Introduction (1 June 2004)

This document is intended to define the standard reference systems realized by the International Earth Rotation Service (IERS) and the models and procedures used for this purpose. It is a continuation of the series of documents begun with the Project MERIT Standards (Melbourne *et al.*, 1983) and continued with the IERS Standards (McCarthy, 1989; McCarthy, 1992) and IERS Conventions (McCarthy, 1996). The current issue of the IERS Conventions is called the IERS Conventions (2003). When referenced in recommendations and articles published in past years, this document may have been referred to as the IERS Conventions (2000).

All of the products of the IERS may be considered to be consistent with the description in this document. If contributors to the IERS do not fully comply with these guidelines, they will carefully identify the exceptions. In these cases, the contributor provides an assessment of the effects of the departures from the conventions so that its results can be referred to the IERS Reference Systems. Contributors may use models equivalent to those specified herein. Products obtained with different observing methods have varying sensitivity to the adopted standards and reference systems, but no attempt has been made in this document to assess this sensitivity.

The reference systems and procedures of the IERS are based on the resolutions of international scientific unions. The celestial system is based on IAU (International Astronomical Union) Resolution A4 (1991). It was officially initiated and named by IAU Resolution B2 (1997) and its definition was further refined by IAU Resolution B1 (2000). The terrestrial system is based on IUGG Resolution 2 (1991). The transformation between celestial and terrestrial systems is based on IAU Resolution B1 (2000). The definition of time coordinates and time transformations, the models for light propagation and the motion of massive bodies are based on IAU Resolution A4 (1991), further defined by IAU Resolution B1 (2000). In some cases, the procedures used by the IERS, and the resulting conventional frames produced by the IERS, do not completely follow these resolutions. These cases are identified in this document and procedures to obtain results consistent with the resolutions are indicated.

The units of length, mass, and time are in the International System of Units (Le Système International d'Unités (SI), 1998) as expressed by the meter (m), kilogram (kg) and second (s). The astronomical unit of time is the day containing 86400 SI seconds. The Julian century contains 36525 days and is represented by the symbol c. When possible, the notations in this document have been made consistent with ISO Standard 31 on quantities and units.

While the recommended models, procedures and constants used by the IERS follow the research developments and the recommendations of international scientific unions, continuity with the previous IERS Standards and Conventions is essential. In this respect, the principal changes are listed below.

Differences between this Document and IERS Technical Note 21

The most significant changes from previous IERS standards and conventions are due to the incorporation of the recommendations of the 24th IAU General Assembly held in 2000. These are shown in Appendix 1 of this document. These recommendations clarify and extend the concepts of the reference systems in use by the IERS and introduce a major revision of the procedures used to transform between them. A new theory of precession-nutation has been adopted by the IAU and this is introduced in this document. The IAU 2000 recommendations also extend the procedures for the application of relativity. Other major changes are due to the adoption by the IERS of a new Terrestrial Reference Frame (ITRF2000) (Altamimi *et al.*, 2002), the recommendation of a new geopotential model and the modification of the solid Earth tide model to be consistent with the model of nutation.

The authors and major contributors are outlined below along with the significant changes made for each chapter.

Chapter 1: General Definitions and Numerical Standards

This chapter was prepared principally by D. McCarthy and G. Petit with major contributions from M. Burša, N. Capitaine, T. Fukushima, E. Groten, P. M. Mathews, P. K. Seidelmann, E. M. Standish, and P. Wolf. It provides general definitions for topics that belong to different chapters of the document and also the values of numerical standards that are used in the document. It incorporates the previous Chapter 4, which has been updated to provide consistent notation throughout the IERS Conventions and to comply with the recommendations of the most recent reports of the appropriate working groups of the International Association of Geodesy (IAG) and the IAU.

Chapter 2: Conventional Celestial Reference System and Frame

This chapter (previously Chapter 1) has been updated by E. F. Arias with contributions from J. Kovalevsky, C. Ma, F. Mignard, and A. Steppe to comply with the recommendations of the IAU 2000 24th General Assembly.

Chapter 3: Conventional Dynamical Realization of the ICRS

In this chapter (previously Chapter 2), the conventional solar system ephemeris has been changed to the Jet Propulsion Laboratory (JPL) DE405. It was prepared by E. M. Standish with contributions from F. Mignard and P. Willis.

Chapter 4: Conventional Terrestrial Reference System and Frame

This chapter (previously Chapter 3) has been rewritten by Z. Altamimi, C. Boucher, and P. Sillard with contributions from J. Kouba, G. Petit, and J. Ray. It incorporates the new Terrestrial Reference Frame of the IERS (ITRF2000), which was introduced in 2001.

Chapter 5: Transformation Between the Celestial and Terrestrial Systems

This chapter has been updated principally by N. Capitaine, with major contributions from P. M. Mathews and P. Wallace to comply with the recommendations of the IAU 2000 24th General Assembly. Significant contributions from P. Bretagnon, R. Gross, T. Herring, G. Kaplan, D. McCarthy, Burghard Richter and P. Simon were also incorporated.

Chapter 6: Geopotential

This chapter was prepared principally by V. Dehant, P. M. Mathews, and E. Pavlis. Major contributions were also made by P. Defraigne, S. Desai, F. Lemoine, R. Noomen, R. Ray, F. Roosbeek, and H. Schuh. A new geopotential model is recommended.

Chapter 7: Displacement of Reference Points

Chapter 7 has been updated to be consistent with the geopotential model recommended in Chapter 6. It was prepared principally by V. Dehant, P. M. Mathews, and H.-G. Scherneck. Major contributions were also made by Z. Altamimi, S. Desai, S. Dickman, R. Haas, R. Langley, R. Ray, M. Rothacher, H. Schuh, and T. van Dam. A model for post-glacial rebound is no longer recommended and a new ocean-loading model is suggested. The VLBI antenna deformation has been enhanced.

Chapter 8: Tidal Variations in the Earth's Rotation

Changes have been introduced to be consistent with the nutation model adopted at the 24th IAU General Assembly. The model of the diurnal/semidiurnal variations has been enhanced to include more tidal constituents. The principal authors of Chapter 8 were Ch. Bizouard, R. Eanes, and R. Ray. P. Brosche, P. Defraigne, S. Dickman, D. Gambis, and R. Gross also made significant contributions.

Chapter 9: Tropospheric Model

This chapter has been changed to recommend an updated model. It is based on the work of C. Ma, E. Pavlis, M. Rothacher, and O. Sovers, with contributions from C. Jacobs, R. Langley, V. Mendes, A. Niell, T. Otsubo, and A. Steppe.

Chapter 10: General Relativistic Models for Space-time Coordinates and Equations of Motion

This chapter (previously Chapter 11), has been updated to be in compliance with the IAU resolutions and the notation they imply. It was prepared principally by T. Fukushima and G. Petit with major contributions from P. Bretagnon, A. Irwin, G. Kaplan, S. Klioner, T. Otsubo, J. Ries, M. Soffel, and P. Wolf.

Chapter 11: General Relativistic Models for Propagation

This chapter (previously Chapter 12), has been updated to be in compliance with the IAU resolutions and the notation they imply. It is based on the work of T. M. Eubanks and J. Ries. Significant contributions from S. Kopeikin, G. Petit, L. Petrov, A. Steppe, O. Sovers, and P. Wolf were incorporated.

The IERS Conventions are the product of the IERS Conventions Product Center. However, this volume would not be possible without the contributions acknowledged above. In addition, we would also like to acknowledge the comments and contributions of S. Allen, Y. Bar-Sever, A. Brzeziński, M. S. Carter, P. Cook, H. Fliegel, M. Folgueira, J. Gipson, S. Howard, T. Johnson, M. King, S. Kudryavtsev, Z. Malkin, S. Pagiatakis, S. Pogorelc, J. Ray, S. Riepl, C. Ron, and T. Springer.

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