

# SENTINEL-3 KML ORBIT FILES

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## 1. INTRODUCTION

## 1.1. PURPOSE

This document describes the relevant information concerning Sentinel-3 KML orbit files delivered for the Sentinel Online webpage. In particular, the KML orbits were generated based on the Sentinel-3A Orbit Scenario File, with Sentinel-3B phase shifted  $\pm 140^{\circ}$ . Given the definition of the KML, with the relative orbit number starting at the nearest ascending node crossing to the Greenwich Meridian, the ground track of Sentinel-3B for both cases is identical and therefore only one KML has been delivered.

## 1.2. SCOPE

This document has been prepared by GMV, in the frame of the project Provision of the Precise Orbit Determination Service for the Sentinel-3 mission, to support the validation of the orbital products generated by Copernicus POD Service.

## **1.3. DEFINITIONS AND ACRONYMS**

Definition of terms and acronyms used throughout this document are present in [AD.1]

## **1.4. APPLICABLE AND REFERENCE DOCUMENTS**

## 1.4.1. APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form part of this document to the extent specified herein. Applicable documents are those referenced in the Contract or approved by the Approval Authority. They are referenced in this document in the form [AD.X]:

#### **Table 1-1: Applicable Documents**

Ref.	Title	Code	Version	Date
[AD.1]	Sentinels POD Glossary of Terms	GMV-GMESPOD-GLO-0001	1.7	01/10/2014

## 1.4.2. REFERENCE DOCUMENTS

The following documents, although not part of this document, extend or clarify its contents. Reference documents are those not applicable and referenced within this document. They are referenced in this document in the form [RD.X]:

#### **Table 1-2: Reference Documents**

Ref.	Title	Code	Version	Date
[RD.1]	OGC KML Standard	OGC 12-007r2	2.3	04/08/2015
[RD.2]	Long Line Paths Disappear on Zoom In ( <u>https://code.google.com/archive/p/earth- issues/issues/1123</u> )	earth-issues - issue #1123	N/A	21/01/2011



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## 2. PACKAGE DESCRIPTION

The delivered Sentinel-3 KML files include the following:

- Sentinel-3A Ground Track KML file
- Sentinel-3B Ground Track KML file

Details on the package are given in Table 2-1.

#### Table 2-1: Package Details

File Name	Version	MD5 checksum
S3A_ground_track_10s.kml	1.0	876f826595f94e91ffc227d9085610b5
S3B_ground_track_10s.kml	1.0	8b422200dd6cd4520e04acdd6f06a316

Content:

- S3A\_ground\_track\_10s.kml
- S3B\_ground\_track\_10s.kml

## 2.1. FILE FORMAT DESCRIPTION

The format of the provided KML files is according to Open Geo Spatial (OCG) KML Standard v2.3 [RD.1].

## 2.2. FILE CONTENT DESCRIPTION

Each KML file contains the ground track points of the Reference Scenario Orbit for the corresponding satellite at a time step of 10 seconds for a full orbit cycle (defined in Section 4.1). Information on the relative orbit number (defined in Section 4.2) and the pass number (defined in Section 4.3) is included as well in the KML files.



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## 3. USAGE

The delivered archive S-3\_KML\_files.zip can be expanded either using a decompressing tool in MS Windows (such as Winzip or 7-Zip) or the command unzip in Linux/Mac OS.

These KML files can be opened with Google Earth 5 or higher. They appear under Temporary Places in the Navigation Panel of Google Earth, with Sentinel-3A ground track in red colour and Sentinel-3B in green colour as shown in Figure 3-1.



Figure 3-1: Sentinel-3A (red colour) and Sentinel-3B (green colour) ground tracks for a complete orbit cycle

The orbits within the "Temporary Places" are organised per Relative Orbit Number (see Section 4.2), and within each per Pole-to-Pole Pass Number (see Section 4.3). Figure 3-2 and Figure 3-3 show this structure, where it can be appreciated how each relative orbit goes from one ascending node crossing to the following one, whereas a pass goes from Pole-to-Pole.





Figure 3-2: Sentinel-3A Relative Orbit 1 – example of KML structure



Figure 3-3: Sentinel-3A Pass No. 2 – example of KML structure



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When clicking on a given line, it is highlighted and additional information is shown on a balloon. This information includes the relative orbit number, the corresponding pass number and whether it is ascending (from South Pole to North Pole) or descending (from North Pole to South Pole), and the closest longitude of ascending node crossing at which the relative orbit starts.



Figure 3-4: Sentinel-3A balloon information on click



Figure 3-5: Sentinel-3B balloon information on click



# 4. TECHNICAL DETAILS

## 4.1. ORBIT AND CYCLE DEFINITION

The orbit ground tracks have been generated from the Sentinel-3A and Sentinel-3B reference orbits produced by ESOC FD. In turn, these are based on the Sentinel-3A Reference Scenario Orbit, with Sentinel-3B phase shifted  $\pm 140^{\circ}$  with respect to the other satellite.

The definition of the relative orbit number (see Section 4.2) implies that the ground track generated for the case where Sentinel-3B is 140° ahead of the other satellite and the case where is 140° behind it generate the same ground track, although the passage through any location would obviously be at a different epoch in each configuration. Therefore, only one Sentinel-3B KML file has been submitted, which is valid for both +140° and -140° of phase shift.

The given KML includes a full cycle for each satellite, defined as the number of orbits required to pass through the same location. After one cycle, the ground track would repeat itself implying that the same KML can be used with a different absolute orbit number. For Sentinel-3 mission, the cycle is defined to be 27 days, encompassing 385 orbits.

## 4.2. RELATIVE ORBIT NUMBER DEFINITION

The relative orbit number is defined as the number of full orbits (between consecutive ascending node crossings through the Equator) since the relative orbit 1 (defined hereafter) until the end of a cycle. It therefore goes from 1 to 385 for the Sentinel-3 mission. The relative orbit 1 is defined as the orbit whose ascending node crossing is closest to the Greenwich Meridian (shown in Figure 4-1). This definition of relative orbit number implies that two satellites with the same orbit number will be at that location at different epochs depending on the phase shift.



Figure 4-1: Sentinel-3A and -3B orbit number 1



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## 4.3. PASS NUMBER DEFINITION

The Pass Number is defined as the number of passes from one Pole to the other one since the pass number 1 (starting at the same time as the relative orbit 1) in a given cycle. Passes can be ascending or descending, depending on whether they go from South to North Pole or vice versa. It has to be noted that, given the definition of passes, each orbit encompass one descending pass and two half ascending passes (from ascending node crossing to North Pole, and latter on, from South Pole to ascending node crossing).

Although the total number of passes in a cycle is 770 (385 orbits x2 passes per orbit), the amount included in the KML file is 771 because the first ascending half pass and the last ascending half pass have been labelled as different passes.

## 4.4. KNOWN LIMITATIONS

A number of limitations associated to the delivered KML files are the following:

- The KML files have been computed from a Reference Scenario Orbit File for Sentinel-3A with an
  accuracy of a few tenths of metres in cross-track at the ascending node crossing of the relative orbit 1.
  A simplified propagation model has been used to generate the rest of the cycle, so accuracy on the
  order of metres can be expected. Additional loss of accuracy may be expected from the interpolation
  method used to generate each segment by Google Earth.
- The lines might disappear when zooming in at a place where an interpolation has been used. This is a known issue with Google Earth paths [RD.2].