

# UPDATING THE IERS CONVENTIONS TO IMPROVE REFERENCE FRAMES

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**ABSTRACT.** The consistency of the reference frames provided by the IERS and its different centers relies on the set of conventional models and procedures that are used to realize them. These conventional models and procedures are mostly the product of the IERS Conventions Center, provided jointly by the Bureau International des Poids et Mesures (BIPM) and the U.S. Naval Observatory (USNO). The latest issue is the IERS Conventions (2003), recently published. In this paper we address issues related to this publication and consider the work under way to provide the future updates of the IERS Conventions.

## 1. THE IERS CONVENTIONS (2003)

After final work on remaining issues, mostly in Chapters 5 (Transformation Between the Celestial and Terrestrial Systems), 9 (Tropospheric Model), 10 (General Relativistic Models for Space-Time Coordinates and Equations of Motion) and in the general outline of the document, the final edition of the IERS Conventions (2003) was submitted to the IERS in November 2003. At that same time, the corresponding files were made available in electronic form on the USNO web site <ftp://maia.usno.navy.mil/conv2003/> (see also the new site at <ftp://tai.bipm.org/iers/conv2003/> which opened in June 2004). The paper edition was released at the end of 2004 (McCarthy and Petit, 2004). The general structure of the IERS Conventions (2003) is described in the Annex.

This electronic release was accompanied by a questionnaire to the general IERS community asking for comments on the present version and future evolution of the IERS Conventions. Although less than ten completed questionnaires were returned, several replies contained detailed answers and suggestions summarized below. The questionnaire was divided into 3 main sections: (i) On the value of the just released IERS Conventions (2003), the structure and overall quality were generally considered fine but the delay of publication was generally considered to be a problem. Some inconsistencies / deficiencies were pointed at (see next section). (ii) On the future IERS Conventions, there was unanimous agreement that any update should be by discrete increments (e.g. yearly) even though some continuously updated version may be available unofficially in the mean time. It was also recommended to continue with a paper version. In

order to gather new and updated information, several techniques were proposed: (a) call to the community, (b) expert groups, and/or (c) use the existing technique services. (iii) Finally on the interactions between the Conventions center and the rest of the IERS, it was recommended to create an Advisory Board. The importance of a formal approval of any update of the Conventions was stressed, although the body for approval was sometimes an issue (Advisory Board or IERS Directing Board). It was recommended that the routine interactions with other groups should be enhanced, although no precise method was stated for this purpose.

## 2. UPDATING THE IERS CONVENTIONS

The Conventions Center has begun preparing the next update of the IERS Conventions. The fundamental hypothesis is that the IERS Conventions should provide the basic models, software and procedures for effects common to several or all space geodetic techniques used by the IERS. On the other hand, items which are specific to one technique (generally hardware-dependent) should be covered by technique-specific conventions. Because the IERS products, notably the terrestrial reference frame (Boucher et al., 2004) and the Earth Orientation parameters are obtained from a combination of the results of different techniques, it is essential that all analysis be consistent by following the same IERS Conventions. It is also necessary that the IERS Conventions themselves provide a complete and consistent set. General rules to be followed in this aim are the following: Ensure global consistency in the document itself e.g. remove ambiguous statements or recommended a unique model / procedure. Update missing or outdated models. Provide all necessary routines. Provide the magnitude of effects and the magnitude of model changes, possibly with numerical examples. In order to fully achieve these goals in the future, two directions of work are taken: Provide new electronic tools to the community and obtain agreement on new (or existing) conventional models.

### 2.1. *New electronic tools*

New tools have been developed to help in the process of updating the IERS Conventions. A new web site and a discussion forum have been installed at the BIPM. The web site for Conventions updates (<http://tai.bipm.org/iers/convupdt/convupdt.html>) is continuously modified, as required by changes in the texts, routines or data files. However, the site is expected to retain the complete history of updates thus ensuring the archiving and the traceability of the changes. It should also contain new products such as numerical examples or explanatory material, as they become available. The discussion forum (<http://tai.bipm.org/iers/forum>) is for users to offer their comments, criticism, and suggestions regarding the update of the IERS Conventions. It is organized in themes following the present structure of the IERS Conventions (2003). Reading the contributions is open and anonymous but, to post a contribution, it is necessary to be registered. Registration is mandatory so that the forum administration can identify participants, but it is a very simple procedure and the only requirement is to accept the terms of the forum, which is designed only for "discussions on the IERS Conventions".

### 2.2. *Topics for updates*

Corrections to the IERS Conventions (2003) are already under way, starting with typos that were discovered after the official release and with some limited text changes that improve the readability of the document (see <http://tai.bipm.org/iers/convupdt/convupdt.html>).

More technical or complex issues are first debated, e.g. on the discussion forum (<http://tai.bipm.org/iers/forum>), numerical examples and test cases are proposed, and topics are being identified as needing investigation and possible new developments for future versions of the Conventions. Several such topics concern contributions to the difference between the instantaneous position of a site and its regularized position, such as the effects of geocenter motion or atmospheric loading. It is expected that all effects (such as station displacement) that are

periodic and have a consistent and accurate a-priori model, expressed in closed form, should be included in the IERS Conventions. To be considered in updating IERS Conventions (2003) are e.g. models for sub-daily effects concerning geocenter motion due to ocean tides and atmosphere pressure loading, revision of models for tidal effects on Earth orientation parameters, etc. Models for long-term or non-periodic effects, which have an impact on the definition of reference frames, are also to be studied, although their inclusion as conventional effects will need to be discussed.

The Conventions Center also intends to gather information by participating to other studies, such as the development of rigorous multi-technique product combinations through the new Combination Pilot Project (<http://www.iers.org/iers/about/wg/wg3/cpp.html>).

### 3. CONCLUSIONS

After the completion of the IERS Conventions (2003), the Conventions Center has provided new tools and methods to prepare the future updates of the Conventions. To achieve this aim it encourages discussions and developments for models, software and procedures that are relevant to the IERS techniques. It also encourages studies on the application of the IERS Conventions by analysis centers of specific techniques, particularly those that study the impact of current or proposed conventional models on the accuracy or on the performance limits of space geodetic results.

### 4. ACKNOWLEDGEMENTS

We thank all those that provided input and advice by responding to the Questionnaire or posting questions and answers through the Conventions forum or other means. Particular thanks are due to Jim Ray for his help in establishing the discussion forum.

### 5. REFERENCES

- Boucher C., Altamimi Z., Sillard P., Feissel-Vernier M., 2004; The ITRF2000, IERS TN31, Verlag des BKG, 270 p.  
McCarthy D.D., Petit G., 2004; IERS Conventions (2003), IERS TN32, Verlag des BKG, 127 p.

## APPENDIX: CONTENTS OF THE IERS CONVENTIONS (2003)

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*Glossary*