Assessment of precession-nutation predictions based on the results of the Second Earth Orientation Parameters Prediction Comparison Campaign (2nd EOP PCC)

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Abstract

The knowledge of Earth orientation parameters (EOP), which include precession-nutation, polar motion (PM), universal time (UT1-UTC), and Length-of-Day (LOD, derivative of UT1-UTC), is necessary for real-time transformation between International Celestial and Terrestrial Reference Frames (ICRF and ITRF). Due to the delay caused by computation processes, the EOP parameters cannot be available in real time. Thus, short-term EOP predictions are provided for many real-time advanced geodetic and astronomical issues, like positioning and navigation on Earth and in space. EOP predictions can also help study the dynamics of numerous geophysical phenomena associated with the EOP.
The IERS Rapid Service/Prediction Center, along with numerous research groups around the world, regularly provides EOP predictions. Various prediction methods, input data, and forecast horizons have been developed and employed to enhance the accuracy of these predictions, leading to varying levels of precision in each forecast.

Progress in geodetic data processing, modelling effective angular momentum functions, and developing new prediction methods raise the need to re-evaluate various EOP predictions. This was the objective of the Second Earth Orientation Parameters Prediction Comparison Campaign (2nd EOP PCC). The official part of the campaign lasted from September 1, 2021, to December 28, 2022. During this period, more than 7000 predictions were submitted by registered participants. The campaign was run by Centrum Badań Kosmicznych Polskiej Academii Nauk (CBK PAN) with support from the German Research Center for Geosciences (GFZ) and under the auspices of the IERS.

In this study, we provide a summary of the 2nd EOP PCC, focusing on predictions of precession-nutation. After providing statistics on involved participants and exploited methods, we move on to the detailed evaluation of collected forecasts.

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The analyses presented here include time series comparison, i.e., differences between predicted and observed values of dX, dY, and dψ, dϵ components of precession-nutation, their basic statistics (mean, standard deviation, range) as well as the mean absolute error (MAE) computed for IERS EOP 14 C04 solution taken as a reference dataset. We compare the obtained results with those received for forecasts provided by the IERS. Finally, we present the ranking of best prediction approaches based on MAE values for different prediction days, rejected input files, range of differences between predicted and observed values, and median of percentage changes of MAE over time.