

Improving prediction of Earth Orientation Parameters for real-time geodesy

We intend to assess the accuracy and improve the quality of Earth Orientation Parameters (EOP) predictions. EOP describe the orientation of the Earth in space as realized by markers at the crust with respect to inertial space. The EOP consists of the nutation components, changes in the pole coordinates and length-of-day variations. Accurate EOP observations are provided by modern space geodesy techniques, such as Global Navigation Satellite Systems (GNSS), Satellite Laser Ranging (SLR) and Very Long Baseline Interferometry (VLBI). Information on EOP is essential for scientific research, practical applications in the field of GNSS, space mission planning, as well as for the users determining the travel route or conducting sky observations. Caused by the huge amount of different observations involved, EOP are not available in real time. They are provided with a delay of several hours to even several weeks, and the only solution to this problem is the use of model data obtained from predictions of our planet's rotation.

Developing an analytical model of the Earth's rotation is a very complex problem. It requires knowledge of the internal structure of the planet, understanding the role of the Earth's surficial fluid layers (including the atmosphere, oceans, hydrosphere) in disturbances in this motion, understanding the gravitational interactions of celestial bodies, and the use of advanced computational procedures. Analytical models available so far do not fulfill accuracy requirements of modern applications, so that rapid observations and subsequent short-term predictions are needed. An international EOP prediction comparison campaign (2nd EOP PCC) is currently conducted by the International Earth Rotation and Reference Systems Service (IERS). The campaign started on September 1, 2021 and will last until December 2022. The Space Research Centre of the Polish Academy of Sciences (Centrum Badań Kosmicznych Polskiej Akademii Nauk, CBK PAN) is coordinating this international activity. At the end of 2021, 22 research centers from around the world actively contribute to the campaign by submitting their predictions of EOP for scientific evaluation.

The aim of this project is to use the unique results of the 2nd EOP PCC to further improve the EOP predictions and to better understand the phenomena disturbing Earth rotation. Increasing the accuracy of EOP forecasts will be achieved by developing a combination of the best prediction methods selected during the campaign and by improving models of the Earth's surficial fluid layers. The German Research Centre for Geosciences (Deutsche GeoForschungsZentrum, GFZ) will participate in the project together with CBK PAN. The CBK PAN team will be responsible for assessing various EOP forecasting methods, validating different predictions using observational data, and creating a combined solution. The GFZ team will be responsible for improving geophysical models of the atmosphere, oceans and hydrosphere needed to determine the effective angular momentum functions. Both teams will jointly determine the current EOP forecasting possibilities and indicate ways to improve the quality of their predictions. Scientists who analyse and forecast changes in the Earth's rotation will benefit from the results of the project.