Status and future plans for the Vienna VLBI Software VieVS

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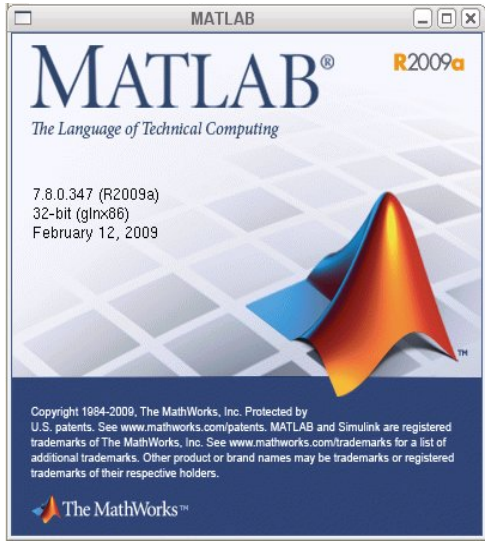
Introduction

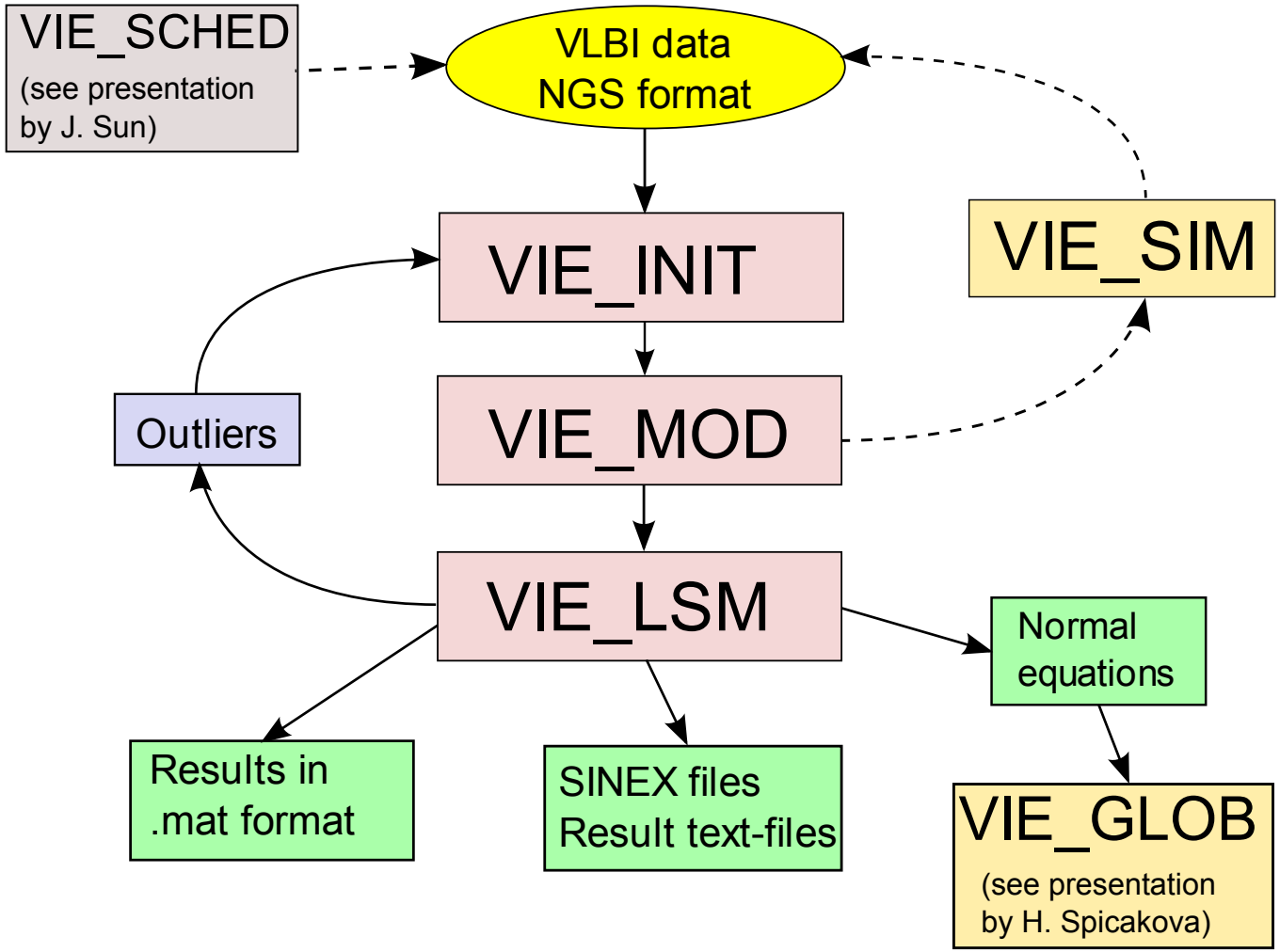
- The Vienna VLBI Software (VieVS) has been developed since 2008.
- Written in Matlab.
- Implements the most recent IERS Conventions.
- Easy to use through a Graphical User Interface (GUI).
- Easy to add new models etc.

Why Matlab?

- **Advantages of Matlab:**
  - Easy to use.
  - Matlab available for several different operating systems.
  - Source code easy to understand and to modify.
  - Matlab has a lot of useful tools, e.g. for plotting.
- **Disadvantages:**
  - Matlab is probably slower than e.g. Fortran. Currently not a major problem.
  - Matlab is a commercial software. VieVS works on the free counterpart GNU Octave (except for the GUI).

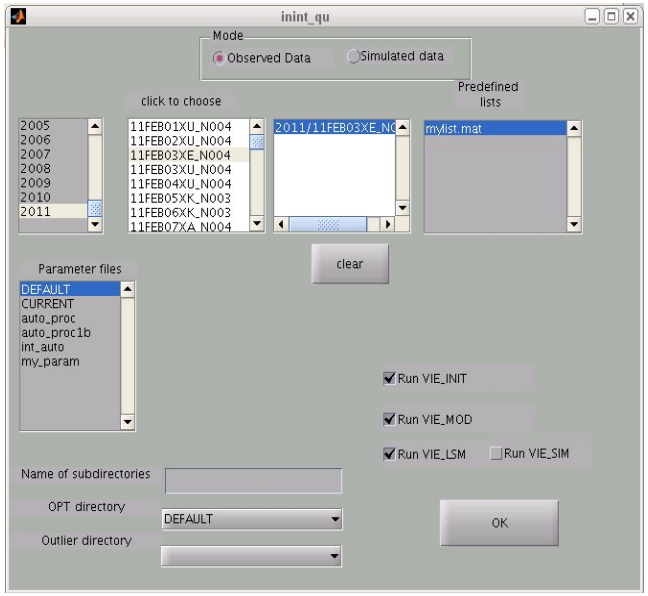


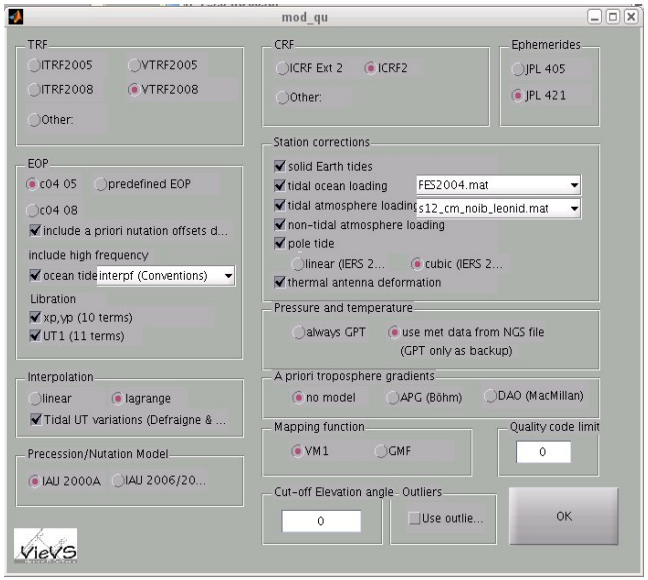
Structure of VieVS

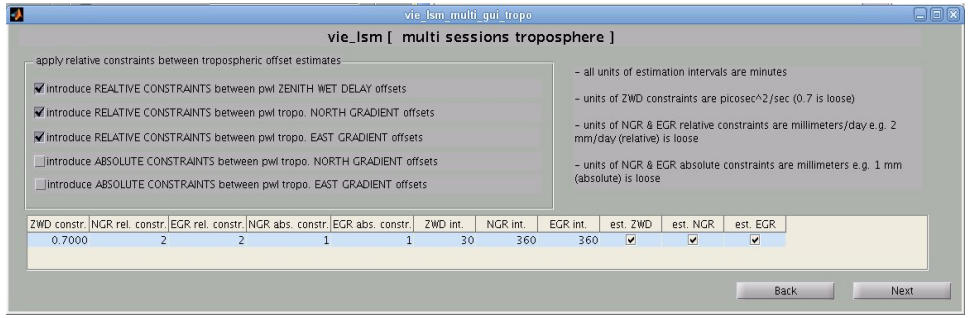


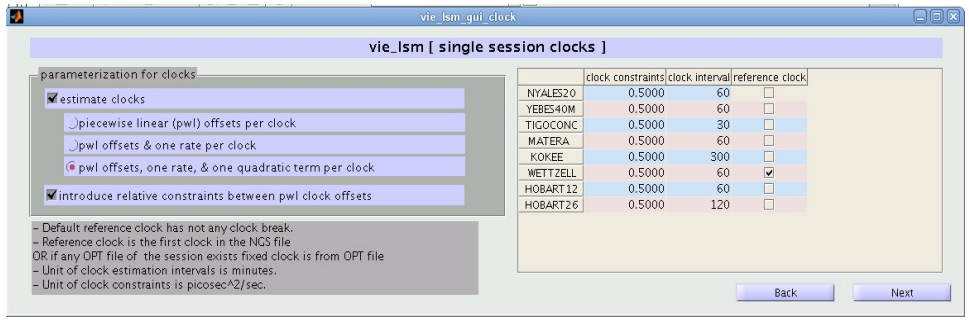
VIE_SETUP: the graphical user interface

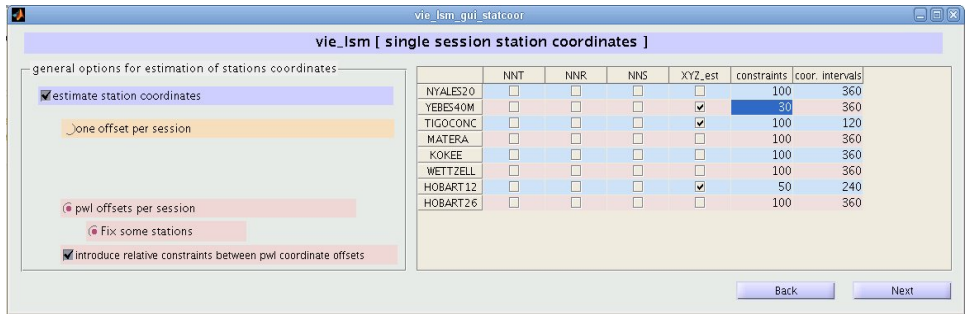
Tobias Nilsson
et al.











Main parts of VieVS

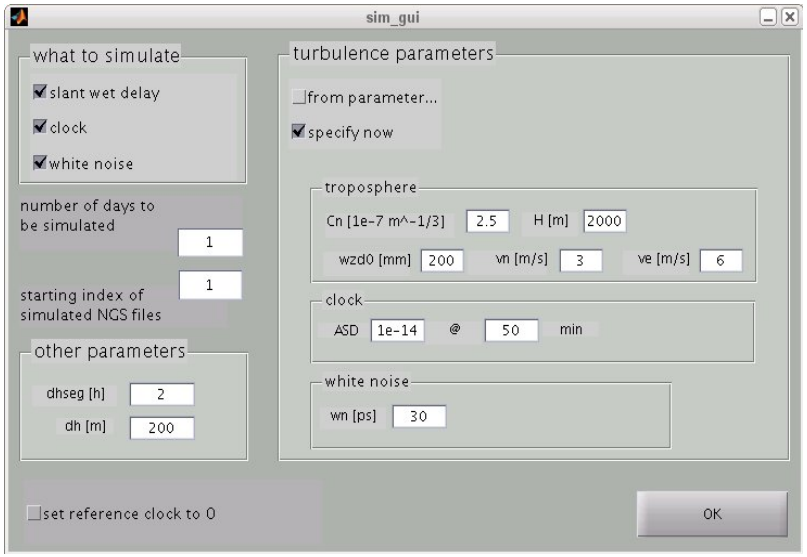
- **VIE_INIT**
  - Reads in the VLBI data.
  - Presently supports NGS-format. Will support new data format specified by IVS WG4.
  - Possible to exclude stations, sources, outliers, ...
- **VIE_MOD**
  - Calculates theoretical delays and partial derivatives.
  - Implements the most recent IERS Conventions.
- **VIE_LSM**
  - Calculates the solution using the classical Least Squares method.
  - Unknown parameters modelled as piece-wise linear offsets at integer hours (or integer fraction of hours).

Additional parts of VieVS

- **VIE_SCHED**
  - Scheduling software.
  - See separate presentation by Jing Sun.
- **VIE_SIM**
  - Simulation tools.
- **VIE_GLOB**
  - Global solution tool. Combine many sessions for estimating TRF, CRF, ...
  - See separate presentation by Hana Spicakova.

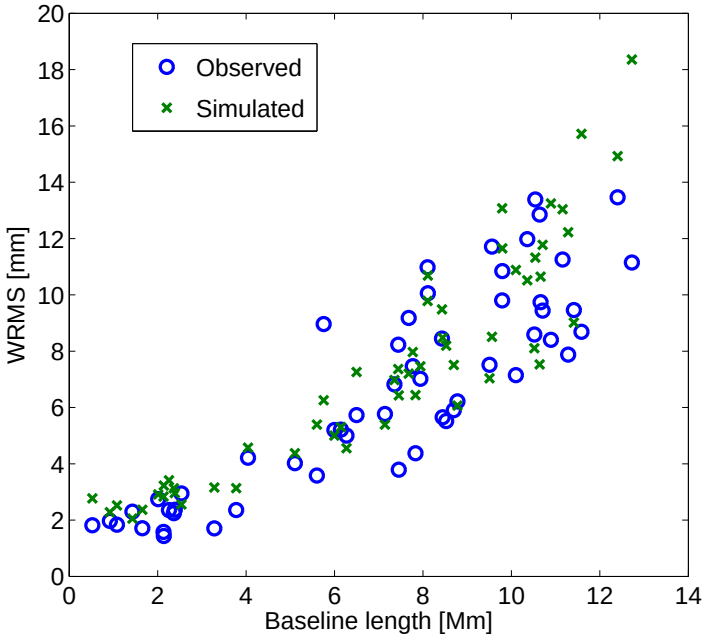
VIE_SIM: the simulation tools

- Can be used to create simulated VLBI observations.
- The simulated observations are saved in NGS data files. Can then be analysed by VieVS or by other VLBI softwares.
- The most important error sources can be simulated:
  - Tropospheric delays (using the method of *Nilsson and Haas, 2010*).
  - Clock errors.
  - Measurement noise.



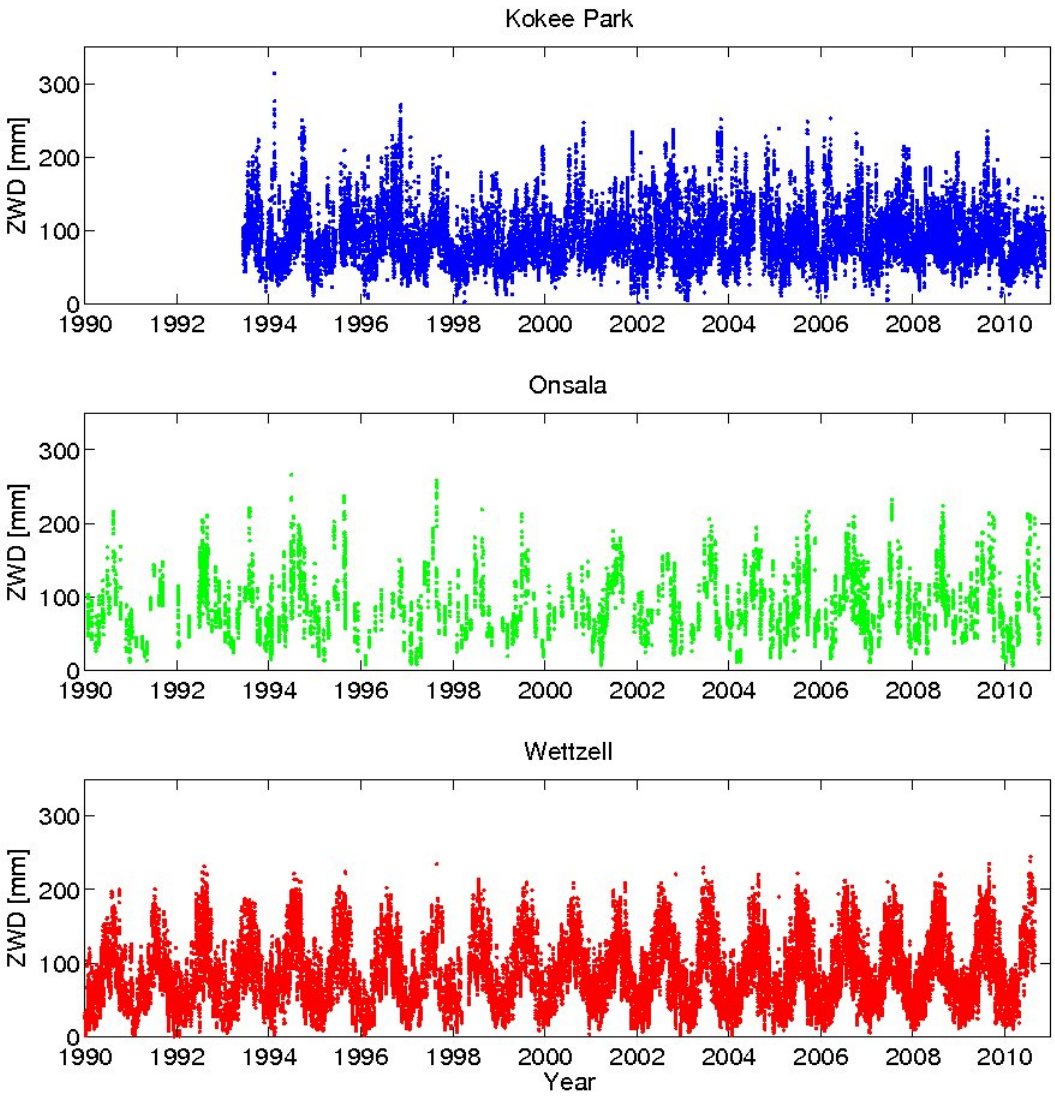
Selected results obtained with VieVS

Simulation results



- Baseline length repeatabilities for CONT08 from simulations and observed data.
- Simulation parameters:
  - Troposphere: $C_n = 2 \cdot 10^{-7}$ m$^{-1/3}$, H=2 km.
  - Clocks: ASD 10^{-14} @ 50 min.
  - White noise: 30 ps.

Time-series of zenith wet delays



Trends:

-0.11 mm/year

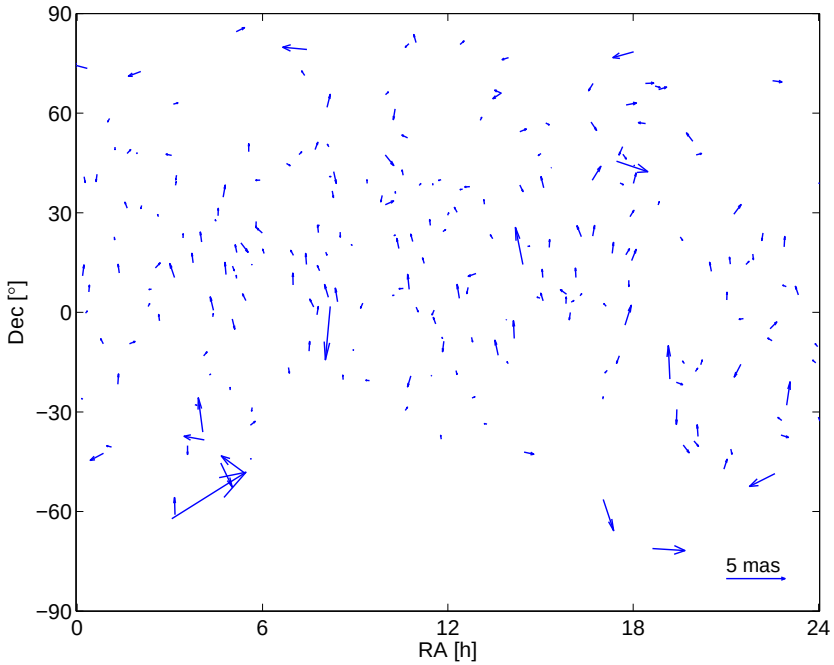
0.36 mm/year

0.51 mm/year

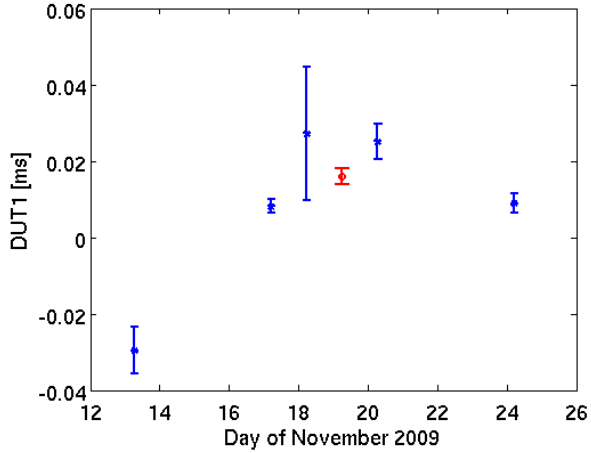
The IYA09 supersession

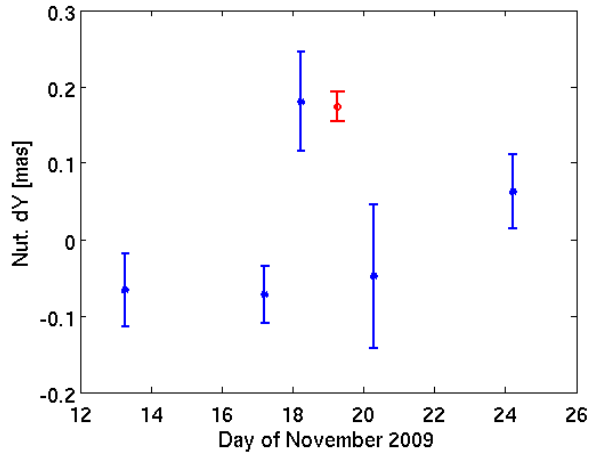
- 18–19 Novemeber, 2009.
- 32 stations.
- Goal: observe all defining ICRF2 sources.

Source Coordinates

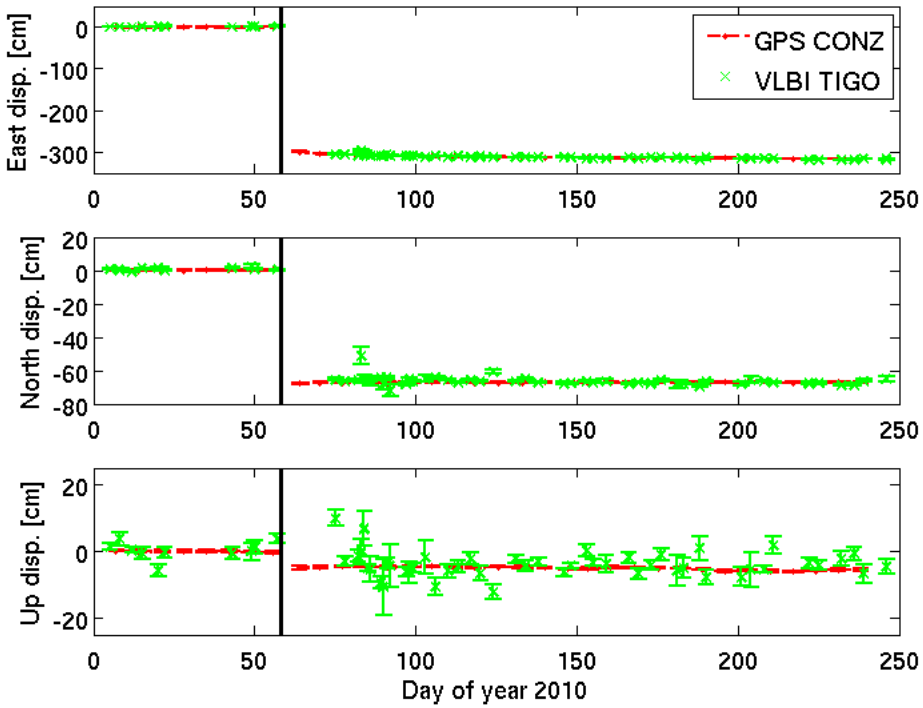


EOP

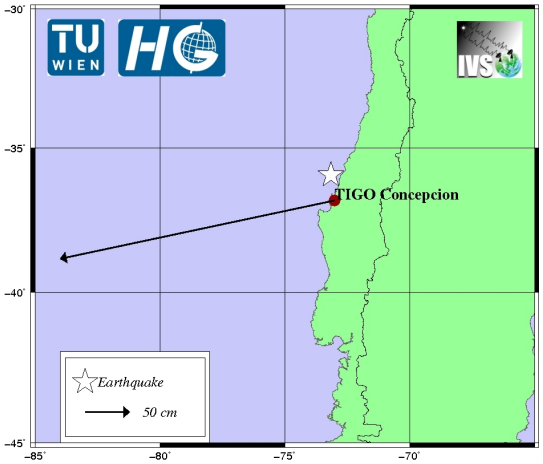




Displacement of TIGO Concepcion



Displacement of the TIGO Concepcion antenna due to the Earthquake on 27 February, 2010.



Automatic data processing

- Every night the VieVS server at TU Vienna automatically downloads the latest sessions (+ files for atmospheric loading, EOP, . . .).
- The downloaded sessions are then automatically processed.
- 24-hour VLBI sessions:
  - Simple processing is made to detect outliers.
  - For each session, a simple report is sent to a responsible analyst.
  - Analyst can determine if the session is ok or if there are problems (e.g. clock breaks).
- Intensives:
  - Sessions are analysed in order to estimate DUT1.
  - Plot of DUT1 from the latest intensives is produced and put on the VieVS homepage: `http://vievs.hg.tuwien.ac.at/dut1.png`

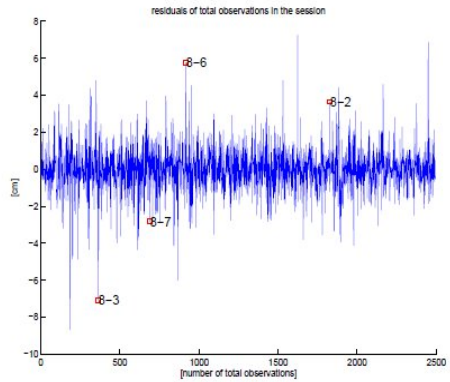
Example of a report:

Session: 11JAN20XE_N004

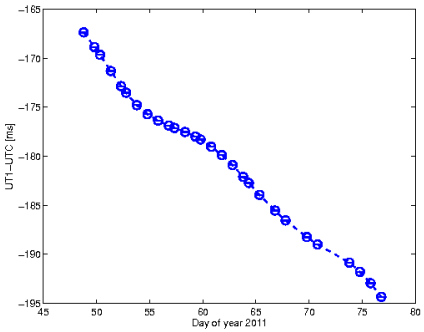
Result of automatic processing

February 4, 2011

List of stations: YEBES40M, ZELENCHK, NYALES20, HOBART26, MATERA , TIGOCONC, WETTZELL, KOKEE .
Reference clock: YEBES40M
Number of scans: 415
Number of observations: 2495
chi-squared of main solution: 1.010146
Number of outliers found: 4

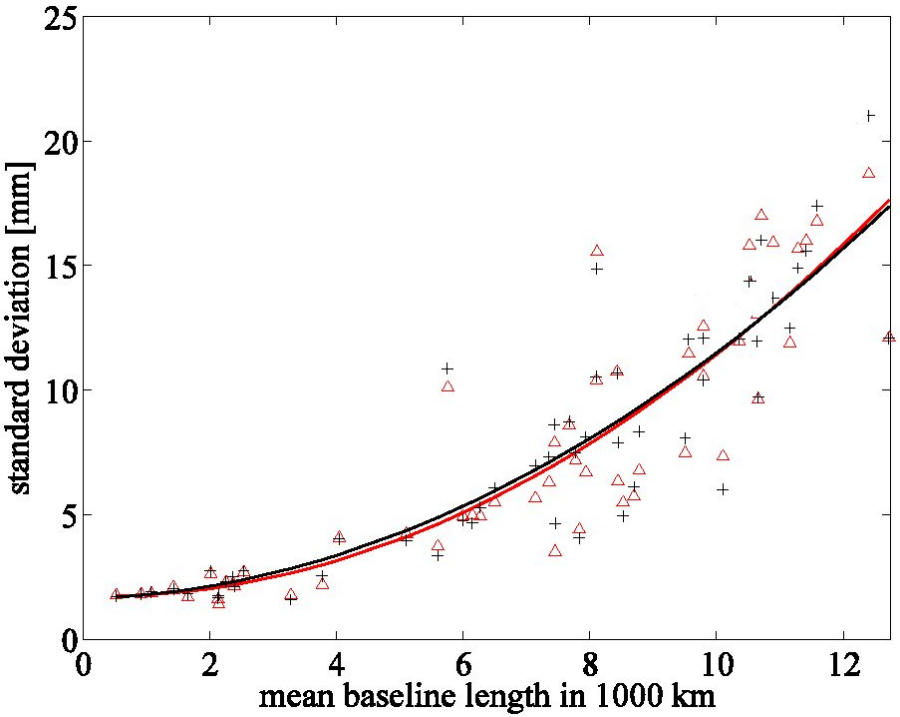


DUT1 form Intensives:



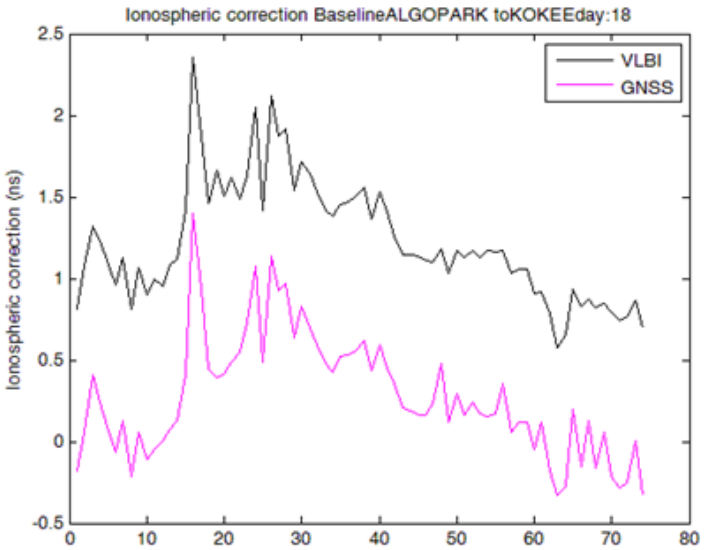
Ongoing and planned developments of VieVS

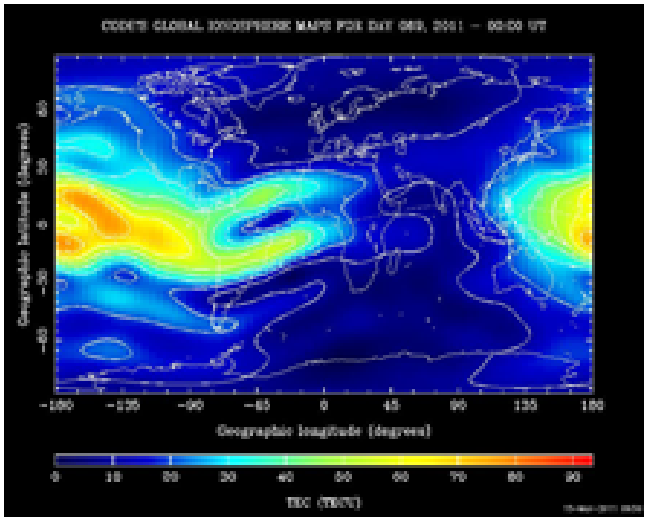
External tropospheric delays



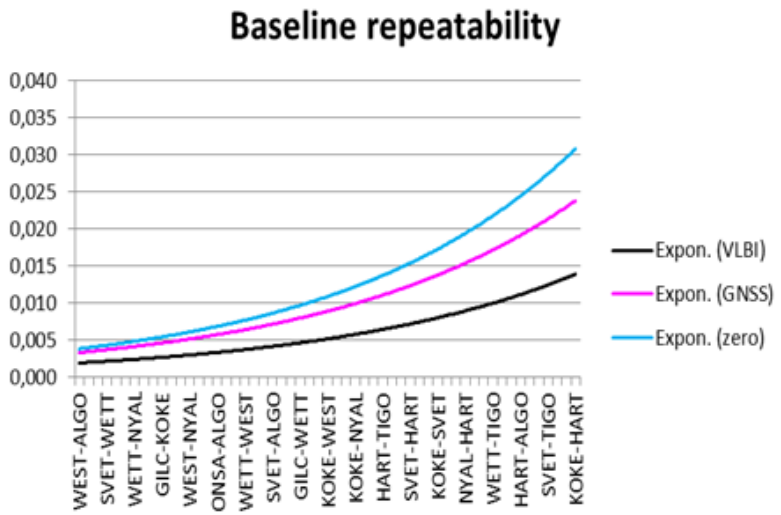
- **Black:** baseline length repeatabilities for CONT08 using tropospheric delays obtained from raytracing.
- **Red:** baseline length repeatabilities from normal solution.

External ionospheric delays





For further details, see poster by
Claudia Tierno Ros



Other planned developments

- Kalman filter solution
  - Alternative to the Least Squares solution.
- Cover earlier steps in the data analysis chain
  - Group (and phase?) delay integer ambiguity resolution
  - Ionospheric corrections
  - ...
- Spacecraft tracking
  - Presentation by Lucia Plank.
- Source structure?
- ...

Summary

- VieVS is a new state-of-the-art VLBI analysis software written in Matlab.
- Results of the same quality as from other VLBI softwares.
- VieVS is available free of charge to registered users.
- For more information, see the VieVS homepage: `http://vievs.hg.tuwien.ac.at`

VieVS User Workshops

- The first VieVS user Workshop was held September 7-9, 2010, at TU Vienna.
- The next VieVS User Workshop will be on September 14-16, 2011 (week before "Journées 2011"). Everybody is welcome to participate.

Participants in the first VieVS User Workshop

`http://vievs.hg.tuwien.ac.at/ws2011/`