VIENNA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF GEODESY AND GEOINFORMATION

UNIVERSITY of TASMANIA

OBSERVING GNSS SATELLITES WITH VLBI ON THE BASELINE HOBART-CEDUNA

FROM SCHEDULING TO ANALYSIS

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AuScope

FWF Der Wissenschaftsfonds.

Erwin Schrödinger Fellowship J 3699-N29
Project SORTS – I 2204

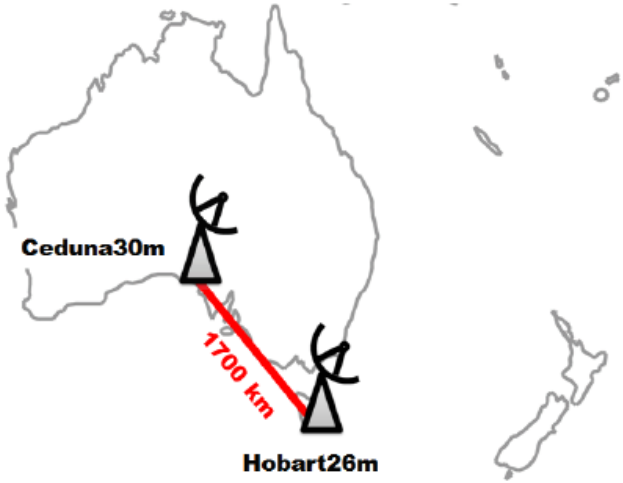
OUR TESTS IN 2015/16

experiment code	date	time (UT)	targets GPS	targets GLONASS	comments
-	June 15	-	✓	✓	tracking tests
179a	28.6.15	18-20	✓	✓	16 satellites, change frequency for each satellite
236a	24.8.15	12-16	✓		fixed frequencies, dual polarisation
238a	26.8.15	12-16	✓	✓	fixed frequencies, dual polarisation
126b	5.5.16	17-23	✓		DBBC in Ho; no Mark4 data
131a	10.5.16	17-23	✓		redundant recording (DBBC + Mark4) in Ho
132a	11.5.16	17-23	✓		not observed due to high winds

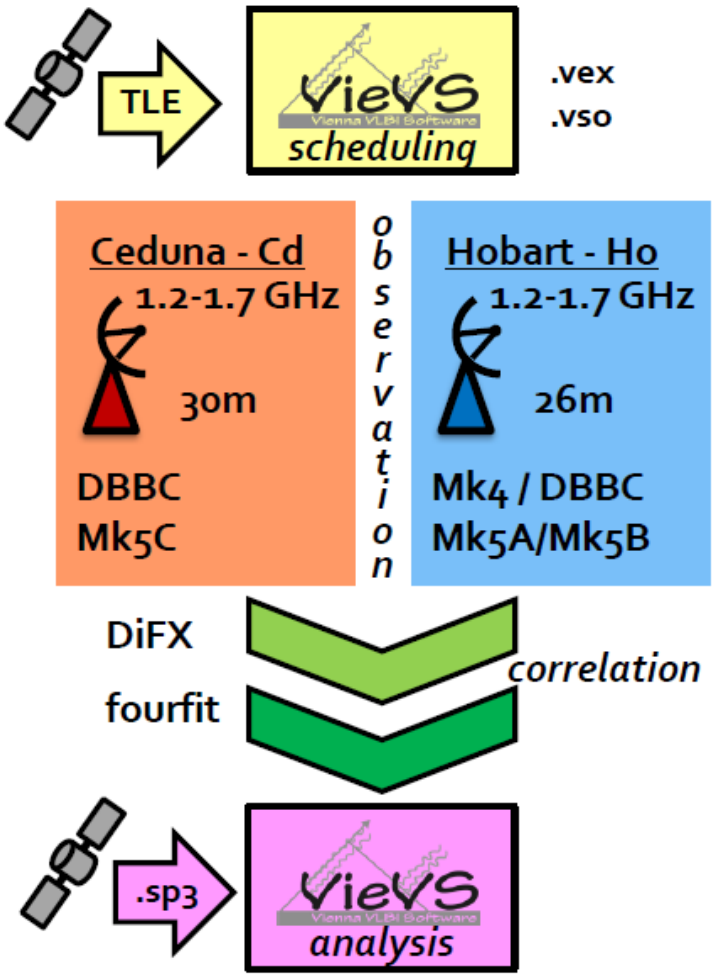
- Single-baseline (Ho-Cd)
- L-band
- Tracking of GPS & GLONASS

Aim:

„enable and streamline the process from scheduling to analysis“



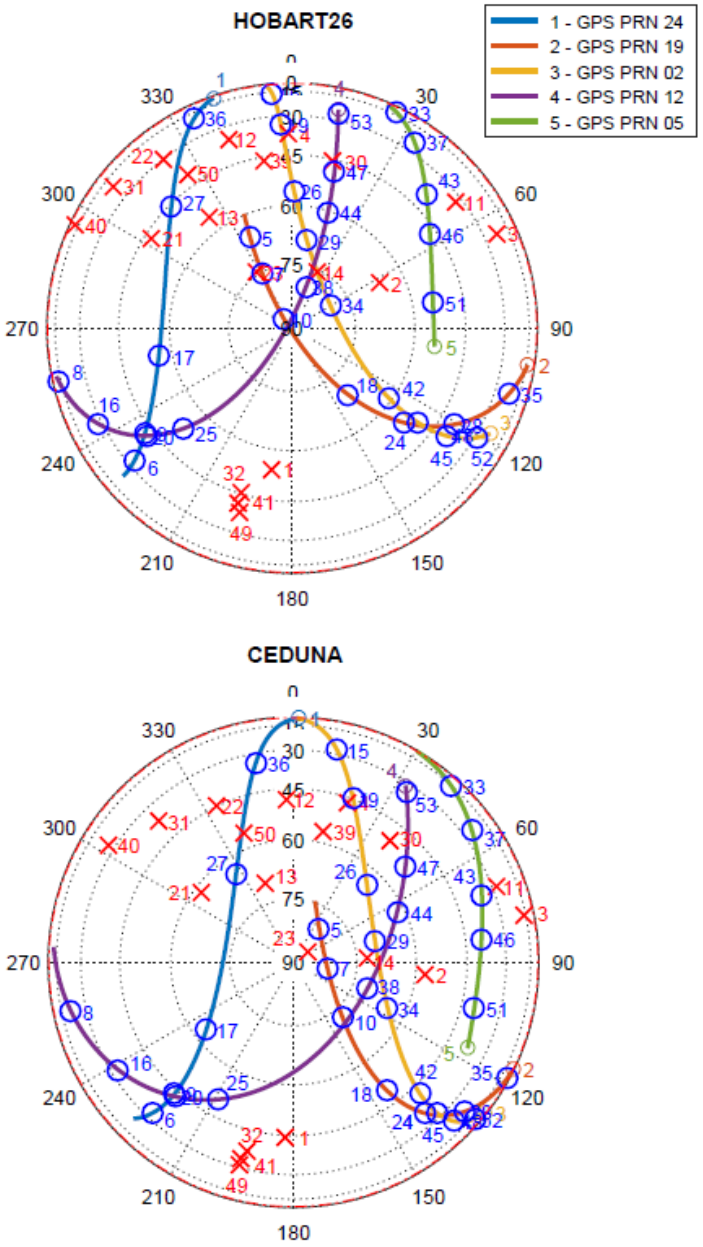
OVERVIEW



- Starting and finishing with VieVS, we have developed a complete process chain.
- Wherever possible, we use standard procedures.

SCHEDULING

- VieVS (as explained by Andreas)
- Station dependent **vex** file
- **Combined vex** file for correlation
- **vso-format** for the calculation of the a priori model in VieVS

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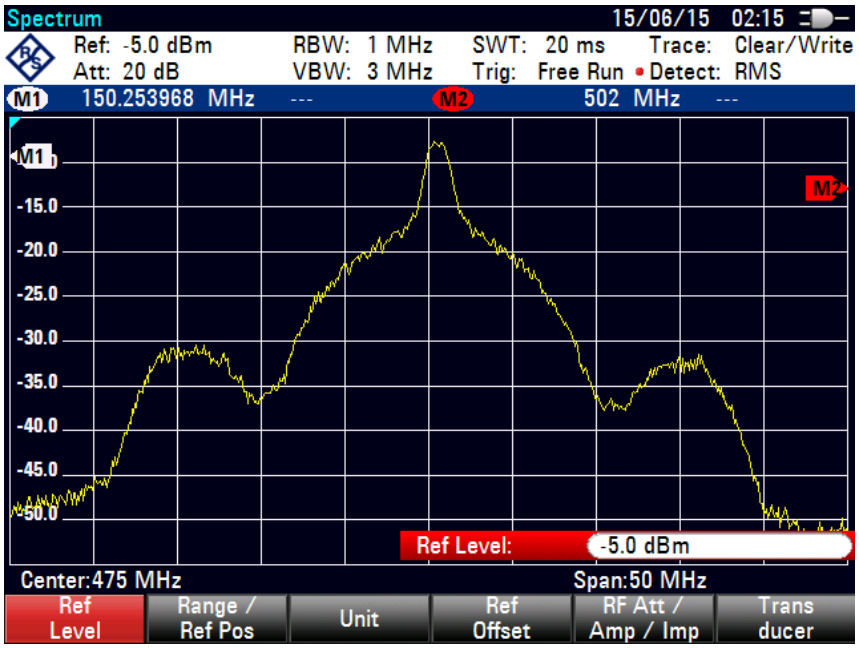
2016 05 10 17 24 27.000000000000 CEDUNA HOBART26    PG24      sc
2016 05 10 17 24 37.000000000000 CEDUNA HOBART26    PG24      sc
2016 05 10 17 24 47.000000000000 CEDUNA HOBART26    PG24      sc
2016 05 10 17 24 57.000000000000 CEDUNA HOBART26    PG24      sc
2016 05 10 17 25  7.000000000000 CEDUNA HOBART26    PG24      sc
2016 05 10 17 25 17.000000000000 CEDUNA HOBART26    PG24      sc
2016 05 10 17 25 27.000000000000 CEDUNA HOBART26    PG24      sc
2016 05 10 17 25 37.000000000000 CEDUNA HOBART26    PG24      sc
2016 05 10 17 25 47.000000000000 CEDUNA HOBART26    PG24      sc
2016 05 10 17 25 57.000000000000 CEDUNA HOBART26    PG24      sc
```

vso – format as input for VieVS

OBSERVATION

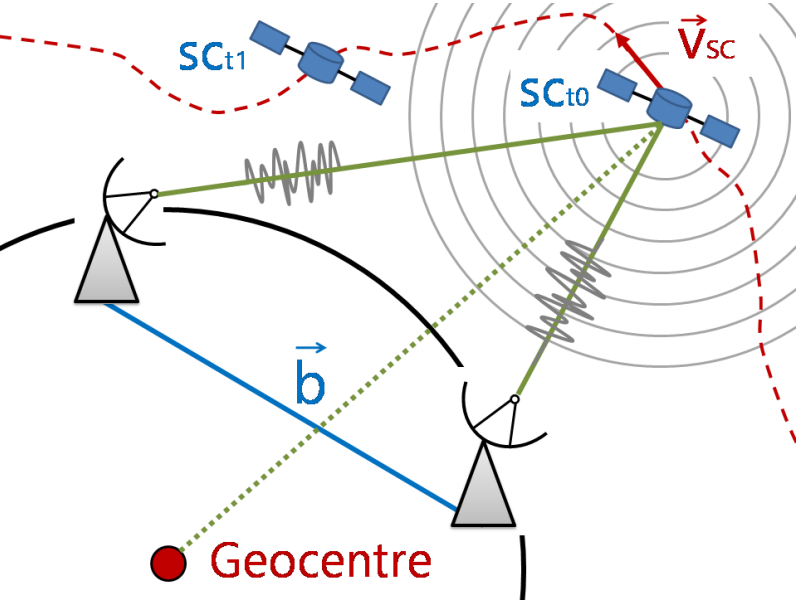
- Mode: 8 IF channels, 16 MHz bandwidth, 2 bit sampling, dual-polarisation
  - 2 channels L1 and L2 each
  - 4 channels for quasar group delay
- 10-sec step wise tracking using the NASA field system
  - continuous recording
  - disable ‚preob‘
- 1 TB data per station over 6-h session



Live L1 GPS signal (spectrum analyser) during 179a.

CORRELATION

- DiFX software correlator (trunk version v7326)
- Combined vex-file
- The a priori model (IM-files) was replaced with the VieVS-model



- Clock model adjusted using quasar scans
- Visibilities in FITS files
- Conversion to Mk4 databases

FRINGE FITTING

details by Jamie

- Tests and high-frequency analysis in AIPS
- Total delays (in the geodetic sense) created with fourfit, using single-band mode
- Total delays at full integer seconds, time reference is signal reception at station 1
  - Four polarisation products, two bands
  - Combination of polarisations and bands pending
  - Group delay solution for quasars failed so far due to non-detections in two bands

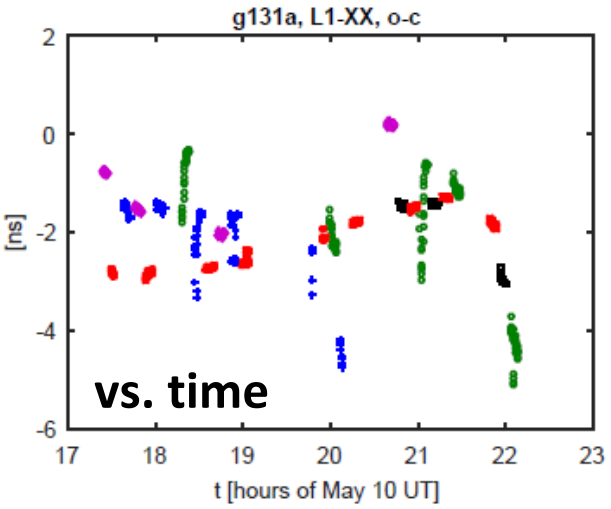
RESIDUAL DELAYS (L1, XX-POLARISATION)

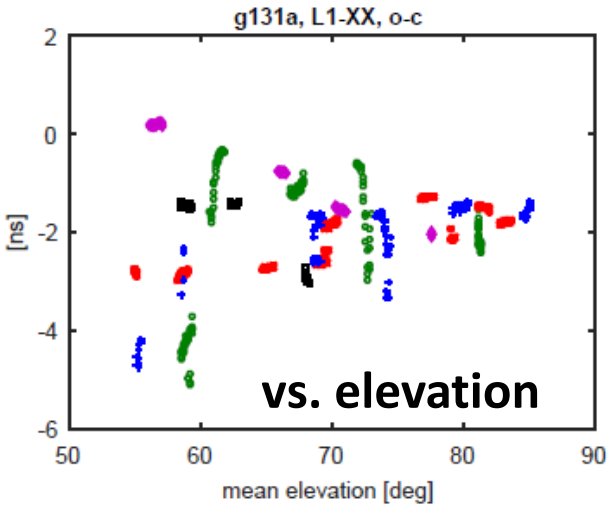
- For 126b and 131a we find residuals (observed minus computed) within 8 ns or ~2.5 m for the observed four or five satellites over the entire session of 2.5 to 6 hours.
  - Applying ionosphere correction (TEC-maps) these residuals drop to 4 ns or ~ 1.2 m.

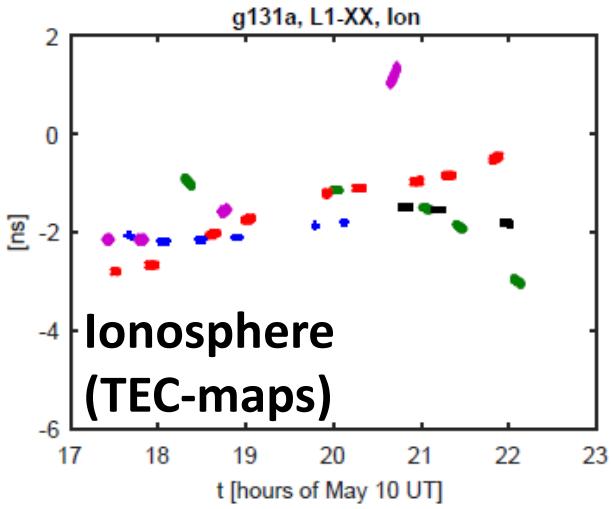
- The residuals within a 5 minute scan are typically a few tens of picoseconds or 1 to 5 cm.

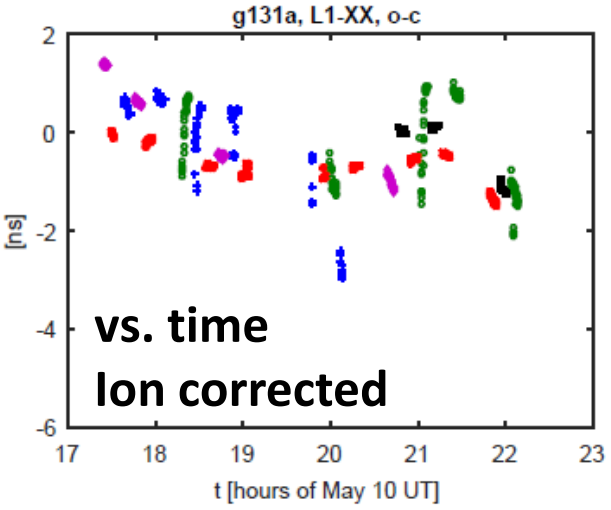
- Some scans show considerable variation or rapid change in the residuals, which we believe is a result of the unresolved issues with gain and polarisation (more details by Jamie).

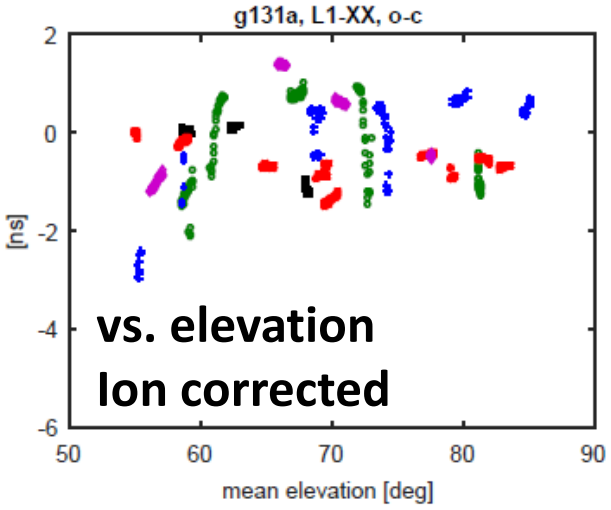
RESIDUALS / IONOSPHERE

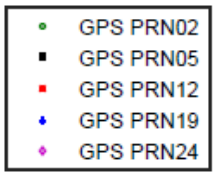






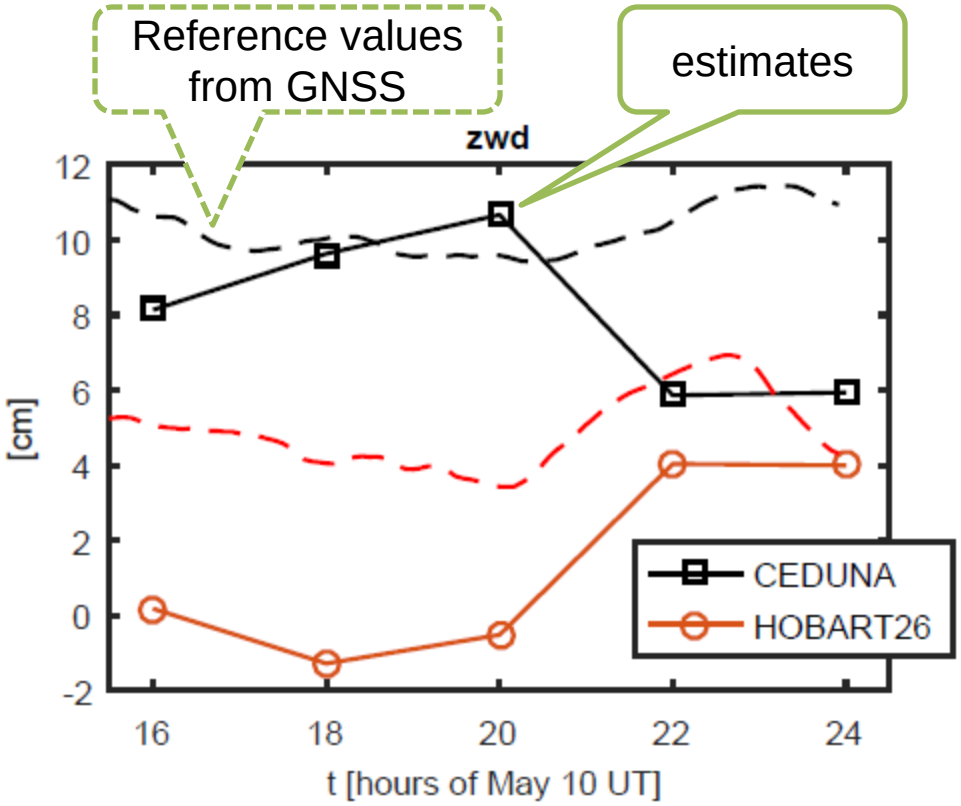






ANALYSIS

- VieVS
- Standard geodetic estimation (clock, station coordinates, troposphere)
  - For single baseline: stations fixed
- Combined analysis of satellite and quasar observations is also possible



Estimated zenith wet delays (zwd) during 131a.

- Post-fit residuals (after estimation) at the level of 10-20 cm

SUMMARY & OUTLOOK

We have developed a closed process chain for VLBI satellite observations, from scheduling to analysis.

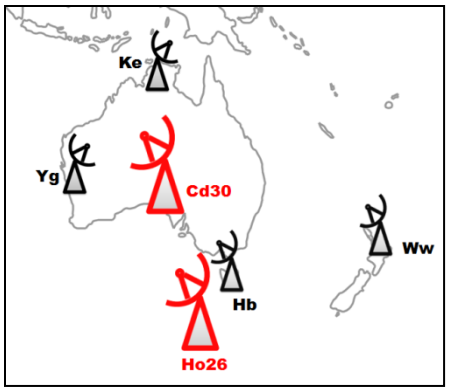
There are still some major issues with the tracking of the circularly polarised signal.

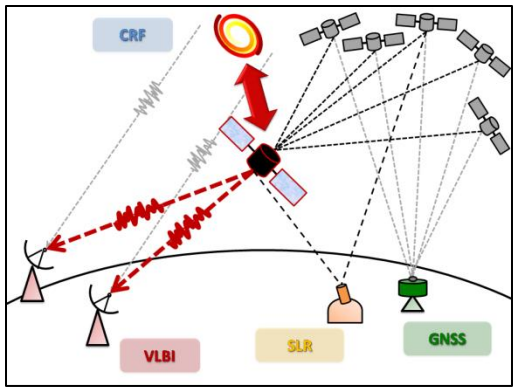
Next steps:

- improve recording (8-bit mode, fix AGC in DBBC)
- third station
- group delay for quasar solution
- more tests (24 h session, new targets, …)

THANK YOU FOR YOUR ATTENTION!

Contact: lucia.plank@utas.edu.au





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