Federal Agency for
Cartography and Geodesy

The IERS Retreat: How to improve Earth rotation products

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On behalf of all participants of the IERS Retreat

IERS Retreat 2013: Overview

- Second IERS Retreat (first retreat held in 2003)
- May 23-24, 2013
- University Paris-Diderot
- 25 participants covering all IERS components

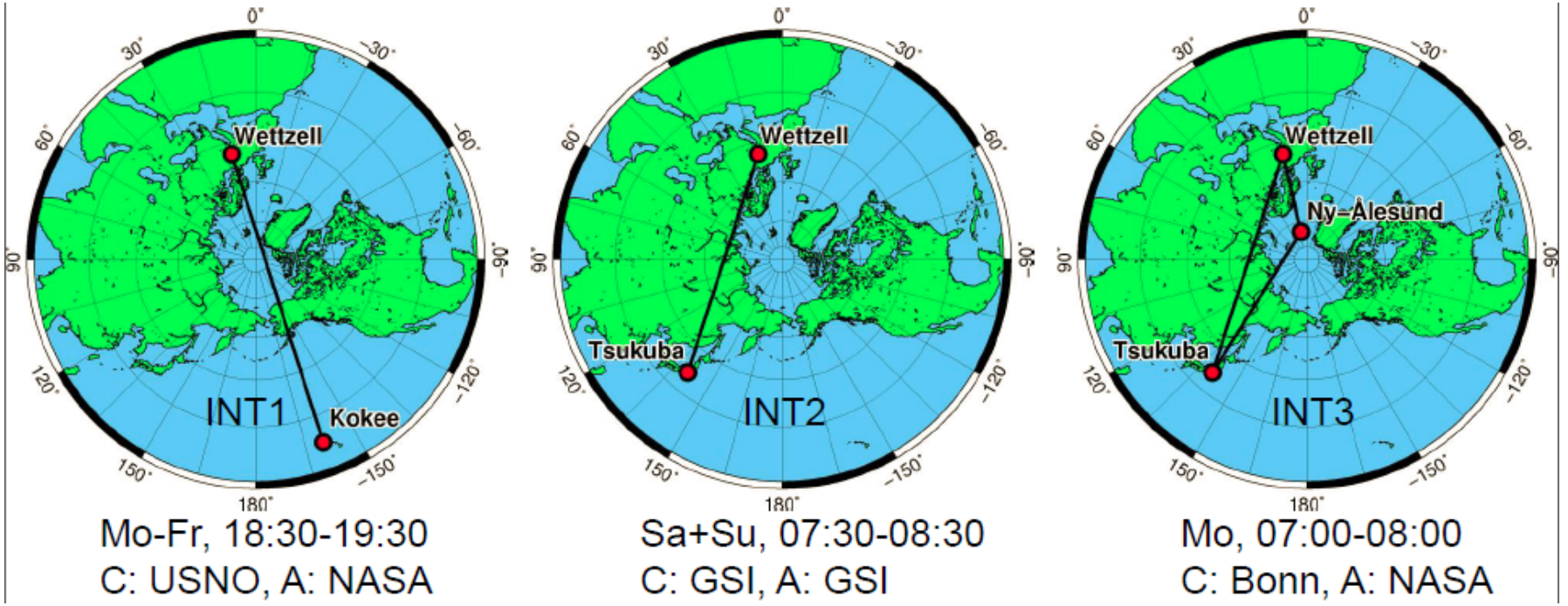
IERS Retreat 2013: Overview

- Session 1: Move towards „real time“ products
- Session 2: Rigorous combined products
- Session 3: Long-term stability and parameterization of the reference frame
- Session 4: Next generation of models and Center-of-Mass products
- Session 5: EOP prediction improvements
- Session 6: Unification of product formats
- Session 7: Establish mechanisms that allow changing contributions

Towards Real-time: UT from Intensives

VLBI Intensive sessions:

- Currently 3 series: INT1 – INT2 – INT3
- Daily dUT1 observations, 1h sessions



From: R. Haas

Towards Real-time: UT from Intensives

Latency is often few hours only, but sometimes > 1 day !

Session name	Observing date/time	Correlation	Analysis	Latency correl. since end of observ.	Latency dUT1-res. since end of observ.
INT3 – 089	Apr 08, 07:00-08:00	Apr 08, 14:51	Apr 08, 18:26	06:51	10:26
INT1 – 089	Apr 08, 18:30-19:30	Apr 09, 04:54	Apr 09, 05:10	09:24	09:40
INT1 – 099	Apr 09, 18:30-19:30	Apr 10, 04:32	Apr 10, 17:45	09:02	22:15
INT1 – 100	Apr 10, 18:30-19:30	Apr 11, 02:15	Apr 11, 17:48	06:45	22:18
INT1 – 101	Apr 11, 18:30-19:30	Apr 12, 02:26	Apr 12, 03:19	06:56	07:49
INT1 – 102	Apr 12, 18:45-19:45	Apr 15, 15:10	Apr 15, 17:48	19:25	24:03
INT2 – 103	Apr 13, 07:30-08:30	Apr 15, 09:57	???	49:27	???
INT2 – 104	Apr 14, 07:30-08:30	Apr 15, 09:59	???	25:29	???

From: R. Haas

Towards Real-time: UT from Intensives

Problem for parameter estimation:

Few observations in VLBI Intensives

⇒ Polar motion has to be kept fix; usually predicted values

⇒ Station coordinates have to be fixed on a priori

⇒ Difficulties to estimate troposphere reliably

Possible improvements due to combination with GNSS:

⇒ Polar motion determined by GNSS: use e.g. IGS Ultra-Rapid or Rapid products

⇒ Troposphere determined by GNSS: combined VLBI-GNSS analysis including troposphere combination

BKG will work towards a combined VLBI-GNSS solution for the Intensives

Towards Real-time: IGS EOP

The „IGS Real-Time Service (RTS)“:

- Launched on April 1, 2013

- Products are at the moment only orbits and clocks

⇒ It should be possible to get also accurate EOPs in realtime

⇒ IGS should look into this aspect

Requirement:

- Format allowing for real-time dissemination of EOPs

Towards Real-time: IGS EOP

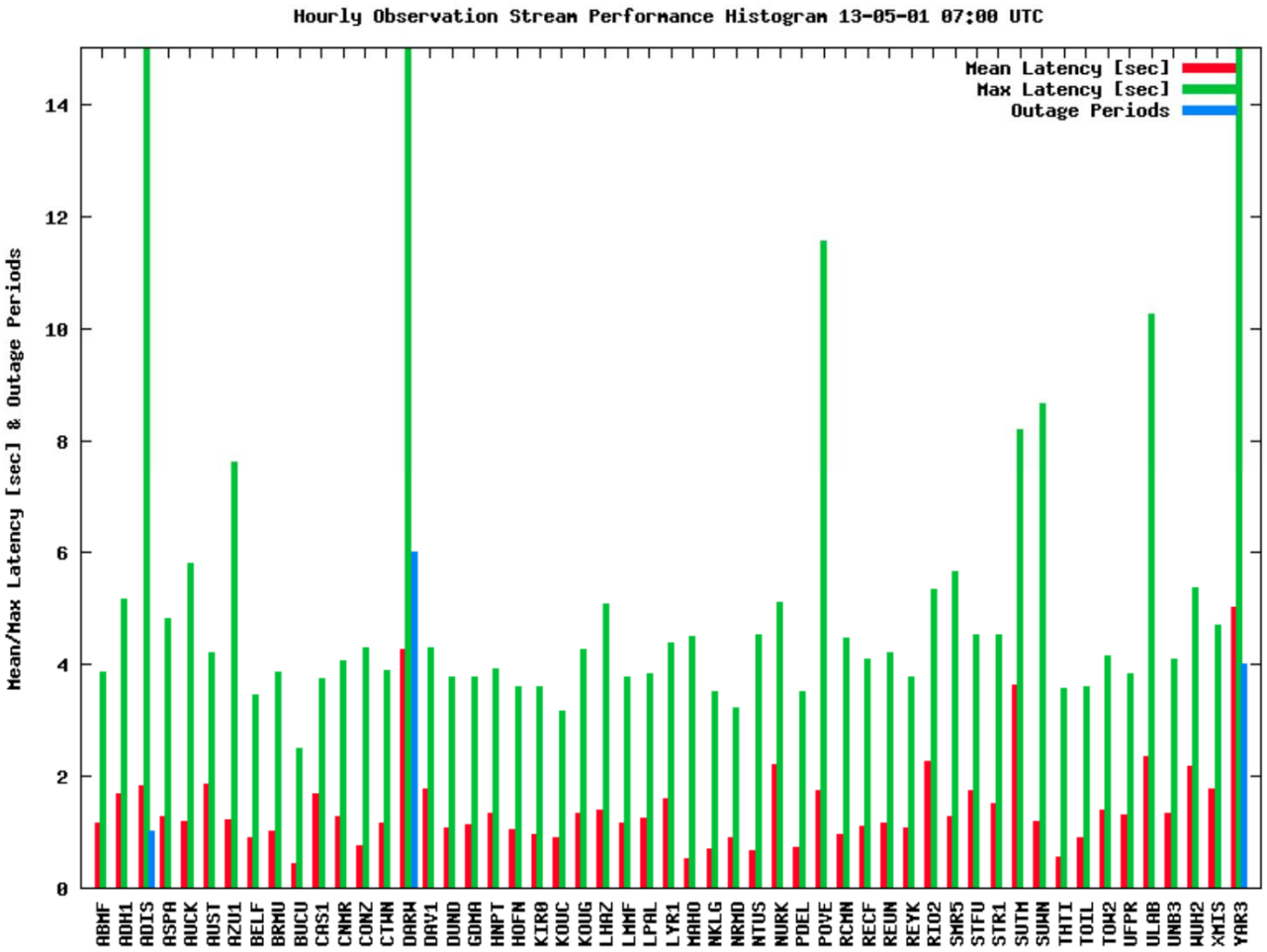
The „IGS Real-Time Service (RTS)“:

Latency:

< 1-4 sec

Data outage:

very seldom



From: J. Wickert

IERS Rapid Service / Prediction Center

Current IERS EOP predictions:

- Multiple solutions per day
  - 0310 UTC, 0910 UTC, 1710 UTC, 2110 UTC
    - Timed to take advantage of latest IGS products
- Solutions take ~10 minutes to complete
  - Time split between data downloads and software runtime

Current concerns / potential for improvements:

- Data input is not optimized for 4 EOP solutions per day
  - Need better temporal distribution
- Data combination algorithm not optimal
  - Investigating alternative methods

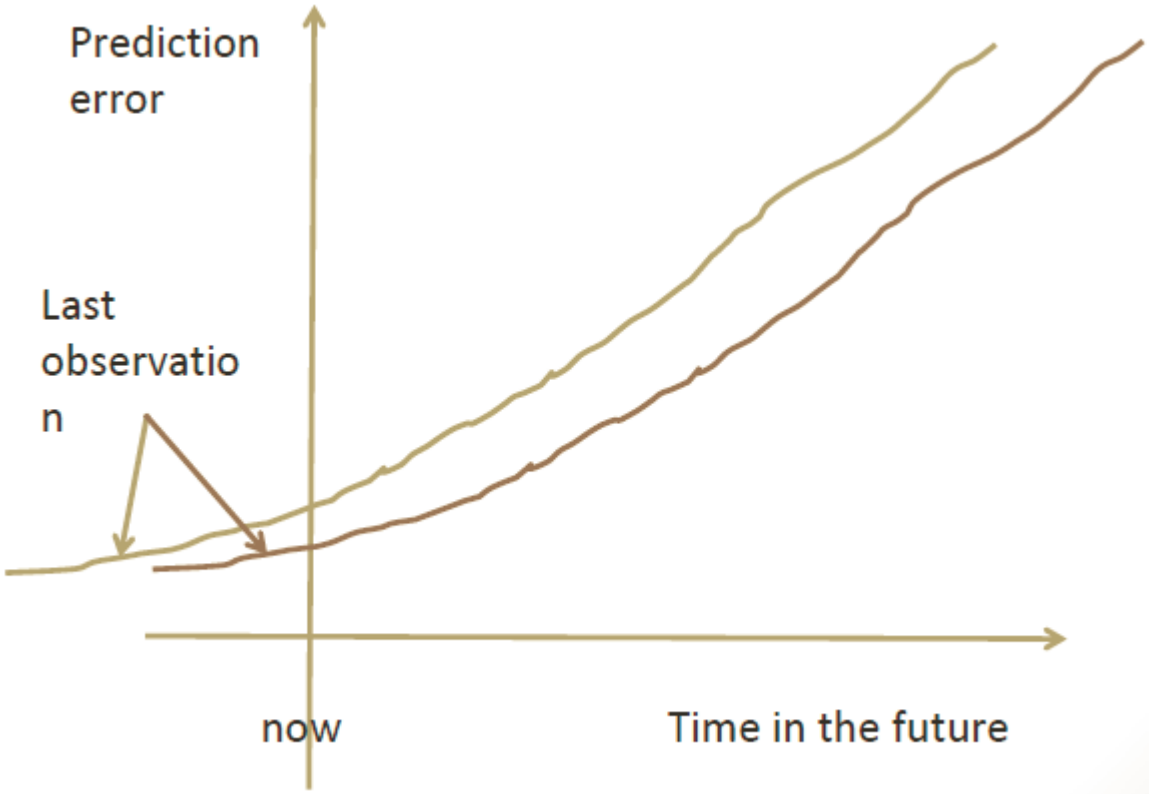
How to improve EOP predictions?

Improve…

- Input EOP data
- Processing algorithm
- EOP modeling
- Geophysical analysis and forecast

Improvement of EOP input data

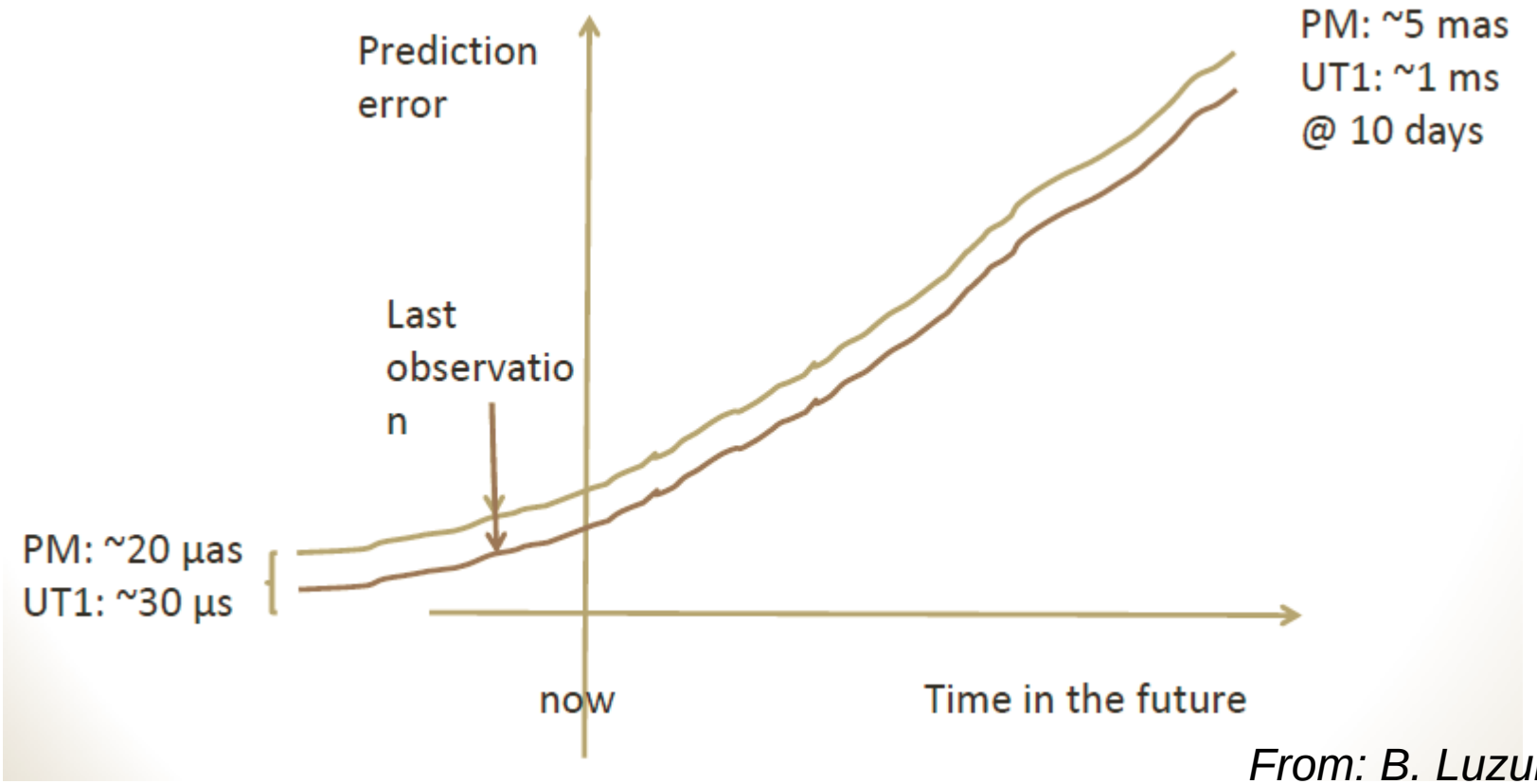
1.) Reduce latency



From: B. Luzum

Improvement of EOP input data

2.) Improve accuracy



From: B. Luzum

Improvement in geophysical analysis and forecast

4 recommendations evolved:

- Formal errors needed for data from AAM analysis (= internal validation)
- Inter-comparison between different sources of AAM data (= external validation)
- Request more frequent updates of AAM data (actually 6 hours)
- OAM should be provided operationally in real-time

From: B. Luzum

IERS Rapid Service / Prediction Center

Current latency and accuracy of IERS Rapid products:

Input	Latency	Refresh rate	PM Accuracy	UT1/LOD Accuracy
AAM	~18-42 hours	1/day		~60 µs/day
GPS (Ultras)	~15-21 hours	4/day	~20 µas	~15 µs/day
SLR	48-72 hours	1/day	~200 µas	
VLBI Intensives	~8-32 hours	1-2/day		~20 µs
VLBI 24-hour	10-17 days	2/week	~200 µas	~5 µs

From: B. Luzum

IERS Rapid Service / Prediction Center

Current latency and accuracy of IERS Rapid products:

Input	Latency	Future Latency
AAM	~18-42 hours	*< 15 hours*
GPS (Ultras)	~15-21 hours	*use from IGS Real-Time Service?*
SLR	48-72 hours	*< 24 hours*
VLBI Intensives	~8-32 hours	*< 2 hours*
VLBI 24-hour	10-17 days	*< 2 days*

From: B. Luzum

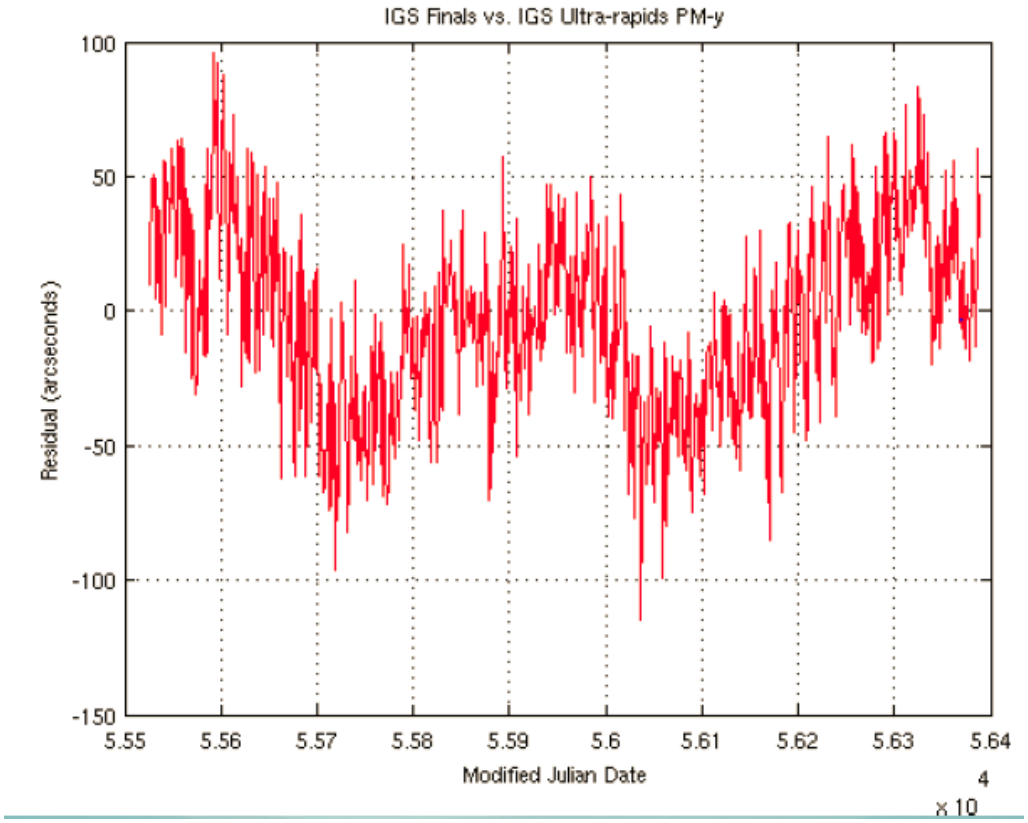
Issues in IGS polar motion

Concerns about differences between **IGS Final** and **IGS Ultra-Rapid** polar motion:

Differences are larger than accuracy of GNSS-derived PM

=> Has to be clarified by IGS

=> Studies are already ongoing



Revision of the Terms of Reference

PRODUCT CENTERS (PC)

- **Rapid Service/Prediction Center** and **Earth orientation Center**, responsible for Earth orientation parameters.
- **ITRS Center**, responsible for the maintenance of the ITRS/ITRF.

⇒ But ITRF is computed with consistent TRF **and** EOP

⇒ Do we need a PC for rigorous combination on a “daily” basis?

⇒ *Decision: wait for results from WG “combination at the observation level (COL)”*

Improvement of product formats

Issues identified to be improved:

- Different formats for different product levels (Bulletin A, B and C04) should be merged into one common format
- Rates of EOPs to be included in the files (currently only LOD is given, but no polar motion rates)
- Leap second file is not computer readable
- No format for “Real-Time” distribution of EOP currently available

$\Rightarrow$ the IERS Analysis Coordinator works on improvements

Summary

- Very good 2-day IERS Retreat
- Several topics have been identified with potential for improvements
- Main issues regarding EOPs:
  - Move towards “Real-Time”
  - Move towards combined EOP products (e.g. for Intensives)
  - Improvements for EOP prediction
  - User-friendly common product formats

$\Rightarrow$ many activities are already ongoing