DPOD2014: a new DORIS extension of ITRF2014 for Precise Orbit Determination

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Abstract

As one of the tracking systems used to determine orbits of the altimeter mission satellites (such as TOPEX/Posidon, Envisat, Jason-1/2 & Cryosat-2), the position of the DORIS tracking stations provides a fundamental reference for the estimation of the precise orbits and so, by extension is fundamental for the quality of the altimeter data and derived products. Therefore, the time evolution of the position of both the existing and the newest DORIS stations must be precisely modeled and regularly updated. To satisfy operational requirements for precise orbit determination and routine delivery of geodetic products, the International DORIS Service maintains the so-called DPOD solutions, which can be seen as an extensions of the latest available ITRF solution from the International Earth Rotation and Reference Systems Service (ITRS).

In mid-2016, the IDS agreed to change the processing strategy of the DPOD solution. The new solution from the IIDS Combination Center consists of a DORIS cumulative position and velocity solution using the latest IFS combined weekly solutions. The first objective of this study is to describe the new DPOD development scheme and to show the IIDS Combination Center internal validation steps. The second purpose is to present the external validation process made by an external lab before the new DPOD is made available to all the users. The development and the validation procedure will be illustrated by preliminary tests done with the ITRF2008 solution and by the presentation first version of the DPOD2014 (ITRF2014 DORIS extension) and validation.

DPOD2014 Construction Scheme

The new DPOD2014 will be based on a DORIS cumulative position and velocity solution from the latest IFS combined series. The cumulative solution will be augmented to include any new stations specified in recent DORIS5mx. Then, the construction of the DPOD2014 can be divided in three main steps:

1. Construction of the IFS combined series from the six IIDS Analysis Center multi-satellite weekly solutions starting in 1993/94. To include almost all the DORIS stations, since the IIDS contribution to the ITRF2014 (see Moreaux et al., 2016), the combination process:
   a. Does not anymore reject stations with regards to the length of the observation period (2.5 years at least for ITRF2014).
   b. Includes stations as soon as they are observed by at least 2 Ac (1 for ITRF2014).

2. Construction of the DORIS position and velocity cumulative solution. a. Update of the position uncertainty and velocity constraint files. These two files are updated after analysis of the stations coordinates time series from the IIDS web service (http://ds-doris.org/vel/w revisit/). Velocity constraints are used to constrain velocities to the same value over multiple segments unless a velocity decorrelation was observed.
   b. Update of the DORIS/DORIS IFS vector file from IFS.
   c. Update of the IFS core network. The core network is the subset of the DORIS stars used to align the cumulative solution on the ITRF. The core network is composed of sites with more than 500 weeks of observations and localized neither in seismic active zones nor SAA region. Currently, the core network includes 36 sites with 17 sites in the northern hemisphere (see Figure 1).
   d. Computation of the cumulative solution. The cumulative position and velocity solution is obtained from the weighting of the weekly solution files and then aligned to the ITRF2014 with No-Red-Rotation (NRR) condition by the IGU CAT software.

3. Including of the most recent DORIS stations which are not already part of the cumulative solution. Positions and velocities will be either extracted from the DORIS5mx or deduced from the DORIS-to-DORIS IFS vectors.

Before sending the DPOD solution to the validation group (see external validation), the IIDS Combination Center do several tests. These tests include:

- Analysis of the station position residuals.
- Analysis of the DORIS-to-DORIS IFS vector residuals.
- Comparison of positions and velocities with the ITRF2014 solution.
- Estimation of the DORIS-to-GNSS IFS vector at collocated sites and comparison with the tie vectors from IGN.
- Prediction and analysis of the position formal errors at T+3 years.

Conclusions

- The IIDS Combination Center developed a new method to estimate a DORIS extension of ITRF2014 for POD.
- The new DPOD2014 is based on a DORIS cumulative position and velocity solution from the latest IFS combined weekly. This cumulative solution is augmented to include any new stations specified in recent DORIS5mx.
- Therefore, by construction, the new DPOD differs from DPOD2005, DPOD2008 (see Willis et al., 2016) and is similar to IGS08 and to a lesser extent (as DPOD2014 does not include PEO corrections) to IGS14.
- So far, the validation tests showed slightly better performances of DPOD2014 compared to ITRF2008, ITRF2014 and DPOD2008.

What’s next?

- Including of observations in 1992 in the cumulative solution.
- For the Jason-2 and Jason-3, some of whose data are affected by the South Atlantic Anomaly: Dewight the SAA-affected stations at the Analysis Center level in the multi-satellite combination.
- Update every 6 months.

How to get DPOD2014?

- The DPOD2014 solution will be available in 3 formats: SINEX, SDC and text.
- The DPOD2014 and DORIS cumulative solution files will be downloadable from the 2 IIDS Data Centers (CCDOS and IGN) as well as from the IIDS ftp server.

References


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