

Past, present and possible updates to the IERS Conventions

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IERS Conventions update: electronic access

<http://tai.bipm.org/iers/convupdt/listupdt.html>



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IERS Conventions update List of updates Working version **last updated 28 June 2007**

Chapter 5: Transformation Between the Celestial and Terrestrial Systems.

- ◆ 16 February 2007: Changes (provided by P. Wallace and N. Capitaine) with respect to [previous version](#) of the chapter: Revised section 5.8.3 to make the references for the planetary fundamental arguments clear.
- ◆ 22 December 2006: Correction to [previous version](#) of the chapter: Equation (14) for the Earth Rotation Angle has been corrected (noted by F. Nievinski).
- ◆ 18 October 2006: Changes (provided by N. Capitaine and P. Wallace) with respect to [previous version](#) of the chapter: Update section 5.7 to provide Table 5.4 and to make notations consistent with those in the electronic version of the [table](#). Make the chapter's terminology consistent with the current IAU Recommendations.
- ◆ 19 September 2005: Add subroutine PMSdnut.for and update section 5.4.2 of [previous version](#) of the chapter.
- ◆ 5 November 2004:
Corrections (provided by N. Capitaine) with respect to [previous version](#) of the chapter: Update header of Table 5.3b in the text and in the [corresponding file](#); Precise the use of equation (23); Add note 1;
Also add info on the new web sites in the notes.

Chapter 6: Geopotential.

- ◆ 20 July 2006: The file [desaiscopolecoef.txt.gz](#) was corrected for an error in the column titles (from S. Desai and R. Gross).
- ◆ 22 March 2006: Changes with respect to [previous version](#) of the chapter: Corrections and precisions for some notations in section 6.5 "Effect of the ocean tides" (noted by F. Zhang). The file [desaiscopole2004.txt](#) was corrected to be consistent with the model of the Conventions (noted by M. Nitschke).
- ◆ 13 March 2006: Main changes with respect to [previous version](#) of the chapter: New section 6.3 on Oceanic pole tide (from S. Desai and J. Chen). Information on the treatment of degree 1 harmonic coefficients is given in the beginning of the chapter (from J. Ries).
- ◆ 23 September 2005: Corrections with respect to [previous version](#) of the chapter: In section 6.3, the reference epoch for value C20 has been corrected (noted by E.C. Pavlis).
- ◆ 18 November 2004: Corrections with respect to [previous version](#) of the chapter: The caption of Table 6.3b has been corrected (from S. Bettadpur and V. Dehant). Unnumbered equations at end of section 6.2 have been corrected (noted by S.Y. Zhu).

Chapter 7: Displacements of reference points.

Introduction

- Add a set of "Guiding Principles" for models to be included in the Conventions
- Draft proposal in **position paper by J. Ray et al. in Session 3**

Ch 1: General Definitions & Numerical Standards

- Are any updates needed to numerical standards ?
- 2006 CODATA value for $G = 6.67428 \times 10^{-11}$
 $\pm 0.00067 \times 10^{-11}$
- Numerical constants to be agreed with IAU Working Group on Numerical Standards of Fundamental Astronomy (NSFA, chaired by B. Luzum)
- Mention of various relativistic scalings to be reviewed following work of IAU Commission 52 on Relativity in Fundamental Astronomy (RIFA) – see presentation by **S. Klioner in this session**

Ch 2: Conventional Celestial Reference System & Frame

- Note work of IAU and IERS/IVS Working Groups to update ICRF
- See presentation by **C. Ma in Session 5**

Ch 3: Conventional Dynamical Realization of the ICRS

- JPL ephemerides updated from DE405 to DE414.
- Possible update of planetary masses & constants (see IAU WG NSFA)
- Mention of time scales to be reviewed following work of IAU Commission 52 (RIFA) – see presentation by **S. Klioner in this session**

Ch 4: Conventional Terrestrial Reference System & Frame

4.1.3 Conventional contributions to local station displacements

- Clarify meaning of eqn (11) by adopting a set of criteria for conventional contributions – see [position papers in Session 3](#)
- Clarify the handling of non-tidal loading effects – see also [position papers in Session 3](#)
- Impose consistency with Chapter 7 models

4.1.5 Realizations of the ITRS

- Definition of ITRF as realization of ITRS is questioned due to systematic differences given in 4.2.4 for permanent tide, scale, and geocenter motion

4.2.3 Datum specifications for ITRF200X

- [See presentations in session 4](#)
- Possible update of the orientation rate datum
 - replace NNR-NUVEL-1A with more modern, stable reference
 - D. Argus has suggested to use a hot-spot model instead
 - also empirical geodetic models by C. Kreemer or H. Drewes

Ch 4: Conventional Terrestrial Reference System and Frame (cont.)

- Definition of the origin to be reviewed
 - see [discussion paper by G. Petit et al. in Session 4](#)
- Possible new approaches to handle non-linear station motions, co- and post-seismic motions, other discontinuities, etc

4.2.4 Geocenter motion

- See [discussion paper by G. Petit et al. in Session 4](#)
- Define more precisely the concept of geocenter motion; rather than as ITRS -> ITRF effect
- Impose consistency with other sections (e.g., Chapter 7), esp in handling of tidal fluid model effects
- Choice of reference frame for loading effects should be clarified to use CM explicitly in all cases (e.g., Chapter 7 effects) => Chapter 7

Ch 5: Transformation between the Celestial and Terrestrial Systems

- Corrections posted 05 Nov 2004, 18 Oct 2006, 22 Dec 2006, 16 Feb 2007
- New subroutine PMsdnut.for, provided by A. Brzezinski, posted 19 Sep 2005 for the prograde diurnal luni-solar effect on polar motion (section 5.4.2)
- Specify that IAU2000A is "official" model recommended for nutation
- Implementation of IAU2006 resolutions for precession (Resolution 1) and nomenclature (Resolution 2), to be effective 1/1/2009, is underway – see presentations by **N. Capitaine and P. Wallace in Session 5**
- Procedure for handling variations due to unmodeled Free Core Nutation to be proposed soon

Ch 6: Geopotential

- Corrections posted 18 Nov 2004, 23 Sep 2005, 22 Mar 2006, 20 Jul 2006
- Model for new effect due to oceanic pole tide posted 13 Mar 2006, from S. Desai & J. Chen (new section 6.3)
- Should secular & annual changes of the low degree & order geopotential coefficients (besides just C21 & S21) be included, based on long-term SLR analyses ???
- Consider accounting for non-tidal geopotential variations
 - F. Lemoine suggests to consider decomposing into solid Earth (mostly static field) plus atmospheric components (strong annual components), as with GRACE analyses
- Update ocean effects to use a consistent ocean tide model throughout all parts of the Conventions
 - see presentation by **R. Biancale in Session 1** on new model derived from FES2004 ocean tide model

Ch 7 : Displacement of Reference Points (1)

Possibly change title to “Conventional corrections to station coordinates”

7.1.1 Ocean tidal loading

- Section completely revised (25 Nov 2006), including provision of routine hardisp.f by D. Agnew as a conventional implementation of the ocean tidal loading computation
 - R. Dach says that hardisp.f uses opposite sign convention from the ocean loading service for the Mf, Mm, & Ssa tides – **issue not yet resolved**
- New, improved ocean models added to ocean loading website at <http://www.oso.chalmers.se/~loading/> by H-G. Scherneck & M. Bos
- Whole-Earth geocenter motion coefficients also added to ocean loading website for each tide model; text modified to describe proper handling of effect

Ch 7 : Displacement of Reference Points (2)

7.1.2 Solid Earth tides

- Subroutine dehanttideinel.f updated 20 Jun 2007 to correct dutc subroutine (from H. Manche) for an error <0.05 mm and step2diu subroutine (from V. Tesmer) for an error that may exceed 0.1 mm.
 - review continues for some other possible corrections (which effects should be <0.05 mm)

7.1.4 Solid Earth pole tide (01 Sep 2006)

- Specify IERS conventional mean pole to be the linear model given
- Correct a typo and account for the anelastic contributions (from J. Wahr)
- Define theta explicitly as the co-latitude & reconcile with earlier notations

Ch 7 : Displacement of Reference Points (3)

7.1.5 Oceanic pole tide

- Model for new effect posted 01 Sep 2006 from S. Desai

7.1.? S1/S2 atmospheric pressure tidal loading model (NEW)

- T. van Dam & R. Ray have provided a gridded model for this effect together with implementation software.
 - loading model under test by SLR & VLBI data analysts – see presentation by **J. Boehm & V. Tesmer in Session 1**
 - still need to consider whether to include effects of annual modulation, which leads to sidebands mainly at K1, P1, R2, & T2; could handle these via an admittance approach depending on size of effects (point raised by R. Ray via T. van Dam)
 - still need whole-Earth geocenter motion translational model to relate CM and crust-fixed frames

Ch 7 : Displacement of Reference Points (4)

7.1.6 Non-tidal atmospheric pressure tidal loading

- Use of GGFC (and other ?) products needs explanation
- Draft proposal in **position paper by J. Ray et al. in Session 3** recommends not to apply in routine data reductions for IERS products
- Same argumentation holds for other non-tidal loading contributions (not yet mentioned in the Conventions)
- See arguments for future integrated Earth model in **position paper by H-P. Plag et al. in Session 3**

Ch 7 : Displacement of Reference Points (5)

7.2 Documentation of technique-specific effects

- see presentations **in session 2**
- Add a set of criteria to determine which technique-specific effects should be mentioned explicitly in IERS Conventions
 - consider level of direct impacts on IERS products
 - also consider possible indirect effects, e.g., through local co-location site ties
- To what level should these effects be documented here versus giving links to external information sources ?
- If VLBI antenna thermal deformation model is retained, how should suitable reference temperatures be computed for all VLBI sites (7.2.1) ?
 - note that local co-location survey ties should be corrected for the temperature-dependent position of VLBI reference point (w.r.t. reference temperature position)

Ch 8 : Tidal Variations in the Earth's Rotation

- Corrections posted 15 Nov 2004, 21 Apr 2005, 06 Feb 2006, 28 Apr 2006
 - clarification added that zonal tidal corrections should not be applied in exchange of UT1 & LOD values to avoid confusion over exact model values used
- Recipe for interpolation to arbitrary epochs should be given along the lines of the old IERS Gazette #13 (30 Jan 1997)
- Review of model for diurnal & semidiurnal EOP variations needed
 - current model for ocean tidal effects is old & can probably be improved (e.g., recent work by Dobslaw & Thomas)
 - R. Ray has indicated he might be able to work on this, see presentation in **this session (C. Ma will present)**
 - new model should perhaps consider effect of S1/S2 atmosphere pressure tides [e.g., de Viron et al., JGR, 110, B11404, 2005]; effect of S1 probably reaches level of 0.2 mas for polar motion and therefore should be included, but current GCM models are not in good agreement with each other
 - S2 & S3 tides are probably small enough to ignore for now
 - S1 thermal tide, see presentation by **A. Brzezinski in this session.**

Ch 9 : Tropospheric models

- Chapter completely revised & updated (28 Jun 2007) by J. Boehm, G. Hulley, A. Niell, E. Pavlis, together with several new subroutines:
 - optical techniques: New mapping function and zenith delay model as standard in ILRS since 1/1/2007
 - radio techniques: New mapping function VMF1 and GMF (not requiring NWM data)
- Should provide a priori model for hydrostatic gradient due to equatorial bulge.
 - see presentation by **P. Steigenberger et al. in Session 1**
- Improvements to GMF mapping function under consideration by J. Boehm

Ch 10 : General Relativistic Models for Space-time Coordinates & Equations of Motion (1)

- Review nomenclature for coordinate quantities, following the work of IAU Commission 52 (RIFA) – see presentation by **S. Klioner in this session**
- Implement new definition of TDB, following IAU2006 Resolution 3
- Possibly add a new section on clock synchronization and transformation of proper time to coordinate time, with application to GNSS satellite clocks
 - specifically, consider adding a description of the conventional models used to model GNSS satellite clocks, such as $2(\mathbf{R}\cdot\mathbf{V})/c$ ellipticity term
 - consider description of neglected relativistic effects on GNSS clock estimates by reference to published work (e.g., J. Kouba, GPS Solutions, 2004) to inform users of these signatures in published satellite clock results

Ch 10 : General Relativistic Models for Space-time Coordinates & Equations of Motion (2)

- Include magnitude of terms in the relativistic formulation of the satellite acceleration. Info in the literature. U. Hugentobler provided the following estimates :
 - primary effect is the 1st term (Schwarzschild field), which affects GPS orbits by about 4 mm radially
 - Lense-Thirring precession (frame dragging) in the 2nd term is about two orders of magnitude smaller for GPS, mainly causing a rotation of the orbit nodes by about -4 uas/day
 - DeSitter (geodesic) precession in the third term is about one order of magnitude smaller than 1st term for GPS, also mainly causing a rotation of the orbit nodes by about 50 uas/day
 - neglect of the Earth's oblateness (J2) in eqn (1) introduces an error at the micrometer level for GPS satellites

Ch 11 : General Relativistic Models for Propagation

- Review nomenclature for coordinate quantities, following the work of IAU Commission 52 (RIFA) – see presentation by **S. Klioner in this session**
- Change section 11.2 title from "Laser Ranging" to "Ranging Techniques" & augment to indicate orders of magnitude of different cases

Possible New Effects to be Treated

- Analogous to Chapter 9 for tropospheric models, a new chapter or section may be considered for the propagation of radio waves through the ionosphere
 - linear combinations of multi-frequency observations
 - influence of higher-order neglected effects
 - possible models for higher-order effects

Other Pending Issues

- Documentation of analysis models in SINEX files
 - is it worthwhile to document data analysis models in SINEX files ???
 - would require standardized names for all model effects
 - IERS does something like this already for SLR, but not computer parsable
- Is it necessary to publish a paper Conventions document or is electronic version alone adequate ?
- Directions for electronic documents?
- Are standards for conventional software implementations needed ?
- See **presentations in Session 7**
- Link with Conventions in International Gravity Field Service.