Improved DORIS accuracy for Precise Orbit Determination and Geodesy

Amélioration de la précision DORIS en orbitographie et en géodésie

Pascal Willis[1,2], Christian Jayles[3], Gilles Tavernier[3]

[1] Institut Géographique National, Direction Technique, Saint-Mandé, France
[2] Jet Propulsion Laboratory, Caltech, Pasadena, USA
[3] Centre National d'Etudes Spatiales, Toulouse, France

Corresponding author:
Pascal Willis
FAX: 1-818-393-4965 (USA/PCT = France + 9 hours)
Email: Pascal.R.Willis@jpl.nasa.gov

Abstract

In 2001 and 2002, 3 more DORIS satellites were launched. Since then, all DORIS results have been significantly improved. For precise orbit determination, 20 cm are now available in real-time with DIODE and 1.5 to 2 cm in post-processing. For geodesy, 1 cm precision can now be achieved regularly every week, making now DORIS an active part of a Global Observing System for Geodesy through the IDS.

Résumé

En 2001 et 2002, 3 nouveaux satellites DORIS ont été lancés. Tous les résultats ont été améliorés, pour obtenir désormais des précisions d'orbite de 20 cm en temps réel avec DIODE et de 1,5 à 2 cm en temps différé. En géodésie, il est désormais possible d'obtenir des précisions de 1 cm chaque semaine. DORIS fait partie des techniques qui participent activement au projet IGGOS à travers l'IDS.

Introduction

In 2001 and 2002, Jason, SPOT5 and ENVISAT were launched, carrying on-board improved DORIS receivers. The goal of this paper is to present the recent improvements obtained for Precise Orbit Determination using these upgraded receivers as well as for Geodesy using data from an increased satellite constellation.

Precise Orbit Determination results

The DORIS system has been established to provide a robust, precise and simple tracking system for Precise Orbit determination. The accuracy has been constantly improved over the past few years leading to 2.5 cm (radial) for MOE and 1.5 to 2 cm (radial) for the POE from CNES. Furthermore, a real-time navigator (DIODE) has been developed, providing a 20 cm orbit in real-time in a very efficient and robust

way, even during large maneuvers. In the case of Jason, the DORIS system has proven its effectiveness as well as its complementarity with the other techniques (SLR and GPS).

Geodetic results

For geodesy, the Jason/DORIS data cannot be used due to un-modeled effects on the satellite oscillator over the South Atlantic Anomaly. However, with a 5 satellites constellations and using recent GRACE-derived gravity field models, results have been improved using now reduced observation period. Typically, 1 cm precision, can now be obtained within a week (instead of a month). External comparisons with GPS and local tie information have also demonstrated that a 1 cm accuracy can also be achieved for global geodetic solutions (positions and velocities) leading to increased applications in terrestrial reference frame monitoring and geodynamics.

More specifically, the station vertical precision derived from DORIS is especially good (1 cm or better for weekly positions and 1-2 mm/year for stations velocities). DORIS can play a role in monitoring stations heights (of critical interest for several scientific investigations such as global mean sea level rise monitoring). Most of the DORIS stations have been continuously operating for more than 11 years, making this system very attractive for long-term series analysis in geophysics and oceanography. The DORIS network is dense (55 stations), geographically well distributed. Furthermore, more than half of the tracking stations are in collocation with other geodetic techniques (SLR, VLBI, GPS).

Finally, geocenter motion monitoring can now also be obtained at the 1 to 2 mm level. Improvement has also been seen when determining daily polar motion values (1.2-2.0 mas with 3 satellites to presently 0.9-1.8 mas with 5 satellites).

The International DORIS Service

In July 2003, after a Pilot Experiment phase, a new International DORIS Service (IDS) was officially established by the IAG. Since then, several groups around the world are regularly submitting geodetic solutions or plan to do so in a near future participating in a more global scheme as set by the International Earth Rotation Service (IERS). The IDS Central Bureau is in France as well as some of the key participants.

Conclusions

In conclusion, the launch of new DORIS satellites carrying improved receivers has significantly improved all results. Mixing of the three techniques (SLR, GPS, DORIS) on Jason now leads to 1.5 cm radial orbits. For ENVISAT, with only the DORIS data, 20 cm in radial can be achieved in real-time. Those new results should enhance the present scientific applications for altimetry. For geodesy, doubling the DORIS constellation now allows groups to achieve a 1-cm precision for stations positions on a weekly basis as well as 2 mm precision for geocenter variations monitoring. Though the IDS, DORIS can now play an active role in the IAG/IGGOS Project. It is very important that the number of DORIS receivers in space be kept at such a high level in order to maintain the accuracy of these scientific results.

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