

The IVS Intensive sessions on their way to near real-time

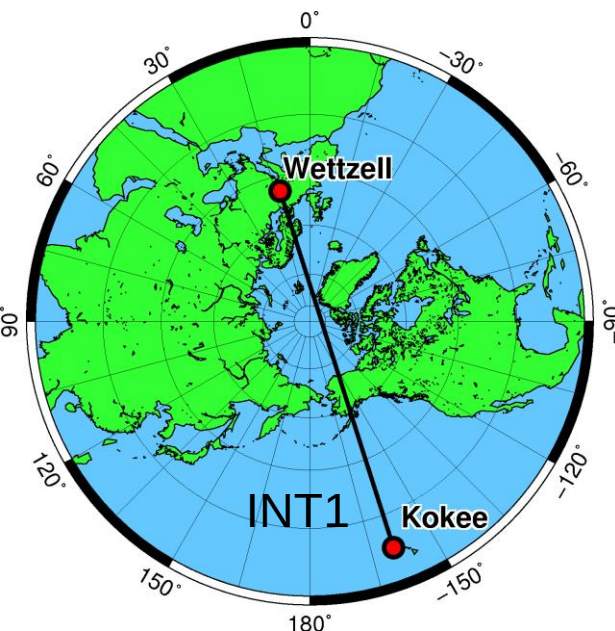
Rüdiger Haas

IERIS Retreat 2013

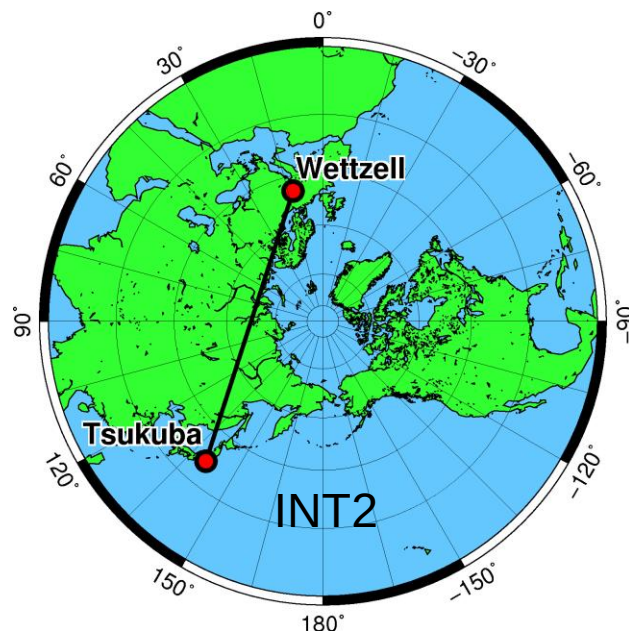
Paris, 2013-05-23/24

IVS intensive sessions

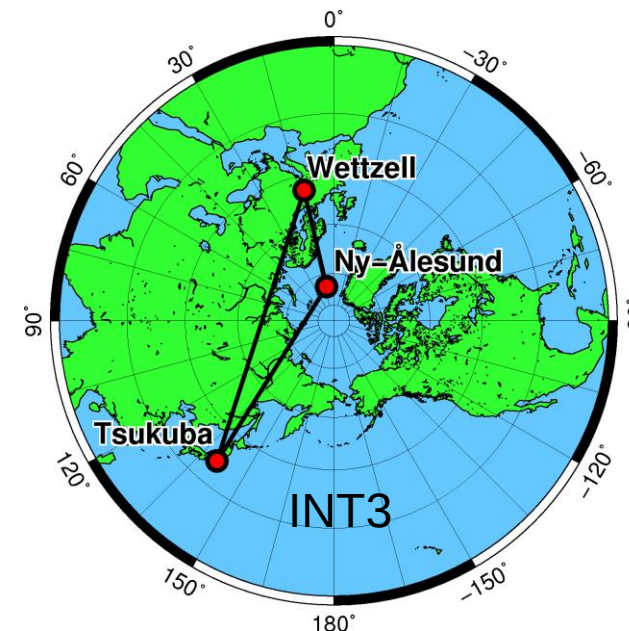
- Currently 3 series: INT1 – INT2 – INT3
- Aim: daily dUT1 observations, 1 h sessions



Mo-Fr, 18:30-19:30
C: USNO, A: NASA



Sa+Su, 07:30-08:30
C: GSI, A: GSI



Mo, 07:00-08:00
C: Bonn, A: NASA

Latency: Example week in April 2013

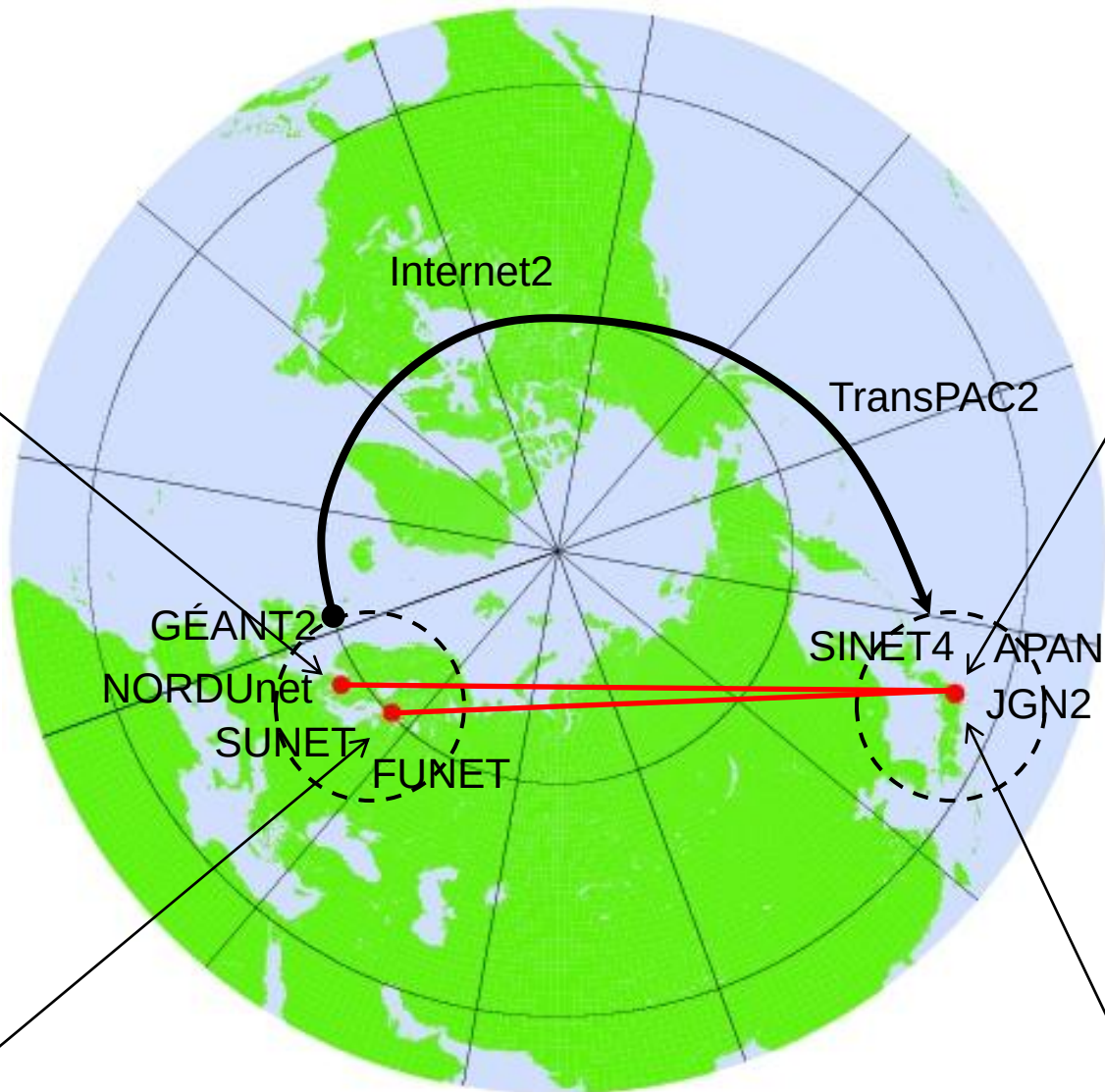
Session name	Observing date/time	Correlation	Analysis	Latency correl. since end of observ.	Latency dUT1-res. since end of observ.
INT3 – 089	Apr 08, 07:00-08:00	Apr 08, 14:51	Apr 08, 18:26	06:51	10:26
INT1 – 089	Apr 08, 18:30-19:30	Apr 09, 04:54	Apr 09, 05:10	09:24	09:40
INT1 – 099	Apr 09, 18:30-19:30	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	???

IVS Task Force for the intensives

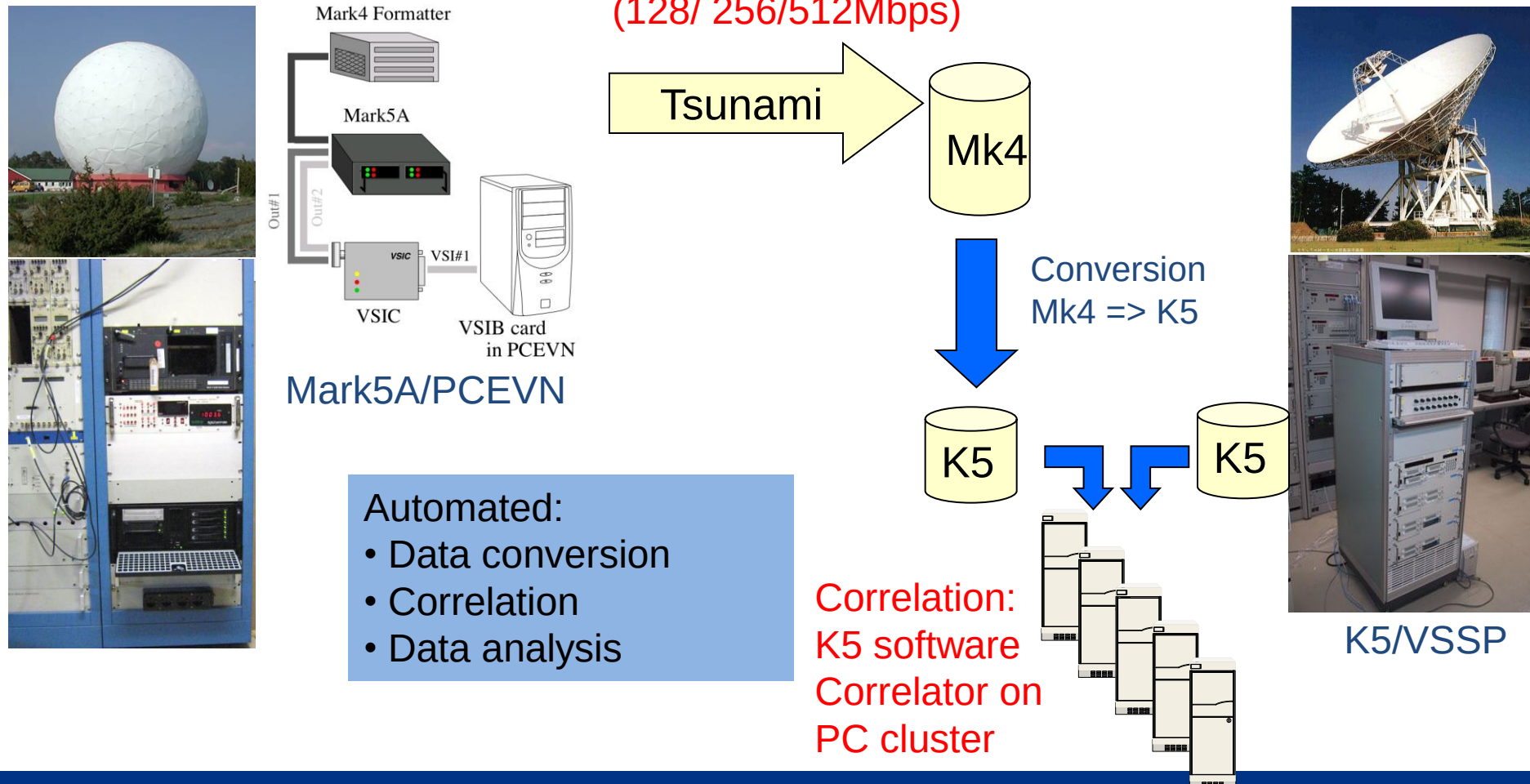
- Task: Review the intensives
 - Unified analysis strategy for INT
 - Ultra-rapid dUT1
 - Different INT products
- Goal: To determine dUT1 (polar motion?) from VLBI with high latency in an automated process
- Pilot project for the up-coming next generation VLBI system => **VGOS**
 - Make use of real-time data transfer from the observing VLBI stations to the correlator
 - Correlation and data analysis in near real-time

Background

- The project started as a Fennoscandian-Japanese collaboration in 2007
- Started with dedicated 1 hour long "INT-style" VLBI session between Onsala (Sweden), Metsähovi (Finland), Tsukuba (Japan) and Kashima (Japan)
- Early record in 2008: dUT1-results within 4 minutes after a 1 hour observing session
- Evaluation in 2008/2009: ultra-rapid as good as standard INT, but much lower latency
- INT-2 adopted the strategy in 2009



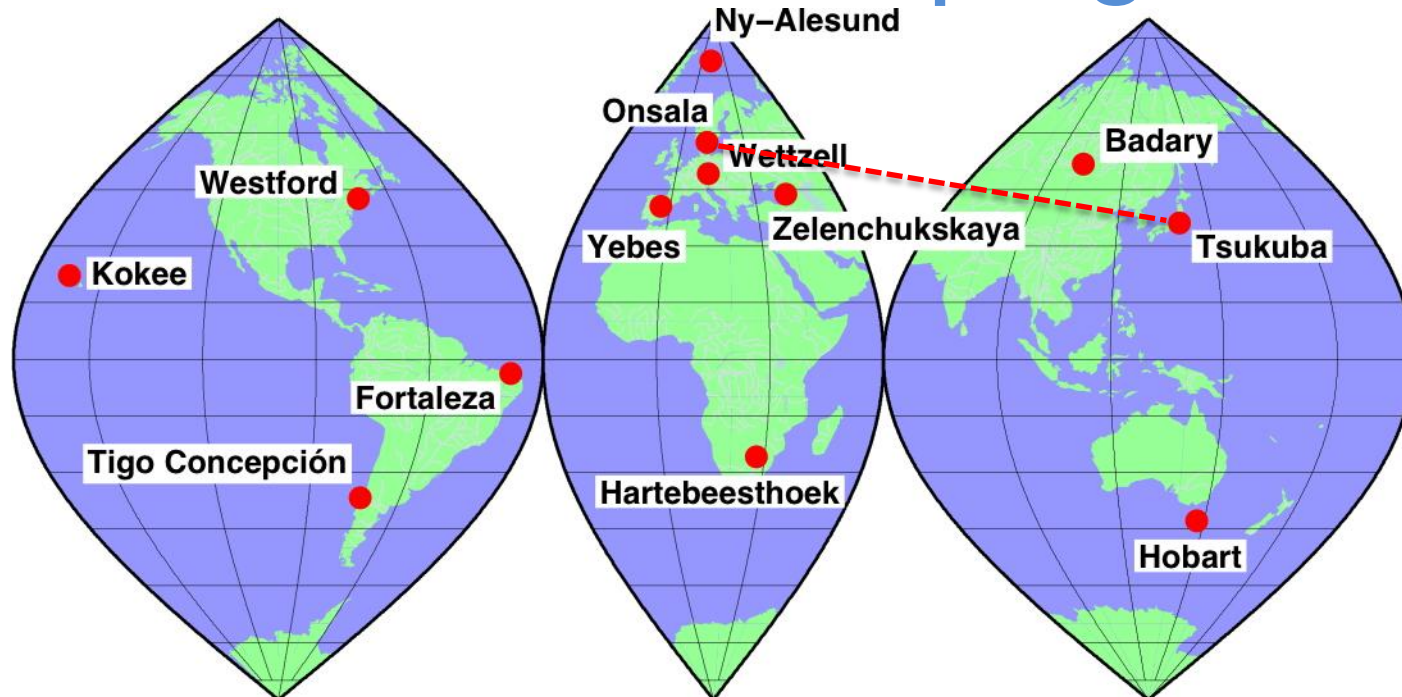
Example of data flow



Background

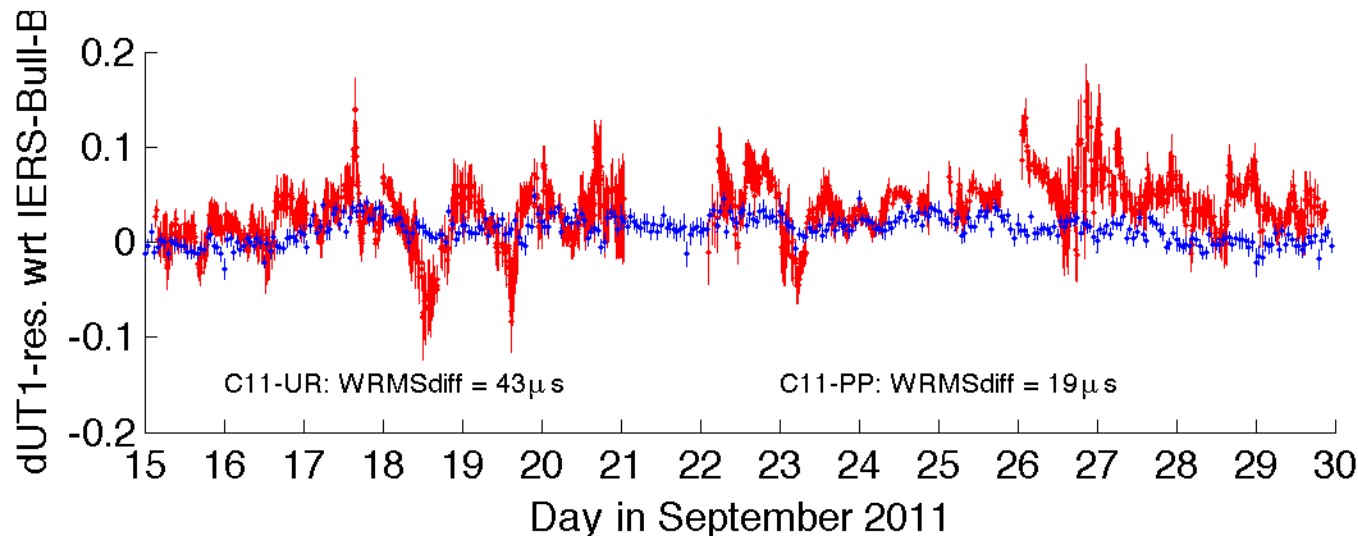
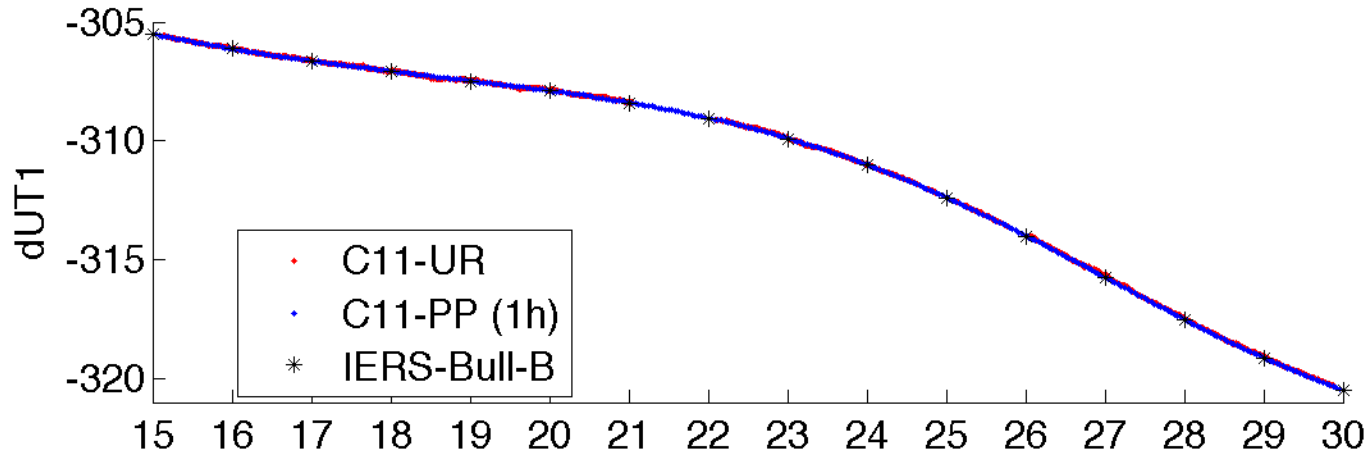
- Since **2009** "ultra-rapid" sessions using standard 24 hour IVS-sessions that involve Onsala and Tsukuba
 - IVS-sessions: R1, RD, T2 (i.e. not optimized for dUT1)
 - Therefore: 'sliding window' approach
 - 'Sliding window' length: 35 scans, 2 h, 3 h, 6 h
 - Ultra-rapid dUT1 during IVS-sessions (Onsala-Tsukuba)
- Complete CONT11 campaign (15 days) operated as ultra-rapid dUT1-session (Onsala-Tsukuba)
- End of **2011**: first dedicated 3-station ultra-rapid EOP session with Onsala-Tsukuba-Hobart
- Since mid of **2012**: 4-station ultra-rapid EOP sessions
 - During standard IVS-sessions
 - Dedicated UREOP-sessions

CONT11-campaign

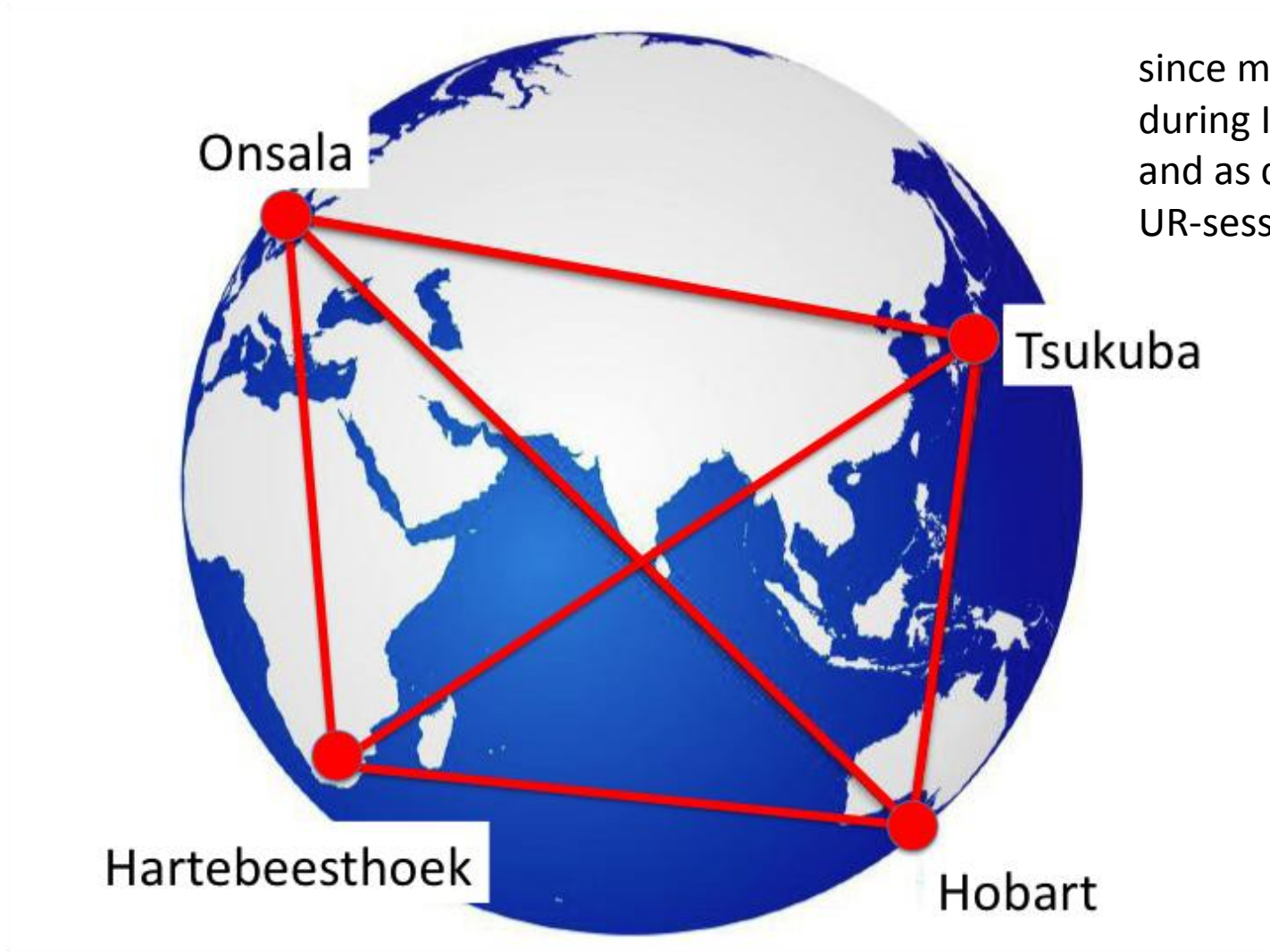


- 15 days continuous VLBI
- 2011 September 15-29
- 13 stations network
- Ultra-rapid dUT1on baseline Onsala-Tsukuba
- dUT1-results while ongoing CONT11-campaign

CONT11 ultra-rapid dUT1



4-stations ultra-rapid EOP network



UR-EOP-sessions during IVS-sessions

-- 2012 --

```
R1546 |AUG13|226|17:00|24 |HhOnTs
R1548 |AUG27|240|17:00|24 |HhOnTs +Hb
R1548 |AUG27|240|17:00|24 |HhOnTs +Hb
RD1206|AUG28|241|17:30|24 |HhOnTs +Hb
R1549 |SEP04|248|17:00|24 |HhOnTs +Hb
R1550 |SEP10|254|17:00|24 |HhOnTs
T2085 |SEP11|255|17:30|24 |HhOnTsHb
R1553 |OCT01|275|17:00|24 |HhOnTs +Hb
RD1208|OCT02|276|17:30|24 |HhOnTs +Hb
R1554 |OCT10|284|17:00|24 |HhOnTs +Hb
R1555 |OCT15|289|17:00|24 |HhOnTs +Hb
R1561 |NOV26|331|17:00|24 |HhOnTs +Hb |
R1563 |DEC10|345|17:00|24 |HhOnTs
RD1210|DEC11|346|17:00|24 |HhOnTs
R1564 |DEC18|353|17:00|24 |HhOnTs
```

-- 2013 --

```
R1569 |JAN22| 22|17:00|24 |HbHhOnTs
R1570 |JAN28| 28|17:00|24 |HhOnTs
RD1301|JAN29| 29|17:30|24 |HhOnTs +Hb
R1573 |FEB18| 49|17:00|24 |HbOnTs +Ht
T2088 |FEB19| 50|17:30|24 |HhOnTs +Hb
R1579 |APR02| 92|17:00|24 |HhOnTs
R1580 |APR08| 98|17:00|24 |HhOnTs +Hb
RD1302|APR09| 99|17:30|24 |HhOnTs +Hb
```

... further sessions planned

Dedicated UR-EOP-sessions

-- 2012 --

```
UR1201|NOV29|334|18:00|24 |HbHtTs
UR1202|DEC06|341|18:00|24 |HbHtTs
UR1203|DEC17|352|07:00|35 |HbHtOnTs
```

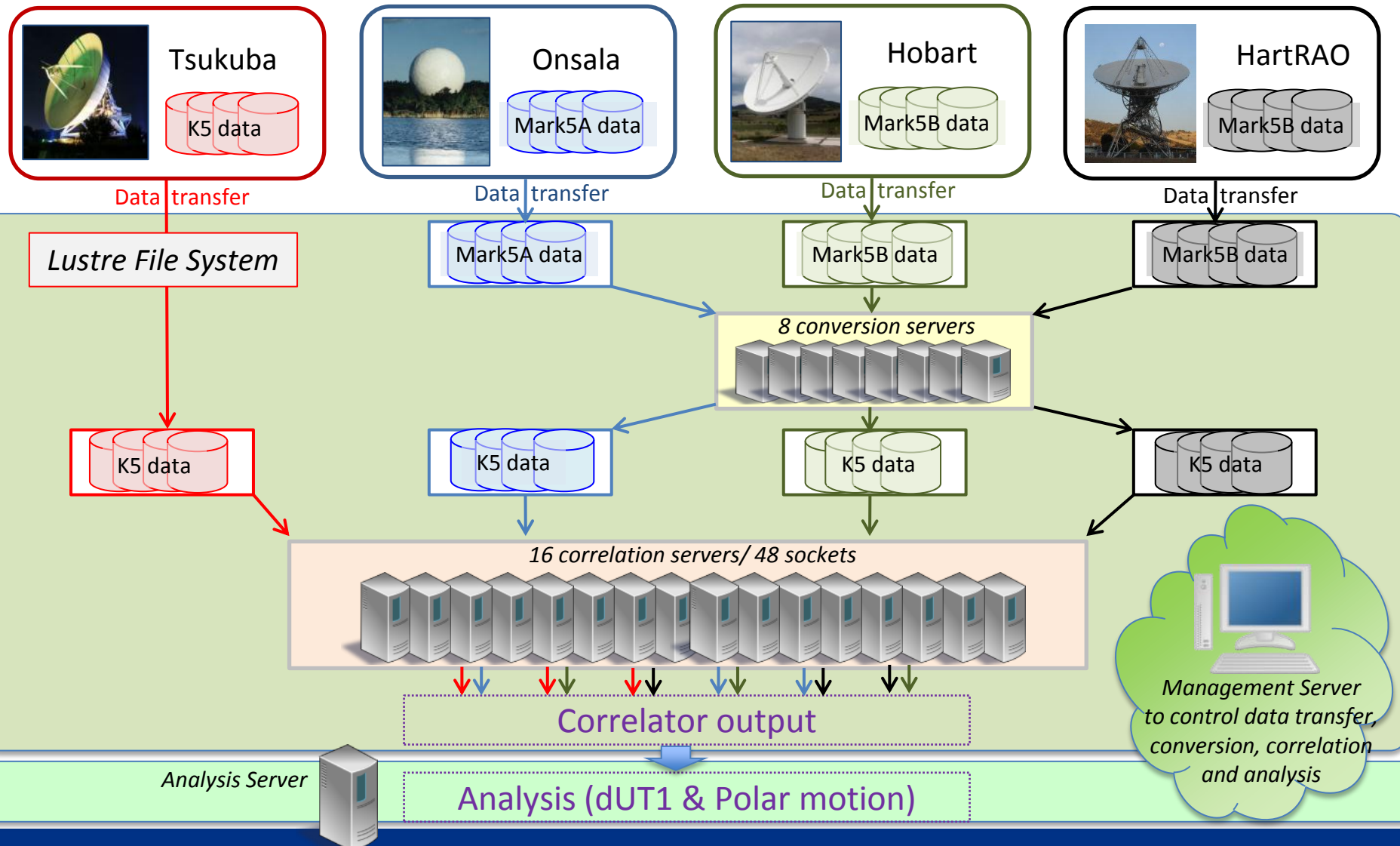
-- 2013 --

```
UR1301|JAN30| 30|18:00|61 |HbHtOnTs
UR1302|FEB05| 36|17:30|48.5|HbHtTs
```

... Further sessions planned

- IVS-UR-sessions are 'network-sessions', i.e. not optimized for EOP-determination with 3 or 4 stations only
- Dedicated UR-sessions are optimized sessions to determine EOP with 3 or 4 stations only

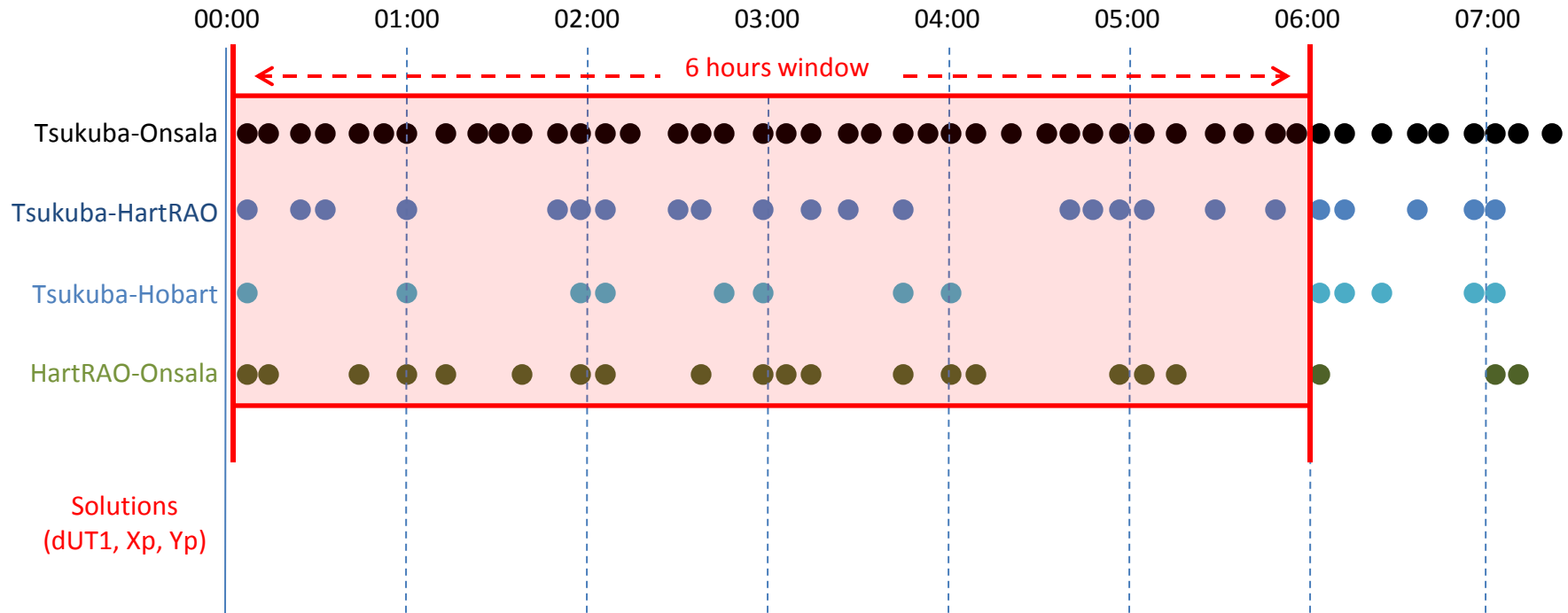
Data flow



Sliding window approach

Session start

● : one correlator output of each baseline

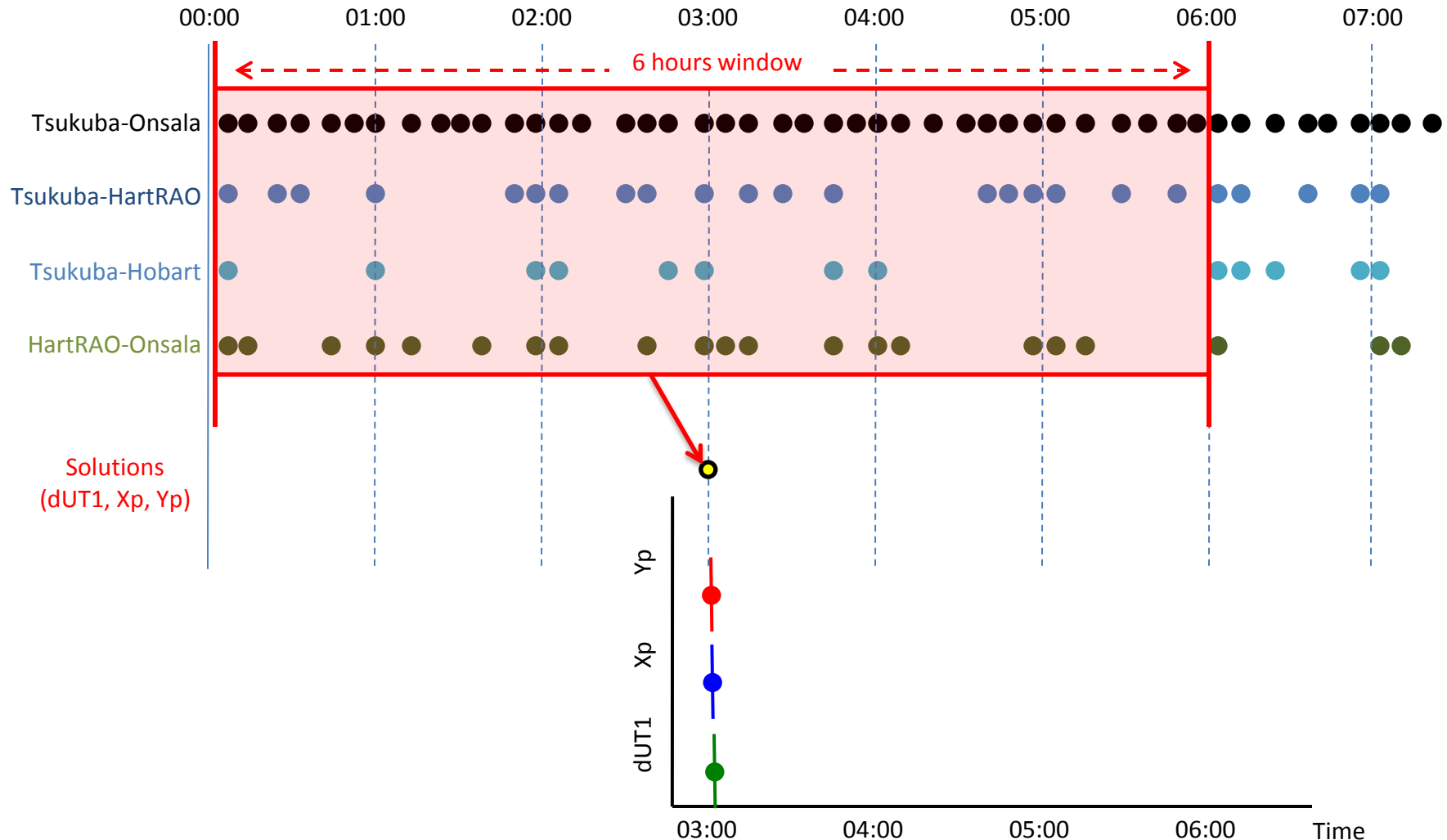


Set a “sliding window”, which means one period of correlator output used in one analysis.

Sliding window approach

Session start

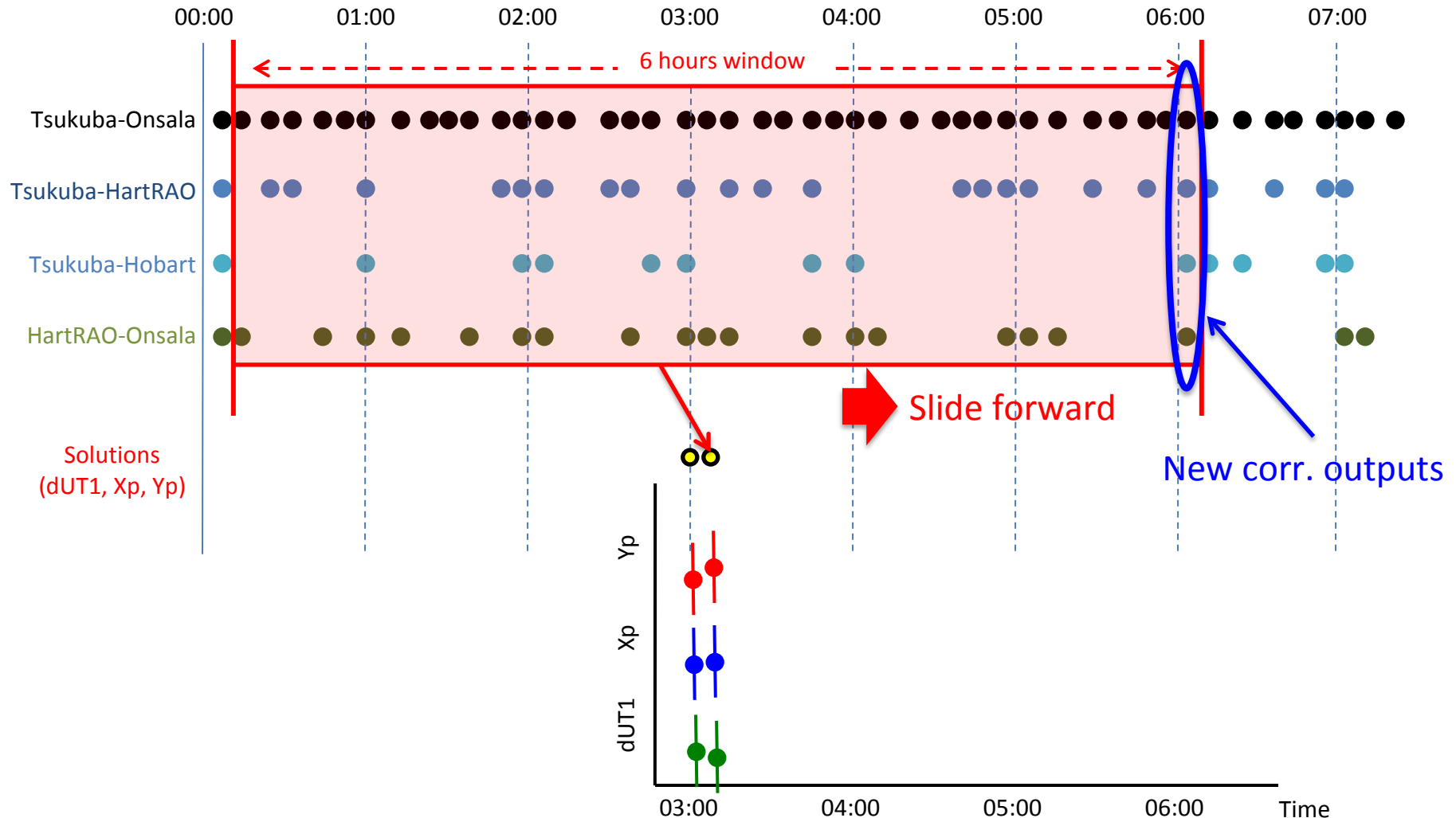
● : one correlator output of each baseline

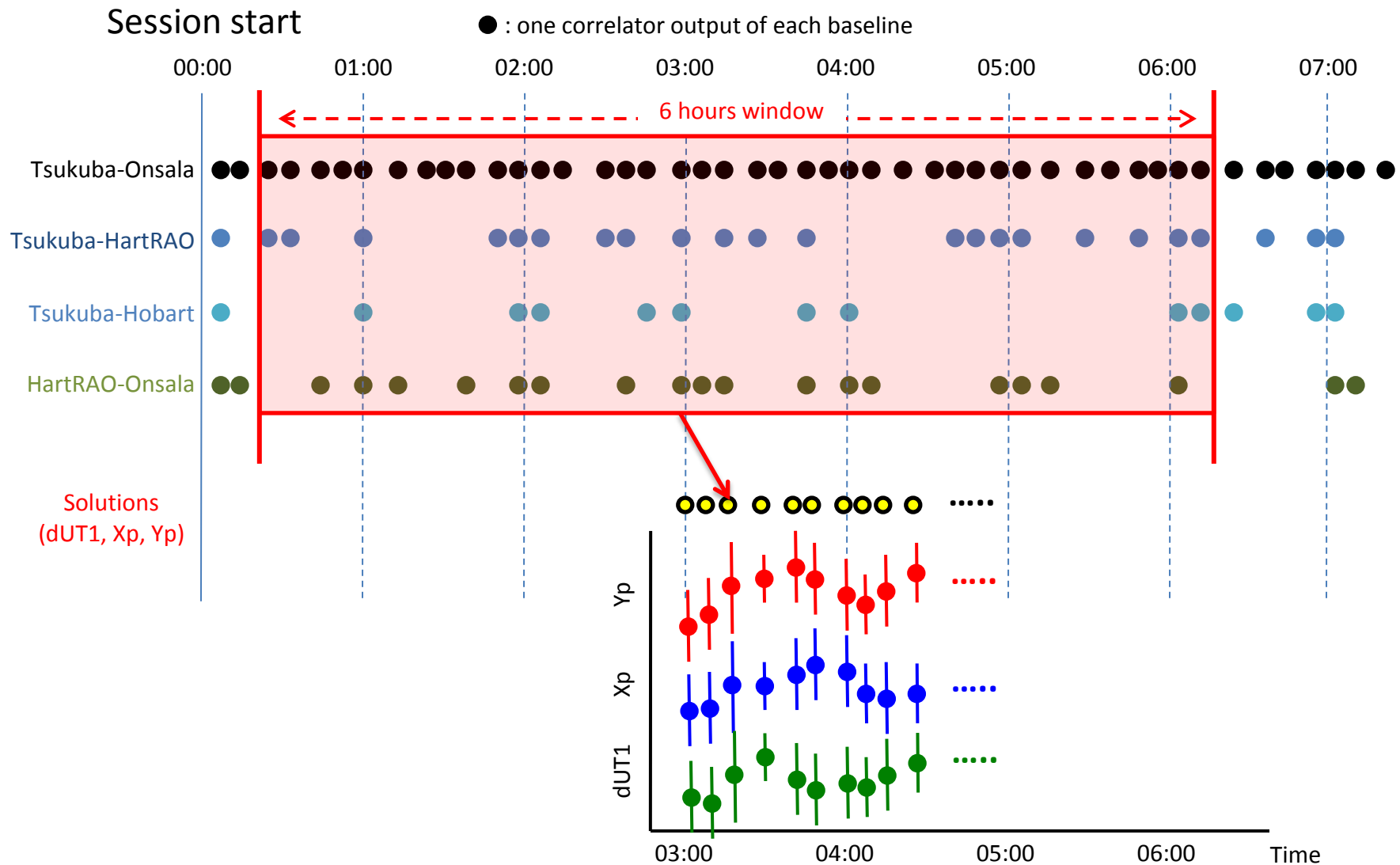


Sliding window approach

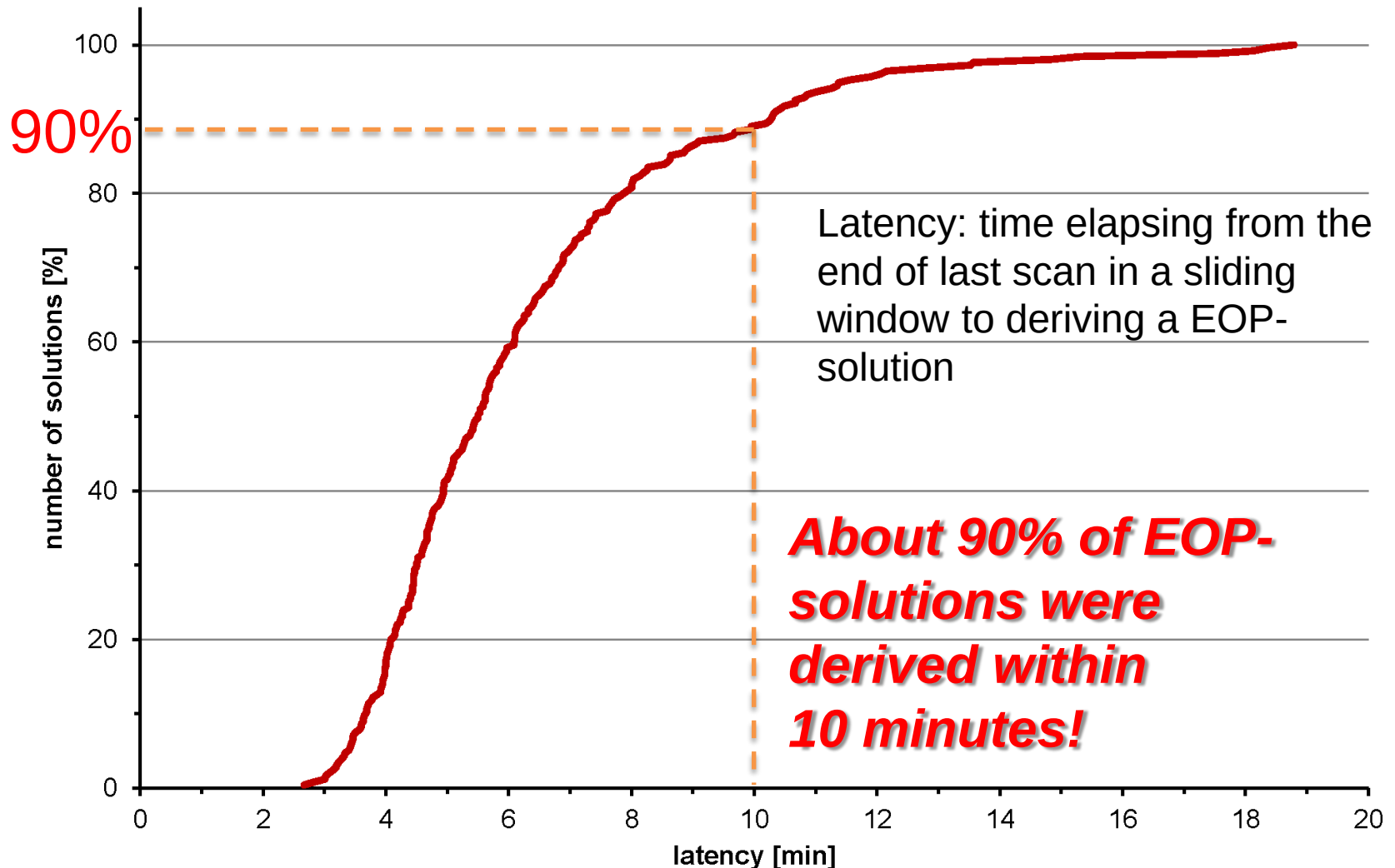
Session start

● : one correlator output of each baseline





Latency: Example R1.555, 12OCT15 (+Hobart as tag-along)



UR1301 Ultra-rapid EOP experiment

Last update: 02/05/2013 07:36:44 UTC

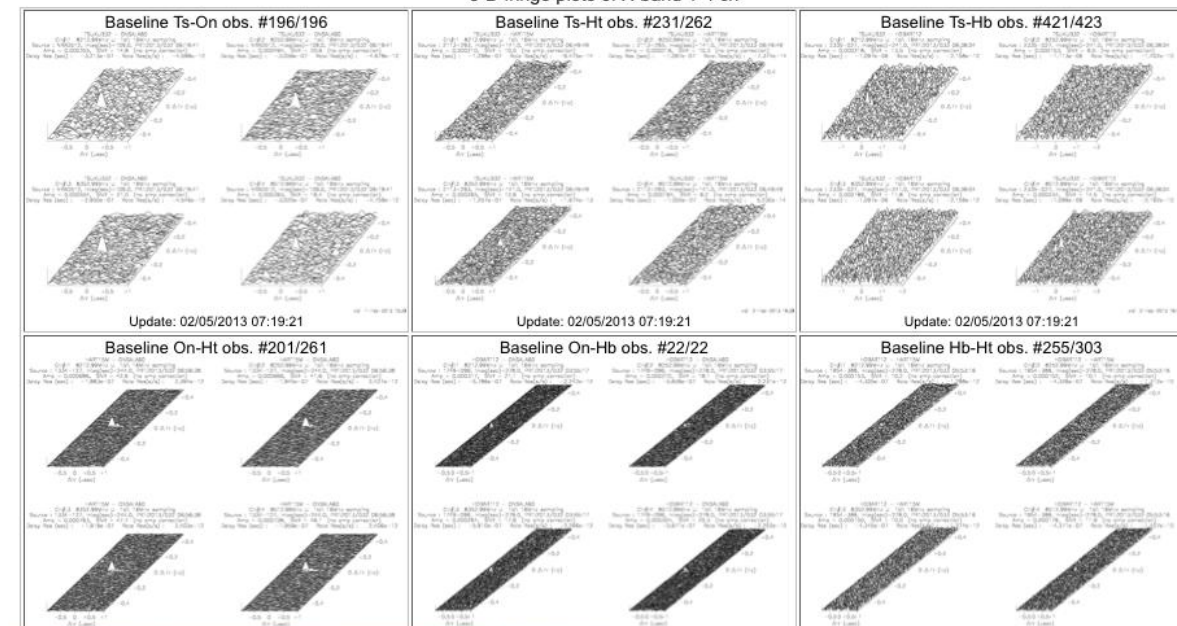
<http://www.spacegeodesy.go.jp/vlbi/dUT1/>

[Return to Index](#)
[ur1301.skd](#) [ur1301-sksum.txt](#) [ur1301-list.txt](#) [ur1301_polazel.pdf](#)

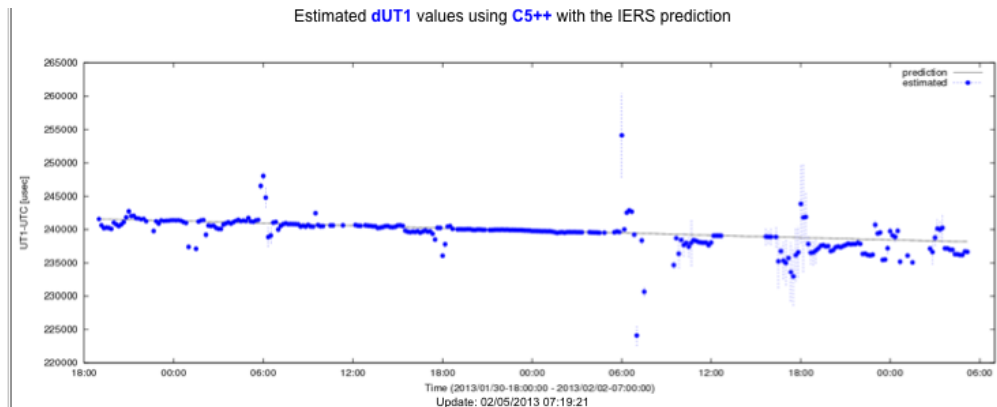
Antenna webcam images



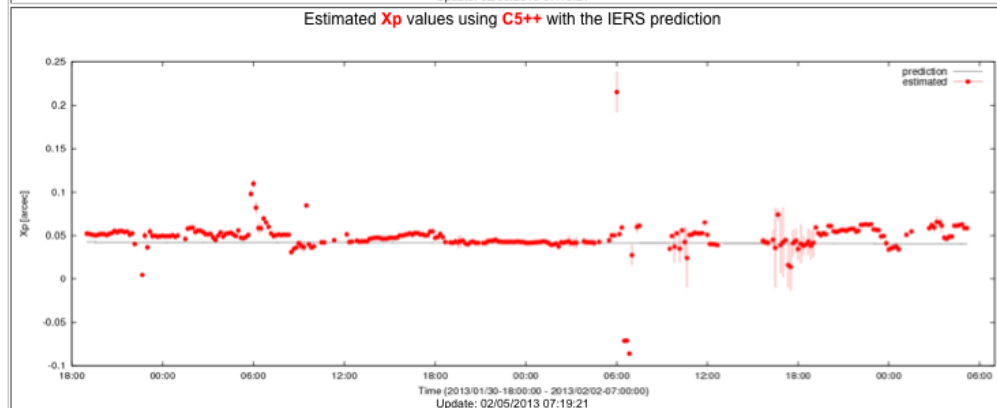
3-D fringe plots of X-band 1-4 ch



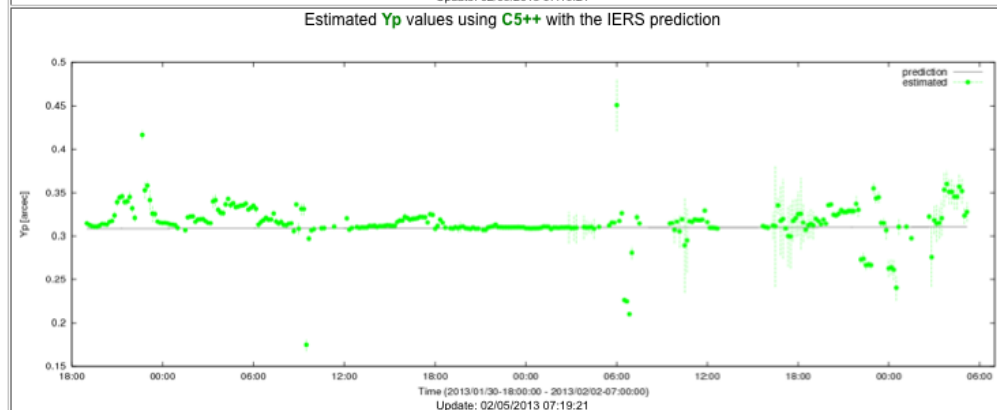
dUT1



Xp



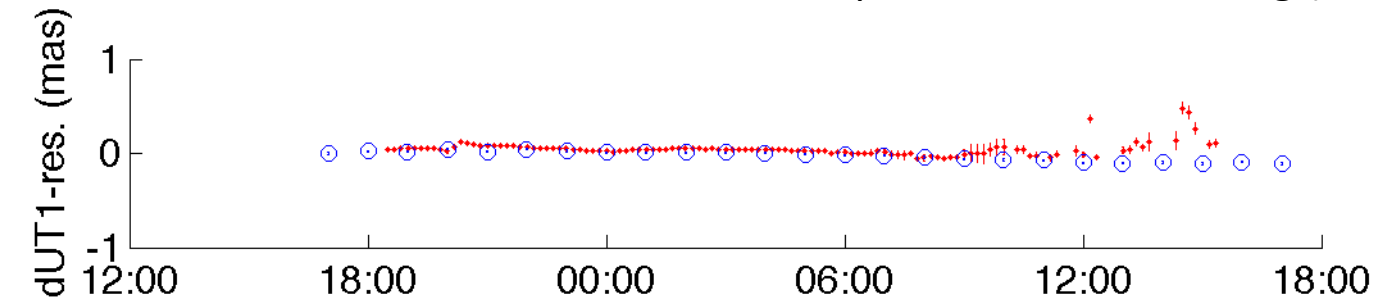
Yp



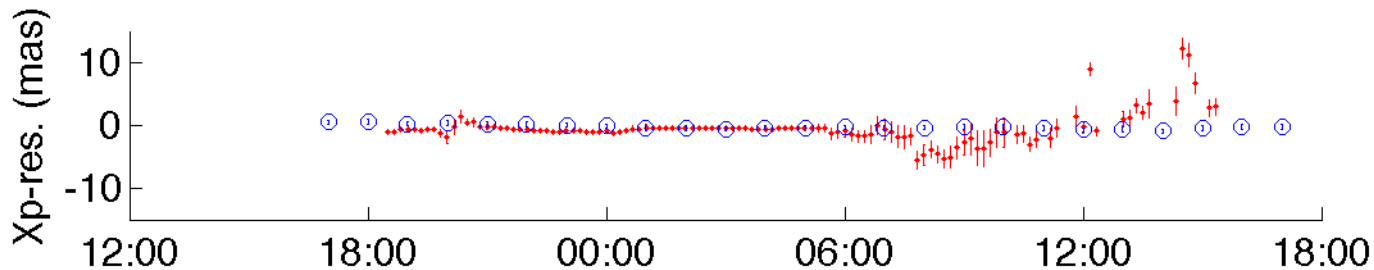
Example: R1.569 (13JAN22)

UR vs. PP: Ultra-Rapid vs. Post-Processing (1 h)

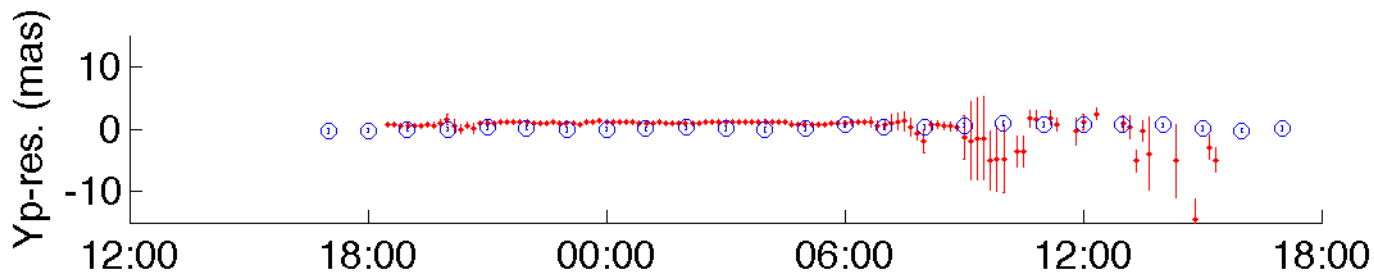
WRMS-differences
w.r.t.
IERS Bulletin-B:



dUT1:
UR: 63 μ s
PP: 55 μ s



Xp:
UR 1500 μ as
PP 425 μ as

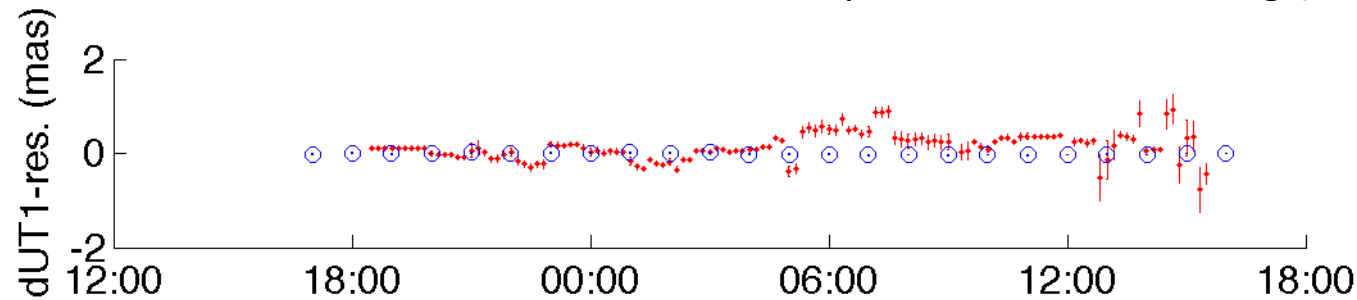


Yp:
UR 1200 μ as
PP 410 μ as

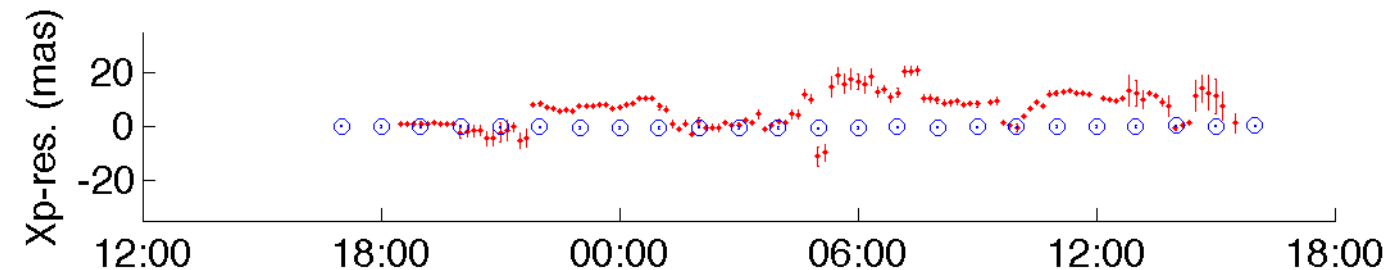
Example: R1.573 (13FEB18)

UR vs. PP: Ultra-Rapid vs. Post-Processing (1 h)

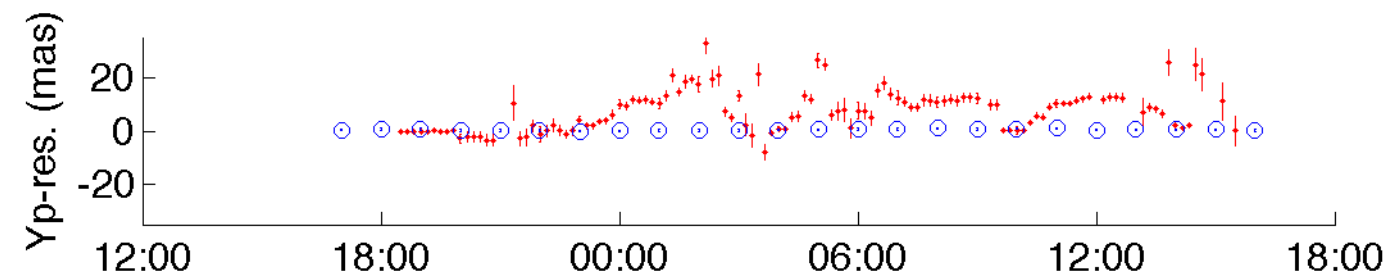
WRMS-differences
w.r.t.
IERS Bulletin-B:



dUT1:
UR: 232 μ s
PP: 20 μ s



Xp:
UR 7830 μ as
PP 334 μ as



Yp:
UR 8762 μ as
PP 568 μ as

Summary

- Dedicated UR-INT sessions (1 h)
 - as good as normal INT-sessions
 - led to adoption of ultra-rapid approach for INT2
- UR-dUT1 during IVS-sessions (2 stations, not optimized for dUT1, e.g. CONT11)
 - about 40 μ s wrms w.r.t. IERS Bulletin-B
 - very low latency (6 h window)
- UR-EOP during IVS-sessions (3/4 stations)
 - worse agreement w.r.t. IERS Bulletin-B than UT-dUT1 sessions
 - in particular for polar motion large WRMS differences
- Dedicated UR-EOP sessions (3/4 stations)
 - still under evaluation

Outlook

- Direct VDIF-streaming to Japan and K5-recording in Tsukuba (for non-Japanese stations)
- Refining 'sliding window' approach
- Implementation of a Kalman-filter approach for the UR-sessions
- Multi-station UR-dUT1 IVS-sessions instead of UR-EOP, northern hemisphere / southern hemisphere
- Further dedicated multi-station UR-EOP sessions during 2013
- Plan for CONT14: multi-station UR-EOP with 4+ station network