SENTINEL-3: GROUND TRACK DATA FILES – FILE TRANSFER DOCUMENT

1. INTRODUCTION

This is the File Transfer Document for the KML data files displaying the Sentinel-3A and Sentinel-3B orbit ground tracks for a complete cycle.

1.1 Change History

Issue	Change Description
1.0	First Issue
1.1	Ground track updated to be consistent with new S3 reference ANX longitude
1.2	Ground track calculated from ESOC FD S3A/S3B reference orbit files Correct relative orbit number displayed (dataset v1.1 was showing absolute orbit numbers instead)
1.3	Sentinel-3A ground track calculated from Orbit Scenario File Sentinel-3B ground track calculated with a phasing of 140 degrees wrt Sentinel-3A
1.4	Two additional KML files provided to have the ground-tracks for a common time interval (i.e. ordered by absolute orbit number)

1.2 Distribution List

Project/Unit	Name	Project/Unit	Name	Project/Unit	Name
Sentinel-3	J.P Batoufflet	Sentinel-3	C. Mavrocordatos	Sentinel-3	B. Seitz
Sentinel-3	C. Donlon	System Support	B. Duesmann	System Support	M. Piñol Solé

1.3 Reference Documents

[RD 01] OGC® KML Standard
Ref. OGC 12-007r2 - Version: 2.3.0 - Date: 2015-08-04

[RD 02] Earth Observation Mission CFI Software. EO_DATA_HANDLING Software User Manual.
Ref. EO-MA-DMS-GS-0007. Issue 4.12- 03/11/16

[RD 03] Google Earth Issue #1123: Long Line Paths Disappear on Zoom In
https://code.google.com/archive/p/earth-issues/issues/1123

2. ARCHIVE CONTENT

The following archive file has been delivered (generated with the zip utility):
EOCFI-FTD-011_1_4.zip

The archive has the following MD5 checksum:
2291e1e219441a8cc27d2fc016f18ce7

The archive contains the following files:
./S3A_abs_orbit_ground_track_10sec_v1_4.kml
./S3A_rel_orbit_ground_track_10sec_v1_4.kml
./S3B_abs_orbit_ground_track_10sec_v1_4.kml
./S3B_rel_orbit_ground_track_10sec_v1_4.kml

3. ARCHIVE CONTENT DESCRIPTION

The archive contains four KML files:

File	Description
S3A_abs_orbit_ground_track_10sec_v1_4.kml	KML file with S3A ground-track points for a complete cycle ,with a time step of 10 seconds, ordered by absolute orbit number
S3A_rel_orbit_ground_track_10sec_v1_4.kml	KML file with S3A ground-track points for a complete cycle, with a time step of 10 seconds, ordered by relative orbit number
S3B_abs_orbit_ground_track_10sec_v1_4.kml	KML file with S3B ground-track points for a complete cycle, with a time step of 10 seconds, ordered by absolute orbit number.
S3B_rel_orbit_ground_track_10sec_v1_4.kml	KML file with S3B ground-track points for a complete cycle, with a time step of 10 seconds, ordered by relative orbit number

The data that have been used as input for the generation of the KML data files are described in Section 6.

3.1 File Format Description

The format of the provide KML files is defined in KML Version 2.3 standard (see [RD 01]).

4. INSTALLATION

The archive can be expanded with Winzip / 7-zip (in MS Windows) or with the command unzip (in Linux/Mac OS).

5. USAGE

The ground-tracks in KML files
S3A_abs_orbit_ground_track_10sec_v1_4.kml
and
S3B_abs_orbit_ground_track_10sec_v1_4.kml
are ordered by absolute orbit number, covering a common time interval of 27 days (one cycle). Both the starting absolute orbit 4594 of S3A and the starting absolute orbit 4362 of S3B take place in day 1, around the same time. These files are useful to identify ground-tracks within a number of days in a time interval of one cycle.

The files
S3A_rel_orbit_ground_track_10sec_v1_4.kml
and
S3B_rel_orbit_ground_track_10sec_v1_4.kml
are ordered by relative orbit number within a cycle, so they do not cover the same time interval. For example, if relative orbit 1 for S3A would take place in day 1, then relative orbit 1 of S3B would take place in day 11. These files are useful to identify tracks based on relative orbit numbers, e.g. for planning purposes.

The KML files can be opened with Google Earth v7 or higher. After opening the files, the S3A and S3B ground-track data can be found in the “Places” window, under “Temporary Places”.

The screenshot below shows how the resulting Google Earth window after double-clicking on the S3A and S3B ground-track files ordered by absolute orbit number (**S3A_abs_orbit_ground_track_10sec_v1_4.kml** and **S3B_abs_orbit_ground_track_10sec_v1_4.kml**).

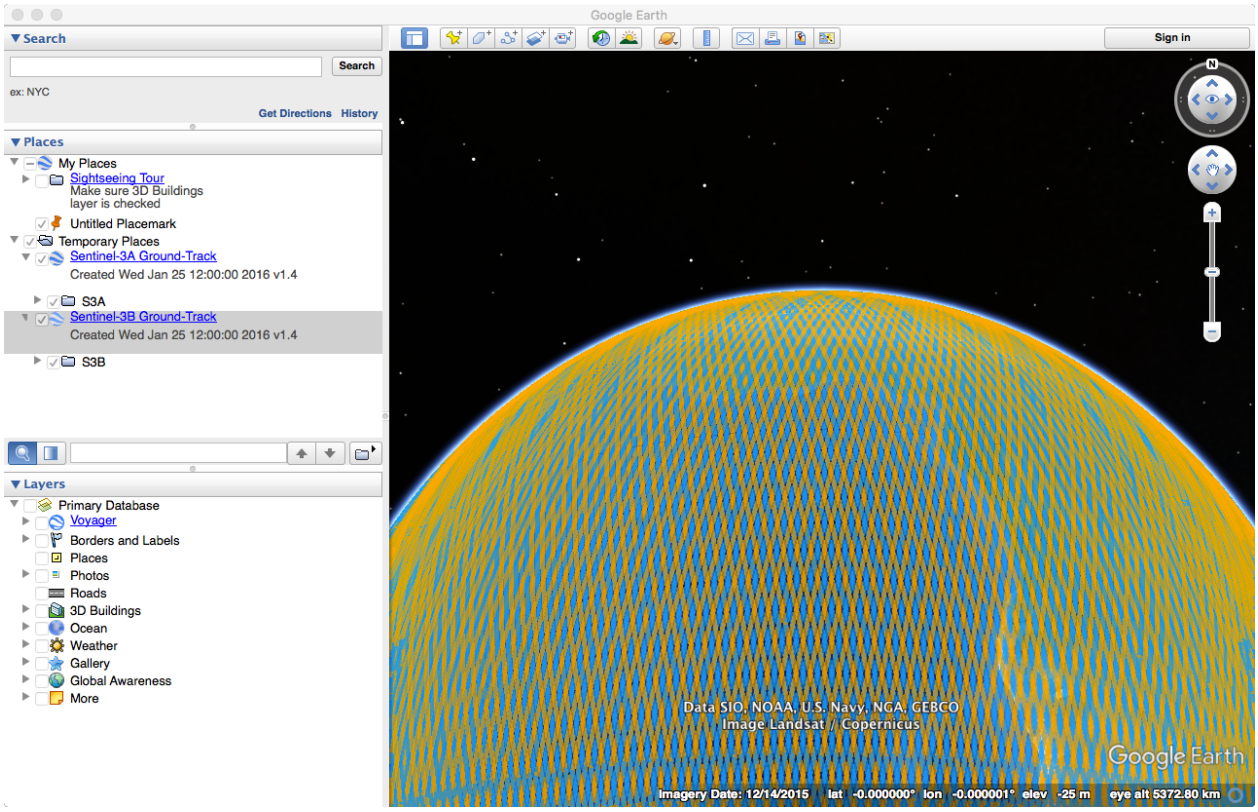

Figure 1: Google Earth Main Application Window

The S3A and S3B folders containing the ground track data can be opened (see **Figure 3**). In this example, the data has been sorted according to S3A or S3B absolute orbit numbers within the defined a given time window of 27 days / 385 orbits (one cycle).

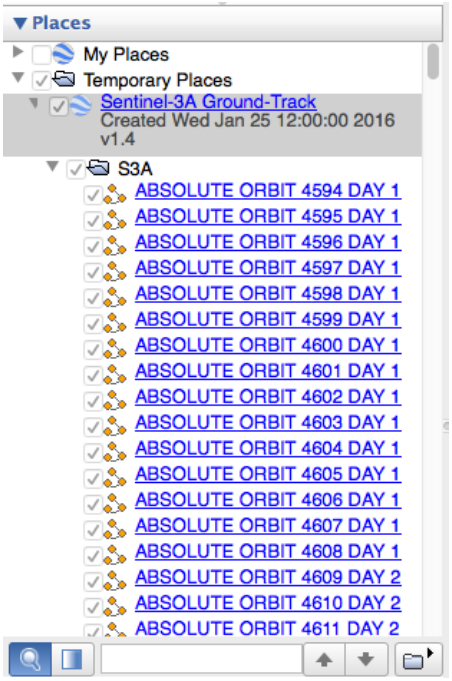

Figure 2: "Places" Tool Window, S3A ground track folder opened (absolute orbit)

If we instead open the KML ground-track files ordered by relative orbit number (`S3A_rel_orbit_ground_track_10sec_v1_4.kml` and

S3B_rel_orbit_ground_track_10sec_v1_4.kml), the data has been sorted according to S3A or S3B relative orbit numbers.
The relative orbit number spans from 1 to 385 (cycle length), see convention used in Section 6.3.

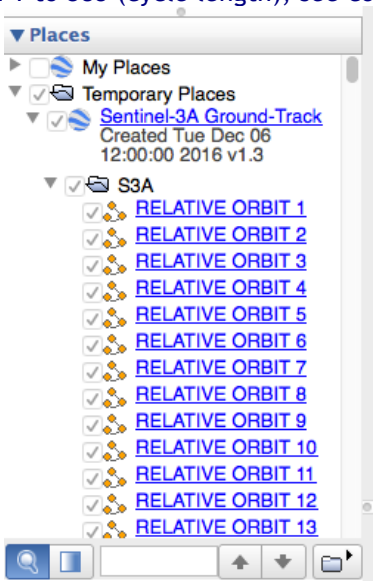

Figure 3: "Places" Tool Window, S3A ground track folder opened (relative orbit)

A couple of Google Earth screenshots after loading the KML files and zooming in are shown below. The orange lines represent the S3A orbit ground tracks and the blue lines correspond to the S3B orbit ground-tracks. When mousing over the ground-track lines, the lines are highlighted (increase in thickness and lighter in colour). Then by clicking on top of the track, a balloon showing additional information is displayed, namely the absolute and relative orbit number sand the longitude and UTC time of the ascending node crossing of the selected orbit.

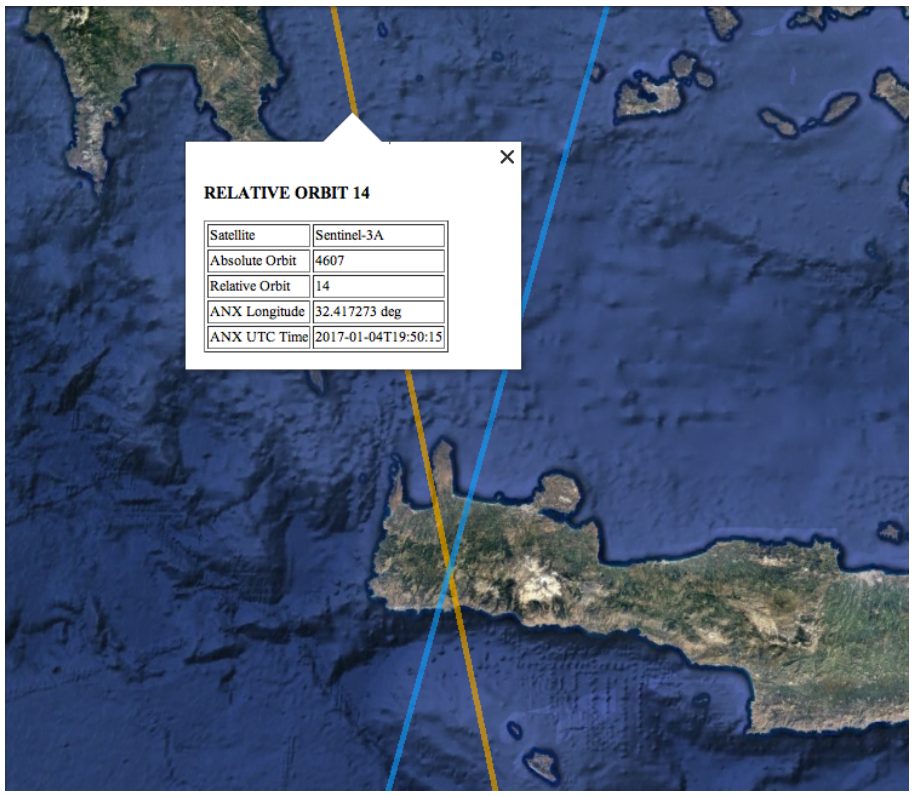

Figure 4: S3A ground track for relative orbit 14. Balloon showing additional information.

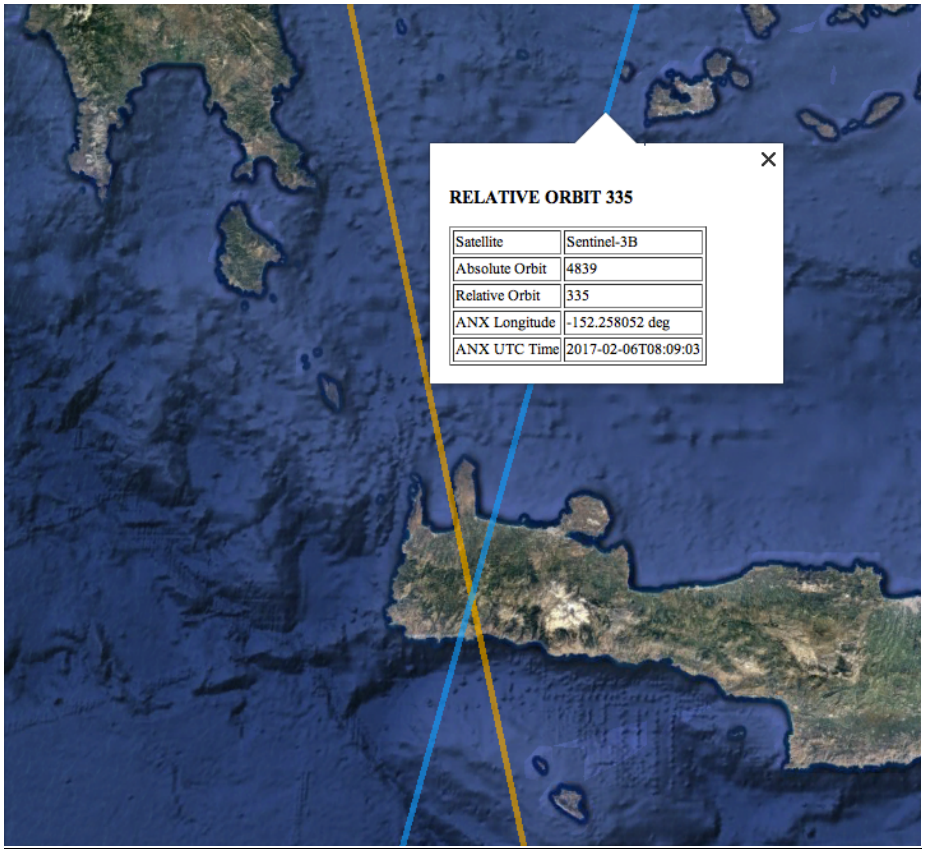

Figure 5: S3B ground track for relative orbit 335. Balloon showing additional information.

6. TECHNICAL DETAILS AND ASSUMPTIONS

6.1 Orbit Definition

The orbit ground track points have been calculated using the following S3A and S3B orbit scenario files

Satellite	Orbit Scenario File
SENTINEL-3A	S3A_OPER_MPL_ORBSCT_20160216T191845_99999999T999999_0002.EOF
SENTINEL-3B +140 deg	S3B_TEST_MPL_ORBSCT_20160304T023226_99999999T999999_0001.EOF

Table 1 – Orbit Scenario Files

Regarding Sentinel-3B, two alternative cases for the phasing wrt Sentinel-3A could be considered: +140 degrees or -140 degrees phasing. Since the resulting ground-tracks are the same for both cases, one of the two options has been assumed (+140 deg phasing).

6.2 Simulation Parameters

Additional information regarding the simulation:

Simulation Interval [orbits]	385 orbits (=one cycle length)

Table 2 – Simulation Parameters

6.3 Relative Orbit Number

The relative orbit number is a count of orbits from 1 to the number of orbits contained in a repeat cycle. The relative orbit number 1 corresponds to the orbit whose ascending node crossing is closest to the Greenwich Meridian (eastwards). The relative orbit number is incremented in parallel to the absolute orbit number up to the cycle length, when it is reset and the cycle number is incremented by one.

6.4 About Displaying S3A & S3B Ground-Tracks in Google Earth

The S3A and S3B ground-tracks have been generated for the complete repeat cycle with a time step of 10 seconds and the resulting ground-tracks have been converted to KML files. After loading them in Google Earth, a few effects may be noticed:

- The ground-track lines as displayed by Google Earth may be shifted with respect to ground-track lines calculated with a much finer resolution (e.g. 1 second time step). This is a consequence of the interpolation method applied by Google Earth to draw the lines joining the ground-track points. The selected time step of 10 seconds seems to be a good trade-off between KML file size and uncertainties introduced due to the Google Earth interpolation method between ground points.

- When the ground-track points are too much apart in time, the path lines may disappear below the terrain when zooming in, even if tessellation is enabled to allow lines and paths to follow the terrain (it appears to be a known problem with Google Earth, see [RD 03] for further details).

Figure 6: S3A and S3B ground tracks near crossing point: ground-track displayed below terrain

Note that this issue could not be completely solved by decreasing the time step.