Annual Report of the IAU/IAG Joint Working Group on Improving Theories and Models of the Earth's Rotation, 2021

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This Joint Working Group (JWG) on Improving Theories and Models of the Earth's Rotation (ITMER) depends on the IAU Commission A2, Rotation of the Earth, and of the International Association of Geodesy (IAG). According to its Terms of Reference, its main purpose is proposing consistent updates of the Earth rotation theories and models and their validation. Taking into account the different methods and expertise required for the treatment of the different kinds of EOP and that their theoretical treatment must be as consistent as their determination from observations, this JWG adopted a functional structure similar to that of the former IAU/IAG JWG on Theory of Earth rotation and validation (TERV), which may be summarized by the distribution of different kinds of tasks among three sub-WGs (SWG) that work in paralel. These SWG (official within the IAG) are: (1) Precession/Nutation, chaired by Alberto Escapa; (2) Polar Motion and UT1, chaired by Aleksander Brzezinski; and (3) Numerical Solutions and Validation, chaired by Robert Heinkelmann.

Along 2021, the development of the JWG planned activities was affected by the pandemic as many other IAU activities. Despite of it, the JWG played a relevant role in the procedure that culminated in the approval of IAU Resolution B2 on the Improvement of the Earth's Rotation Theories and Models, in September 2021. The proposal was submitted by C.A2, which designated the JWG Chair as its representative to take part in the discussions in the final part of the approval process and presentation to the business plenary sessions and dedicated-to-resolutions one of the General Assembly (GA). Some comments on the motivation and scope of Resolution B2 may be found in the March 2022 issue of The IAU Catalyst.

Regarding the organization of specific meetings, the JWG chair people and some other members were involved in the convening of Earth rotation sessions at the 2021 GA of the European Geosciences Union (EGU) and the Scientific Assembly (ScA) of the IAG, held in April and June, respectively, both in virtual format. The first one was session G3.3, Earth Rotation: Theoretical aspects, observation of temporal variations and physical interpretation, convened by Escapa together with other JWG members, and welcomed contributions in the scope of this JWG among others (https://meetingorganizer.copernicus.org/EGU21/session/39900). In the same EGU GA, the JWG organized a virtual meeting-of-opportunity open to all EGU registered attendees, the SPM7 (https://meetingorganizer.copernicus.org/EGU21/session/41591). As for the ScA, it is the main IAG meeting in betwwen its GAs, and we co-organized a successful Session (3.1, Earth rotation, low- degree gravitational change and mass transport in geophysical fluids).

As for the main scientific objectives of the JWG, new research outcomes by JWG members were presented at those and other meetings and/or published in journals. These contributions include the development of several potential corrections to the IAU2006 precession or IAU2000 nutation models, including updating of forced nutation amplitudes and research on new free core nutation models. A suitable selection of corrections, applied together, allows noticeable reductions of the unexplained variance of the celestial pole offsets (CPO), achieving a lowering till nearby 100 micro arc seconds.

The activity of meeting organization included the proposal of Earth rotation sessions at the GAs of the EGU and the Asia Oceania Geosciences Society (AOGS) in 2022, which were accepted. Besides, the JWG helped in the organization of a mini symposium at the 2022 scientific sessions of the IAU GA, namely Reference Frames & Rotations, among whose topics one is dedicated to Improving Theories and Models of Earth rotation.

Appendix. *Selected contributions by JWG members and associates in 2021*

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