

## README file for ENVISAT DORIS Precise Orbit Determination files

<i>Field</i>	<i>Content</i>						
<i>Document Title</i>	README file: ENVISAT DORIS Precise Orbit Determination files						
<i>Reference</i>	QA4EO-SER-IPF-TSP-4173, issue 1, 24/06/2020						
<i>Applicability</i>	This README file applies to the latest version of the ENVISAT DORIS Precise Orbit Determination dataset (DOR_VOR_AX) generated with GDR standards version E.  ENVISAT DORIS Precise Orbit GDR-E						
<i>ESA Reference Documents</i>	[RD.1] ENVISAT-1 PRODUCTS SPECIFICATIONS VOLUME 9: DORIS PRODUCTS SPECIFICATIONS, PO-RS-MDA-GS-2009, Issue 3B, 2008 [RD.2] ENVISAT-1 PRODUCTS SPECIFICATIONS VOLUME 16: AUXILIARY DATA FILES, PO-RS-MDA-GS-2009, issue 3G, 2007 [RD.3] ENVISAT ADF Consolidation Technical Note, V2.3 - XPreSS-SER-TN-0168						
<i>Filled by</i>	IDEAS/QA4EO service team						
<i>Changelog</i>	<p>The table below records history and status of this README file.</p> <table border="1"> <thead> <tr> <th><b>Issue</b></th> <th><b>Date</b></th> <th><b>Major Changes</b></th> </tr> </thead> <tbody> <tr> <td>1.0</td> <td>24/06/2020</td> <td>First version</td> </tr> </tbody> </table>	<b>Issue</b>	<b>Date</b>	<b>Major Changes</b>	1.0	24/06/2020	First version
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## 1 ENVISAT Orbit State Vector Data

Orbit State Vector Data is used to obtain the satellite orbital parameters (latitude, longitude, trajectory, height, and height rate) employing orbit computation routines. The ESA CFI software (<http://eop-cfi.esa.int/index.php>) is a collection of precompiled C libraries for timing, coordinate conversions, orbit propagation, satellite pointing, and target visibility calculations.

All ENVISAT ground processing makes use of the CFI orbit propagator module and a state vector as input to determine the satellite position all along the orbit. Different types of files are available for a precise orbit determination: Orbit State Vectors generated via the ESA Flight Operation Segment (FOS) and Orbit State Vectors derived off-line within the ESA Payload Data Segment (PDS) from Doppler Orbitography and Radio positioning Integrated by Satellite (DORIS) measurements.

Usage and selection are driven by rules where the processing software preferentially selects the "best quality" file among the available ones, according to the order summarised in the table below (in descending qualitative order).

	<b>Highest Quality</b>
DORIS Precise	DOR_VOR_AX
DORIS Preliminary	DOR_POR_AX
FOS Restituted	AUX_FRO_AX
FOS Predicted	AUX_FPO_AX
	<b>Lowest Quality</b>

**Table 1 – ENVISAT orbit state vectors in descending order of accuracy.**

## 2 DORIS POD data

During ENVISAT operations, the processing of DORIS orbitography measurements enabled to create Precise Orbit Determination (POD) products, which give the accurate location of the satellite in the International Terrestrial Reference Frame (ITRF). The DORIS Preliminary (DOR\_POR\_AX) and Precise (DOR\_VOR\_AX) Orbit State Vector files are DORIS Level 2 products and are used as auxiliary data for the ENVISAT precise orbit reconstructions. They have the specific Envisat PDS format (ASCII) with the following structure (details in RD.1)

- UTC of Orbit State Vector
- $\Delta_{UT1} = UT1 - UTC$  [s]
- Absolute Orbit number
- X position in Earth fixed reference frame [m]

- Y position in Earth fixed reference frame [m]
- Z position in Earth fixed reference frame [m]
- X velocity relative to Earth fixed reference frame [m/s]
- Y velocity relative to Earth fixed reference frame [m/s]
- Z velocity relative to Earth fixed reference frame [m/s]
- POD Quality Flags

The DORIS Precise Orbit file product (DOR\_VOR) is the most accurate estimate produced and provides the orbit state vector needed for the processing of all ENVISAT instruments with the highest quality achievable. Usage of DOR\_VOR is recommended by ESA for off-line processing and reprocessing campaigns to improve data quality and harmonize among the different ENVISAT instruments.

File naming convention

DORIS Precise Orbit file filenames share the same structure of all ENVISAT auxiliary data files as detailed in RD.2. The filename is 61 characters long with the following fields

**DOR\_VOR\_AXVF-PYYYYMMDD\_hhmmss\_YYYYMMDD\_hhmmss\_YYYYMMDD\_hhmmss**

DOR_VOR_AX	10	Auxiliary data type ID
V	1	Processing Stage flag
F-P	3	Originator ID
YYYYMMDD_hhmmss	15	date and time of creation
_	1	Underscore character
YYYYMMDD_hhmmss	15	date and time of validity start
_	1	Underscore character
YYYYMMDD_hhmmss	15	date and time of validity stop

Temporal coverage

The DORIS Precise Orbit dataset covers ENVISAT orbits from 09 April 2002 (orbit 580) to 08 April 2012 (orbit 52867).

Size

Each DOR\_VOR file covers 26 hours + 29 minutes with 1 MDSR (129 bytes) per minute (1589 MDSRs in total) and total file size of 0.2 MB (MPH and SPH have fixed size).

$$\text{MPH (1247 bytes) + SPH (378 bytes) + MDS (204981 bytes) = 206606 bytes = 0.2 MB}$$

Data access

Access to DOR\_VOR full mission archive is provided to existing ESA Proposals and/or Registrations by contacting EO Helpdesk, or through a new user Registration on the ESA EOPI Portal.

POD Quality Flags

The POD orbit quality flag for the DORIS precise orbit implements the following values:

- 3: adjusted precise orbit
- 4: precise orbit estimated during a maneuver period
- 5: precise orbit interpolated over a tracking data gap
- 6: precise orbit extrapolated for a duration less than 1 day

### 3 GUIDE TO VERSIONS

Orbit quality is a determining factor in e.g. global altimetry. Several versions of the Envisat DOR\_VOR\_AX dataset were generated by ESA adopting different standards, defined for the Geophysical Data Records (GDRs) orbit products, and applied to the DORIS systems, to improve such determination. The latest version of the ENVISAT data is GDR-E released in July 2019 (link). At present, the last two versions are distributed to users.

Baseline	Year of release
GDR D	2012
GDR E	2019

Details on GDR standards are available at <ftp.ids-doris.org/pub/ids/data>

The ESA consolidation activity for the ENVISAT DOR\_VOR auxiliary data files resulted in a rather complete master dataset of 3640 products of nominal quality for the whole ENVISAT mission. The overall data completeness is 99.78% respect to the planned products [RD.3]. Table 2 reports the number of products available for every year of the mission (GDR\_E) for a total data volume of about 0.7 GB.

YEAR	#
2002	253
2003	365
2004	368
2005	365
2006	365
2007	365
2008	366
2009	365
2010	365
2011	365
2012	98
	<b>3640</b>

Table 2: Number of ENVISAT DOR\_VOR version E products.

	<p><b>3.1 GDR Version E</b></p> <p>This latest version of the dataset was generated by the Centre de Traitement Doris Poseidon (CTDP) and released in 2019. The most significant changes related to the GDR-E standards concern the new ocean tide model (FES2012) and the updated gravity field (a new mean model from CNES/GRGS spanning 12 years of GRACE data including the drifts terms). The new standards significantly improve all POD metrics and, most importantly, the consistency of Envisat Altimeter Sea Surface Height (SSH) with that of Jason-1 and Jason-2 Altimeter missions.</p> <p>Note that not all the product files of the DOR_VOR GDR-E dataset were re-processed in 2016, i.e. only the files subject to improvements were re-generated. Therefore, the resulting dataset is composed of files newly generated in 2016 with GDR-E and files generated in 2012 (156) using GDR-D and copied to the final dataset. The resulting dataset presents data with two s/w versions:</p> <pre style="text-align: center;">SOFTWARE_VER="orbito/4.2  156 SOFTWARE_VER="orbito/4.4  3484</pre> <p><b>3.2 GDR Version D</b></p> <p>GDR version D was released in 2012 and is still available to users, as it is still used.</p> <p><b>4 Known Processing Issues</b></p> <p>In the DOR_VOR dataset a single data gap was identified for the year 2002 (between 29 May and 5 June, during the Envisat commissioning phase).</p> <p><b>5 Product format</b></p> <p>Dataset GDR-E and GDR-D share the same format: Envisat PDS format (ASCII) detailed in [RD.2].</p>						
<p><i>Acronyms</i></p>	<table> <tr> <td>GDR</td> <td>Geophysical Data Records</td> </tr> <tr> <td>POD</td> <td>Precise Orbit Determination</td> </tr> <tr> <td>UTC</td> <td>Universal Time Coordinate</td> </tr> </table>	GDR	Geophysical Data Records	POD	Precise Orbit Determination	UTC	Universal Time Coordinate
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