In-depth analysis of schedules optimized for certain VLBI experiments using VieSched++

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TU WIEN VieSched++ Vienna VLBI and Satellite Software

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Introduction

- **VieSched++** is a new, modern scheduling software written in C++
- implementing many new ideas and features:
  - recursive scan selection (allowing a priori scan selection and fillin-mode a posteriori)
  - automated iterative source selection
  - multi-scheduling approach
  - station-, source- and baseline based parameters
  - sophisticated optimization criteria
- easy to use
  - Graphical User Interface (GUI)
  - installer (Windows 10, Ubuntu 18.04…)
  - many comparisons and statistics tools
  - built-in help
- freely available at https://github.com/TUW-VieVS

How are schedules generated?

- several hundred versions of one schedule are created using **VieSched++** multi-scheduling feature
  - e.g.: by varying weight factors and parameters
- generate and analyze 500 simulations per version using **VieVS**
  - troposphere: $C_n = 1.8 \cdot 10^{-7}\ m^{-1/3}$
  - clock: $1 \cdot 10^{-14}\ s$ @ $50\ min$
  - white noise: $30\ ps$
- best version is selected based on simulated repeatabilities, formal errors, and statistics

Schedules created with VieSched++

- AUA (035, 037, 040, 041, 044, 047)
- INT3 (021, 028, 035, 042, 049, 056, 063, 077, 084)
- AUM (001 - 010)
- EUR (149)
- T2 (129, 130)
- OHG (117)
- EURR&D (09)
- EINT (001 - 012)

Why multi-scheduling?

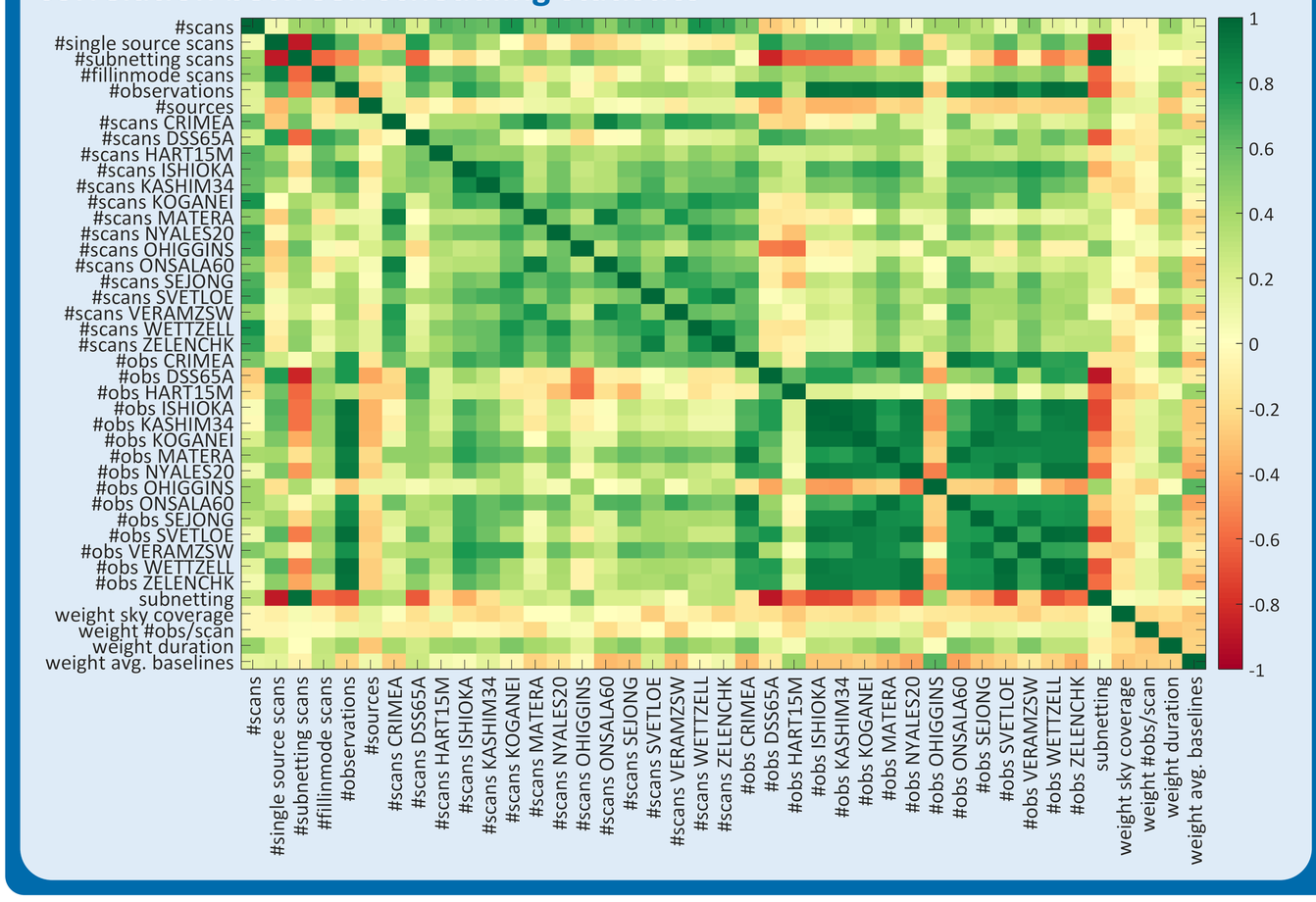
- generated 411 schedules for T2 and 999 for EURD09
  → **705.000 simulations**
- depending on selected parameters the results vary greatly:

		T2129		EURD09	
		min	max	min	max
#scans		841	1302	604	1373
#obs		8867	15670	5983	17646
#obs Oh		180	563		
X-Pol	[µas]	90	147	263	892
Y-Pol	[µas]	71	132	311	1129
3d coord	[mm]	4.5	7.4	1.9	5.1

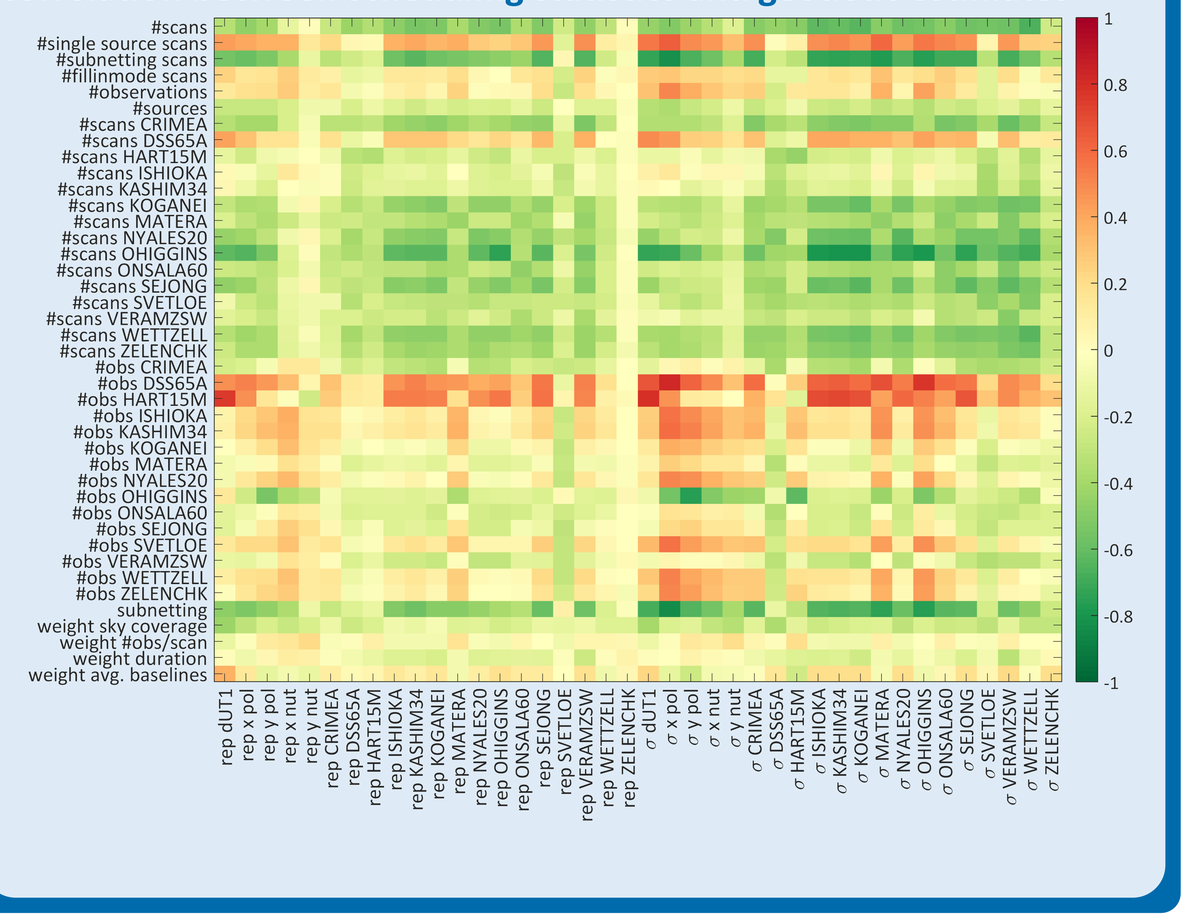
- highest number of observations does not correspond with best geodetic results → simulations are necessary
- this process is highly automated in **VieSched++** and **VieVS**

T2129

correlation between scheduling statistics

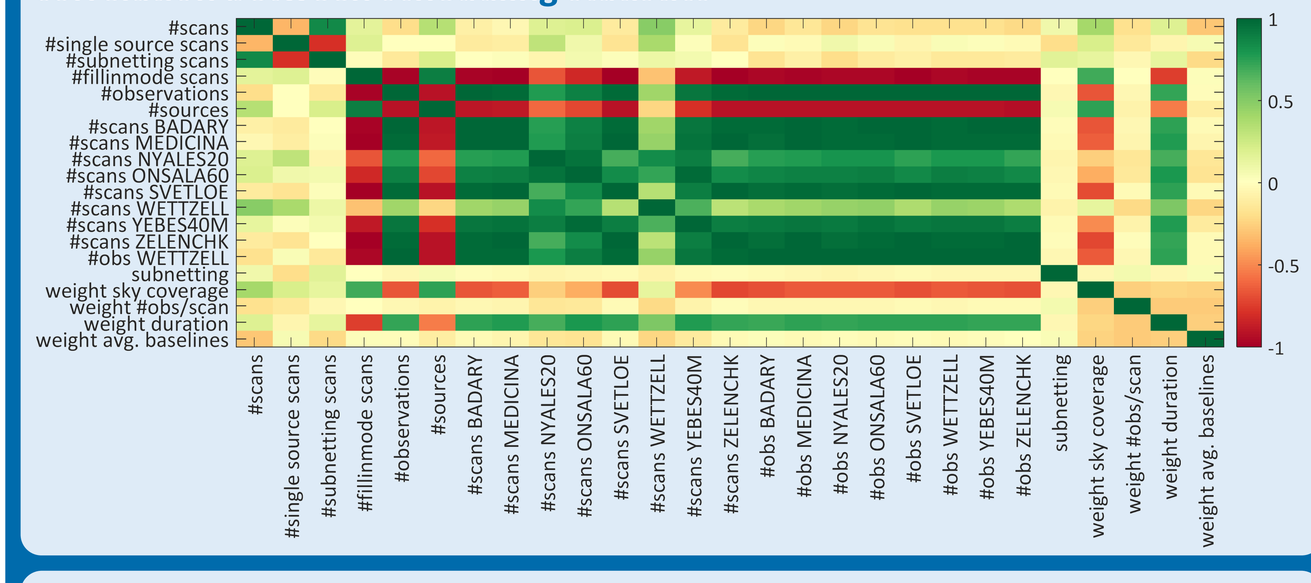


correlation between scheduling statistics and geodetic estimates

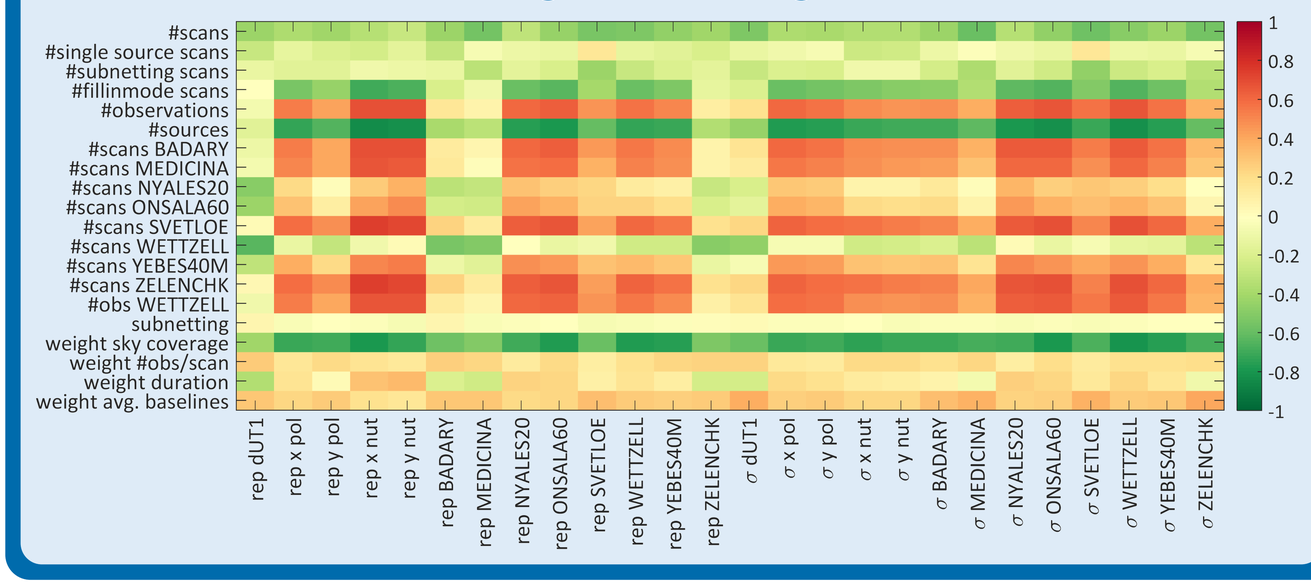


EURD09

correlation between scheduling statistics



correlation between scheduling statistics and geodetic estimates



Conclusion

Multi-scheduling

- for this study 5 parameters are varied: enabling subnetting, weight sky coverage, weight #obs/scan, weight duration, weight average baselines

Conclusion T2129

- enabling subnetting
  - reduces the number of observations but increases the number of scans
  - improves result quite severely
- O'Higgins
  - strong negative correlation between the number of observations with O'Higgins and the number of observations with other stations
    → O'Higgins tends to reduce number of observations of other stations
  - high number of observations with O'Higgins improves geodetic result
  - O'Higgins benefits most from subnetting (due to its remote location)
- weight factors
  - high weight of sky coverage leads to fewer scans and observations but improves the geodetic result
  - high weight on duration increases the number of scans and observations and has a positive influence on the result

Conclusion EURD09

- weight factors
  - high weight of sky coverage leads to less scans and observations but improves the geodetic result, opposite for weight on duration
  - important influence of station WETTZELL, less for NYALES20 and ONSALA60

Be aware!

- results vary depending on network, recording rate, source list…
- often times weight duration is the most important weight factor
- this study shows correlation, not causation