Space-time references and General relativity: IERS Conventions Centre Relativistic geodesy

G. Petit (BIPM)

21st CCTF Meeting

8-9 June 2017

Bureau International des Poids et Mesures

IERS Conventions Centre

Since 2001, the BIPM and the U. S. Naval Observatory (USNO) have been providing the Conventions Centre of the International Earth Rotation and Reference Systems Service (IERS).

BIPM: G. Petit, F. Arias
USNO: N. Stamatakos, M. Davis, D. McCarthy (contractor);
All part-time (with parts ranging from small to very small).

Since 2015:
Minimal work of updating the existing web documents and software

Co-responsibility of the Conventions Centre transferred to Paris Observatory in July 2016 (still with the USNO team)

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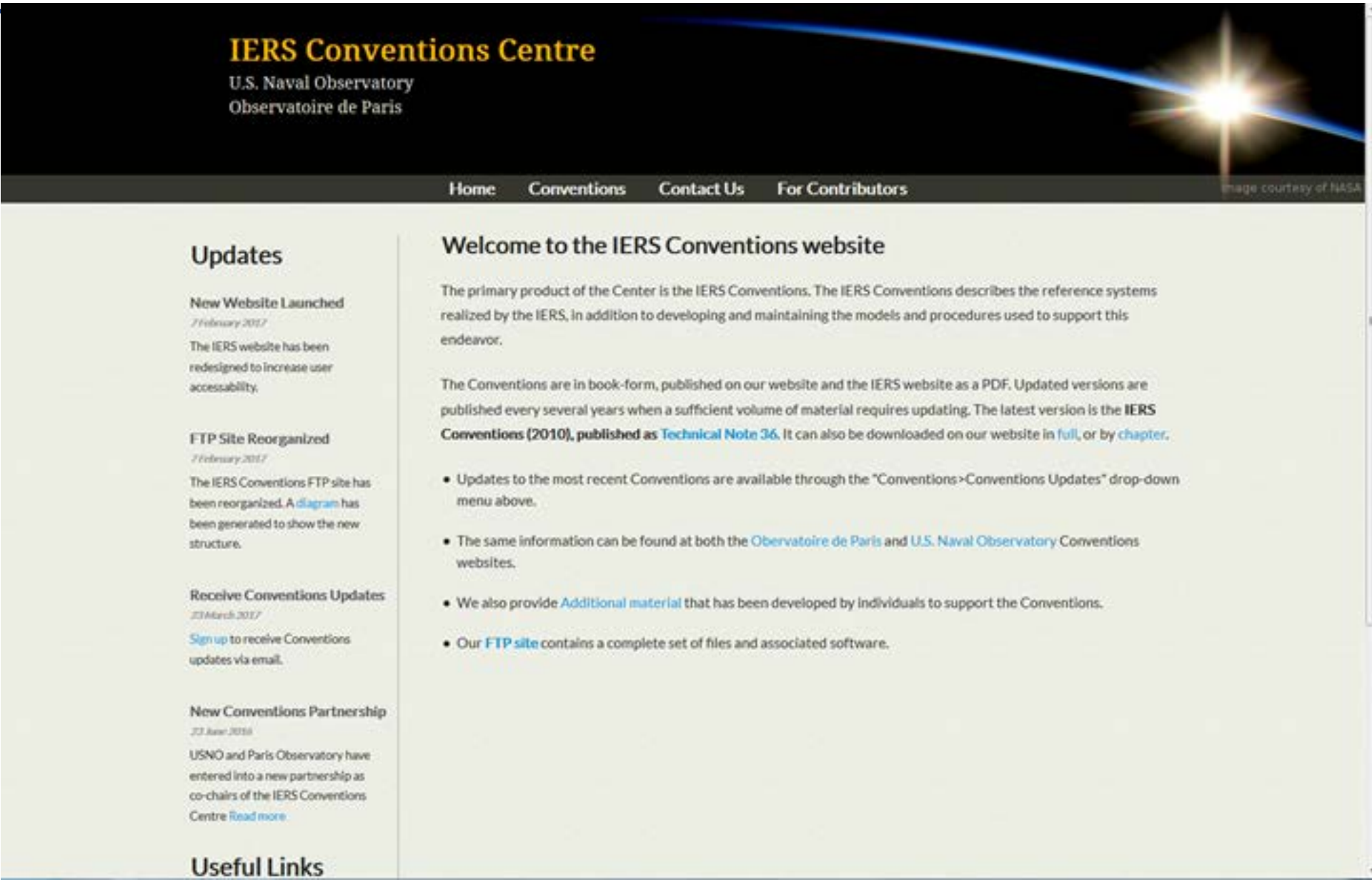
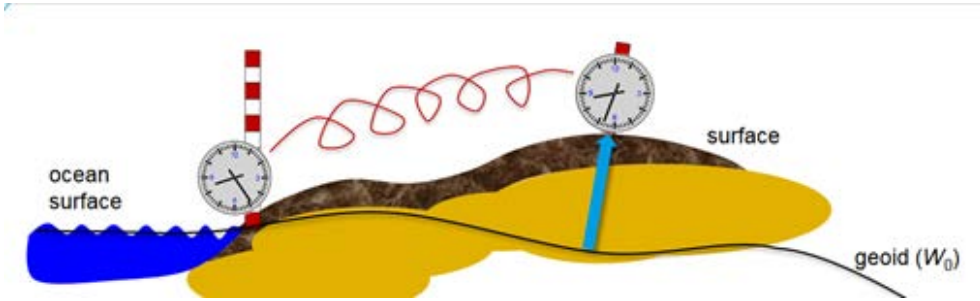
http://iers-conventions.obspm.fr/



Relativistic Geodesy

- The frequency of an ideal clock wrt. Coordinate time depends on the gravity potential (relativistic shift).
- Chronometric levelling directly measures the geopotential (height) difference between any two clocks (1cm $\approx 10^{-18}$) if
  - Clocks are accurate
  - Frequency difference can be measured
- This allows determining geopotential and discriminating sources of sea level changes.

$\Rightarrow$ **Clock accuracy must be checked** e.g. by regular clock transport.



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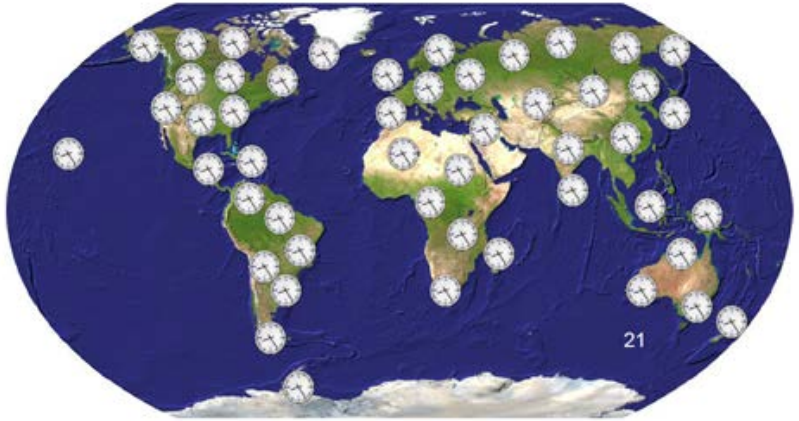

New IAG Joint WG 2.1

Relativistic geodesy: First steps towards a new geodetic technique

- Under the auspices of IAG Commission 2 (Gravity Field)
  - Joint with Sub--Commission 1--2 on Global Reference Frames

The objectives of the Working Group are to:

- Act as interface between groups in geodesy (gravity fields, reference frames...) and in time and frequency metrology (clock development, clock comparisons ...);
- Provide a platform to promote the further development and application of relativistic geodesy, e.g. in physics, astronomy and other fields of geodesy and metrology;
- Foster the geodetic interests in the realization of the concept of relativistic geodesy;
- Develop an optimal strategy for the installation and analysis of clock networks and for the combination of clock data with classical geodetic data (e.g. for height systems);
- Advocate the implementation of a clock network of sufficient capability to obtain data products essential for geodetic applications;
- Study the use of clock networks in space;
- Provide relevant information for the geodetic community including key contacts and links;
- Organize meetings and sessions on relativistic geodesy;
- Prepare a document on the perspectives and applications of relativistic geodesy.

Initial membership / activity

- Kick-off meeting 15-16 May 2017 in Hannover
- ~18 participants incl. 9 WG members
- Topics reviewed:
  - Theory
  - References (geoid, MSL, time ….)
  - Classical gravity potential determination
  - Frequency transfer, fiber links, campaigns
  - Optical clocks, calibration and comparisons
  - Use of accurate clocks for gravity potential determination
- Plans to prepare a « mise en pratique » for T/F labs to compute relativistic shift to 10^{-18} based on several recent publications by WG members

- Members

Chair: Jakob Flury (Leibniz Universität)
Co-chair: Gerard Petit (BIPM)
Jürgen Müller (Leibniz Universität)
Claude Boucher (Observatoire de Paris)
Pacome Delva (Observatoire de Paris)
Paul Eric Pottie (Observatoire de Paris)
Davide Calonico (INRIM)
Pascale Defraigne (Royal Observatory Belgium)
Sergei Kopeikin (U Missouri)
Claus Lämmerzahl (ZARM Bremen)
Stefan Schiller (U Düsseldorf)
Piet Schmidt (Leibniz Universität / PTB)
Christian Lisdat (PTB Braunschweig)
Gesine Grosche (PTB Braunschweig)
Bijunath Patla (NIST Boulder)
Nikos Pavlis (UMB)
Geoff Blewitt (U Nevada)
Pavel Novak (U W Bohemia, ICCT)
Chris Hugues (U Newcastle)

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