ABSTRACT:

Terrestrial reference frames are realized by sets of stations that coordinate with a network of satellites, including GPS, SLR, and DORIS. The accuracy of these reference frames can be improved by integrating data from LEO satellites, such as JASON-2. This integration is particularly effective when the LEO satellite has a good field of view over the network of stations, minimizing the impact on GPS satellite orbit and clock parameters.

Here we show first results in combined processing of ground and spaceborne GPS, DORIS and SLR measurements and estimation of reference frame parameters, including station coordinates of different space geodesy techniques, tropospheric zenith delays, Earth rotation parameters, geocenter coordinates, and GPS satellite orbit and high-rate clock parameters. We analyse the impact of the LEO data on the estimation of reference frame parameters and possible improvements they can bring. This is a continuation of the same satellite, flying below the constellation of GPS satellites and above the ground networks of the different space geodesy techniques, like GPS, DORIS and SLR. With the collocation of different space geodesy techniques onboard JASON-2 satellite, one can connect all GPS satellites in the GPS constellation in only about 90 minutes, and all ground SLR and DORIS stations at the same time. One could imagine JASON-2 as a station with well-defined ties between different space geodesy techniques collocated on the same satellite, like satellite with well-defined ties between different space geodesy techniques collocated on the same satellite.

To demonstrate this, one can take two different GPS orbit and clock solutions from two of the most accurate IGS Analysis Centers and compare the estimated LEO orbits in the spectral domain. The quality of the instantaneous reference frame realized by the GPS satellites will more strongly affect LEO orbits in very low orbits (like GOCE) than satellites in a high LEO orbit (like JASON-2), due to the use of kinematic or very reduced-dynamic POD approaches for the lower orbit altitudes. POD for JASON-2 satellite require a rather modest number of estimated orbital parameters and it is compatible with the GPS orbit constraints.

Numerical experiments with JASON-2 data and GPS, SLR, and DORIS measurements have already been demonstrated by means of variance-covariance analysis. The impact on GPS and DORIS stations was statistically significant, and the quality of the instantaneous reference frame, will directly propagate into LEO orbit and directly alias into gravity field determination (as in the case of GOCE) or indirectly results (as in the case of JASON-2).

We conclude that the combination of different space geodesy techniques provides a powerful tool for improving terrestrial reference frames. The integration of LEO data with GPS, SLR, and DORIS measurements can lead to significant improvements in the accuracy and stability of these reference frames. This is particularly important for applications requiring high-precision positioning and monitoring of geophysical processes.