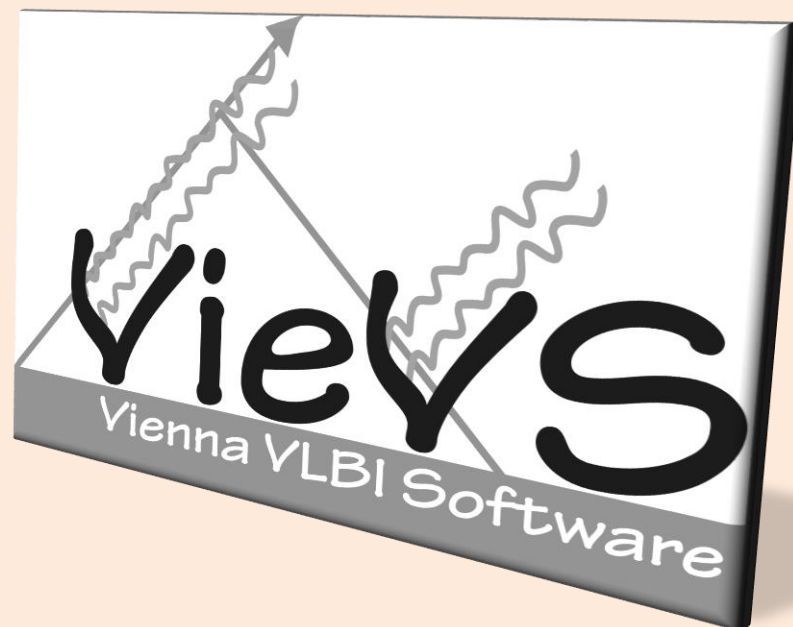


Vie_LSM_V22

Kamil Teke and Johannes Böhm



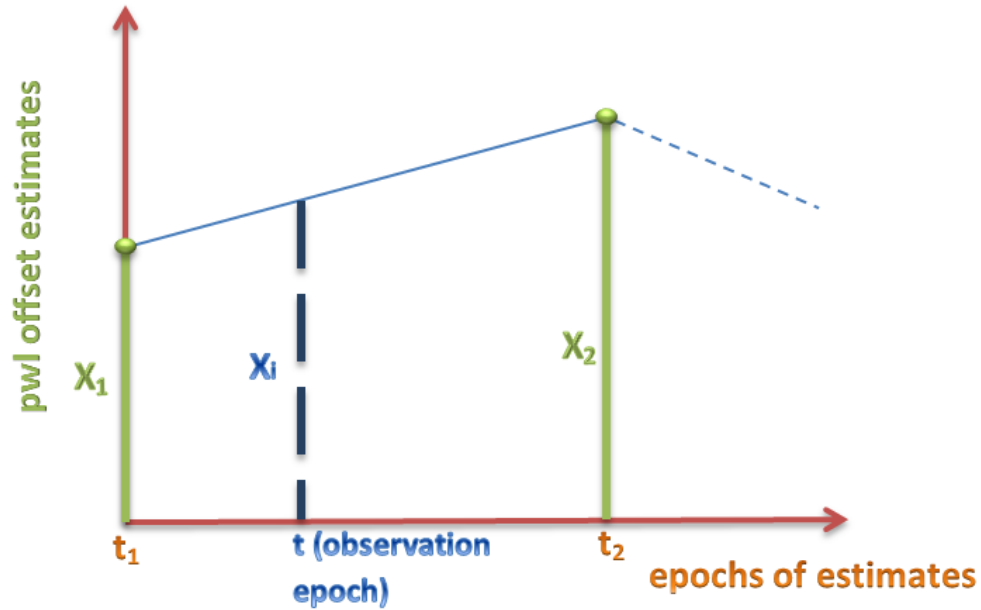
Introduction

- “vie_lsm” is a module of “VieVS”, which estimates geodetic parameters with least squares adjustment from VLBI observations.
- All the parameters can be estimated as piece-wise linear offsets (PWLO) in sub-daily and daily temporal resolution.

Estimated parameters per session are:

- Clocks (offset (cm), rate (cm/day), quadratic term (cm/day²), PWLO (cm)),
- Zenith wet delays (cm) as PWLO,
- Troposphere gradients (cm) as PWLO,
- EOP (mas and ms) as PWLO,
- Antenna coordinates in TRF (cm) as one offset per session (NNT + NNR) or as PWLO,
- Source coordinates in CRF (declinations in mas and right ascensions in ms) as one offset per session (NNR) or as PWLO.

PWLO function



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

Partial derivatives of the delay model w.r.t. a parameter's first and second offset

$$\frac{\partial \tau(t)}{\partial x_1} = \frac{\partial \tau(t)}{\partial x_i} \cdot \frac{\partial x_i}{\partial x_1} \rightarrow \frac{\partial x_i}{\partial x_1} = 1 - \frac{t - t_j}{t_{j+1} - t_j}$$

$$\frac{\partial \tau(t)}{\partial x_2} = \frac{\partial \tau(t)}{\partial x_i} \cdot \frac{\partial x_i}{\partial x_2} \rightarrow \frac{\partial x_i}{\partial x_2} = \frac{t - t_j}{t_{j+1} - t_j}$$

$$t_j < t < t_{j+1}$$

Least-Squares Adjustment in vie_lsm_v22

$$A = [A(1).sm \quad \cdots \quad A(15).sm] \quad \Rightarrow \quad \text{design matrix of real observation equations}$$

$$H = \begin{bmatrix} H(1).sm & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & H(15).sm \end{bmatrix} \quad \Rightarrow \quad \text{design matrix of pseudo-observation equations (constraints)}$$

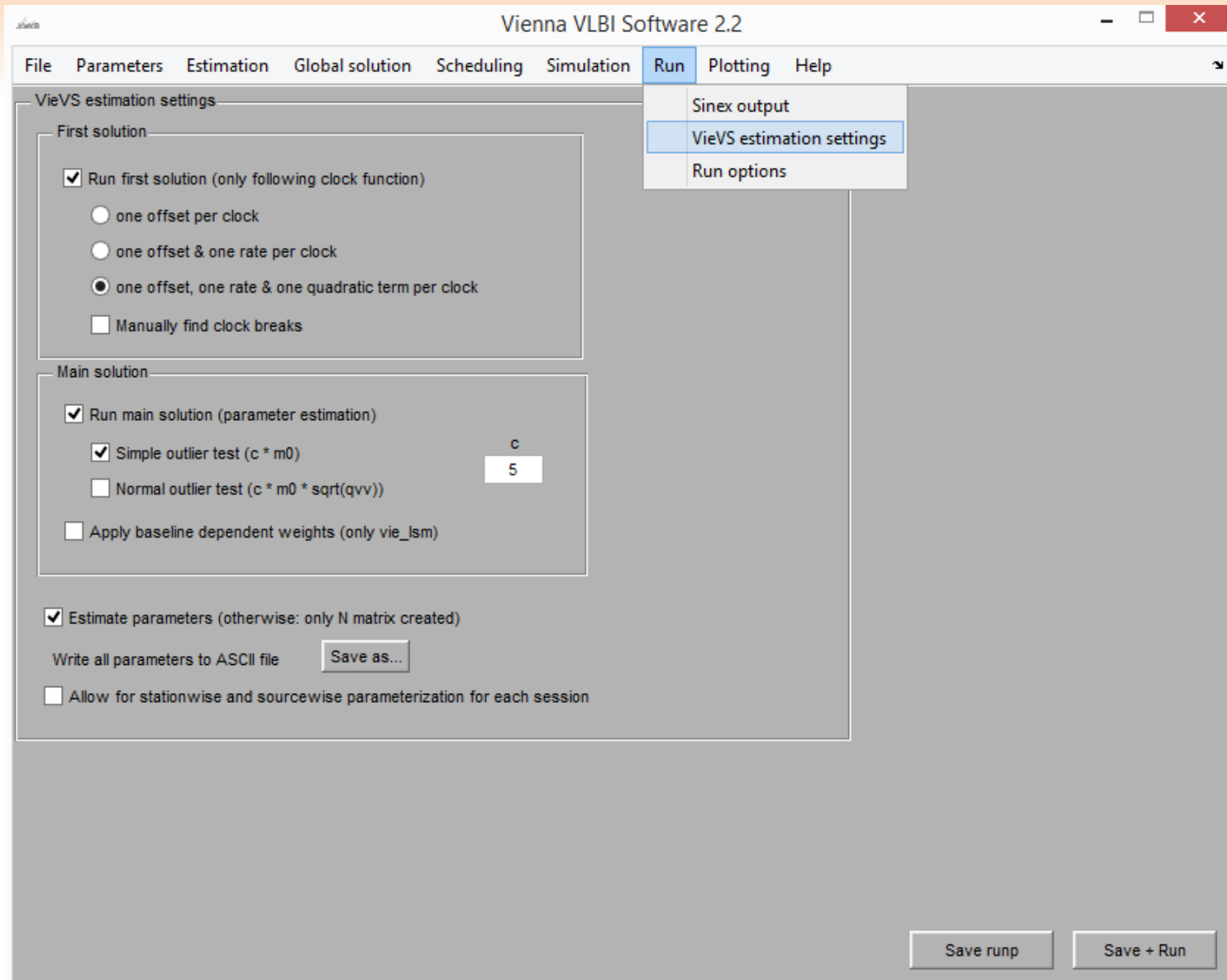
$$N = \begin{bmatrix} A^T P A + H^T P_H H & C^T \\ C & 0 \end{bmatrix} \quad b = \begin{bmatrix} A^T P o c + H^T P_H o c h \\ b_c \end{bmatrix} \quad \begin{array}{l} bc \text{ is a zero} \\ \text{vector} \\ \text{(due to NNT} \\ \text{and NNR} \\ \text{conditions)} \end{array}$$

parameter vector
(estimates)

$$x = N^{-1} b \quad m_0 = (v^T P v + v_H^T P_H v_H) / (n_{obs} + n_{constr} - n_{unk})$$

$$K_x = m_0 N^{-1} \quad \Rightarrow \quad \text{variance-covariance matrix of the estimates}$$

Reducing large clock errors and correcting clock breaks in a first least-squares solution



Reducing large clock errors and correcting clock breaks in a first least-squares solution

Vienna VLBI Software 2.2

File Parameters Estimation Global solution Scheduling Simulation Run Plotting Help

VieVS estimation settings

First solution

- ☒ Run first solution (only following clock function)
 - ☐ one offset per clock
 - ☐ one offset & one rate per clock
 - ☒ one offset, one rate & one quadratic term per clock
- ☐ Manually find clock breaks

Main solution

- ☒ Run main solution (parameter estimation)
- ☒ Simple outlier test ($c * m0$) c
5
- ☐ Normal outlier test ($c * m0 * \sqrt{qv}$)
- ☐ Apply baseline dependent weights (only vie_lsm)

☒ Estimate parameters (otherwise: only N matrix created)

Write all parameters to ASCII file Save as...

☐ Allow for stationwise and sourcewise parameterization for each session

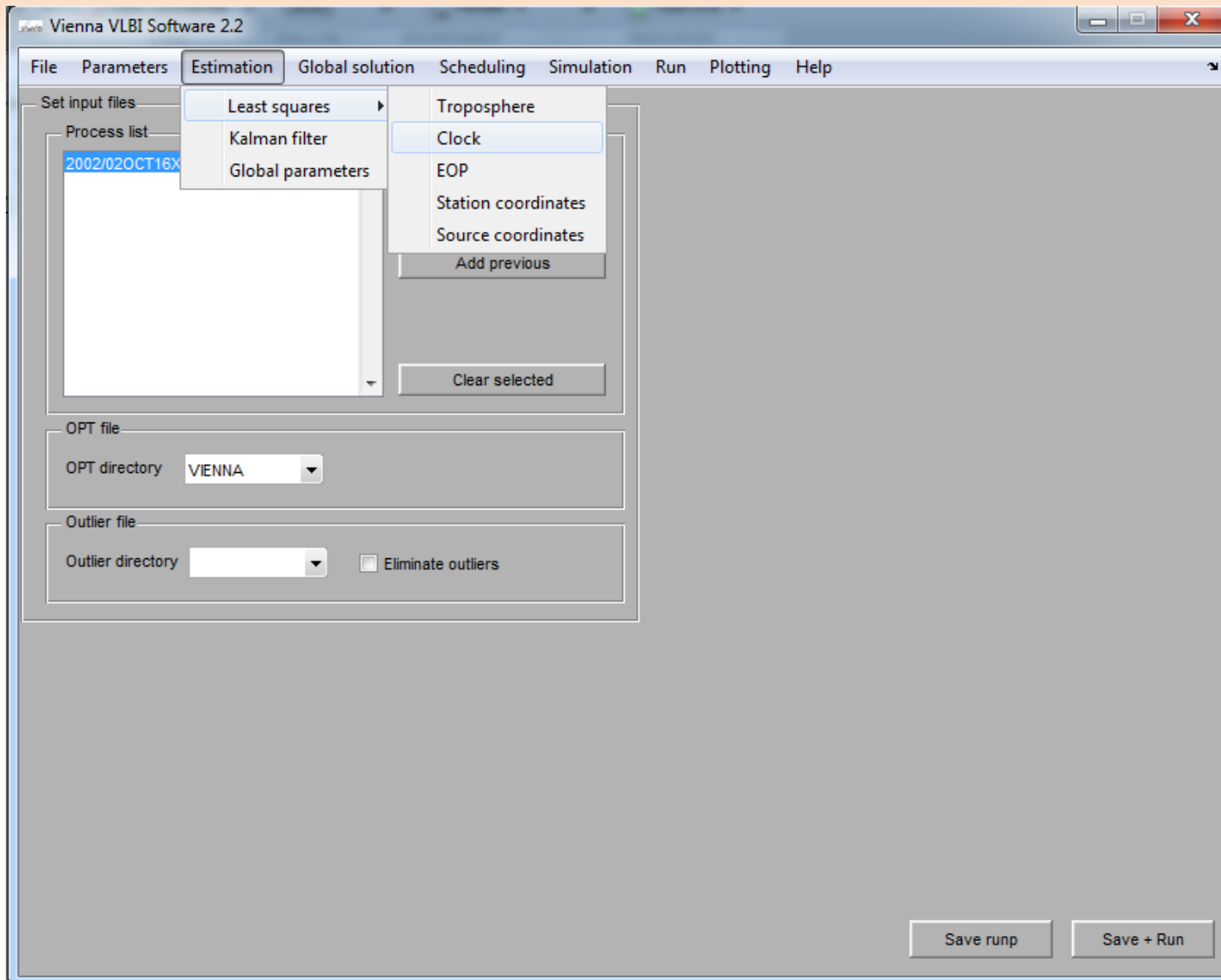
| | | |
|----------|----------|--------------------|
| KOKEE | MATERA | 56457.21302083333 |
| KOKEE | WETTZELL | 56457.141226851854 |
| KOKEE | MATERA | 56457.383483796293 |
| FORTLEZA | MATERA | 56457.416435185187 |
| KOKEE | MATERA | 56457.653912037036 |
| HOBART12 | TIGOCONC | 56456.884803240740 |
| KOKEE | NYALES20 | 56457.141226851854 |

A first LS solution is done for reducing large clock errors from the observations and for fixing clock breaks.

The graph illustrates the clock error over time. The y-axis is labeled 'Clock error' and the x-axis is labeled 'Time'. The timeline starts at 'Beginning of the session', followed by a 'First clock break', then a 'Second clock break', and ends at 'End of the session'. Three polynomial segments are shown: 'First clock polynomial' (purple), 'Second clock polynomial' (blue), and 'Third clock polynomial' (orange). Each segment represents a linear fit to the clock error data between consecutive clock breaks.

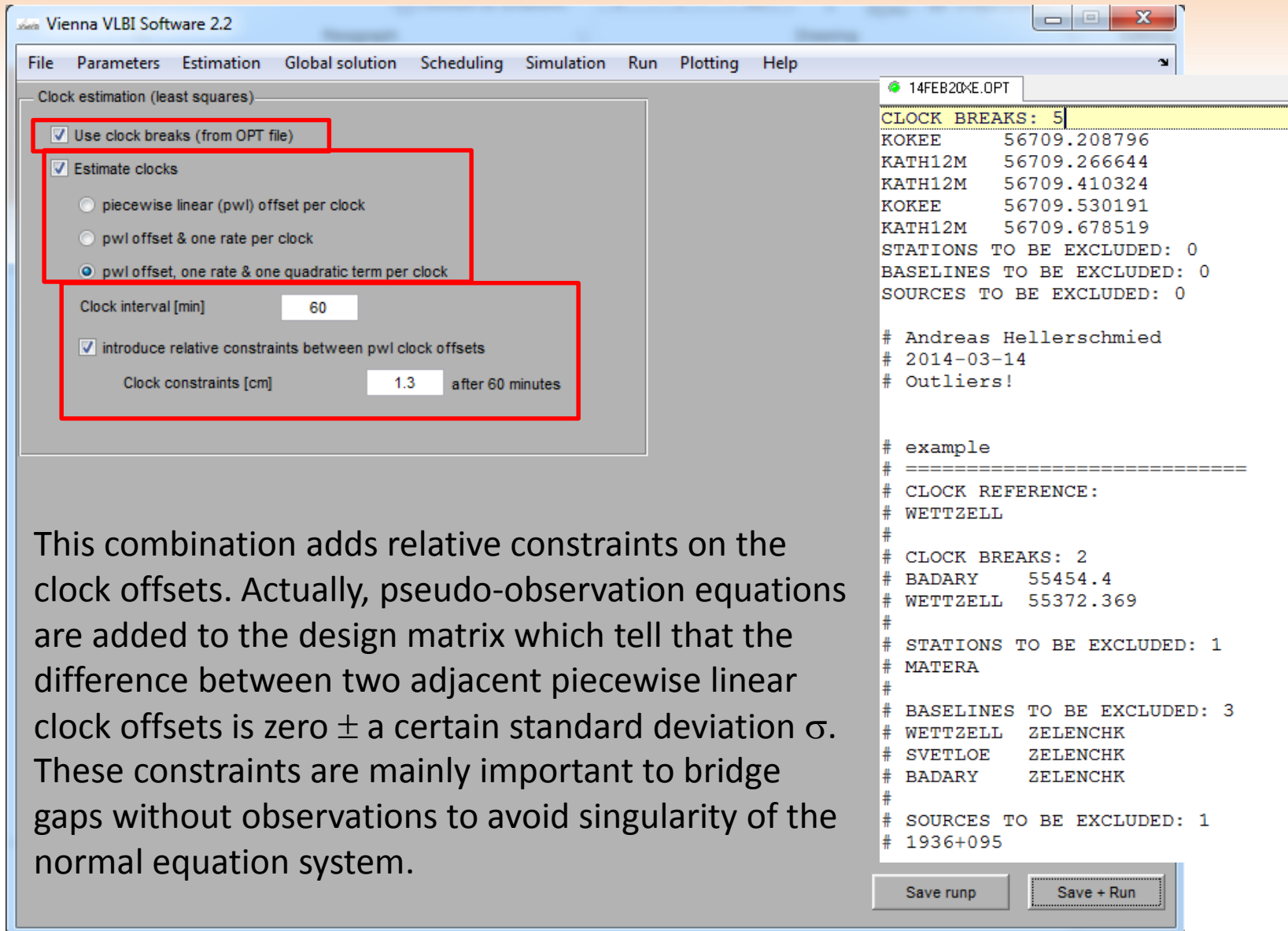
Save runp Save + Run

Parameterisation of Least-Squares Adjustment in VieVS



Clocks

(Coefficients of a quadratic function and PWLO)



The screenshot shows the Vienna VLBI Software 2.2 interface. The 'Clock estimation (least squares)' panel is active, with the following settings:

- ☒ Use clock breaks (from OPT file)
- ☒ Estimate clocks
 - ☐ piecewise linear (pwl) offset per clock
 - ☐ pwl offset & one rate per clock
 - ☒ pwl offset, one rate & one quadratic term per clock
- Clock interval [min]: 60
- ☒ introduce relative constraints between pwl clock offsets
 - Clock constraints [cm]: 1.3 after 60 minutes

The log window on the right displays the following output:

```

14FEB20XE.OPT
CLOCK BREAKS: 5
ROKKEE      56709.208796
KATH12M     56709.266644
KATH12M     56709.410324
ROKKEE      56709.530191
KATH12M     56709.678519
STATIONS TO BE EXCLUDED: 0
BASELINES TO BE EXCLUDED: 0
SOURCES TO BE EXCLUDED: 0

# Andreas Hellerschmied
# 2014-03-14
# Outliers!

# example
# =====
# CLOCK REFERENCE:
# WETTZELL
#
# CLOCK BREAKS: 2
# BADARY      55454.4
# WETTZELL    55372.369
#
# STATIONS TO BE EXCLUDED: 1
# MATERA
#
# BASELINES TO BE EXCLUDED: 3
# WETTZELL    ZELENCHK
# SVETLOE     ZELENCHK
# BADARY      ZELENCHK
#
# SOURCES TO BE EXCLUDED: 1
# 1936+095
  
```

Buttons at the bottom right: Save runp, Save + Run

This combination adds relative constraints on the clock offsets. Actually, pseudo-observation equations are added to the design matrix which tell that the difference between two adjacent piecewise linear clock offsets is zero \pm a certain standard deviation σ . These constraints are mainly important to bridge gaps without observations to avoid singularity of the normal equation system.

Troposphere delays

(Zenith wet delays, north and east gradients)

Vienna VLBI Software 2.2

File Parameters Estimation Global solution Scheduling Simulation Run Plotting Help

Troposphere estimation (least squares)

Zenith wet delays

☒ Estimate zenith wet delays

ZWD interval [min]

☒ introduce relative constraints between pwl zenith wet delay offsets

ZWD constraints [cm] after 60 minutes

Gradients

☒ Estimate north gradients

NGR interval [min]

☒ introduce relative constraints between pwl NGR offsets

NGR constraints [cm] after 360 minutes

☐ introduce absolute constraints between pwl NGR offsets

NGR abs. constr. [cm]

☒ Estimate east gradients

EGR interval [min]

☒ introduce relative constraints between pwl EGR offsets

EGR constraints [cm] after 360 minutes

☐ introduce absolute constraints between pwl EGR offsets

EGR abs. constr. [cm]

Save runp Save + Run

reduced from
observations a
priori to the
adjustment

$$\Delta \tau_{trop}(\alpha, \varepsilon) = ZHD m_h(\varepsilon) + ZWD m_w(\varepsilon) + m_w(\varepsilon) \cot(\varepsilon) [G_n \cos(\alpha) + G_e \sin(\alpha)]$$

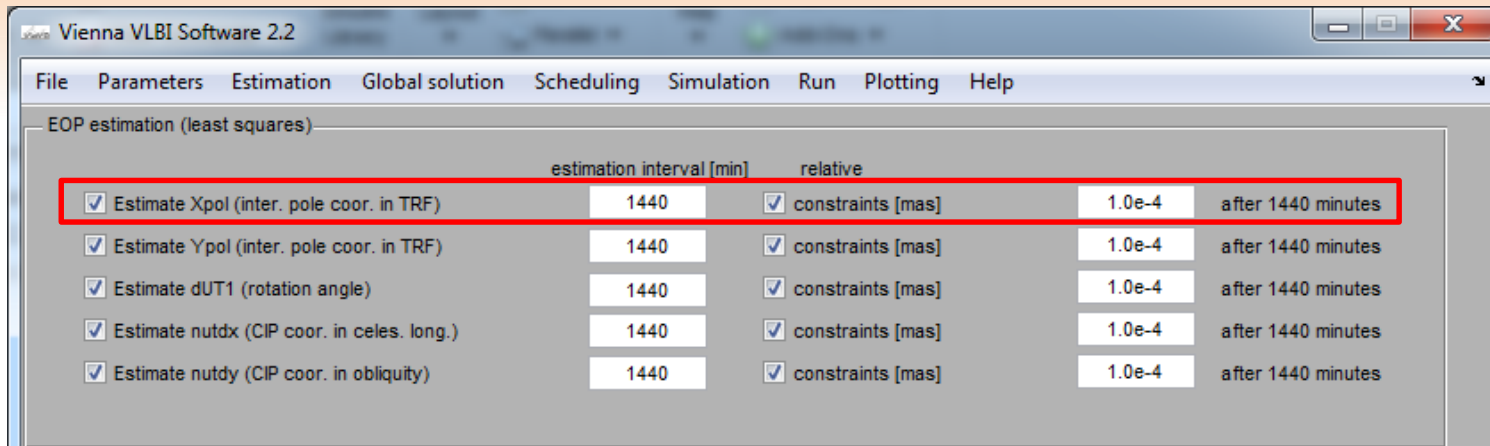
estimated

estimated

estimated

e.g. MacMillan 1995

Earth Orientation Parameters



| | estimation interval [min] | relative |
|---|---------------------------|---|
| <input checked="" type="checkbox"/> Estimate Xpol (inter. pole coord. in TRF) | 1440 | <input checked="" type="checkbox"/> constraints [mas] 1.0e-4 after 1440 minutes |
| <input checked="" type="checkbox"/> Estimate Ypol (inter. pole coord. in TRF) | 1440 | <input checked="" type="checkbox"/> constraints [mas] 1.0e-4 after 1440 minutes |
| <input checked="" type="checkbox"/> Estimate dUT1 (rotation angle) | 1440 | <input checked="" type="checkbox"/> constraints [mas] 1.0e-4 after 1440 minutes |
| <input checked="" type="checkbox"/> Estimate nutdx (CIP coord. in celes. long.) | 1440 | <input checked="" type="checkbox"/> constraints [mas] 1.0e-4 after 1440 minutes |
| <input checked="" type="checkbox"/> Estimate nutdy (CIP coord. in obliquity) | 1440 | <input checked="" type="checkbox"/> constraints [mas] 1.0e-4 after 1440 minutes |

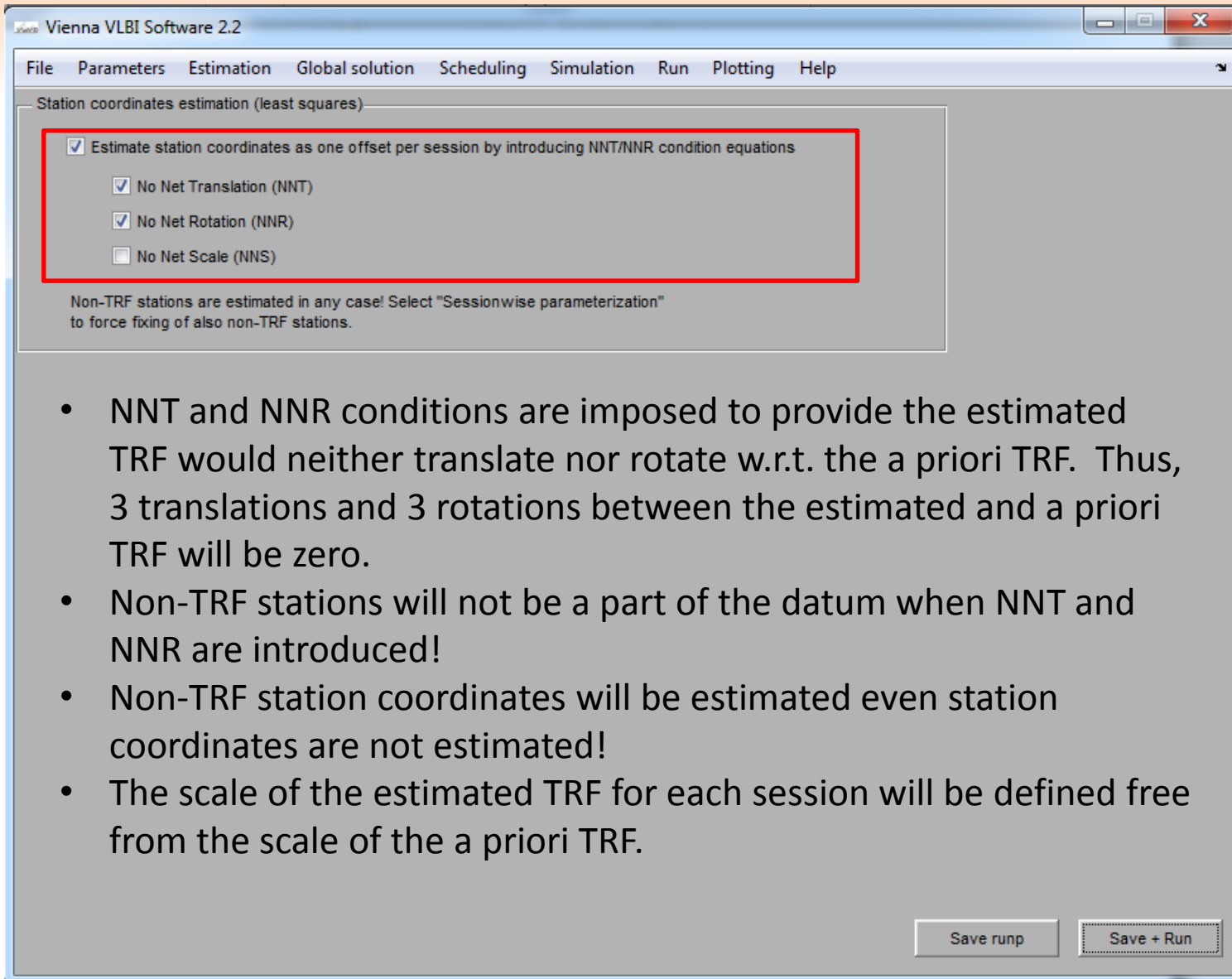
If you want to estimate one constant value per session, the recommendation is to set the parameterization as shown above. Very strong relative constraints of $1\text{e-}4$ m(a)s/day take care that the estimates are the same over the session.

Example: The session is from 18 UT to 18 UT. Then, three piecewise linear offsets are set up for each EOP. (They are set up a midnight before the session, at midnight during the session, and at midnight after the session.) The strong constraints take care that all three estimates per session are the same.

Save runp

Save + Run

Antenna TRF coordinates



Vienna VLBI Software 2.2

File Parameters Estimation Global solution Scheduling Simulation Run Plotting Help

Station coordinates estimation (least squares)

- ☒ Estimate station coordinates as one offset per session by introducing NNT/NNR condition equations
 - ☒ No Net Translation (NNT)
 - ☒ No Net Rotation (NNR)
 - ☐ No Net Scale (NNS)

Non-TRF stations are estimated in any case! Select "Sessionwise parameterization" to force fixing of also non-TRF stations.

- NNT and NNR conditions are imposed to provide the estimated TRF would neither translate nor rotate w.r.t. the a priori TRF. Thus, 3 translations and 3 rotations between the estimated and a priori TRF will be zero.
- Non-TRF stations will not be a part of the datum when NNT and NNR are introduced!
- Non-TRF station coordinates will be estimated even station coordinates are not estimated!
- The scale of the estimated TRF for each session will be defined free from the scale of the a priori TRF.

Save runp Save + Run

Source CRF coordinates

Vienna VLBI Software 2.2

File Parameters Estimation Global solution Scheduling Simulation Run Plotting Help

Source estimation (least squares)

estimation interval [min] 1440

☒ Estimate source coordinates as pwl offsets ☒ relative constraints [mas] 1.0e-4 after 1440 minutes

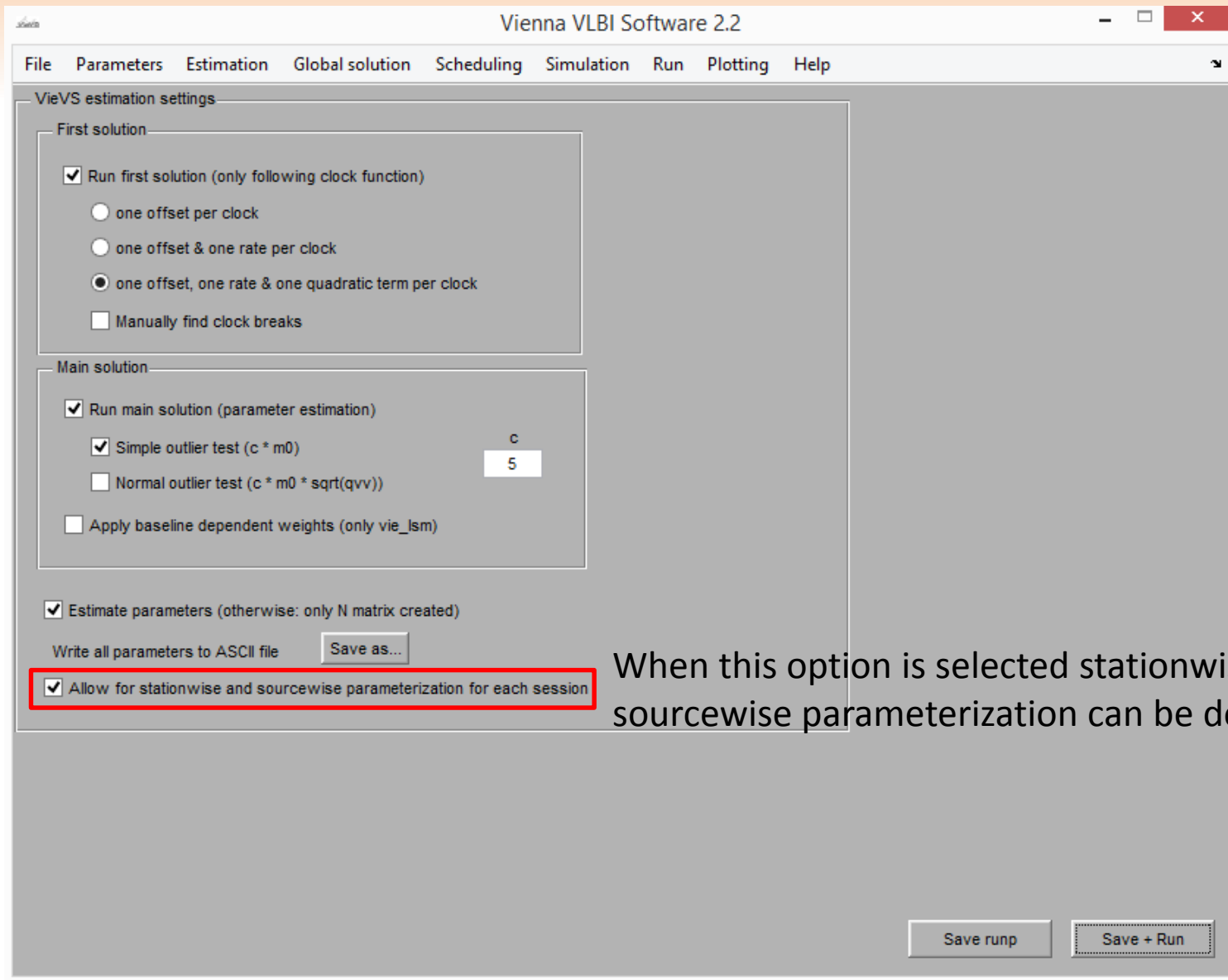
Only non-CRF sources are estimated if this checkbox is ticked (select "Sessionwise parameterization" if you want otherwise...)

☐ Estimate coordinates of all sources with NNR condition

(only sources in the catalogue are included in the NNR condition)

Save runp Save + Run

Stationwise and sourcewise parameterization for each session



When this option is selected stationwise and sourcewise parameterization can be done!

Reference clock selection for first LS

Untitled

vie_lsm [single session first solution]

parameterization for removing large clock errors

- ☒ apply first basic solution (only with clock function)
 - ☐ one offset per clock
 - ☐ one offset & one rate per clock
 - ☒ one offset, one rate, & one quadratic term per clock
- ☒ use clock breaks (From OPT file)

reference clock for the first solution

WESTFORD ▼

- WESTFORD
- WETTZELL
- HARTRAO
- KOKEE
- NYALES20
- ONSALA60
- GILCREEK
- ALGOPARK

main solution

- ☒ apply main solution
 - ☒ simple outlier test [coefficient * mo] coefficient 5
 - ☐ basic outlier test [coefficient * mo * sqrt(qw)]

clock/s that have breaks in the session

WETTZELL
ONSALA60

Next

Stationwise clock parameterization

vie_lsm_gui_clock

vie_lsm [single session clocks]

parameterization for clocks

- ☒ estimate clocks
 - ☐ piecewise linear (pwl) offsets per clock
 - ☐ pwl offsets & one rate per clock
 - ☒ pwl offsets, one rate, & one quadratic term per clock
- ☒ introduce relative constraints between pwl clock offsets

- Default reference clock has not any clock break.
- Reference clock is the first clock in the NGS file
OR if any OPT file of the session exists fixed clock is from OPT file
- Unit of clock estimation intervals is minutes.
- Unit of clock constraints is centimeters
E.g. 1.3 cm after 1 hour is relatively loose.

| | clock constraints | clock interval | reference clock |
|----------|-------------------|----------------|-------------------------------------|
| WESTFORD | 1.3000 | 60 | <input checked="" type="checkbox"/> |
| WETTZELL | 1.3000 | 60 | <input type="checkbox"/> |
| HARTRAO | 1.3000 | 60 | <input type="checkbox"/> |
| KOKEE | 1.3000 | 60 | <input type="checkbox"/> |
| NYALES20 | 1.3000 | 60 | <input type="checkbox"/> |
| ONSALA60 | 1.3000 | 60 | <input type="checkbox"/> |
| GILCREEK | 1.3000 | 60 | <input type="checkbox"/> |
| ALGOPARK | 1.3000 | 60 | <input type="checkbox"/> |

Back Next

Stationwise troposphere delay parameterization

vie_lsm_gui_tropo

vie_lsm [single session troposphere]

apply relative constraints between tropospheric offset estimates

☒ introduce RELATIVE CONSTRAINTS between pwl ZENITH WET DELAY offsets
☒ introduce REALTIVE CONSTRAINTS between pwl tropo. NORTH GRADIENT offsets
☒ introduce RELATIVE CONSTRAINTS between pwl tropo. EAST GRADIENT offsets
☐ introduce ABSOLUTE CONSTRAINTS between pwl tropo. NORTH GRADIENT offsets
☐ introduce ABSOLUTE CONSTRAINTS between pwl tropo. EAST GRADIENT offsets

- unit of estimation intervals is minute.

- unit of ZWD relative constraints is cm e.g. 1.5 cm after 1 hour is relatively loose.

- unit of NGR & EGR relative constraints is cm, e.g. 0.05 cm after 6 hours is relatively loose.

- unit of NGR & EGR absolute constraints is cm, e.g. 0.1 cm absolutely loose.

| | ZWD coef. | NGR rel. coef. | EGR rel. coef. | NGR abs. coef. | EGR abs. coef. | ZWD int. | NGR int. | EGR int. | est. ZWD | est. NGR | est. EGR |
|----------|-----------|----------------|----------------|----------------|----------------|----------|----------|----------|-------------------------------------|-------------------------------------|-------------------------------------|
| WESTFORD | 1.5000 | 0.0500 | 0.0500 | 0.1000 | 0.1000 | 60 | 360 | 360 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| WETTZELL | 1.5000 | 0.0500 | 0.0500 | 0.1000 | 0.1000 | 60 | 360 | 360 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| HARTRAO | 1.5000 | 0.0500 | 0.0500 | 0.1000 | 0.1000 | 60 | 360 | 360 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| KOKEE | 1.5000 | 0.0500 | 0.0500 | 0.1000 | 0.1000 | 60 | 360 | 360 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| NYALES20 | 1.5000 | 0.0500 | 0.0500 | 0.1000 | 0.1000 | 60 | 360 | 360 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| ONSALA60 | 1.5000 | 0.0500 | 0.0500 | 0.1000 | 0.1000 | 60 | 360 | 360 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| GILCREEK | 1.5000 | 0.0500 | 0.0500 | 0.1000 | 0.1000 | 60 | 360 | 360 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| ALGOPARK | 1.5000 | 0.0500 | 0.0500 | 0.1000 | 0.1000 | 60 | 360 | 360 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

ZWD(t2)-ZWD(t1)=0±σ cm

NGR(ti) =0±σ cm

Back

Next

$$\text{NGR}(t_2) - \text{NGR}(t_1) = 0 \pm \sigma \text{ cm}$$

Antenna TRF coordinates are estimated as one offset per session (NNT and NNR constraints on some of the antenna coordinates)

vie_lsm_gui_statcoor

vie_lsm [single session station coordinates]

general options for estimation of stations coordinates

☒ estimate station coordinates

☒ one offset per session

☒ NNT/NNR

☐ Fix some stations

☐ pwl offsets per session

| | NNT | NNR | NNS | XYZ_est | constraints | coord. intervals |
|----------|-------------------------------------|-------------------------------------|--------------------------|-------------------------------------|-------------|------------------|
| WESTFORD | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| WETZELL | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| HARTRAO | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| KOKEE | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| NYALES20 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| ONSALA60 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| GILCREEK | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| ALGOPARK | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |

Unit of TRF relative constraints is cm, e.g. 10 cm after 6 hours is relatively loose.

Back Next

Antenna TRF coordinates are estimated as one offset per session (some antenna coordinates are fixed to their apriori coordinates)

vie_lsm_gui_statcoor

vie_lsm [single session station coordinates]

general options for estimation of stations coordinates

☒ estimate station coordinates

☒ one offset per session

☐ NNT/NNR

☒ Fix some stations

☐ pwl offsets per session

| | NNT | NNR | NNS | XYZ_est | constraints | coord. intervals |
|----------|-------------------------------------|-------------------------------------|--------------------------|-------------------------------------|-------------|------------------|
| WESTFORD | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 10 | 360 |
| WETTZELL | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 10 | 360 |
| HARTRAO | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| KOKEE | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| NYALES20 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| ONSALA60 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 10 | 360 |
| GILCREEK | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| ALGOPARK | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |

Unit of TRF relative constraints is cm, e.g. 10 cm after 6 hours is relatively loose.

Back Next

Antenna TRF coordinates as PWLO

vie_lsm_gui_statcoor

vie_lsm [single session station coordinates]

general options for estimation of stations coordinates

☒ estimate station coordinates

☐ one offset per session

☒ pwl offsets per session

☒ Fix some stations

☒ introduce relative constraints between pwl coordinate offsets

| | NNT | NNR | NNS | XYZ_est | constraints | coord. intervals |
|----------|-------------------------------------|-------------------------------------|--------------------------|-------------------------------------|-------------|------------------|
| WESTFORD | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 10 | 360 |
| WETTZELL | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 10 | 360 |
| HARTRAO | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |
| KOKEE | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 20 | 60 |
| NYALES20 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 50 | 60 |
| ONSALA60 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 10 | 360 |
| GILCREEK | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 5 | 180 |
| ALGOPARK | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 10 | 360 |

Unit of TRF relative constraints is cm, e.g. 10 cm after 6 hours is relatively loose.

Back Next

In this option,

- Troposphere delays and antenna TRF positions are highly correlated, e.g. for 1h or 2h segments, caused by inhomogeneous sky distribution of the observations. Due to this large correlations, troposphere delays propagate into antenna positions in parameter estimation.

Source CRF coordinates as PWLO

vie_lsm_gui_sourcoord

vie_lsm [single session source coordinates]

☒ estimate coordinates of sources as pwl offsets [all the unselected sources will be fixed to CRF]

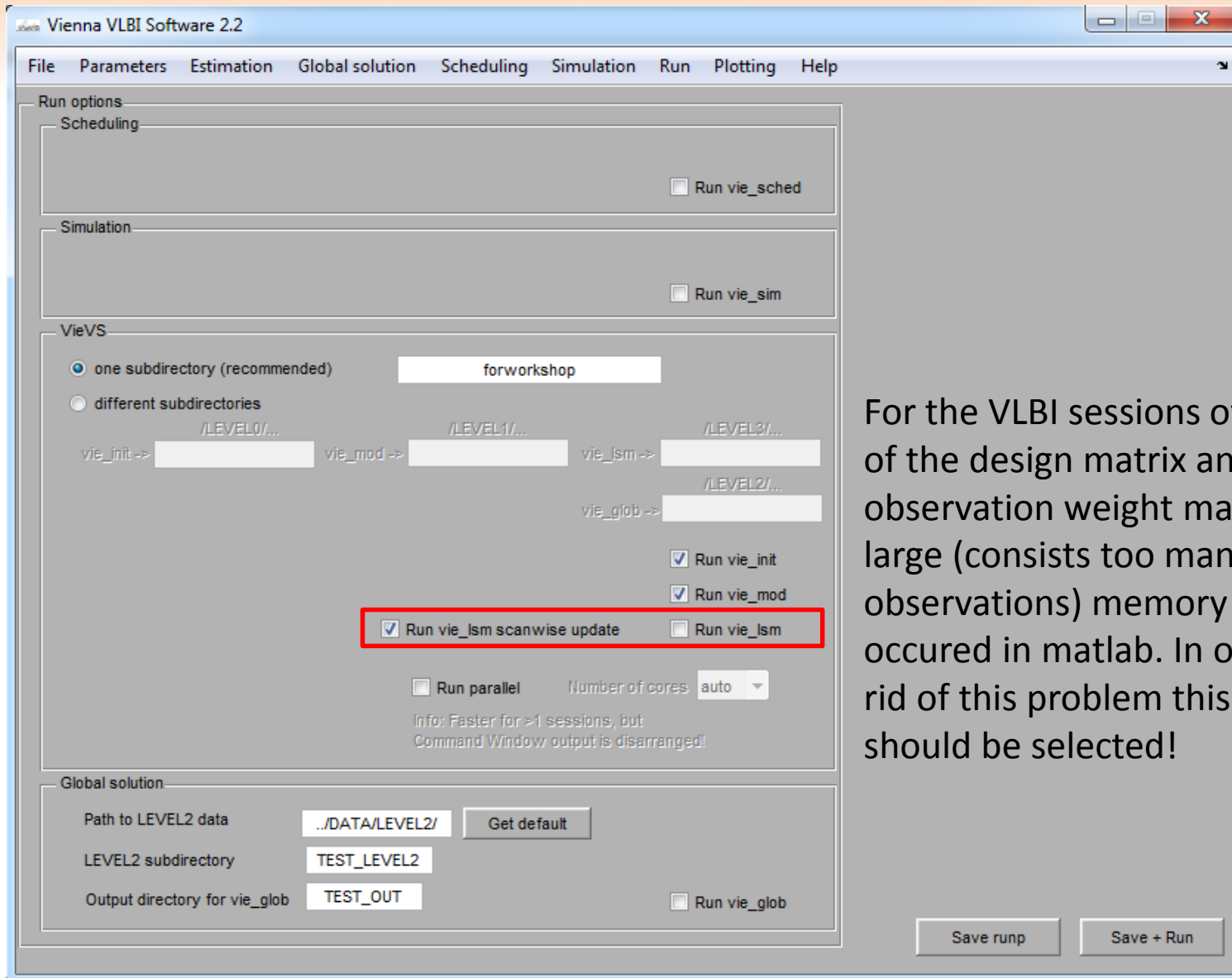
☒ introduce relative constraints between pwlo source coordinates

- unit of constraints is mas.
- unit of coordinate estimation intervals in minutes.
- Please, fix at least one source which has more than 1 observation
if you select estimate sources
- Non-CRF sources will be estimated as default.

| | source name | total observations | est. coord. | constraints | coord. interval |
|----|-------------|--------------------|-------------------------------------|-------------|-----------------|
| 13 | 1606+106 | 96 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 14 | NRAO512 | 98 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 15 | 1044+719 | 17 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 16 | 0003-066 | 18 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 17 | 1219+044 | 20 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 18 | 0235+164 | 146 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 19 | 0955+476 | 84 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 20 | 0823+033 | 4 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 21 | 2234+282 | 89 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 22 | 1357+769 | 172 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 23 | 0743+259 | 36 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 24 | CTA26 | 60 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 25 | 0552+398 | 211 | <input checked="" type="checkbox"/> | 1 | 60 |
| 26 | 1519-273 | 6 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 27 | 1300+580 | 131 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 28 | 0048-097 | 12 | <input type="checkbox"/> | 1.0000e-04 | 1440 |
| 29 | 1923+210 | 18 | <input type="checkbox"/> | 1.0000e-04 | 1440 |

Back Next

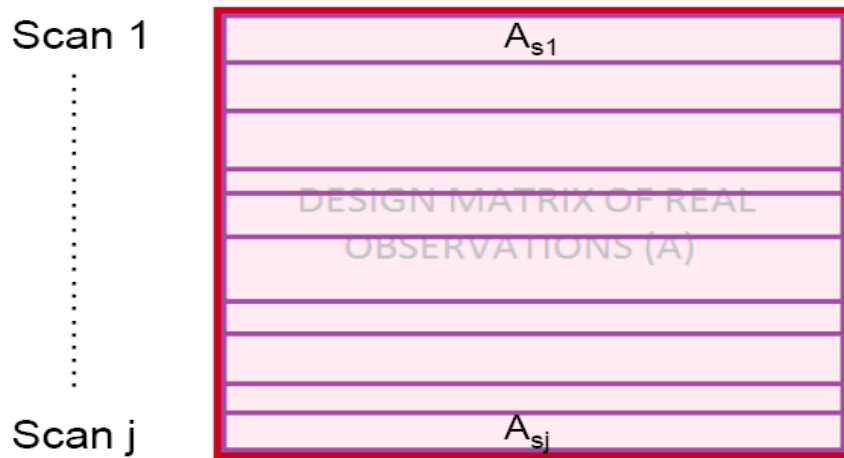
vie_lsm scan-wise update



For the VLBI sessions of which size of the design matrix and observation weight matrix is too large (consists too many observations) memory error occurred in matlab. In order to get rid of this problem this option should be selected!

Scan-wise update of normal equation system

1 A-matrix per scan



$$N_{s1} = A_{s1}^T \cdot P_{s1} \cdot A_{s1}$$

$$N_A = N_{s1} + N_{s2} + \dots + N_{sj}$$

$$b_{s1} = A_{s1}^T \cdot P_{s1} \cdot oc_{s1}$$

$$b_A = b_{s1} + b_{s2} + \dots + b_{sj}$$

j : number of scans in the session

$$N = A^T \cdot P \cdot A \quad \rightarrow \quad N = N_A + N_H$$

$$b = A^T \cdot P \cdot oc \quad \rightarrow \quad b = b_A + b_H$$

$$x = N^{-1} \cdot b$$

The work was done by Claudia Tierno Ros. This slide is from her presentation which was prepared for the Third VieVS user workshop, 11-13 September, 2012

Conclusions

- vie_lsm corrects clock breaks and detects outlier observations.
- vie_lsm provides SINEX input and datum free normal equations for global solutions.
- PWLO estimates of VieVS are in a good agreement with those derived from other space geodetic techniques.
- Scan-wise update of normal equation system ensures a successful process of the future sessions with lots of observations.

Thanks for your attention!