‘The power of where’

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An introduction to SNAP

Survey Network Adjustment Package

Paula Gentle | Senior Geodesist

Overview

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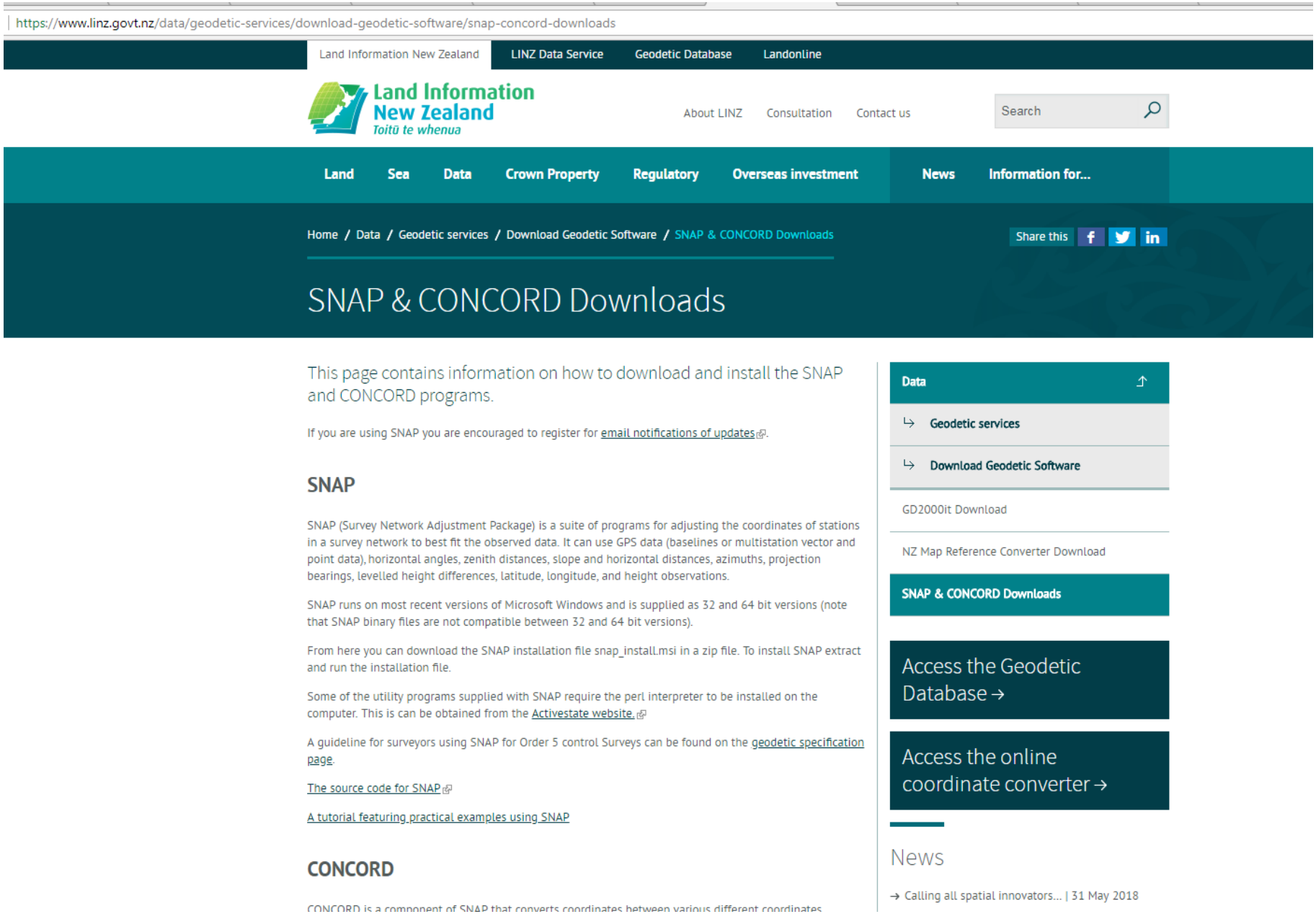
- What is SNAP?
- Setup
  - Coordinate files and datum selection
  - Observations types
  - Command file
- Running an adjustment
  - Simple analysis on results

What is SNAP?

- Least square survey network adjustment package

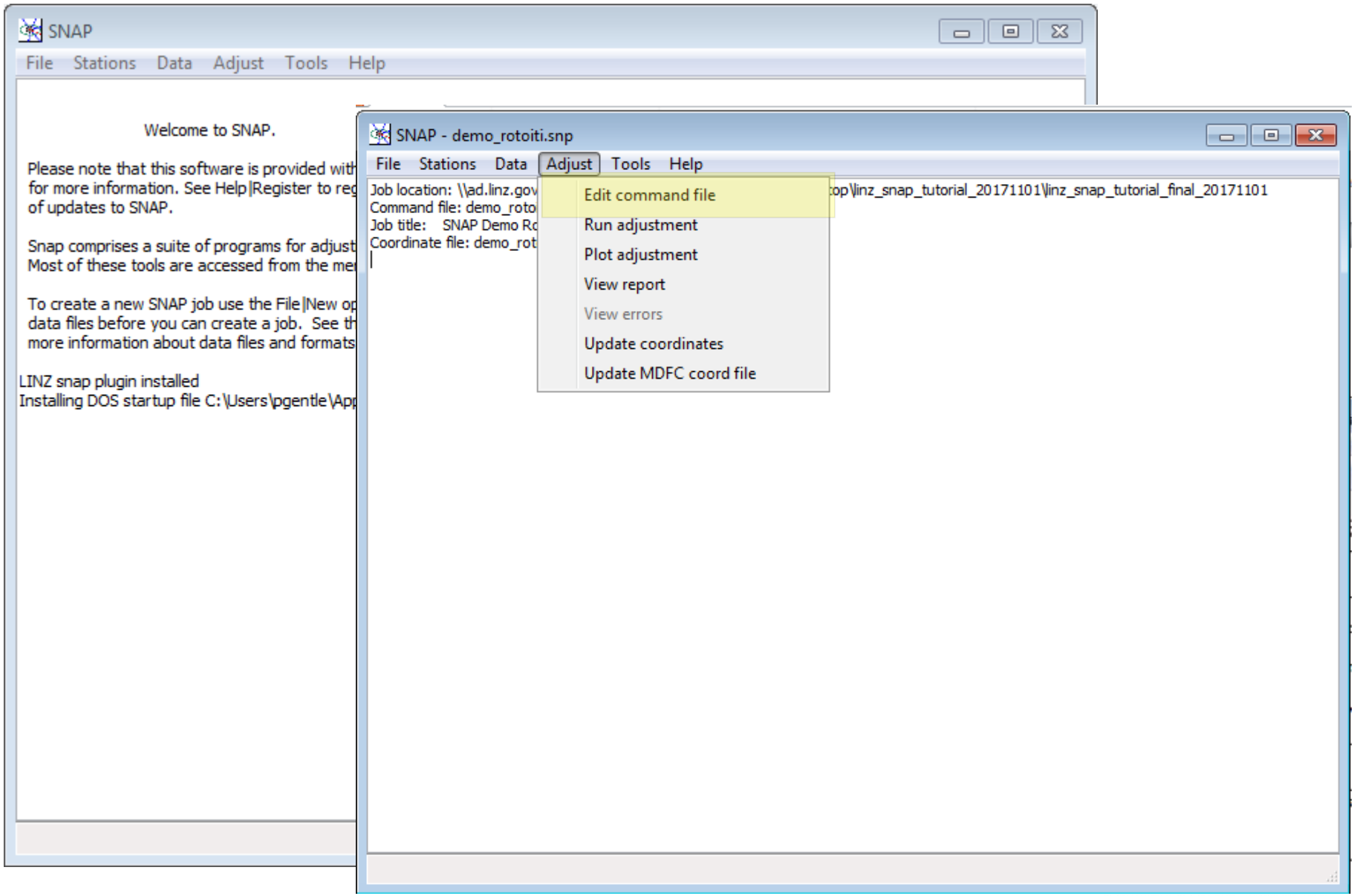
Why Least Squares?

- Enables rigorous testing against accuracy standards
- Calculates the best set of coordinates from the observations
- Enables detection of outliers



Software, data and documentation within this presentation is available on the LINZ website
https://www.linz.govt.nz/data/geodetic-services/download-geodetic-software/snap-concord-downloads

Setup


SNAP
File Stations Data Adjust Tools Help
Welcome to SNAP.
Please note that this software is provided with
for more information. See Help|Register to reg
of updates to SNAP.
Snap comprises a suite of programs for adjust
Most of these tools are accessed from the me
To create a new SNAP job use the File|New op
data files before you can create a job. See th
more information about data files and formats
LINZ snap plugin installed
Installing DOS startup file C:\Users\pgentle\App
SNAP - demo_rotoiti.snp
File Stations Data Adjust Tools Help
Job location: \\ad.linz.gov
Command file: demo_roto
Job title: SNAP Demo Ro
Coordinate file: demo_rot
op\linz_snap_tutorial_20171101\linz_snap_tutorial_final_20171101
Edit command file
Run adjustment
Plot adjustment
View report
View errors
Update coordinates
Update MDFC coord file

SNAP Command file

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File Edit Search View Encoding Language Settings Macro Run Plugins Window ? X

demo_rotoiti.snp

```
1  title SNAP Demo Rotoiti
2
3  coordinate_file demo_rotoiti.crd
4
5  data_file demo_rotoiti_gnss.csv csv format=demo_rotoiti_gnss error_factor 1.0
6  data_file min_RGMK_0.snx sinex ref_frame=ITRF2008 error_factor 15.0
7
8  mode 3d adjustment
9
10 !fix ALICE
11 !fix vertical BRODY
12 !fix BE48
13
14 !fix order=0 order=2 order=3
15
16 horizontal_float_error 0.005
17 vertical_float_error 0.010
18
19 float order=0 order=3
20
21 free RGMK
22
23 !recode suffix _A before 2017-01-01 for inside NZTM affected_area.wkt
24 reject_observations before 2017-01-01 using_stations inside NZTM affected_area.wkt
25
26 !bearing_orientation_error calculate PLENTM1949
27
28 deformation datum
29
30 reference_frame ITRF2008 IERS_ETSR 2000.0 -4.8 -2.09 17.67 -1.40901 0.16508 -0.26897 -0.11984 -0.79 0.6 1.
31
32 output_csv all
33 output_precision GB 3
34 coordinate_precision 3
35 flag_significance 95 maximum 95
36
37 specification order_4 confidence 95% horizontal 10mm 10ppm 50mm_abs vertical 10mm 50ppm 135mm_abs
38 specification rotoiti_vert confidence 95% vertical 5mm
39 test_specification order_4 ALICE BRODY CRAIG DEVON ETHEL
40 test_specification rotoiti_vert ALICE DEVON ETHEL
41 spec_test_options list_fail
```

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SNAP Files

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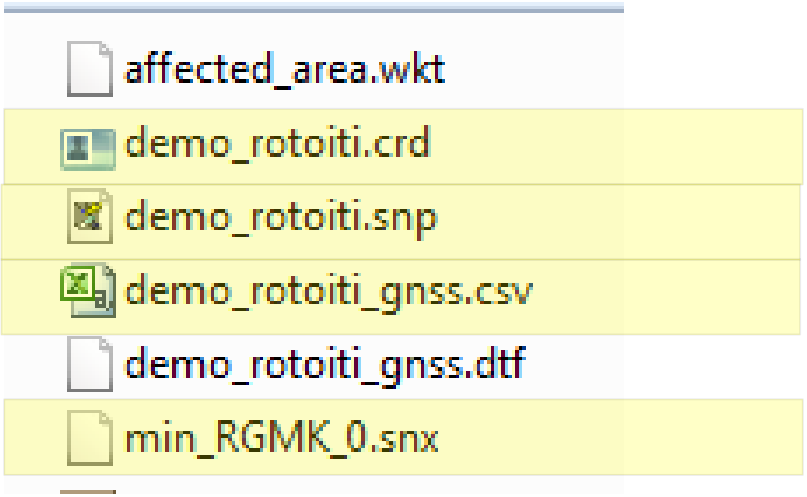
Snap command file (.snp)

Coordinate files (.crd)

Baseline data (.csv) and its configuration file (.dtf)

Sinex data (.snx)



Least Squares

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Inputs

- Control station coordinates
- Non-control station approximate coordinates
- Observations
- Observation uncertainties

Least Squares Engine

Outputs

- Station coordinates (refined from approximates)
- Coordinate uncertainties
- Observation residuals

Coordinate file

demo_rotoiti.crd

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demo_rotoiti.crd

```
SNAP Demo Rotoiti
NZGD2000/NZVD2016
options orthometric_heights deflections geoid_heights c=Order c=MarkType
! Geoid undulations from New Zealand Vertical Datum 2016

!Code       Latitude          Longitude       Orth.Hgt    Xi    Eta   G.Hgt Order MarkType Name
RGMK   38 08 18.029742 S 176 28 01.606364 E   926.5181 -10.8   7.2 28.8479 2     FCTR  Makatiti
BE48   38 03 08.659555 S 176 27 06.853280 E   280.1376  -5.4   6.3 29.2054 3     PIN   GISBORNE POI
BXUJ   38 02 27.544985 S 176 32 49.275629 E   307.6742  -7.0   8.2 28.9538 3     PIN   MANAWAHE ROA
TAUP   38 44 33.779940 S 176 04 51.580783 E   400.6066  -9.6  -1.3 26.4214 0     OTHR  Taupo Airpor
TRNG   37 43 43.723326 S 176 15 39.158395 E   120.3918  -2.5   5.9 30.7112 0     FCTR  Tauranga
WHKT   37 58 54.070608 S 177 00 49.960620 E   204.4993  -3.9  10.3 27.3387 0     FCTR  Whakatane
ETHEL  38 07 00.815605 S 176 28 15.525642 E   312.7187  -7.6   8.2 28.9300 -     -     ETHEL
CRAIG  38 06 34.545670 S 176 29 12.665351 E   278.8669  -8.9   9.1 28.8996 -     -     CRAIG
BRODY  38 06 02.628713 S 176 28 16.318197 E   298.9987  -7.7   7.9 28.9966 -     -     BRODY
ALICE  38 06 22.746023 S 176 27 23.525633 E   284.2961  -7.9   5.2 29.0162 -     -     ALICE
DEVON  38 06 54.776116 S 176 28 48.903854 E   291.3580  -7.9   9.7 28.9006 -     -     DEVON
```

Normal t length : 1337 lines : 18 | Ln : 1 Col : 1 Sel : 0 | 0 | Dos\Windows | ANSI as UTF-8

demo_rotoiti.snp

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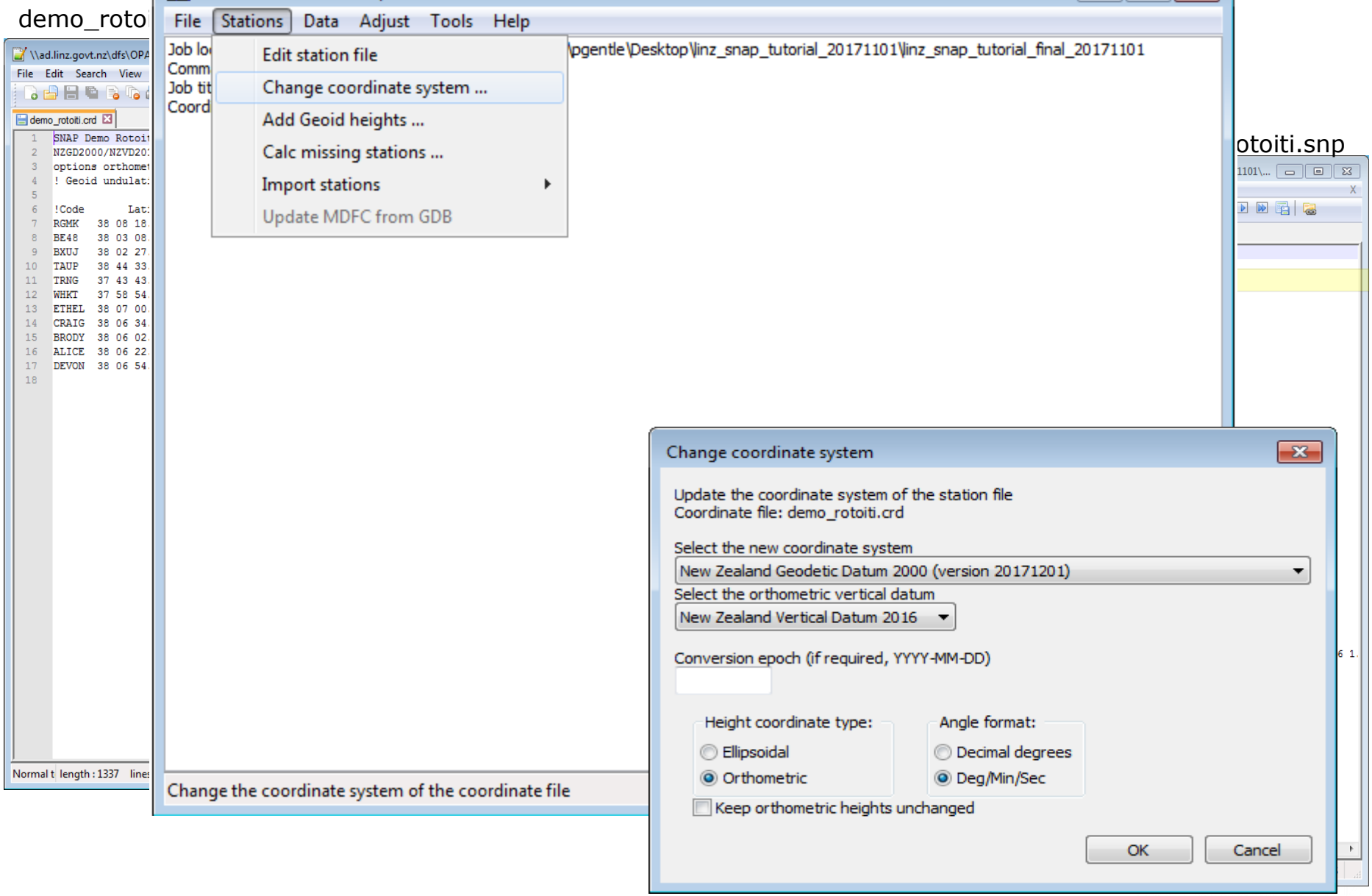
File Edit Search View Encoding Language Settings Macro Run Plugins Window ? X

demo_rotoiti.snp

```
title SNAP Demo Rotoiti

coordinate_file demo_rotoiti.crd

data_file demo_rotoiti_gnss.csv csv format=demo_rotoiti_gnss error_factor 1.0
data_file min_RGMK_0.snx sinex ref_frame=ITRF2008 error_factor 15.0

mode 3d adjustment

!fix ALICE
!fix vertical BRODY
!fix BE48

!fix order=0 order=2 order=3

horizontal_float_error 0.005
vertical_float_error 0.010

float order=0 order=3

free RGMK

!recode suffix _A before 2017-01-01 for inside NZTM affected_area.wkt
reject_observations before 2017-01-01 using_stations inside NZTM affected_area.wkt

!bearing_orientation_error calculate PLENTM1949

deformation datum

reference_frame ITRF2008 IERS_ETSR 2000.0 -4.8 -2.09 17.67 -1.40901 0.16508 -0.26897 -0.11984 -0.79 0.6 1.

output_csv all
output_precision GB 3
coordinate_precision 3
flag_significance 95 maximum 95

specification order_4 confidence 95% horizontal 10mm 10ppm 50mm_abs vertical 10mm 50ppm 135mm_abs
specification rotoiti_vert confidence 95% vertical 5mm
test_specification order_4 ALICE BRODY CRAIG DEVON ETHEL
test_specification rotoiti_vert ALICE DEVON ETHEL
spec_test_options list_fail
```

Normal t length : 1176 lines : 41 | Ln : 1 Col : 1 Sel : 0 | 0 | Dos\Windows | ANSI as UTF-8 | INS

Coordinate file



GNSS baseline data

demo_rotoiti_gnss.csv

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demo_rotoiti_gnss.csv

```
1  FROMSTN,TOSTN,STATUS,DATE,VALUE1,VALUE2,VALUE3,c_SESSION
2  RGMK,ALICE,,20170927,-1629.033,1030.137,3192.985,session_0
3  ALICE,BE48,,20170927,-3655.682,633.652,4713.186,session_0
4  RGMK,BE48,,20170927,-5284.727,1663.798,7906.17,session_1
5  BE48,BRODY,,20170927,3182.752,-1893.169,-4234.147,session_1
6  RGMK,BRODY,,20170927,-2101.981,-229.372,3672.028,session_2
7  BRODY,BXUJ,,20170927,-4493.831,-6391.753,5215.677,session_2
8  RGMK,BXUJ,,20170927,-6595.827,-6621.124,8887.708,session_3
9  BXUJ,CRAIG,,20170927,5031.618,4983.211,-5977.595,session_3
10 RGMK,CRAIG,,20170927,-1564.229,-1637.913,2910.119,session_4
11 CRAIG,DEVON,,20170927,410.017,554.769,-498.514,session_4
12 RGMK,DEVON,,20170927,-1154.211,-1083.144,2411.611,session_5
13 DEVON,ETHEL,,20170927,147.924,805.545,-159.719,session_5
14 RGMK,ETHEL,,20170927,-1006.292,-277.598,2251.893,session_6
15 ETHEL,ALICE,,20170927,-622.729,1307.728,941.078,session_6
16
```

length : 894 lines : 16 Ln : 9 Col : 59 Sel : 0 | 0 Dos\Windows ANSI as UTF-8

demo_rotoiti_gnss.dft

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demo_rotoiti_gnss.dft

```
1  format_name SNAP CSV obs format for Rotoiti GNSS Baseline Demo
2  FORMAT CSV HEADER=Y
3  required_columns fromstn tostn
4
5  OBSERVATION
6  TYPE @obstype DEFAULT "GB"
7  REJECTED rejcode(@status)
8  INSTRUMENT_STATION @fromstn
9  TARGET_STATION @tostn
10 DATETIME @date
11 DATETIME_FORMAT YMDhms
12 VALUE @value1 " " @value2 " " @value3 DEFAULT @value
13 ERROR @error DEFAULT "4 6 8 mm 0.5 0.75 1 ppm"
14 VECTOR_ERROR_TYPE calculated
15 CLASSIFICATION_COLUMNS c_**
16 END_OBSERVATION
17
18 LOOKUP rejcode
19 rej Y
20 reject Y
21 * Y
22 default N
23 END_LOOKUP
24
25
26
```

length : 525 lines : 26 Ln : 1 Col : 2 Sel : 0 | 0 Dos\Windows ANSI as UTF-8 INS

GNSS baseline data

demo_rotoiti_gnss.csv

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File Edit Search View Encoding Language Settings Macro Run Plugins Window ? X

demo_rotoiti_gnss.csv

```
FROMSTN,TOSTN,STATUS,DATE,VALUE1,VALUE2,VALUE3,c_SESSION
RGMK,ALICE,,20170927,-1629.033,1030.137,3192.985,session_0
ALICE,BE48,,20170927,-3655.682,633.652,4713.186,session_0
RGMK,BE48,,20170927,-5284.727,1663.798,7906.17,session_1
BE48,BRODY,,20170927,3182.752,-1893.169,-4234.147,session_1
RGMK,BRODY,,20170927,-2101.981,-229.372,3672.028,session_2
BRODY,BXUJ,,20170927,-4493.831,-6391.753,5215.677,session_2
RGMK,BXUJ,,20170927,-6595.827,-6621.124,8887.708,session_3
BXUJ,CRAIG,,20170927,5031.618,4983.211,-5977.595,session_3
RGMK,CRAIG,,20170927,-1564.229,-1637.913,2910.119,session_4
CRAIG,DEVON,,20170927,410.017,554.769,-498.514,session_4
RGMK,DEVON,,20170927,-1154.211,-1083.144,2411.611,session_5
DEVON,ETHEL,,20170927,147.924,805.545,-159.719,session_5
RGMK,ETHEL,,20170927,-1006.292,-277.598,2251.893,session_6
ETHEL,ALICE,,20170927,-622.729,1307.728,941.078,session_6
```

length : 894 lines : 16 Ln : 9 Col : 59 Sel : 0 | 0 Dos\Windows

demo_rotoiti.snp

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File Edit Search View Encoding Language Settings Macro Run Plugins Window ? X

demo_rotoiti.snp

```
title SNAP Demo Rotoiti

coordinate_file demo_rotoiti.crd

data_file demo_rotoiti_gnss.csv csv format=demo_rotoiti_gnss error_factor 1.0
data_file min_RGMK_0.snx sinex ref_frame=ITRF2008 error_factor 15.0

mode 3d adjustment

!fix ALICE
!fix vertical BRODY
!fix BE48

!fix order=0 order=2 order=3

horizontal_float_error 0.005
vertical_float_error 0.010

float order=0 order=3

free RGMK

!recode suffix _A before 2017-01-01 for inside NZTM affected_area.wkt
reject_observations before 2017-01-01 using_stations inside NZTM affected_area.wkt

!bearing_orientation_error calculate PLENTM1949

deformation datum

reference_frame ITRF2008 IERS_ETSR 2000.0 -4.8 -2.09 17.67 -1.40901 0.16508 -0.26897 -0.11984 -0.79 0.6 1.

output_csv all
output_precision GB 3
coordinate_precision 3
flag_significance 95 maximum 95

specification order_4 confidence 95% horizontal 10mm 10ppm 50mm_abs vertical 10mm 50ppm 135mm_abs
specification rotoiti_vert confidence 95% vertical 5mm
test_specification order_4 ALICE BRODY CRAIG DEVON ETHEL
test_specification rotoiti_vert ALICE DEVON ETHEL
spec_test_options list_fail
```

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SINEX Data

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min_RGMK_0.snx

```
%=SNX 2.01 LNZ 17:290:69704 IGS 17:270:00000 17:271:00000 P 00012 1 S
*-------------------------------------------------------------------------------
+FILE/REFERENCE
*INFO_TYPE_________ INFO_____________________________________________________
 DESCRIPTION        Land Information New Zealand
 OUTPUT             Solution generated by LINZ PositioNZ-PP service
 CONTACT            positionz@linz.govt.nz
 SOFTWARE           Bernese GNSS Software Version 5.2
 HARDWARE           PositioNZ-PP processor
 INPUT              IGS/IGLOS GNSS tracking data, PositioNZ station data
-FILE/REFERENCE
*-------------------------------------------------------------------------------
+INPUT/ACKNOWLEDGMENTS
*AGY DESCRIPTION_____________________________________________________________
 LNZ Land Information New Zealand (positionz@linz.govt.nz)
 IGS International GNSS Service
-INPUT/ACKNOWLEDGMENTS
*-------------------------------------------------------------------------------
+SOLUTION/STATISTICS
*_STATISTICAL PARAMETER________ __VALUE(S)___________
 NUMBER OF OBSERVATIONS                        59347
 NUMBER OF UNKNOWNS                              105
 NUMBER OF DEGREES OF FREEDOM                  59242
 PHASE MEASUREMENTS SIGMA                    0.00100
 SAMPLING INTERVAL (SECONDS)                      30
 VARIANCE FACTOR                1.328724626621669
-SOLUTION/STATISTICS
*-------------------------------------------------------------------------------
+SITE/ID
*CODE PT __DOMES__ T _STATION DESCRIPTION__ APPROX_LON_ APPROX_LAT_ _APP_H_
 RGMK  A      M    P                       176 28  1.6 -38  8 18.0   955.5
 TAUP  A      M    P                       176  4 51.6 -38 44 33.8   427.0
 TRNG  A      M    P                       176 15 39.2 -37 43 43.7   151.1
 WHKT  A      M    P                       177  0 50.0 -37 58 54.1   231.8
-SITE/ID
*-------------------------------------------------------------------------------
+SITE/RECEIVER
*SITE PT SOLN T DATA_START__ DATA_END____ DESCRIPTION_________ S/N__ FIRMWARE___
 RGMK  A    1 P 17:270:00000 17:270:86370 TRIMBLE NETR9        ----- -----------
 TAUP  A    1 P 17:270:00000 17:270:86370 TRIMBLE NETR9        ----- -----------
 TRNG  A    1 P 17:270:00000 17:270:86370 TRIMBLE NETR9        ----- -----------
 WHKT  A    1 P 17:270:00000 17:270:86370 TRIMBLE NETR9        ----- -----------
-SITE/RECEIVER
*-------------------------------------------------------------------------------
```

Normal t length : 11980 lines : 178 Ln : 68 Col : 19 Sel : 0 | 0 Dos\Windows

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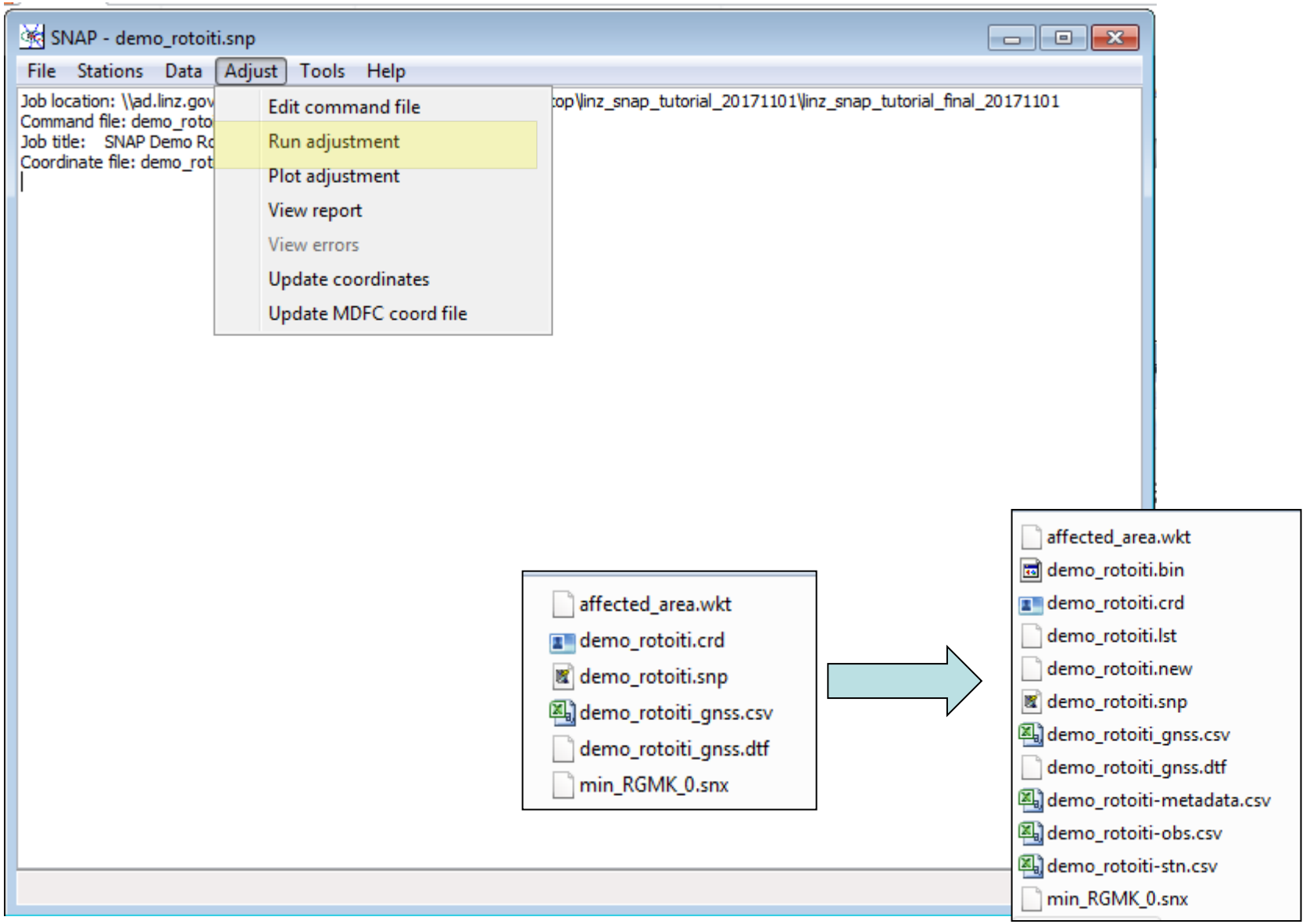
File Edit Search View Encoding Language Settings Macro Run Plugins Window ? X

demo_rotoiti.snp

```
title SNAP Demo Rotoiti

coordinate_file demo_rotoiti.crd

data_file demo_rotoiti_gnss.csv csv format=demo_rotoiti_gnss error_factor 1.0
data_file min_RGMK_0.snx sinex ref_frame=ITRF2008 error_factor 15.0

mode 3d adjustment

!fix ALICE
!fix vertical BRODY
!fix BE48

!fix order=0 order=2 order=3

horizontal_float_error 0.005
vertical_float_error 0.010

float order=0 order=3

free RGMK

!recode suffix _A before 2017-01-01 for inside NZTM affected_area.wkt
reject_observations before 2017-01-01 using_stations inside NZTM affected_area.wkt

!bearing_orientation_error calculate PLENTM1949

deformation datum

reference_frame ITRF2008 IERS_ETSR 2000.0 -4.8 -2.09 17.67 -1.40901 0.16508 -0.26897 -0.11984 -0.79 0.6 1.

output_csv all
output_precision GB 3
coordinate_precision 3
flag_significance 95 maximum 95

specification order_4 confidence 95% horizontal 10mm 10ppm 50mm_abs vertical 10mm 50ppm 135mm_abs
specification rotoiti_vert confidence 95% vertical 5mm
test_specification order_4 ALICE BRODY CRAIG DEVON ETHEL
test_specification rotoiti_vert ALICE DEVON ETHEL
spec_test_options list_fail
```

Normal t length : 1176 lines : 41 Ln : 1 Col : 1 Sel : 0 | 0 Dos\Windows ANSI as UTF-8 INS

Run Adjustment



SNAPPLOT

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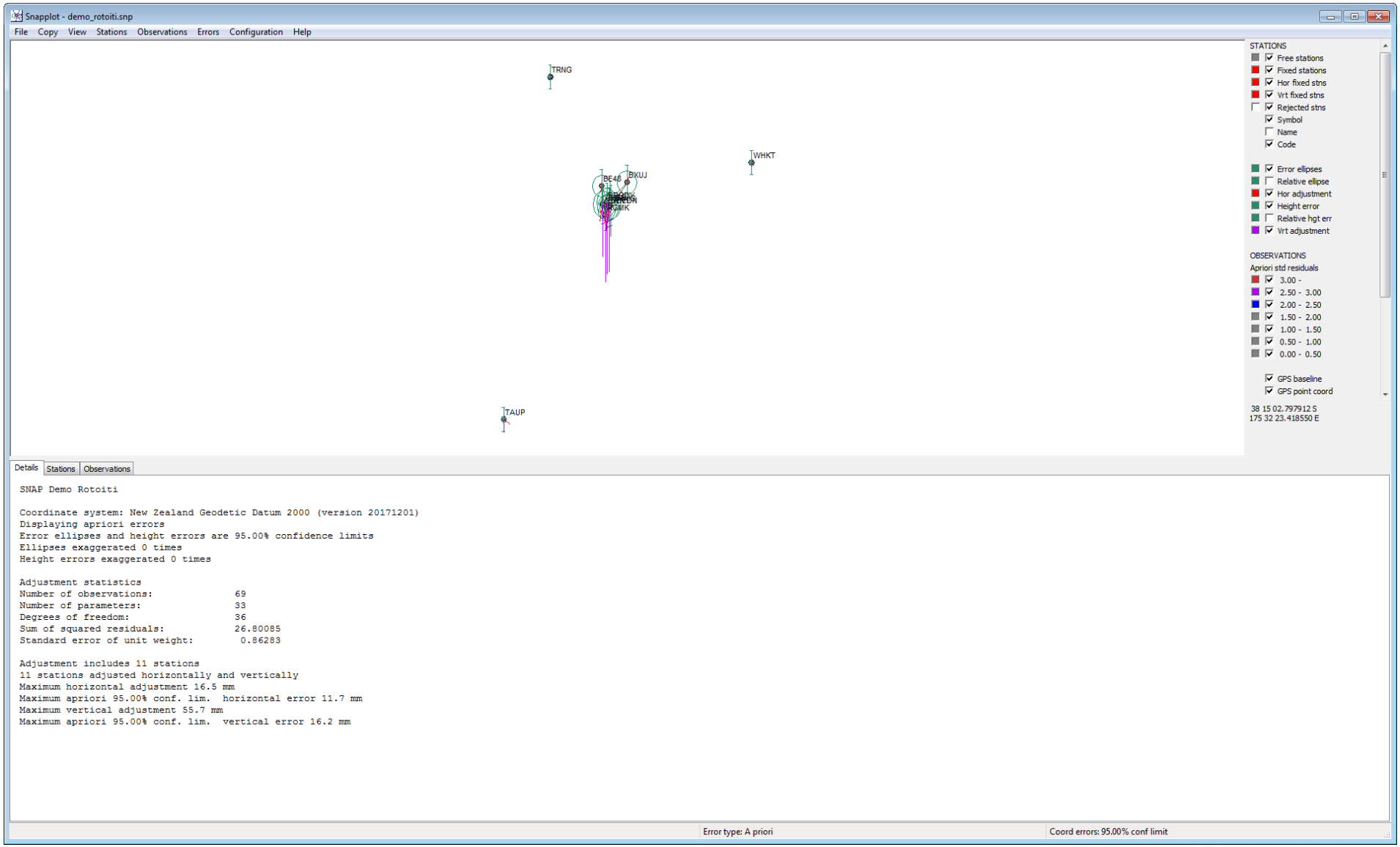

SNAPPLOT

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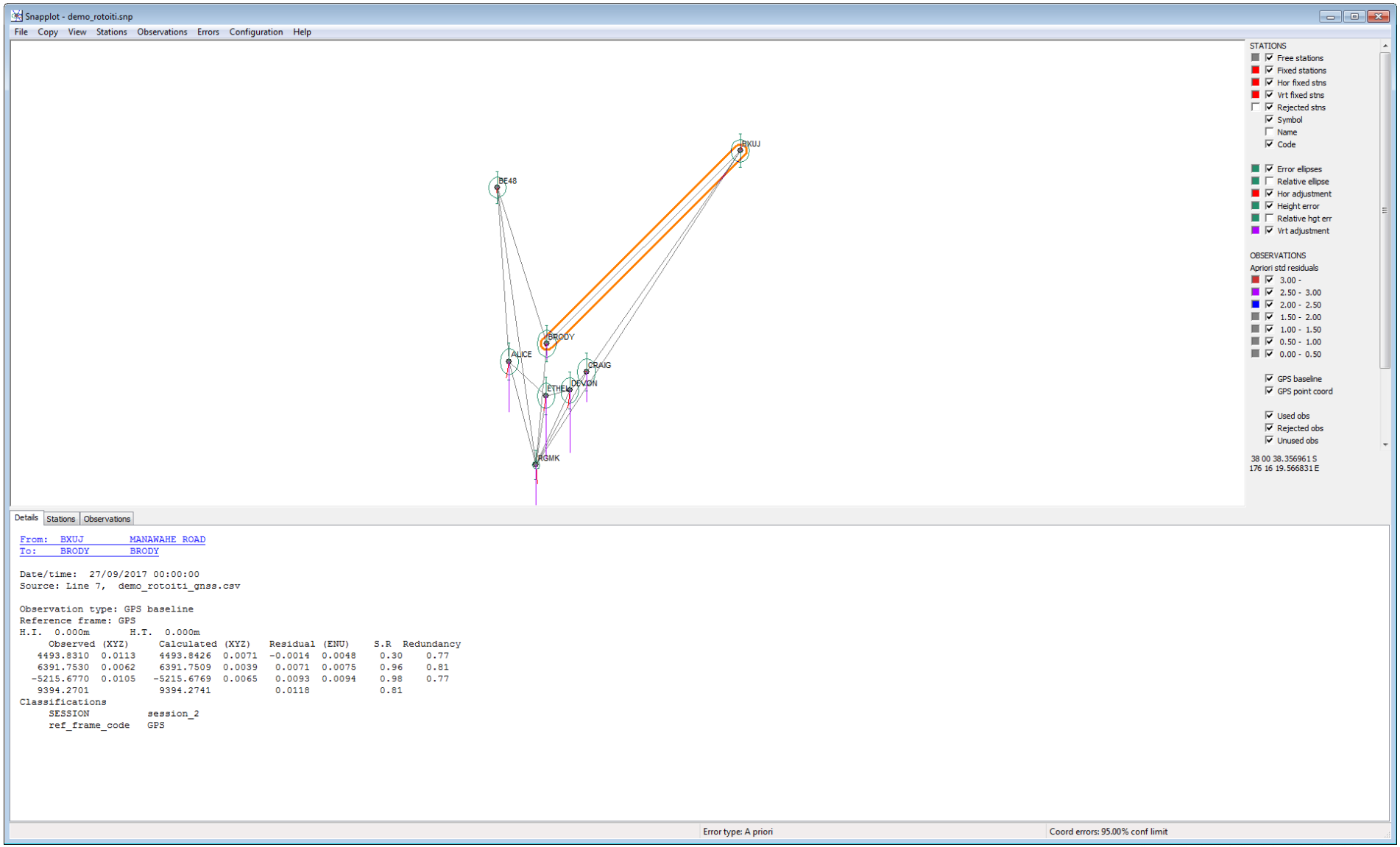

SNAPPLOT

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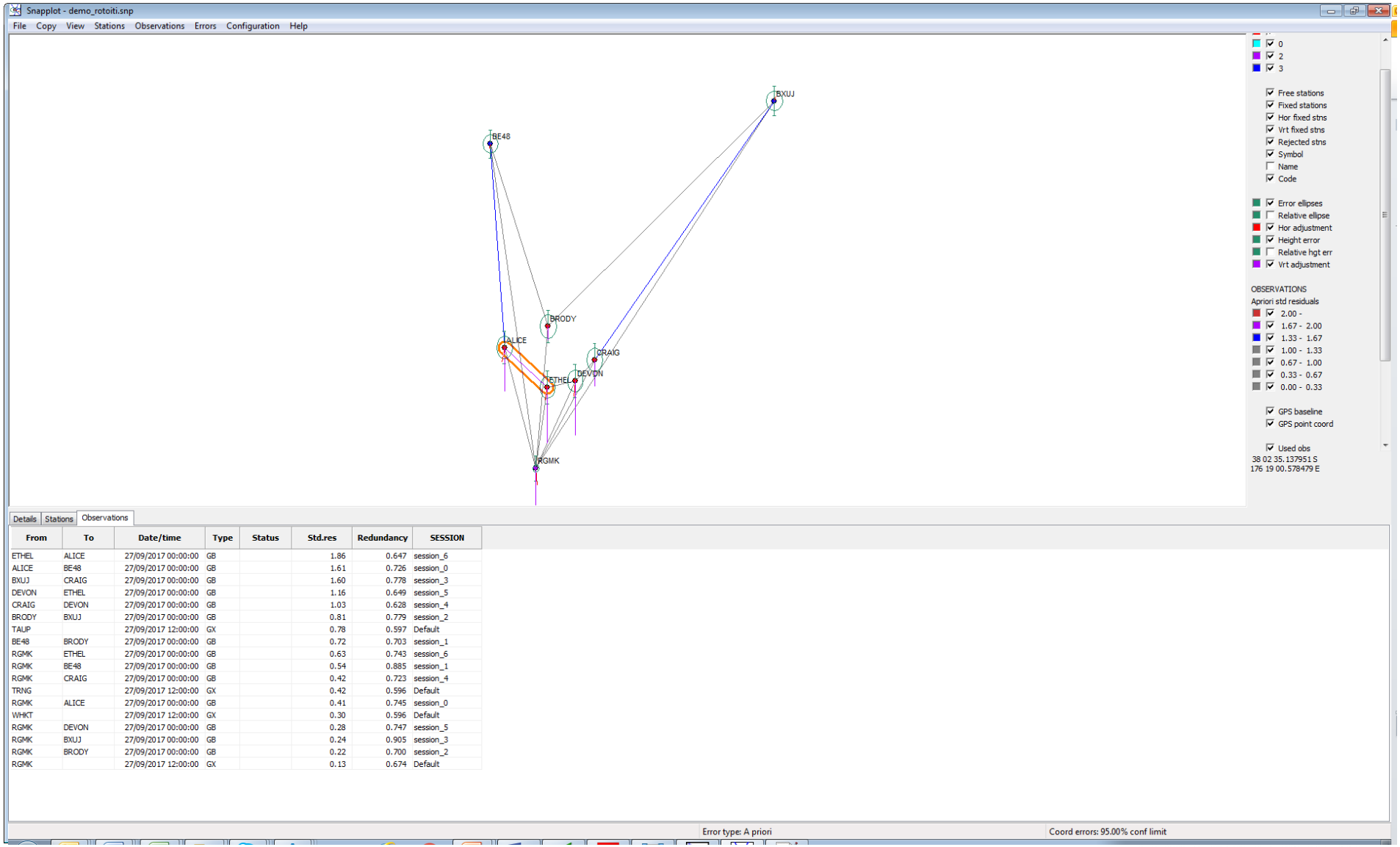

From	To	Date/time	Type	Status	Std.res	Redundancy	SESSION
ETHEL	ALICE	27/09/2017 00:00:00	GB		1.86	0.647	session_6
ALICE	BE48	27/09/2017 00:00:00	GB		1.61	0.726	session_0
BXUJ	CRAIG	27/09/2017 00:00:00	GB		1.60	0.778	session_3
DEVON	ETHEL	27/09/2017 00:00:00	GB		1.16	0.649	session_5
CRAIG	DEVON	27/09/2017 00:00:00	GB		1.03	0.628	session_4
BRODY	BXUJ	27/09/2017 00:00:00	GB		0.81	0.779	session_2
TAUP		27/09/2017 12:00:00	GX		0.78	0.597	Default
BE48	BRODY	27/09/2017 00:00:00	GB		0.72	0.703	session_1
RGMK	ETHEL	27/09/2017 00:00:00	GB		0.63	0.743	session_6
RGMK	BE48	27/09/2017 00:00:00	GB		0.54	0.885	session_1
RGMK	CRAIG	27/09/2017 00:00:00	GB		0.42	0.723	session_4
TRNG		27/09/2017 12:00:00	GX		0.42	0.596	Default
RGMK	ALICE	27/09/2017 00:00:00	GB		0.41	0.745	session_0
WHKT		27/09/2017 12:00:00	GX		0.30	0.596	Default
RGMK	DEVON	27/09/2017 00:00:00	GB		0.28	0.747	session_5
RGMK	BXUJ	27/09/2017 00:00:00	GB		0.24	0.905	session_3
RGMK	BRODY	27/09/2017 00:00:00	GB		0.22	0.700	session_2
RGMK		27/09/2017 12:00:00	GX		0.13	0.674	Default

SNAP Report

- SNAP provides a comprehensive report
- Residuals and standardised residuals on individuals observations
- Standard error of unit weight (SEUW) is close 1.0

Summary

- SNAP is a free least squares adjustment software package
- LINZ can assist in adding your local datums
- Network analysis can be completed using a configurable user interface

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Questions?