

AUA047: Students at TU Wien organize their own VLBI Session

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Introduction

At TU Wien students got an insight in VLBI by participating in the lecture „Space Geodetic Techniques“ over one semester. The students had the task to carry out the VLBI experiment AUA047. More than 30 students took part in this course and worked independently in groups of four people to perform all necessary steps. Each group defined their own scientific goal, created schedules using **VieSched++**, simulated and analysed the schedules using **VieVS**.

The schedule from one group was selected and based on their result the AUA047 VLBI session was observed on Tuesday, 4th of December 2018 with the Australian telescopes Hobart, Katherine, Yarragadee.



Network

- Australian network
 - HOBART26
 - YARRA12M
 - KATH12M



AUA047 scheduling statistics

| | |
|------------------------|---------|
| #scans | 513 |
| #obs | 1358 |
| #scheduled sources | 66 |
| average observing time | 58.65 % |
| average slew time | 30.11 % |
| average idle time | 1.77 % |

Scheduling

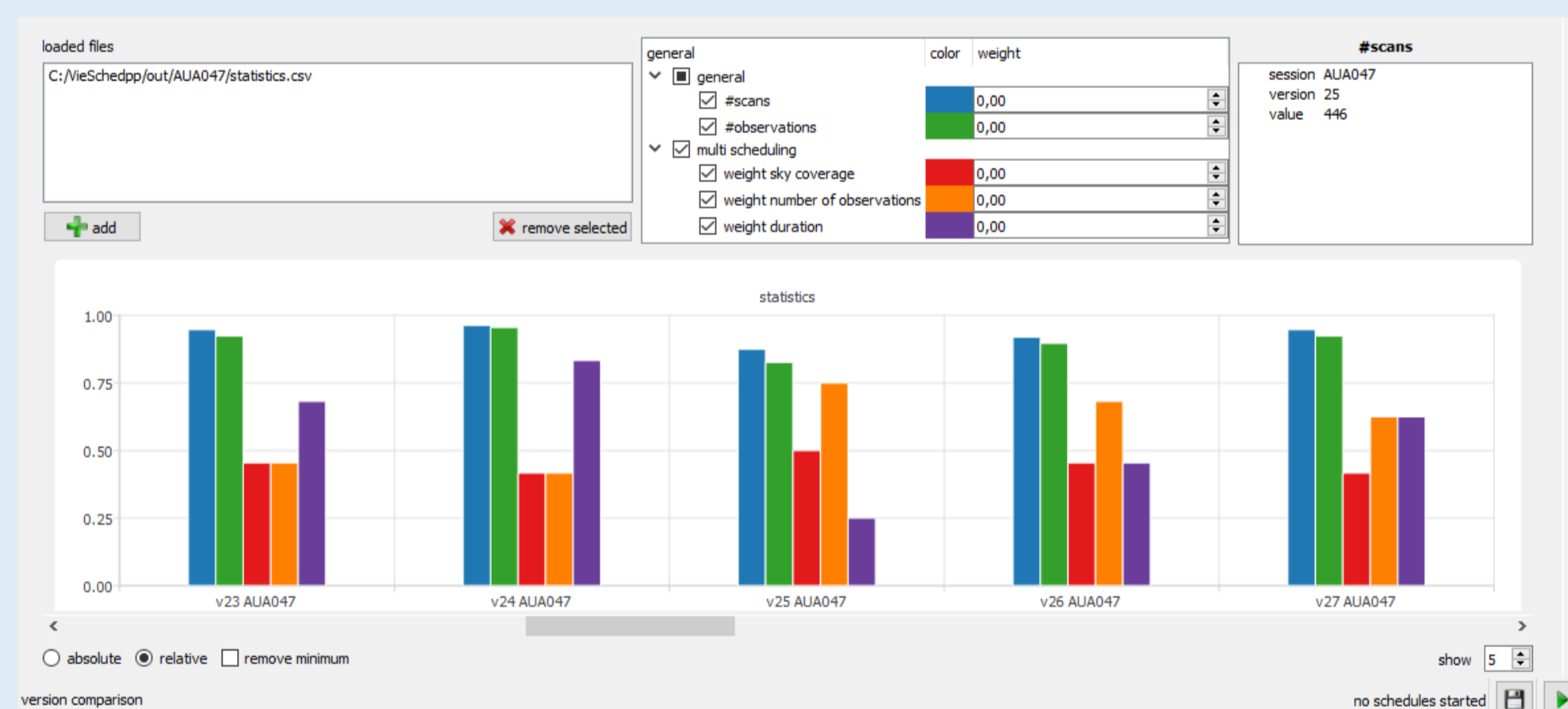
Workflow

- each group defined their own scientific goal like
 - geodesy (station coordinates, EOP)
 - astrometry (source position, imaging)
 - intensive like (dut1)
- based on that scientific goal an optimized schedule was created using the **VieSched++** multi-scheduling tool, varying
 - weights factors
 - sky coverage
 - #observation/scan
 - duration
 - maximum allowed idle time
 - sky coverage parameters
 - minimum number of stations
 - weight of HOBART
 - minimum number of scans per source
- in total, several hundred schedules were created
- each schedule was simulated and analysed using **VieVS**
- best version is picked based on simulated repeatability

sky coverage displayed in VieSched++ Analyzer



multi-scheduling comparison



Simulations

- large-scale Monte-Carlo simulations
 - generated using **VieVS**
 - troposphere: $C_n = 1.8 \cdot 10^{-7} m^{-1/3}$
 - clock: $1 \cdot 10^{-14} s @ 50 min$
 - white noise: 30 ps
 - 100 simulations per schedule
- in total **several tens of thousands of simulations** were generated and analyzed

Correlation

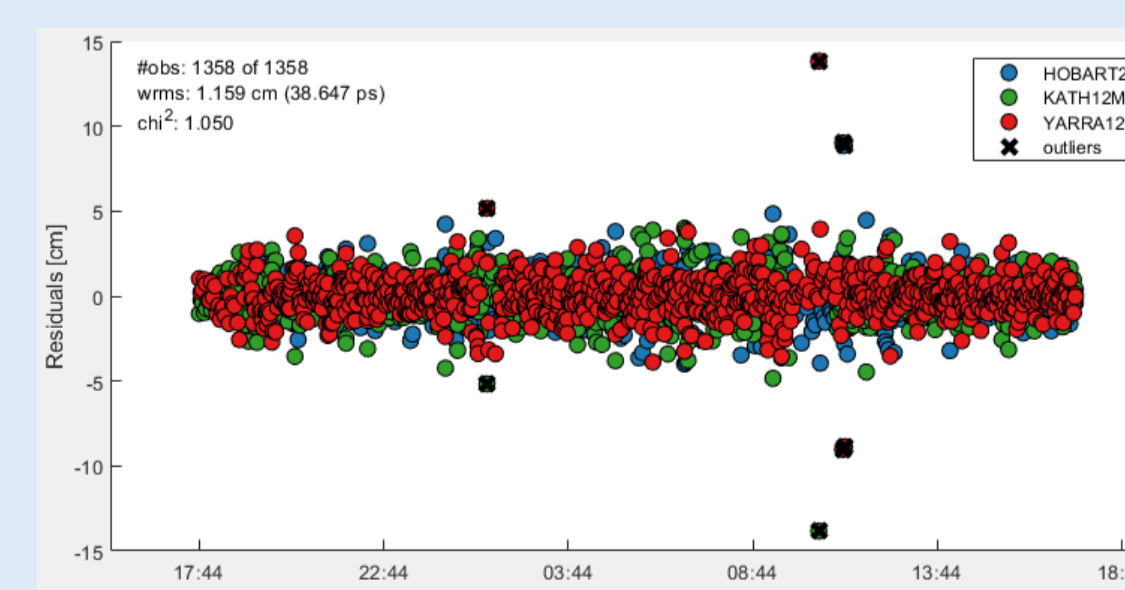
- introduction to correlation of VLBI sessions in DiFX
- presentation of correlation on the Vienna Scientific Cluster (VSC-3)
- exercise to calculate the expected data size, transfer time and the correlation time for AUA047
- exercise to develop a FX and XF style correlator in Matlab and comparison of the processing times

Analysis

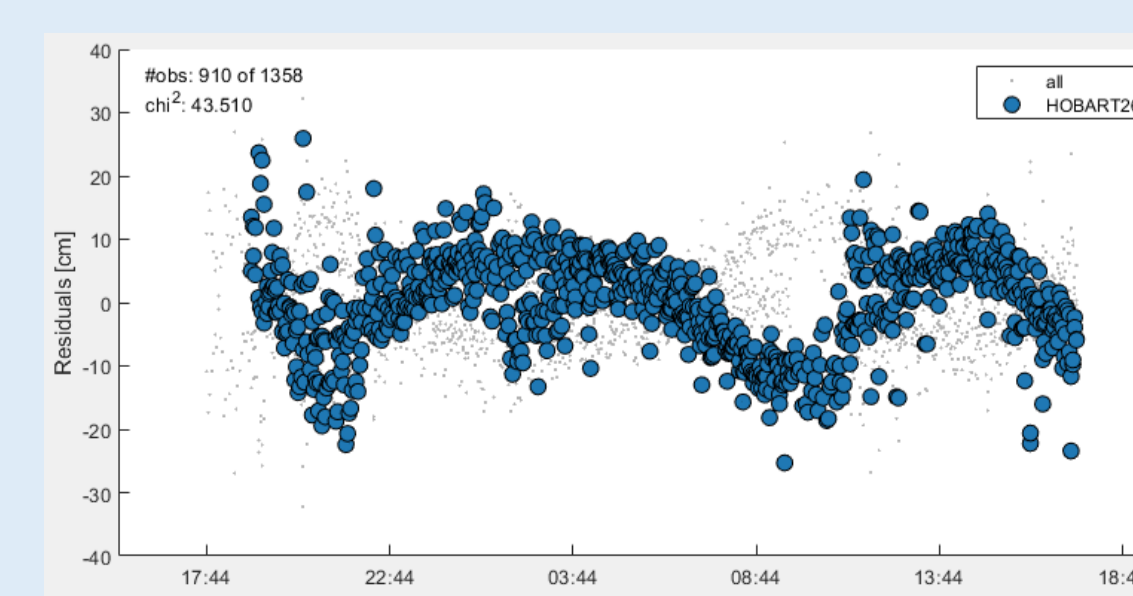
Workflow

- the analysis was done with **VieVS** using vgosDB format
- four clock breaks have been found and removed at station Yarragadee
- outlier detection was performed
- optimising analysis based on scientific goal
 - varying zenith wet delay intervals
 - estimate source positions
 - varying constraints
 - varying mapping functions
- effect of a priori models was investigated
 - solid earth tides
 - tidal atmospheric loading
 - tidal ocean loading
- session fit: 38.6 ps

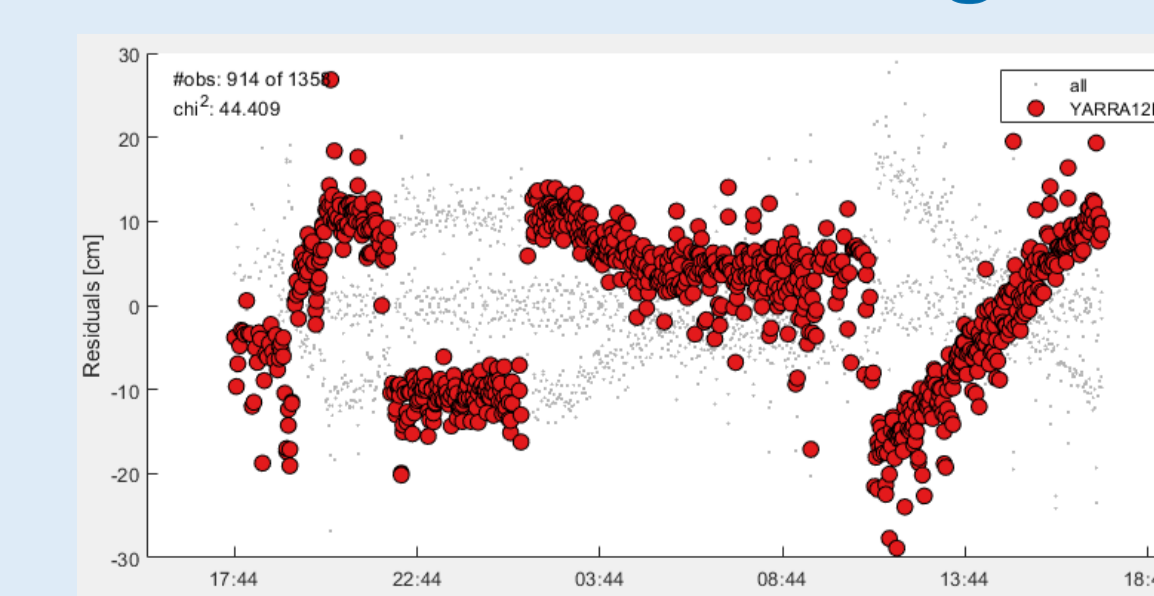
outlier detection in VieVS



effect of solid earth tides



clock breaks at Yarragadee



Conclusion

The official IVS session AUA047 was fully organized by students at TU Wien. All necessary steps, including scheduling, large-scale Monte Carlo simulations, correlation and analysis were done by each group independently. This shows that both software packages, **VieSched++** and **VieVS**, are understandable and easy to use. The students got an insight into VLBI through the practical tasks and exercises. Next to the success in university teaching this course delivered scientific results as any other VLBI session does, like station coordinates and earth orientation parameters.