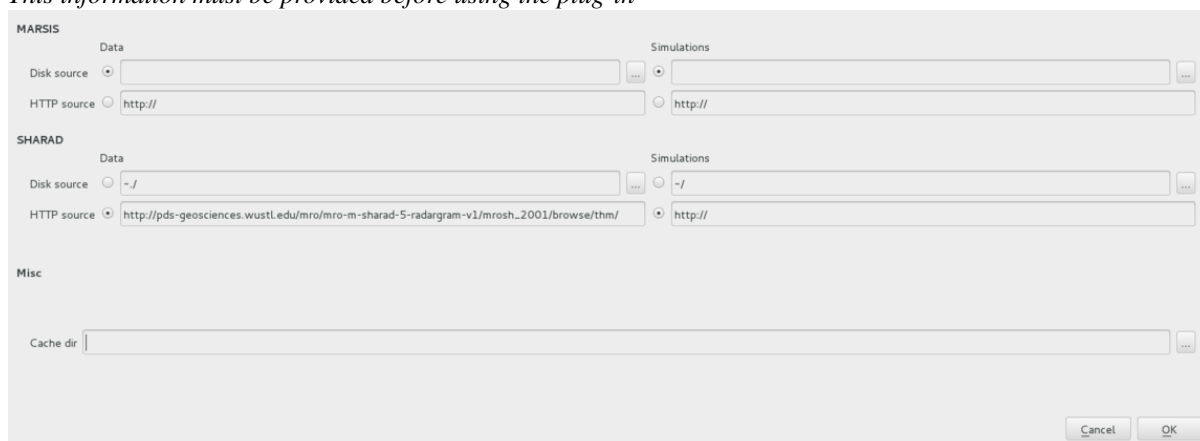
## USING THE PLUG-IN

### 3.1 Set plug-in preferences

Open the *Mars radars->Settings* dialog from the menu bar.

The dialog (see the figure below) allows to set the radargram source and the plug-in cache directory.

*This information must be provided before using the plug-in*



Radargrams (and possibly clutter simulations) can be fetched both from the disk and from a web server via *http* protocol.

Default server for the *SHARAD* radargrams

([http://pds-geosciences.wustl.edu/mro/mro-m-sharad-5-radargram-v1/mrosh\\_2001/browse/thm/](http://pds-geosciences.wustl.edu/mro/mro-m-sharad-5-radargram-v1/mrosh_2001/browse/thm/))

is already set.

Regarding *MARSIS* data, since an official repository is not yet available, local copy of the data must be set up.

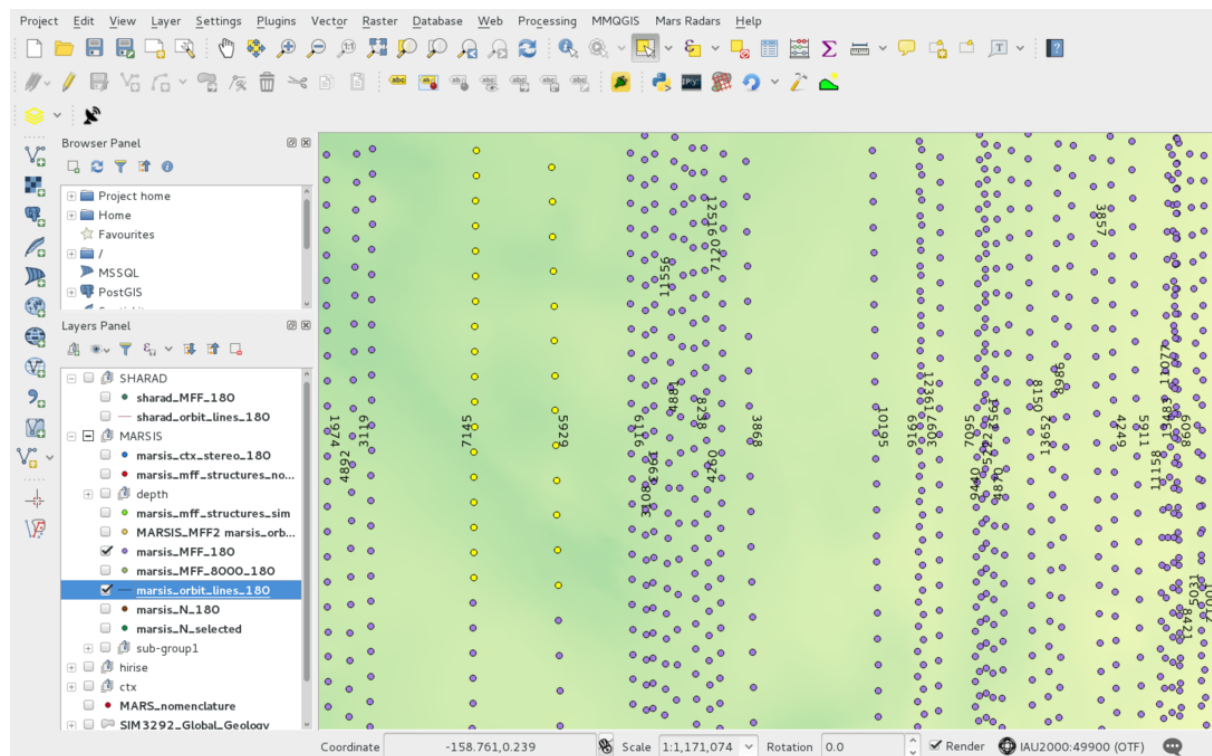
### 3.2 Orbits selection

The MARSIS/SHARAD viewer will show data on the basis of the selected features on the QGIS map.

Features can be selected with any selection tool provided by QGIS. A multiple layer selection plug-in (<http://plugins.qgis.org/plugins/MultipleLayerSelection/>) can be useful.

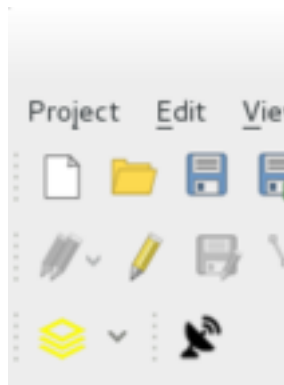
Layers containing MARSIS and SHARAD tracks features must have their name starting with *marsis\_* and *sharad\_* respectively in order to be correctly recognised

The image below shows a QGIS map with selected features on two MARSIS tracks.



### 3.3 Running the plug-in

Once the features of interest are selected, the plug-in can be started using either the *Mars radars* > *MARSIS/SCHARAD Viewer* menu or by pressing the plug-in launch button (see figure below).



The viewer will open and show the radargrams belonging to the selected orbits.

#### 3.3.1 Single radargram viewer

The *Single radargram* is the default view provided by the plug-in.

Radargrams belonging to the selected orbits will be shown, one orbit per row. For MARSIS data one radargram per frequency band will be shown.

The section of the radargram highlighted with a blue band is the region corresponding to the selected features on the map. Plots can be zoomed and panned. For each plot, a vertical and an horizontal marker line are available.

Radio buttons at the top of the viewer allows to select among only radargrams, only clutter simulation and superposed view, using different look up table preset. The *swap last two* button toggle between the views corresponding to the last two selected radio buttons.

In case of MARSIS data, the plots of the different frequencies are synchronised.



### Adjusting the selection

Moving the highlight selection will cause the features selection on the QGIS map to change accordingly. (*It is suggested to use this functionality with a small subset of orbits for a good responsiveness of the system*)

### Subsurface depth measurement

The *subsurfaces depth measurement tool* allows to select subsurfaces and measure their depth with respect to the planet surface saving data on QGIS layers.

On each plot, the tool can be accessed by right-clicking on the mouse/touch-pad and positioning the mouse pointer on *Depth measurement* on the context menu. The following options are available:

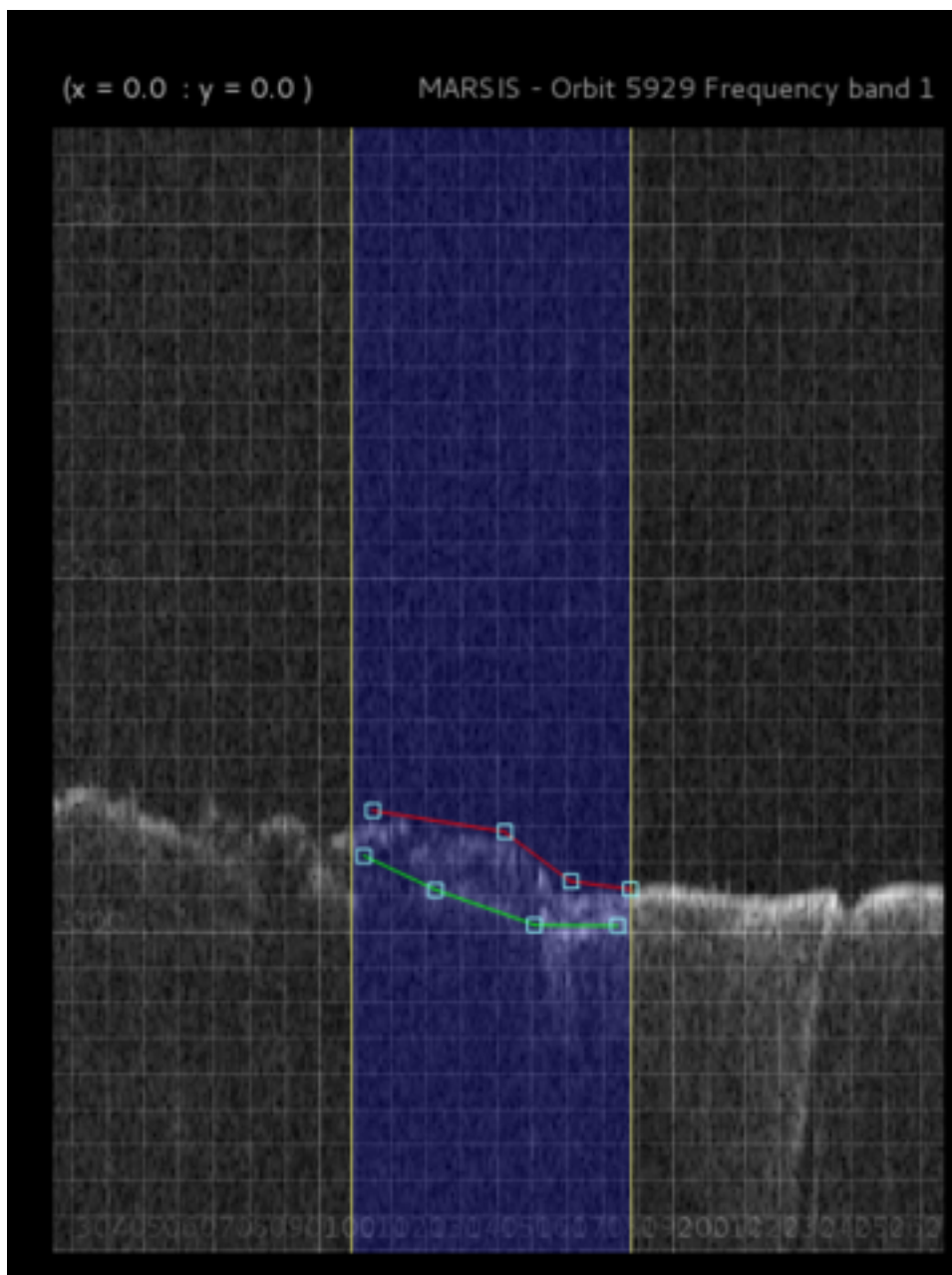
- Add surface line
- Add subsurface line
- Measure...
- Load lines from selected layer

**Add surface line** add a line to be used to draw the surface. New *handles* can be added to the line clicking on it, to split the line in segments. The line and each handle can be moved to match the surface. Only one *surface line* can be added to the plot.

**Add subsurface line** add a line to be used to draw a subsurface. The *subsurface lines* act as the *surface line*. An arbitrary number of *subsurface lines* can be added to the plot.

**Measure...** compute the subsurfaces depth. Computed data (in pixels and time), together with the position of the line's handles, are stored in a new memory layer automatically added to the QGIS map. Since memory layers are not automatically saved by QGIS, a copy of the layer in *SQLite* format is saved in the *cache directory* selected in the *settings dialog*.

**Load lines from selected layer** load surface and subsurface lines from a proper selected layer. The user must select the correct layer to load data from **before** using the command.



### 3.3.2 Synchronised viewer

The *synchronised view* acts as the default view except the radargrams belonging to different orbits are aligned by latitude and linked when zooming and panning. The aim of the view is to help to inspect structures in close, quasi-parallel radargrams.

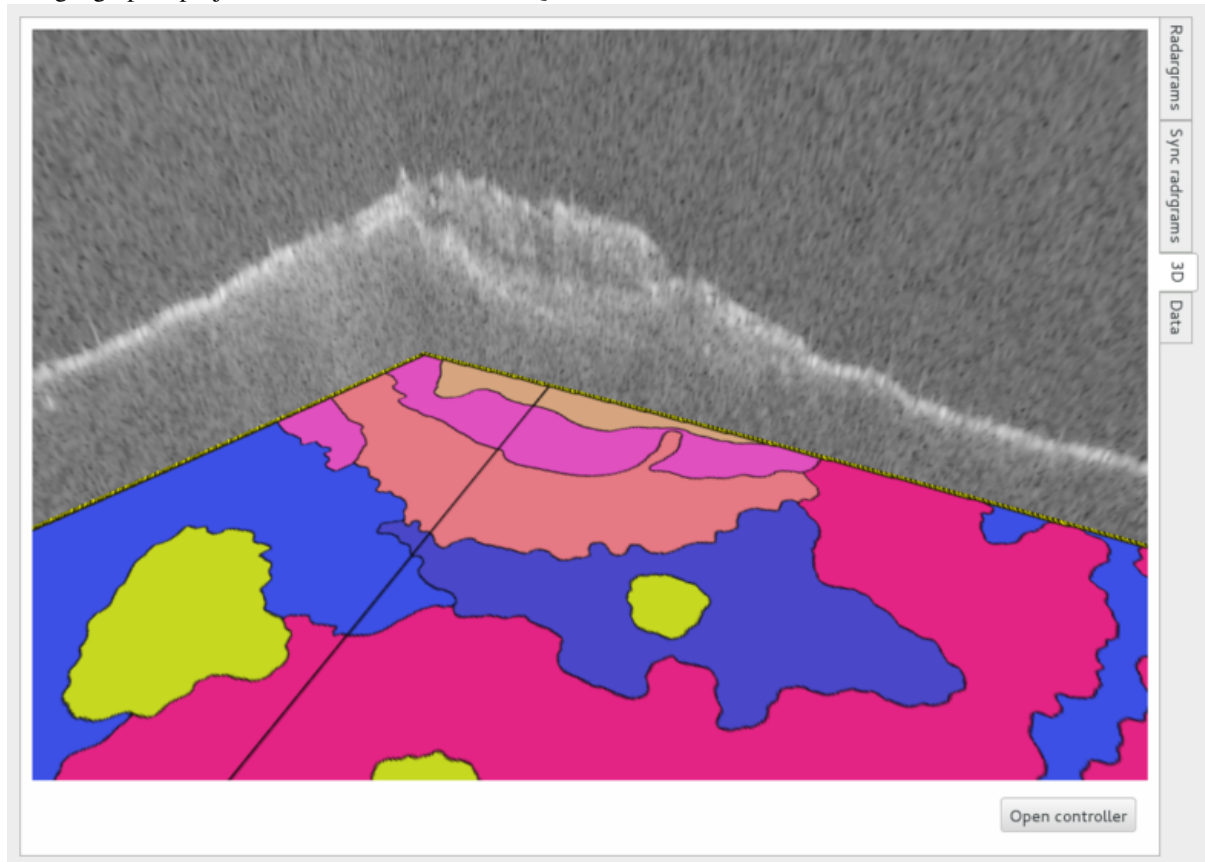
The alignment is done on the selected area (blue highlight bands) corresponding to the features selection of the QGIS map. Outside this region, the latitude alignment is not guaranteed.

Highlight region editing and subsurface selection are currently **not** available in this view.

### 3.3.3 3D viewer

The *3D view* shows a 3D representation of the radargrams in the space, together with the map layer selected on the QGIS map. The aim of the view is to show intersecting radargrams, especially in the polar regions.

The geographic projection is the one selected on QGIS.



#### Radargrams alignment

The *Open controller* button opens a dialog to toggle the visibility and adjust the vertical alignment of each radar-gram as well as the map layer.