Kashima Space Research Center

NiCT

Systematic Range Bias 2005-06

Toshimichi Otsubo and Naoko Obara

Kashima Space Research Center

National Institute of Information and Communications Technology

15th International Laser Ranging Workshop, Canberra, 17 Oct 2006

It's now DAILY!

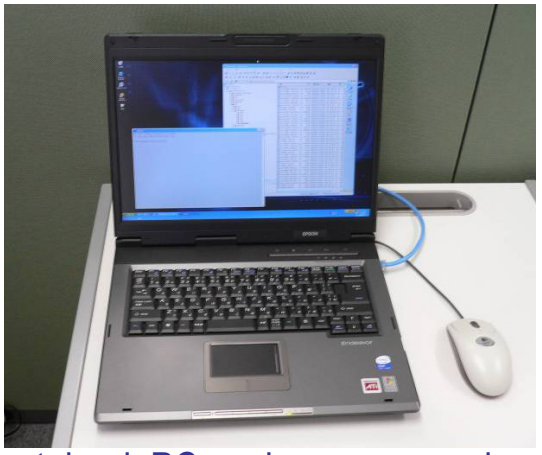
Bias reports from NICT (since Oct 1999)

- Major upgrade in May 2005.

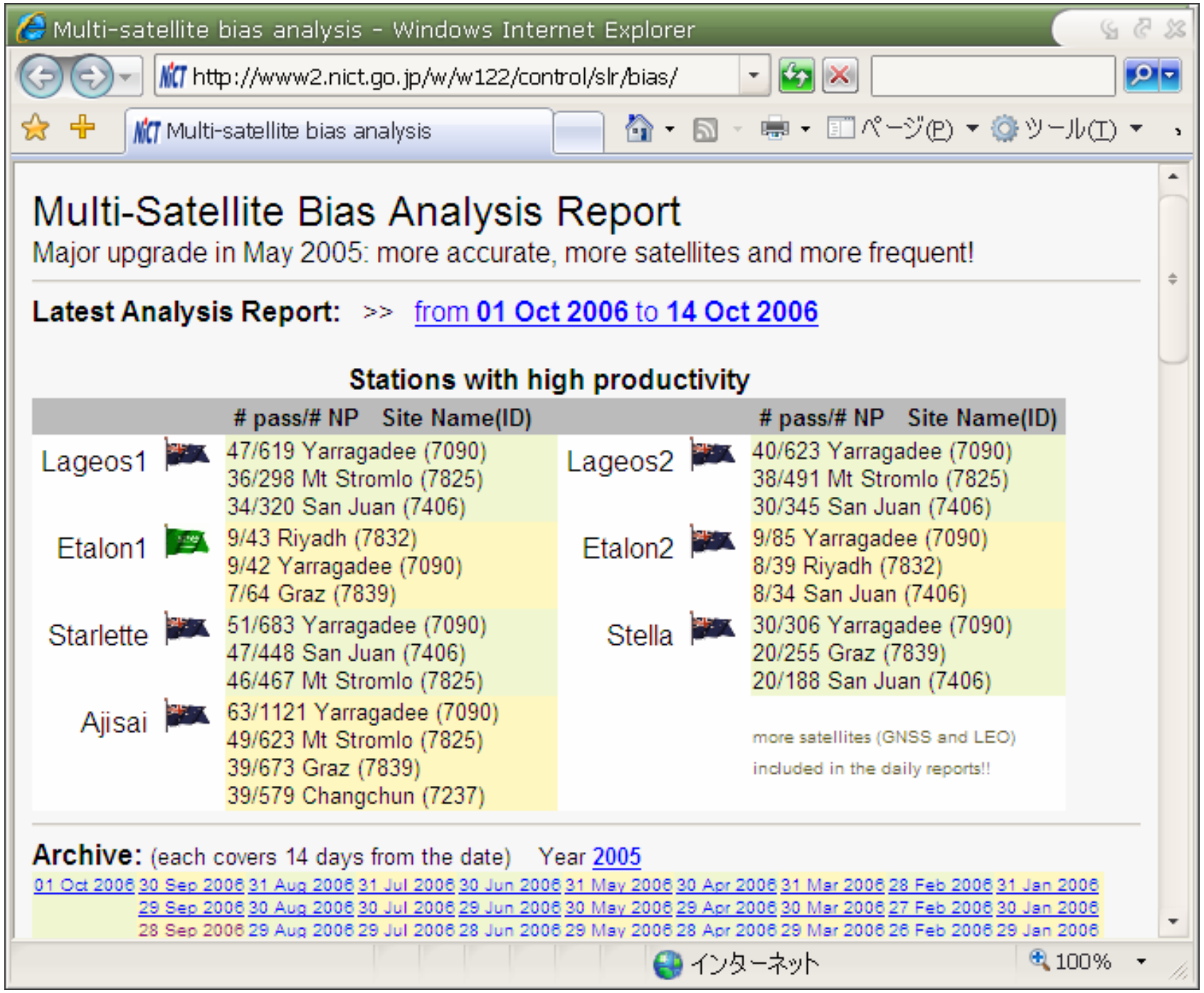
  More satellites (> 10). More accurate. More frequent.
- Available at http://www.nict.go.jp/w/w122/control/slr/bias/

  also via email (daily or weekly).
- Almost trouble free (stopped only at the time of power interruption).
- Able to detect range errors > 10 or 20 cm

  in a pass-by-pass basis.
- To do soon: TRF switched to ITRF2005



This notebook PC works every morning.
Update: 0 to 1 h UT.


Multi-satellite bias analysis - Windows Internet Explorer
http://www2.nict.go.jp/w/w122/control/slr/bias/
Multi-satellite bias analysis
ページ(P)
ツール(T)
Multi-Satellite Bias Analysis Report
Major upgrade in May 2005: more accurate, more satellites and more frequent!
Latest Analysis Report: >> from 01 Oct 2006 to 14 Oct 2006
Stations with high productivity
pass/# NP Site Name(ID)
Lageos1
47/619 Yarragadee (7090)
36/298 Mt Stromlo (7825)
34/320 San Juan (7406)
Lageos2
40/623 Yarragadee (7090)
38/491 Mt Stromlo (7825)
30/345 San Juan (7406)
Etalon1
9/43 Riyadh (7832)
9/42 Yarragadee (7090)
7/64 Graz (7839)
Etalon2
9/85 Yarragadee (7090)
8/39 Riyadh (7832)
8/34 San Juan (7406)
Starlette
51/683 Yarragadee (7090)
47/448 San Juan (7406)
46/467 Mt Stromlo (7825)
Stella
30/306 Yarragadee (7090)
20/255 Graz (7839)
20/188 San Juan (7406)
Ajisai
63/1121 Yarragadee (7090)
49/623 Mt Stromlo (7825)
39/673 Graz (7839)
39/579 Changchun (7237)
more satellites (GNSS and LEO)
included in the daily reports!!
Archive: (each covers 14 days from the date) Year 2005
01 Oct 2006 30 Sep 2006 31 Aug 2006 31 Jul 2006 30 Jun 2006 31 May 2006 30 Apr 2006 31 Mar 2006 28 Feb 2006 31 Jan 2006
29 Sep 2006 30 Aug 2006 30 Jul 2006 29 Jun 2006 30 May 2006 29 Apr 2006 30 Mar 2006 27 Feb 2006 30 Jan 2006
28 Sep 2006 29 Aug 2006 29 Jul 2006 28 Jun 2006 29 May 2006 28 Apr 2006 29 Mar 2006 26 Feb 2006 29 Jan 2006
インターネット
100%

Sub-cm Systematic Range Bias

"Towards 1-mm Accuracy"

Best if…

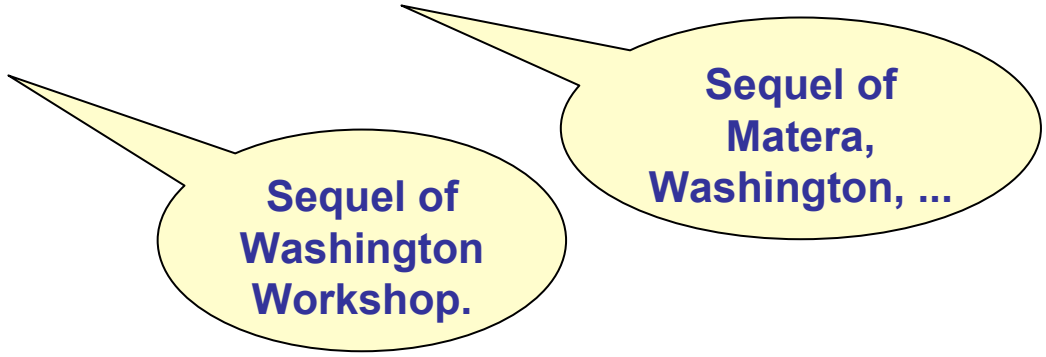
- All ILRS stations were bias free.
- Or, their biases were constant.

Systematic error → harmful in the analysis stage

[1] vs Intensity (# of single-shot returns per normal point bin).

[2] vs Applied system delay.

- Other effect is possible.



Analysis Procedure

Orbit determination

- Period: Sep 2005 to Aug 2006 (360 days)
- Satellites: LAG1+LAG2, AJISAI, STARLETTE+STELLA
- '*concerto v4*' solved for orbits (5-day arc for LAG, 2-day arc for LEOs), station position & range bias
- Stations: Top 24 in ILRS Quarterly Performance Card

Post-fit residuals sorted

[1] by "single-shot returns per NP bin" (~ intensity)

[2] by "applied system delay"

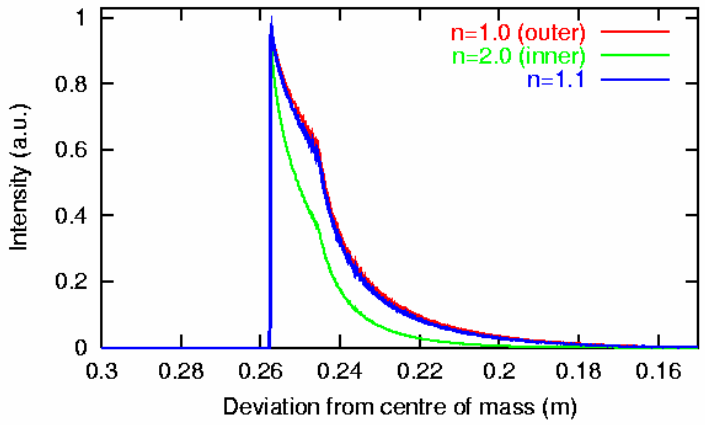
[1] Intensity-dependent Bias

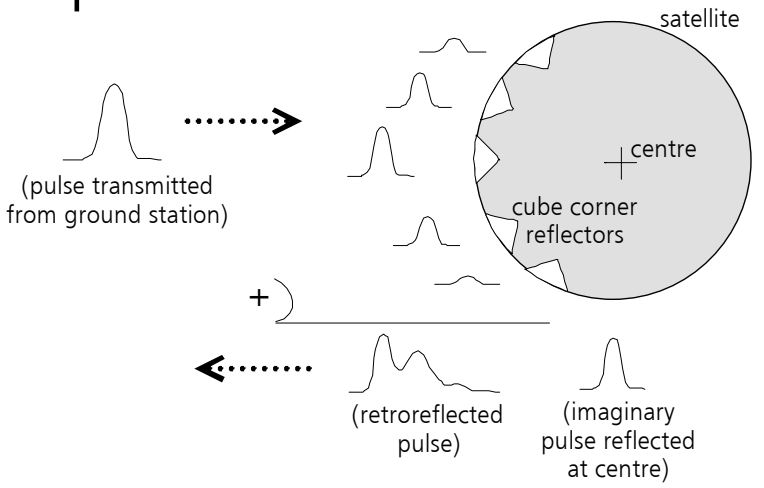
Are CoM corrections constant in the real world?

- Big challenge for “1-mm accuracy”

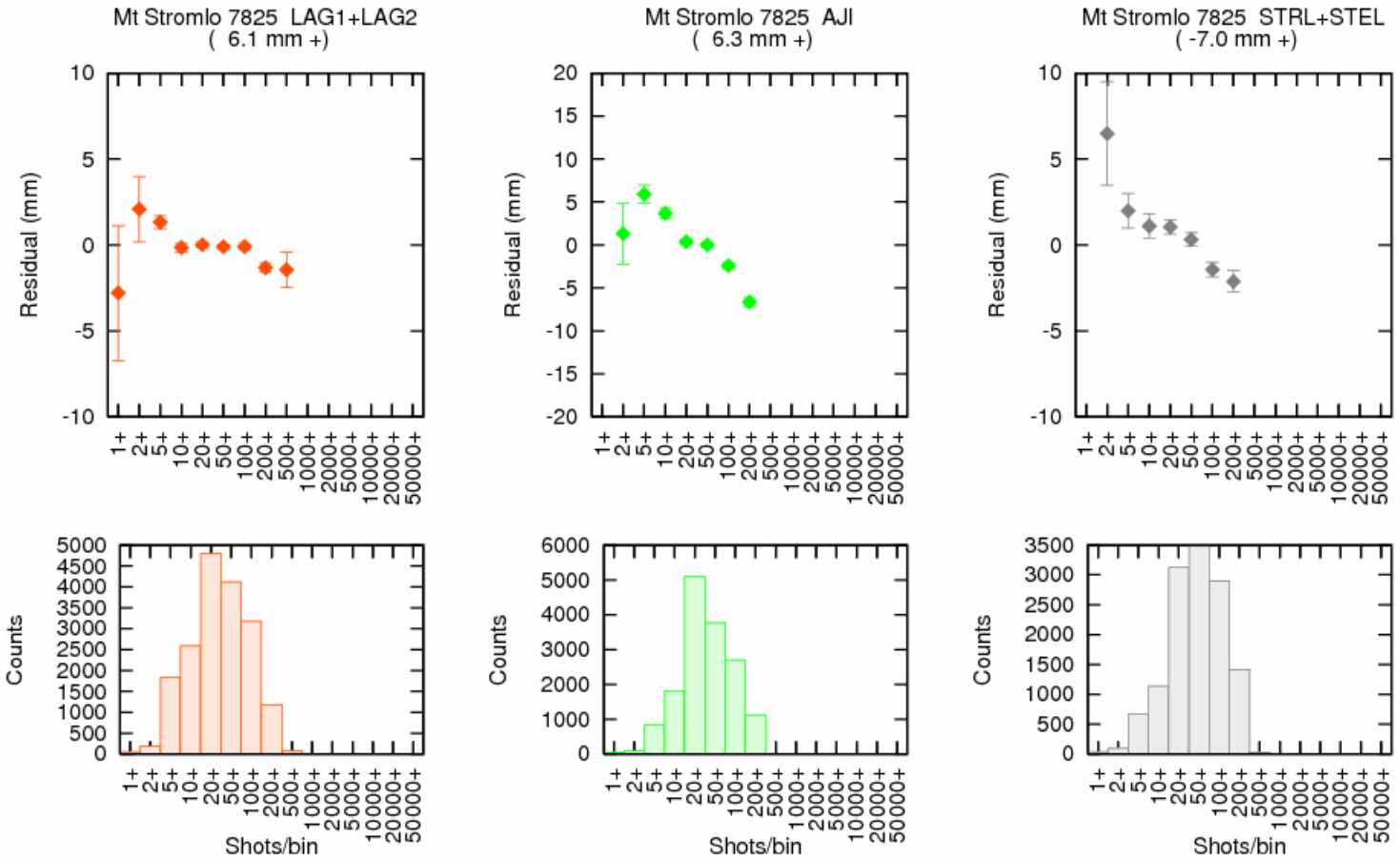
Systematic error → harmful in the analysis stage

- Likely to be elevation-angle-dependent
- Directly contaminates station heights (Otsubo, 2004) and TRFs.
- The stronger, the shorter? Not so simple?

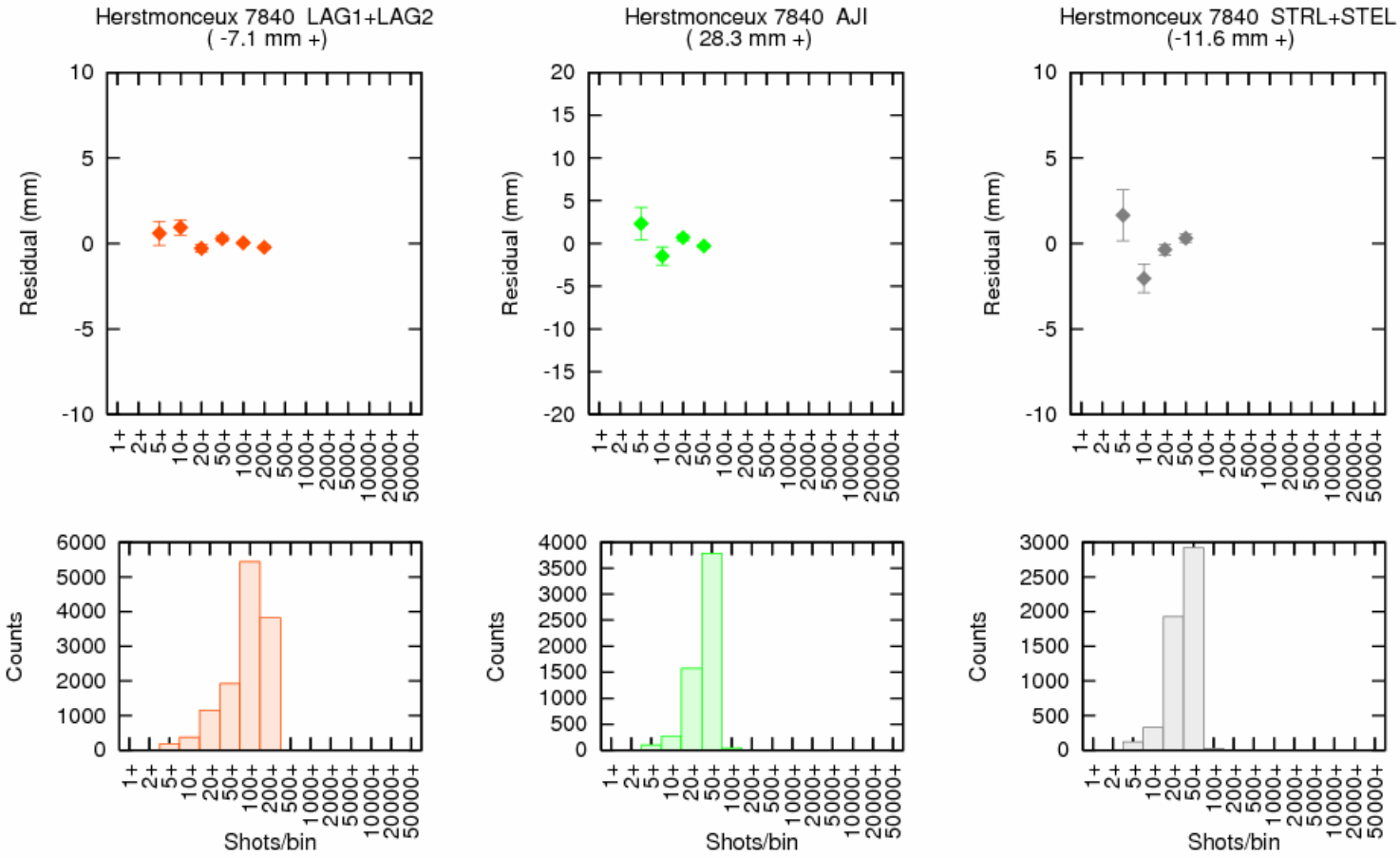




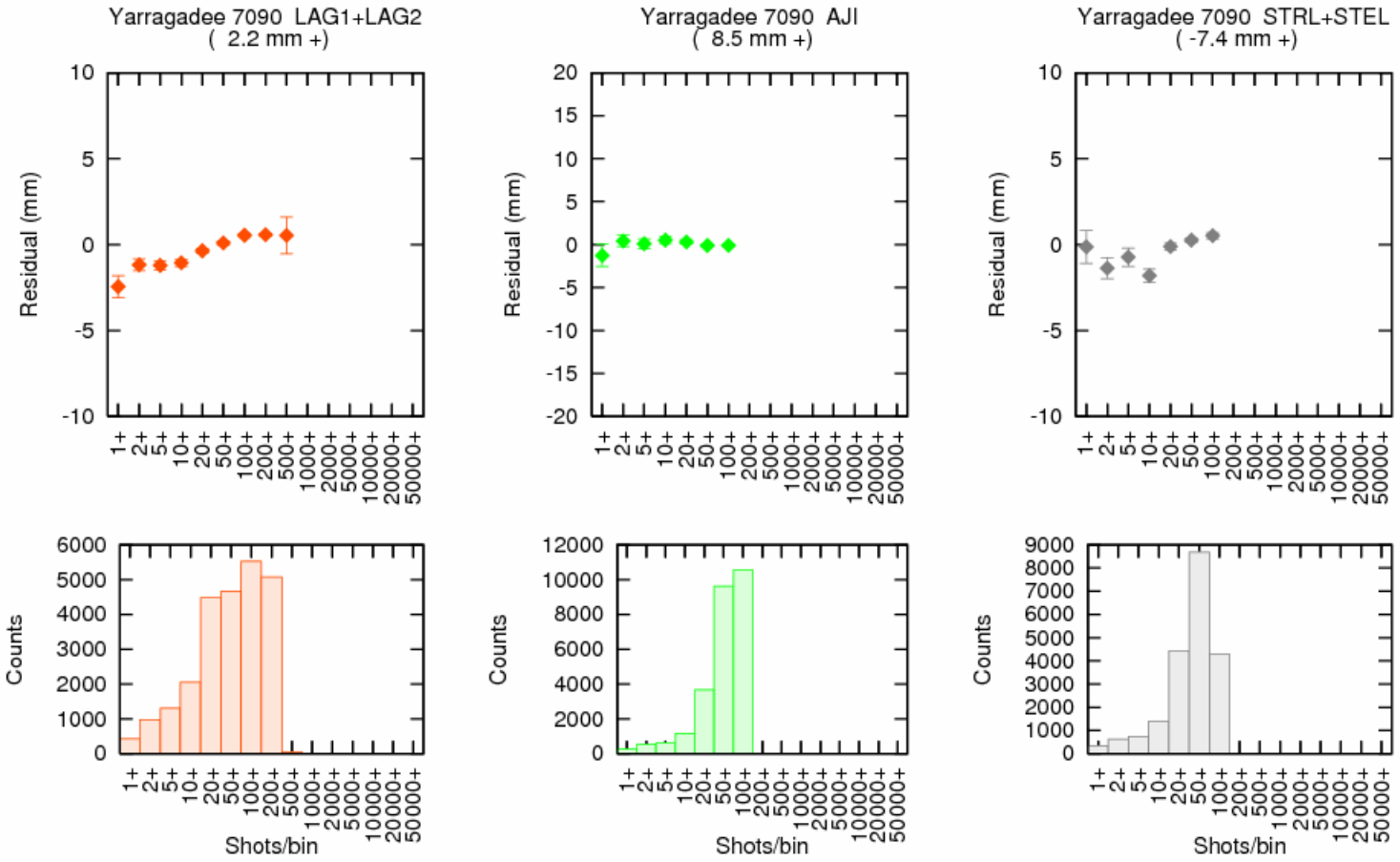
Intensity-dependent Bias: C-SPAD Mt Stromlo



Intensity-dependent Bias: Single Photon Herstmonceux



Intensity-dependent Bias: MCP Yarragadee



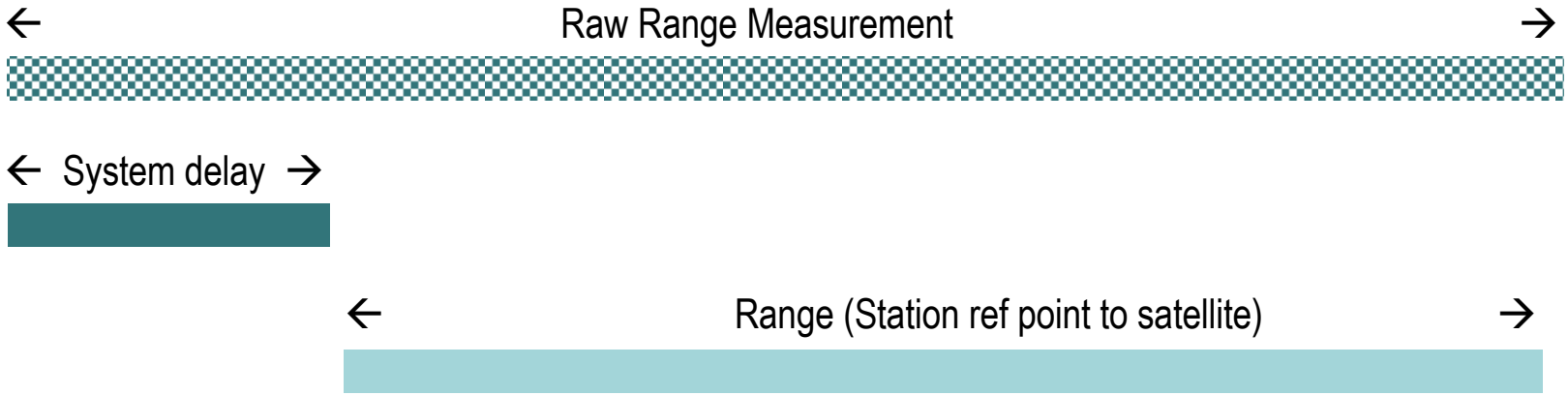
[2] Calibration-dependent Bias

New target? New timer? → New calibration value.

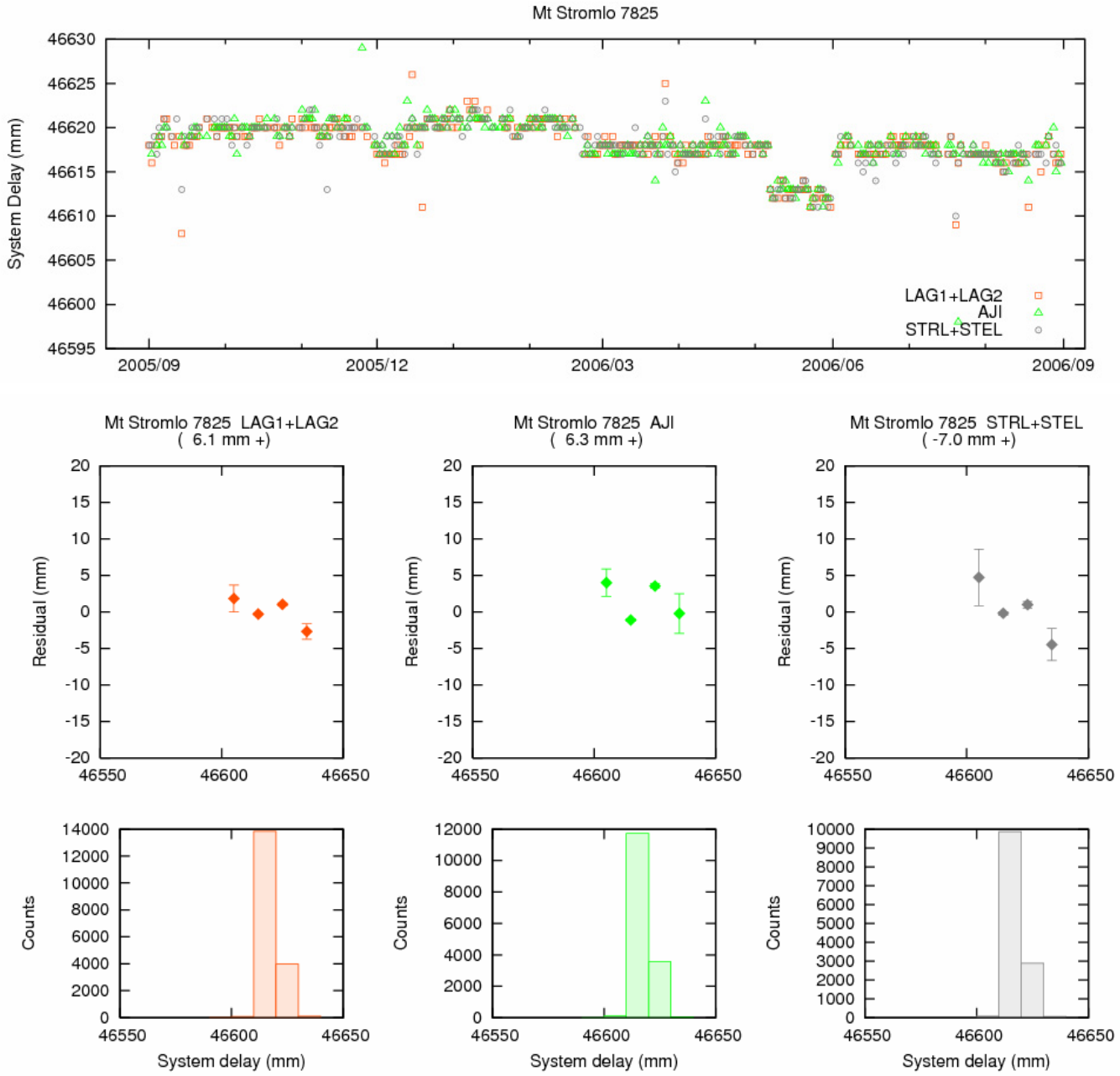
- Is the new one consistent with (or better than) the old one?

What if you found a 30-ps jump in the calibration ranging?

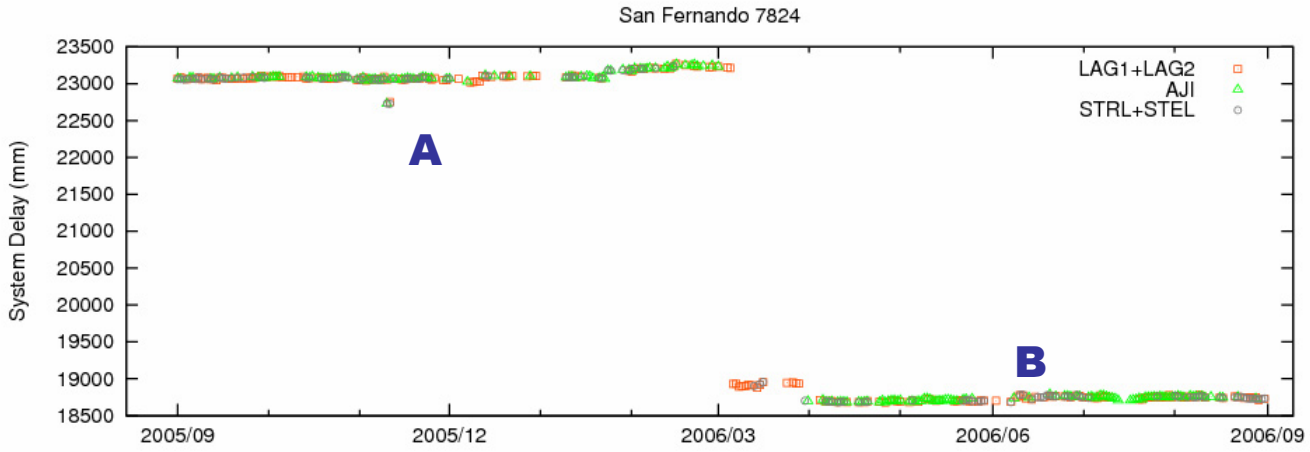
- Does it really come from the “system delay”?

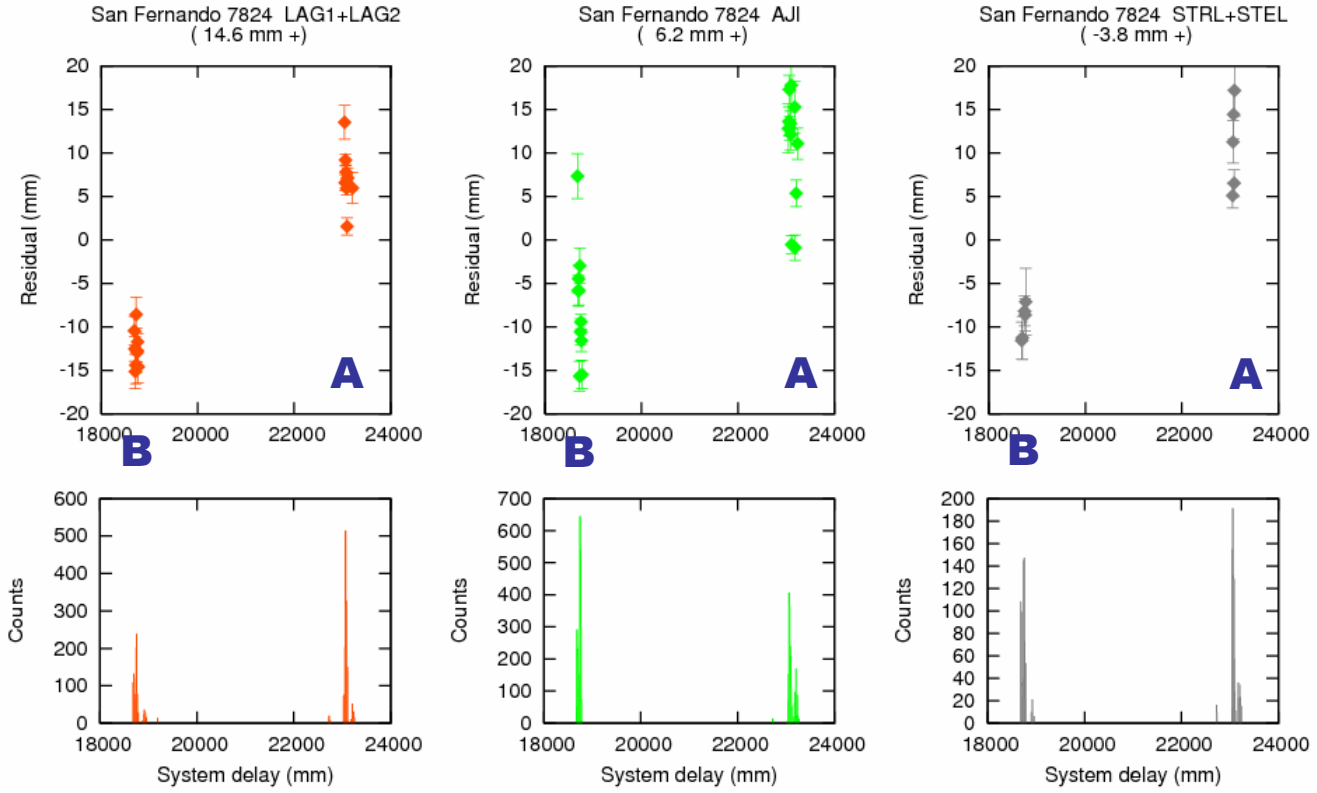


Cal-dependent Bias: Ultra-stable Mt Stromlo

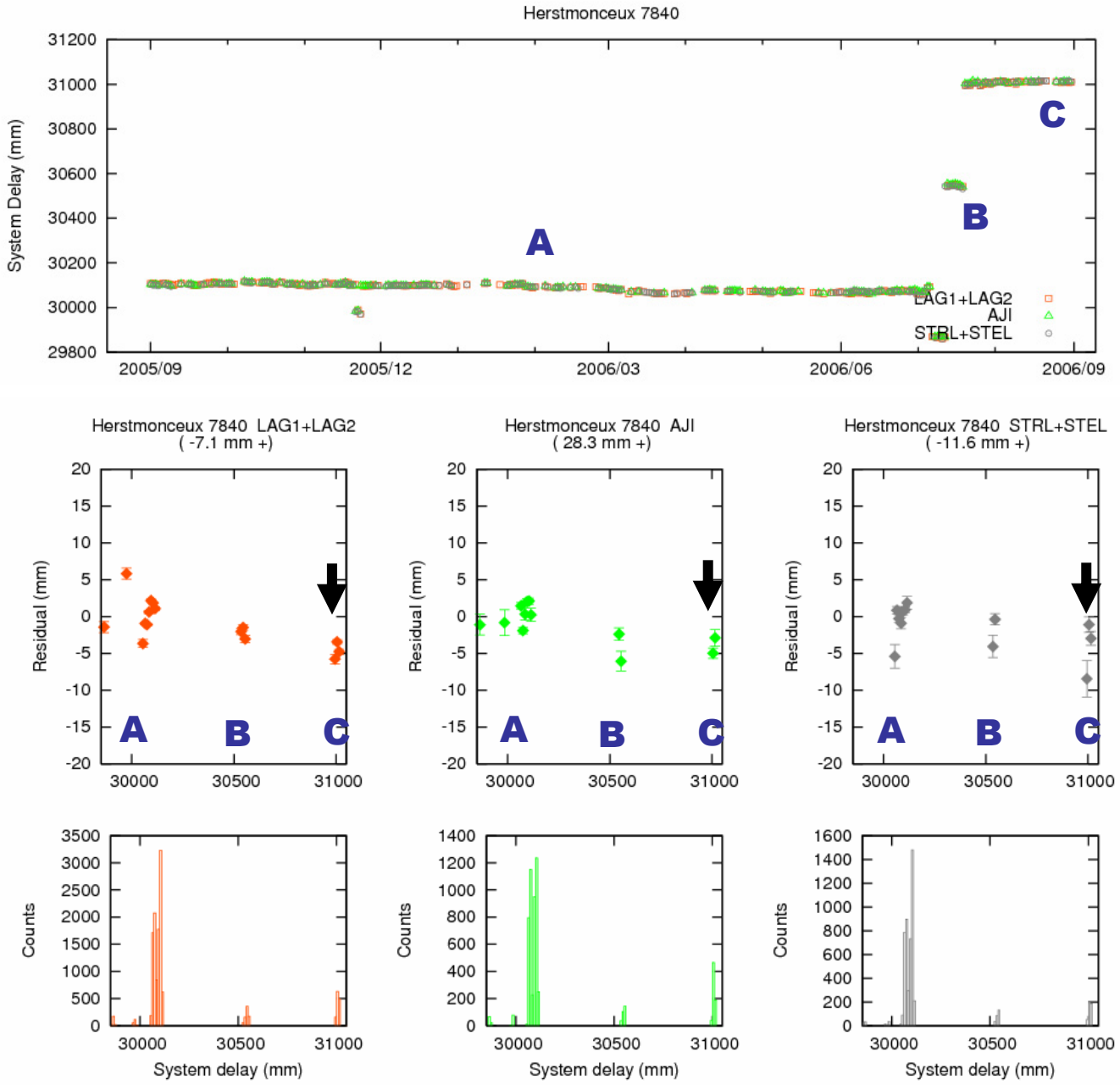


Cal-dependent Bias: 2-cm jump at San Fernando

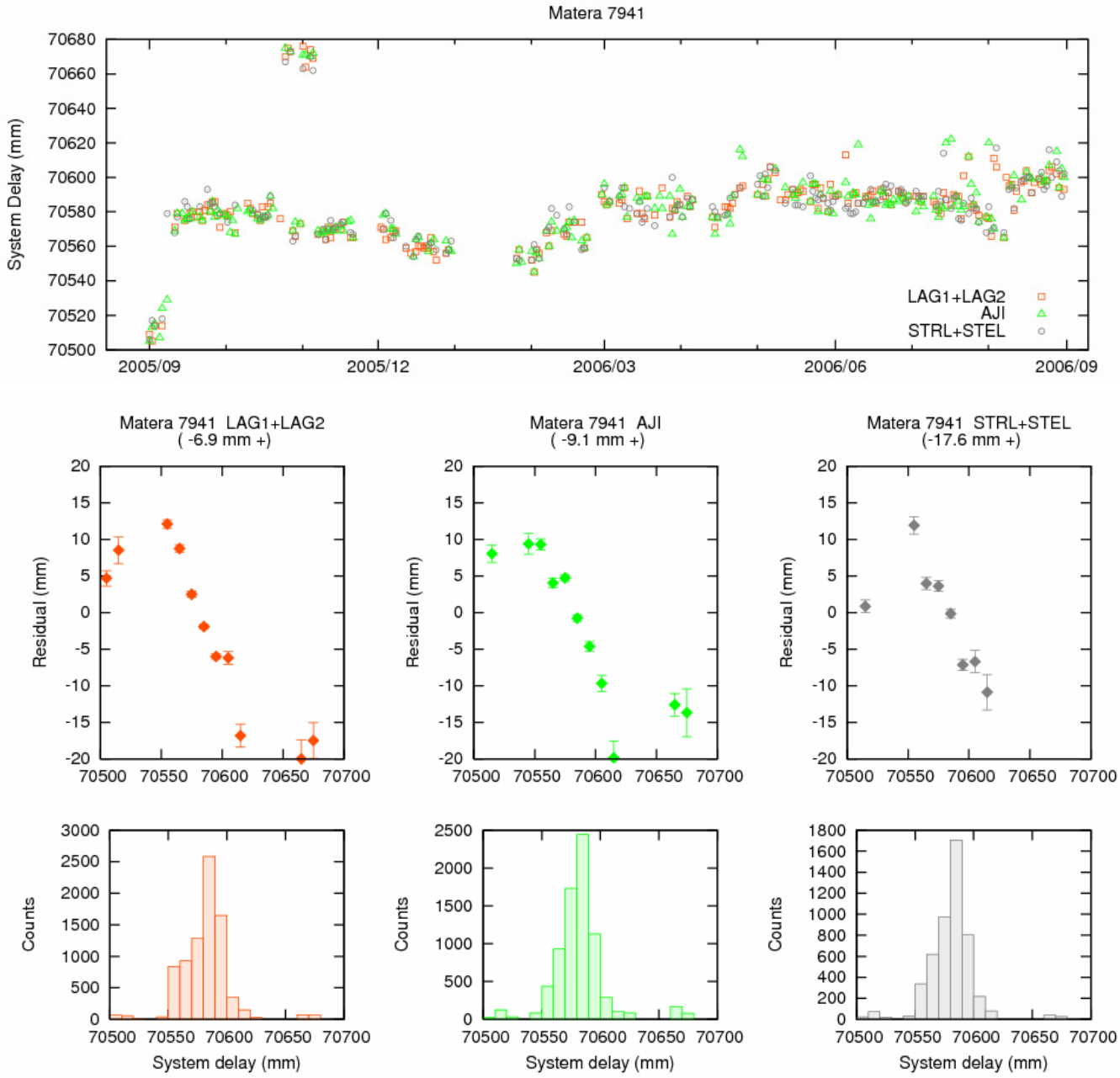




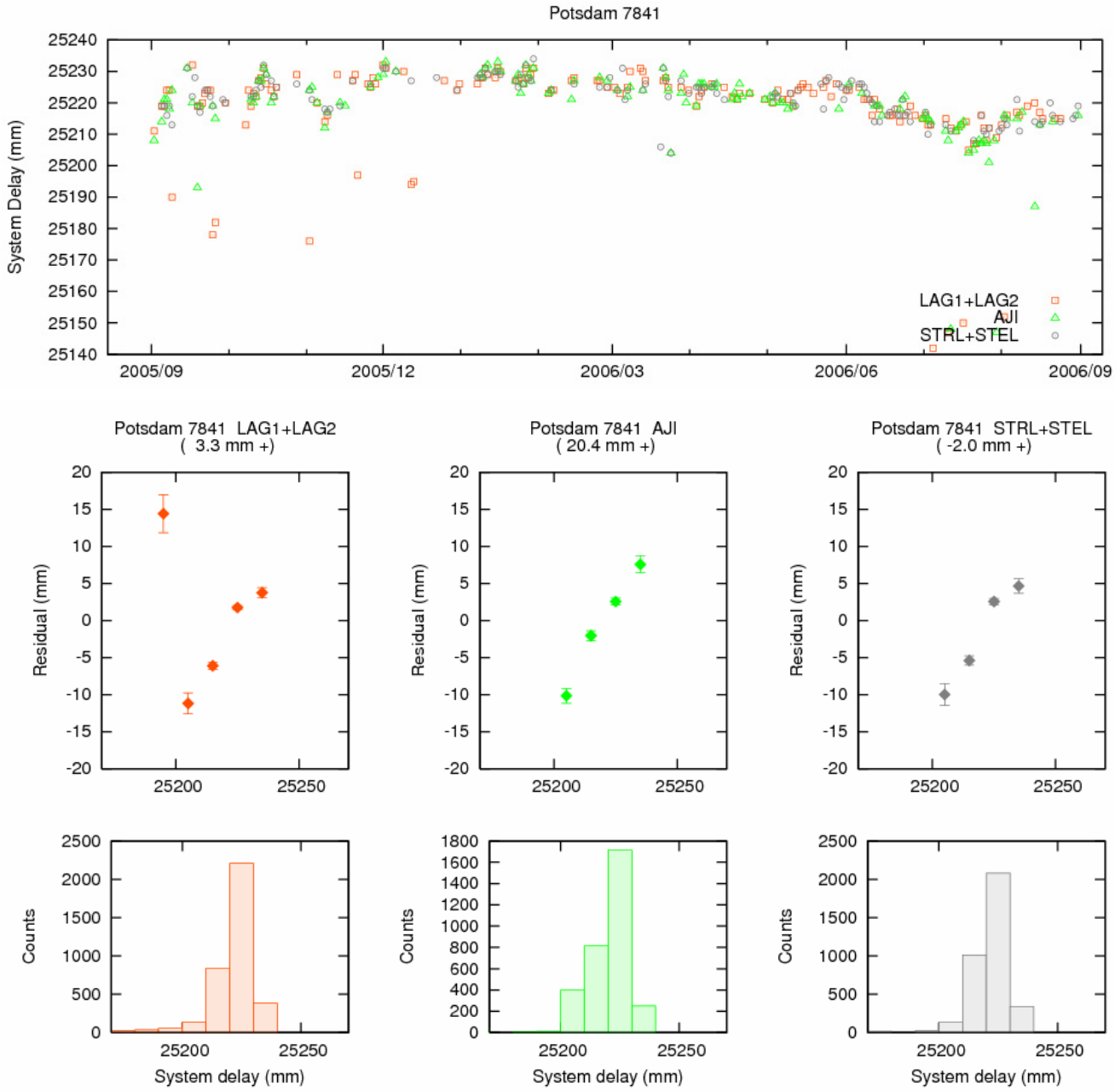
Cal-dependent Bias: Even 3 or 5-mm jump at Herstmonceux



Cal-dependent Bias: Matera: negative trend



Cal-dependent Bias: Potsdam: positive trend (??)



Conclusions

Visit the POSTER for all the results!

1-mm accuracy?

… Still lots of things to do!

Find the “truth” at home.

- Intensity-dependence: likely to be underestimated.
- Cal-dependence: possible correlation with seasonal loading effects.

Each effort at each station counts.

- “High-Low” Test for satellite ranging and terrestrial ranging.
- System change: Really getting more accurate?

SLR *Extreme*

Sep 05 to Aug 06

Longest range:	**McDonald** → AP-15 2006/04/10 06:34	**2.658684 sec**
Longest range (sat):	**Yarragadee** → GIOVE-A 2006/08/23 16:58	**182.049 ms**
Shortest range:	**Zimmerwald** → CHAMP 2006/03/18 16:37	**2.324 ms**
Highest temp. (?):	Wuhan → BE-C 2005/09/11 21:01	323.4 K = 50.3 degC (?)
Highest temp.:	**Riyadh** → STRL 2006/06/26 11:41	**316.7 K = 43.6 degC**
Lowest temp.:	**Changchun** → AJI 2006/01/16 20:22	**242.1 K = –31.0 degC**
Highest pres.:	**Katsively** → AJI 2006/07/10 19:54	**1050.0 hPa**
Lowest pres.:	**Maidanak** → ERS-2 2006/01/17 18:02	**724.0 hPa**
Max returns/bin:	**Graz** → LAGEOS-1 2006/04/04 19:55	**89130 returns**