



**International Association
of Geodesy**

Newsletter

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The *IAG Newsletter* is under the editorial responsibility of the *Communication and Outreach Branch* (COB) of the IAG.

It is an open forum and contributors are welcome to send material (preferably in electronic form) to the IAG COB (newsletter@iag-aig.org). These contributions should complement information sent by IAG officials or by IAG symposia organizers (reports and announcements). The *IAG Newsletter* is published monthly. It is available in different formats from the IAG new internet site: <http://www.iag-aig.org>

Each *IAG Newsletter* includes several of the following topics:

- I. news from the Bureau Members
- II. general information
- III. reports of IAG symposia
- IV. reports by commissions, special commissions or study groups
- V. symposia announcements
- VI. book reviews
- VII. fast bibliography

General Announcements

Advances in Space Research

Dear colleagues,

for your information, issue 61(1) of *Advances in Space Research* (COSPAR official journal), published on January 1, 2018, is now available online and will remain free-of-charge without any paid subscription to this journal for a complete year, courtesy of Elsevier, at

<https://www.sciencedirect.com/journal/advances-in-space-research/vol/61/issue/1>



In particular, the articles below could be of scientific interest to the geodetic community.

I remind you that ASR publishes 24 issues per year (2 issues of 20 or more papers each per month), that accepted papers appear online with a DOI in “accepted proofs” only a couple of days after acceptance and that this journal accepts electronic supplements and supports OpenAccess. Review process takes on average about 9 weeks before the first decision is sent back to the authors (4 weeks to find proper reviewers and 5 weeks to get their report and make a first decision). Published articles are referenced in ISI Web of Science, Scopus and many other scientific databases. This journal also accepts Special Issues. Its Impact Factor has been steadily increasing in the past few years and is now 1.401.

Submissions can be done electronically at any time using the EES System (<http://ees.elsevier.com/asr>).

Published articles can be found online at <https://www.sciencedirect.com/journal/advances-in-space-research/issues>

Astrodynamics And Space Debris

Nikita P. Zelensky, Frank G. Lemoine, Brian D. Beckley, Douglas S. Chinn and Despina E. Pavlis (2018) Impact of ITRS 2014 Realizations on Altimeter Satellite Precise Orbit Determination, *Adv. Space Res.*, 61(1), 45-73, DOI: 10.1016/j.asr.2017.07.044.

<https://doi.org/10.1016/j.asr.2017.07.044>

Stefano Bertone, Christophe Le Poncin-Lafitte, Pascal Rosenblatt, Valéry Lainey, Jean-Charles Marty, Marie-Christine Angonin (2018) Impact analysis of the transponder time delay on radio-tracking observables, *Adv. Space Res.*, 61(1), 89-96, DOI: 10.1016/j.asr.2017.09.003.

<https://doi.org/10.1016/j.asr.2017.09.003>

Junyang Pan, Xiaogong Hu, Shanshi Zhou, Chengpan Tang, Rui Guo, Lingfeng Zhu, Guifeng Tang and Guangming Hu (2018) Time Synchronization of New-generation BDS Satellites Using Inter-satellite Link Measurements, *Adv. Space Res.*, 61(1), 145-153, DOI: 10.1016/j.asr.2017.10.004.

<https://doi.org/10.1016/j.asr.2017.10.004>

Ernst Schrama (2018) Precision Orbit Determination Performance for CryoSat-2, *Adv. Space Res.*, 61(1), 235-247, DOI: 10.1016/j.asr.2017.11.001.

<https://doi.org/10.1016/j.asr.2017.11.001>

Earth Sciences

Liang Chen, Qile Zhao, Zhigang Hu, Xinyuan Jiang, Changjiang Geng, Maorong Ge and Chuang Shi (2018) GNSS Global Real-time Augmentation Positioning: Real-time Precise Satellite Clock Estimation, Prototype System Construction and Performance Analysis, *Adv. Space Res.*, 61(1), 367-384, DOI: 10.1016/j.asr.2017.08.037.

<https://doi.org/10.1016/j.asr.2017.08.037>

Siyao Wang, Bofeng Li, Xingxing Li and Nan Zang (2018) Performance Analysis of PPP Ambiguity Resolution with UPD Products Estimated from Different Scales of Reference Station Networks, *Adv. Space Res.*, 61(1), 385-401, DOI: 10.1016/j.asr.2017.09.005.
<https://doi.org/10.1016/j.asr.2017.09.005>

Alina L. Barbu, Julien Laurent-Varin, Felix Perosanz, Flavien Mercier and Jean-Charles Marty (2018) Efficient QR Sequential Least Square Algorithm for High Frequency GNSS Precise Point Positioning Seismic Application, *Adv. Space Res.*, 61(1), 448-456, DOI: 10.1016/j.asr.2017.10.032.
<https://doi.org/10.1016/j.asr.2017.10.032>

Space Technology, Policy and Education

Vera Mayorova, Dmitriy Grishko, Victor Leonov (2018) New educational tools to encourage high-school students' activity in stem, *Adv. Space Res.*, 61(1), 457-465, DOI: 10.1016/j.asr.2017.07.037.
<https://doi.org/10.1016/j.asr.2017.07.037>

Seasons Greetings
PASCAL WILLIS
Editor-in-Chief
Advances in Space Research

Meeting Announcements

REFAG2018 Symposium and Panel on Satellite Dynamics Meeting

Hosted at COSPAR 2018, 42nd Scientific Assembly
July 14-22, 2018, Pasadena, California, USA
<https://www.cospar-assembly.org>
<http://cospar2018.org>



The next COSPAR meeting will attract about 2500 scientists and engineers from the world over. More than 100 symposia will cover all areas of space science: Space studies of the Earth's surface, meteorology and climate, Space studies of the Earth-Moon, Planets and small bodies of the solar system, Space studies of the upper atmospheres of the Earth and Planets including reference atmosphere, Space plasmas in the Solar system, including planetary magnetospheres, research in astrophysics from space, life sciences as related to space, material sciences in space, fundamental physics in space, and several Panel meetings.

Interdisciplinary lectures will also be given by key scientists and several associated events are planned, such as a meeting organized by Elsevier for young scientists to help them publish or review scientific articles.

In particular, we would like to draw the attention of geodesists to IAG Commission 1 "Reference Frames" participation in COSPAR: (1) the multi-session symposium "Reference Frames for Applications in Geosciences" (REFAG2018), and (2) the 2-day meeting organized by the Panel on Satellite Dynamics.

REFAG2018 Symposium

"Reference Frames for Applications in Geosciences" (REFAG2018) continues the quadrennial series of symposia of IAG Commission 1 "Reference Frames", which is identical to COSPAR Sub-Commission B2 "International Coordination of Space Techniques for Geodesy."

Reference systems and frames are of primary importance for research in the geosciences, satellite orbit determination, precision navigation, as well as for practical applications in geo-information. For the geosciences, precisely defined reference frames are needed for an improved understanding of the Earth's rotation and its gravity field, geocenter motion, glacial isostatic adjustment, surface loading deformation and global redistribution of water, sea level change with time, tectonic plate motion and plate boundary deformation, the earthquake cycle, and other crustal displacements.

We solicit presentations dealing with theoretical aspects and the practical realization of reference frames, as well as their applications in the geosciences. Further emphases of the session are on global terrestrial and regional reference frames, celestial reference frames, and the co-location of space geodetic techniques on ground and in space. Additionally, we encourage scientific reports from the many dedicated participants of IAG Commission 1, its sub-commissions, and associated working groups.

REFAG 2018 will be the occasion to celebrate the 30th anniversary of the International Earth Rotation and Reference Systems Service (IERS). Presentations on the diverse IERS combination activities related to ITRF, ICRF and Earth rotation parameters are most welcome.

Panel on Satellite Dynamics Meeting

The aim of the Panel on Satellite Dynamics is to support activities related to the detailed description of the motion of artificial celestial bodies. This goal should be achieved by improving the current theories of motion and by evaluating their determining forces in a more sophisticated way. Detailed theoretical understanding of the dynamics of satellites should coincide with the results of precise tracking in order to obtain the most precise knowledge possible of the orbit and the corresponding orbital positions.

The scope of the Panel on Satellite Dynamics entails the positioning of a wide range of objects in space, including Earth orbiting satellites for Earth observation such as GRACE, Swarm and the Copernicus Sentinels, and navigation satellite systems such as GPS, GLONASS, Galileo, Beidou, QZSS or tracking systems such as SLR and DORIS. In addition, positioning plays an important role in the success of the continuously growing number of today's and tomorrow's planetary and solar system missions. Recent and future solar system missions have to deal with complex trajectories and innovative propulsion and braking techniques to visit multiple bodies (e.g., Cassini, Dawn, JUICE), small unconventional bodies (e.g., Rosetta, AIM), and harsh and unknown environmental conditions at the edge of exploration (e.g., Messenger, Venus Express, BepiColombo, JUNO). Both advances in the modeling of spacecraft dynamics and the theoretical understanding of space observables (e.g., range, Doppler, VLBI, optical) are required to allow a more efficient exploration and a deeper understanding of our Solar System.

Limiting errors in Precise Orbit Determination (solar radiation pressure, time variable gravity fields, phase center corrections, attitude variations, etc...) are of critical interest for many stakeholders. Moreover, formations of satellites are being realized and proposed for Earth observation and fundamental sciences, that impose very severe constraints on (relative) positioning and orbit and attitude control solutions (e.g. micro-propulsion). Mini-satellites and cubesats also represent a new frontier for both Earth and planetary exploration, posing new challenges as well as new opportunities.

Satellite orbit determination requires the availability of tracking systems, well established reference frames and accurate station coordinate solutions, detailed force and satellite models, and high-precision time and frequency standards.

Contributions covering all recent developments and plans in ground, satellite or probe positioning and navigation are solicited.

Important dates:

9 February 2018: Abstract submission deadline

27 April 2018: end of early registration fees

Geoffrey Blewitt, Johannes Böhm, Zuheir Altamimi, and Urs Hugentobler
Convenors of REFAG2018 Symposium, COSPAR Scientific Commission B
<http://iag.geo.tuwien.ac.at/c1/>

Heike Peter, Jose van den IJssel

Convenors of the Satellite Dynamic Panel sessions
<https://cosparhq.cnes.fr/scientific-structure/psd>

Deadline extended for water resources remote sensing workshop

Deadline extended for water resources remote sensing workshop in Burkina Faso, February 12-15, 2018 - new deadline **January 5, 2018**

Aim of the workshop is to provide PhD students and scientists with hands-on experience in remote sensing for hydrological modelling, including precipitation, evapotranspiration, GRACE and river/lake radar altimetry. See:

<https://www.geographie.uni-bonn.de/forschung/ags/ag-diekkrueger/research/coast-workshop-call>

Contact: Thomas Pomeon (thomas.pomeon@uni-bonn.de)
Location: WASCAL Competence Center, Ouagadougou

Meetings Calendar

IAG Sponsored Meetings

International Review Workshop on Satellite Altimetry Cal/Val Activities and Applications

April 23-26, 2018, Chania, Greece

URL: <http://frm4alt.eu/int-cal-val-review>

UN GGIM AP / IAG / FIG Technical Seminar on Reference Frames in Practice

May 4-5, 2018, Istanbul, Turkey

URL: <https://iag.dgfi.tum.de/en/meetings-calendar/>

EUREF Symposium 2018

May 30 – June 1, 2018, Amsterdam, The Netherlands

URL: <http://euref2018.nl>

10th IVS General Meeting

June 3-8, 2018, Longyearbyen, Spitsbergen, Norway

URL: <https://video.kartverket.no/the-10th-ivs-general-meeting>

IX Hotine-Marussi Symposium on Mathematical Geodesy

June 18-22, 2018, Rome, Italy

URL: <https://sites.google.com/uniroma1.it/hotinemarussi2018/>

42nd COSPAR Scientific Assembly

July 14-22, 2018, Pasadena, CA, USA

URL: <http://cospar2018.org/>

IAU XXXth General Assembly

August 20-31, 2018, Vienna, Austria

URL: <http://astronomy2018.univie.ac.at/>

GGHS2018

September 17-21, 2018, Copenhagen, Denmark

“Gravity, Geoid and Height Systems 2” Symposium, 2nd joint meeting of the International Gravity Field Service and Commission 2 of the IAG

URL: <http://www.space.dtu.dk/gghs2018>

International DORIS Service (IDS) Workshop

September 24-29, 2018, Ponta Delgada, Azores

URL: <https://iag.dgfi.tum.de/en/meetings-calendar/>

IGS 2018 Workshop

October 29 – November 2, 2018, Wuhan, China

URL: <https://iag.dgfi.tum.de/en/meetings-calendar/>

21st International Workshop on Laser Ranging

November 5-9, 2018, Canberra, Australia

URL: <http://www.serc.org.au/ilrs-2018/>

27th IUGG General Assembly

July 8 – 17, 2019, Montreal, Canada

URL: <http://www.iugg.org/assemblies/>

IGAG Related Meetings

LBS 2018

January 15-17, 2018, Zurich, Switzerland

URL: <http://lbsconference.org>

Munich Satellite Navigation Summit 2018

March 15-17, 2018, Munich, Germany

URL: <http://www.munich-satellite-navigation-summit.org>

EGU General Assembly 2018

April 8-13, 2018, Vienna, Austria

URL: <http://www.egu2018.eu/>

AOGS 15th Annual Meeting

June 3-8, 2018, Hawaii, USA

URL: http://www.asiaoceania.org/society/public.asp?view=up_coming

Baltic Geodetic Congress 2018

June 21-23, 2018, Olsztyn, Poland

URL: <http://bgc2018.systemcoffee.pl>

AGU 2018 Fall Meeting

December 10-14, 2018, Washington, D.C., USA

URL: <https://meetings.agu.org/>

EGU General Assembly 2019

April 7-12, 2019, Vienna, Austria

URL: <http://www.egu2019.eu/>

AOGS 16th Annual Meeting

July 28 – August 2, 2019, Singapore, Singapore

URL: http://www.asiaoceania.org/society/public.asp?view=up_coming

Reports

The 10th International Comparison of Absolute Gravimeters ICAG-2017 and Workshop on Absolute Gravimetry

In the year of 2015, The National Institute of Metrology (NIM), China was officially appointed in year 2015 by the Consultative Committee on Mass and Related Quantities (CCM) and the International Association of Geodesy (IAG) to be the pilot laboratory for hosting the 10th International Comparison of Absolute Gravimeters (ICAG-2017). Since 2009 this comparison has been registered as a Key Comparison of the CCM under the name CCM.G-K2.2017. The measurement campaign took place in Changping Campus of NIM, close to Beijing, from October 16 to November 20, 2017, bringing together more than 30 absolute gravimeters from 14 countries, including China, USA, France, Germany, Japan, Korea, Switzerland, Austria, Finland, Czech, turkey, Luxembourg, Saudi Arabia and Thailand, to participate in such grand-scale international comparison. Six atom gravimeters from China and many FG5(X) absolute gravimeters had been participated in the comparison. This is the first time an ICAG is held outside Europe and will contribute to the gravity standard in the world.

In addition, the Absolute Gravimetry Workshop was organized at the occasion of the measurement campaign of ICAG-2017, with the contribution of 19 speakers, experts from many institutes worldwide located. Some of the topics of the workshop were the new developments for the measurement of gravity, the global, regional and national gravity networks, the applications, and the importance of the gravity measurements in the redefinition of the kilogram. The workshop was opened with a talk on “Absolute gravity” by Prof. James E. Faller, from the US National Institute of Standards and Technology (NIST).



Picture 1: The ICAG-2017 comparison site



Picture 2: Atom gravimeters from China in the ICAG-2017



Picture 3: Prof. James Faller lecturing at the workshop



Picture 4: View of the meeting room during the workshop



Picture 5: Attendees to the workshop on “Absolute Gravimetry”

Workshop Programme

1. Absolute gravity (Prof. James E. Faller)
2. The first ICAG site in Asia (Dr. WU Shuqing)
3. g measurement for the redefinition of the kilogram and its effect on related quantities (Prof. Alessandro Germak)
4. Towards a global absolute gravity reference system (Prof. Reinhard Falk)
5. Gravity activities at the National Geodetic Survey (Dr Derek van Westrum)
6. Tidal correction of the absolute gravimetry by using local precise synthesized tide at Beijing station (Dr CHEN Xiaodong)
7. The Austria absolute gravity network, research and projects (Dr Christian Ullrich)
8. The geodesy gravity reference standard site in China (Dr HE Zhitang)
9. Recent activities of the Finnish National Standards Laboratory for the acceleration of free-fall (Dr Maria Bilker-Koivula)
10. Repeated Gravimetry for Earthquake Monitoring in China (Dr HU Minzhang)
11. Investigation of systematic effects of FG5(x) gravimeters (Dr Vojtech Palinkas)
12. WHIGG Miniaturized Absolute Gravimeter (Dr TIAN Wei)
13. Gravimetry and its needs in current and future weighing technologies (Dr Christian Rothleitner)
14. Determination of the local acceleration of gravity for the NIST-4 Watt Balance (Prof. David Newell)
15. LNE-SYRTE quantum absolute sensors for the gravity measurements (Dr Sebastien Merlet)
16. Precise and accurate gravity measurement with NIM-AGRb-1 (Dr. WANG Shaokai)
17. Progress on measurement of absolute gravity by transportable compact cold atom gravimeter (Prof. Lin Qiang)
18. Gravity measurement by atom interferometry in HUST (Dr.HU Zhongkun)
19. Gravity measurement based on cold atoms and its applications (Dr WANG Yu)

WU SHUQING
NIM, China

Book Review

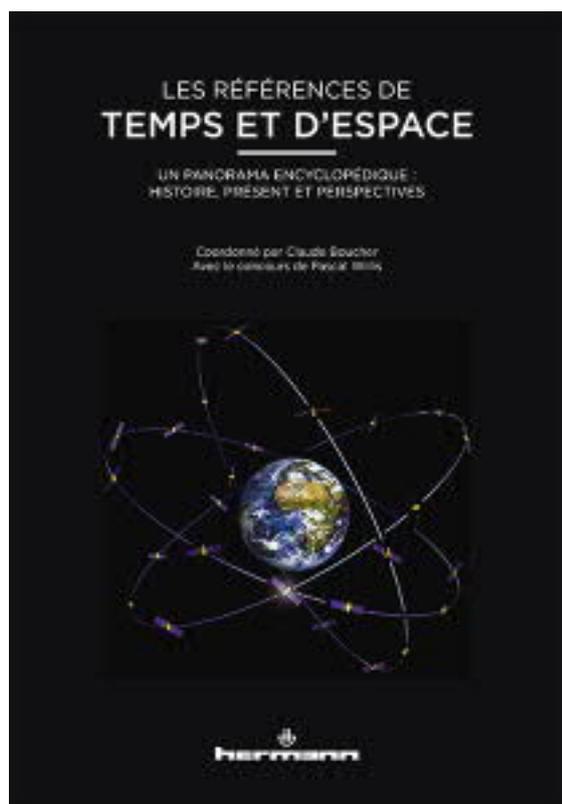
Les références de temps et d'espace (Time and Space references)

un panorama encyclopédique : histoire, présent et perspectives

Coordonné par Claude Boucher avec le concours de Pascal Willis

(An encyclopaedic panorama: history, the present and perspectives for the future

Coordinated by Claude Boucher¹ with the participation of Pascal Willis²)



Title: Les références de temps et d'espace
Coordinated by: Claude Boucher and Pascal Willis
Publisher: Editions Hermann, Sciences et arts
ISBN: 978-270-5684-18-1 (Paper), 978-270-5679-73-6 (e-book)
Year: 2017 (published 24 May 2017)
Price: € 32 (Paper), € 25 (e-book)
Details: 17 x 24 cm, 400 pages
Other: <http://www.editions-hermann.fr/5084-les-references-de-temps-et-d-espace.html>

This volume of some 480 pages is exactly what the title says it is: an encyclopaedic survey of the references used to describe and measure time and space. In the first paragraph of his Preamble to this volume, the late Bernard Guinot set out the range of subjects it encompasses, he wrote: “This work treats the references used in astronomy, in geodesy and in geophysics. On the one hand, it includes the references for expressing the positions and the movements of natural and artificial bodies in the solar system, their orbital movements and rotations. On the other hand the description of the planets as well as the study of their deformations, as the case

¹ Current President of the Bureau des Longitudes

² Former Secretary of the Bureau des Longitudes

arises, demanding local reference systems to accompany their movements in space. At present this concerns mostly the Earth. It is something of great importance for practical reasons such as navigation, positioning to follow the evolution of our planet which, at the level of precision now attained, is “soft”, and for its enveloping fluids.”

The volume is in five principal parts: Part 1 treats the historical development of celestial references, terrestrial references and earth rotation, and the measurement of time from antiquity to about the end of the 20th century; Part 2 sets out the basic principles of Special and General Relativity giving the equations and formalisms necessary to treat space/time reference systems to the high accuracies now available; Part 3 begins the practical applications from early atomic clocks to the latest optical frequency standards, then clock comparisons of remote clocks and finally time scales; Part 4 includes the application of reference systems to the Earth; Part 5 includes practical applications: experimental gravitation, Global Navigation Systems, Sea level, spacecraft, Units, Constants and Conventions, earth rotation, artificial satellite trajectories in the vicinity of the Earth. The volume ends with short discussion of future perspectives and conclusions followed by section added in proof on the implications of the recent observation of gravitational waves.

Overall, this encyclopaedia of Space/Time, as one might refer to it, does indeed give a comprehensive account at a high level of the methods and theories upon which they are based used in today’s science and engineering related to space and time. I use the term science and engineering deliberately because in the past much of the content of this volume would have been considered abstruse and of interest only to a small number of specialist physicists and astronomers. Today, with the wide range of Earth observation satellites, Global Navigation Systems, probes to other planets to say nothing of gravitational wave detectors, the practical application of general relativity is part of space engineering. Without it, GPS or more generally GNSS, would fail.

There is a preliminary chapter giving an account of the creation and history of the Bureau des longitudes under whose auspices it is published. The BdL as it is often known is one of those institutions created at the time of the French revolution – like the decimal metric system – which survives today albeit with a mission that has evolved, see its website for a full account of its history and role today (<https://www.bureau-des-longitudes.fr>).

The essential attribute of this volume is the quality of the contributors. All are high level scientists or historians of science, and well-known in their field. Most of the seventeen contributors are either members or corresponding members of the BdL and five are either Members or Correspondents of the Académie des sciences. It is this that makes this work unique with everything in it having the stamp of absolute reliability.

Finally, I must add a word of appreciation for the late Bernard Guinot who was for many years Director of the Bureau international de l’heure at the Paris observatory and later Head of the new Time Section at the International Bureau of Weights and Measures (BIPM) when responsibility the world’s time scales was transferred there in 1985. At the time I was Director of the BIPM. Bernard Guinot was a key player in the establishment of International Atomic Time, the reference since 1972 for all of today’s accurate timekeeping as well as the world’s civil time UTC.

This volume is a high level comprehensive account of the science and practical applications of time and space which I strongly recommend.

Terry Quinn CBE FRS,
Emeritus Director Bureau international des poids et mesures and Corresponding Member of the Bureau des longitudes.