Current status and future plans for the Vienna VLBI Software (VieVS)

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Introduction

The Vienna VLBI Software (VieVS) is state-of-the-art VLBI analysis software, developed and maintained by the VLBI group at Technische Universität Wien since 2008, with important contributions of other groups worldwide. VieVS is designed for the analysis of geodetic VLBI observation data, as well as for scheduling and simulation of different VLBI sessions. The software incorporates the latest IERS Conventions and uses the concept of continuous piecewise linear offsets at integer hours for the parameter setup, consistent with the terms of reference of the GGOS. VieVS comes with a graphical user interface and is written in MATLAB for convenient handling and coding. This also facilitates entry into VLBI analysis for students.

VieVS structure

- VIE_SETUP (GUI)
- VIE_SCHED, VIE_SIM, VIE_INIT
- VIE_MOD
- VIE_LSM, VIE_LSM scan
- VIE_GLOB
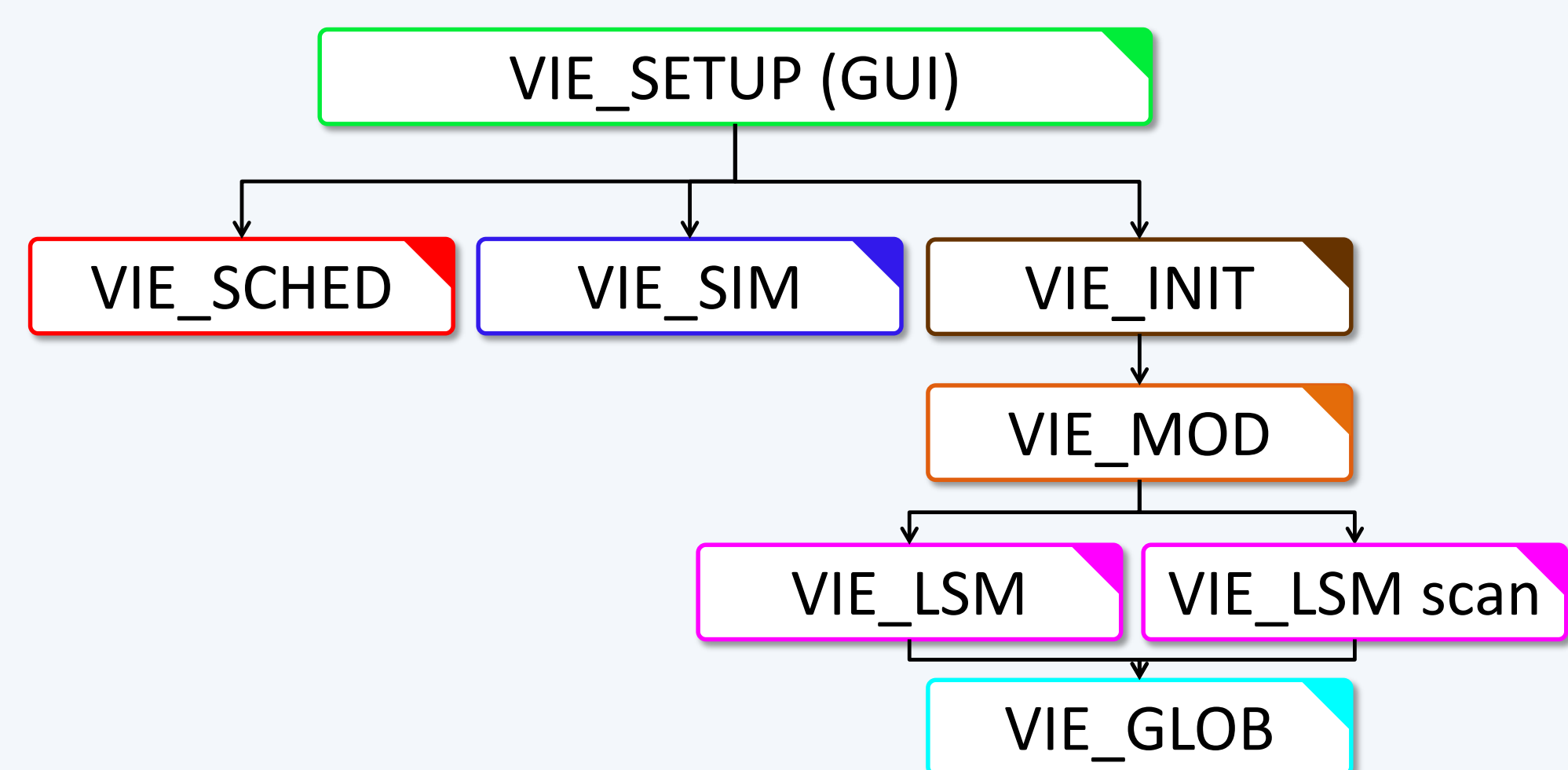
VIE_SETUP
- The processing setup is realized in one common graphical user interface (GUI).
- Start single session solution as well as single modules (scheduling, simulation, global solution).

VIE_SCHED
- Scheduling of VLBI sessions → NGS files for simulation, SKD/VEX-files for antenna steering.

VIE_SIM
- Simulation of observations from real sessions or sessions scheduled with VIE_SCHED.

VIE_INIT
- Reading of all required data: observations, station coordinates and velocities, source coordinates, etc.
- Removing of outliers and bad observations, exclusion of stations, sources or baselines.

VIE_MOD
- Calculation of theoretical delay and partial derivatives.
- Accounting for station corrections.

VIE_LSM & VIE_LSM scan
- Computation of least squares adjustment (inversion of whole design matrix or scan-wise update of normal equation matrix).
- Setup and storing of normal equations for global solution.

VIE_GLOB
- Stacking of single session normal equations to obtain global parameters.

VieVS features
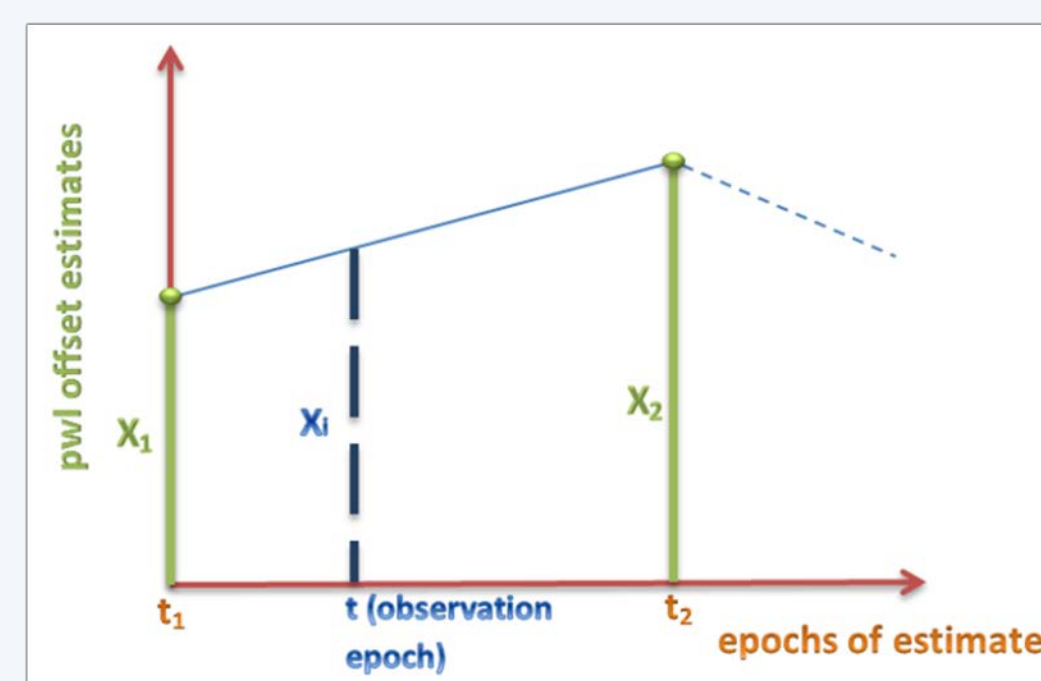
Session analysis

Single session analysis
Select session and analysis setup parameters via a user-friendly GUI.
Estimate parameters as continuous piecewise linear offsets:
- EOP
- Station and source coordinates
- Zenith wet delays
- Clock offsets

$$x_i = x_1 + \frac{(t-t_1)}{(t_2-t_1)}(x_2 - x_1)$$

Multi session analysis
Analysis of sessions in a predefined process list with the same parameterization.
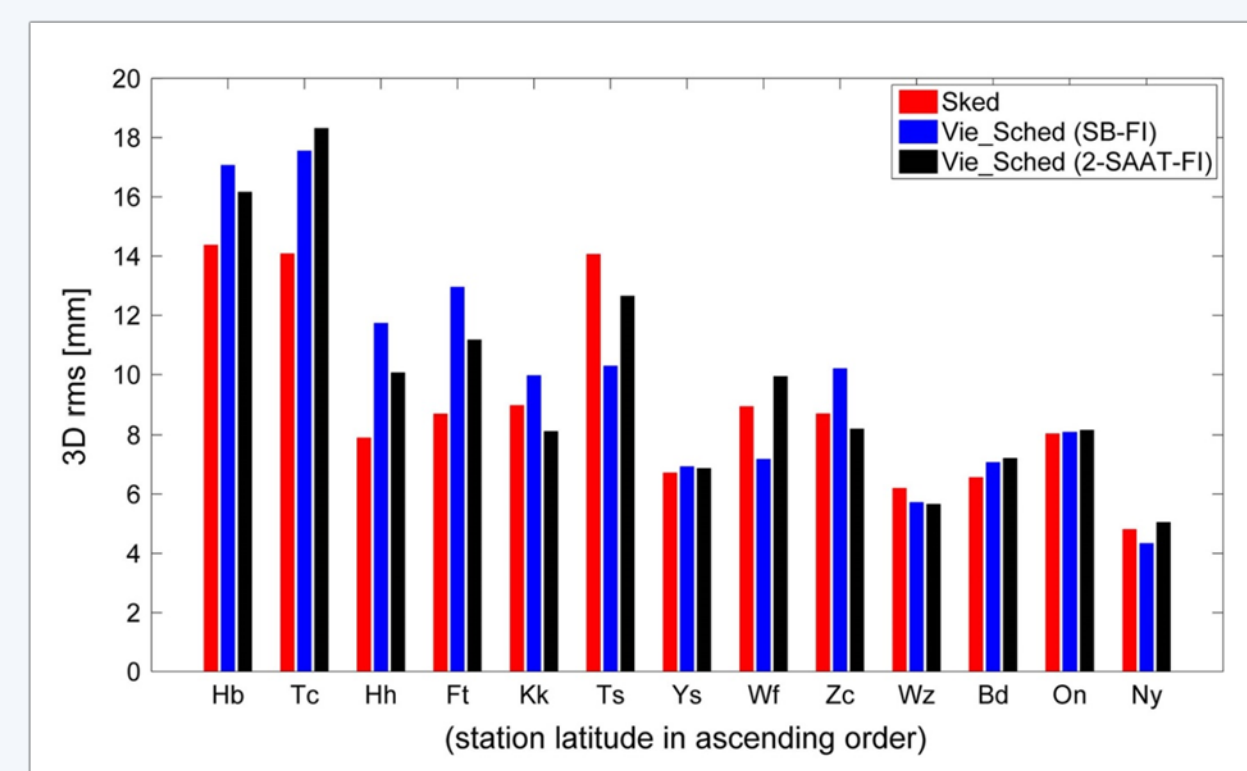
Scheduling and simulation

Scheduling
- Prepare schedules (VEX and SKD format) for VLBI sessions automatically
- Include twin telescopes
- Station- or source-based strategy
- AUST sessions are scheduled with VIE_SCHED

Simulation
- Monte-Carlo-simulations
- Simulated parameters:
  - Clocks
  - White noise
  - Troposphere
  - Source structure

Comparison of schedules (Sun et al. 2014)

Global Solution
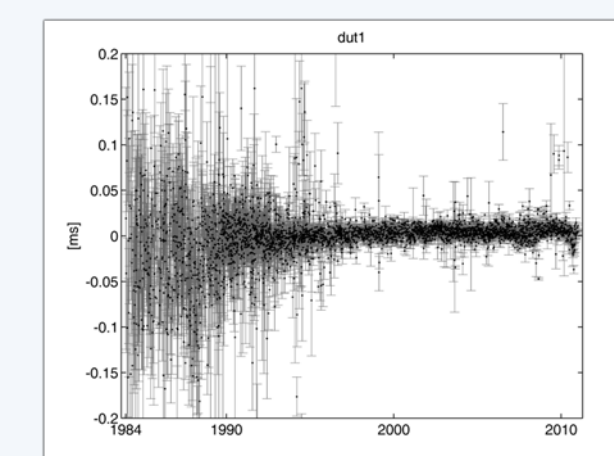Estimate parameters which are common to all VLBI sessions:
- Station coordinates and velocities (TRF)
- Source coordinates (CRF)
- Earth orientation parameters (EOP)

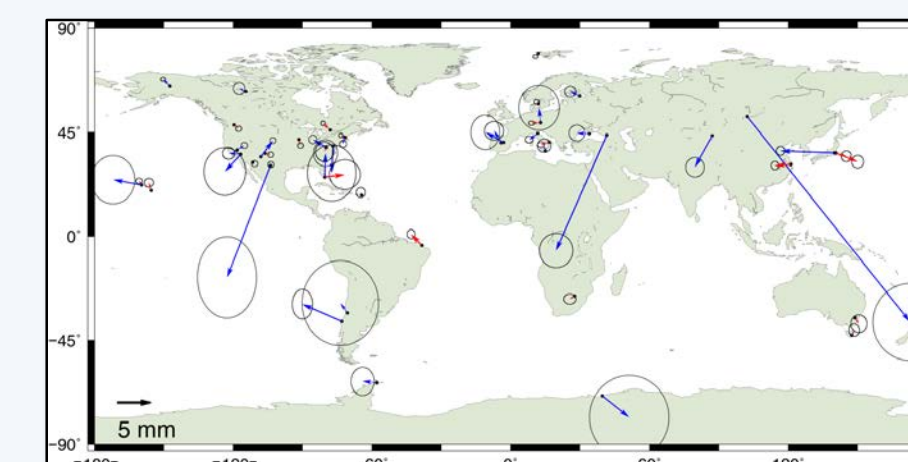Backwards solution for reduced parameters:
- Tropospheric delays, gradients
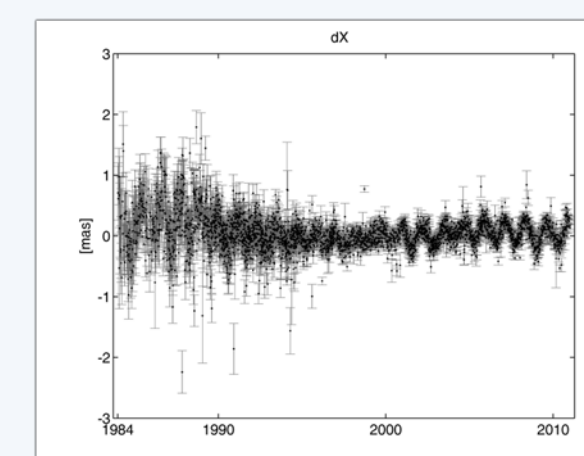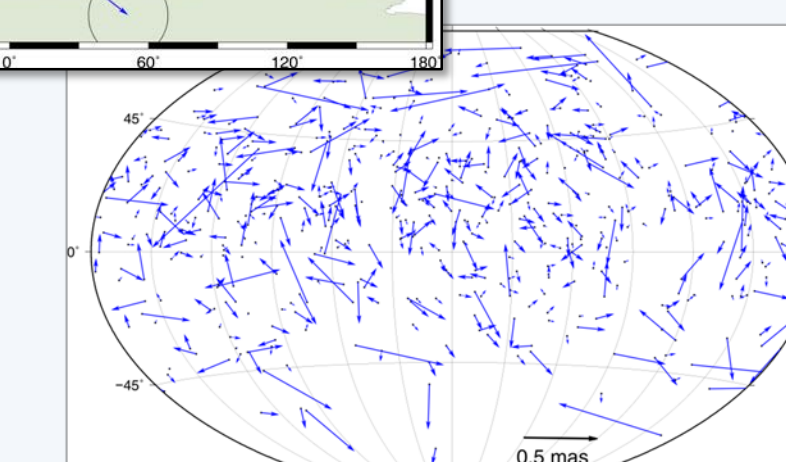- Station and source coordinates
- EOP, e.g.:

Nutation dX   dUT1 (UT1-UTC)

Horizontal positions in VieTRF10a w.r.t. VTRF2008
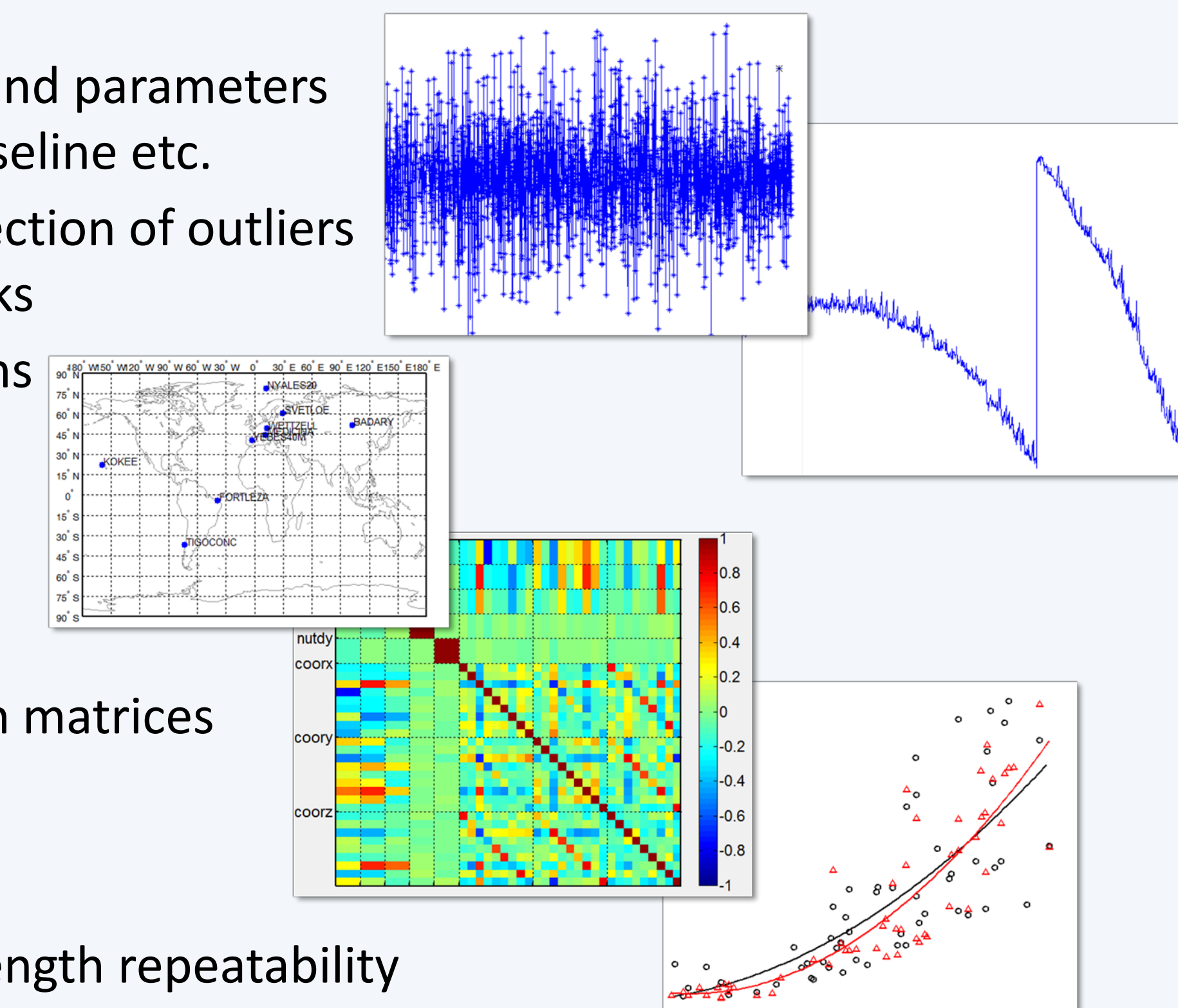
Source positions in VieCRF10a w.r.t. ICRF2

Plotting tools
- Plot residuals and parameters per station, baseline etc.
- Interactive selection of outliers and clock breaks
- Analyze sessions
  - Plot network
  - Plot correlation matrices
  - Plot baseline length repeatability

How can I become a user?

- VieVS is available free of charge for registered users.
- Registration: If you want to have access to VieVS, take a look at the VieVS-Wiki webpage (http://vievs.geo.tuwien.ac.at/) under the heading "Get VieVS".
- Current VieVS Reference:

J. Böhm, S. Böhm, T. Nilsson, A. Pany, L. Plank, H. Spicakova, K. Teke, H. Schuh. The new Vienna VLBI Software VieVS, in Proceedings of IAG Scientific Assembly 2009, International Association of Geodesy Symposia Series Vol. 136, edited by S. Kenyon, M. C. Pacino, and U. Marti, pp. 1007-1011, 2012.

Future plans

Source structure
- Refining simulations
- Correct observations for source structure effects

Ray-traced delays
- Improved tropospheric delay modeling based on ray-tracing
- Direct application for all VLBI observations

Schedule satellite observations
- Generation of fully realistic schedules for simulations and actual satellite observations
- Combination of observations to quasars and satellites in one session

Twin and sibling telescopes
- Improved scheduling and analysis capabilities with dedicated optimization approaches

Implementation of up-to-date file formats
- VEX 2.0 for schedule files
- VGOS database files (NetCDF)

GNSS-VLBI Hybrid Observations
- Combination of GNSS and VLBI data at the observation level
- Introduction of local tie vectors and site common parameters

The VieVS-Wiki
- The new VieVS-Wiki (http://vievswiki.geo.tuwien.ac.at/) provides an open platform for VieVS related topics.
- A full documentation can be accessed.

System requirements
- MATLAB 7.6 (R2008a) or later.
- Tested on Linux and Windows.

6th VieVS workshop
- Introduction to VieVS and practical exercises to learn how to work with the software
- September 23-24 2015, at Technische Universität Wien, Vienna, Austria

We highly appreciate the contributions all former members of the VieVS developers team!