



TECHNISCHE
UNIVERSITÄT
WIEN
Vienna University of Technology

Creating OPT-files





Detecting and solving problems

Tobias Nilsson




VieVS User Workshop
7 – 9 September, 2010
Vienna



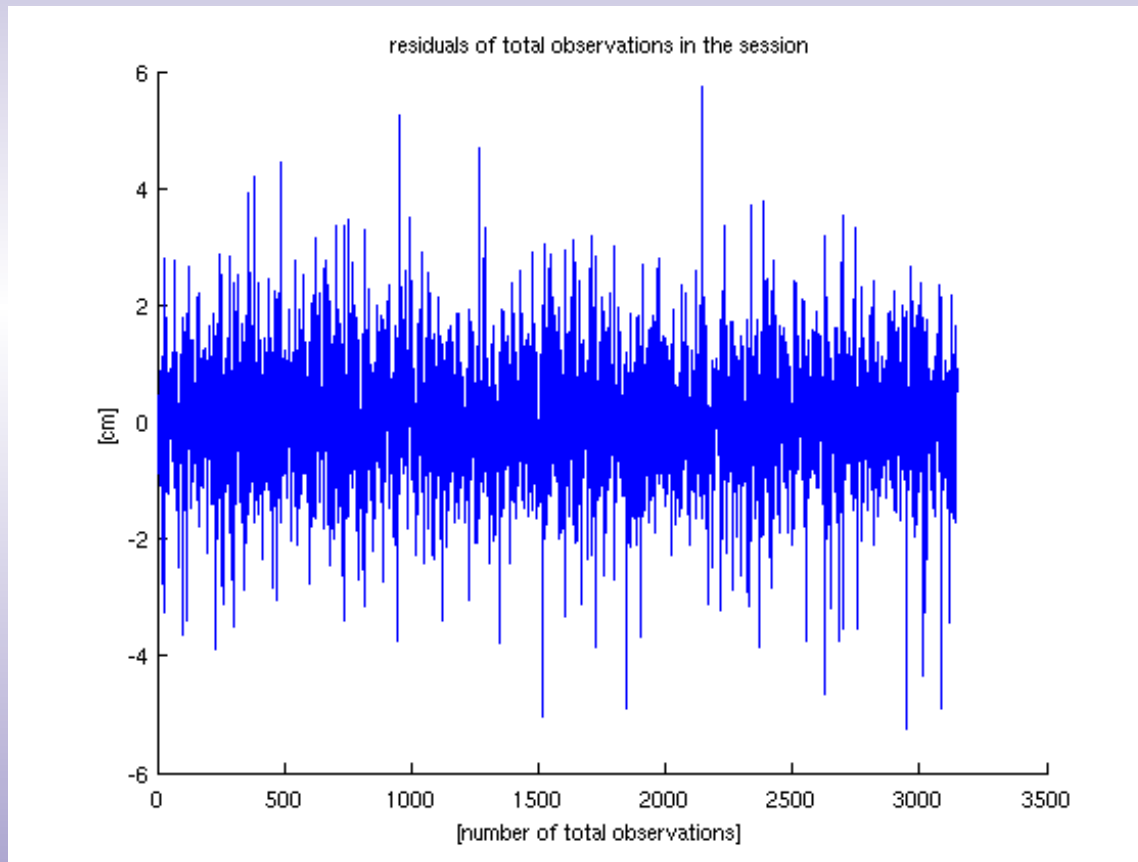
Sometimes there are problems with a session...

-  Clock breaks
-  Noisy stations
-  Bad sources
-  ...

How do you know if there is a problem with a session?

-  Large residuals after processing, e.g. chi-squared of main solution is large (larger than 1.5-2.5)
-  Strange results
-  Stations or correlator report a problem

Residuals of a good session



Session
10JAN25XA
(R1415)



Chi-squared of
main solution:
0.86









Looks good, no
OPT-file is
needed for this
session (except
for special
investigations)

The OPT-file

- ▶ Contains specific information for making the problematic sessions work:
 - ▶ Reference clock
 - ▶ Clock breaks
 - ▶ Stations to be excluded
 - ▶ Sources to be excluded
 - ▶ Baselines to be excluded
- ▶ Directory: **DATA/OPT/SUBDIR/YYYYYI**

Example of an OPT-file

```
CLOCK REFERENCE:
GOODSTAT
CLOCK BREAKS: 3
JUMPY      55403.09
JUMPY      55403.67
BADCLOCK   55403.25
STATIONS TO BE EXCLUDED: 2
BADSTAT1
BADSTAT2
SOURCES TO BE EXCLUDED: 1
0000+666
BASELINES TO BE EXCLUDED: 1
BAD_BAS1  BAD_BAS2
NO CABLE CAL: 1
BADCABLE
# This is a comment
```

-  GOODSTAT is chosen as reference clock
-  3 clock breaks (2 in JUMPY, 1 in BADCLOCK)
-  2 station excluded
-  1 source excluded
-  1 baseline excluded
-  Cable cal. of station BADCABLE not used.








Reference clock

CLOCK REFERENCE :
GOODSTAT




- ▶ The clock reference option specifies the default reference clock for the experiment.
- ▶ A station with a good clock should be used (i.e. it should not have any clock breaks!).
- ▶ If not specified, first station in the antenna structure array will be used as reference.

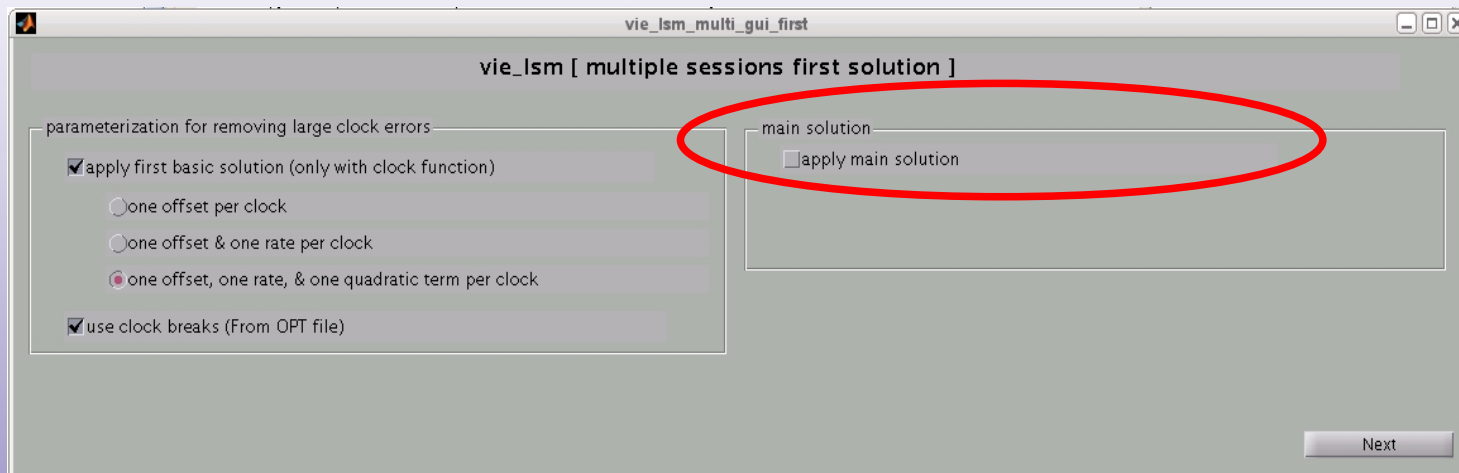

```
CLOCK BREAKS: 3
JUMPY          55403.09
JUMPY          55403.67
BADCLOCK      55403.25
```

Clock breaks

-  Sometimes there is a jump in a stations clock.
-  The number after “*CLOCK BREAKS:*” specifies the number of clock breaks in the session.
-  The following lines specifies the clock breaks: station name (8 characters) followed by the modified Julian date of the break.
-  How to detect clock breaks:
 -  Find it manually using VieVS
 -  From correlator report or from e.g. the Goddard analysis.
 -  Divine inspiration.

Finding clock breaks

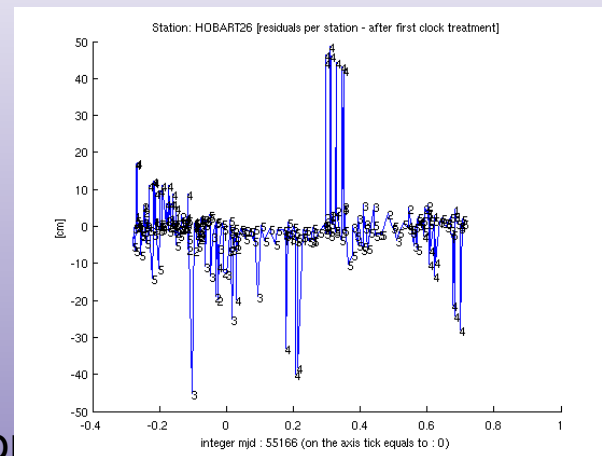
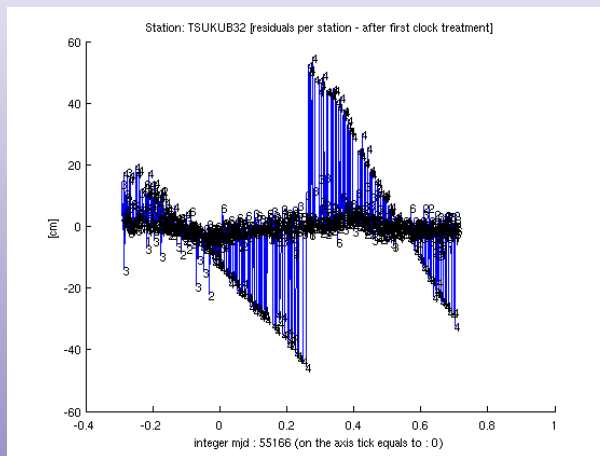
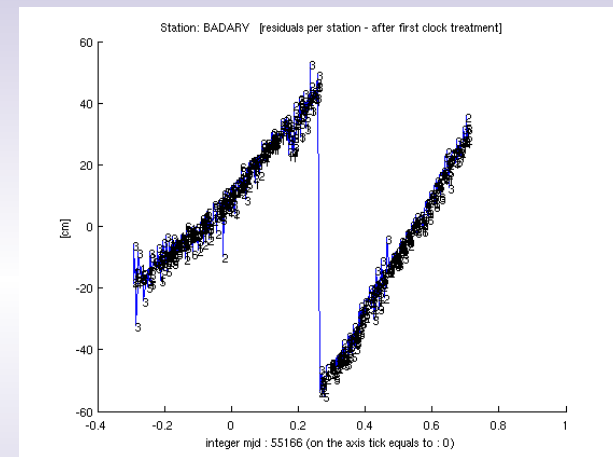
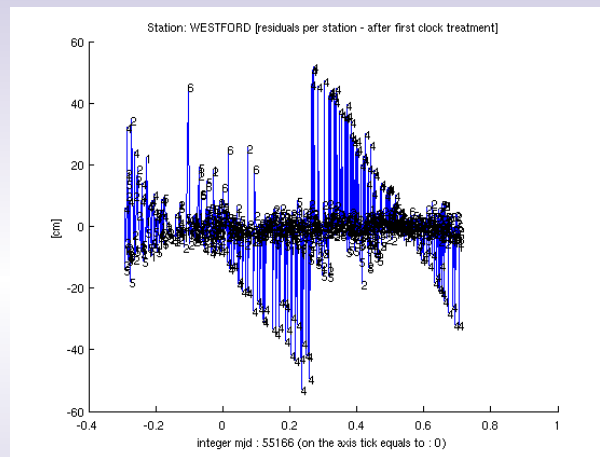
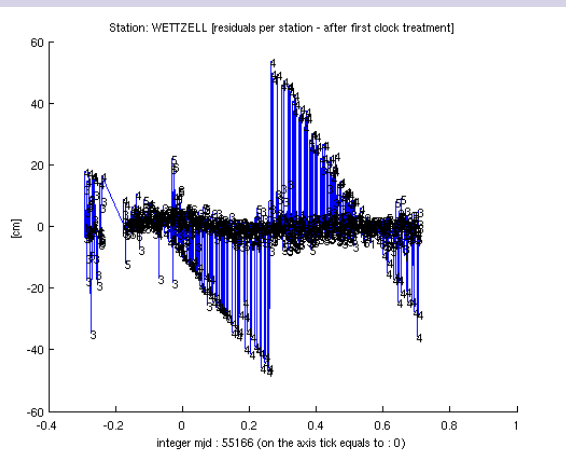
-  Unselected the “*apply main solution*” in the first Vie_Ism GUI.
-  Now only the first solution will be performed (only estimating quadratic clock functions and one ZWD per station).
-  Afterwards, station-wise residual plots will be shown (except for the station with the reference clock).



Finding clock breaks (II)



Station-wise residuals plots after first solution:



Finding Clock breaks (III)



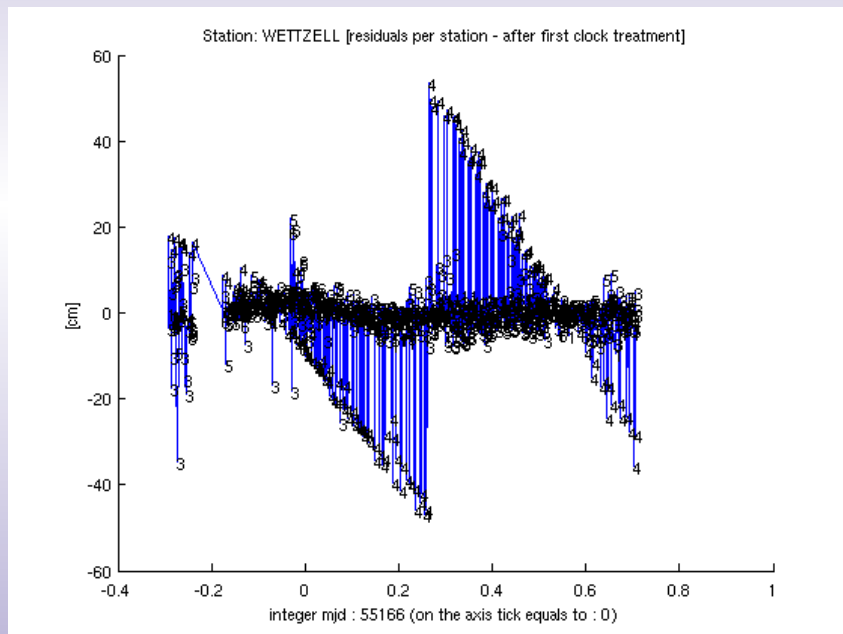
Residuals for WETTZELL, session 09NOV24XA_N004



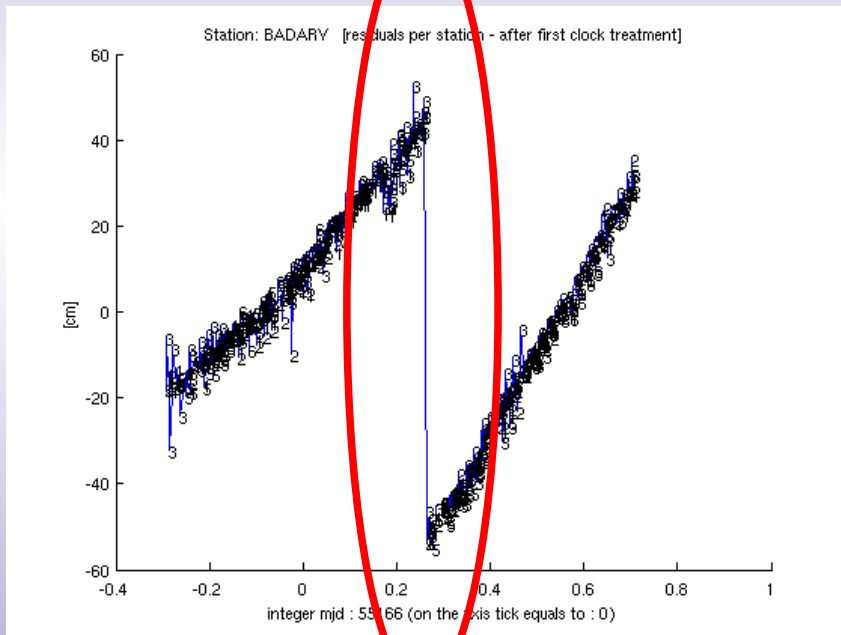
Large residuals for observations with station 4 (BADARY). Sudden change between negative and positive residuals. Indicates a clock break at BADARY.






If BADARY would be the reference clock, you would have to change the reference clock to another station and re-run the solution to get the residual plot for BADARY.

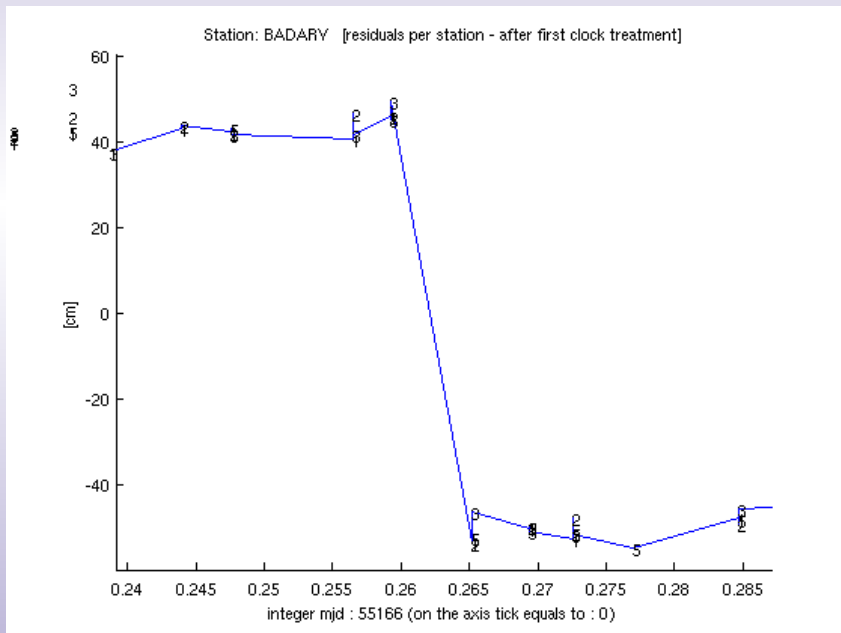






Finding Clock breaks (IV)




-  Residuals for BADARY, session 09NOV24XA_N004
-  Clear clock break in the middle of the session.
-  To find the exact time of the break, zoom in.


Finding Clock breaks (V)



-  Zoomed in around the time of the clock break.
-  Clock break seems to be between Modified Julian dates 55166.260 and 55166.265.
-  Any time between the last observation before the break and the first after the break will do (e.g. 55166.263).
-  The clock break then needs to be entered into the OPT-file.

Finding Clock breaks (VI)

 Create/edit the OPT-file and enter the clock break.

 When you now re-run the solution (using the OPT-file), the clock breaks should be corrected for in the first solution.

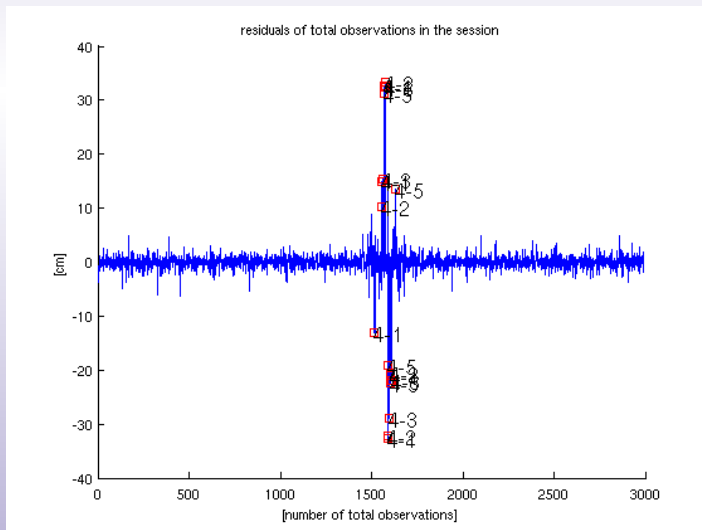
09NOV30XA.OPT

```
CLOCK BREAKS: 1
BADARY      55166.263
```

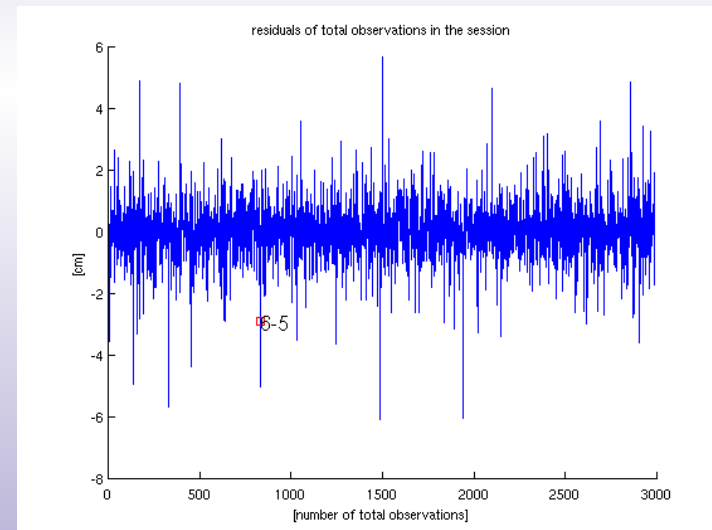
Finding Clock breaks (VII)



After entering the clock break into the OPT-file, the solution gets better.



Before correcting for clock break
Chi-squared: 2.32



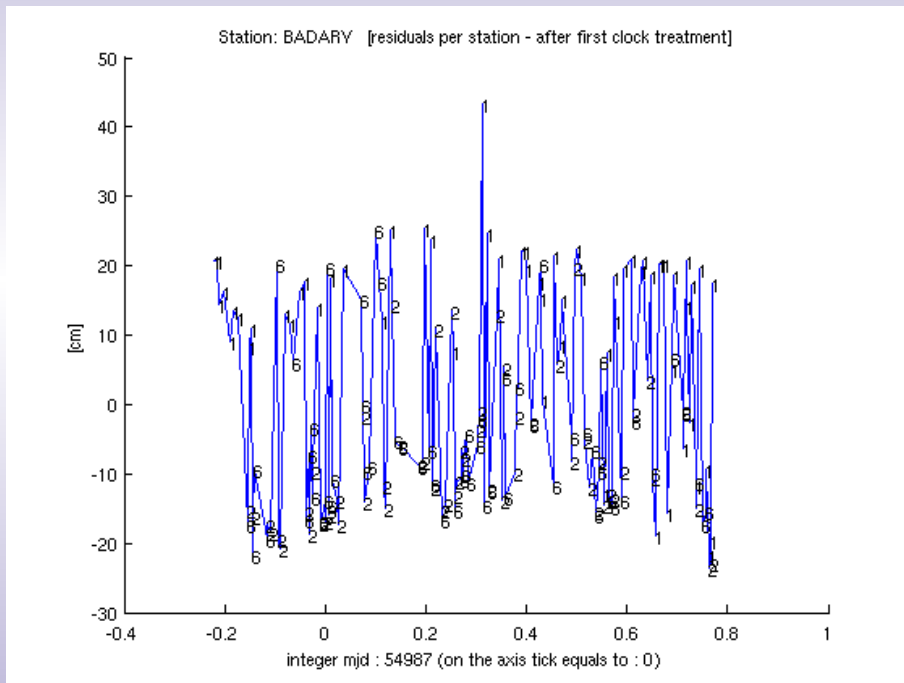
After correcting for clock break
Chi-squared: 0.69

Excluding stations

- 📌 Reasons for excluding a station:
 - 📌 Problematic station (e.g. very noisy observations for the station).
 - 📌 Few observations for the station.
 - 📌 Special investigations (test the impact of excluding the station).

```
STATIONS TO BE EXCLUDED: 2  
BADSTAT1  
BADSTAT2
```

Detecting bad stations



Example of a noisy station:



BADARY, session 09JUN04XE (R4381)



Residuals after first solution








Large residuals, no obvious reason (e.g. clock breaks)



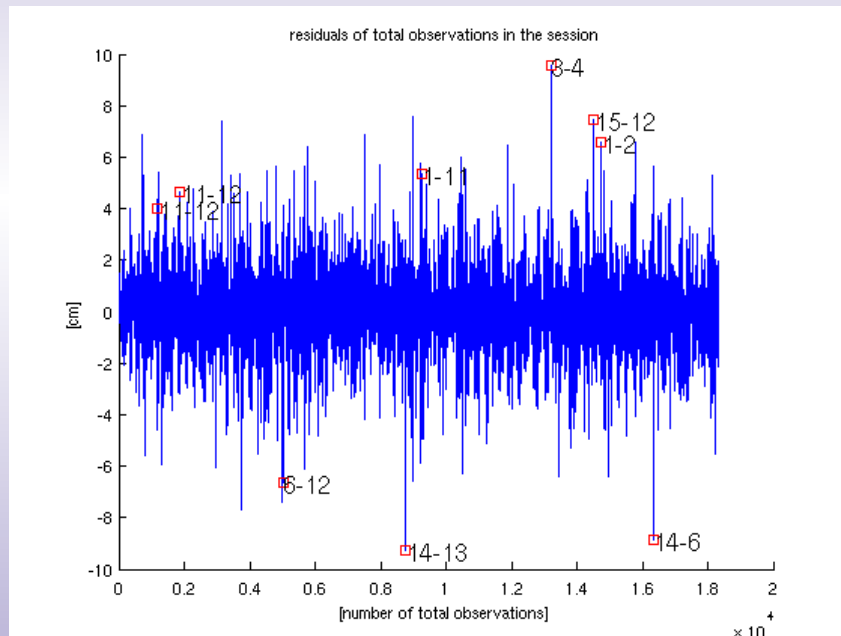
Removing BADARY from this session decreases chi-squared from 1.7 to 0.8



Excluding sources

SOURCES TO BE EXCLUDED: 1
0000+666

-  Reasons for excluding a source:
 -  Bad source
 -  Bad coordinates for the source (and source coordinates fixed)
 -  Very few observations of a source (when you estimate all source coordinates).
 -  Special investigations (test the impact)

Detecting bad sources (II)



-  Residuals of main solution after removal of sources 1936+095 and 0130-447
-  Large residuals disappeared (chi-squared now 0.79)

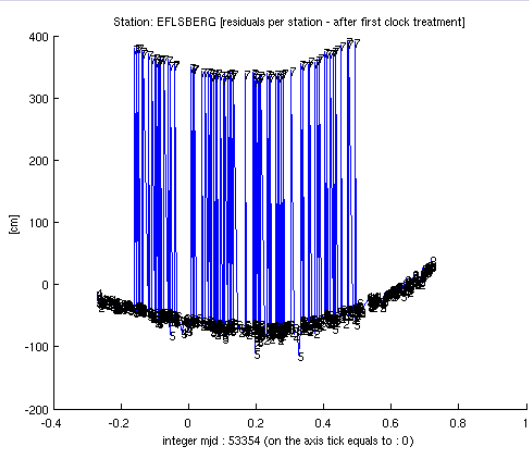
Excluding baselines

```
BASELINES TO BE EXCLUDED: 1  
BAD_BAS1  BAD_BAS2
```

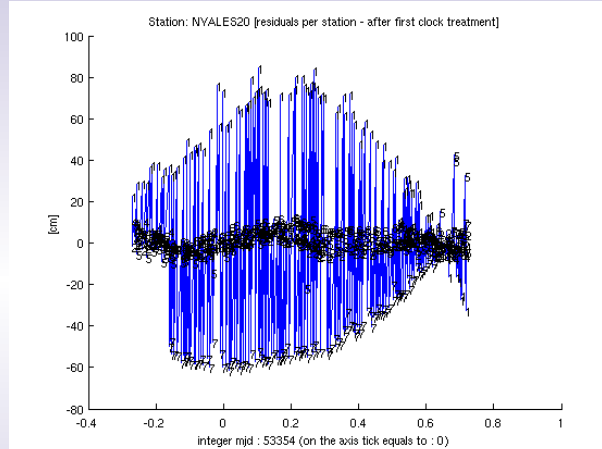
- 🐾 Excludes all observations from a specific baseline
- 🐾 Reasons to exclude a baseline:
 - 🐾 Some error with the observations for that baseline
 - 🐾 Special investigations

 Example: 04DEC14XA (EURO74)

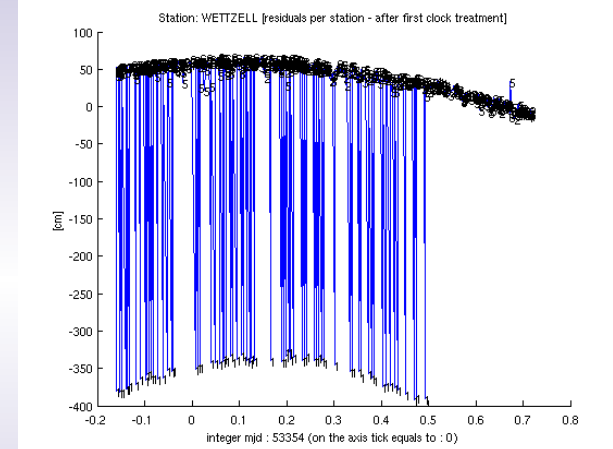
 Residuals after first solution:



Effelsberg



Ny Ålesund (other stations similar)



Wetzell

 Effelsberg large residuals with Wetzell






 Wetzell large residuals with Effelsberg

 All other stations: large residuals to Effelsberg and Wetzell

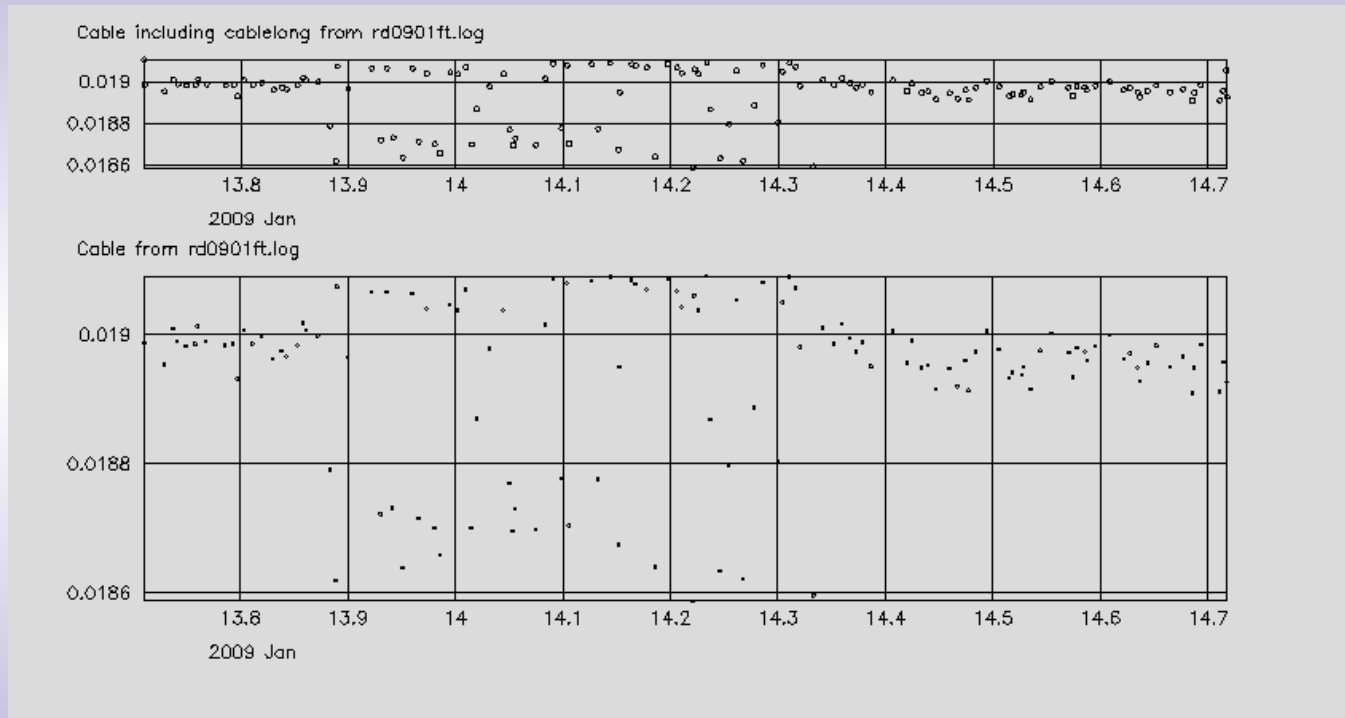
 Indicate problem with observations between Effelsberg and Wetzell

Remove cable measurements

```
NO CABLE CAL: 1  
BADCABLE
```

-  Sometimes the cable measurements of a station is of bad quality. It is better not to use them at all (i.e. assume cable corrections zero)
-  The “*NO CABLE CAL*” option specifies that the calbel calibration measurements of a station should not be used.
-  How to know if a cable is bad:
 -  Correlation report, Goddard analysis report, station logs etc.
 -  Visual inspection of plots of the cable cal. measurements

Example of a bad cable



FORTLEZA, session 09JAN13XA (RD0901)



From:

<http://lupus.gsfc.nasa.gov/sess/sesshtml/2009/rd0901.html>

Other problems that can occur

- 🐾 A few observations are bad
 - 🐾 Solution: add observations manually to Outlier file (if not done by outlier test)
- 🐾 A clock has a large diurnal variability
 - 🐾 Solution, use very loose constraints for the piecewise linear offsets of that clock.
- 🐾 The normal equation matrix in the Least squares adjustment is (close to) singular
 - 🐾 Solution: reduce the number of parameters to be estimated

Hopefully, you are now able to
process VLBI sessions with
VieVS without any problems!