Impact of the low elevation measurements on the DORIS scale factor and on the station position estimation

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Introduction

All the DORIS Analysis Centers observe a jump in the scale factor of their combined solution in 2012. The introduction of the HY-2A satellite data in the solution seems to cause the largest jump in the DORIS scale. However, some investigations made on the Jason-2 and CryoSat-2 single-satellite solutions are also responsible of the DORIS scale jump. This contribution in the scale jump seems fully explained by a variation in the number of low-elevation measurements included in the processing. We propose here to demonstrate the origin of this scale jump by taking into account another data format (RINEX) and by processing DORIS data with different cutoff angles. We also analyze the impact of the low elevation measurements on the height station position estimation and the Helmert parameters (scale factor and geocenter).

Processing context

We analyzed DORIS data on 3.5-day arcs and with a cut-off angle of 12°, computed with GINS/DYNAMO software.

- Configuration: we use the same configuration as that used for the ITRF2008 contribution
- Time span of the pre-processing: from January 2011 to June 2015
- DORIS data: DORIS2.2 and RINEX 3.0 phase measurement converted to DOPPLER

Single satellite and multi-satellite solutions compared to DPOD2008

We computed weekly single satellite solutions for Jason-2, CryoSat-2, HY-2A from January 2011 to June 2015. Comparisons of these weekly solutions to DPOD2008 are performed with the CATREF (Combination and Analysis of Terrestrial Reference Frames) package.

Impact of the cutoff angle on the DORIS scale on the station position estimation

Impact of the cutoff angle on the DORIS scale factor

We are interested in the impact on the scale factor. We determined the single-satellite Jason-2 and CryoSat-2 weekly solutions that we compared to DPOD2008 with CATREF. These results show that measurements at low elevations have a significant impact on the scale factor. It can be seen that the scale factor is at a different level depending on the cutoff angle used.

In addition, as discussed in more detail in another section, a jump in the scale factor was observed in 2012. These figures show that with a 20° cut-off angle, the scale factor jump in 2012 is significantly reduced. The number of high elevations and the number of low elevation could be the cause of the scale factor jump observed in 2012.

Impact of the cutoff angle on the station position estimation

We are now interested in the impact of the cutoff angle on the DORIS station position estimation. We analyzed the time series of the differences to DPOD2008 of the Jason-2 and CryoSat-2 single-satellite solutions for all DORIS stations observed over the time span processed. We did some comparisons for different stations in order to obtain the best cutoff angle for 2012 (explained in the dedicated section).

The results of the CryoSat-2 single-satellite solution for two stations, Yarragadee and Thuile show that the cutoff angle has no significant impact on the position estimation. The 10° cut-off allows a more stable determination thanks to a larger number of measurements.

Let us now focus on the Jason-2 single-satellite solution. As the CryoSat-2 USD is not affected by the South Atlantic Anomaly (SAA), we use the CryoSat-2 single-satellite solution as a reference. The table presents the differences between the Jason-2 and CryoSat-2 solutions in North/East/Up for the different stations in the SAA and one outside (Yarragadee), for two different cut-off angles: 10° and 20°. The differences between the Jason-2 and CryoSat-2 solutions are noticeably smaller with a cut-off angle of 20°, but only for SAA stations. These comparisons show the sensitivity of Jason-2 to the SAA effect.

Conclusions

DORSIS scale jump in 2012:
The increase in the number of measurements for Jason-2 and CryoSat-2 is fully explained by the change of tropospheric model used by CNES POD team in its POD processing (GDR standards) from CNET (IDR-C) to GFT/GMRF (GRD-0). The larger number of data, especially at low elevation, is the cause of the change in the scale factor.

Impact of the cutoff angle on the DORIS scale factor on the station position estimation:
With an elevation cutoff angle of 20° the scale change in 2012 is significantly reduced. Changing the cutoff angle and/or downweighting low measurements has an impact on the scale factor. In terms of station height, the cutoff angle has mostly an impact on the SAA stations for the Jason-2 single-satellite solution.