FWF project SPOT

Abstract

Short period variations in Earth rotation, quantified as Earth rotation parameters (ERP), are induced predominantly by diurnal and subdiurnal ocean tides. Secondary causes of such variations are thermal tides of the atmosphere, driven by the diurnal solar heating cycle, and the effect of the lunisolar torque on the triaxial figure of the Earth, called libration. Detailed descriptions of diurnal and subdiurnal ERP variations based on a profound geophysical background are essential for various parameter estimation problems in space geodesy, like processing of special VLBI (Very Long Baseline Interferometry) sessions or GPS (Global Positioning System) orbit determination. Several studies on high-frequency ERP measured by GPS or VLBI reveal significant discrepancies between the observational evidence and the present conventional model for ocean tide induced variations of Earth rotation. The core intention of project SPOT Earth Rotation is the development of an utmost precise model for the impact of short period ocean tides on Earth rotation meeting the requirements of modern geodetic research and applications. The model will be built on the basis of the up-to-date global ocean tide model EOT11a which is computed at DGFI (Deutsches Geodätisches Forschungsinstitut) by means of empirical analysis of multi-mission satellite altimetry data from nearly two decades. As EOT11a does not provide the tidal current velocities which are fundamental contributors to Earth rotation excitation, the calculation of current velocities from the tidal elevations is one of three main areas of operation in project SPOT Earth Rotation. The second key aspect is the conversion from ocean tidal angular momentum to corresponding ERP variations. The peculiar innovation at this step will be to consider the Earth's response to ocean tidal loading based on a realistic Earth model, including an anelastic mantle. The third part of the project deals with the introduction of the influence of minor tides. Ocean tide models usually only provide eight major semidiurnal and diurnal tidal terms and minor tides have to be inferred through admittance assumptions. Within the proposed project, selected minor tidal terms and the corresponding ERP variations shall be derived directly from satellite altimetry data. One of the principal developers of EOT11a will be actively involved in project SPOT Earth Rotation. This will enable a very close collaboration of Earth rotation and ocean tide modelers and offer a unique possibility for mutual adjustment and iterative refinement of the ocean tidal ERP model. At IGG Vienna a strong VLBI group exists which is acting as Special Analysis Center within the IVS (International VLBI Service for Geodesy and Astrometry) and has access to all VLBI data. Thus a validation of the model with measurements through determination of Earth rotation variations from VLBI data can be conducted at any stage of the project and will be an important asset of the project. Besides its relevance for the processing of space geodetic data, a new high-quality ocean tidal ERP model will support the study of secondary effects, such as libration and thermal tides of the atmosphere, and thus, support Earth system research. Since the model is part of the transformation between terrestrial and celestial reference systems, which is important for all precise navigation tasks in space, the results of the project are of significant importance even beyond the scientific domain.