Analysis of the EOP reference series and their impact on the analysis of the Second Earth Orientation Parameters Prediction Comparison Campaign (2nd EOP PCC) results

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Abstract

Earth Orientation Parameters (EOPs) are the key link between the terrestrial reference frame, determined by geodetic instruments on the Earth's surface, and the celestial reference frame, determined by the positions of distant quasars, which are considered constant over time. These parameters include precession-nutation, polar motion (PM), difference between universal time and universal coordinated time (UT1-UTC), or its time-derivative Length-of-Day (LOD). The International Earth Rotation and Reference Systems Service (IERS) is responsible for providing EOP data, which comes from various observational techniques. However, complex calculations often cause delays in obtaining final solutions. Given that many applications require real-time knowledge of EOPs, it becomes crucial to predict these parameters in advance.
In recent years, the international geodetic community has focused on improving EOP prediction, leading to the development of various forecasting methods by research centers worldwide. For this reason, the Second Earth Orientation Parameters Prediction Comparison Campaign (2nd EOP PCC) run by the Centrum Badań Kosmicznych Polskiej Akademii Nauk (CBK PAN) with support from the German Research Center for Geosciences (GFZ) and under the auspices of the IERS, was established. The official part of the campaign lasted from September 1, 2021 to December 28, 2022. The main reference data used in the 2nd EOP PCC were the IERS 14 C04 series. However, the impact of the utilized reference series on the prediction accuracy can be non-negligible due to the fact that not all campaign participants used the same solutions as an input.

In our work, we would like to present an analysis of the available EOP reference series, including observations from single measurement techniques such as GNSS (Global Navigation Satellite Systems), SLR (Satellite Laser Ranging) and VLBI (Very Long Baseline Interferometry), as well as combined series that integrate observations from a number of measurement techniques, such as those delivered by IERS, Jet Propulsion Laboratory (JPL) or Bundesamt für Kartographie und Geodäsie (BKG).

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Our analysis of reference series will focus on the period 2014-2023 due to the availability of all data at that time. A spectral analysis of all studied series will be presented to determine the most common oscillations . Statistics such as the standard deviation and root mean square error (RMSE) of the reference series with regard to the official IERS 14 C04 solution will be shown.
We will also present the impact of the choice of reference series on the Mean Absolute Error (MAE) of the predictions submitted by 2nd EOP PCC participants during the campaign period.