MARS ground penetrating radars tracks GIS vector layers Documentation

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CHAPTER

ONE

ABOUT THE DB

This is a short documentation about the database of tracks' **geometric data and metadata** of the two MARS ground penetrating radars existing so far: MARSIS (http://sci.esa.int/mars-express/34826-design/?fbodylongid=1601) and SHARAD(http://mars.nasa.gov/mro/mission/instruments/sharad/). The data are available as **vector layers** to be used with **GIS software**.

The database is a result of the contribution of the EPFL Space Engineering Center (http://espace.epfl.ch/) **to the iMars grant agreement n°607379 (http://www.i-mars.eu/) of the European Union's Seventh Framework Programme (FP7/2007-2013).**

The layers are available through a direct connection to a PostgreSQL/PostGIS DBMS (http://postgis.net/ http://www.postgresql.org/).

CHAPTER

TWO

AVAILABLE LAYERS

Several layers are available for MARSIS and SHARAD tracks data.

_points layers contain, for each radar sampling point, geometric data and other metadata. For the list of the included data see Included data (page 5).

_lines layers are intended for a quick visualization of the orbits' footprint without providing further details included in the *_points* layers. They can be used to show the track number on the QGIS canvas and maps.

In the layers named with the **_180_ suffix**, the **longitude** is represented **between -180° and +180°**. In the other layers the longitude is represented **between 0° and 360°**.

2.1 PostGIS DB

For the PostGIS connection parameters refer to PostGIS connection parameters (page 7)

2.1.1 MARSIS layers

- *marsis_orbit_points*: MARSIS sampling points (longitude between 0° and 360°. Features geometry type is *point*)
- *marsis_orbit_points_180*: MARSIS sampling points (longitude between -180° and 180°. Features geometry type is *point*)
- *marsis_orbit_lines*: MARSIS orbit tracks (longitude between 0° and 360°. Features geometry type is *line*)
- *marsis_orbit_lines_180*: MARSIS orbit tracks (longitude between -180° and 180°. Features geometry type is *line*)

2.1.2 SHARAD layers

- *sharad_orbit_points*: SHARAD sampling points (longitude between 0° and 360°. Features geometry type is *point*)
- *sharad_orbit_points_180*: SHARAD sampling points (longitude between -180° and 180°. Features geometry type is *point*)
- *sharad_orbit_lines*: SHARAD orbit tracks (longitude between 0° and 360°. Features geometry type is *line*)
- *sharad_orbit_lines_180*: SHARAD orbit tracks (longitude between -180° and 180°. Features geometry type is *line*)

2.2 SQLite files

The aforementioned tracks layers are also available in *SQLite* format from https://drive.google.com/open?id=0B_iYniNmEIOVVXZFRmZoeWN5MnM.

Google drive account is required to download the files.

The files are *zipped*.

For both MARSIS and SHARAD, the tracks files are the following:

- *_N_Pole.sqlite*: North pole, latitude > 70°, longitude between 0° and 360°
- *_N_Pole_180.sqlite*: North pole, latitude > 70°, longitude between -180° and 180°
- *_S_Pole.sqlite*: North pole, latitude < -70°, longitude between 0° and 360°
- *_S_Pole_180.sqlite*: North pole, latitude < -70°, longitude between -180° and 180°
- *_0_60E*: Longitude between 0° and 60°, latitude between -70° and 70°
- *_60_120E*: Longitude between 60° and 120°, latitude between -70° and 70°
- *_120_180E*: Longitude between 120° and 180°, latitude between -70° and 70°
- *_180_240E*: Longitude between 180° and 240°, latitude between -70° and 70°
- *_240_300E*: Longitude between 240° and 300°, latitude between -70° and 70°
- *_300_360E*: Longitude between 300° and 360°, latitude between -70° and 70°
- *_0_60W_180*: Longitude between 0° and -60°, latitude between -70° and 70°
- *_60_120W_180*: Longitude between -60° and -120°, latitude between -70° and 70°
- *_120_180W_180*: Longitude between -120° and -180°, latitude between -70° and 70°
- *_orbit_lines*: Longitude between 0° and 360°, latitude between -90° and 90°
- *_orbit_lines_180*: Longitude between -180° and 180°, latitude between -90° and 90°

Further layers including MOLA raster map, USGS geologic map and Mars nomenclature are available here https://drive.google.com/open?id=0B_iYniNmEIOVMXZ6aTJ2MGtGdVE.

CHAPTER

THREE

INCLUDED DATA

For each radar sampling point, the *points* layers provide the follwing data:

3.1 MARSIS layers:

- *point_id*: id of the corresponding radargram column
- *scetw*: SCET timeof the frame (whole)
- *scetf*: SCET timeof the frame (frac)
- *ephemt*: Ephemeris time (number of seconds since Jan 1 2000 - 12:00 UTC)
- *geoep*: Ephemeris time in UTC format
- *sunlon*: Mars solar longitude
- *sundist*: Mars to Sun distance
- *orbit*: Orbit number of the related dataproduct
- *target*: Celestial body observed
- *tarscx*: Target posistion (X component)
- *tarscy*: Target posistion (Y component)
- *tarscz*: Target posistion (Z component)
- *scalt*: Distance from the Mars Express spacecraft to the reference surface
- *scelon*: Longitude of the footprint location
- *sclat*: Latitude of the footprint location
- *tarscvx*: Mars Express spacecraft velocity vector in the reference frame of the target body (X component)
- *tarscvy*: Mars Express spacecraft velocity vector in the reference frame of the target body (Y component)
- *tarscvz*: Mars Express spacecraft velocity vector in the reference frame of the target body (Z component)
- *tarscradv*: Radial component of the Mars Express spacecraft velocity vector in the reference frame of the target body
- *tarsctanv*: Tangential component of the Mars Express spacecraft velocity vector in the reference frame of the target body
- *locsunt*: Local true solar time
- *sunzenith*: Solar zenith angle
- *dipx*: Unit vector directed along MARSIS dipole Antenna in the reference frame of the target body (X component)
- *dipy*: Unit vector directed along MARSIS dipole Antenna in the reference frame of the target body (Y component)

- *dipz*: Unit vector directed along MARSIS dipole Antenna in the reference frame of the target body (Z component)
- *monox*: Unit vector directed along MARSIS monopole Antenna in the reference frame of the target body (X component)
- *monoy*: Unit vector directed along MARSIS monopole Antenna in the reference frame of the target body (Y component)
- *monoz*: Unit vector directed along MARSIS monopole Antenna in the reference frame of the target body (Z component)
- *f1*: Values in Hz of the first radar frequency
- *f2*: Values in Hz of the second radar frequency
- *snr_f1_m1*: Signal to noise ratio of the first frequency band, filter -1
- *snr_f1__0*: Signal to noise ratio of the first frequency band, filter 0
- *snr_f1_p1*: Signal to noise ratio of the first frequency band, filter 1
- *snr_f2_m1*: Signal to noise ratio of the second frequency band, filter -1
- *snr_f2__0*: Signal to noise ratio of the second frequency band, filter 0
- *snr_f2_p1*: Signal to noise ratio of the second frequency band, filter 1
- *qi1*: Overall track quality index as reported in official L2 data release (frequency band 1)
- *qi2*: Overall track quality index as reported in official L2 data release (frequency band 2)

3.2 SHARAD layers:

The data provided in the SHARAD layers are those included in the SHARAD geometric data files (http://pds-geosciences.wustl.edu/mro/mro-m-sharad-5-radargram-v1/mrosh_2001/data/geom/)

- *point_id*: id of the corresponding radargram column
- *epoch*: UT date and time of observation
- *lat*: Latitude of the footprint location
- *lon*: Longitude of the footprint location
- *mars_r*: Radius of Mars at the footprint time
- *sc_r*: Distance from center of mass to MRO
- *rad_v*: MRO radial velocity
- *tan_v*: MRO tangential velocity
- *sza*: Solar zenith angle
- *phase*: Signal phase distortion
- *orbit*: Orbit number of the related dataproduct

CHAPTER

FOUR

POSTGIS CONNECTION PARAMETERS

4.1 eSpace Mars radars tracks layers DB

Host: redmine-espace.epfl.ch
Port: 5432
Database: radartracks
Username: radaruser

Please write an email to federico.cantini@epfl.ch or anton.ivanov@epfl.ch to get the password.

CHAPTER

FIVE

GETTING LAYERS SUBSETS USING GDAL'S OGR2OGR

"GDAL (http://www.gdal.org/) is a translator library for raster and vector geospatial data formats that is released under an X/MIT style Open Source license by the Open Source Geospatial Foundation (http://www.osgeo.org/)."

Using the proper GDAL utility it is possible to **download subsets of data from MARSIS and SHARAD layers and saving it in one of the format managed by GDAL**. This can be useful to work without a network connection, download only the data of interest and can also lead to QGIS performance improvement.

5.1 Download GDAL

Information about GDAL download and installation for GNU/Linux, OSX and Windows operating systems can be found here: (https://trac.osgeo.org/gdal/wiki/DownloadingGdalBinaries)

GDAL sources can be downloaded from here (http://download.osgeo.org/gdal/)

5.2 Getting layers subsets

The GDAL utility to fetch layers subsets is *ogr2ogr* (http://www.gdal.org/ogr2ogr.html). It is included in the GDAL installation.

The generic syntax of *ogr2ogr* command is the following:

```
ogr2ogr -f "driver" filename PG:"host=redmine-espace.epfl.ch user=dbuser
    dbname=dbname password=password" layer_name -spat min_lon min_lat
    max_lon max_lat -where "restricted_where" -select "field1, field2 [,...]"
```

- *driver*: name of the GDAL driver to use to write data
- *filename*: name of the output file
- *dbuser*: database username. Please refer to PostGIS connection parameters (page 7)
- *dbmane*: name of the database to fetch data from. Please refer to PostGIS connection parameters (page 7)
- *password*: password provided to the users
- *layer_name*: name of the layer to fetch data from. Please refer to Available layers (page 3)
- *min_lon min_lat max_lon max_lat*: longitude and latitude extent
- *restricted_where*: list of attribute to include in the output. Please refer to Included data (page 5)

5.2.1 examples:

```
ogr2ogr -f "GML" file.gml PG:"host=redmine-espace.epfl.ch user=dbuser dbname=dbname
     password=password" marsis_orbit_points_180 -spat -10 -30 10 30
```

Fetches data of MARSIS sampling points from table *marsis_orbit_points_180* with **longitude between 10°W and 10°E and latitude between 30°S and 30°N** and save it in *file.gml* using GML format.

```
ogr2ogr -f "SQLite" file.sqlite PG:"host=redmine-espace.epfl.ch user=dbuser
    dbname=dbname password=password" marsis_orbit_points_180
    -where "orbit>=8000 and orbit<=8999"
```

Fetches data of MARSIS sampling points from table *marsis_orbit_points_180* with **orbit number between 8000 and 8999** and save it in *file.sqlite* using SQLite format.

```
ogr2ogr -f "SQLite" file.sqlite PG:"host=redmine-espace.epfl.ch user=dbuser
    dbname=dbname password=password" marsis_orbit_points_180
     -select "orbit, point_id,sunzenith"
```

Fetches data of MARSIS sampling points from table *marsis_orbit_points_180* **restricted to orbit number, orbit point id and solar zenith angle** and save it in *file.sqlite* using SQLite format.

- For a detaild description* of *ogr2ogr* syntax please refer to http://download.osgeo.org/gdal/ or the documentation of your GDAL installation.