1. Solar radiation pressure modeling

The main non-gravitational orbit perturbation acting on GNSS satellites is the solar radiation pressure. Mismodeling of this force has the potential to explain orbit-related frequencies found in GPS-derived station coordinates, geocenter and Earth orientation parameters (e.g. Y-pole rate). In this work, we study the impact on geodetic parameters of two different models:

**CODE empirical model** (Beutler et al., 1994), commonly used by the IGS analysis centers and based on the following empirical parameters:
- D0: direct acceleration
- Y0: Y-bias acceleration
- B0, BC, BS: constant and once-per-rev acceleration terms in B-direction

**Adjustable box-wing model** (Rodriguez-Solano et al., 2012), based on the physical interaction between the satellite’s structure and solar radiation. The following parameters are estimated:
- SF: solar panel scaling factor
- SB: solar panel rotation lag angle
- Y0: Y-bias acceleration
- +XR: reflection coefficient of +X bus
- +ZR: reflection coefficient of +Z bus
- -ZR: reflection coefficient of -Z bus

Fig. 1: Relative geometry of Sun, Earth and satellite. Illustration of D3B (Sun-fixed) and XYZ (body-fixed) frames.

In this study, four multi-year (2004-2011) GPS/GLONASS solutions have been computed, using a processing scheme derived from CODE (Center for Orbit Determination in Europe). Two 1-day solutions using the CODE and the adjustable box-wing models were computed. Furthermore, as the parameters of the box-wing model should be constant over time, we study the impact of stacking orbit and radiation pressure parameters of contiguous 1-day solutions, producing 3-day solutions.

2. Stacking of box-wing parameters

**1-day**
- Solar panel orientation

**3-day**
- Solar panel orientation

Fig. 2: Daily estimates of the adjustable box-wing model parameters from 1-day (left) and 3-day (right) solutions. The parameters are shown as a function of β, and for all GPS-IIA and GLONASS-M satellites available from 2007 to 2008.

3. Impact on station coordinates

**1-day**
- Y-pole rate (1-day)

**3-day**
- Y-pole rate (1-day)

Fig. 3: Average power spectrum of GNSS daily position estimates (290 ground tracking stations) from 2004 to 2011. Comparison between CODE (blue) and box-wing (red) radiation pressure models and between 1-day (left) and 3-day (right) solutions.

4. Impact on geocenter

**1-day**
- CODE
  - Power spectrum of the geocenter Z-component from 2004 to 2011. Comparison between CODE (blue) and box-wing (red) radiation pressure models and between 1-day (left) and 3-day (right) solutions.

**3-day**
- CODE

Fig. 4: Power spectrum of the geocenter Z-component from 2004 to 2011. Comparison between CODE (blue) and box-wing (red) radiation pressure models and between 1-day (left) and 3-day (right) solutions.

**5. Impact on Earth orientation parameters**

**X-pole rate (1-day)**
- CODE

**Y-pole rate (1-day)**
- CODE

Fig. 5: Geocenter Z-component position for the adjustable box-wing model, comparison between 1-day and 3-day solutions. The β, angle to the GPS and GLONASS satellites is shown in gray.

**Fig. 6:** Power spectrum of X- and Y-pole rates (1-day solution) after taking difference to IERS 08 C04 time series from 2004 to 2010.

**Fig. 7:** Length of Day (LOD) difference to IERS 08 C04 time series at noon, after applying tidal corrections. Best fitting line is plotted in black.

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REFERENCES