

Annual Report of the IAU/IAG Joint Working Group on Improving Theories and Models of the Earth's Rotation, 2022

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During this period the main activity of the JWG has been to continue the assessment and refinement of the possible corrections for improving the current precession and nutation models IAU2006 and IAU2000, trying to balance reducing the unexplained variance with minimizing the risks of overfitting and mis-separation of periodic components. Special attention has been paid to the potential correction sets derived from the celestial pole offsets (CPO) solutions obtained by the different main analysis centers and the combination center of the International VLBI Service for Geodesy and Astrometry (IVS) by analyzing the two ordinary VLBI weekly sessions R1 & R4 - thus oddly spaced. That approach allows more variance to be explained through corrections to forced nutation, and also prevents potential artifacts caused by the numerical densification of the said solutions needed to produce the daily and evenly spaced CPO values demanded by most users.

Throughout the year, new research outcomes by JWG members have been published in journals and presented at different conferences, which in general transitioned from only virtual at the beginning of the year, like the IVS General Meeting held in March 2022, to mixed and in-person at the end of the year. The most relevant for the main WG goals are those that went deeper into the development of potential corrections to the IAU2006 precession or IAU2000 nutation models, either by updating the amplitudes of selected forced nutation terms of lunisolar and planetary origins, or by derivation of new free core nutation (FCN) models.

As a general overview, several sets of corrections derived directly from different VLBI solutions, applied together, allow noticeable reductions of the unexplained CPO variance, which can be reduced from the initial 180-200 micro-arcseconds to 90 or less, in WRMS terms.

Results of the internal assessment of the various proposed corrections, as it advanced, were presented first at the IVS General Meeting and then and in-person at the General Assemblies of the European Geosciences Union (EGU) and the IAU held in May and August 2022, respectively, with the participation of the chairs of the JWG and its SWG 1 and 3, among others. The last two meetings hosted sessions co-organized by Escapa and other members that welcomed JWG ITMER contributions, namely EGU Session G3.5, "Earth Rotation: Theoretical aspects, temporal variability, physical interpretation, and prediction" (<https://meetingorganizer.copernicus.org/EGU22/session/43011>), and IAU Division A Meeting Session 4 "Reference frames and rotations" (https://www.iau.org/science/scientific_bodies/divisions/A/meeting2022). The JWG report to IAU Commission A2, Rotation of the Earth, was also presented in person in Busan. Finally, a set of corrections including the linear parts of precession and corrections to the amplitudes of a reduced set of nutations composed of only 5 planetary forced nutation periods and 8 lunisolar ones, was selected among the different options and proposed as a good trade-off candidate at the session on Conventions, Standards and Formats of the IERS/GGOS Unified Analysis Workshop held in Thessaloniki in October 21-23. It was derived from an IVS combined solution and allows a noticeable reduction of the variance of the celestial pole offsets, which can be about halved if corrections are supplemented with suitable FCN models. In the discussion, it was agreed to submit it to the IERS Analysis Coordinator for independent external validation, which is still pending.