TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

VIE_GLOB

Hana Spicakova

VieVS User Workshop

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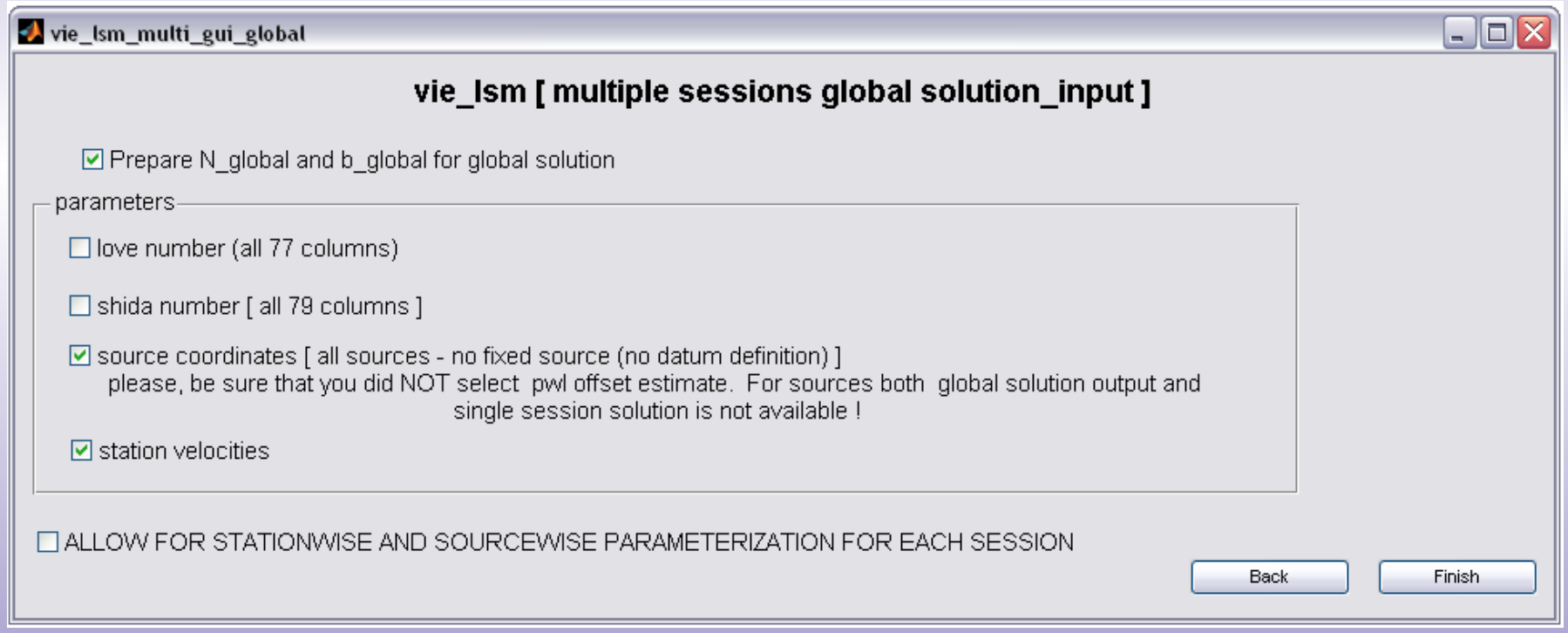
Vienna

Vie_glob 1c

- compatible with VieVS Version 1c



How to run Vie_glob

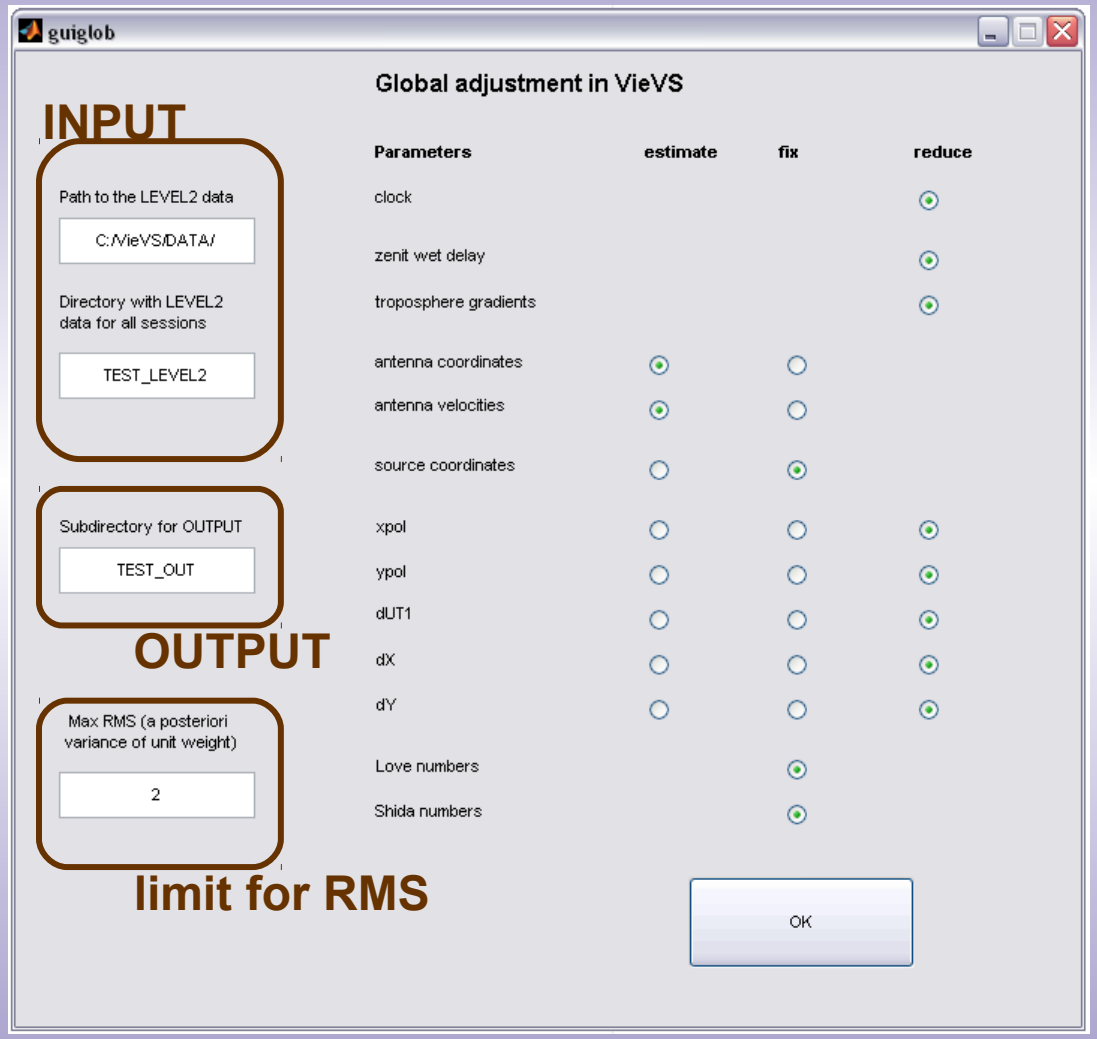
- VieVS/COMPILE/
  VIE_GLOB/vie_glob.m

- *TEST_OUT* will be created in
  VieVS/OUT/GLOB/_ESTIMATES/
  _PLOTS/
  CRF/
  TRF/

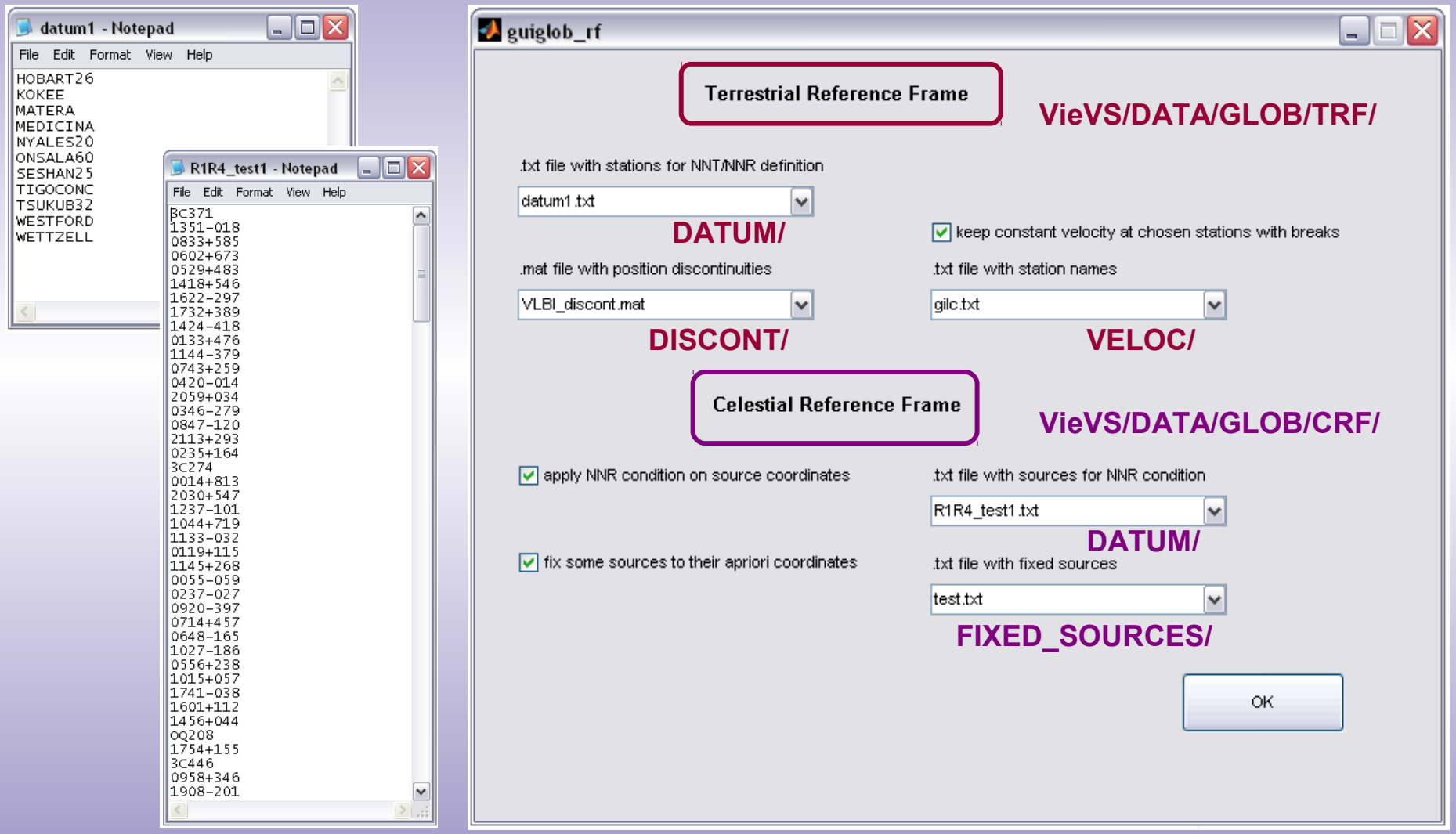
- RMS – „a posteriori variance of unit weight“

$$\sigma_0 = \sqrt{\frac{v^T P v}{n - u + c}}$$

only sessions with a lower RMS will be used in the global adjustment



GUI for RF
Definition of datum



Theoretical background

- Sort parameters in the N-matrix and b-vector
- Reduction of parameters
  - always reduced: clock parameters, zwd and troposhere gradients
  - can be reduced: EOP

$$\begin{bmatrix} N_{11} & N_{12} \\ N_{21} & N_{22} \end{bmatrix} \cdot \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

estimated p.

reduced p.

$$N_{reduc} = N_{11} - N_{12} \cdot N_{22}^{-1} \cdot N_{21}$$

$$b_{reduc} = b_1 - N_{12} \cdot N_{22}^{-1} \cdot b_2$$

- Stacking of the reduced normal equation systems

$$N = N_{reduc\_1} + N_{reduc\_2} + \ldots + N_{reduc\_nse}$$

$$b = b_{reduc\_1} + b_{reduc\_2} + \ldots + b_{reduc\_nse}$$

Datum definition

- Station coordinates and velocities
  - constrained 12 parameters Helmert transformation (3 translation and 3 rotation components + their time derivatives w.r.t. time), i.e., **NNT/NNR** condition

- Source coordinates
  - 4-parameters transformation (**3 rotations** (A_1, A_2, A_3) around X, Y and Z axis and a parameter *dz* accounting for a global **translation** of the source coordinates **in declination**, caused e.g. by inaccuracy of the tropospheric propagation correction for sources observed at low elevations) (Feissel-Vernier et al. (2006))
  - fixing selected sources to a priori coordinates

Final solution

- Jacobian matrix $H = \left(BB^T\right)^{-1} B$
- applying of the constraints

$$N^C_{REDUC} = N_{REDUC} + \left(H^T H\right)$$

$$b^C_{REDUC} = b_{REDUC} + \left(H^T h\right) = b_{REDUC}$$

$h = 0$ (requirement of free-network constraints)

- final solution

$$dx_1 = \left(N^C_{REDUC}\right)^{-1} \cdot b_{REDUC}$$

- estimates are stored as a structure array in Matlab format and as a txt file
  - VieVS/OUT/GLOB/_ESTIMATES/*TEST_OUT*/
    - globsol_*TEST_LEVEL2*.mat
    - glob_results_*TEST_LEVEL2*.txt

Estimates (example)

glob_results_R1R42010_ofic - Notepad

File Edit Format View Help

```
 % Sessions in the solution
10JAN04XA_N004
10JAN07XE_N004
10JAN11XA_N004
10JAN14XE_N004
10JAN19XA_N004
10JAN21XE_N004
10JAN25XA_N004
10JAN28XE_N004
10FEB01XA_N004
10FEB04XE_N004
10FEB08XA_N004
10FEB11XE_N004
10FEB16XA_N004
10FEB18XE_N004
10FEB22XA_N004
10FEB25XE_N004

 % Number of sessions in the global adjustment
16

 % Maximal RMS of the sessions in the solution
2.00

 % Sessions which were excluded from the solution (RMS > 2.00)


 % Corrections to station coordinates and standard dev. in [cm]

 % station        dx        dy        dz        mx        my        mz       epoch    start      end
BADARY          1.12     -0.62     -0.31      1.21      1.11      1.06       51544        0    99999
HOBART26        0.01      0.05     -0.30      1.11      1.17      1.08       51544        0    99999
KOKEE           0.71      0.17     -0.20      0.96      1.17      1.16       51544        0    99999
MATERA         -0.64     -0.30     -0.84      1.04      1.19      1.08       51544        0    99999
MEDICINA       -1.18     -0.88     -0.35      1.11      1.22      1.13       51544    50265    99999
NYALES20        0.30      0.18     -0.15      1.19      1.20      0.87       51544        0    99999
ONSALA60        0.39      0.15      0.47      1.12      1.20      0.98       51544        0    99999
PARKES         -3.97      1.52     -0.83      2.59      1.94      1.96       51544        0    99999
SESHAN25        0.16      1.51      1.18      1.15      1.04      1.13       51544        0    99999
TIGOCONC        0.66     -0.73     -0.17      1.20      1.07      1.14       51544        0    55253
TSUKUB32       -0.61     -0.51      0.16      1.08      1.12      1.10       51544    51299    99999
WESTFORD        0.30      0.51      0.23      1.19      1.05      1.07       51544        0    99999
WETTZELL       -0.09     -0.16     -0.02      1.07      1.20      1.02       51544        0    99999
ZELENCHK       -1.23     -1.01     -1.32      1.12      1.14      1.08       51544    54282    99999


 % Corrections to station velocities and standard dev. in [cm/y]

 % station       dvx       dvy       dvz       mvx       mvy       mvz       epoch    start      end

 % datum definition (NNT+NNR)
HOBART26
KOKEE
MATERA
MEDICINA
NYALES20
ONSALA60
SESHAN25
TIGOCONC
TSUKUB32
WESTFORD
WETTZELL


 % Corrections to source coordinates and standard dev. in [mas]
```

names of sessions

number of sessions

sessions with RMS>maxRMS

stations which were used for NNT/NNR

VieVS/OUT/GLOB/_ESTIMATES/*TEST_OUT*/glob_results_*TEST_LEVEL2*.txt

corrections to station a priori coordinates and their standard deviations [cm]

epoch of the coordinates [mjd]

start, end [mjd] of the interval (time between breaks)

corrections to station a priori velocities and their standard deviations [cm/y]

Estimates (example)

glob_results_R1R42010_ofic - Notepad

File Edit Format View Help

```
 % Corrections to source coordinates and standard dev. in [mas]

 % source            RA          De          mRA         mDe
0003-066         -0.2818     -0.4968      0.9018      0.9205
0007+171         15.9524      0.9487      9.6987      1.0439
0014+813         -0.4269      0.1307      5.8846      0.8592
0019+058         -0.0420     -0.1660      0.9089      0.8677
0035-252          0.0800      0.3281      0.9852      0.8632
0039+230         -0.2491      0.1208      0.9896      0.8721
0048-097          0.1237      0.3528      0.9122      0.8914
0048-427          0.1964     -0.3388      1.2226      0.8780
0055-059         -0.0525     -0.2459      0.9180      0.8667
0059+581          0.0038      0.0059      1.6727      0.8590
0104-408          0.0026      0.0739      1.1526      0.8638
0106+013         -0.1063      0.2044      0.8974      0.8614
0109+224         -0.1922      0.0603      0.9961      0.9023
0115-214          0.1080      0.2246      1.1750      0.8769
0119+041         -0.8533      0.7275      1.3225      1.0775
0119+115         -0.1309      0.4121      0.9213      0.8964
0131-522         -1.1462      0.8478      2.2540      1.0386
0133+476         -0.0727      0.0908      1.3162      0.8588
0134+311         -0.2554      0.2416      1.0492      0.8713
0206+136          0.0681     -0.0870      0.9745      0.8857
0208-512          0.7664     -0.3476      1.7078      0.9544
0215+015         -0.1541      0.2825      0.8980      0.8628
0219+428          0.0910      0.3579      1.2145      0.8642
0227-369         -0.1734      0.6151      1.1467      0.8704
0235+164         -0.1326      0.1928      0.9353      0.8593
0237-027          0.0198      0.4077      0.9055      0.8642
0256-005         -0.0118     -0.0752      0.8999      0.8640
0302+625          1.                                     097
0307+380         -0.                                     589
0322+222          0.                                     532
0332+078          0.                                     769
0332-403          2.                                     366
0338-214          1.                                     131
0345+460         -0.                                     596
0346-279         -0.                                     618
0347-211         -0.                                     640
0358+210         -0.                                     685
0400-319          0.                                     538
0405-385         -0.                                     859
0406+121         -0.                                     089
0414-189         -0.                                     705
0415+398         -0.                                    .246
0420-014         -0.1061      0.1927      0.8978      0.8615
0422-380         -0.2676     -0.5525      1.1965      0.8869
0430+289         -0.1987      0.0106      1.0196      0.8681
0436-129         -0.0273      0.3218      0.9271      0.8715
0446+112         -0.1766      0.2451      0.9159      0.8621
0454+844          0.2801     -0.1292      9.0450      0.8654
0454-234         -0.3849      0.1529      0.9742      0.8601
0458-020         -0.3746      0.0902      0.8987      0.8601
0506-612         -0.1263     -0.0570      2.1188      0.9276
0515+208         -0.0479      0.1958      0.9567      0.8679
0528+134         -0.1454      0.3791      0.9220      0.8618
0529+483          0.0606      0.1214      1.3141      0.8573
```

corrections to source a priori coordinates (RA, De) and their standard deviations [mas]

glob_results_CONT05_EOPloose - Notepad

File Edit Format View Help

```
% source            RA          De          mRA         mDe


% EOPs were:  0 = fixed,  1 = estimated,  2 = reduced


% x pole: mjd of estimates, corrections in [mas], standard dev. in [mas]
1
53625.0000        2.1047      0.5838
53626.0000       -0.1506      0.0413
53627.0000       -0.0163      0.0386
53628.0000        0.0034      0.0290
53629.0000       -0.2119      0.0298
53630.0000        0.0813      0.0265
53631.0000        0.0955      0.0282
53632.0000        0.0398      0.0264
53633.0000       -0.0254      0.0268
53634.0000       -0.0716      0.0321
53635.0000
53636.0000
53637.0000
53638.0000
53639.0000
53640.0000
53641.0000

% y pole: mjd
1
53625.0000
53626.0000
53627.0000
53628.0000
53629.0000
53630.0000
53631.0000
53632.0000
53633.0000
53634.0000
53635.0000
53636.0000       -0.0109      0.0269
53637.0000        0.1093      0.0284
53638.0000       -0.0251      0.0283
53639.0000        0.0922      0.0297
53640.0000        0.1422      0.0406
53641.0000       -0.1499      0.1159

% ut1: mjd of estimates, corrections in [ms], standard dev. in [ms]
1
53625.0000       -0.0076      0.0107
53626.0000        0.0118      0.0014
53627.0000        0.0139      0.0011
53628.0000        0.0227      0.0011
53629.0000        0.0279      0.0011
53630.0000        0.0142      0.0011
53631.0000        0.0054      0.0011
53632.0000       -0.0079      0.0011
53633.0000       -0.0232      0.0011
53634.0000       -0.0293      0.0012
53635.0000       -0.0229      0.0011
53636.0000       -0.0260      0.0011
```

estimates of EOP:

dx, dy pole [mas]

dut1 [ms]

dX, dY [mas]

and their standard deviations

Results

trf_R1R42010_ofic - Notepad

File Edit Format View Help

```
% A priori catalogue of station positions used for the analysis: ../../TRF/VTRF2008
% were the station coordinates estimated? (0/1) 1

% were the station velocities estimated?  (0/1) 0


% station          x [m]          y [m]          z [m]          vx [m/y] vy [m/y] vz [m/y]      epoch   start  end

MATERA         4641938.7066   1393003.0720   4133325.5796     -0.0186   0.0189   0.0147       51544       0  99999
WETTZELL       4075539.8341    931735.3124   4801629.4008     -0.0157   0.0170   0.0103       51544       0  99999
HOBART26      -3950236.8529   2522347.5755  -4311562.4140     -0.0389   0.0089   0.0413       51544       0  99999
PARKES        -4554232.0827   2816758.9222  -3454035.6533     -0.0318  -0.0040   0.0506       51544       0  99999
NYALES20       1202462.7150    252734.4218   6237766.0745     -0.0142   0.0073   0.0108       51544       0  99999
WESTFORD       1492206.5450  -4458130.5099   4296015.5513     -0.0153  -0.0014   0.0038       51544       0  99999
KOKEE         -5543837.6479  -2054567.6713   2387852.0380     -0.0091   0.0631   0.0323       51544       0  99999
TSUKUB32      -3957408.7891   3310229.4029   3737494.8066     -0.0020   0.0058  -0.0049       51544   51299  99999
ZELENCHK       3451207.7657   3060375.1939   4391914.9008     -0.0165   0.0175   0.0123       51544   54282  99999
SESHAN25      -2831687.0044   4675733.6511   3275327.6718     -0.0296
ONSALA60       3370605.9879    711917.5305   5349830.7757     -0.0140
MEDICINA       4461369.9192    919596.8702   4449559.2395     -0.0179
TIGOCONC       1492054.0736  -4887961.0093  -3803541.4137      0.0353
BADARY          -838200.6718   3865751.5528   4987670.9379     -0.0310
```

crf_R1R42010_ofic - Notepad

File Edit Format View Help

```
% A priori catalogue of source positions used for the analysis: ../CRF/ICRF2
% Estimates dRA, dDe from LEVEL2 data: R1R42010_ofic


% source          RA [h min sec]              De [° min sec ]

0003-066          0   6  13.89286970          -6  23  35.3358130
0007+171          0  10  33.99169482          17  24  18.7622704
0014+813          0  17   8.47489259          81  35   8.1366595
0019+058          0  22  32.44120634           6   8   4.2689147
0035-252          0  38  14.73551226         -24  59   2.2348581
0039+230          0  42   4.54515518          23  20   1.0621442
0048-097          0  50  41.31739581          -9  29   5.2099160
0048-427          0  51   9.50183321         -42  26  33.2935868
0055-059          0  58   5.06630602          -5  39  52.2781055
0059+581          1   2  45.76238273          58  24  11.1366068
0104-408          1   6  45.10796868         -40  34  19.9601552
0106+013          1   8  38.77110237           1  35   0.3175305
0109+224          1  12   5.82470472          22  44  38.7864512
0115-214          1  17  48.78013614         -21  11   6.6327849
0119+041          1  21  56.86164267           4  22  24.7350615
0119+115          1  21  41.59503467          11  49  50.4135133
0131-522          1  33   5.76247966         -52   0   3.9448731
0133+476          1  36  58.59480101          47  51  29.1001353
0134+311          1  37   8.73361267          31  22  35.8556027
0206+136          2   9  35.99832387          13  52   0.7518911
0208-512          2  10  46.20047618         -51   1   1.8921405
0215+015          2  17  48.95474155           1  44  49.6993529
0219+428          2  22  39.61150219          43   2   7.7991739
0227-369          2  29  28.44905449         -36  43  56.8215817
0235+164          2  38  38.93009782          16  36  59.2747771
0237-027          2  39  45.47226907          -2  34  40.9139943
0256-005          2  59  28.51615437          -0  19  59.9753369
```

this new TRF catalogue can be used as input catalogue in VieVS

„new catalogues“ (TRF and CRF) will be created automatically in **VieVS/OUT/GLOB/**

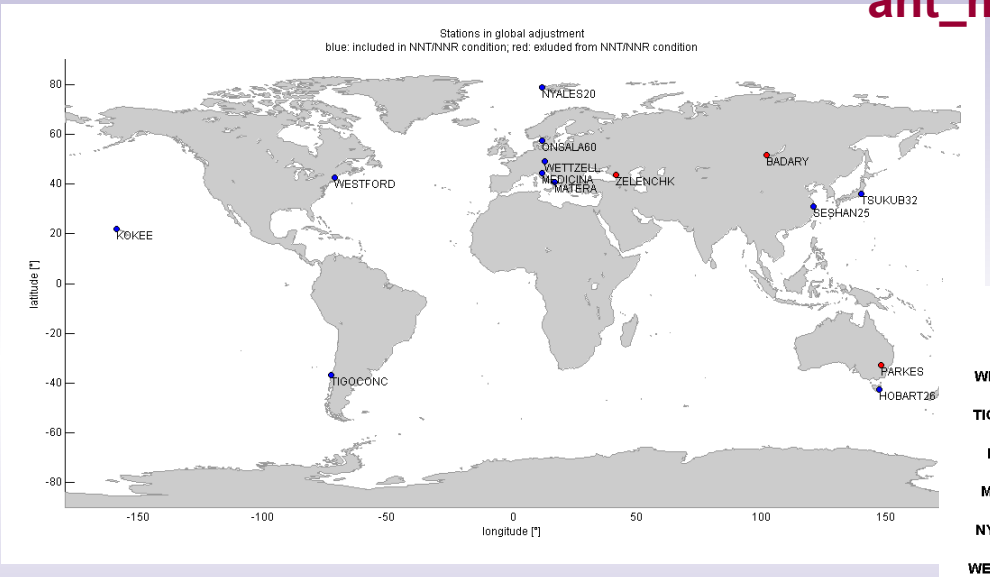
TRF/*TEST_OUT*/trf_*TEST_LEVEL2*.txt

and

CRF/*TEST_OUT*/trf_*TEST_LEVEL2*.txt

Plots

VieVS/OUT/GLOB/_PLOTS/*TEST_OUT*/

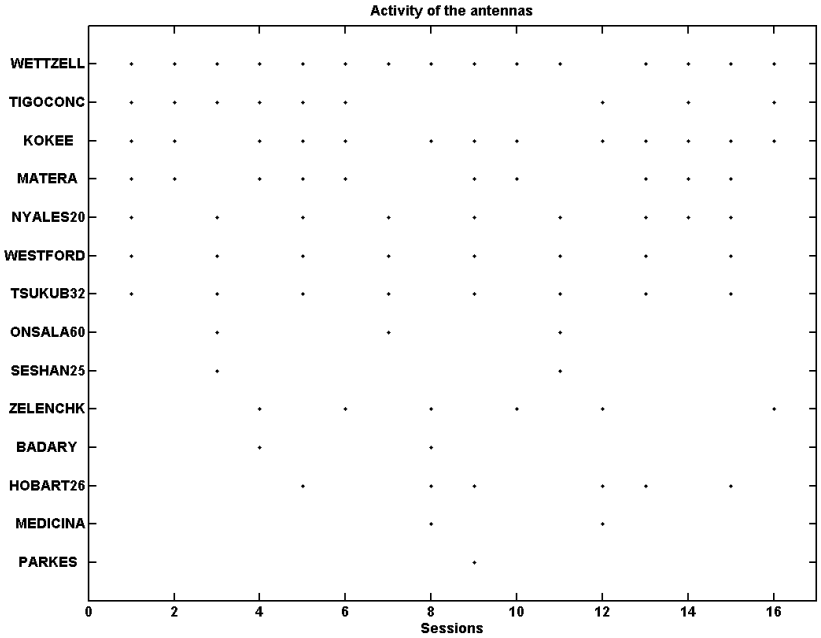


ant_map_*TEST_LEVEL2*.eps

map of stations,

blue circles: station included in NNT/NNR

red circles: station excluded from NNT/NNR

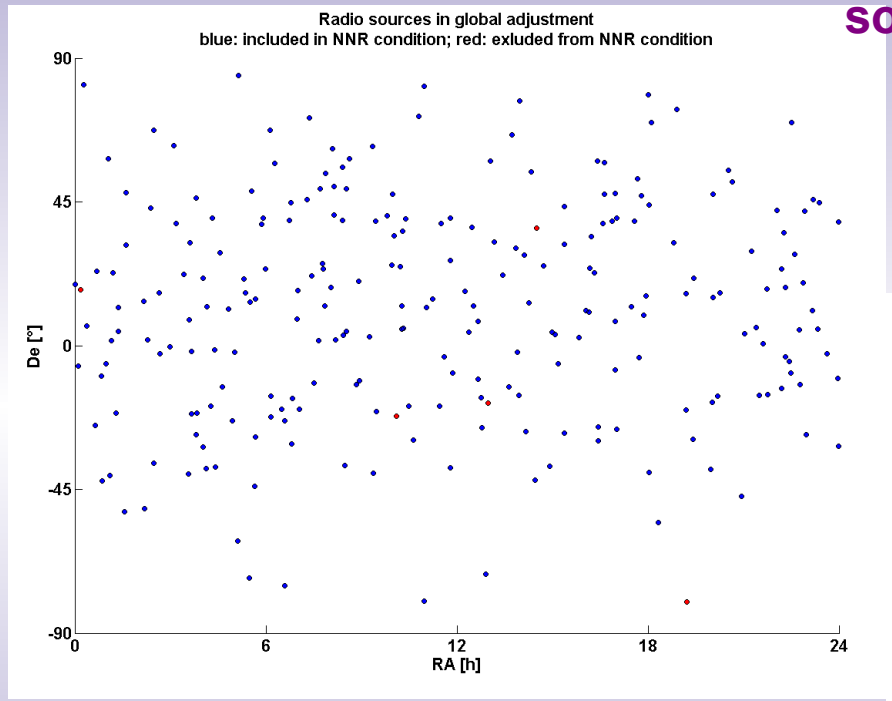


stations in sessions included in the global adjustment

ant_activity_*TEST_LEVEL2*.eps

Plots

VieVS/OUT/GLOB/_PLOTS/*TEST_OUT*/



sou_map_*TEST_LEVEL2*.eps

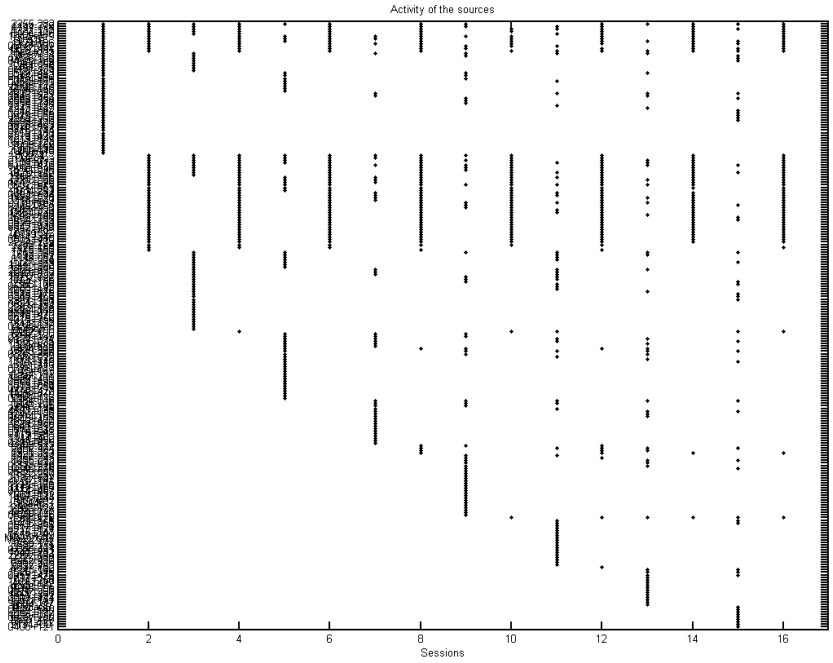
map of sources,

blue circles: source included in NNR

red circles: source excluded from NNR

stations in sessions included in the global adjustment

sou_activity_*TEST_LEVEL2*.eps



Thank you for your attention!