

Geodesy Division Meeting

Johannes Böhm and Michael Schmidt

Vienna, Wednesday, April 26, 2017

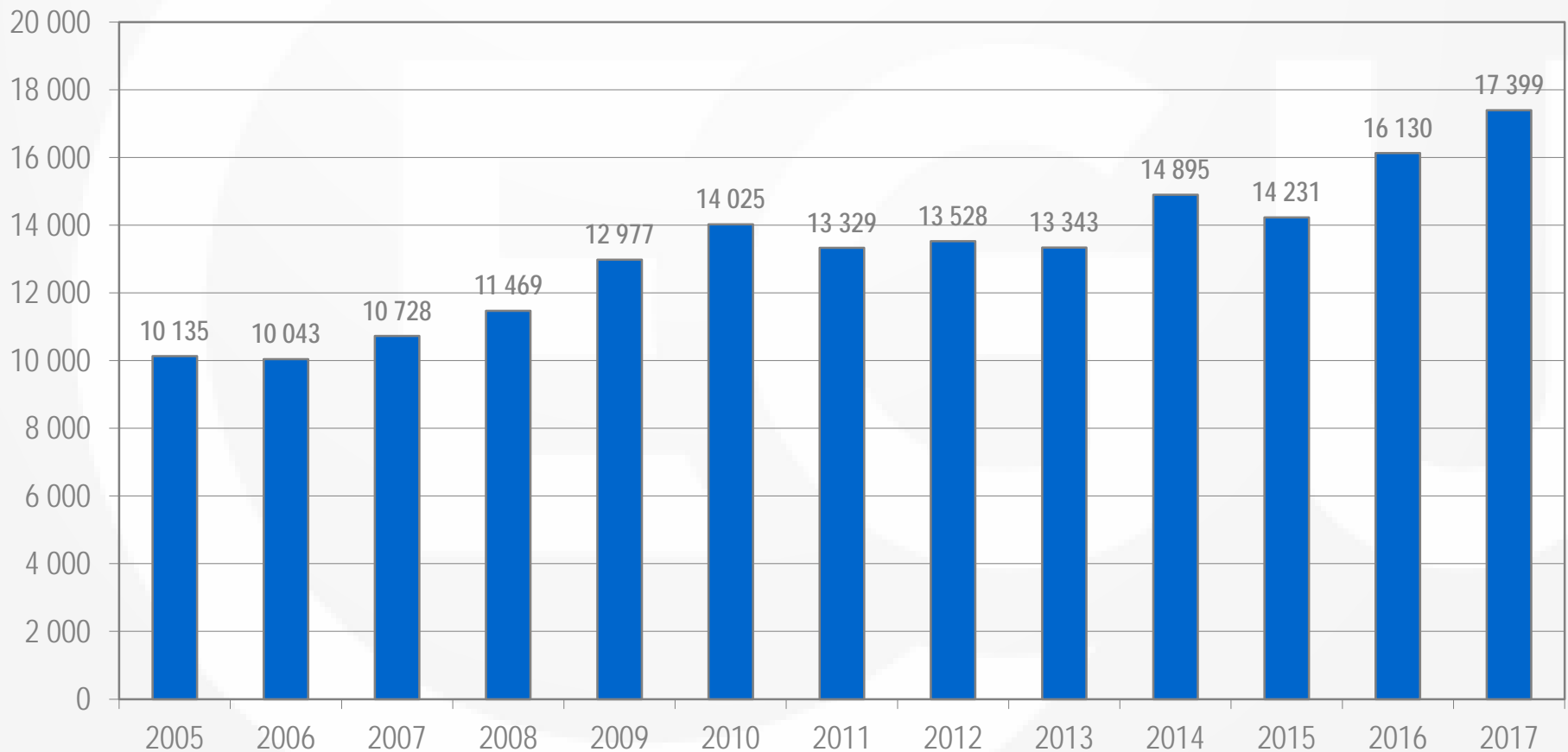


Agenda

- Statistics 2017
- Geodesy Sessions 2017
- Call for Sessions 2018
- Medals and Awards
 - Vening-Meinesz Medal
 - Outstanding Young Scientist Award
 - EGU Outstanding Student Poster Award in Geodesy
- Structure of the Geodesy Division
- Early Career Scientist Representation
- EGU Journals and Support for Conferences
- AOB

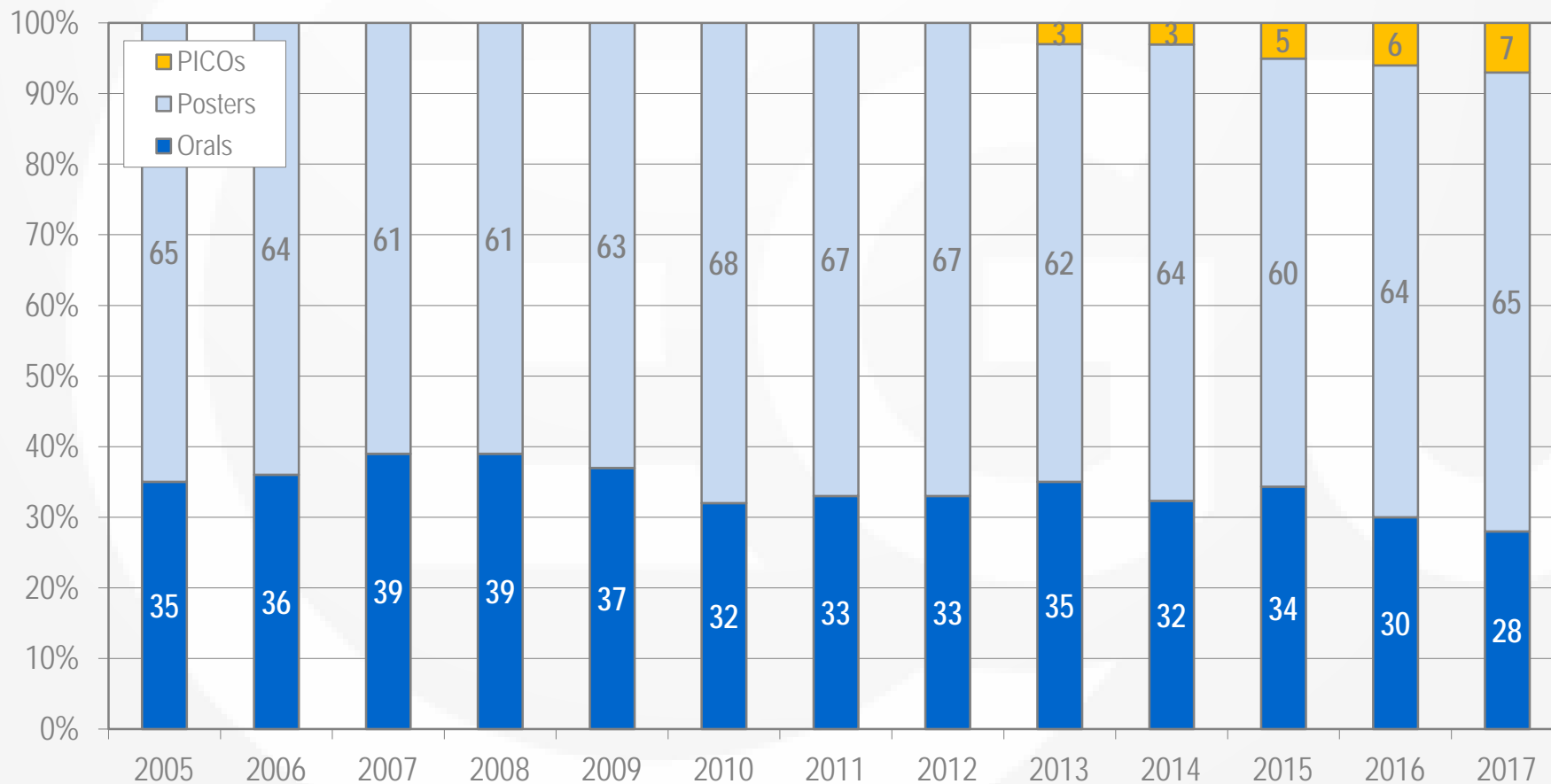
Statistics 2017

Papers in programme 2005–2017

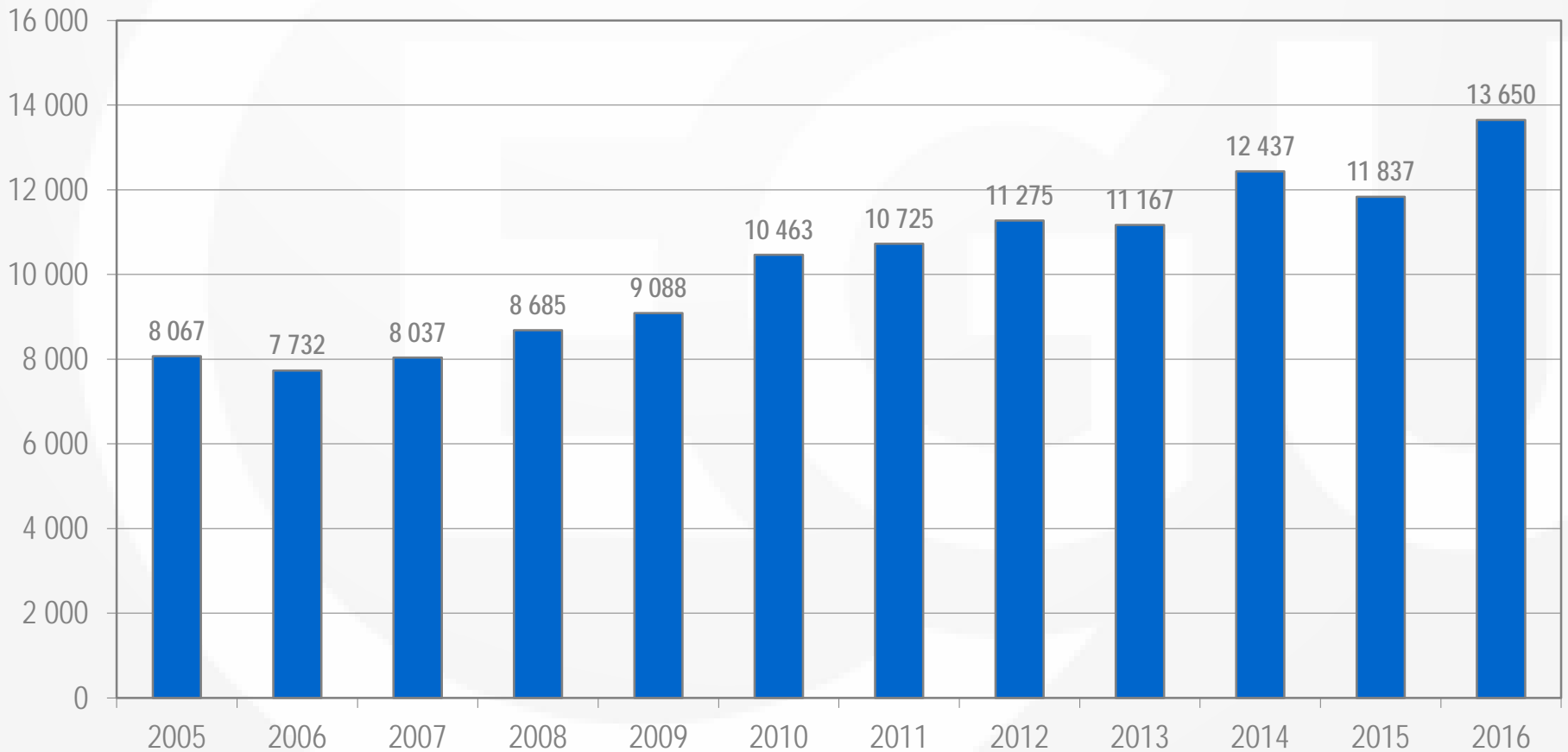


Statistics 2017

Presentation ratio 2005–2017



Participants at EGU Assemblies 2005–2016



Geodesy Sessions 2017

Title	co-org.	all abstracts 2017	all abstracts 2016	all abstracts 2015	differences w.r.t. 2016	oral blocks	orals	pico	post.
G1.1		22	29	18	-7	1	6	0	16
G1.2		16	16	17	0			16	
G1.3		8	0	0	8		0	0	8
G1.4		60	45	30	15	3	18	0	42
G2.1		24	11	24	13	1	6	0	18
G2.2		30	34	32	-4	1	6	0	24
G3.1	x	23	25	16	-2	1	6	0	17
G3.2	x	40	52	50	-12	2	12	0	28
G3.4	x	23	30	21	-7	1	6	0	17
G3.5		11	0	0	11		0	0	11
G4.1	x	34	34	29	0	2	12	0	22
G4.2		41	43	45	-2	2	12	0	29
G5.1	x	21	24	19	-3	1	6	0	15
G5.2	x	49	25	27	24	3	18	0	31
G6.1		22	35	5	-13	1	6	0	16
		424	403	333	21	19	114	16	294

Rules for oral slots in 2017 (2016, 2015):

- 16 (16, 15) abstracts: 1 oral block,
- 32 (32, 30) abstracts: 2 oral blocks,
- 48 (45, 45) abstracts: 3 oral blocks

- Again increase of abstracts w.r.t. the previous years
 - 2016: 5%
 - 2015: 21%
- The number of oral slots (19) does not reflect this evolution sufficiently. Reason is limited capacity of the building.
 - But this year improved situation because of new halls
- This year we have
 - two poster-only sessions
 - one PICO session

Call for Sessions 2018

- Skeleton **could** be based on successful sessions at EGU 2017
- **Important:** each EGU member can
 - **propose new** sessions
 - **modify existing** sessions
- Proposals to be sent by **mid of September 2017:**
 - no overlapping or similar topics; these should or will be merged
 - **relevant** topics to attract enough contributions; are **all important geodetic topics represented?**
 - **number of sessions** reasonable?
 - is the **title** of a session **general** and **attractive enough?**
- **Programme Committee** will finalize the programme

Call for Sessions 2018

Additional Remarks

- Consider proposing **co-organized** sessions – this is the way to strengthen the **interdisciplinary character** of EGU; in such a case there should be at least **one co-convener** from the co-organizing division
- Consider for the **team of conveners**:
 - **gender diversity** (i.e. are there female conveners included?)
 - **diversity in countries/institutes**
 - **young (early career) scientists** (especially the established sessions should include young (co-)conveners into the conveners group)
 - a minimum of **three conveners** is desirable

Medal and Awards

Vening Meinesz Medal

- This medal has been established by the Division on Geodesy in recognition of the scientific achievements of **Vening Meinesz**



Medal and Awards

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2014

Reinhard Dietrich



2016

Srinivas Bettadpur



2013

Zuheir Altamimi



2015

Geoffrey Blewitt



2012

Che-Kwan Shum



Medal and Awards

2017 Vening Meinesz Medallist:

Isabella Velicogna

The 2017 Vening Meinesz Medal is awarded to Isabella Velicogna in recognition of her pioneering and groundbreaking work on the application of time-variable gravity for ice-sheet mass balance and land-water hydrology studies.



Division Medal Ceremony and the Medal Lecture will be on
Thursday, 27 April 2017, 19:00-20:00, Room K1

WELCOME

Title: **Weighting Climate Change from Space**

Medal and Awards

Division Outstanding Early Career Scientists Award

- The Division Outstanding Young Scientist Award recognizes scientific achievements in the field covered by the related Division, made by a young scientist.



2016 Witold
Rohm



2015 Krzysztof
Sońnica



2014 Roelof
Rietbroek



2012 Xavier
Collilieux



2011 Thomas
Hobiger

Medal and Awards

Division Outstanding Early Career Scientists Award

The 2017 Division Outstanding Early Career Scientists Award is awarded to **Xingxing Li** for his innovative contributions in improving the performance of precise point positioning, significantly extending the high-rate GNSS applications in geosciences.



Presentation on Thursday morning 8:30 room D1

**Multi-GNSS real-time precise positioning service and
Initial assessment of BDS-3**

Medal and Awards

Call for Nominations

- Nominations for all the medals and Union Service Award are to be sent to the e-mail address awards.medals@egu.eu by **15 June** of each year (absolute deadline) in pdf format. Only EGU members can submit nominations.
- Nominations for the Outstanding Early Career Scientists Award are to be sent to the e-mail address awards.medals@egu.eu by **15 June** of each year (absolute deadline).
- See <http://www.egu.eu/awards-medals/proposal-and-selection-of-candidates.html> for more details

Medal and Awards

Call for Nominations

Additional Information

- “If only one nomination is received for a ... Division medal, the ... Medals Committee will assess the merits of the candidate and may seek the help of external peers to ensure that the candidate is high profile and deserving.”
- **“The EGU reserve the right to not confer the medal when there is only one nomination.”**
- See <http://www.egu.eu/awards-medals/proposal-and-selection-of-candidates.html> for more details.

Medal and Awards

Outstanding Student Poster and PICO (OSPP) Award

“... further improve the overall quality of poster and PICO presentations and most importantly, to foster the excitement of younger colleagues in presenting their work in form of a poster and/or PICO.”

Awarded in the Divisions, based on evaluation of Judges during the poster sessions.

The **awardees receive**

- a conference fee waiver for the next EGU General Assembly and
- are invited to submit a paper free of publication costs to one of the [EGU journals](#).

Medal and Awards

2016 OSPP Winner

Matthias Ellmer

The 2016 Outstanding Student Poster and PICO (OSPP) Award is given to Matthias Ellmer for his poster entitled:

Numerically stable approach for high-precision orbit integration using Encke's method and equinoctial elements

(Ellmer, M.; Mayer-Gürr, T.)



Introduction

Dynamic orbits play an important role in the setup of the observation equations in low-low satellite-to-satellite gravity field determination. These orbits are determined through integration of the accelerations acting on a satellite, which can then be added to a known or estimated initial state.

We show investigations into the precision of an improved Encke approach^[1] to the numerical integration of dynamic orbits.

Our approach allows for computation of dynamic orbits with repeatability at machine precision over a large swath of the spectral domain.

Methods

We compute 24h dynamic orbit arcs from real data by integrating all acting accelerations (as measured by the accelerometer and computed from gravitational background models) using a polynomial integration approach. An initial orbit is used as a Taylor point for the evaluation of force models.

The integrated orbit is then fitted to GPS observations. We use this fitted orbit as the Taylor point while repeating the integration. After some iterations, the orbit will converge. This can be observed in the coordinate changes between iterations.

After such convergence occurs, we can compare the results from two successive iterations of orbit integration. For different integration algorithms, this coordinate difference can be of vastly different magnitude, giving an indication to the performance of the method.

Thus, the magnitude of the orbit difference between iterations after convergence can be used as an indicator for the quality of the integration algorithm.

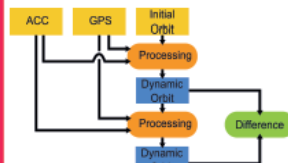
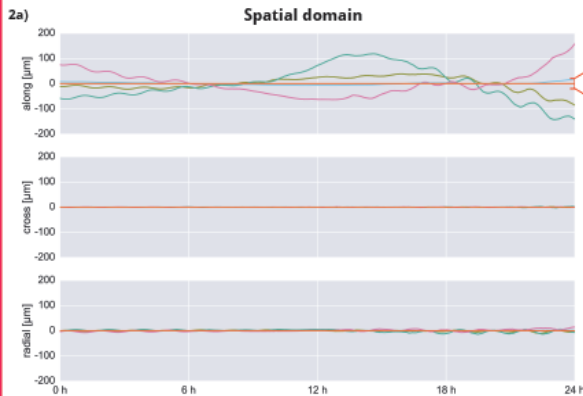


Fig 1: Processing steps from initial observations to comparison result.



Using a linear reference motion, we observe differences on the order of 100µm between successive integrations. This is magnitudes larger than for example the GRACE K-Band ranging accuracy. As in all other cases, the differences are largest in the along-track component.



Using a first epoch reference ellipse computed with Kepler elements, we can observe no improvement to the integration results over the linear reference motion (see figure 2a). The quality gain from computing a smaller integral is offset by the insufficient accuracy of the reference motion.

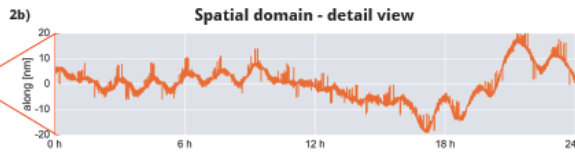


Fig 2a: Shows the difference between orbit iterations in the spatial domain. All integration methods have the largest errors in the along-track axis.

Fig 2b: Detail view of improved Encke method using equinoctial elements. Numerical artefacts due to machine precision visible.

Fig 2c: Shows the difference between orbit iterations in the spectral domain. All integration methods have the largest error at a frequency of once per revolution (dark blue line). Flat parts of the spectrum indicate that the errors in this band are due to machine precision.

Type of reference motion and parametrization

- Initial position and velocity
- Kepler elements (first epoch)
- Kepler elements (best fit)
- Equinoctial elements (first epoch)
- Equinoctial elements (best fit)

Minimizing the forces to be integrated by using a best-fit Kepler ellipse does not lead to better results. The reference motion computed from Kepler elements has insufficient accuracy when computed in double precision arithmetic.

Going back to a reference ellipses at the first epoch, use of equinoctial elements for the parametrization leads to significantly smaller deviations between iteration steps, on the order of 20µm (see figure 2a). The overall error in integration is improved by an order of magnitude (see figure 2c).

By using a best-fit reference ellipse, we minimize the power of the computed integral. This leads to a deviation between iterations of only machine precision over a large part of the spectrum (see figure 2c and box Precision). Most of the remaining error is at very long wavelengths, above ~1/rev.

Encke approach to integration

The position of a satellite along its orbit can be interpreted as the sum of a well-described reference motion and the integral of all acting residual accelerations f not included in the reference motion.

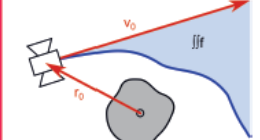


Fig 3: In the simplest case the reference motion is linear, as described by the initial position and velocity r_0, v_0 . This may lead to the integrated accelerations f becoming large, and possibly numerically difficult.

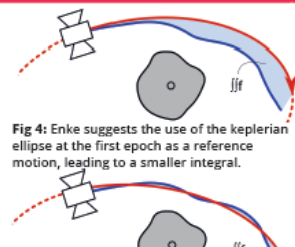


Fig 4: Encke suggests the use of the Keplerian ellipse at the first epoch as a reference motion, leading to a smaller integral.

Fig 5: We refine this approach by determining a best-fit orbital ellipse, thus minimizing the energy of the integral of the accelerations.

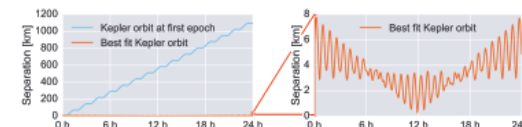


Fig 6: Separation between reference motion and integrated orbit over one day.

Equinoctial elements

The equinoctial elements^[2] are non-singular for all elliptical orbits. Position and velocity can be derived from the equinoctial elements with high precision and efficiency, as no trigonometric functions are used. In terms of Kepler elements, the equinoctial elements are given by:

$$\begin{aligned} a &= a & h &= e \sin(\omega+1) & p &= \tan(i/2) \sin \Omega \\ \lambda &= M + \omega + \Omega & k &= e \cos(\omega+1) & q &= \tan(i/2) \cos \Omega \end{aligned}$$

Precision

We inspect the values for one coordinate at a random point along the orbit in two successive iteration steps:

Linear motion: 6436944.4055793351m 6436944.4056150075m
6436944.4055785714m 6436944.4056150084m

Best fit using equinoctials: 6436944.4056150075m 6436944.4056150084m

The improved Encke approach using a best fit Kepler ellipses provides 15 digits of precision.

Results

We improved on Encke's method by using a best-fit Kepler ellipses as reference motion for dynamic orbit integration.

We show that using equinoctial elements for the parametrization of this ellipse leads to a substantial increase in precision for the result of the dynamic orbit integration.

A need for higher precision would necessitate the consistent use of quadruple precision arithmetic.

[1] Encke, Johann Franz. "Über eine neue Methode der Berechnung der Planetenstörungen." *Astronomische Nachrichten* 33, no. 26 (February 1852): 377-398.
[2] Brownie, R. A., and P. J. Crifola. "On the Equinoctial Orbit Elements." *Celestial Mechanics* 5, no. 3 (May 1, 1972): 303-310.

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Structure of Geodesy Division and upcoming elections

President:

Johannes Böhm (2017-2019)

- **term will end** with the EGU GA 2019
- a **re-election** is **possible**
- the **nomination phase** will be in **September 2017** and the **election** of the next EGU division presidents in **November 2017**
- optionally president-elect for one year

Deputy President:

Adrian Jäggi (2015-2018)

Science Officer:

Annette Eicker (2017-2018)

Geodesy Programme Committee:

- Division President,
- Deputy President, Science Officer
- Possibly other selected geodesists to cover the whole field of geodesy

Approval of the Medal and Award committees

Vening-Meinesz Medal committee:

- Voting: four past medalists + past President (Michael Schmidt)
- *Non-voting (ex officio)*: Geodesy Division President and EGU Award committee chair
- 2018 committee members:
 - *Isabella Velicogna (1)*
 - *Srinivas Bettadpur (2)*
 - *Geoff Blewitt (3)*
 - *Reinhard Dietrich (4)*
 - *Michael Schmidt (Chair)*
 - ex officio: Johannes Böhm, Award Committee Chair

Outstanding Early Career Scientist Award:

- Division President + Deputy President + Science Officer

Outstanding Student Poster and PICO Award:

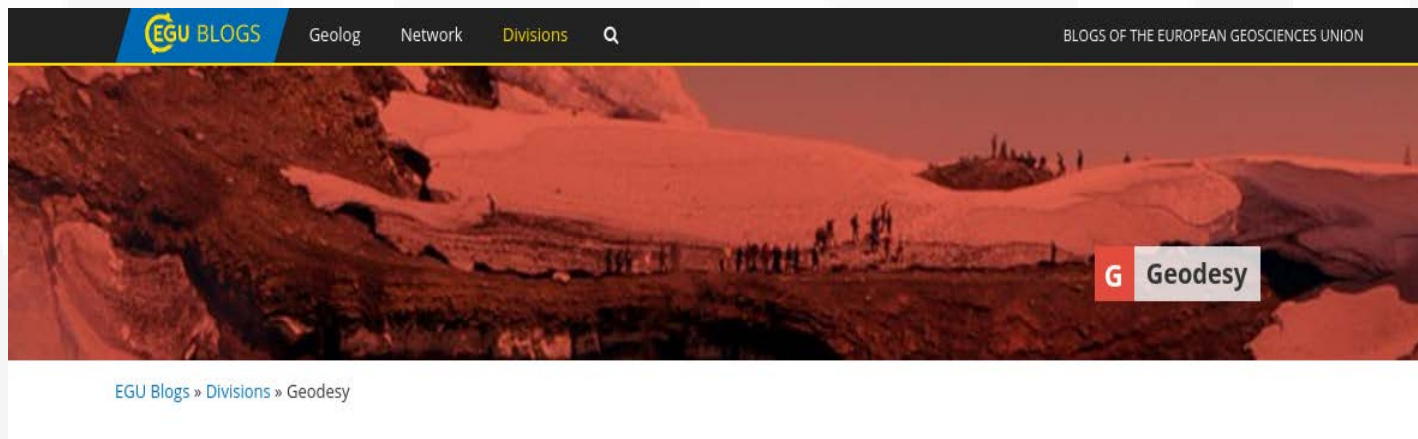
- Division President + Deputy President + Science Officer

Early Career Scientist (ECS) Representatives: appointed for a term of 2 years, i.e. the period 2017-2019

- Katrin Bentel and Mathis Bloßfeld
- (Roelof Rietbroek now ECS-Rep. at Union Level)

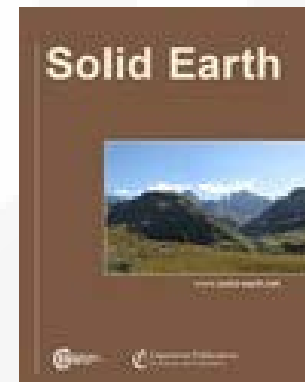
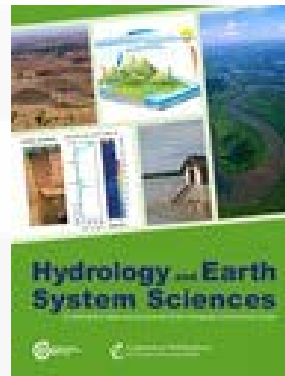
Early Career Scientist (ECS) Representatives: appointed for a term of 2 years, i.e. the period 2017-2019

- Katrin Bentel and Mathis Bloßfeld
- Organising events, short courses, etc
- Social Media, Blog, Webpage
- Contact with ECS Rep. of other divisions



<http://www.egu.eu/publications/open-access-journals/>

- Atmospheric Measurement Techniques (IF 2,9)
- Solid Earth (IF 2,1)
- Hydrology and Earth System Sciences (IF 3.9)
- ...



<http://www.egu.eu/meetings/>

- EGU Galileo Conferences address cutting-edge topics
- EGU Co-sponsored meetings
 - Training Schools
 - Conference Series
 - Topical Meetings
 - Workshops

Communication Activities at the General Assembly

EGU Today

- EGU Today is a daily newsletter highlighting interesting workshops, lectures and GeoCinema screenings, amongst activities at the Assembly
- Paper copies will be distributed daily and are available to download at http://www.egu2017.eu/egu_today.html

Blogs

- GeoLog, the EGU Blog Network & EGU Division Blogs will be sharing great sessions, research, interviews and more throughout the Assembly
- Follow them at geolog.egu.eu and blogs.egu.eu

Social Media

- Sessions will be advertised on Twitter (@EuroGeosciences) and Facebook (European Geosciences Union)
- For behind the scenes access to the conference follow us on Instagram (@EuroGeosciences)
- Participants can ask questions & keep updated by following #EGU17

Other items



Any other business

EGU