Status of Precise Orbit Determination for Jason-2 using GPS

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1. Abstract

The Jason-2 satellite, launched in June 2008, is the latest follow-on to the successful TOPEX/Poseidon (T/P) Jason-1 mission. Jason-2 is equipped with a TRSR BlackJack GPS dual-frequency receiver, a laser retroreflector array, and a DORIS receiver for precise orbit determination (POD).

The most recent time series of orbits computed at NASA GSFC, based on SLR/DORIS data, have been completed using both TRF2005 and TRF2008. These orbits have been shown to agree radially to 1 cm for dynamic vs. SLR/DORIS reduced-dynamic orbits and in comparison with orbits produced by other analysis centers (Lemarchand et al. 2010; Zelensky et al., 2010; Cerri et al., 2010). We have recently upgraded the GEODYN software to implement model improvements for GPS processing. We describe the implementation of the JASON-2 GEODYN GPS processing, and other dynamical and measurement model improvements.

Our GPS-only Jason-2 orbit accuracy is assessed using a number of tests including analysis of independent SLR and altimeter crossover residuals, orbit centroid differences, and direct comparison to orbits generated at GSFC using SLR and DORIS tracking, and to orbits generated externally at other centers. Tests based on SLR and the altimeter crossover residuals provide the best performance indicator for independent validation of the NASA/GSFC/GEODYN-only reduced-dynamic orbits. For the TRF2005 and TRF2008 implementation of our GPS-only orbits we use the IGS05 and IGS08 standards. Reduced dynamic versus dynamic orbit differences are used to characterize the remaining force model error and TRF instability. We evaluate the GPS vs. SLR & DORIS orbits produced using the GEODYN software and assess in particular their consistency with the altimeter crossover residuals.

2. GPS strategy

- 38 IGSO and iGSO8 stations
- Tracking data : D L C Iono-free tracking data
- GPS PCOs and PCVs : ig05.atx and ig08_1604 woGLO_final
- TRF 1/v scale(wet-dry) troposphere (GMP/GHP-finalg) ± 1
- Float ambiguities
- j2 jpl GPS antenna PCV map
- j2 revised LC GPS antenna PCO values
- Solutions S1: troposphere is adjusted / 1 hr using 2 paths (1 station + 2 GPS s/c) during the POD
- Solutions S2: troposphere is adjusted / 1 hr using 4 paths (2 stations + 2 GPS s/c) in a ground network solution

3. GPS POD

The dense and highly precise Jason-2 GPS tracking provides significant improvement for POD capability. We base our POD strategy on the concept of a reduced-dynamic (RD) solution. An RD solution is based on the denser geometrically stronger GPS tracking data rather than the force model accuracy (Wu et al. 1990, Luthcke et al. 2003). In our GEODYN RD implementation once per (OPR) along & cross-track accelerations are estimated every 30 min with sigma≈1e-09 and correlation time of 1 hr.

3.1 GPS data Performance

Our main objective is to compare the GPS system performance to that of the SLR/DORIS -- in terms of POD performance -- and to compare the consistency of the reference frames as evaluated within one software package with the consistency of the reference frames. Secondarily and since our POD strategy is primarily based on the density of the GPS tracking, we are interested in monitoring GPS system performance through time (deCarvalho et al. 2011).

3.2 Relative centering (Fig. 8)

One can also look at the relative centering of the ITRF-based orbits obtained. In this case we tested all orbits with the jpl_gps_rise11a. All orbits that contain SLR are positively biased with respect to the JPL orbits except for the gsfc_gpsrd0905_s1 GPS-only orbits. Also the drifts presented are of the order of 1 mm/y. Fig. 9 – 12 demonstrate the radial orbit rates with the annual and semiannual terms removed. A N/S component is observed between the JPL and the SLR/DORIS and GDR-C orbits. The JPL vs GSFC GPS-only and ESOC orbits show an E/W component.