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Comparison of different Radiation Pressure models for GNSS orbit determination

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Solar radiation pressure is the dominant non-gravitational force acting on MEO satellites like those from GNSS. A reliable modelisation of this force is complex as it reflects the interaction between the incident fluxes (solar and also earth albedo) and each elementary satellite surface. The shape of the satellite has to be known as well as its orientation in space (attitude) and its optical characteristics (reflectivity, absorption, emissivity coefficients). Two alternative approaches have been identified and adopted in most scientific POD software used to compute GNSS orbits : (1) the so-called box&wing model, consisting in approximating the shape of the satellites by a limited number of simple surfaces like plans, spheres, cylinders. This approach can be extended to more complex models using a precise geometry, with a description using interpolation tables (2) empirical models defined by polynomials and periodic terms in a specific reference frame (usually solar axis, radial and solar array axis). Nevertheless, SRP remains the main source of orbit error for GNSS satellites.
Also, it is necessary to take into account other fluxes emitted by the satellite (thermal self radiation for example). This force acts mainly along the solar array and is taken into account in the models as an empirical force along this axis (the so called Y-bias).
The GINS POD software which is being developed by CNES/GRGS for 40 years has a long tradition in using the bow&wing approach. The joint CNES-CLS became an IGS Aanalysis Centre in May 2010 using a different strategy than the other groups for the direct and indirect solar radiation pressure modelling.
This paper compares different bow&wing and empirical models in terms of orbit and by products impact as well as on residuals and ambiguity fixing success rate. The reference orbits are the final IGS and a recent release of JPL's solutions derived from an updated SRP modelisation.