How to measure more than 110 satellites ☹

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Content

- Which satellites are measured in Graz
- Purpose of tracking additional satellites
- Some preliminary results

Which satellites are measured in Graz?

- 39 ‚ILRS‘ satellites: LAGEOS, LARES & Co….

- 20 Glonass satellites added some years ago:
  - To test / optimize / maximize tracking of larger number of HEOs

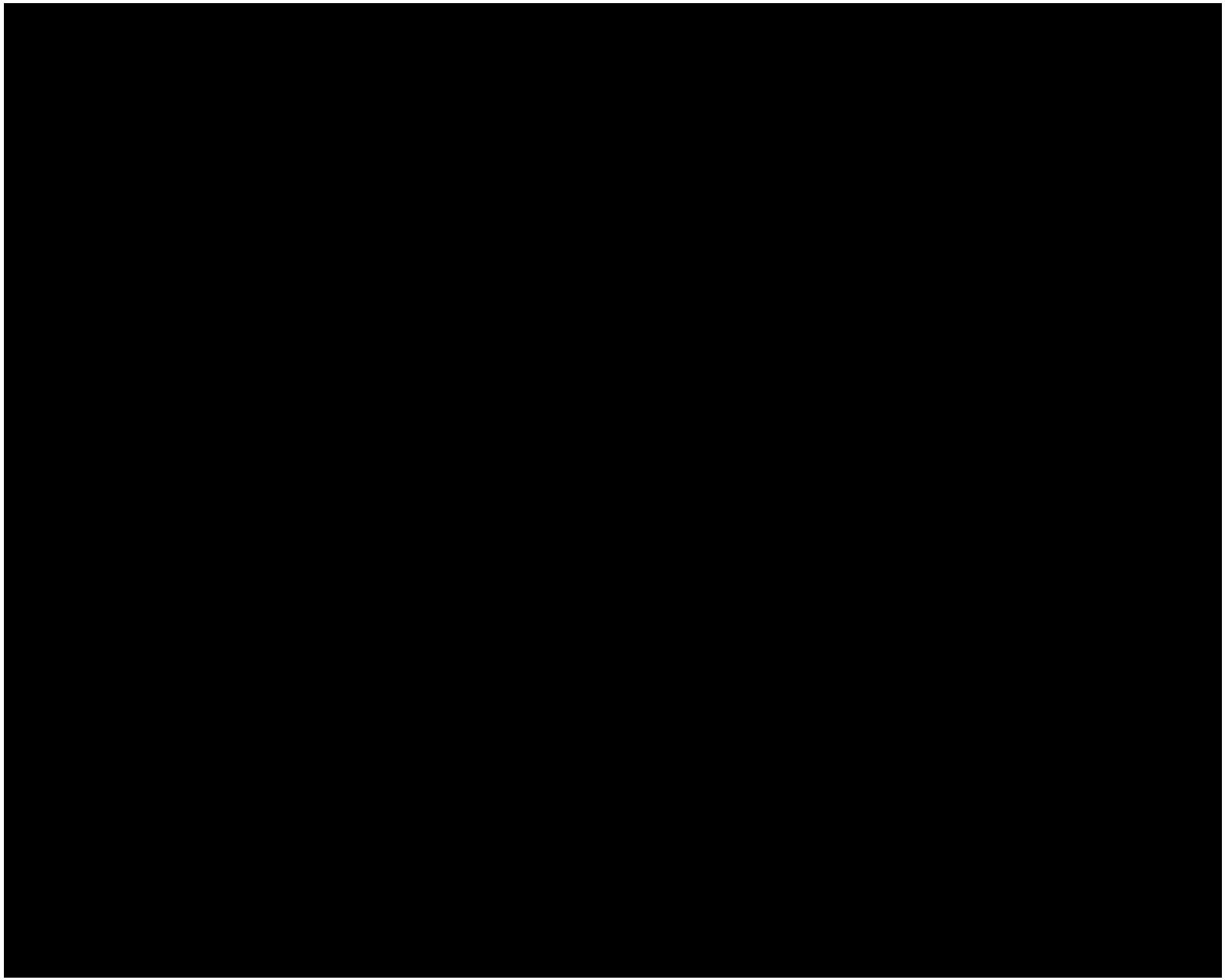
-10 Defunct / past ILRS satellites added 06/2014:
  - Main purpose: To determine spin / tumbling / attitude

- 45 defunct Glonass satellites added 09/2014:
  - Determine spin / tumbling / attitude

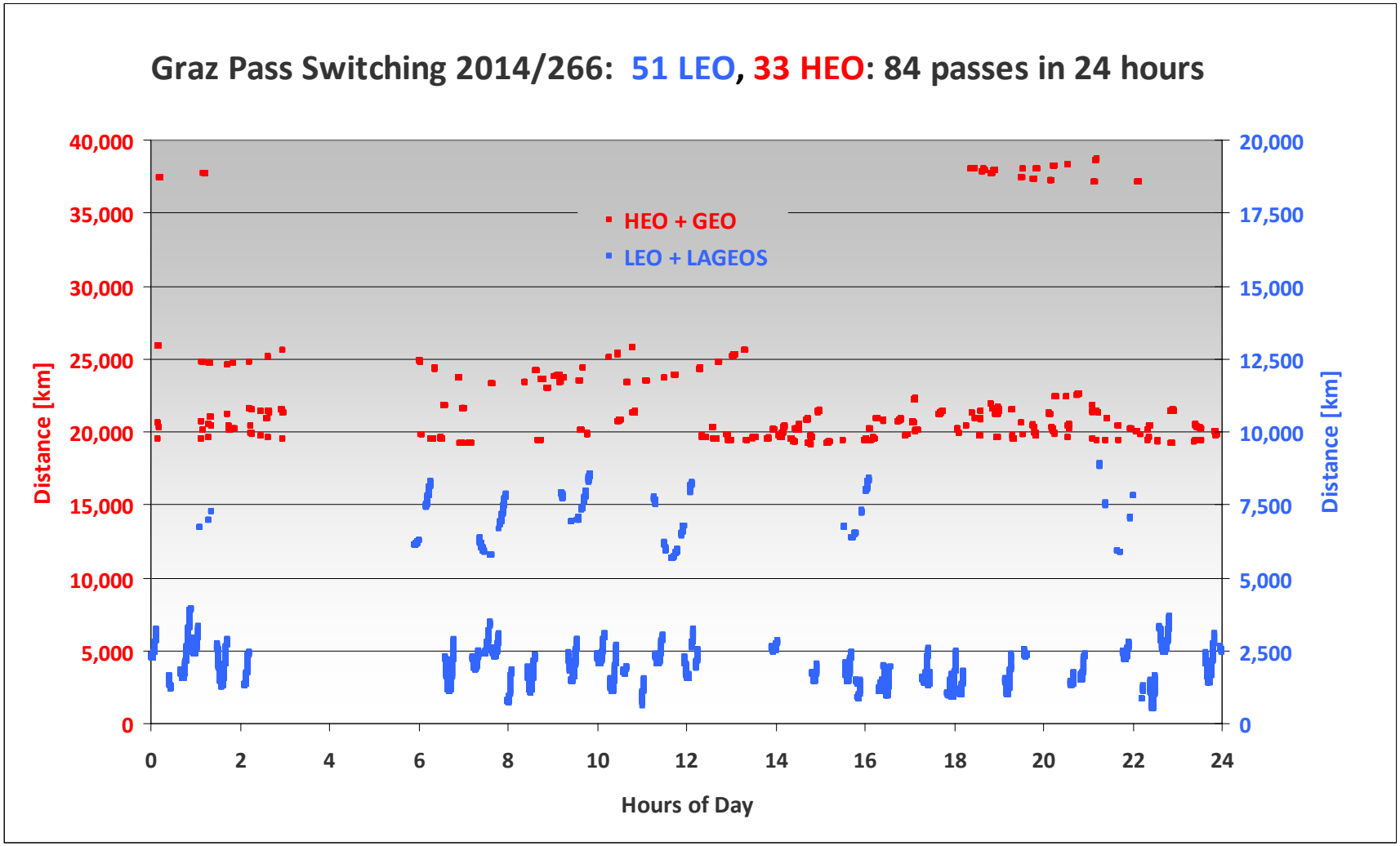
Total: 114 satellites; how to track them all:

YOU HAVE TO BE FAST ☺ ☺ ☺

Observatory Lustbühel, Graz: SLR in action ☺



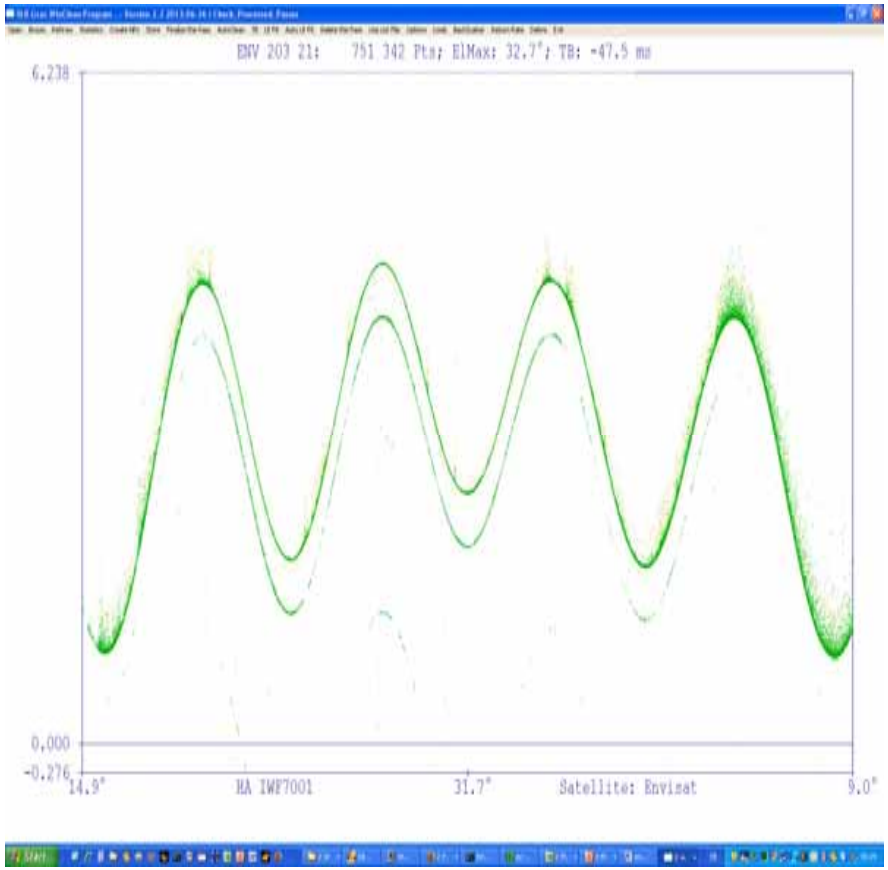
Fast pass switching in Graz, using 2 kHz, 1000 pts/NP

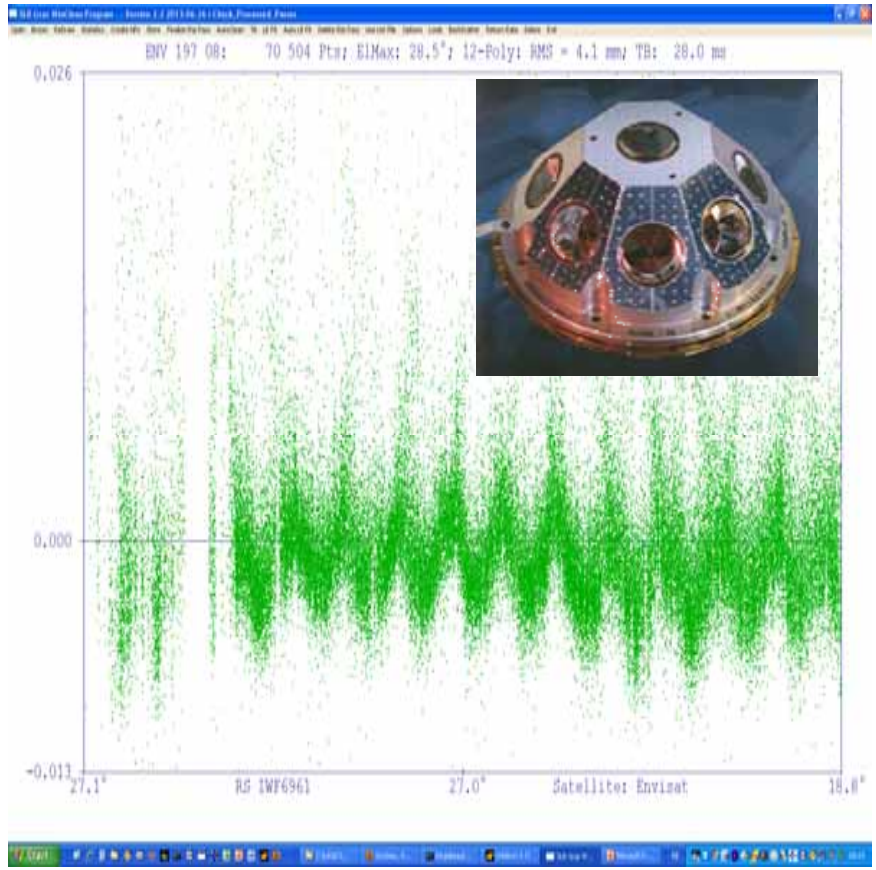


With kHz, 1000 pts/NP, and fast pass switching, you can track > 100 satellites;
this example period: Still without the 45 defunct Glonass (added later);
Gap at early morning: Not enough money to finance observers for the full night ☹

Determine tumbling of defunct LEO satellites

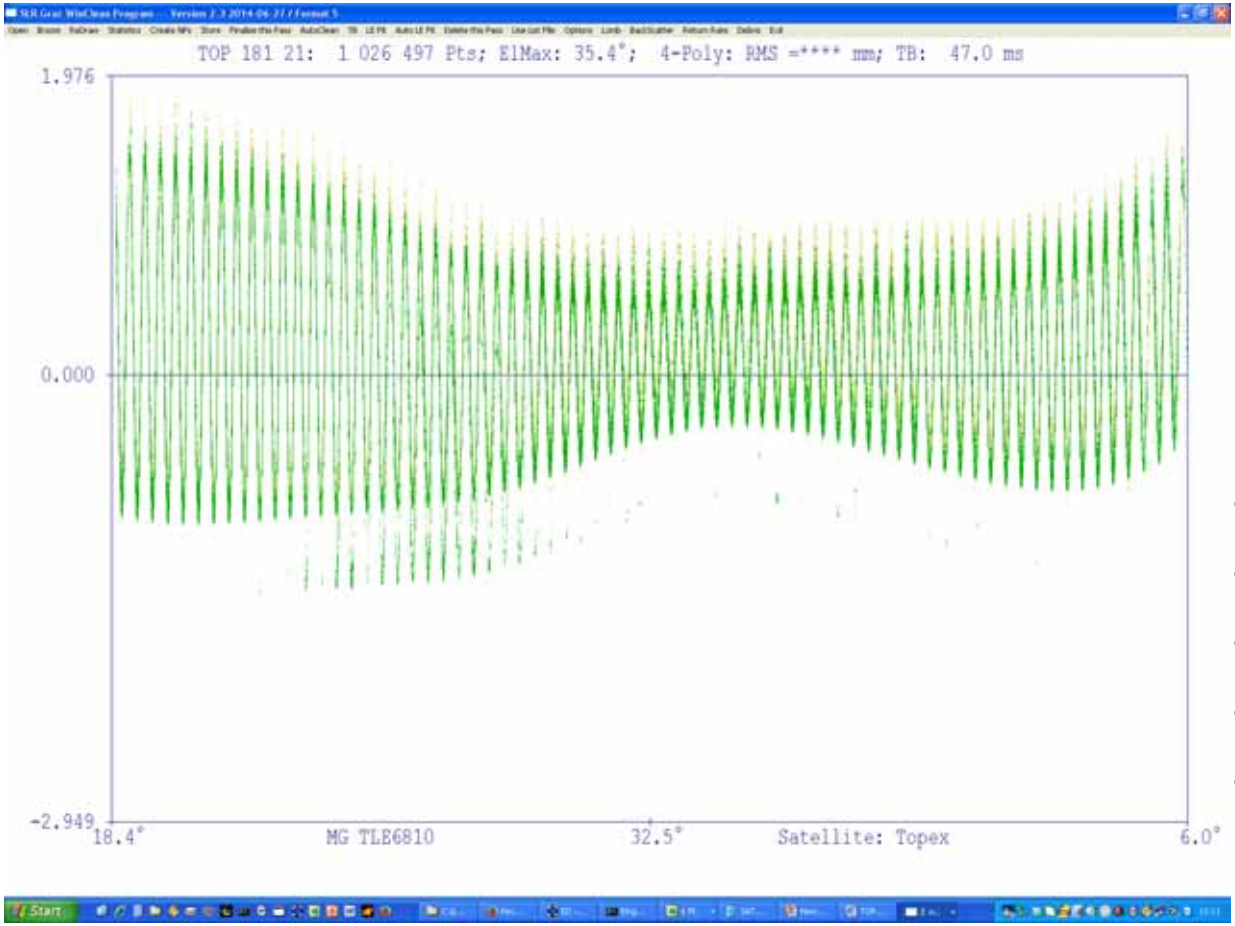
- In 2012, we restarted tracking of the defunct Envisat, together with other ILRS stations
- With SLR, precise spin parameter were determined: ENV spins with 1 revolution in ≈ 140 s
- This is almost 10 times faster then predicted from theories, and might be prohibitive for eventually planned de-orbiting missions (8 tons rotating relatively fast ☹)

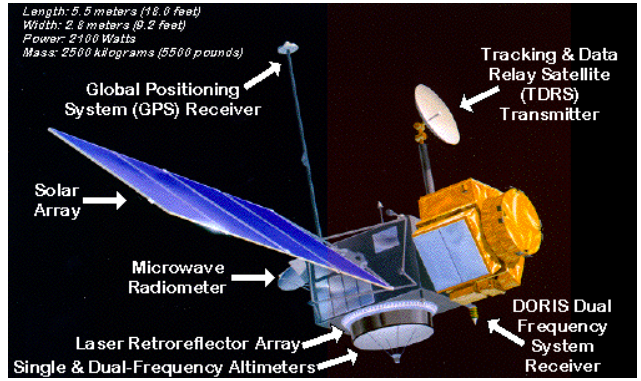




Determine tumbling of defunct LEO satellites

- Example: SLR tracking of TOPEX was stopped end of 2005
- In summer 2014, we re-started tracking of the decommisioned TOPEX
- The satellite has started to rotate; the spin period now is ≈ 12 seconds

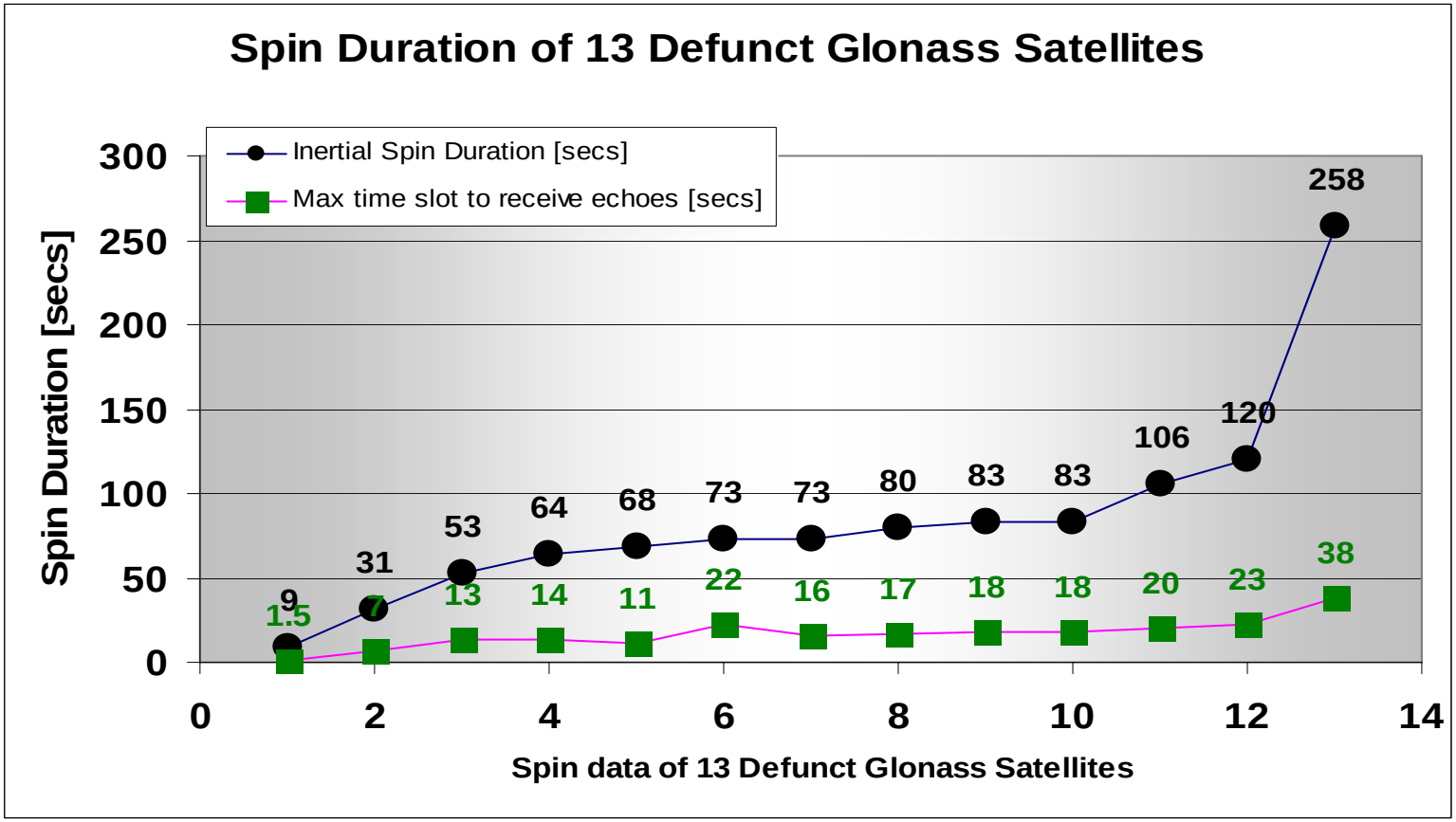




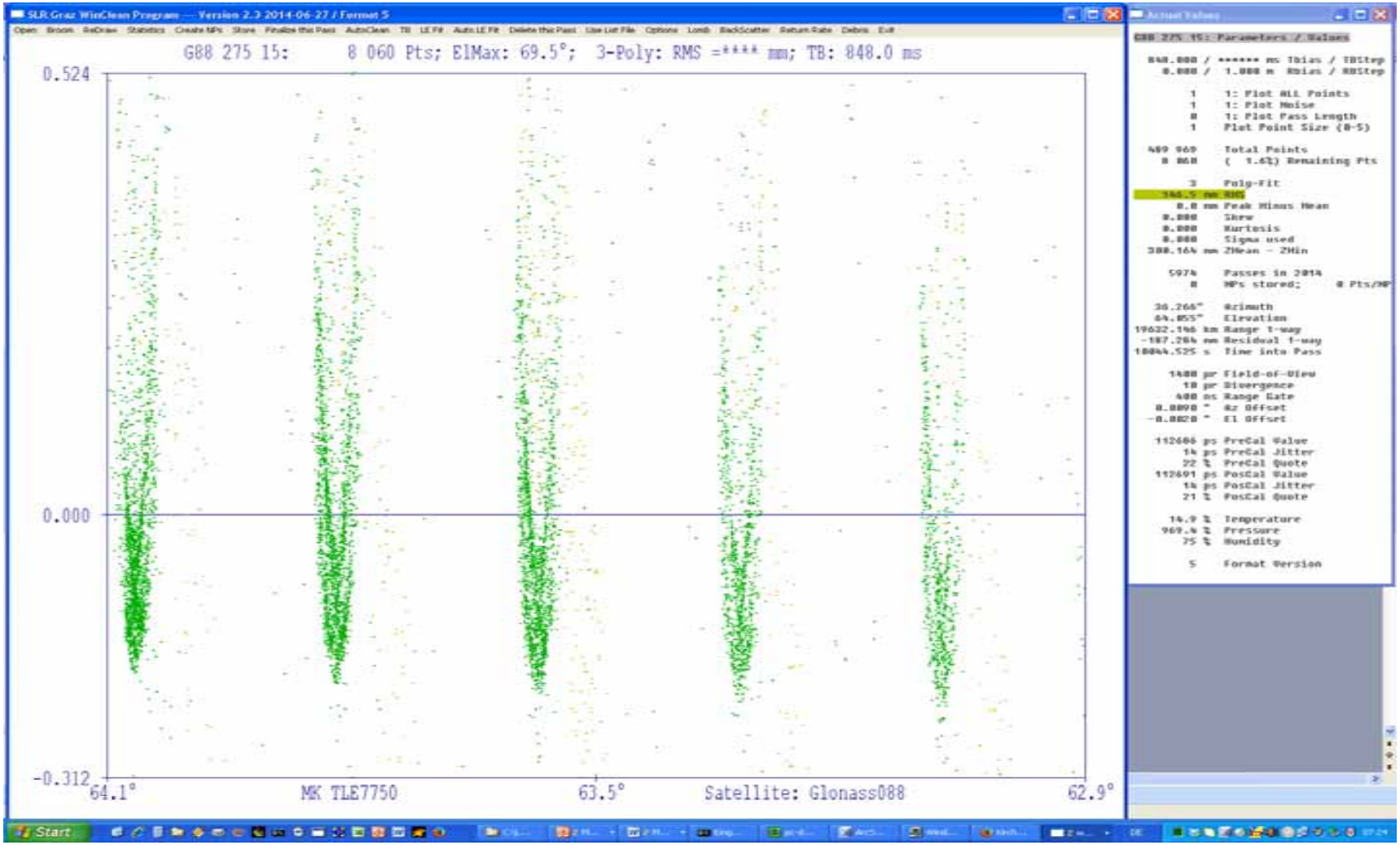
- Topex Pass: > 1 million returns
- Max elevation here: 35.4°
- Rotating fast: 11.81 s/rev
- Retros always accessible
- Max oscillations: 2.5 m

Determine tumbling of defunct Glonass satellites

- 45 defunct Glonass satellites are ‚available' up there ☺
- In 09/2014, we started to track those old satellites again (spin / attitude determination)
- Some of them ‚show us' their retros, some do not (floating upside down? We will check …)
- Within few nights, 13 tumbling defunct Glonasses have been tracked / identified



Determine tumbling of defunct Glonass satellites



- Example: Glonass 88: Spin duration: 53 secs, retros visible for 13 secs ….
- The (up to now …) fastest tumbling Glonass needs only 9 secs for one revolution

Thank you !

http://www.youtube.com/watch?v=5o6OtPJKRJ8
Video of Graz SLR station ranging to ILRS satellites