

Report on the Quality of Land Surface Observations in Region II (Asia)

January – June 2022

No. 63

December 2022

RSMC Tokyo

Lead Center for Monitoring Quality of Land Surface Observations

Japan Meteorological Agency

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Japan

Report on the Quality of Land Surface Observations in Region II
(No. 63)
January – June 2022

Summary

In its role as a Lead Center, RSMC Tokyo has issued the 63rd report on the land surface observation quality monitoring for the period from January to June 2022. The report includes a consolidated list of stations suspected of producing low-quality observation data.

(1) SLP

As a result of monitoring, four stations (38232, 38836, 42295, 44424) were excluded from the consolidated lists of the previous report (July – December 2021), and two stations (41244, 48925) were newly added to the lists.

(2) MSLP

As a result of monitoring, two stations (38232, 40587) were excluded from the consolidated lists of the previous report (July – December 2021), and one station (41244) was newly added to the lists.

(3) GZ

As a result of monitoring, two stations (42295, 44424) were excluded from the consolidated lists of the previous report (July – December 2021).

1. Introduction

Pursuant to Paragraph 22 of Attachment II.7 of the Manual on the Global Data Processing and Forecasting System (WMO No. 485), the Regional Specialized Meteorological Center (RSMC) Tokyo was designated by the President of the Commission for Basic Systems (CBS) as a Lead Center for monitoring the quality of land surface observations (i.e., SYNOP) in Region II in March 1991. The Center is responsible for monitoring the quality of land surface observations and maintaining consolidated lists of stations suspected of reporting low-quality observation data together with adequate evidence. The lists are to be passed on to the WMO Secretariat and monitoring centers participating in this activity as well as to Members of Regional Association (RA) II for their reference.

2. Monitored Data

Monitored surface observation data are obtained at 00, 06, 12 and 18 UTC and collected at RSMC Tokyo before the data cut-off time, defined as the end of the period in which observation data are gathered for operational analysis. The cut-off times for Japan Meteorological Agency (JMA) global analysis are shown in Table 1.

Table 1 Data cut-off times for JMA global analysis.

Analysis time	Data cut-off time
00 UTC	11:50 UTC
06 UTC	13:50 UTC
12 UTC	23:50 UTC
18 UTC	01:50 UTC

The observation elements monitored are (1) station level pressure, (2) mean sea level pressure and (3) geopotential height, hereafter referred to as SLP, MSLP and GZ, respectively. In accordance with the Manual on Codes (WMO No. 306) Volume II, GZ data on an agreed standard pressure level are reported at the stations whose elevation is higher than 800 m. Standard pressure levels defined in line with station elevation are shown in Table 2.

Table 2 Elevation of stations reporting GZ data and corresponding standard pressure levels.

Station elevation (m)	Pressure level (hPa)
800 - 2,300	850
2,300 - 3,700	700
Higher than 3,700	500

The numbers of stations reporting SLP, MSLP and/or GZ data in Region II are shown in Table 3, and the locations of these land surface stations are shown in Figure 1.

Table 3 Numbers of stations reporting SLP, MSLP and/or GZ data in Region II

Element	Number of stations
SLP	1894
MSLP	1993
GZ	87

3. Monitoring Methods

The three items described below are examined for each element.

- (i) Monthly statistics on observation deviations from the most recent forecast of JMA's global model (referred to as first-guess values) (observation minus guess, hereafter referred to as O-G) and on related trends over the monitoring period
- (ii) Monthly statistics on deviations from values observed at surrounding stations
- (iii) Reference information from other monitoring centers

Information on the latitude, longitude and altitude of each station is necessary for calculation of first-guess values. Such data for land surface station locations is retrieved from the surface-based observing

system component of the Observing Systems Capability Analysis and Review Tool (OSCAR/Surface)* , replacing WMO No. 9, Volume A.

The monitoring procedure has two steps as outlined below.

(1) Exclusion of data with gross errors from the statistical calculation sample

The following thresholds are applied for the gross error check in the first step:

$$\begin{aligned} |O-G| &\geq 15 \text{ hPa for SLP and MSLP} \\ |O-G| &\geq 100 \text{ gpm for GZ} \end{aligned}$$

Gross error data are excluded from the calculation of BIAS (the mean of O-G) and SD (the standard deviation of O-G).

(2) Identification of suspect stations

When the total number of observations (NOBS) is 181 or more, the next criteria are applied:

- | | |
|------------------------------------|---|
| - BIAS | $ BIAS \geq 3 \text{ hPa for SLP and MSLP}$
$ BIAS \geq 30 \text{ gpm for GZ}$ |
| - SD | $SD \geq 5 \text{ hPa for SLP and MSLP}$
$SD \geq 40 \text{ gpm for GZ}$ |
| - Percentage of gross errors (PGE) | $PGE \geq 25\%$ |

Stations with even one statistic exceeding the threshold are considered suspect.

Note:

- (i) The quality of observation data from stations is not checked when the NOBS value is less than 181 or the difference between the station elevation and the model elevation is greater than 1,000 m. MSLP reports are also not checked for stations located at altitudes higher than 1,000 m above sea level.
- (ii) In case of low quality of the first-guess field, those statistics can exceed the threshold and the stations are listed in the consolidated list. To avoid such situations, statistics of surrounding stations and information from other monitoring centers are also used to judge whether the quality of the station's first-guess field value is appropriate.

*<https://oscar.wmo.int/surface/index.html#/>

4. Monitoring Results

4.1 Consolidated list of suspect stations throughout the period

Table 4 List of suspect land surface stations during the period from January to June 2022

WMO IDENT	LAT (N)	LON (E)	H (m)	HM (m)	ELEM	NOBS	PGE (%)	SD	BIAS	RMS
35284	50.6	70.0	384	324	SLP	716	0	0.7	6.5	6.5
					MSLP	716	0	0.8	0.7	1.1
35615	47.6	53.3	-21	-20	SLP	589	0	0.5	0.4	0.6
					MSLP	589	0	0.6	5.4	5.4
35701	47.2	51.0	-27	-21	SLP	533	0	0.7	0.1	0.7
					MSLP	533	0	0.7	6.4	6.4
38262	43.0	59.8	93	58	SLP	724	0	0.8	4.1	4.2
					MSLP	724	0	0.8	0.9	1.2
38313	43.7	69.0	405	709	SLP	530	92	0.7	14.3	14.3
					MSLP	530	0	2.2	-0.3	2.2
38318	42.1	68.1	183	221	SLP	667	0	0.7	-8.3	8.3
					MSLP	667	0	0.7	-4.0	4.1
38836	38.6	68.7	800	1188	SLP	715	1	3.1	-2.9	4.2
					MSLP	709	0	4.5	-3.7	5.8
38875	39.0	73.6	3930	4306	SLP	355	100	*****	*****	*****
					GZ500	4	25	76.9	-40.9	87.1
38880	38.0	58.4	312	308	SLP	724	1	1.5	12.1	12.2
					MSLP	723	0	1.0	0.3	1.0
38944	37.5	69.4	447	586	SLP	714	0	1.5	-5.6	5.8
					MSLP	714	0	1.5	-5.8	6.0
40877	28.0	57.7	499	682	SLP	714	0	0.5	-0.8	0.9
					MSLP	714	0	1.1	-4.3	4.4
41265	22.8	58.5	469	592	SLP	657	0	0.5	-5.1	5.1
					MSLP	657	0	0.7	-2.0	2.1
41315	17.3	54.1	881	597	SLP	680	90	0.5	14.5	14.5
					GZ850	284	99	58.0	10.6	59.0
41573	33.9	73.4	2127	1312	SLP	680	0	1.7	9.2	9.4
					GZ850	679	0	13.4	-0.1	13.4
42056	32.7	74.8	323	308	SLP	706	0	0.8	-6.6	6.6
					-	-	-	-	-	-
42083	31.1	77.2	2202	1560	SLP	356	79	0.2	14.8	14.8
					-	-	-	-	-	-
42111	30.3	78.0	683	871	SLP	710	0	1.0	5.6	5.7
					MSLP	710	0	1.6	-2.2	2.7
42114	30.4	78.5	770	1525	SLP	354	100	*****	*****	*****
					-	-	-	-	-	-
42147	29.5	79.7	2311	1571	SLP	355	0	0.5	4.3	4.3
					-	-	-	-	-	-

WMO IDENT	LAT (N)	LON (E)	H (m)	HM (m)	ELEM	NOBS	PGE (%)	SD	BIAS	RMS
42299	27.3	88.6	1756	1989	SLP	359	0	0.8	0.2	0.8
					GZ850	359	0	9.6	54.9	55.7
43418	8.6	81.3	79	8	SLP	541	0	0.6	4.6	4.6
					MSLP	542	0	0.5	-0.3	0.6
43479	7.0	81.1	670	862	SLP	341	0	0.5	-9.7	9.7
					-	-	-	-	-	-
44406	29.3	80.9	617	1566	SLP	499	0	1.9	4.1	4.5
					MSLP	497	0	3.4	-3.2	4.7
44429	28.0	82.5	634	806	SLP	499	0	0.6	-3.6	3.6
					MSLP	499	0	1.7	0.4	1.7
47037	40.0	125.3	99	215	SLP	724	0	1.3	-3.7	3.9
					MSLP	724	0	1.3	-3.7	3.9
47102	38.0	124.7	146	4	SLP	724	0	0.6	12.3	12.3
					MSLP	724	0	0.6	-1.1	1.3
47145	36.8	127.3	26	112	SLP	724	0	0.6	-7.1	7.1
					MSLP	724	0	0.6	0.0	0.6
47152	35.6	129.3	36	121	SLP	723	0	0.7	-5.9	5.9
					MSLP	723	0	0.7	-0.5	0.9
48001	27.3	97.4	434	794	SLP	529	96	0.7	0.3	0.8
					MSLP	528	0	1.9	-1.1	2.2
48018	24.2	96.3	95	197	SLP	520	0	1.3	3.6	3.8
					MSLP	520	0	1.1	-0.5	1.2
48062	20.1	92.9	5	3	SLP	534	0	0.9	6.3	6.4
					MSLP	535	0	0.7	-0.3	0.8
48085	17.6	94.6	3	78	SLP	531	0	0.9	7.0	7.1
					MSLP	532	0	0.7	-0.1	0.7
48107	15.3	97.9	7	89	SLP	532	0	1.0	-3.4	3.5
					MSLP	532	0	1.0	0.2	1.0
48921	21.6	101.9	1360	1072	SLP	530	2	1.1	-4.5	4.6
					GZ850	529	100	18.1	71.7	73.9
48935	19.5	103.1	1094	1196	SLP	527	2	0.9	0.9	1.3
					GZ850	523	2	9.8	-82.3	82.9
48952	15.7	106.4	180	334	SLP	524	0	1.4	3.6	3.9
					MSLP	525	0	1.4	2.3	2.7
54945	35.5	119.6	37	22	SLP	724	0	0.6	-3.4	3.5
					MSLP	724	0	0.6	0.1	0.6
56946	23.6	99.4	1104	1396	SLP	724	0	0.8	-4.1	4.2
					MSLP	724	0	2.6	0.5	2.6
56951	24.0	100.2	1503	1839	SLP	724	0	0.7	-13.0	13.0
					MSLP	724	0	3.0	1.0	3.2
57731	28.0	108.3	418	727	SLP	724	100	0.0	-14.9	14.9
					MSLP	724	0	1.2	0.8	1.4
58921	26.0	117.4	204	530	SLP	724	0	0.7	-6.6	6.6
					MSLP	724	0	0.9	0.0	0.9
59632	22.0	108.6	6	25	SLP	724	0	0.5	-5.2	5.2

WMO IDENT	LAT (N)	LON (E)	H (m)	HM (m)	ELEM	NOBS	PGE (%)	SD	BIAS	RMS
					MSLP	724	0	0.5	0.1	0.5

WMO IDENT: WMO station identification number
 LAT: station latitude
 LON: station longitude
 H: barometer elevation
 HM: model elevation
 ELEM: observed element
 NOBS: total number of observations during the period
 PGE: percentage of gross errors
 SD: standard deviation of (observation - guess)
 BIAS: bias of (observation - guess)
 RMS: root mean square of (observation - guess)

KAZAKHSTAN

- 35284** - Positive bias of O-G at the station level (Figures 2 and 3)
- 35615** - Positive bias of O-G at the mean sea level (Figures 4 and 5)
- 35701** - Positive bias of O-G at the mean sea level (Figures 4 and 6)
- 38313** - Positive bias of O-G at the station level (Figures 9 and 10)
- 38318** - Negative bias of O-G at the station level (Figures 9 and 11)

UZBEKISTAN

- 38262** - Positive bias of O-G at the station level (Figures 7 and 8)

TAJIKISTAN

- 38836** - Negative bias of O-G at the mean sea level (Figures 12 and 13)
- 38875** - Positive bias of O-G at the station level (Figures 9 and 14)
- 38944** - Negative bias of O-G at the station level and at the mean sea level (Figures 9, 12 and 16)

TURKMENISTAN

- 38880** - Positive bias of O-G at the station level (Figures 7 and 15)

IRAN, ISLAMIC REPUBLIC OF

- 40877** - Negative bias of O-G at the mean sea level (Figures 17 and 18)

OMAN

- 41265** - Negative bias of O-G at the station level (Figures 19 and 20)
- 41315** - Positive bias of O-G at the station level and Negative bias of O-G at 850 hPa (Figures 21 and 22)

PAKISTAN

41573 - Positive bias of O-G at the station level (Figures 23 and 24)

INDIA

42056 - Negative bias of O-G at the station level (Figures 23 and 25)

42083 - Positive bias of O-G at the station level (Figures 23 and 26)

42111 - Positive bias of O-G at the station level (Figures 23 and 27)

42114 - Negative bias of O-G at the station level (Figures 23 and 28)

42147 - Positive bias of O-G at the station level (Figures 23 and 29)

42299 - Positive bias of O-G at 850 hPa (Figure 30)

SRI LANKA

43418 - Positive bias of O-G at the station level (Figures 31 and 32)

43479 - Negative bias of O-G at the station level (Figures 31 and 33)

NEPAL

44406 - Positive bias of O-G at the station level (Figures 23 and 34)

44429 - Negative bias of O-G at the station level (Figures 23 and 35)

KOREA, DEMOCRATIC PEOPLE'S REPUBLIC OF

47037 - Negative bias of O-G at the station level and at the mean sea level (Figures 36, 37 and 38)

KOREA, REPUBLIC OF

47102 - Positive bias of O-G at the station level (Figures 36 and 39)

47145 - Negative bias of O-G at the station level (Figures 36 and 40)

47152 - Negative bias of O-G at the station level (Figures 36 and 41)

MYANMAR

48001 - The percentage of gross errors (PGE) is equal to or greater than 25% (Figures 42 and 43).

48018 - Positive bias of O-G at the station level (Figures 42 and 44)

48062 - Positive bias of O-G at the station level (Figures 45 and 46)

48085 - Positive bias of O-G at the station level (Figures 45 and 47)

48107 - Negative bias of O-G at the station level (Figures 45 and 48)

LAO PEOPLE'S DEMOCRATIC REPUBLIC

48921 - Negative bias of O-G at the station level and at 850 hPa (Figures 42 and 49)

48935 - Negative bias of O-G at 850 hPa (Figure 50)

48952 - Positive bias of O-G at the station level (Figures 51 and 52)

CHINA

54945 - Negative bias of O-G at the station level (Figures 36 and 53)

56946 - Negative bias of O-G at the station level (Figures 42 and 54)

56951 - Negative bias of O-G at the station level (Figures 42 and 55)

57731 - Negative bias of O-G at the station level (Figures 56 and 57)

58921 - Negative bias of O-G at the station level (Figures 58 and 59)

59632 - Negative bias of O-G at the station level (Figures 60 and 61)

4.2 Stations where quality deteriorated during the period

Table 5 List of suspect land surface stations where quality deteriorated during the period

WMO IDENT	LAT (N)	LON (E)	H (m)	HM (m)	ELEM	NOBS	PGE (%)	SD	BIAS	RMS
41244	24.2	55.9	372	438	SLP	643	13	5.7	-0.2	5.7
					MSLP	646	14	5.6	-0.9	5.7
48925	20.7	102.0	636	950	SLP	514	1	1.1	-3.6	3.8
					MSLP	514	0	1.5	-1.7	2.3

OMAN

41244 - O-G at the station level and at the mean sea level has been fluctuating wildly since February 2022 (Figures 17, 19 and 62).

LAO PEOPLE'S DEMOCRATIC REPUBLIC

48925 - Negative bias of O-G at the station level (Figures 42 and 63)

4.3 Stations improved and excluded from the previous consolidated list

KAZAKHSTAN

38232 - The positive bias of O-G at the station level and at the mean sea level has improved since May 2022 (Figure 64).

4.4 Stations removed from the previous consolidated list

TAJIKISTAN

38836 - Although station 38836 still displays negative biases of O-G at the station level, it was removed from the consolidated list because the biases did not exceed the threshold (Figure 65).

KUWAIT

40587 - Station 40587 was removed from the consolidated list because observed values of mean sea

level pressure were unnaturally constant during the period, and the number of reports (87) was insufficient for quality checking (Figure 66).

INDIA

42295 - Although station 42295 still displays positive biases of O-G at the station level and at 850 hPa, it was removed from the consolidated list because the number of reports (131) was insufficient for quality checking (Figure 67).

NEPAL

44424 - Although station 44424 showed no particular change in the O-G bias trend at the station level or at 700 hPa, it was removed from the consolidated list because the difference between the station elevation (2,300 m) and JMA's model elevation (3,315 m) exceeds 1,000 m due to a change from 3,288 m in March 2021 (Figure 68).

5. Possible Causes of Remarkable and Sustained Biases

The following are possible causes of remarkable and sustained biases

- (i) The barometer used for observation is not correctly calibrated.
- (ii) The latitude, longitude or altitude of the station in OSCAR/Surface has not been updated in a timely and appropriate manner. This could result in remarkable biases because it may cause incorrect calculated first-guess field values.
- (iii) Biases are specific to the NWP model used in quality monitoring.

Note: Model biases are likely to appear in relatively large areas.

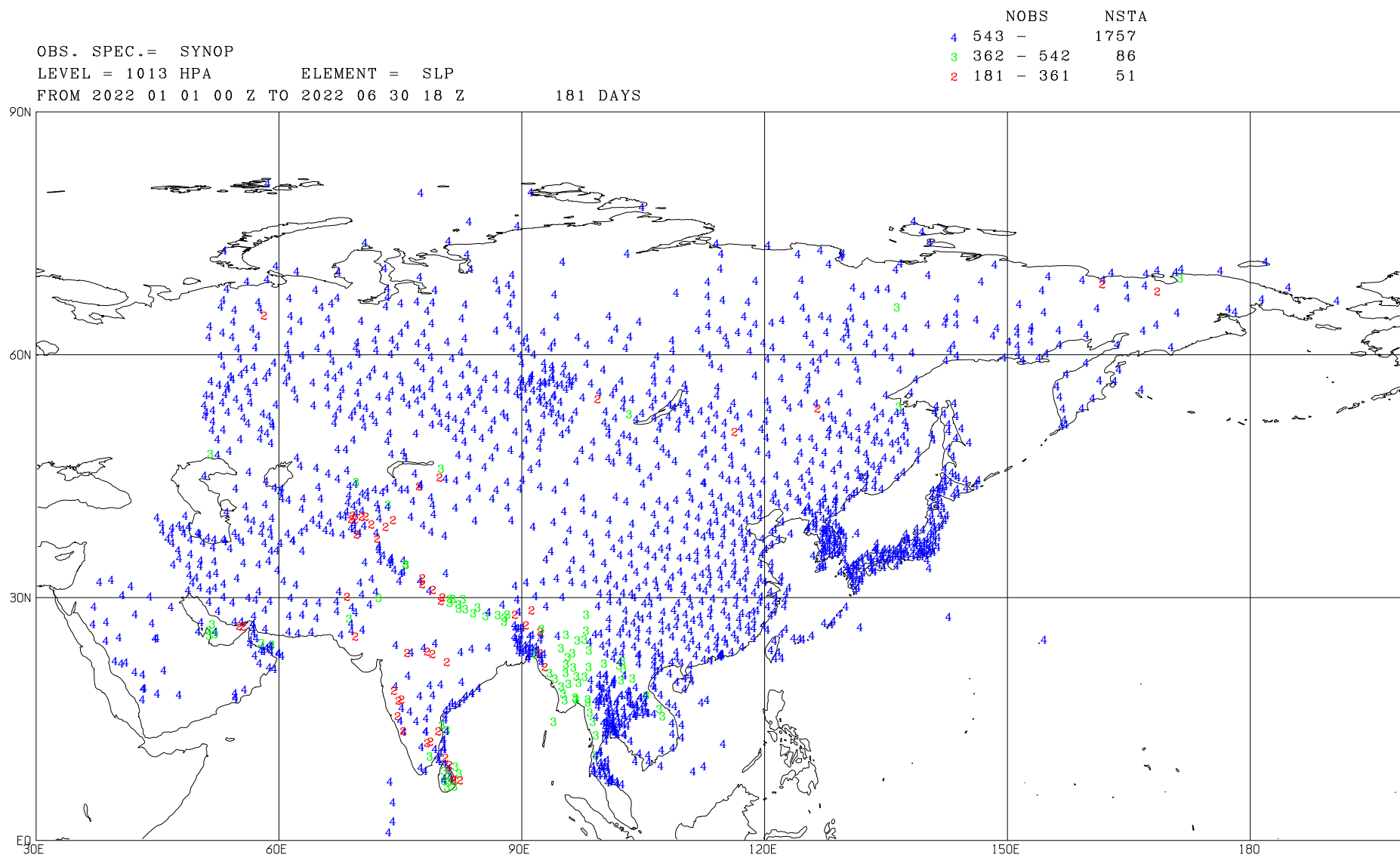


Figure 1(a) Location of all land surface stations reporting station level pressure (SLP) observations in Region II over the six-month period from January to June 2022. Numbers (2, 3, 4) show the total number of observations (NOBS) received at RSMC Tokyo. The total numbers of stations (NSTA) reporting SLP are shown at the top of the figure.

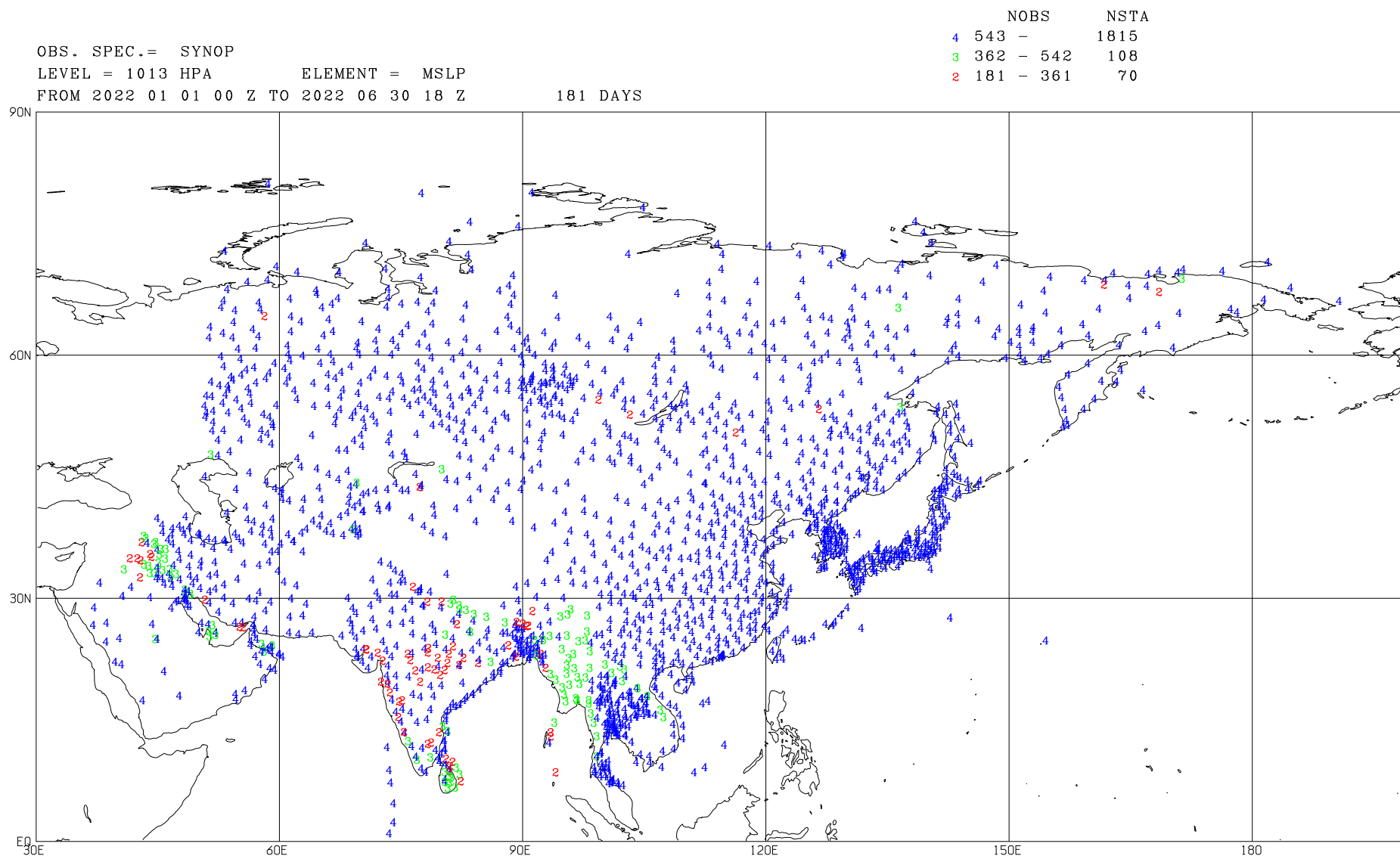


Figure 1(b) Location of all land surface stations reporting mean sea level pressure (MSLP) observations in Region II over the six-month period from January to June 2022. Numbers (2, 3, 4) show the total number of observations (NOBS) received at RSMC Tokyo. The total numbers of stations (NSTA) reporting MSLP are shown at the top of the figure.

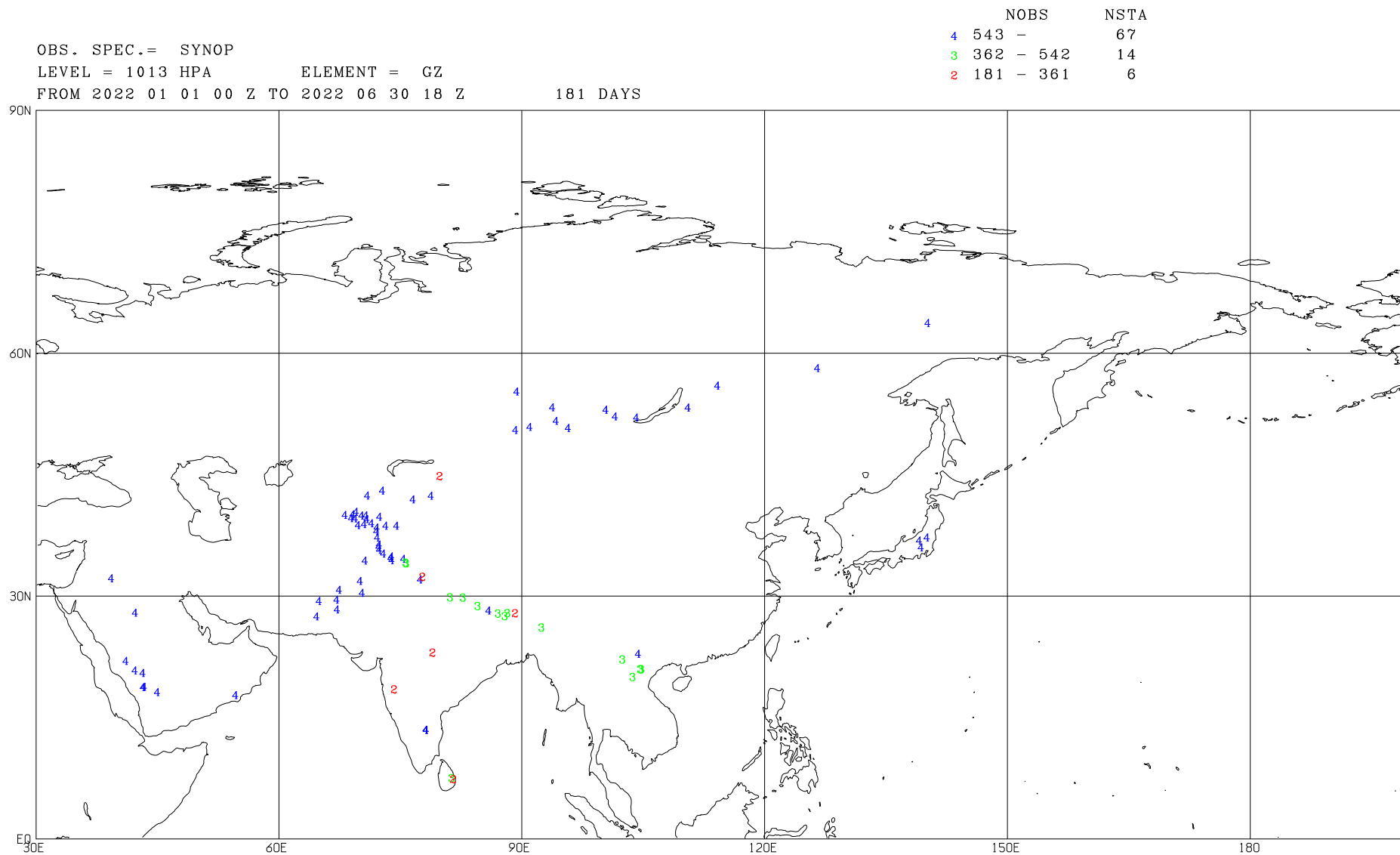


Figure 1(c) Location of all land surface stations reporting geopotential height (GZ) observations in Region II over the six-month period from January to June 2022. Numbers (2, 3, 4) show the total number of observations (NOBS) received at RSMC Tokyo. The total numbers of stations (NSTA) reporting GZ are shown at the top of the figure.

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

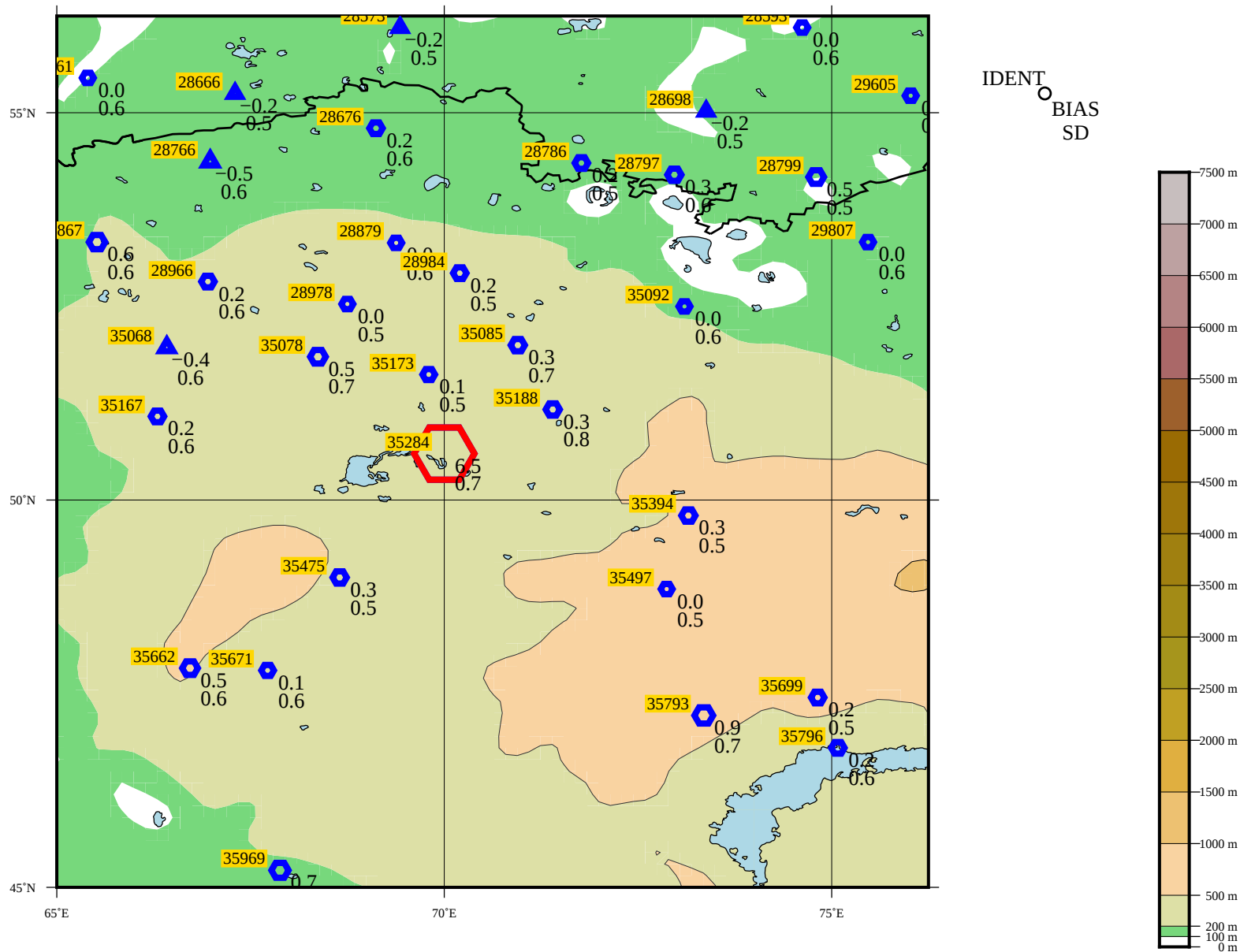


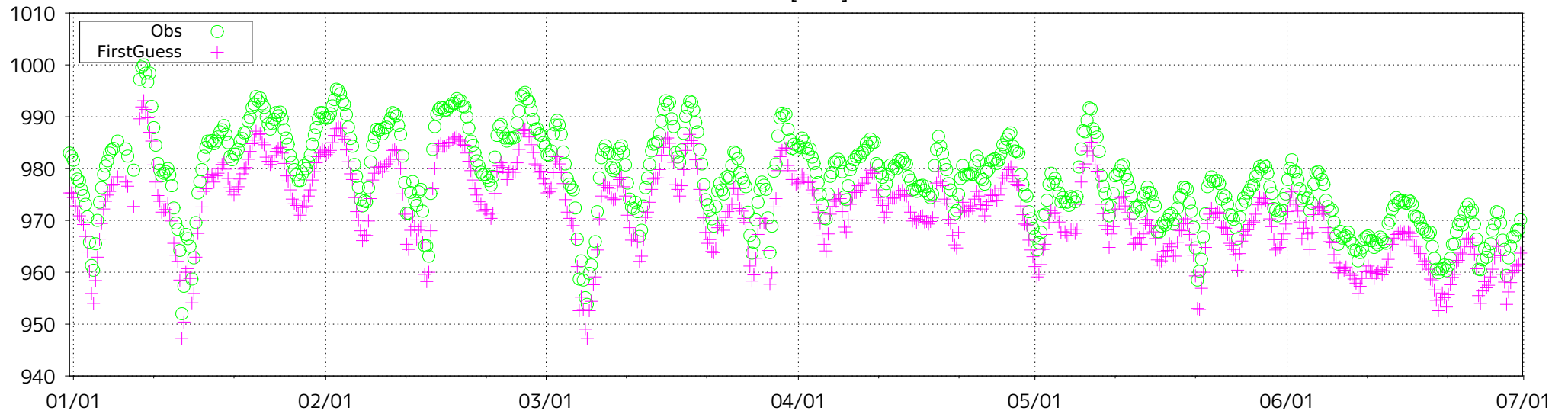
Figure 2 BIAS and SD of SLP for station 35284 (red) and surrounding stations (blue).

The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.

The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 35284 (lat: 50.6N, lon: 70.0E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

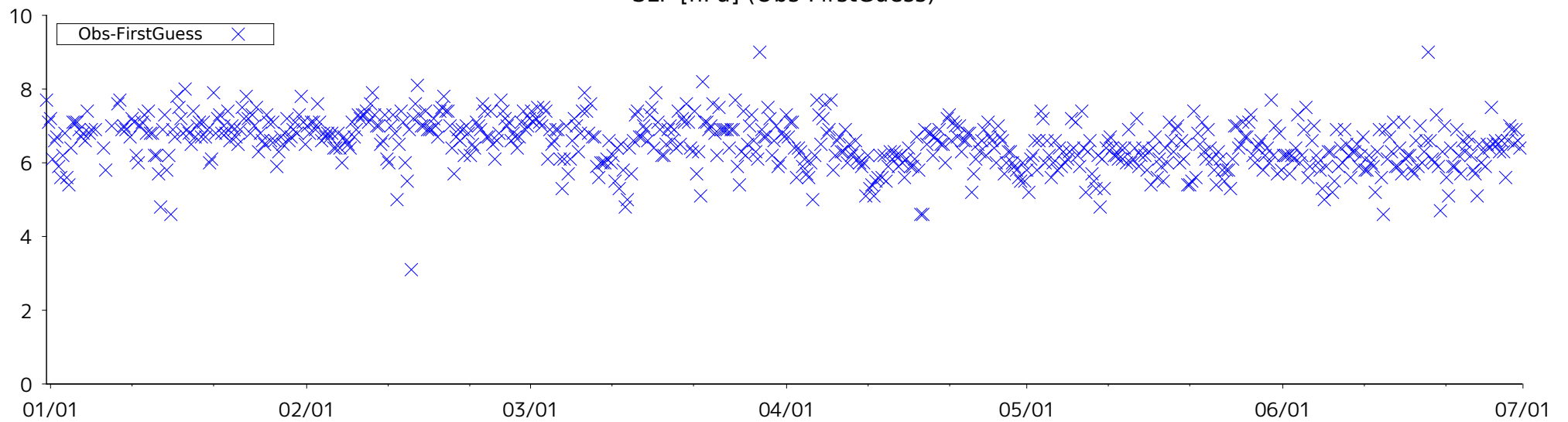


Figure 3 Time-series representation of SLP Obs minus FirstGuess for station 35284

LEVEL = SUR ELEMENT = MSLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

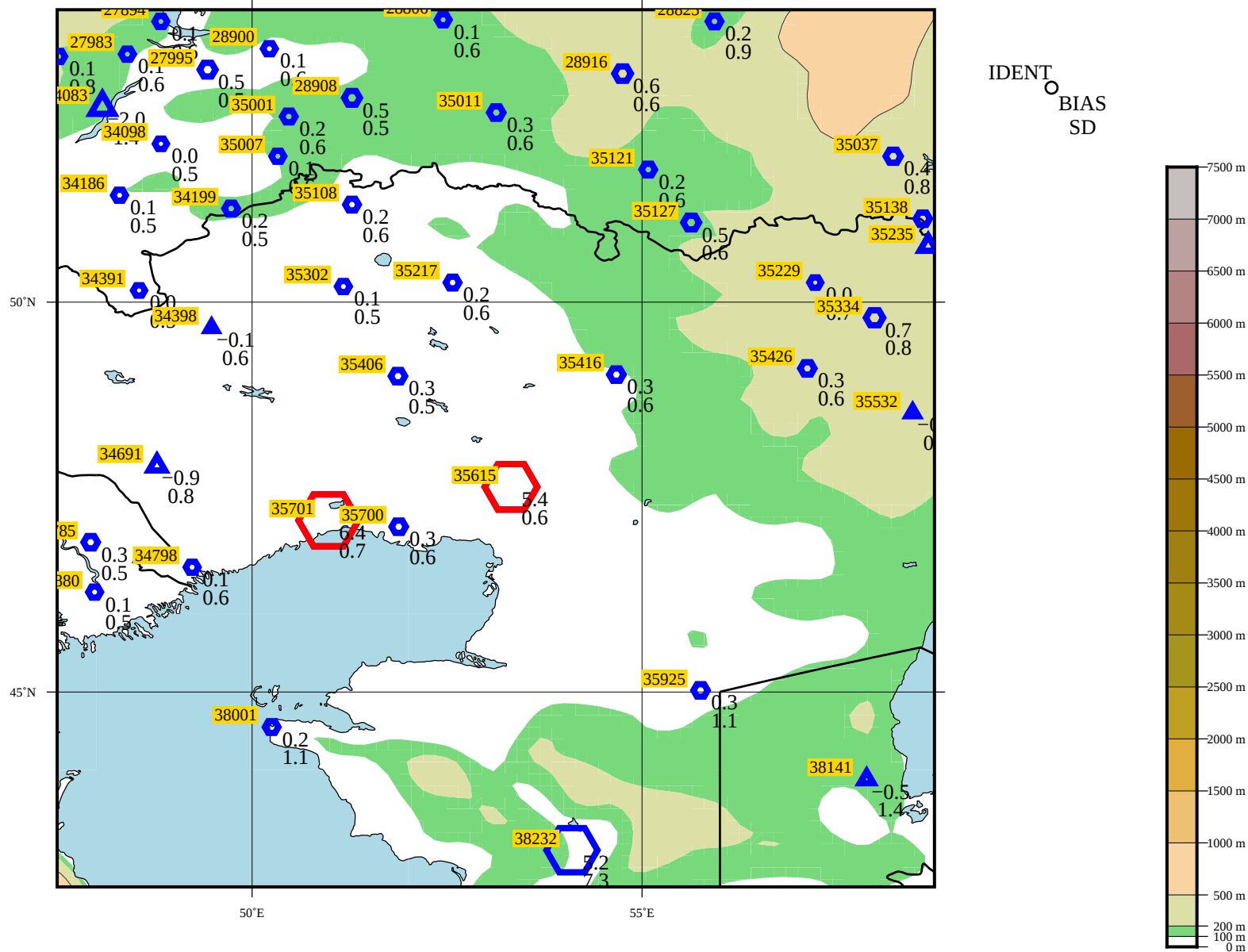
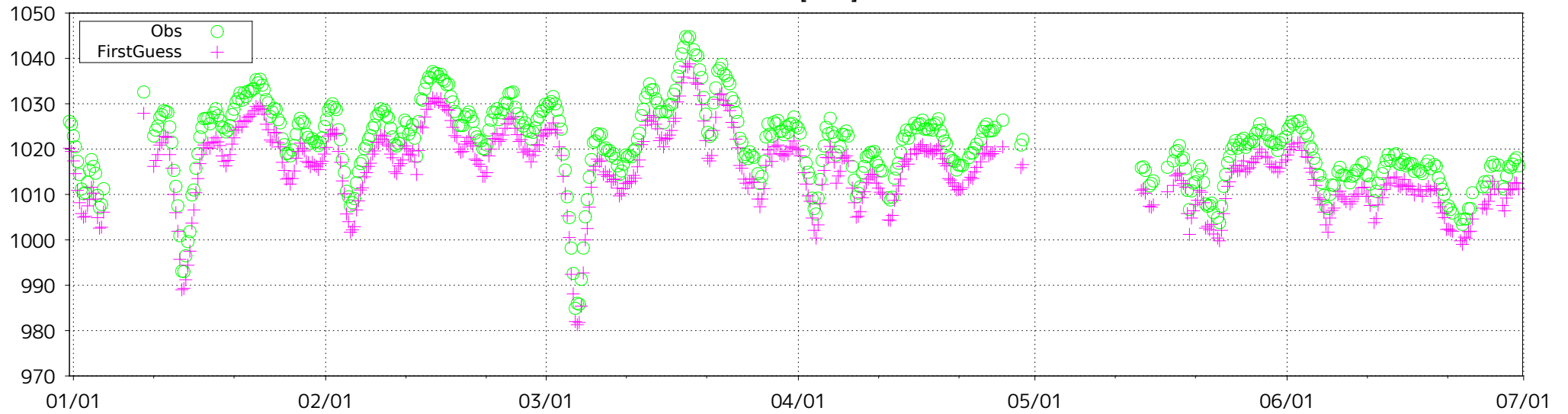


Figure 4 BIAS and SD of MSLP for station 35615, 35701 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 35615 (lat: 47.6N, lon: 53.3E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

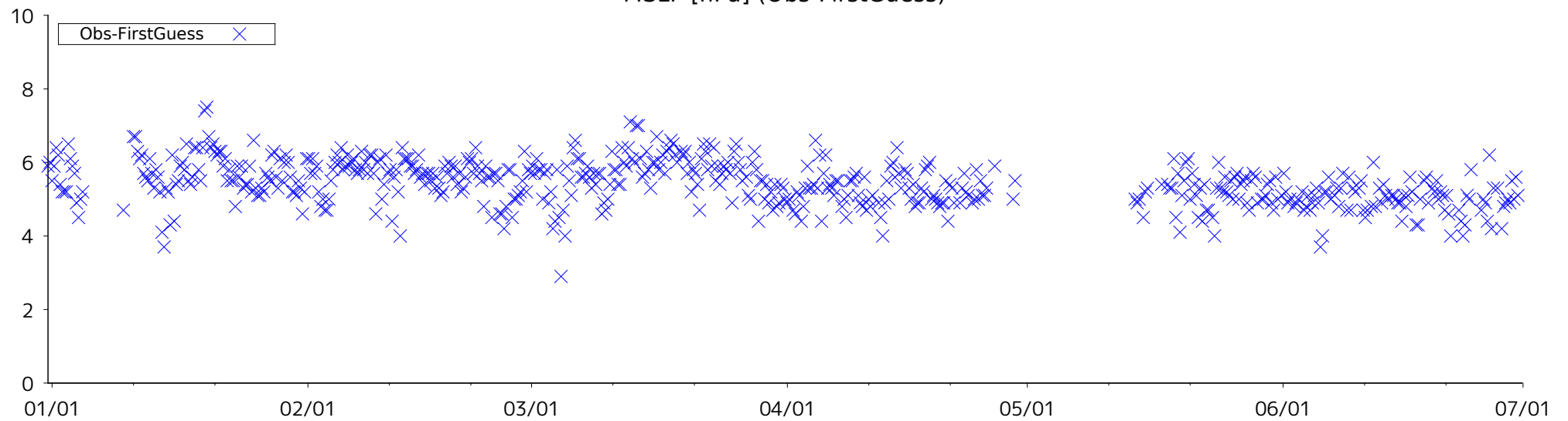
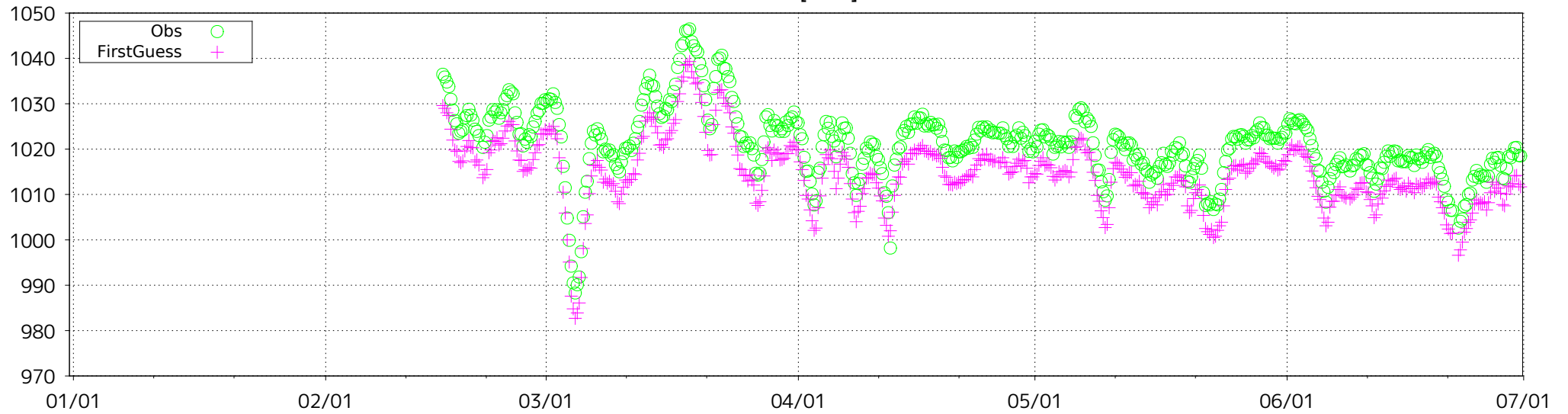


Figure 5 Time-series representation of MSLP Obs minus FirstGuess for station 35615

ID: 35701 (lat: 47.2N, lon: 51.0E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

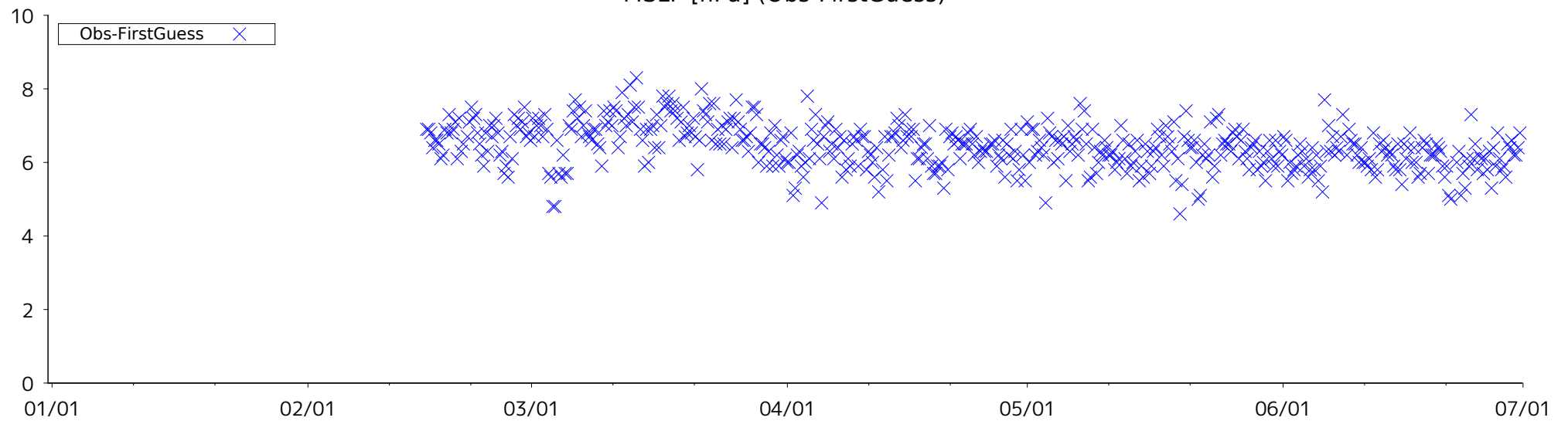


Figure 6 Time-series representation of MSLP Obs minus FirstGuess for station 35701

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

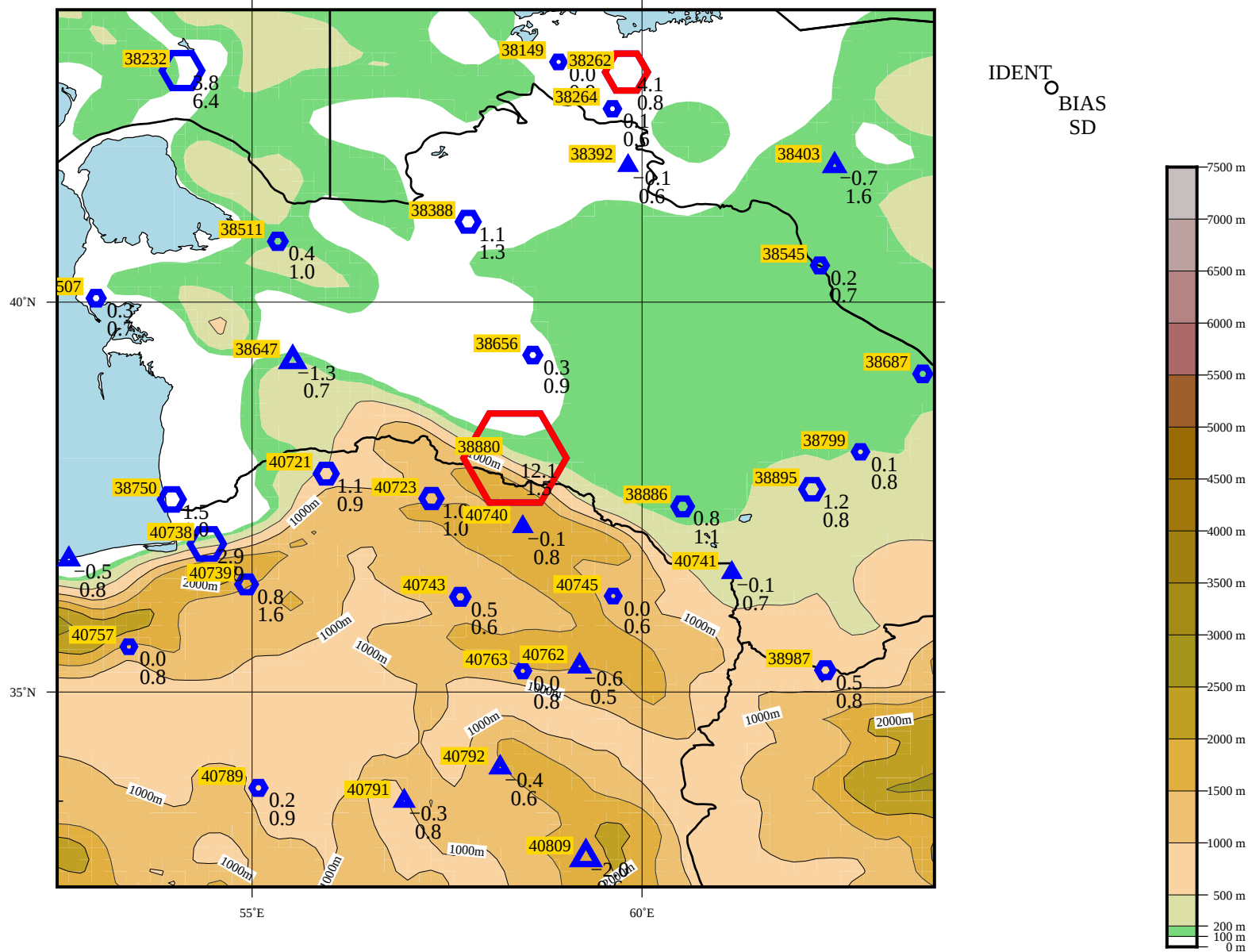
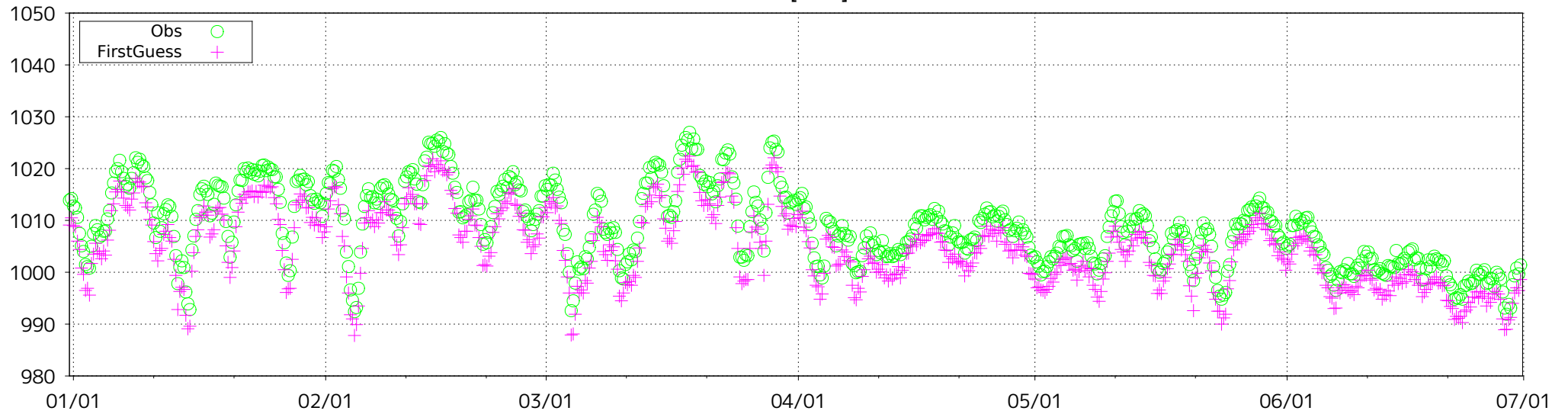


Figure 7 BIAS and SD of SLP for station 38262, 38880 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 38262 (lat: 43.0N, lon: 59.8E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

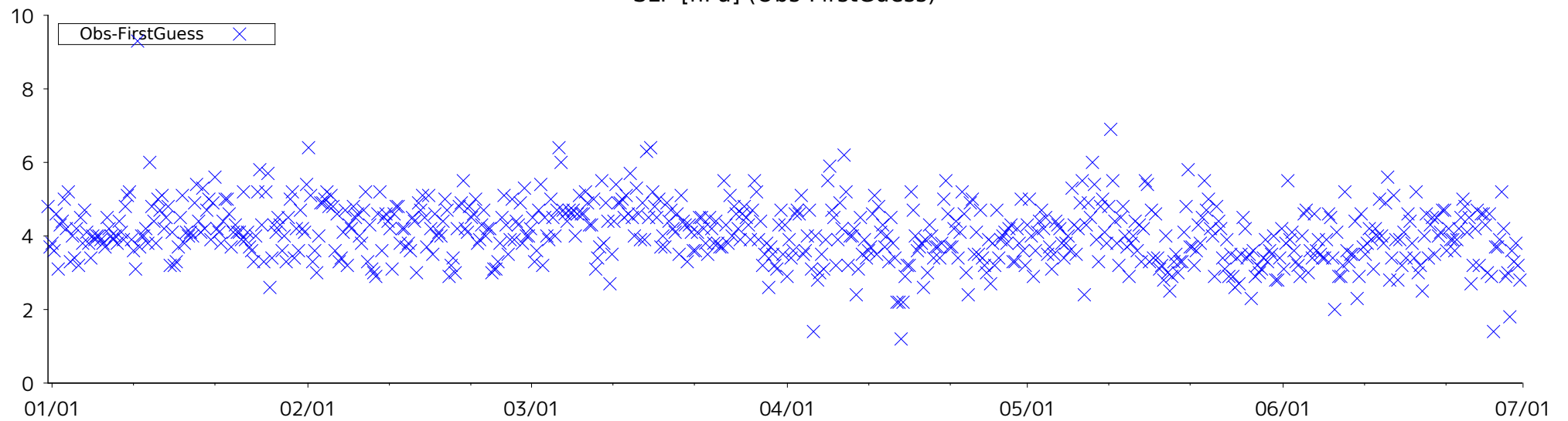


Figure 8 Time-series representation of SLP Obs minus FirstGuess for station 38262

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

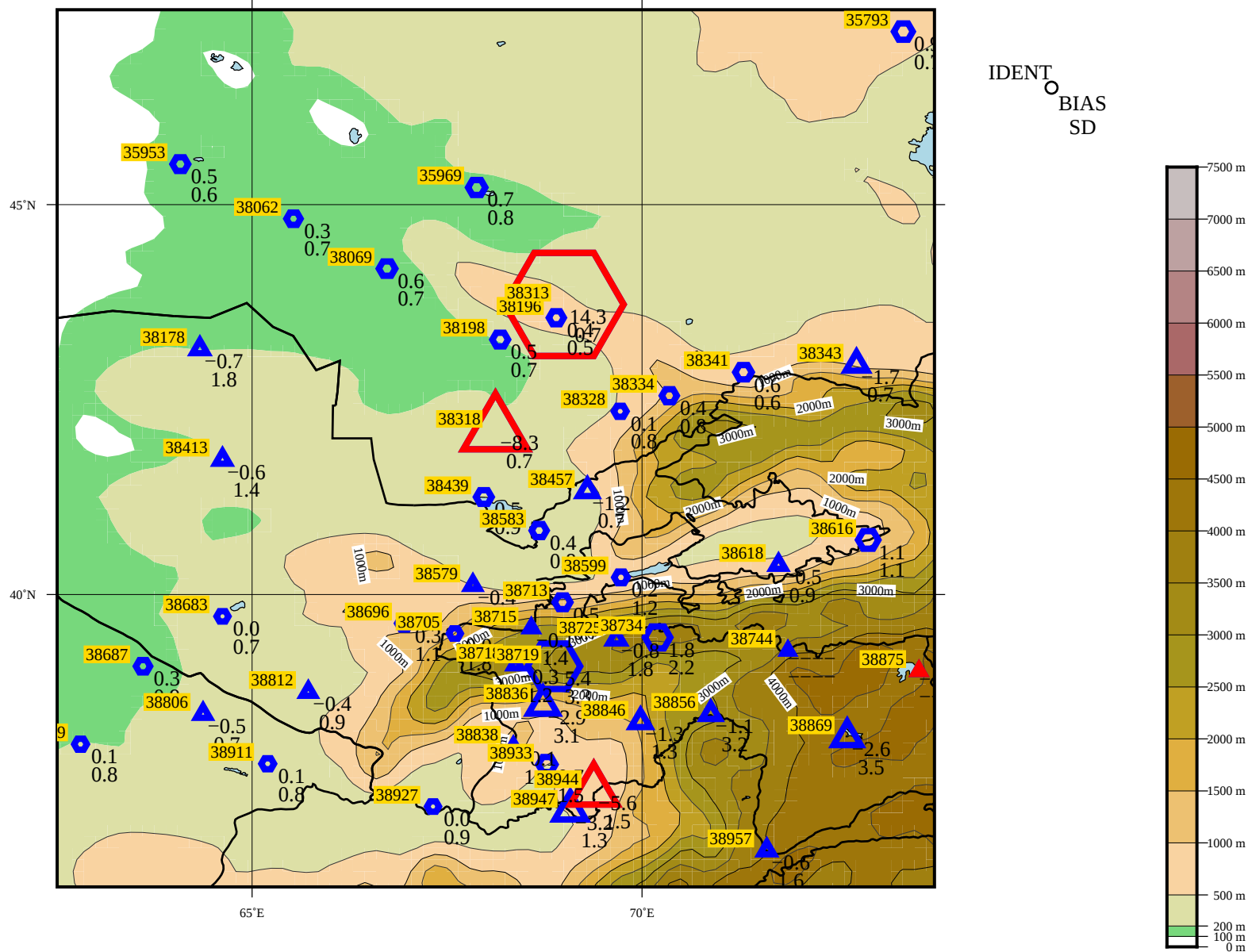
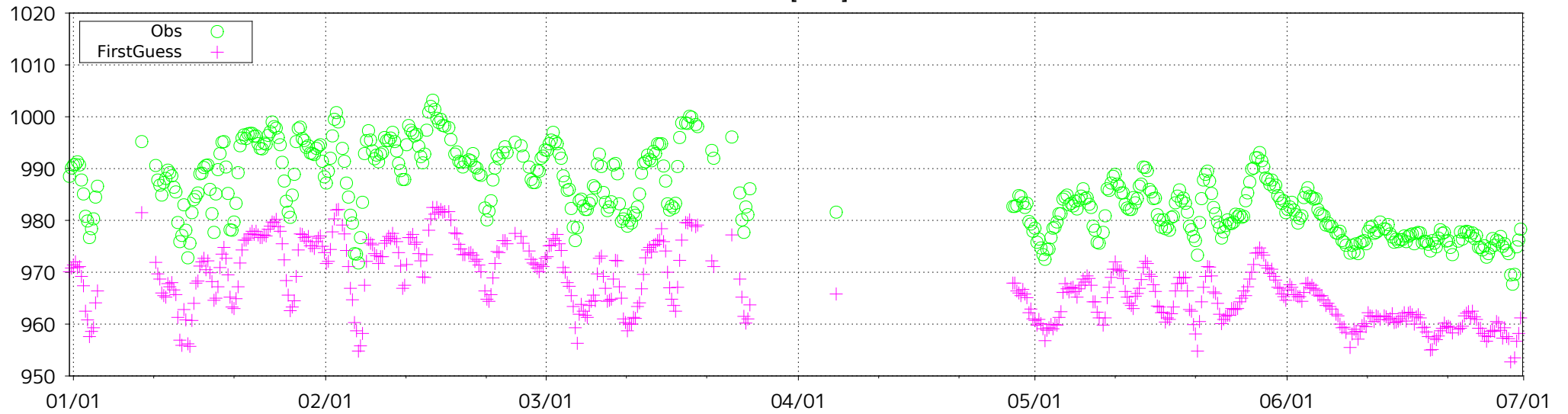


Figure 9 BIAS and SD of SLP for station 38313, 38318, 38875, 38944 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 38313 (lat: 43.7N, lon: 69.0E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

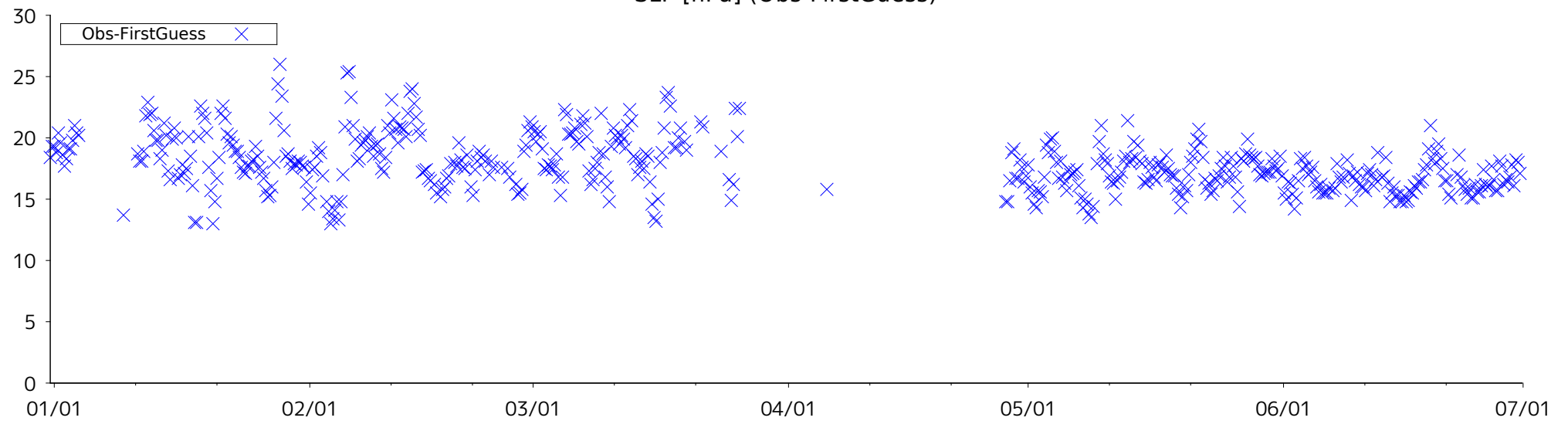
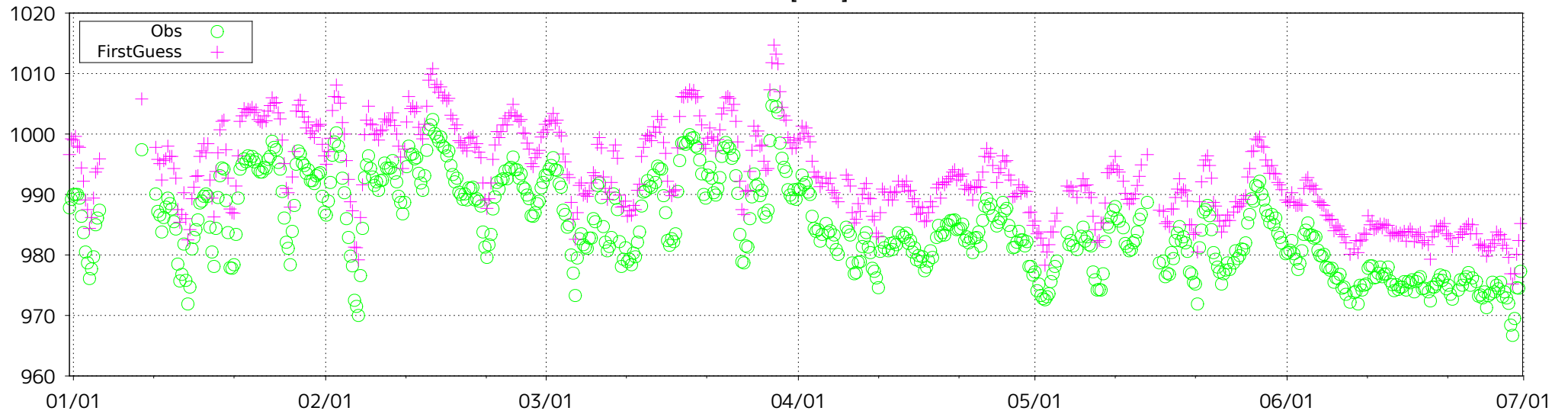


Figure 10 Time-series representation of SLP Obs minus FirstGuess for station 38313

ID: 38318 (lat: 42.1N, lon: 68.1E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

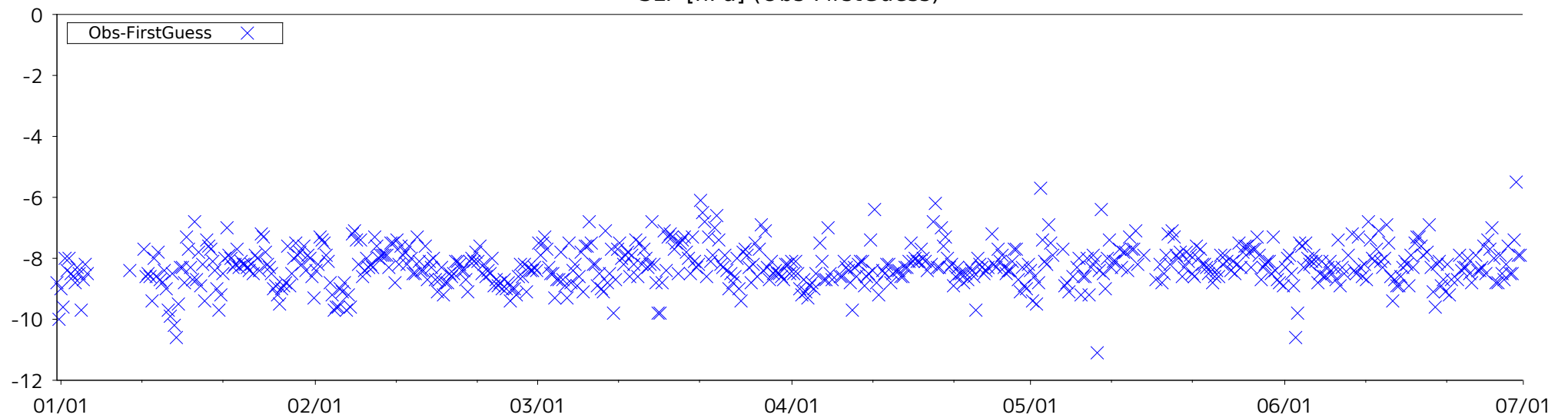


Figure 11 Time-series representation of SLP Obs minus FirstGuess for station 38318

LEVEL = SUR ELEMENT = MSLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

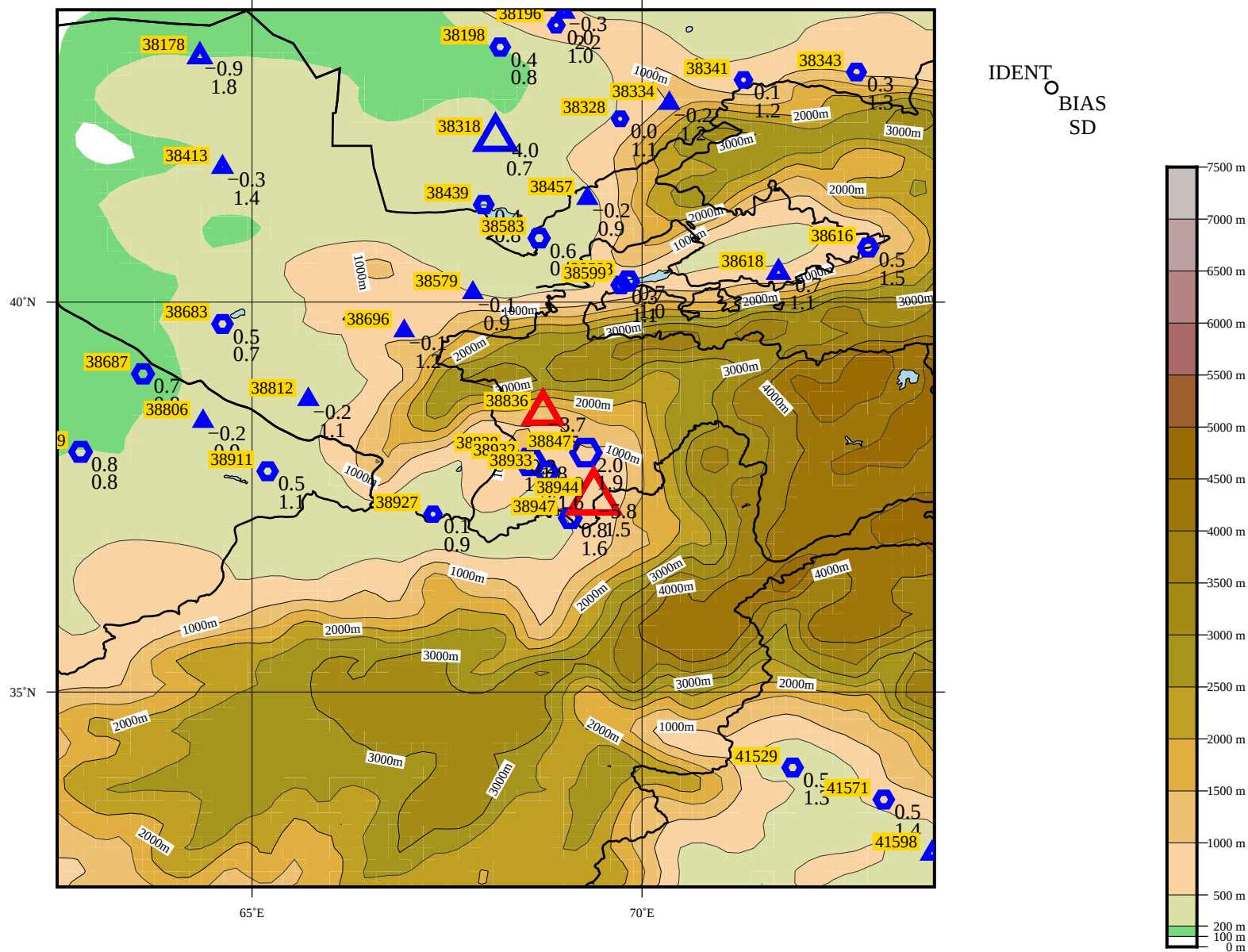
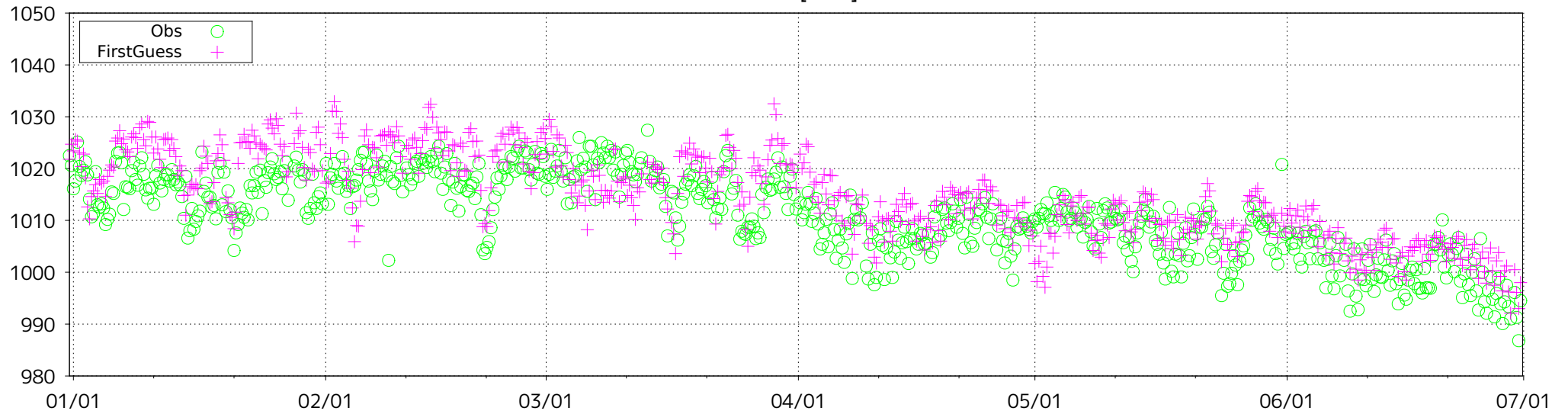


Figure 12 BIAS and SD of MSLP for station 38836, 38944 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 38836 (lat: 38.6N, lon: 68.7E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

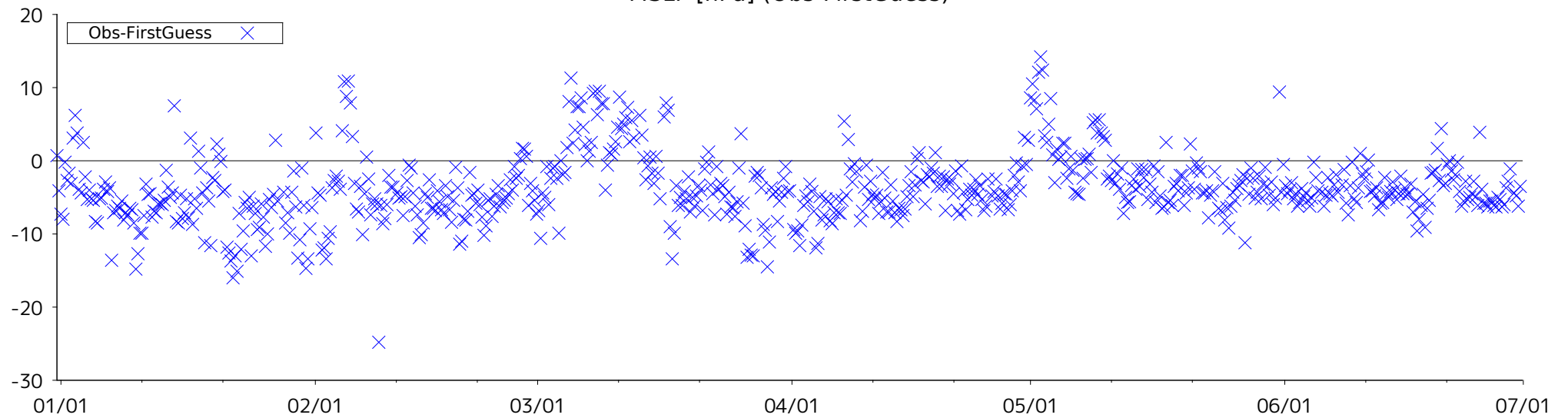
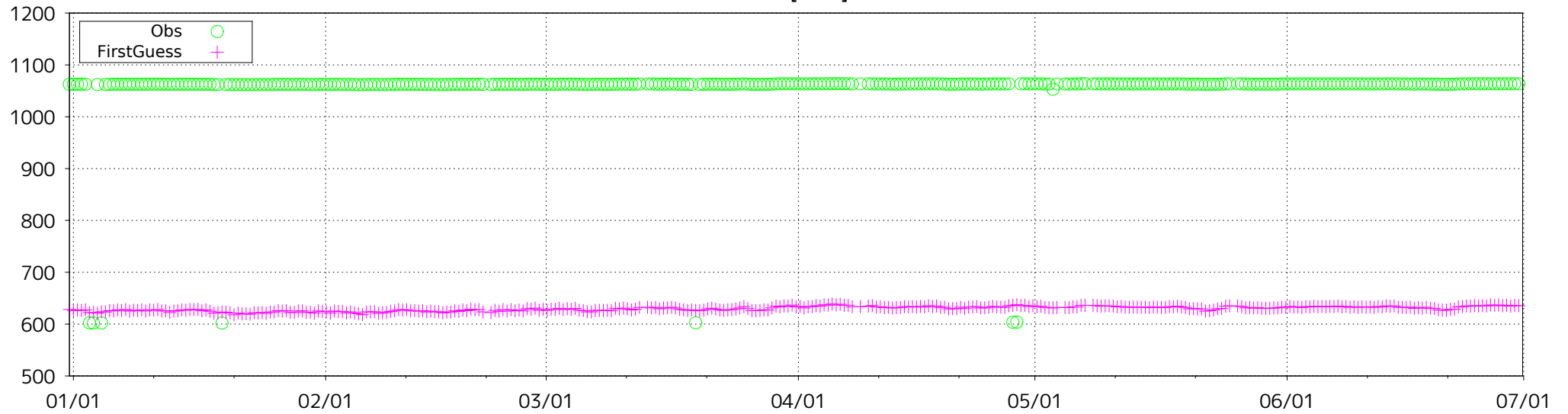


Figure 13 Time-series representation of MSLP Obs minus FirstGuess for station 38836

ID: 38875 (lat: 39.0N, lon: 73.6E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

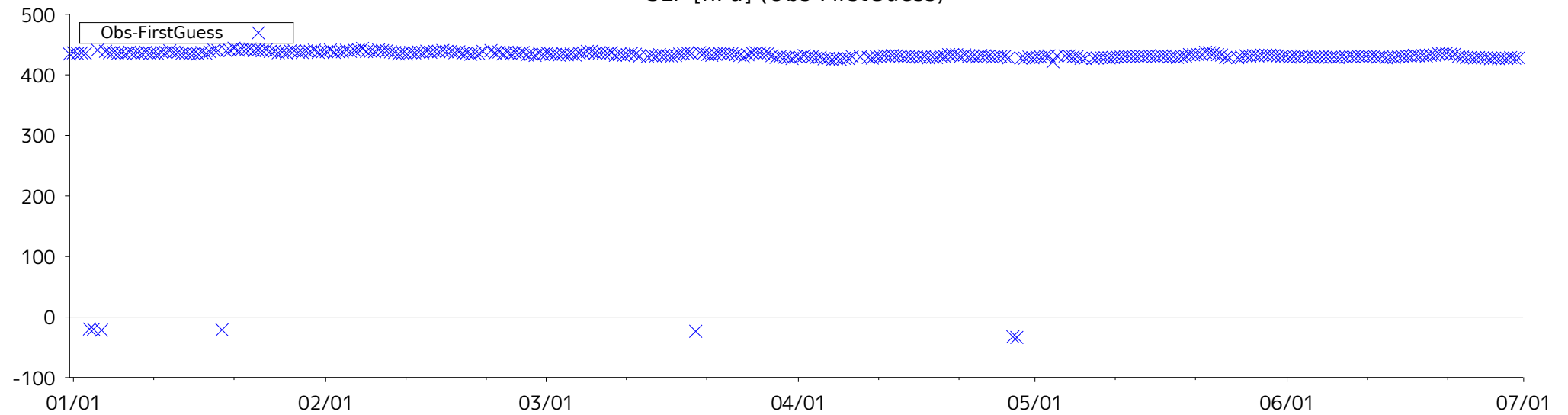
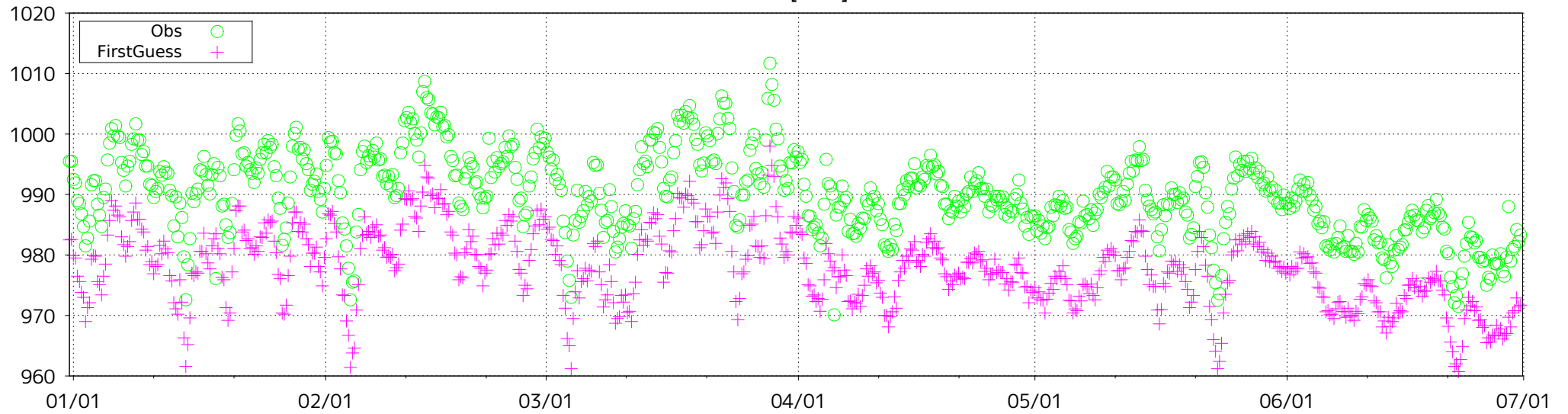


Figure 14 Time-series representation of SLP Obs minus FirstGuess for station 38875

ID: 38880 (lat: 38.0N, lon: 58.4E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

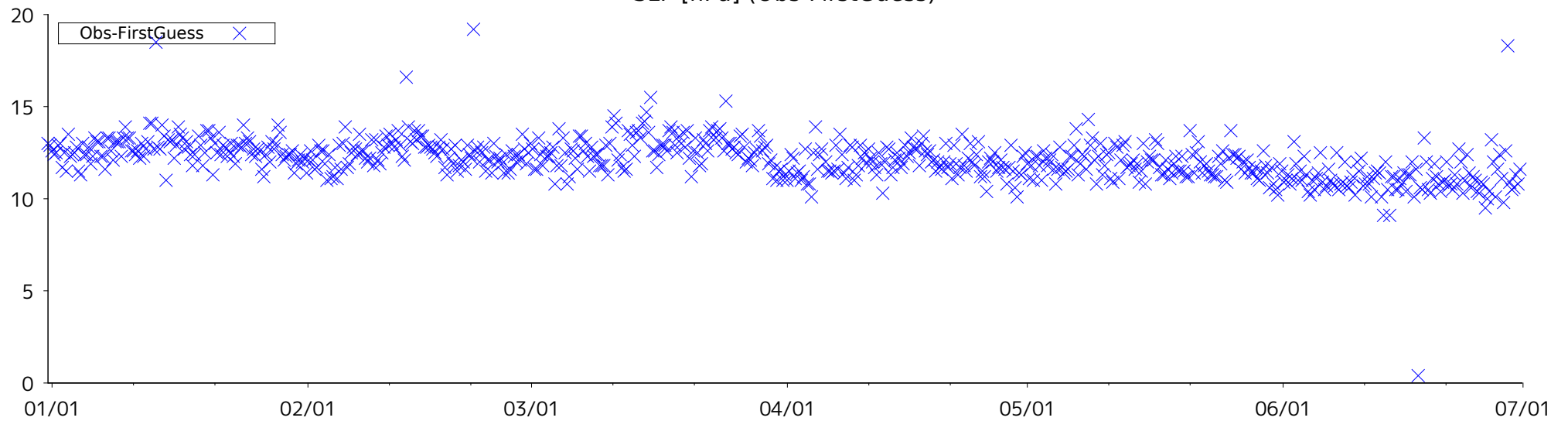
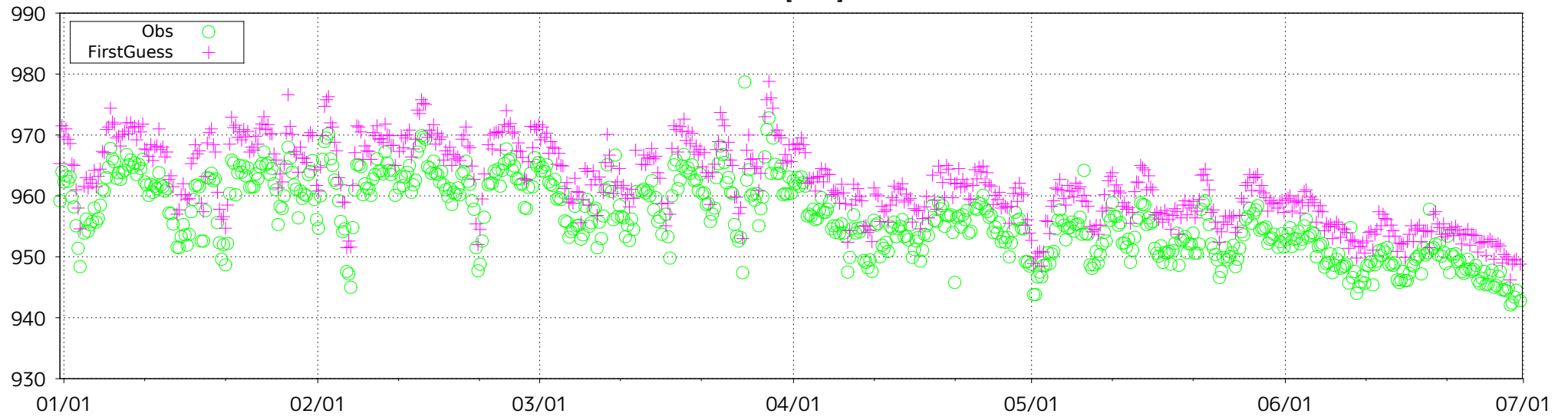


Figure 15 Time-series representation of SLP Obs minus FirstGuess for station 38880

ID: 38944 (lat: 37.5N, lon: 69.4E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

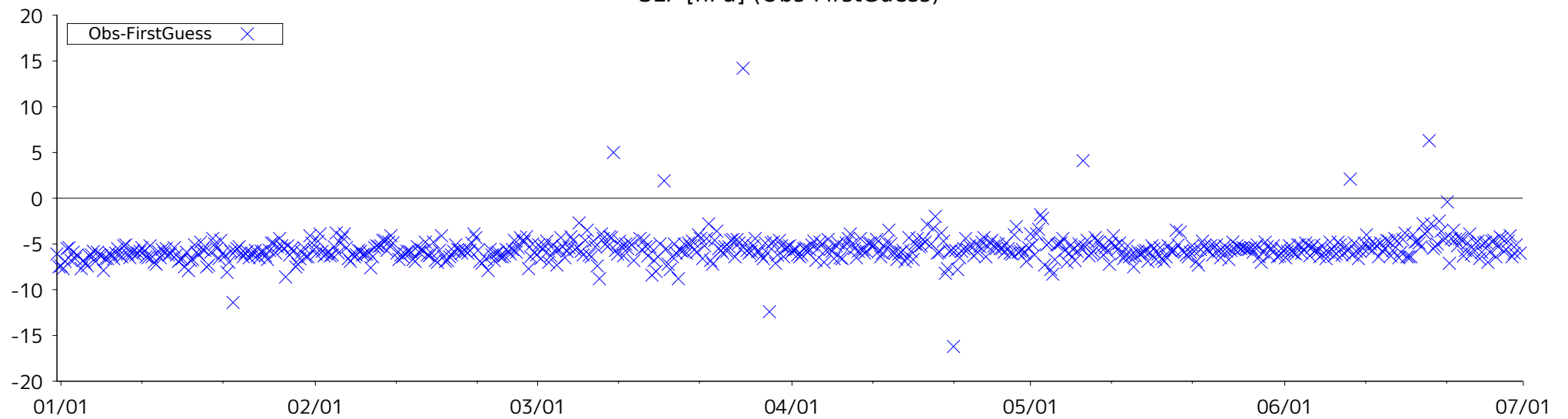
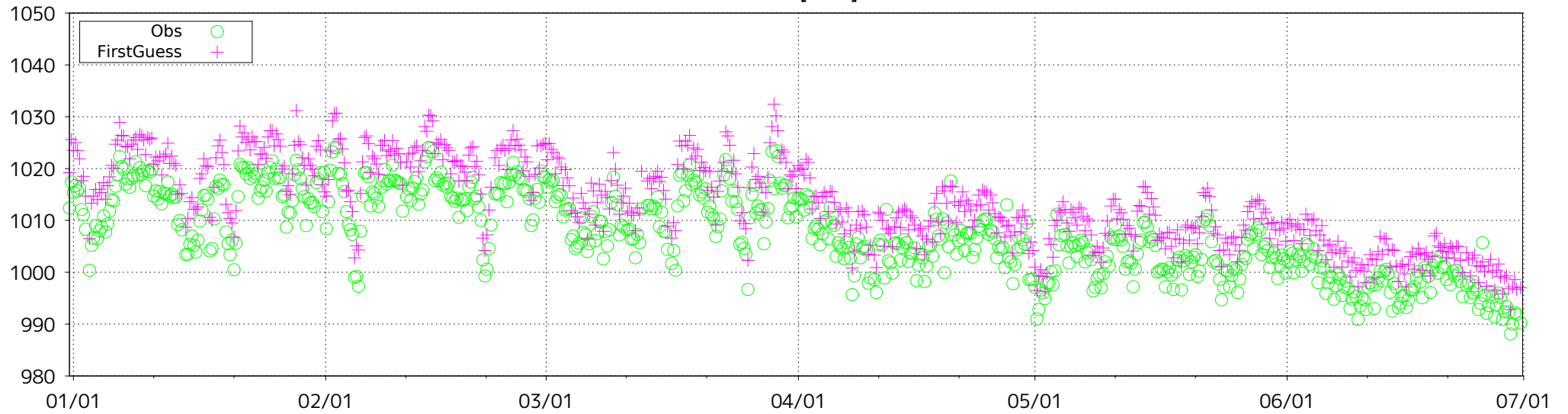


Figure 16(a) Time-series representation of SLP Obs minus FirstGuess for station 38944

ID: 38944 (lat: 37.5N, lon: 69.4E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

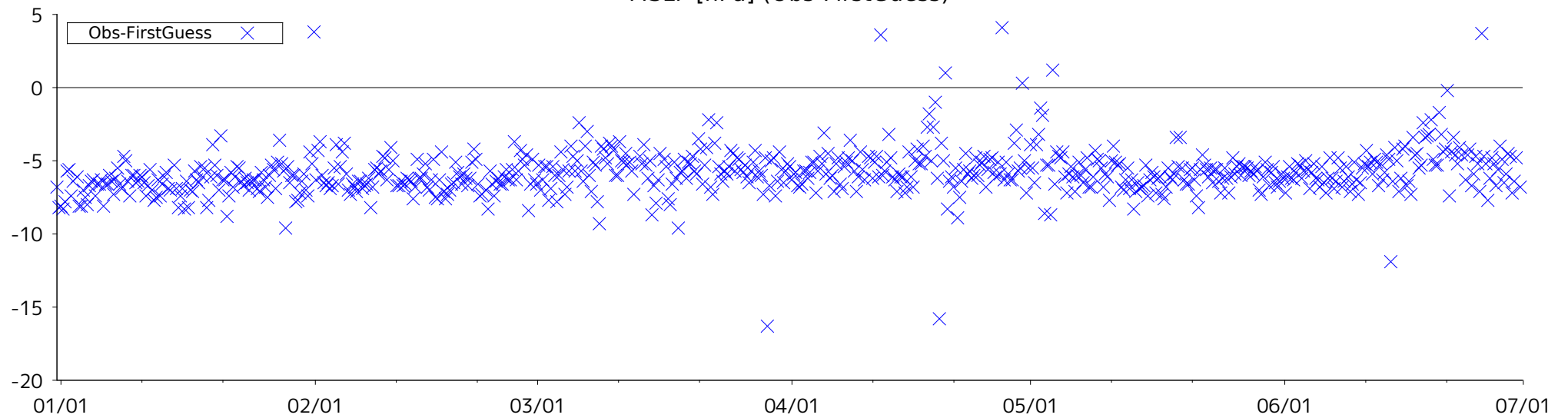


Figure 16(b) Time-series representation of MSLP Obs minus FirstGuess for station 38944

LEVEL = SUR ELEMENT = MSLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

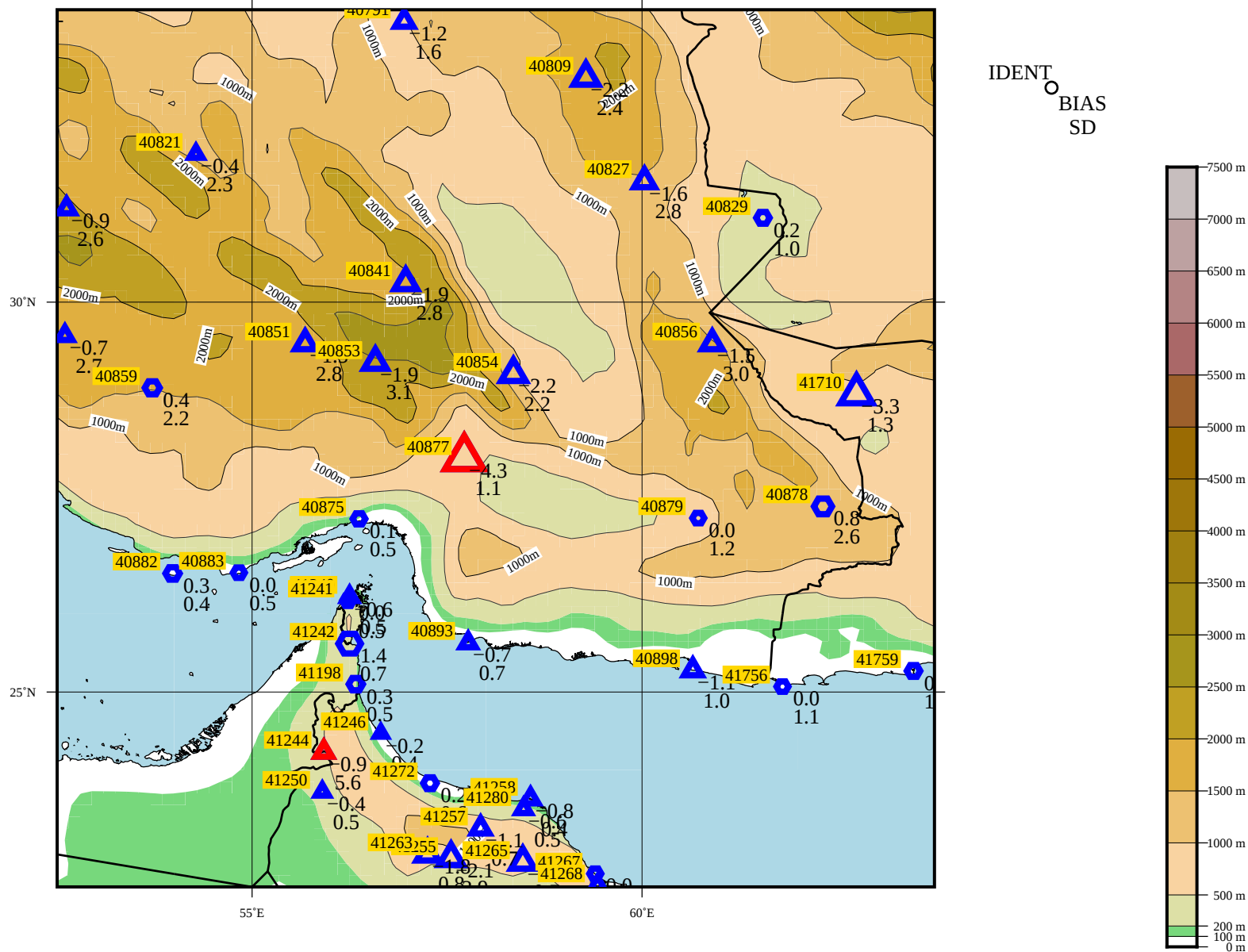
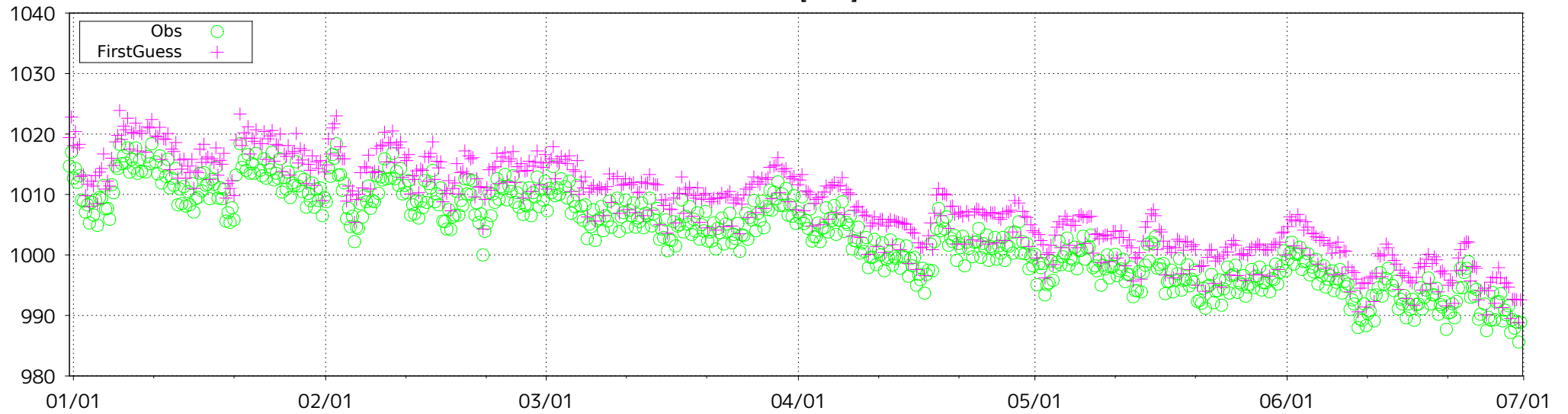


Figure 17 BIAS and SD of MSLP for station 40877, 41244 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 40877 (lat: 28.0N, lon: 57.7E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

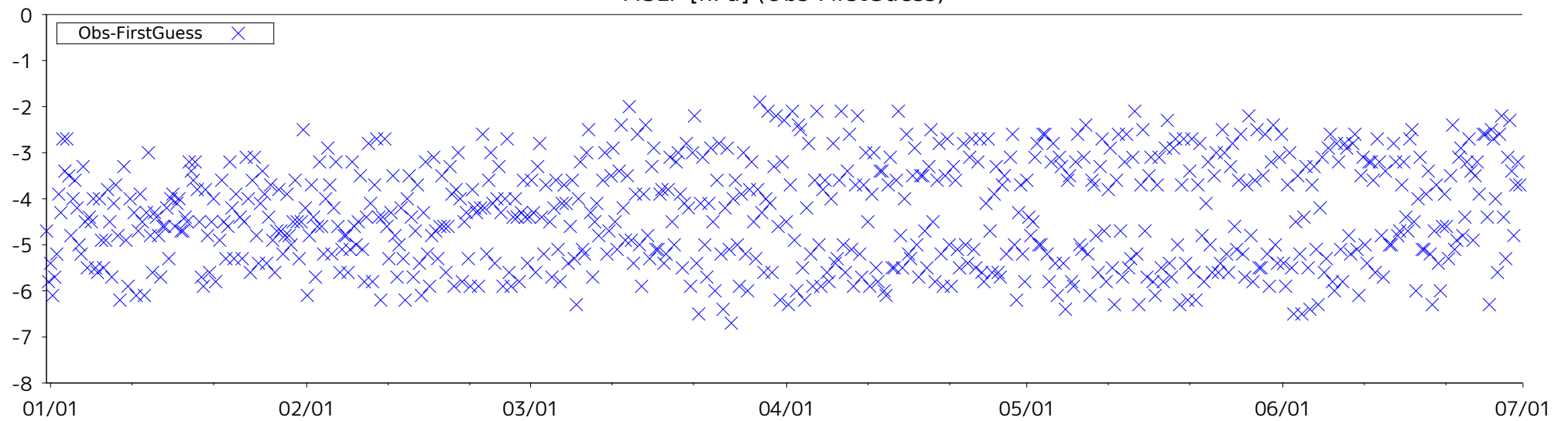


Figure 18 Time-series representation of MSLP Obs minus FirstGuess for station 40877

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

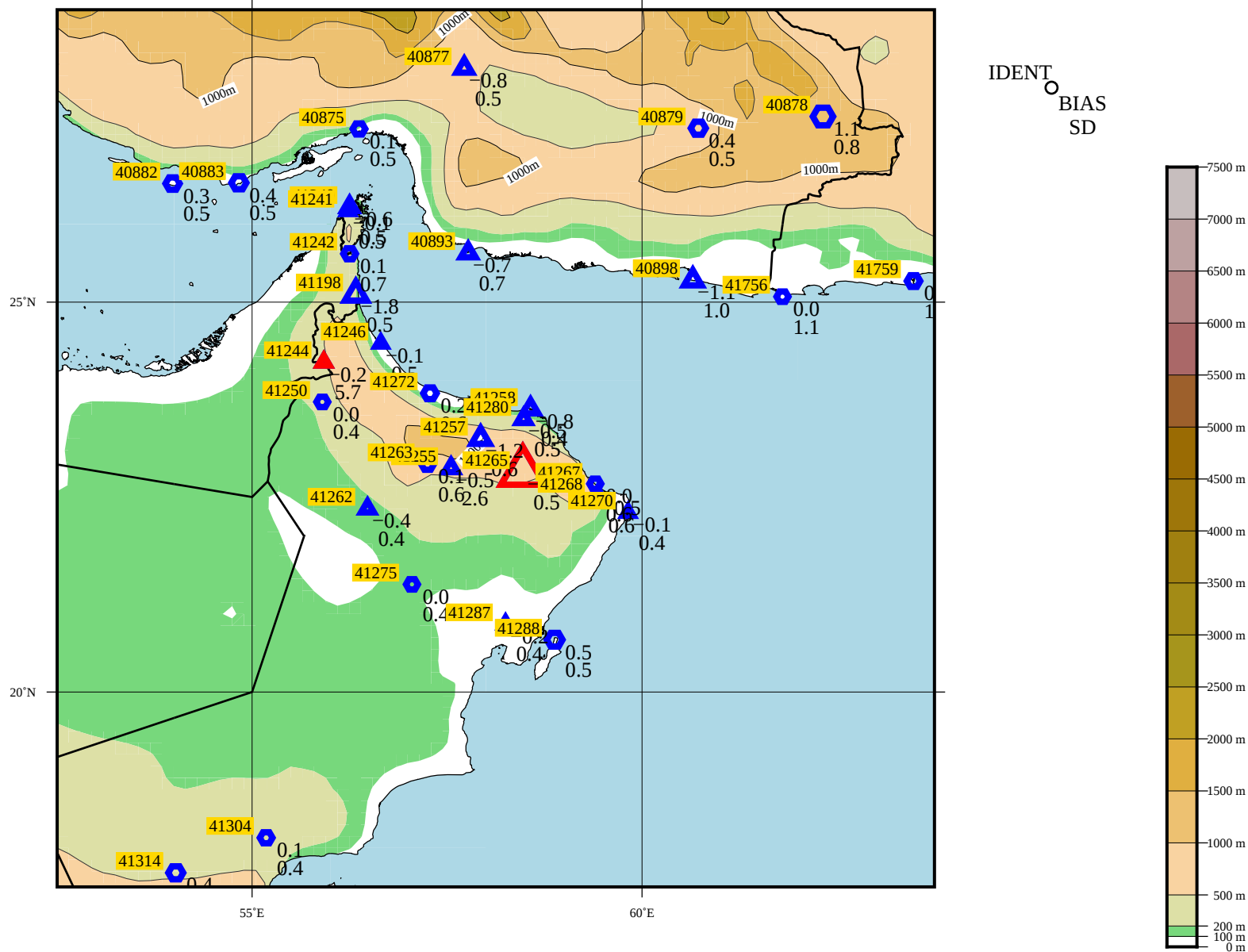
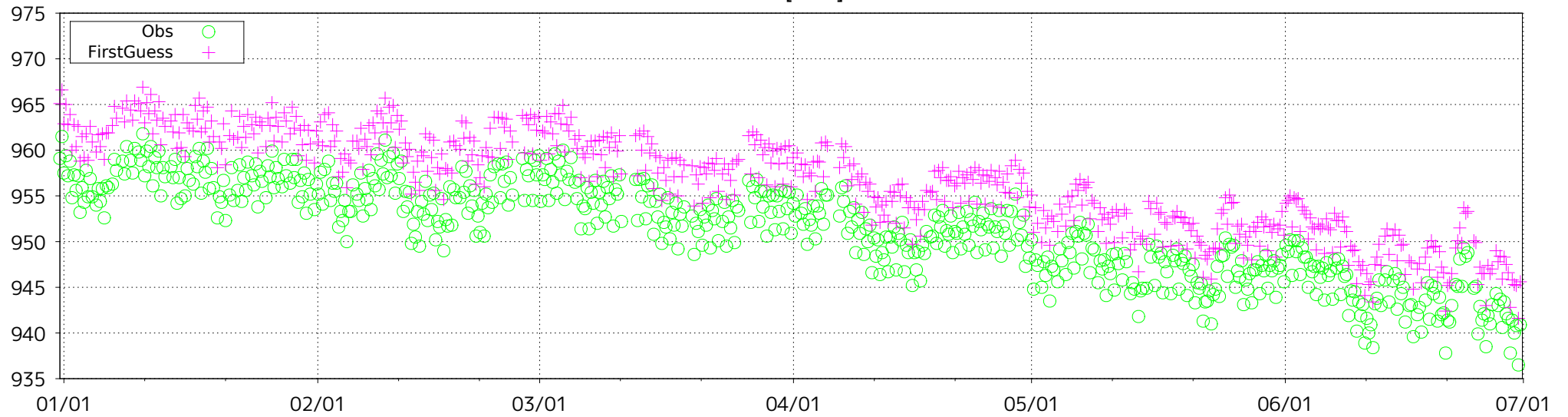


Figure 19 BIAS and SD of SLP for station 41244, 41265 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 41265 (lat: 22.8N, lon: 58.5E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

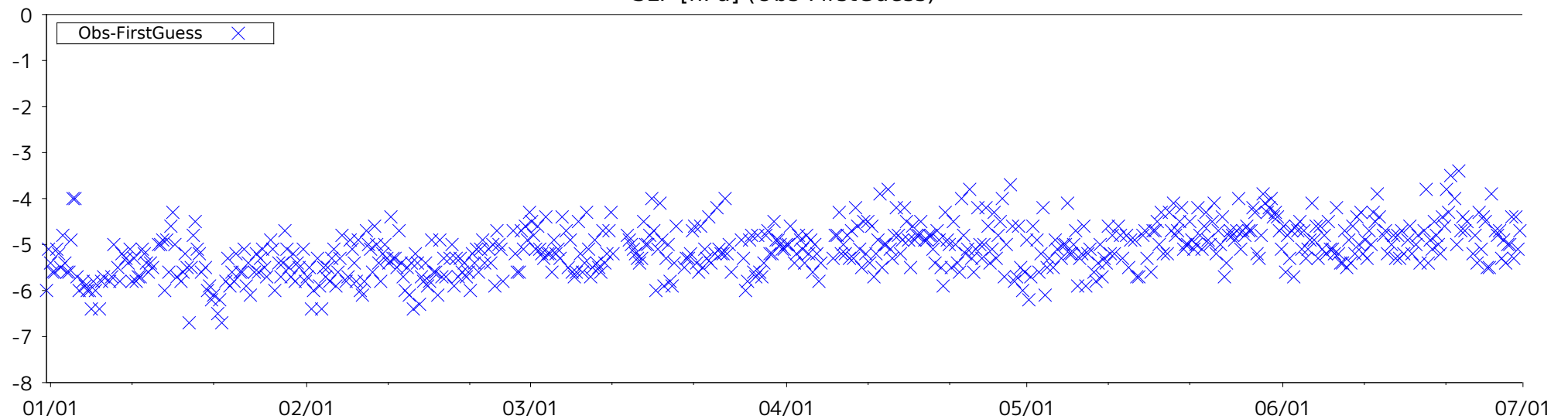


Figure 20 Time-series representation of SLP Obs minus FirstGuess for station 41265

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

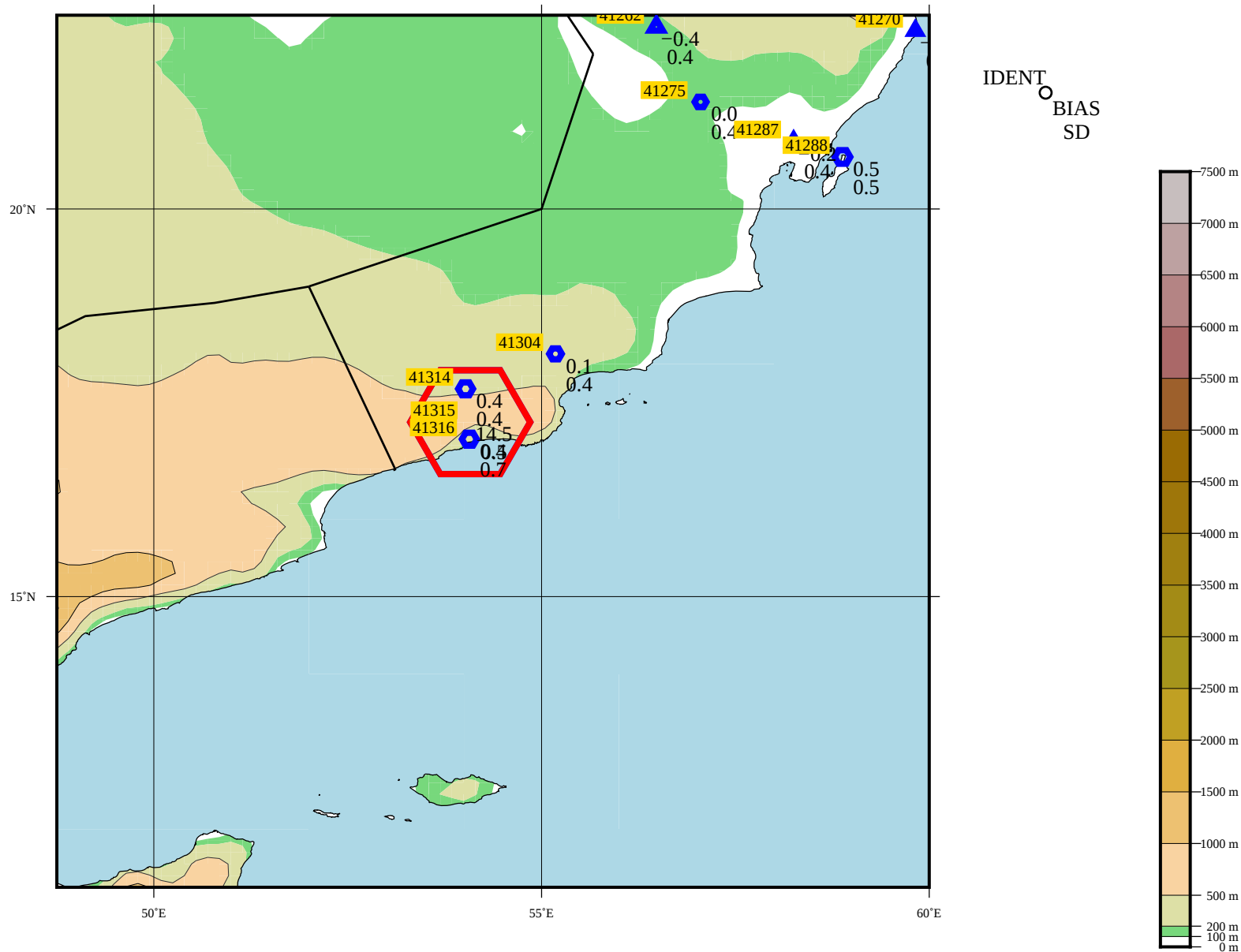


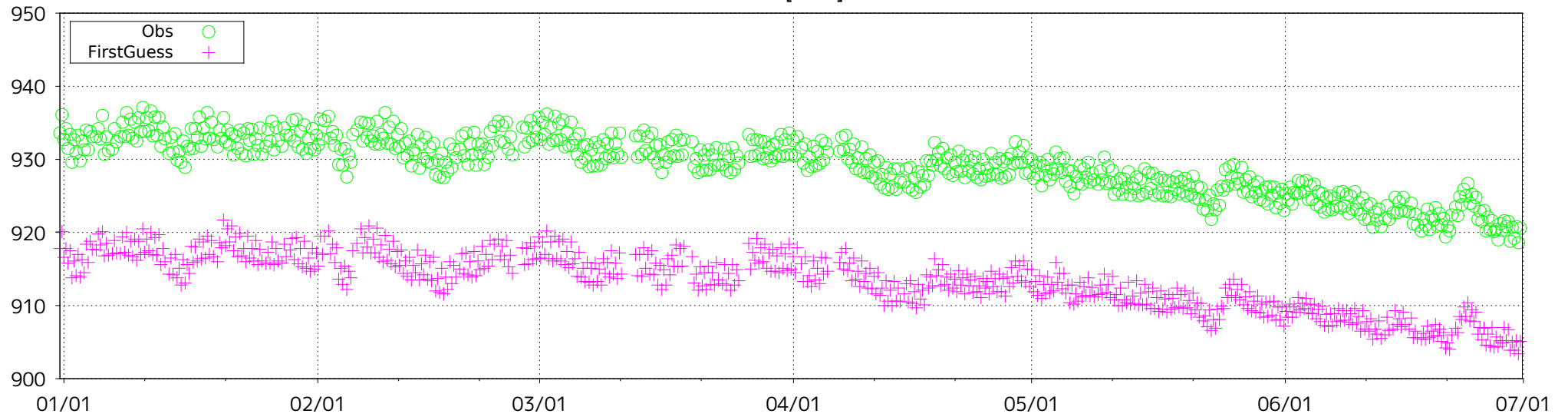
Figure 21 BIAS and SD of SLP for station 41315 (red) and surrounding stations (blue).

The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.

The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 41315 (lat: 17.3N, lon: 54.1E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

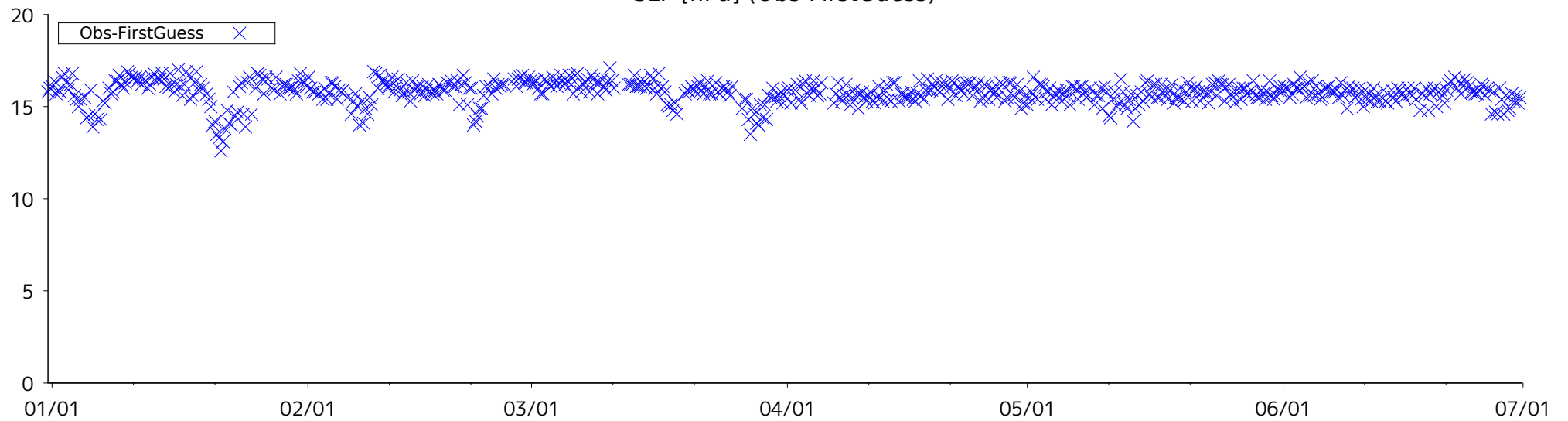
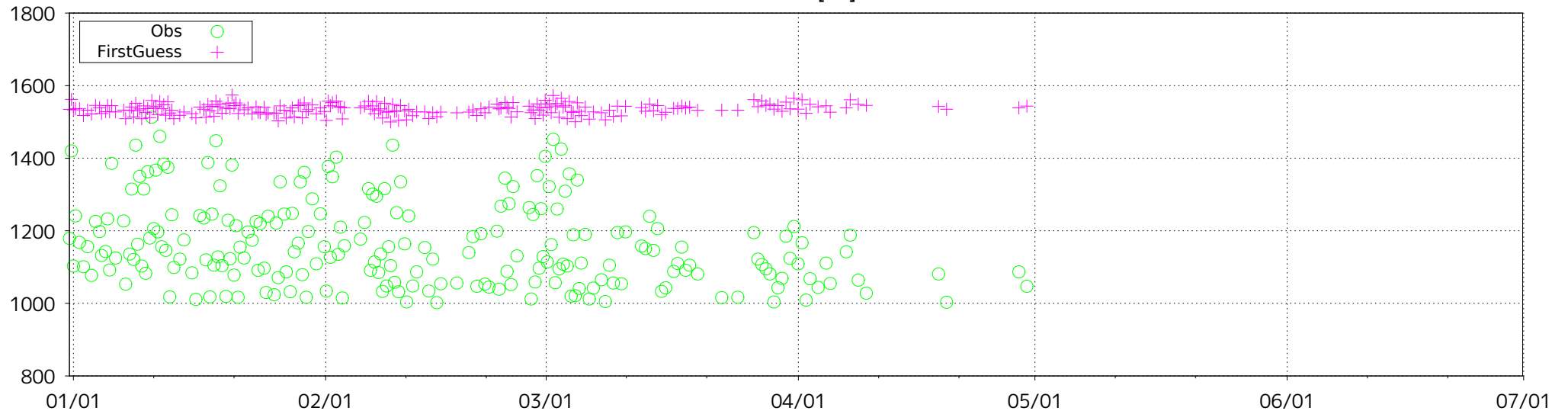


Figure 22(a) Time-series representation of SLP Obs minus FirstGuess for station 41315

ID: 41315 (lat: 17.3N, lon: 54.1E)

GZ850 [m]



GZ850 [m] (Obs-FirstGuess)

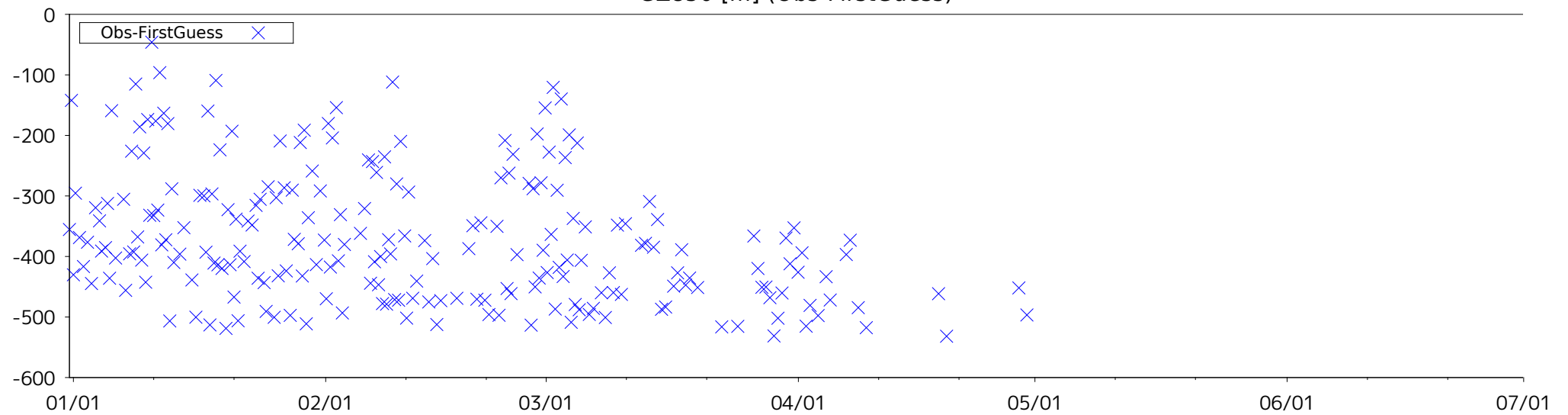


Figure 22(b) Time-series representation of GZ850 Obs minus FirstGuess for station 41315

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

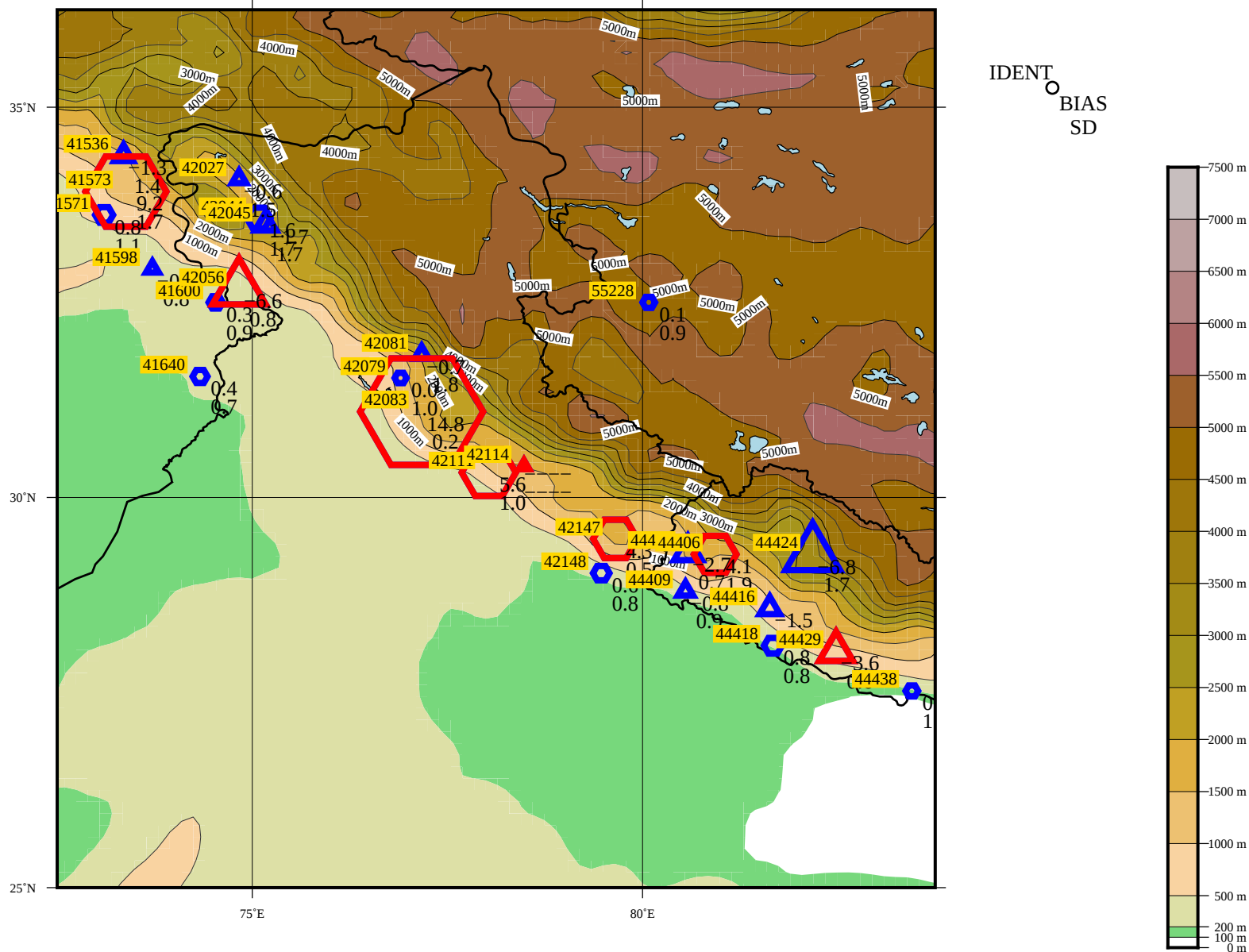
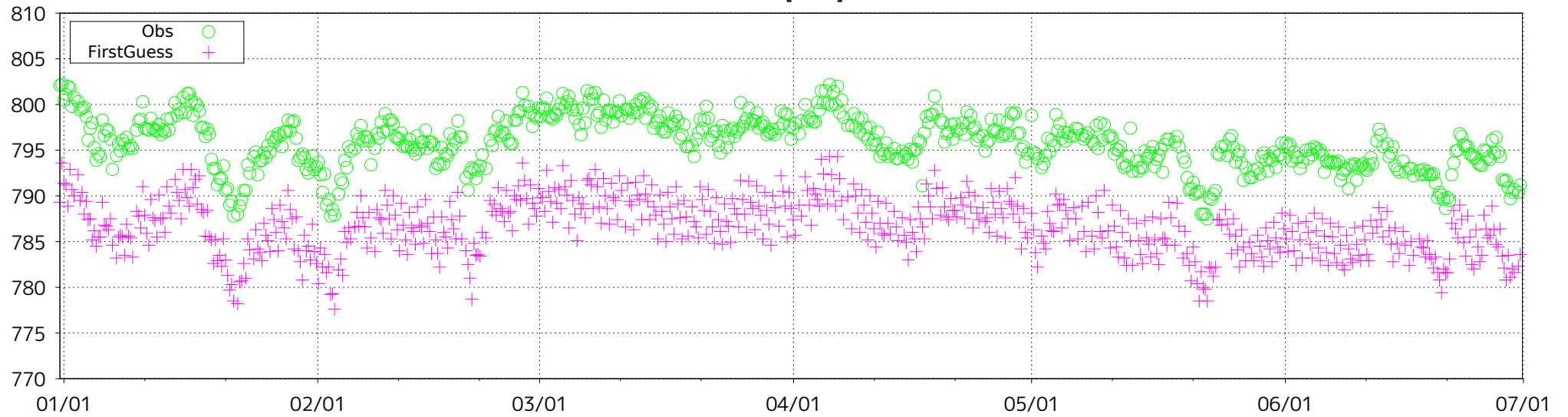


Figure 23 BIAS and SD of SLP for station 41573, 42056, 42083, 42111, 42114, 42147, 44406, 44429 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 41573 (lat: 33.9N, lon: 73.4E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

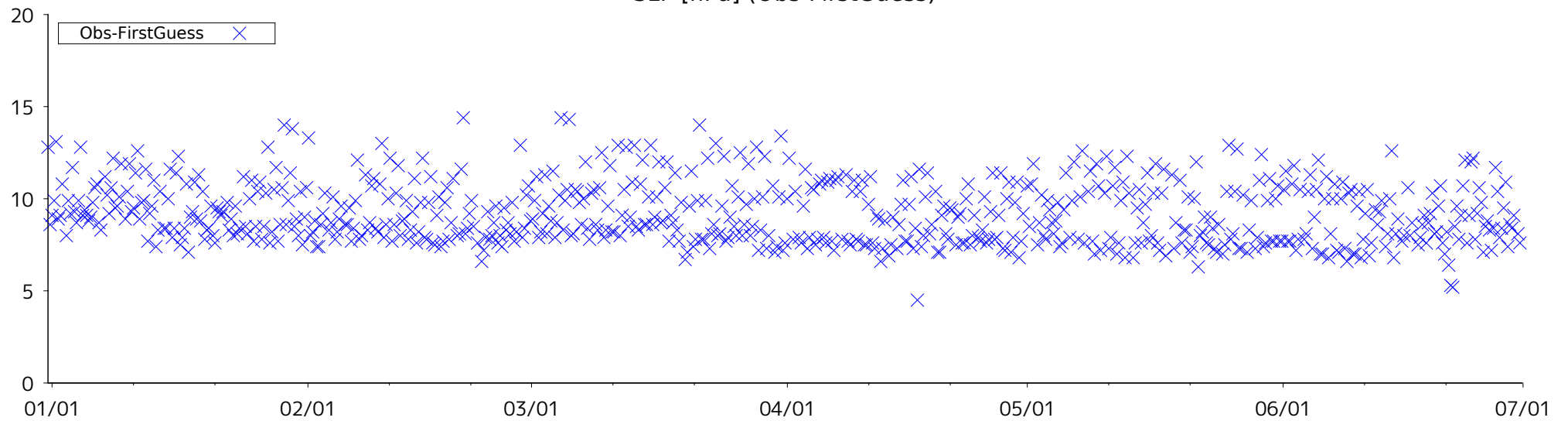
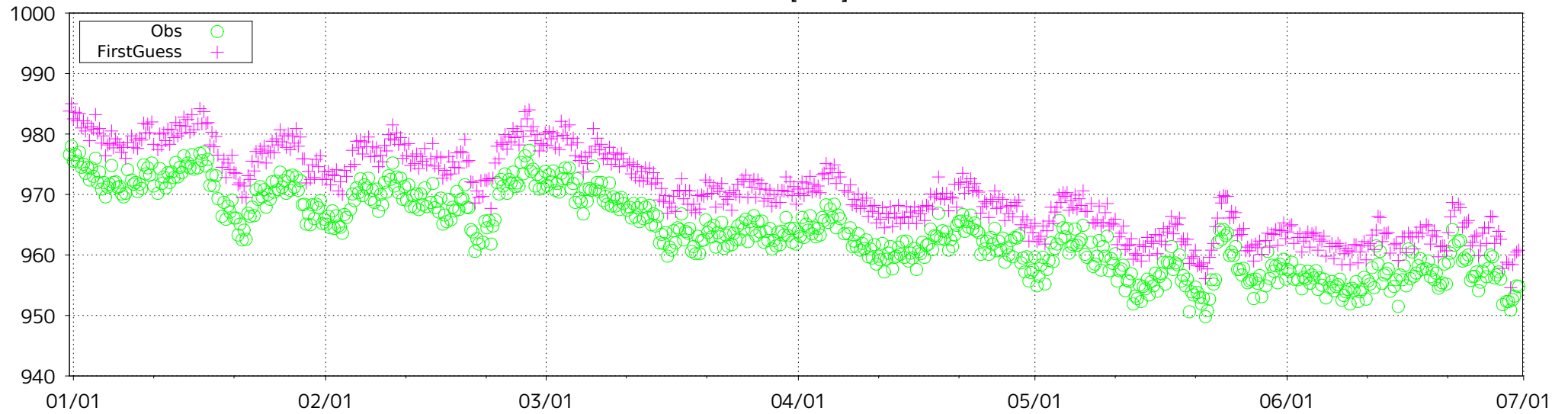


Figure 24 Time-series representation of SLP Obs minus FirstGuess for station 41573

ID: 42056 (lat: 32.7N, lon: 74.8E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

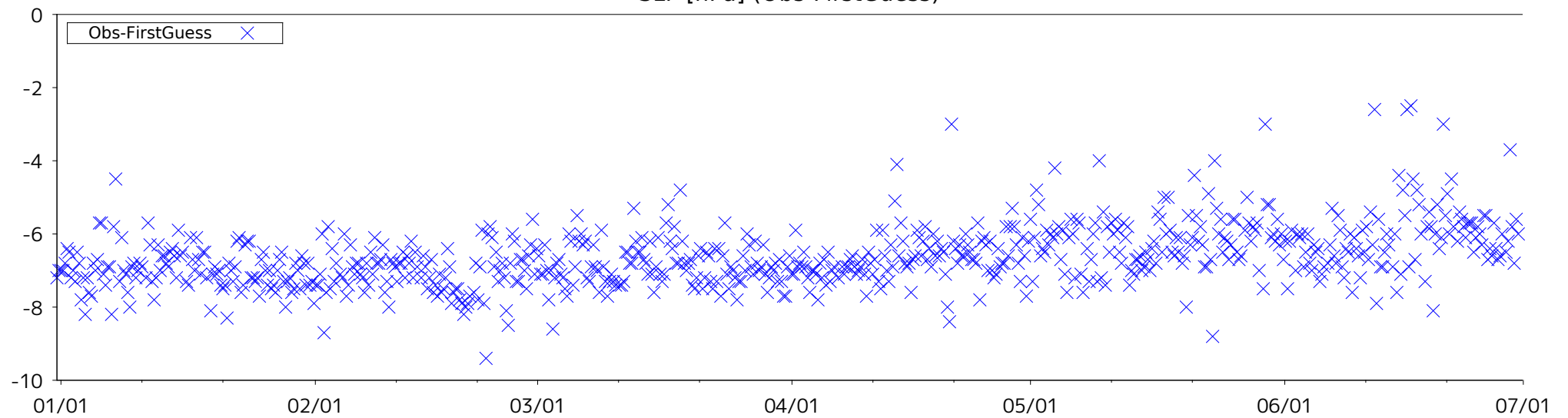
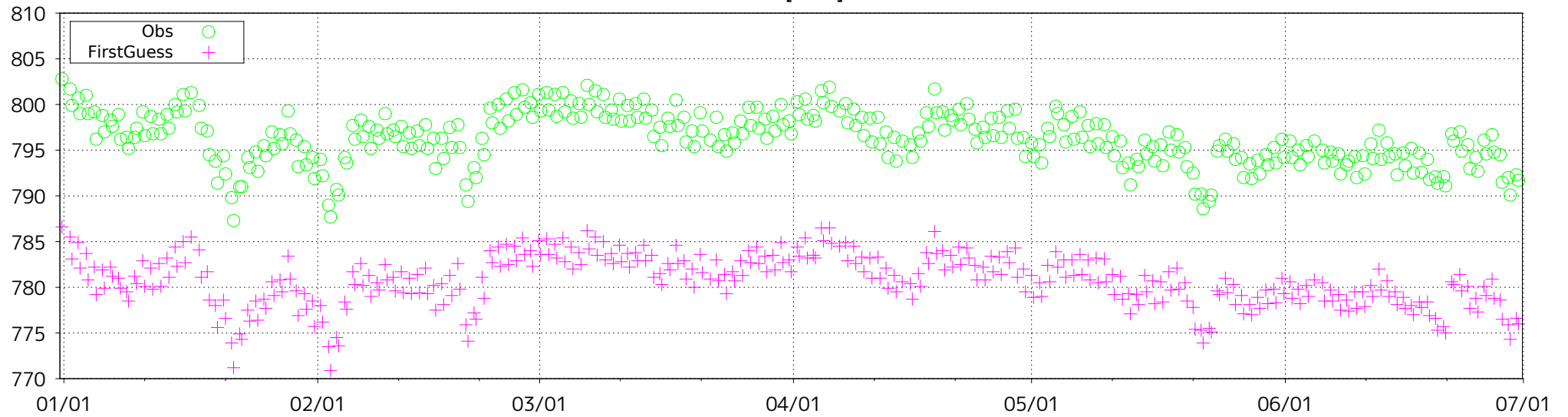


Figure 25 Time-series representation of SLP Obs minus FirstGuess for station 42056

ID: 42083 (lat: 31.1N, lon: 77.2E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

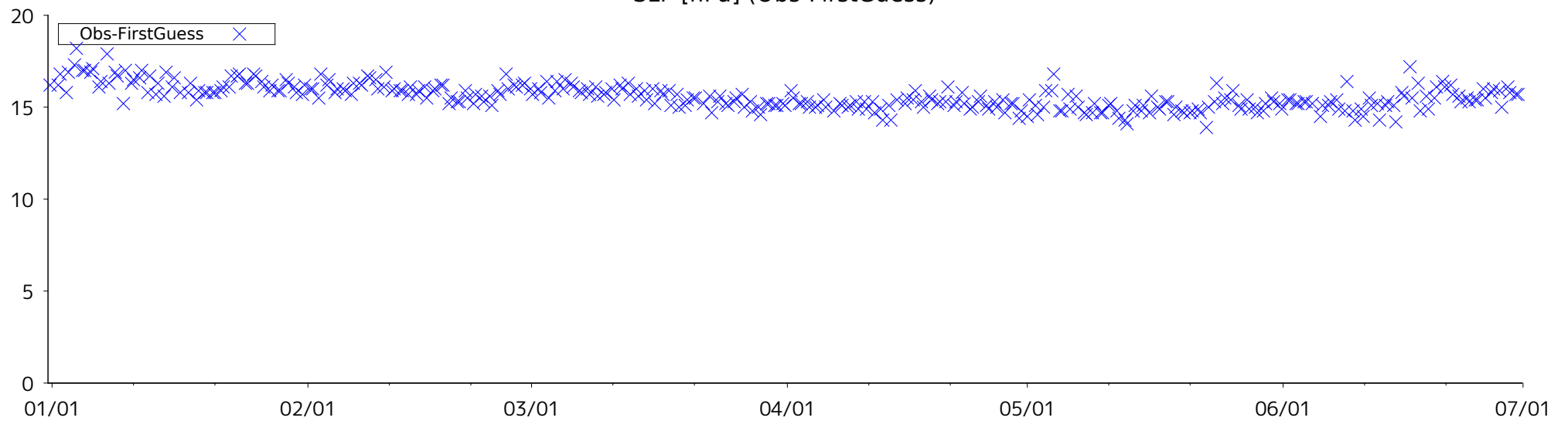
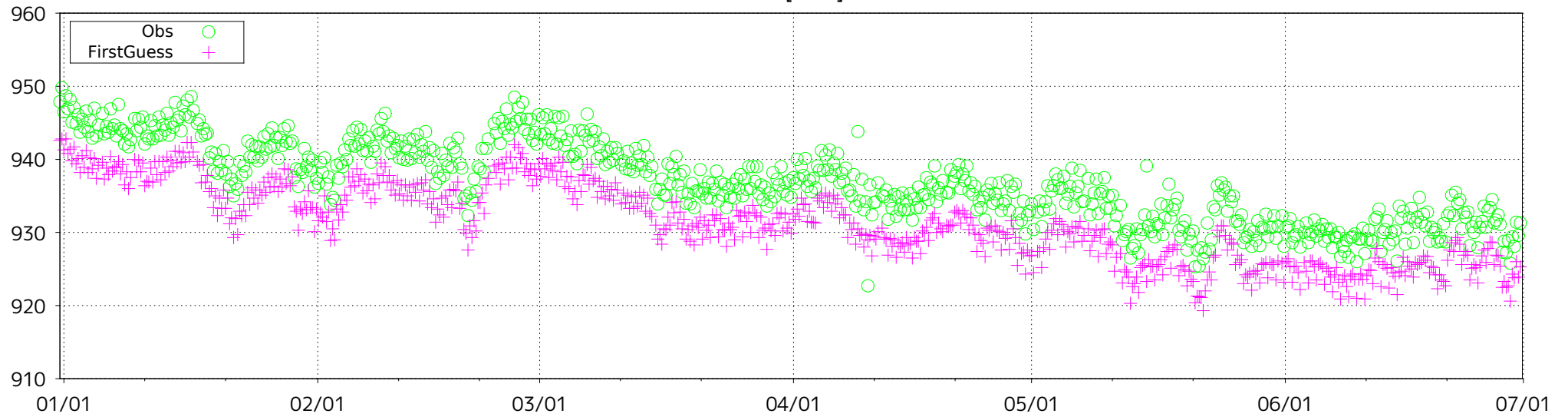


Figure 26 Time-series representation of SLP Obs minus FirstGuess for station 42083

ID: 42111 (lat: 30.3N, lon: 78.0E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

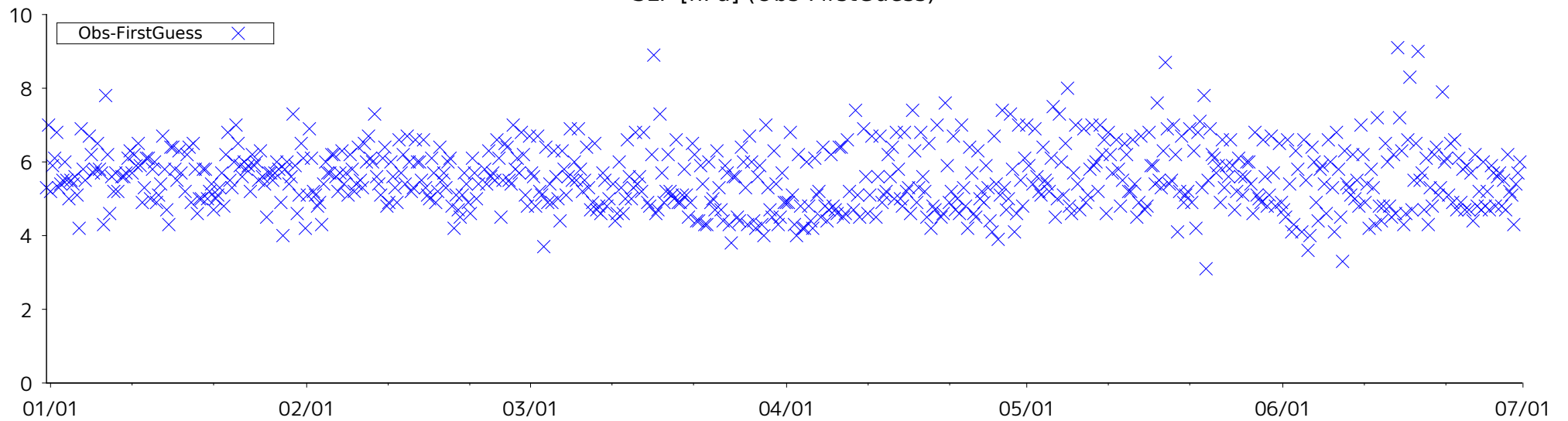
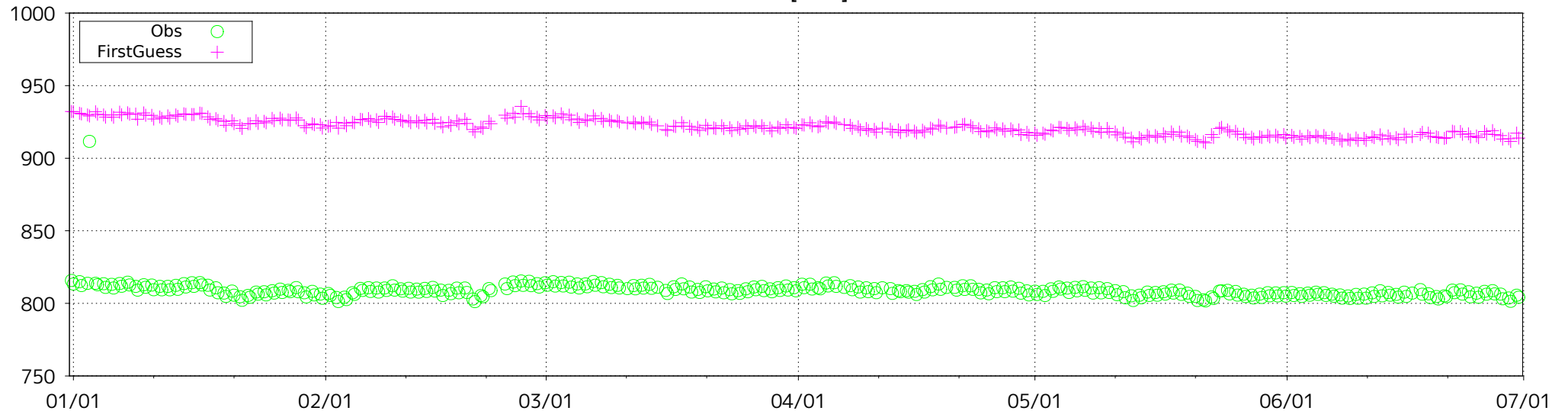


Figure 27 Time-series representation of SLP Obs minus FirstGuess for station 42111

ID: 42114 (lat: 30.4N, lon: 78.5E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

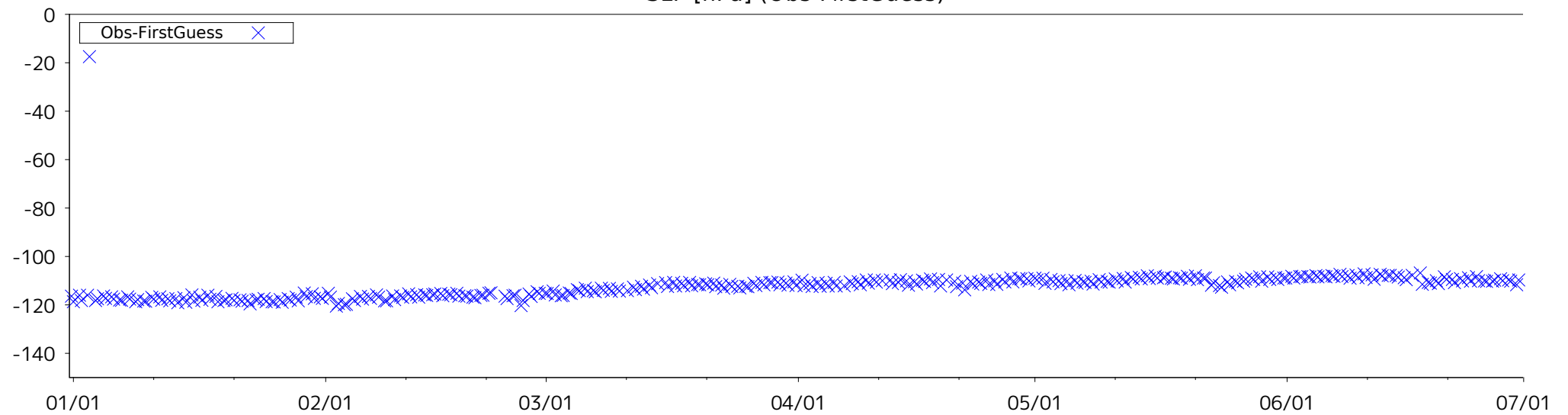
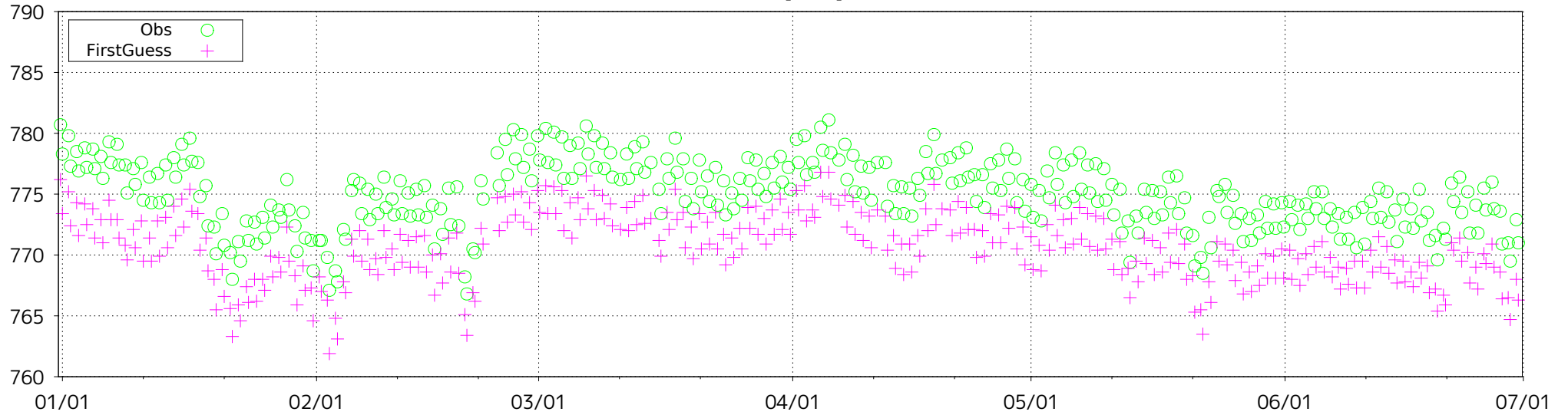


Figure 28 Time-series representation of SLP Obs minus FirstGuess for station 42114

ID: 42147 (lat: 29.5N, lon: 79.7E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

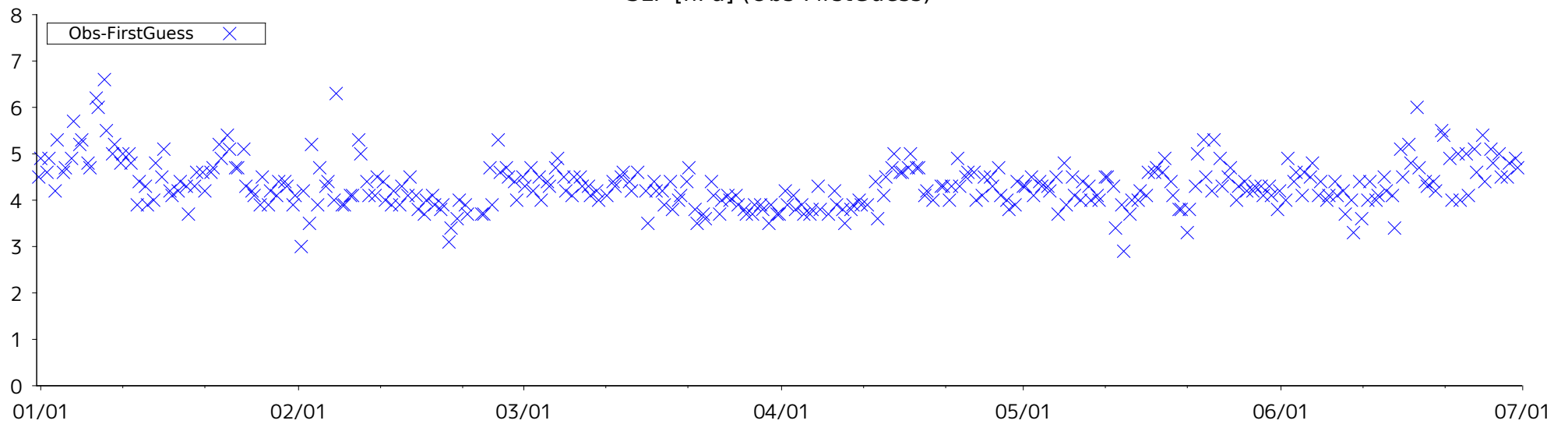
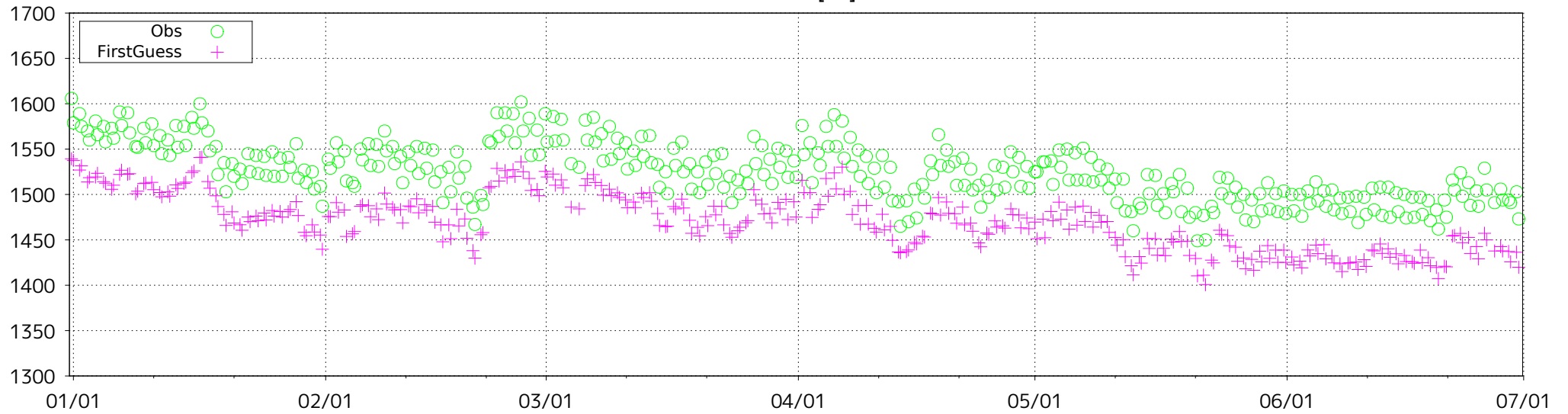


Figure 29 Time-series representation of SLP Obs minus FirstGuess for station 42147

ID: 42299 (lat: 27.3N, lon: 88.6E)

GZ850 [m]



GZ850 [m] (Obs-FirstGuess)

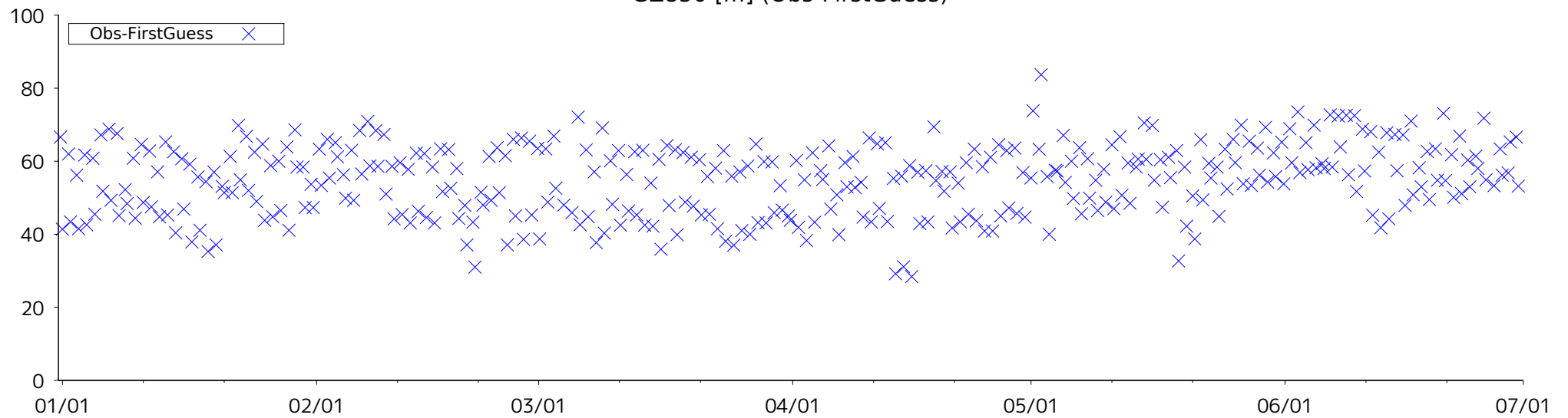


Figure 30 Time-series representation of GZ850 Obs minus FirstGuess for station 42299

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

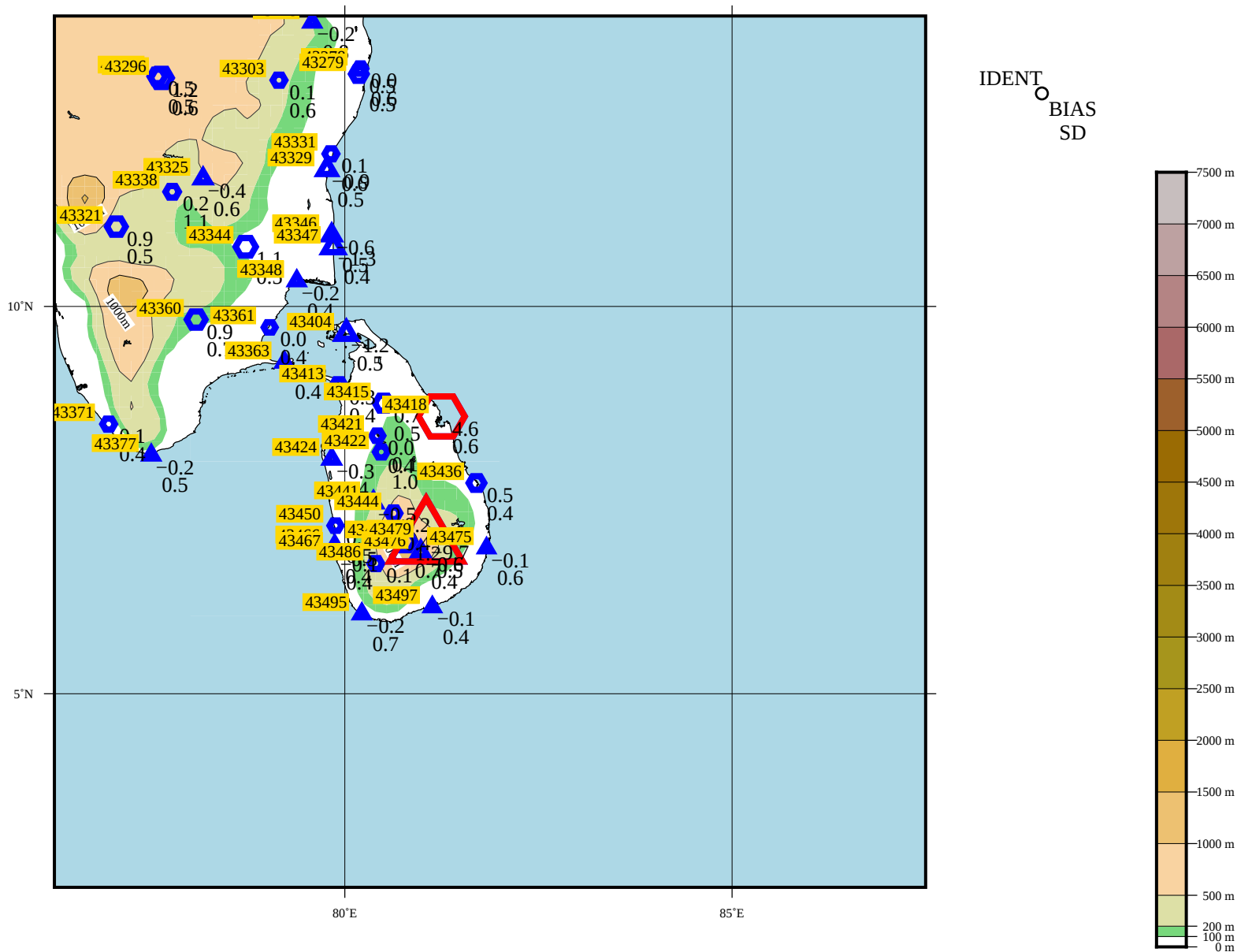
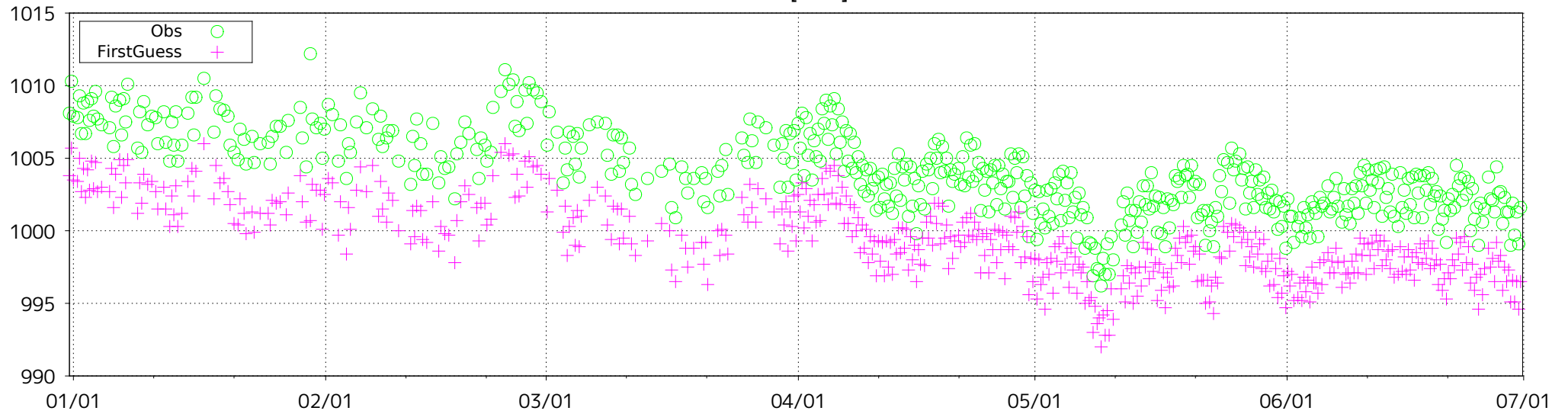


Figure 31 BIAS and SD of SLP for station 43418, 43479 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 43418 (lat: 8.6N, lon: 81.3E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

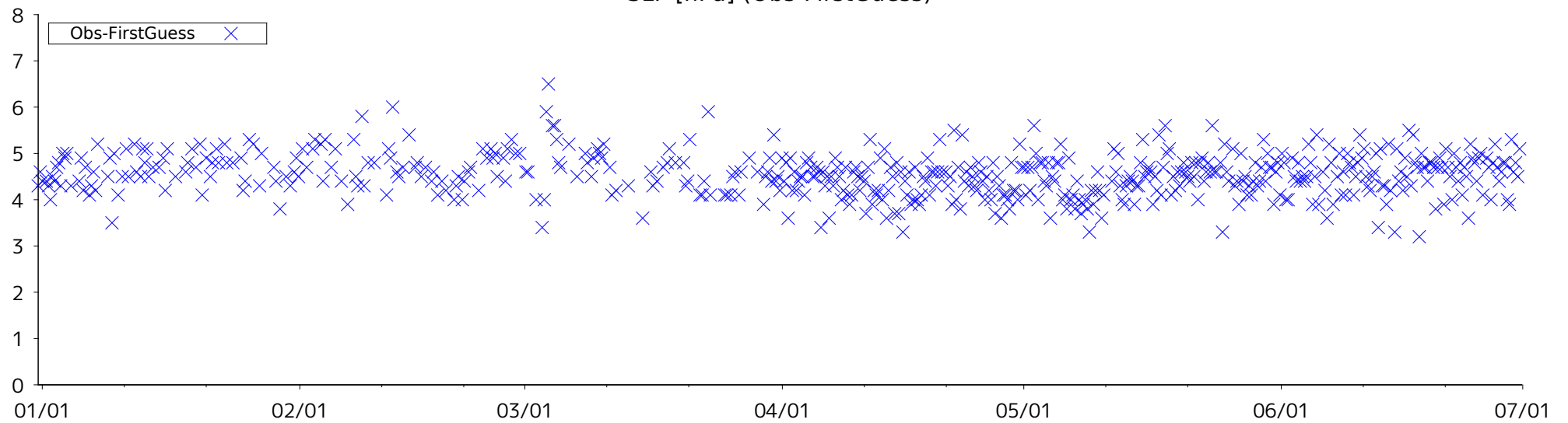
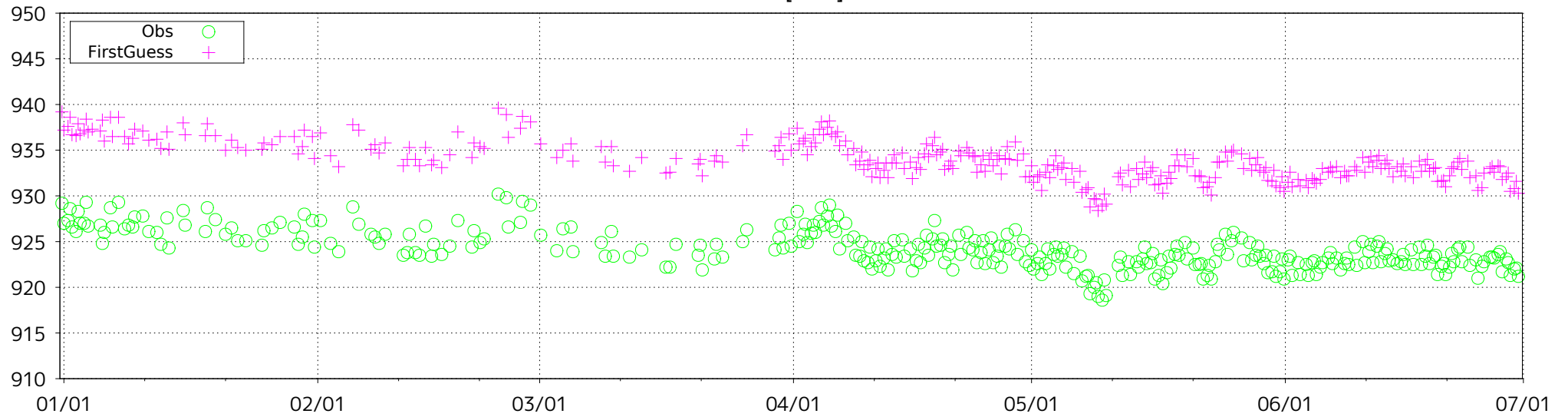


Figure 32 Time-series representation of SLP Obs minus FirstGuess for station 43418

ID: 43479 (lat: 7.0N, lon: 81.1E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

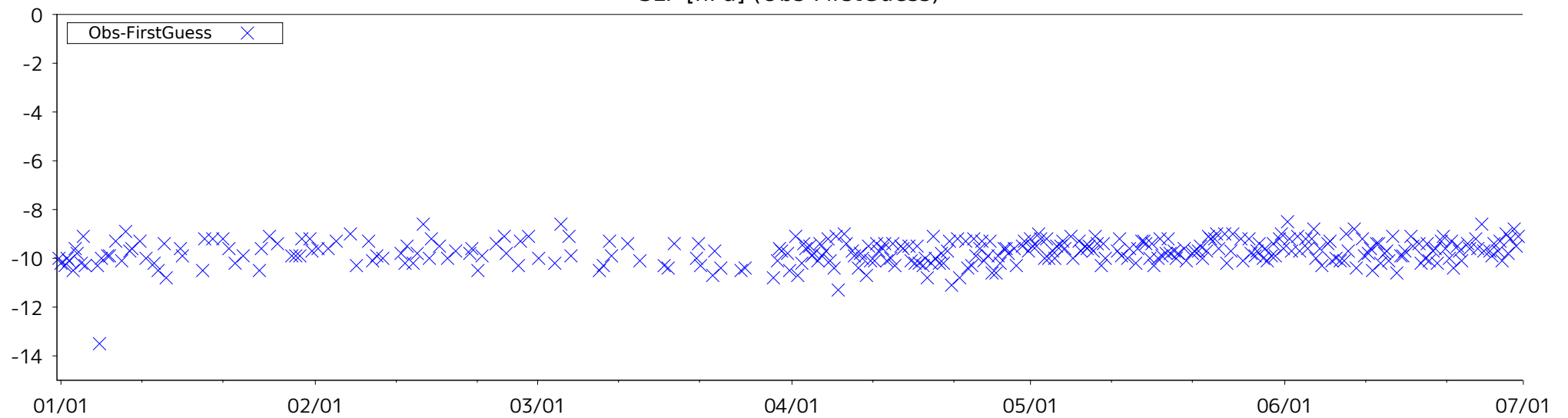
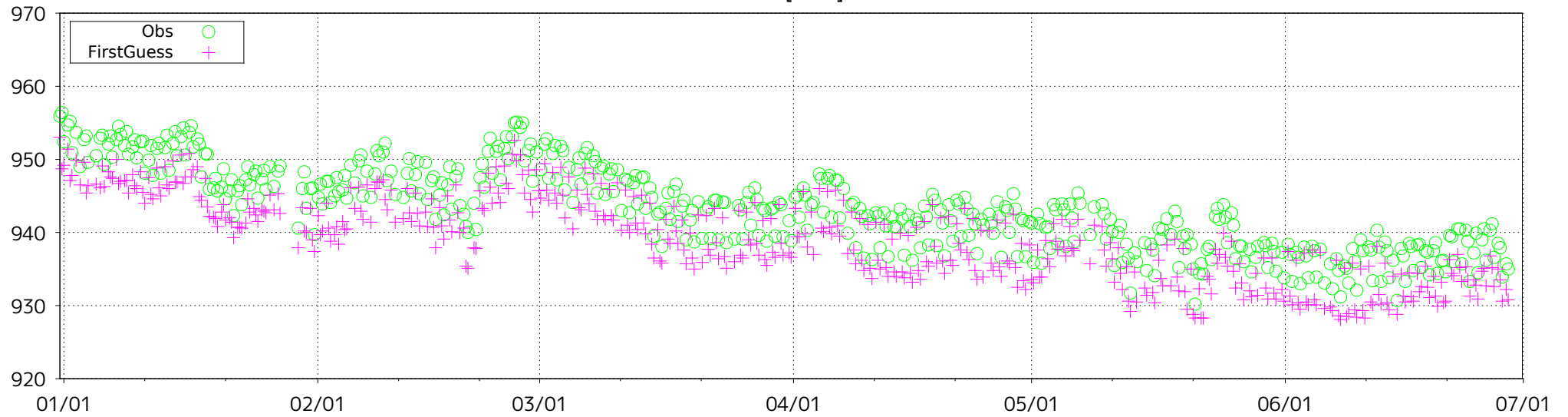


Figure 33 Time-series representation of SLP Obs minus FirstGuess for station 43479

ID: 44406 (lat: 29.3N, lon: 80.9E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

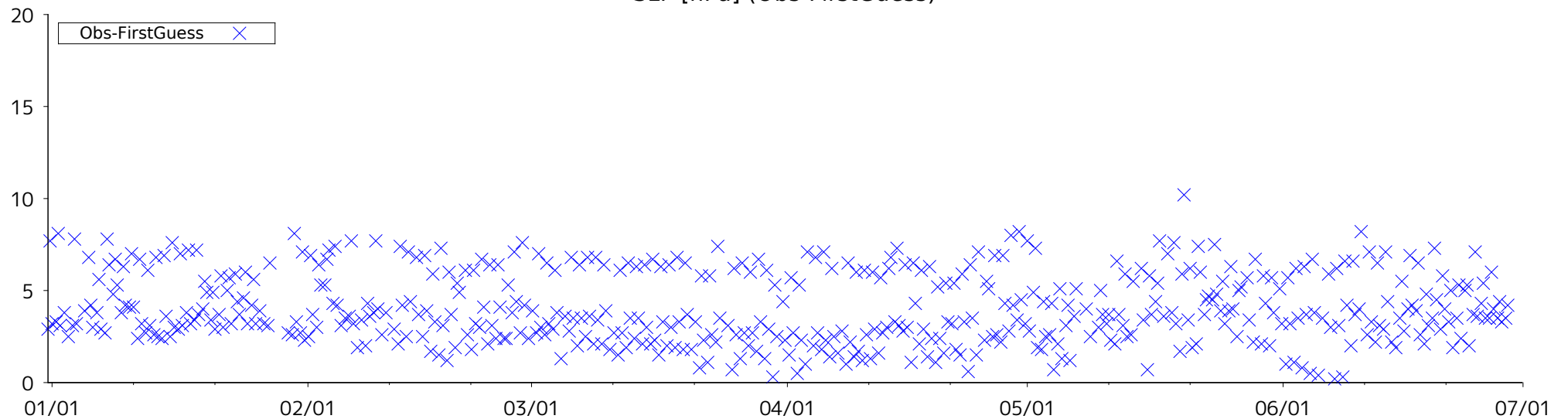
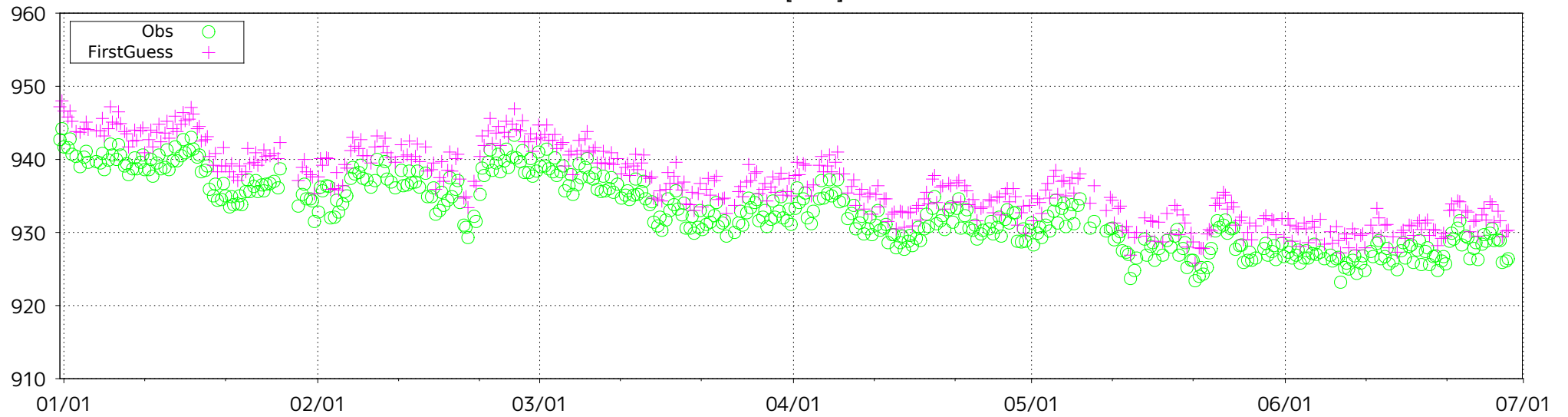


Figure 34 Time-series representation of SLP Obs minus FirstGuess for station 44406

ID: 44429 (lat: 28.0N, lon: 82.5E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

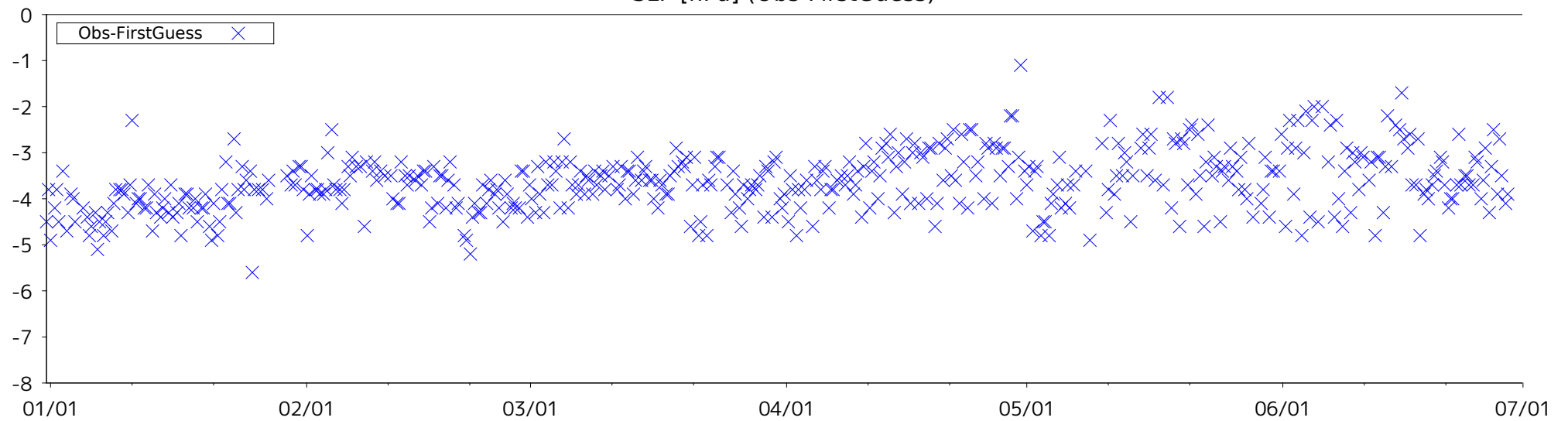


Figure 35 Time-series representation of SLP Obs minus FirstGuess for station 44429

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

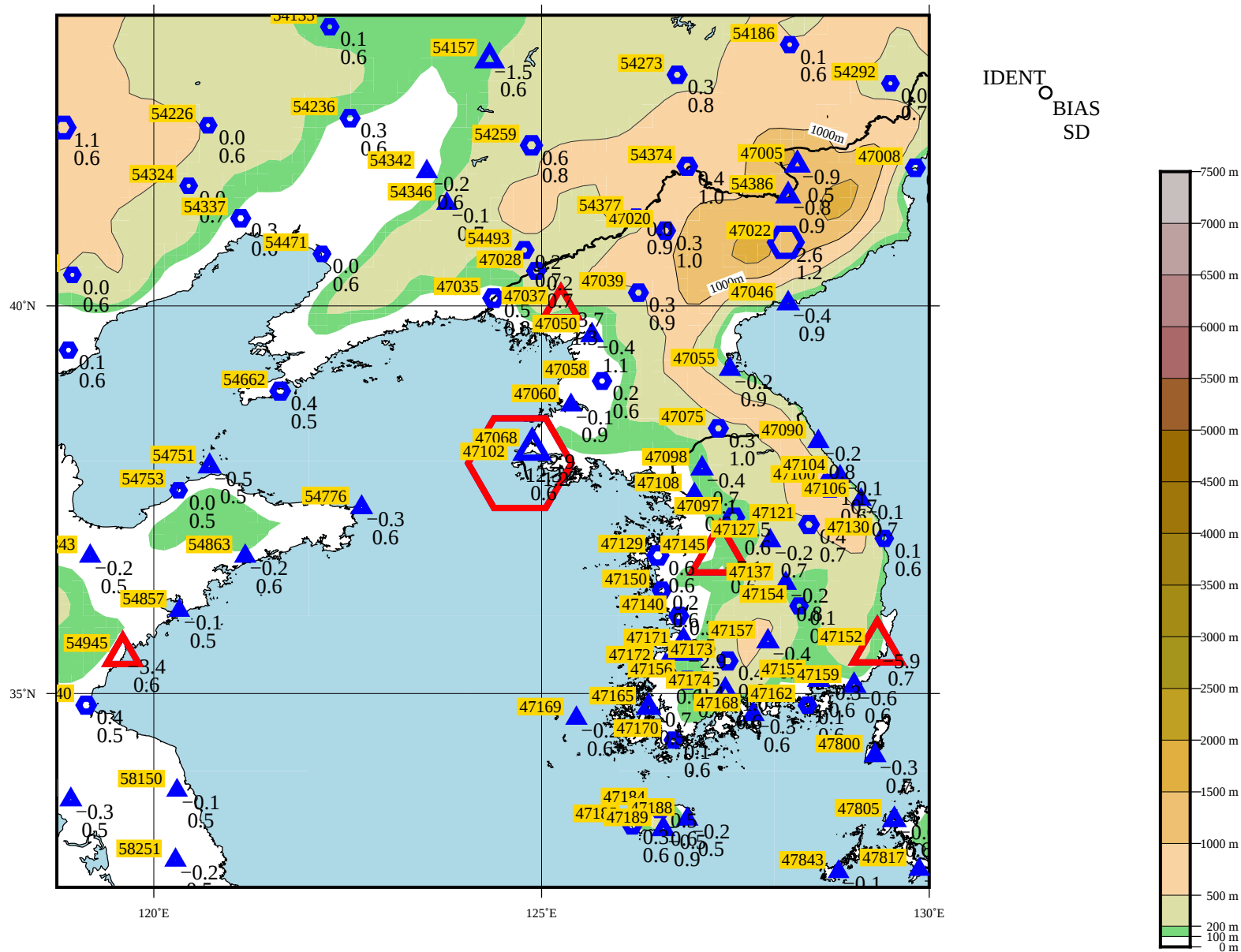


Figure 36 BIAS and SD of SLP for station 47037, 47102, 47145, 47152, 54945 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

LEVEL = SUR ELEMENT = MSLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

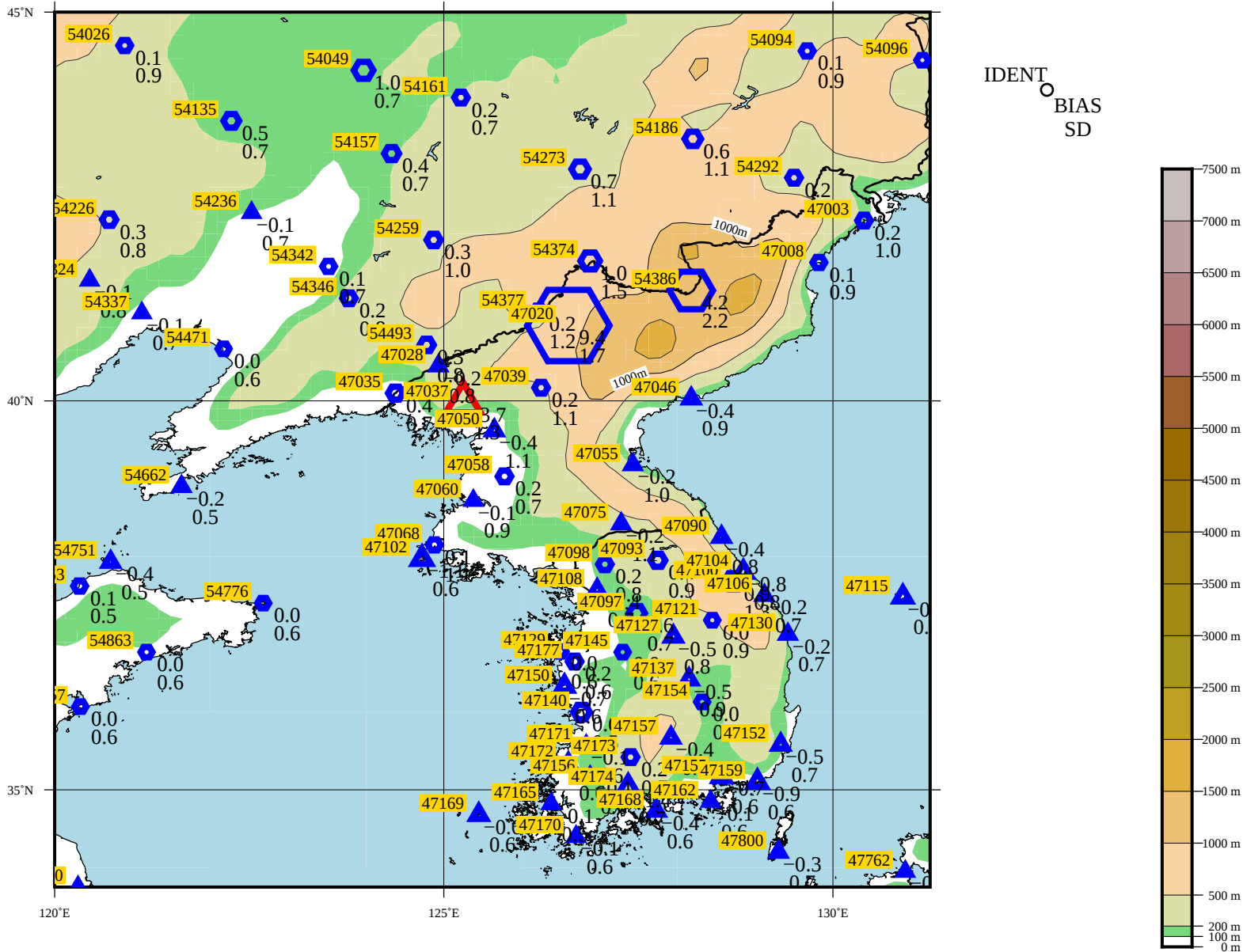
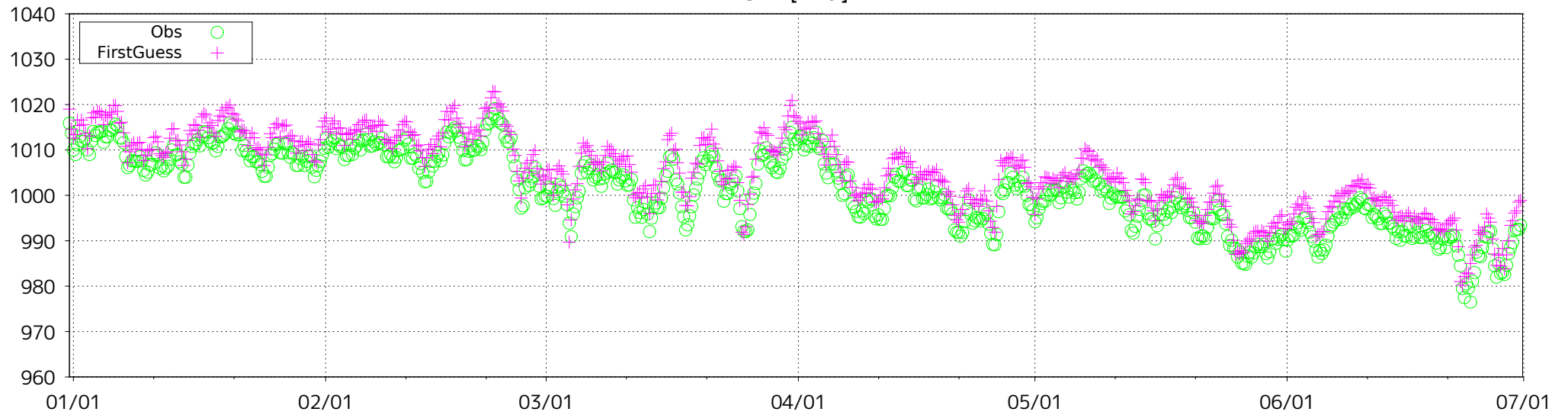


Figure 37 BIAS and SD of MSLP for station 47037 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 47037 (lat: 40.0N, lon: 125.3E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

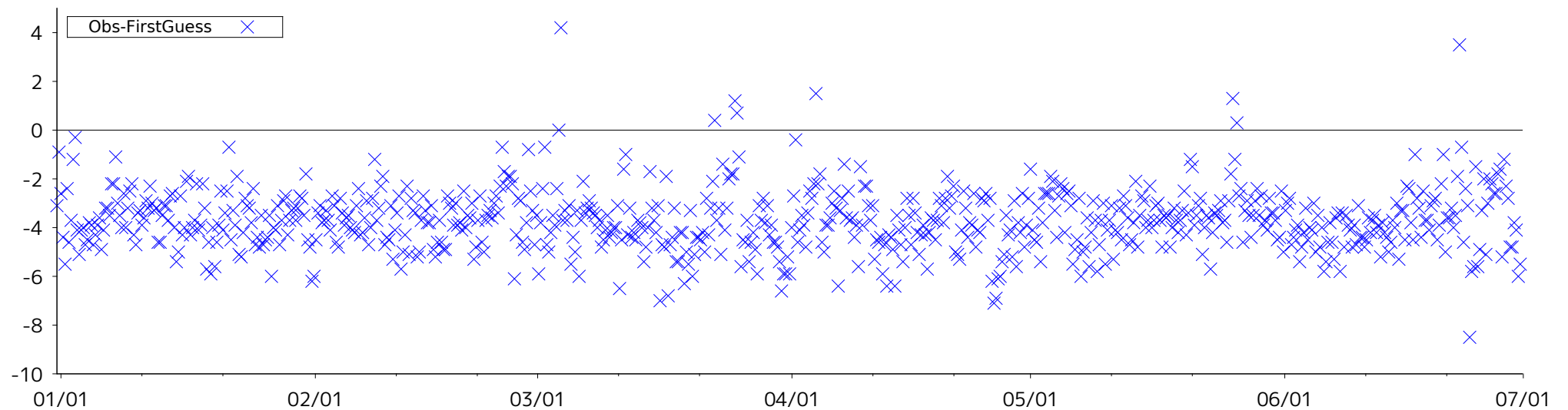
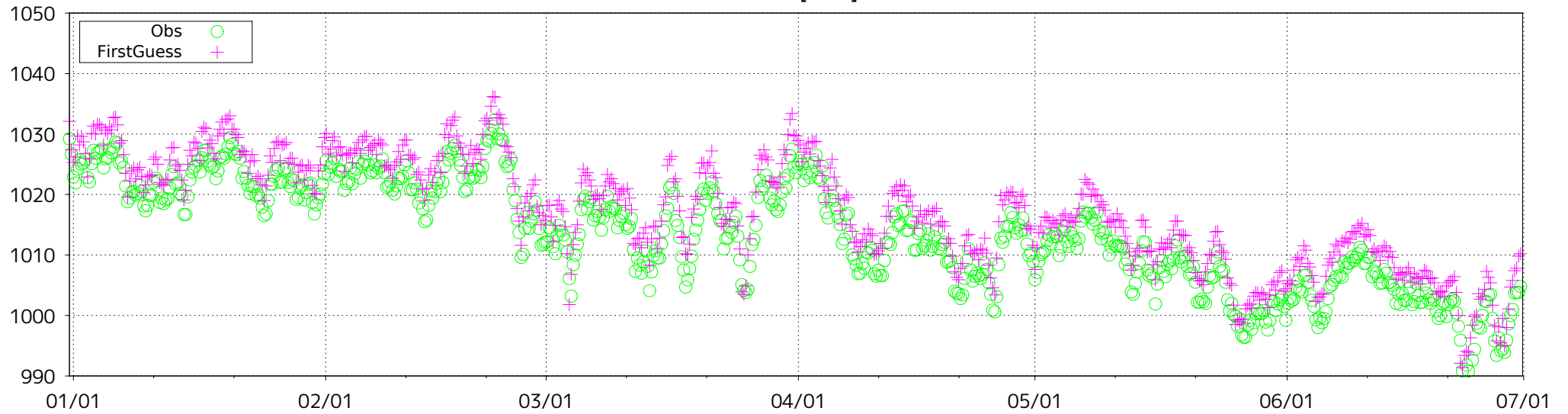


Figure 38(a) Time-series representation of SLP Obs minus FirstGuess for station 47037

ID: 47037 (lat: 40.0N, lon: 125.3E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

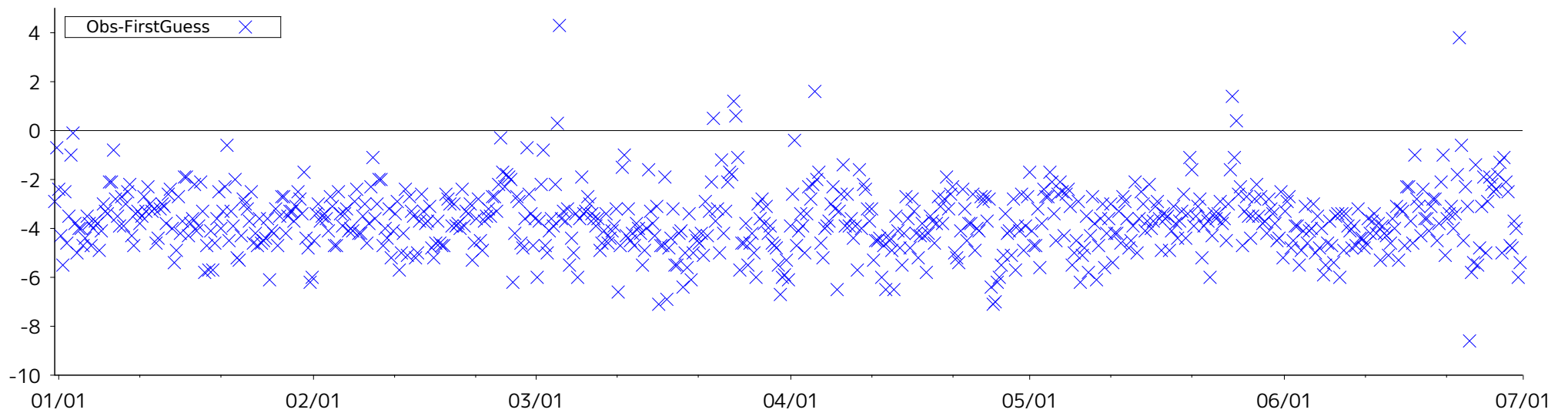
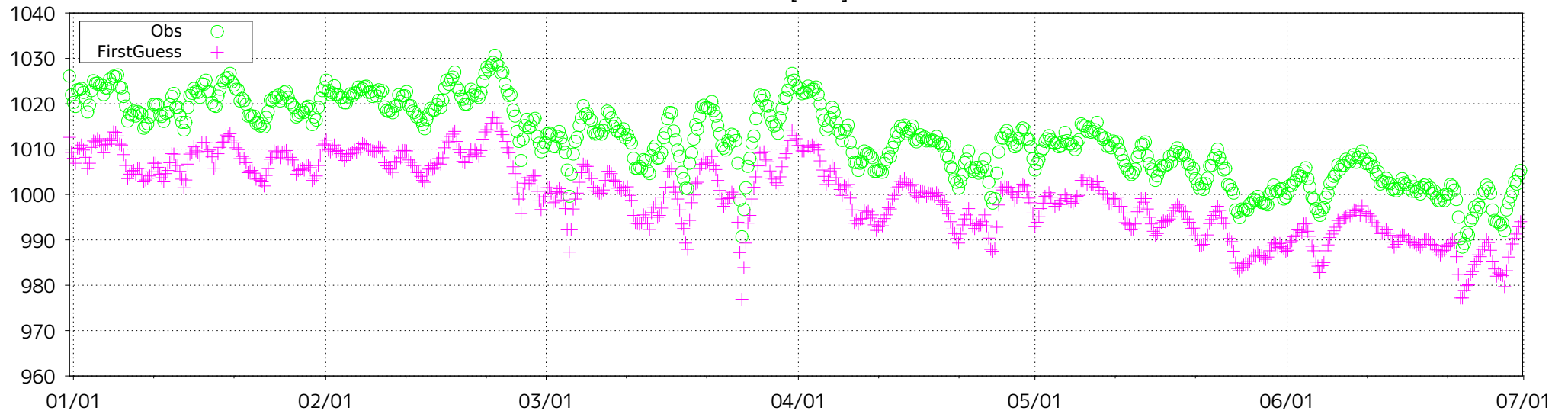


Figure 38(b) Time-series representation of MSLP Obs minus FirstGuess for station 47037

ID: 47102 (lat: 38.0N, lon: 124.7E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

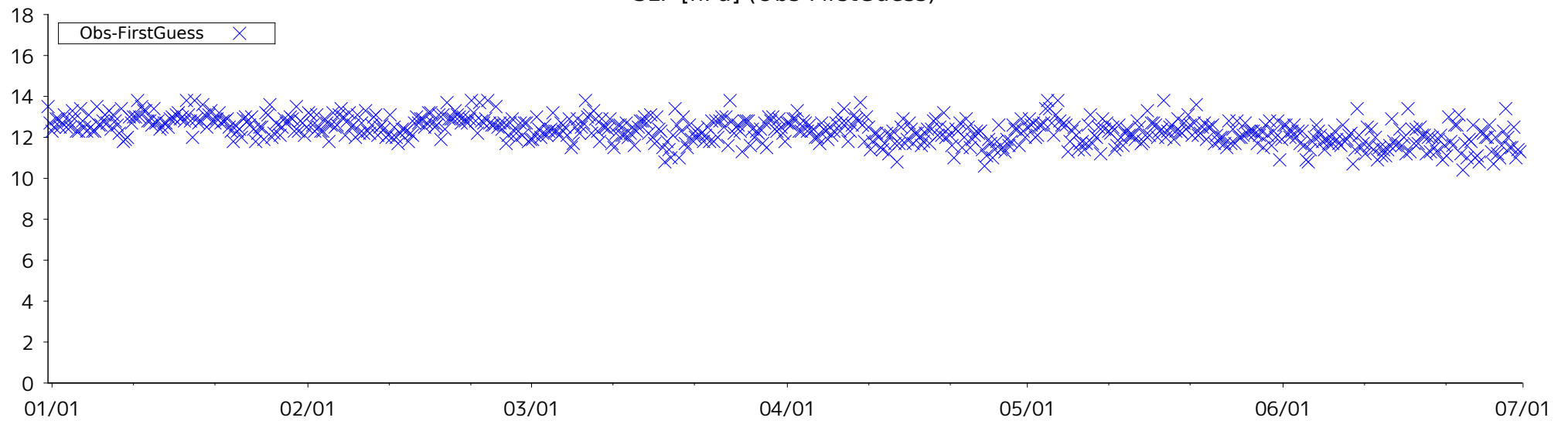
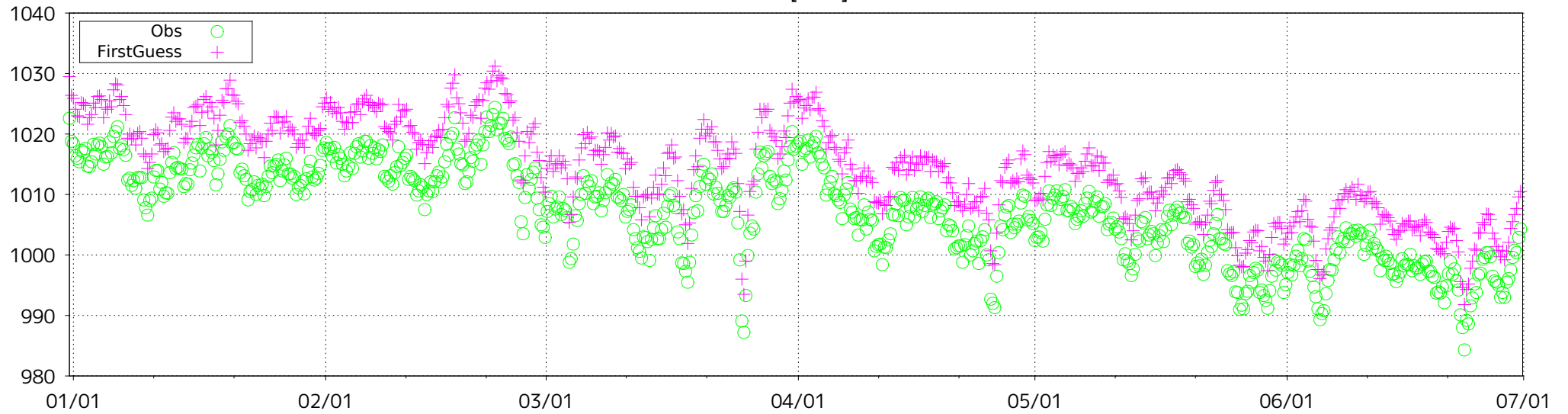


Figure 39 Time-series representation of SLP Obs minus FirstGuess for station 47102

ID: 47145 (lat: 36.8N, lon: 127.3E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

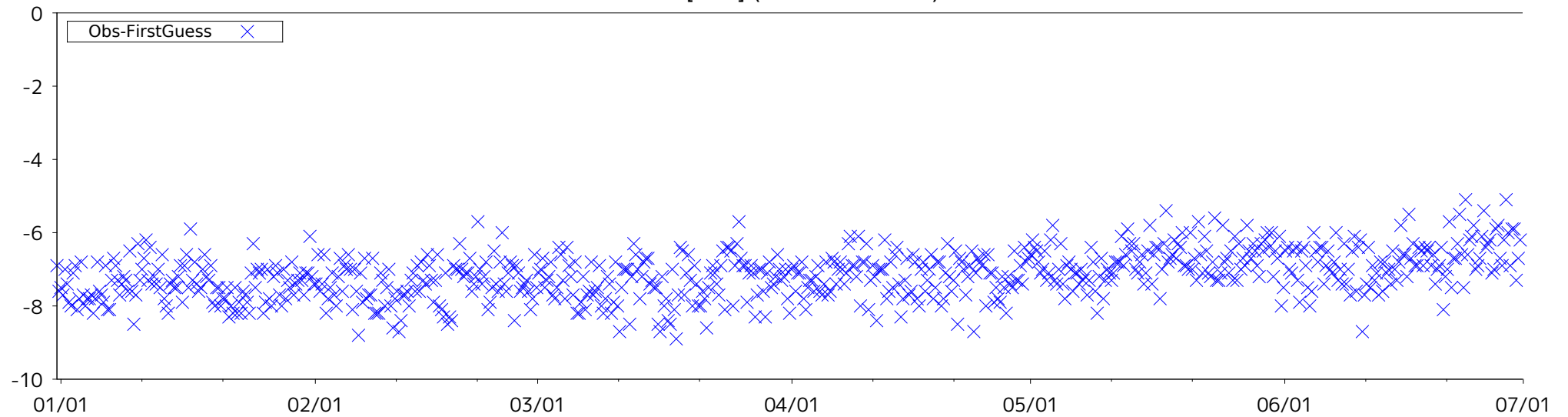
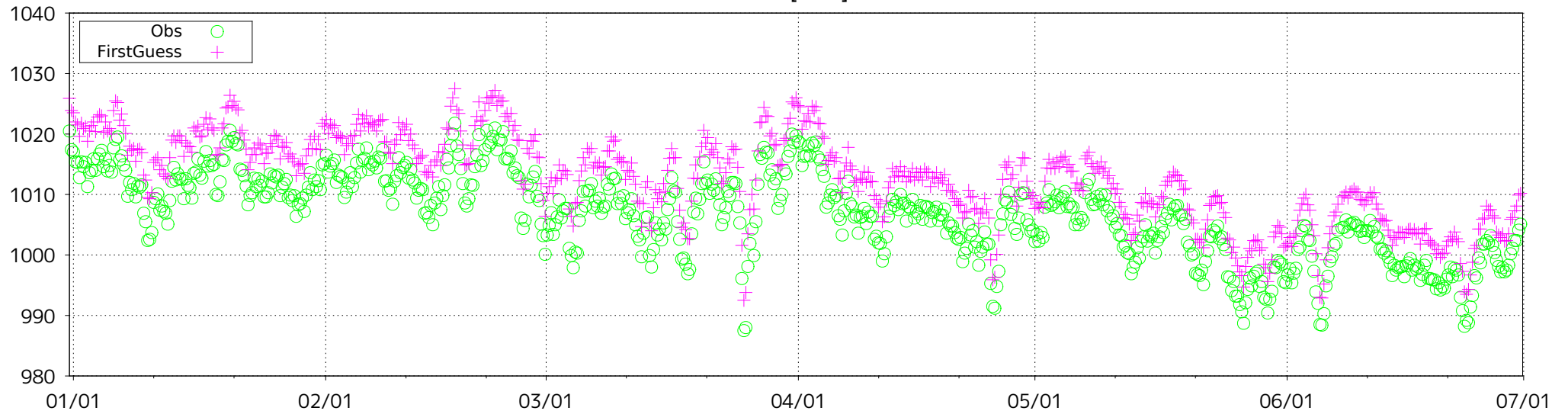


Figure 40 Time-series representation of SLP Obs minus FirstGuess for station 47145

ID: 47152 (lat: 35.6N, lon: 129.3E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

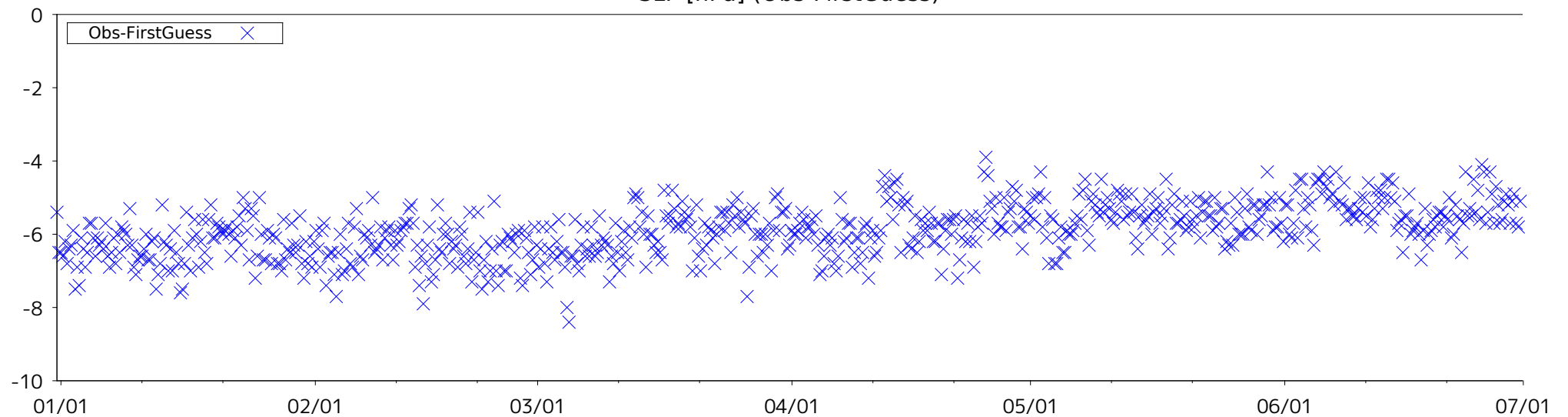


Figure 41 Time-series representation of SLP Obs minus FirstGuess for station 47152

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

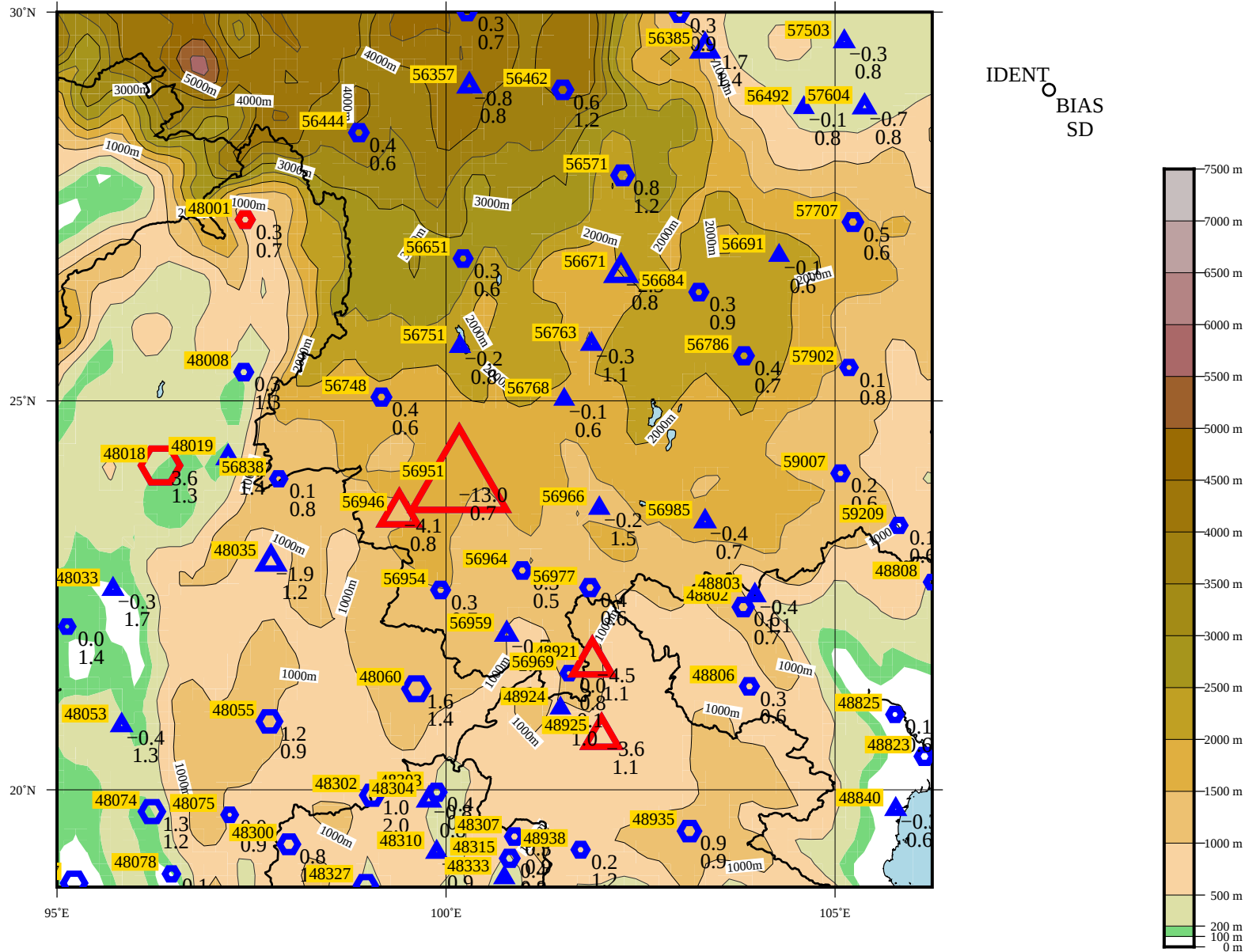
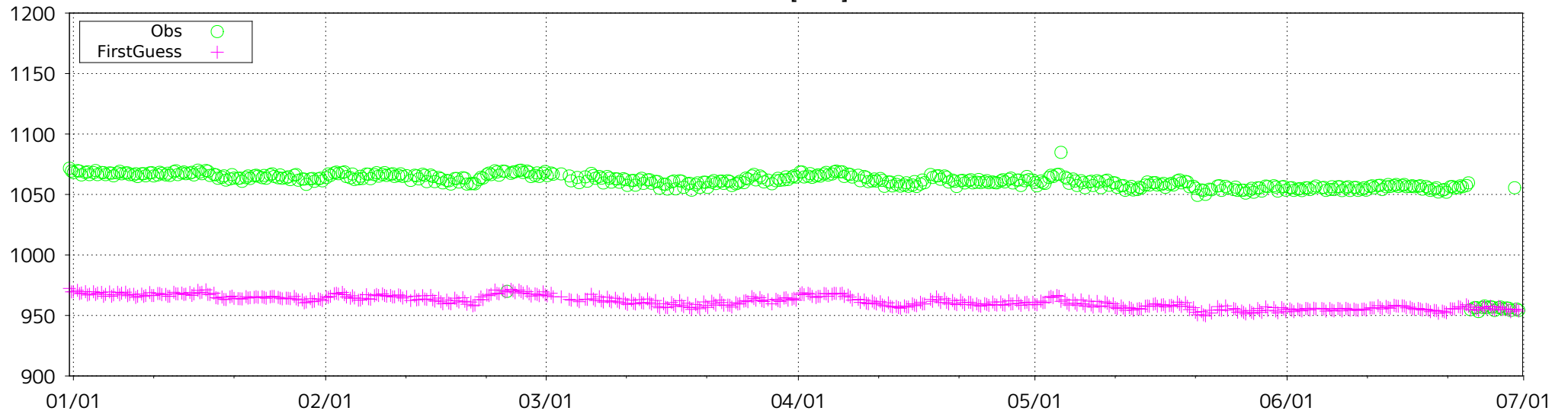


Figure 42 BIAS and SD of SLP for station 48001, 48018, 48921, 48925, 56946, 56951 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 48001 (lat: 27.3N, lon: 97.4E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

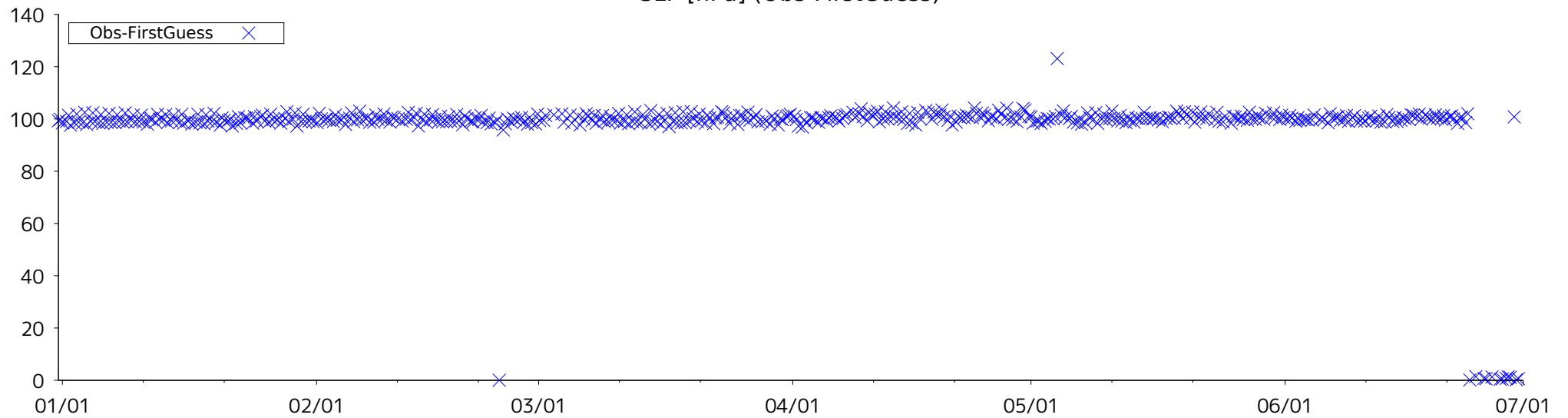
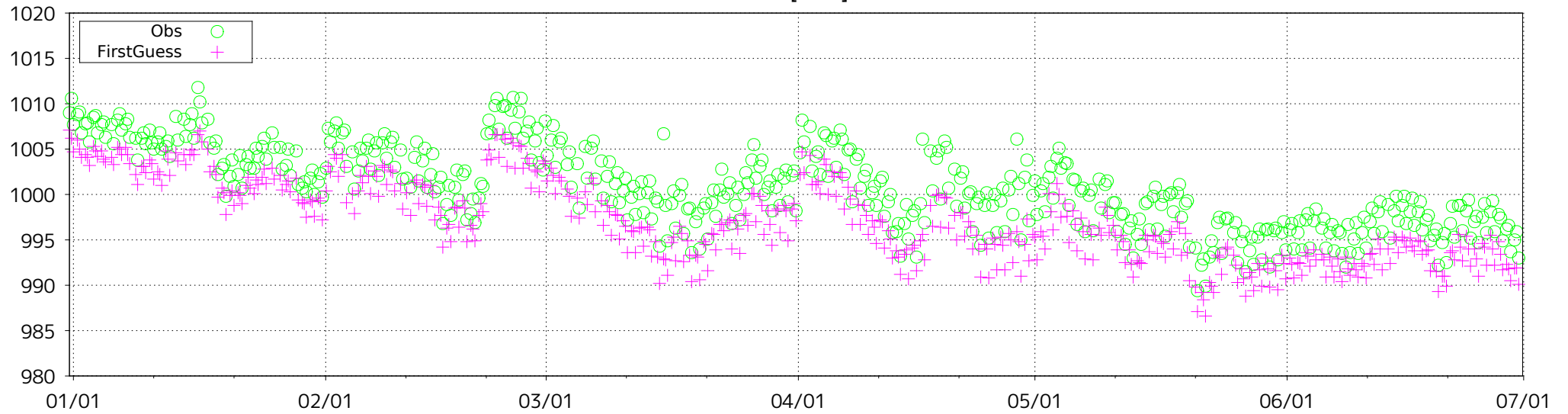


Figure 43 Time-series representation of SLP Obs minus FirstGuess for station 48001

ID: 48018 (lat: 24.2N, lon: 96.3E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

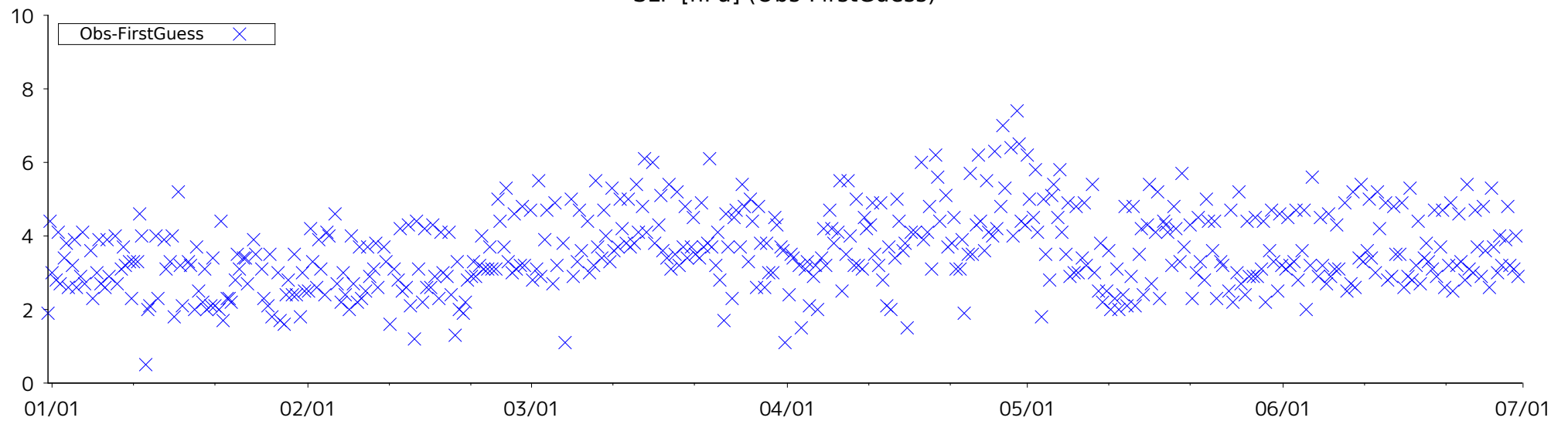


Figure 44 Time-series representation of SLP Obs minus FirstGuess for station 48018

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

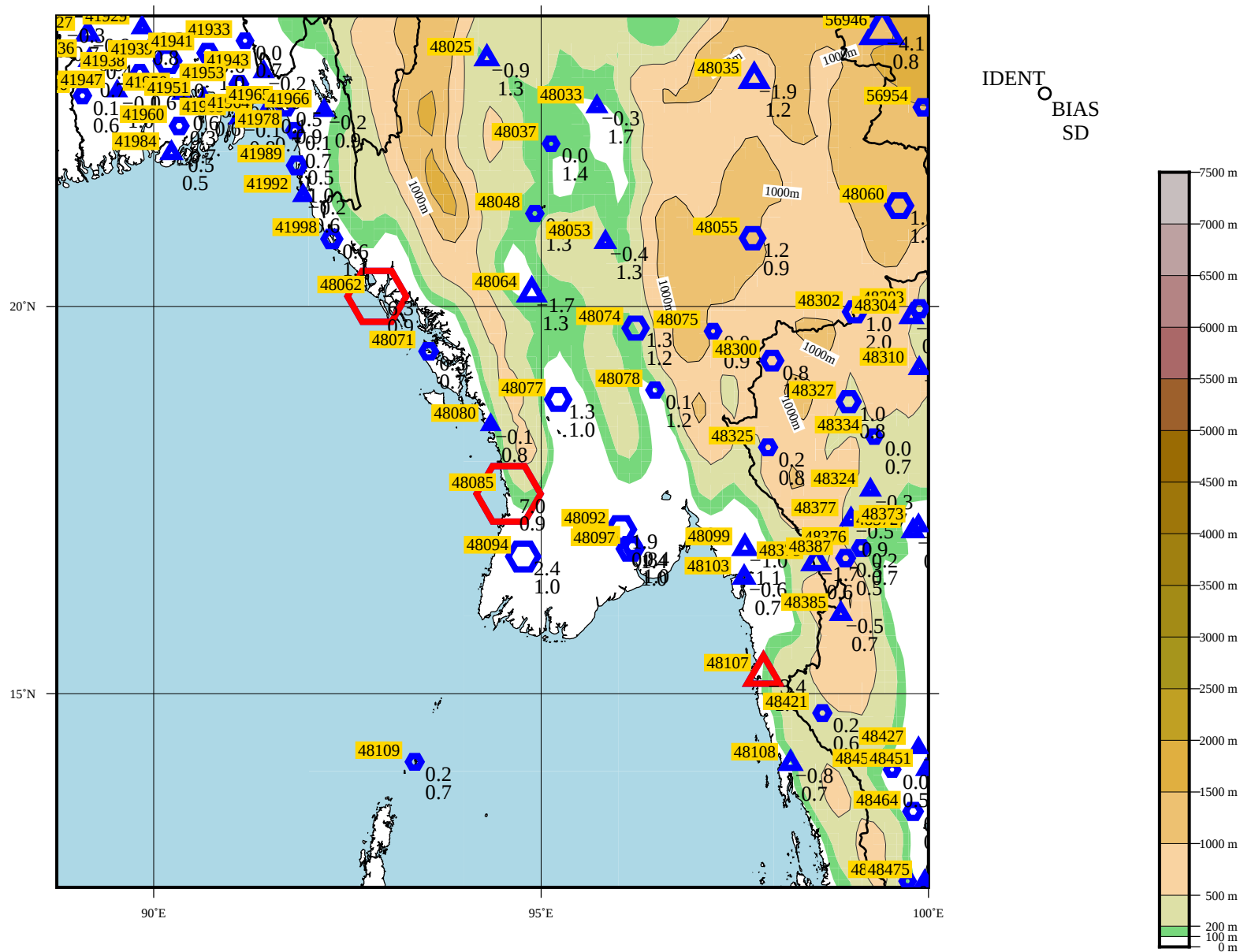
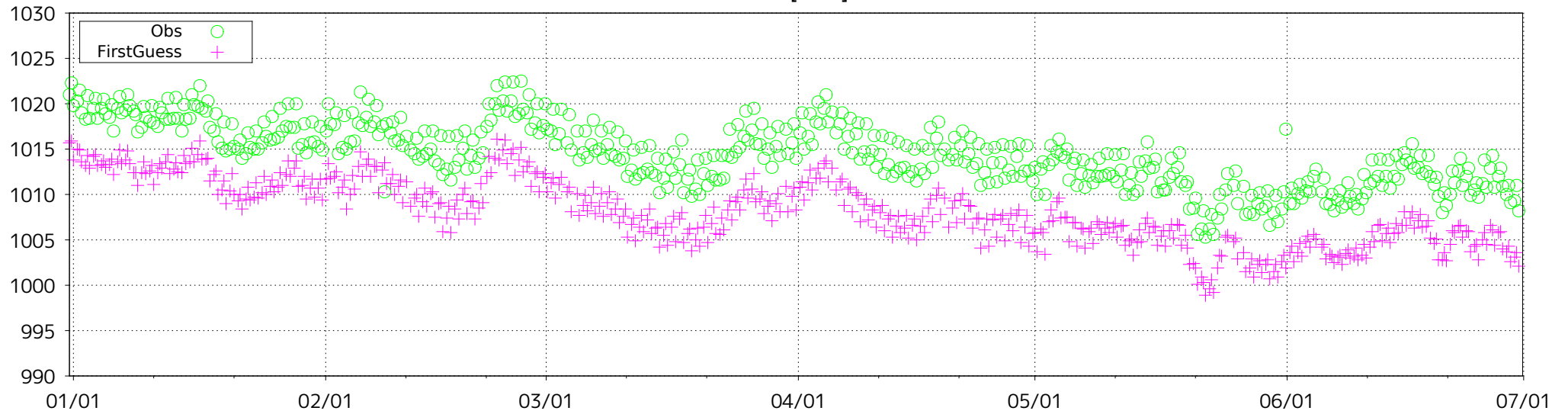


Figure 45 BIAS and SD of SLP for station 48062, 48085, 48107 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 48062 (lat: 20.1N, lon: 92.9E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

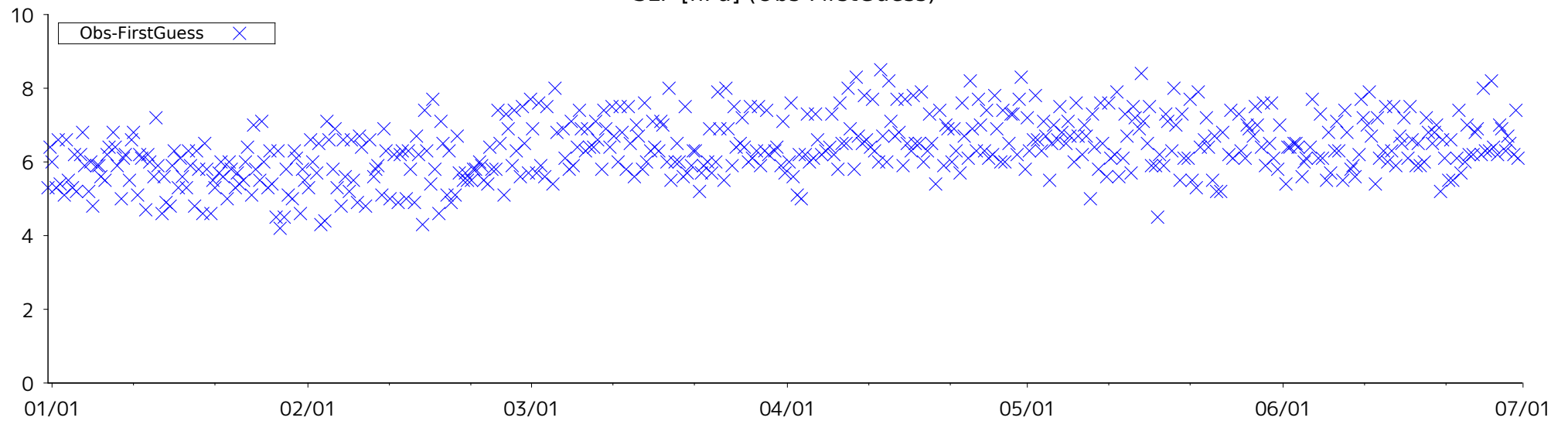
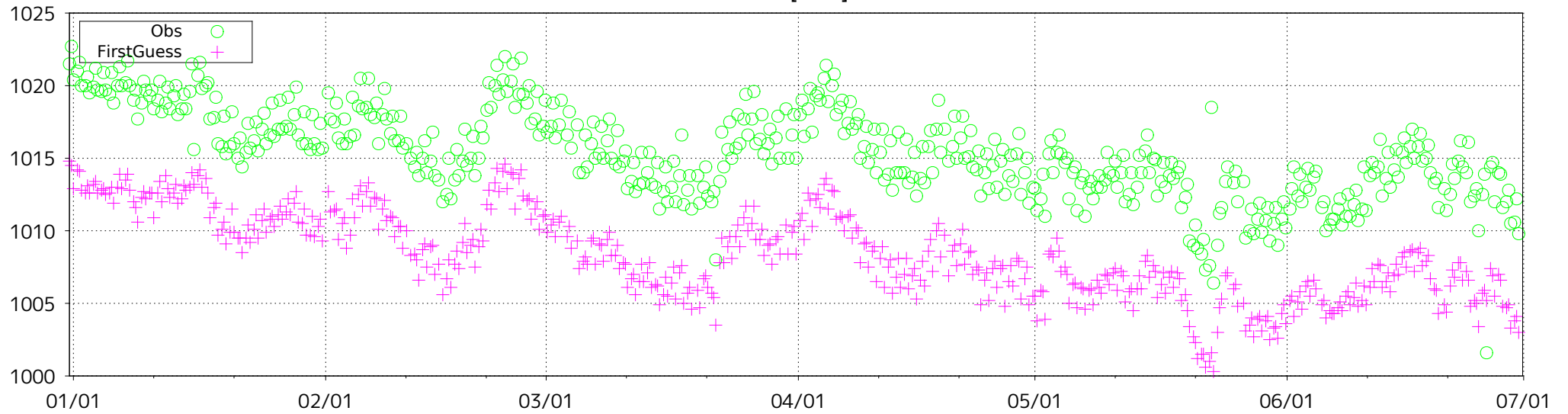


Figure 46 Time-series representation of SLP Obs minus FirstGuess for station 48062

ID: 48085 (lat: 17.6N, lon: 94.6E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

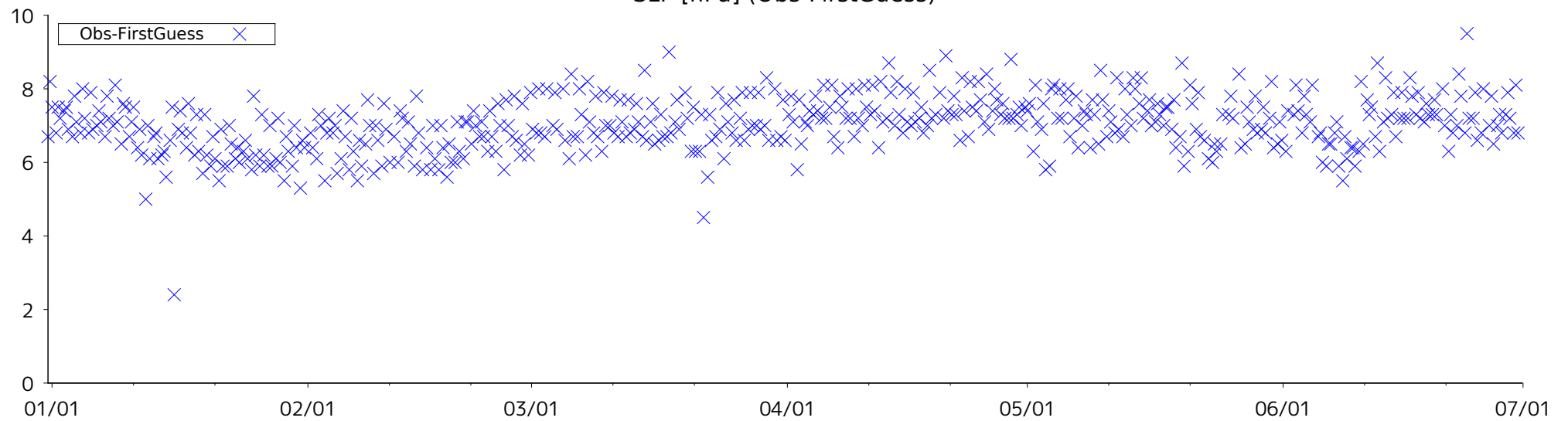
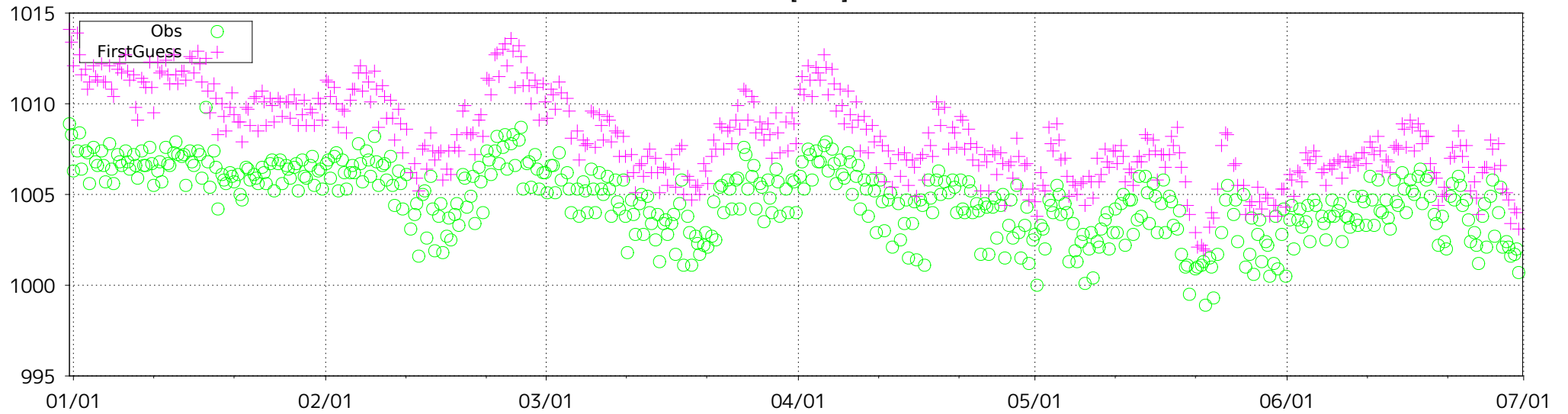


Figure 47 Time-series representation of SLP Obs minus FirstGuess for station 48085

ID: 48107 (lat: 15.3N, lon: 97.9E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

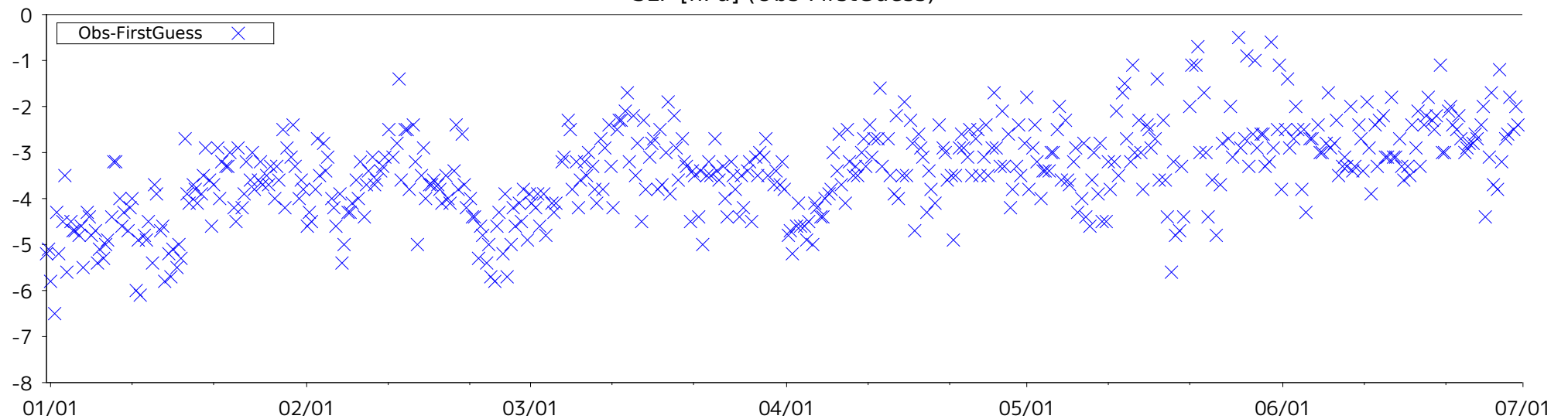
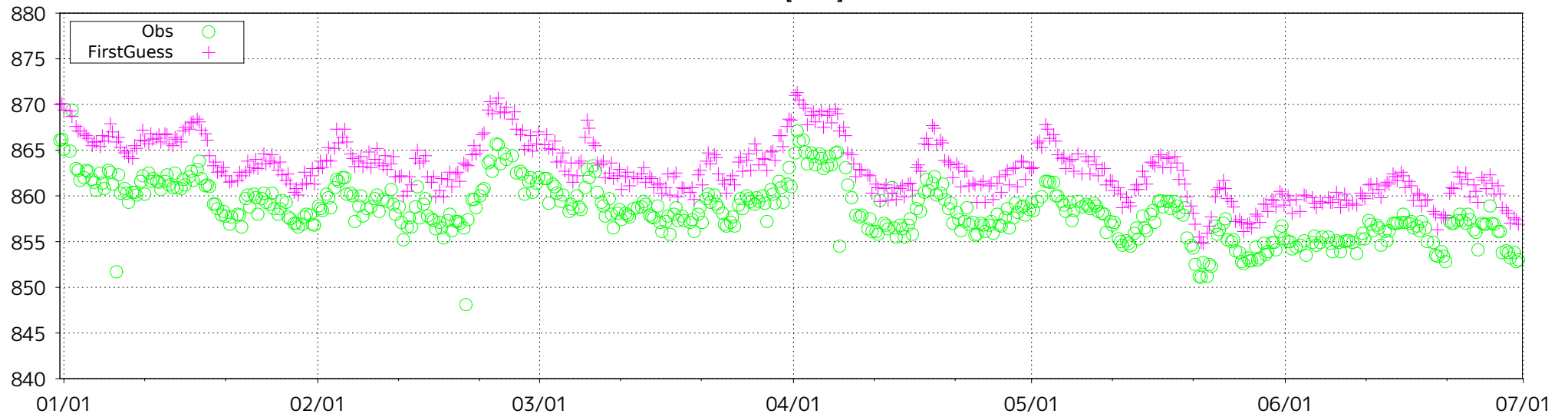


Figure 48 Time-series representation of SLP Obs minus FirstGuess for station 48107

ID: 48921 (lat: 21.6N, lon: 101.9E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

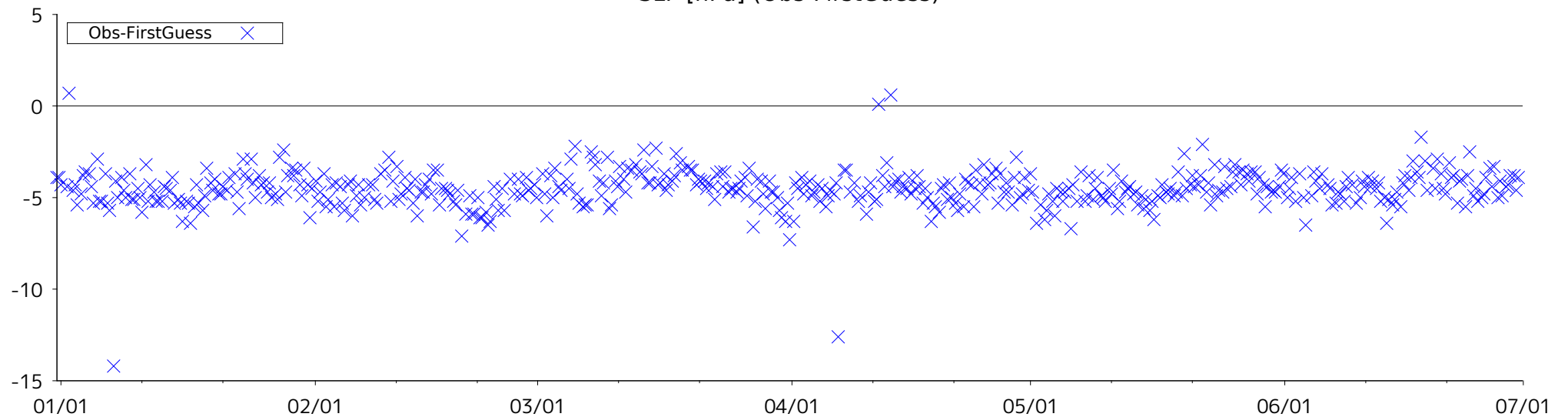
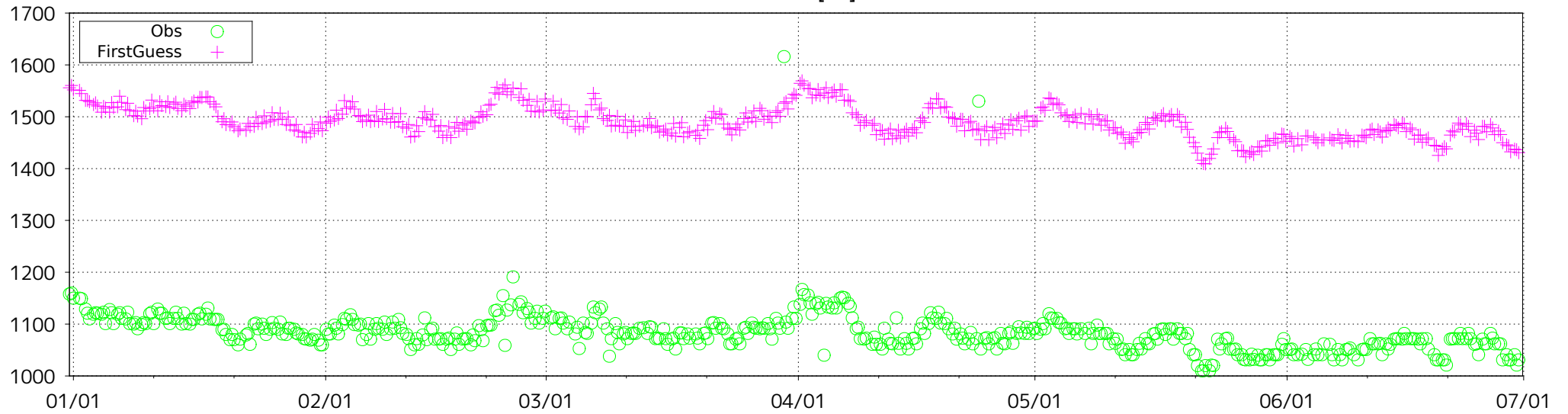


Figure 49(a) Time-series representation of SLP Obs minus FirstGuess for station 48921

ID: 48921 (lat: 21.6N, lon: 101.9E)

GZ850 [m]



GZ850 [m] (Obs-FirstGuess)

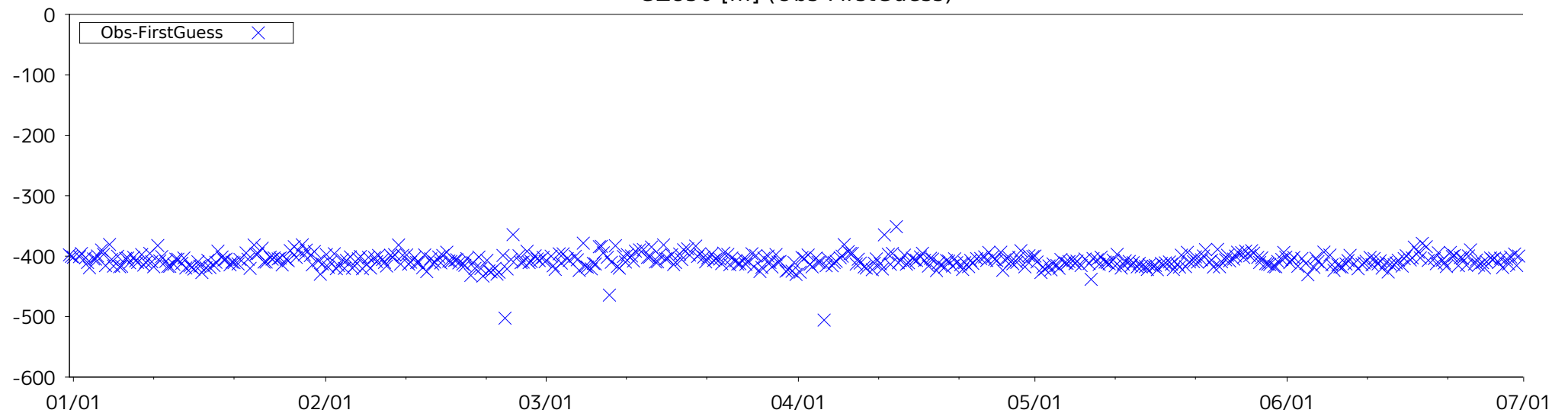
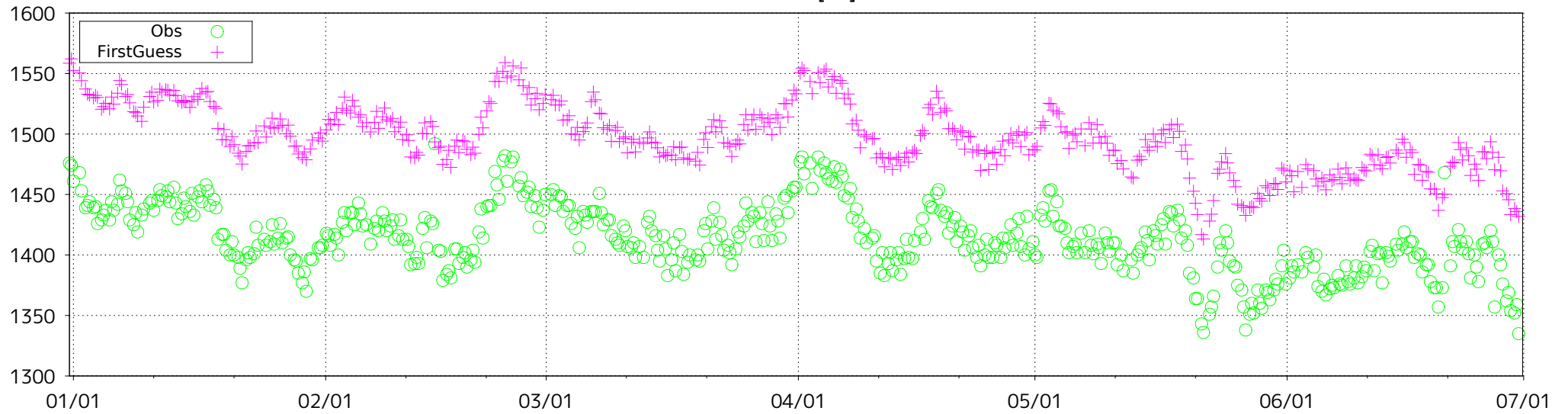


Figure 49(b) Time-series representation of GZ850 Obs minus FirstGuess for station 48921

ID: 48935 (lat: 19.5N, lon: 103.1E)

GZ850 [m]



GZ850 [m] (Obs-FirstGuess)

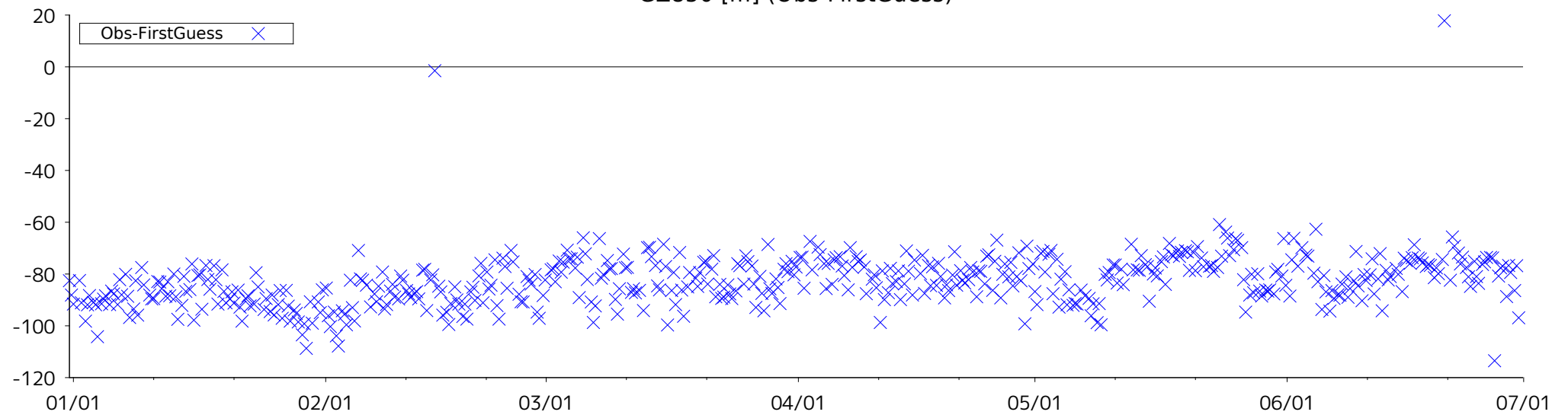


Figure 50 Time-series representation of GZ850 Obs minus FirstGuess for station 48935

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

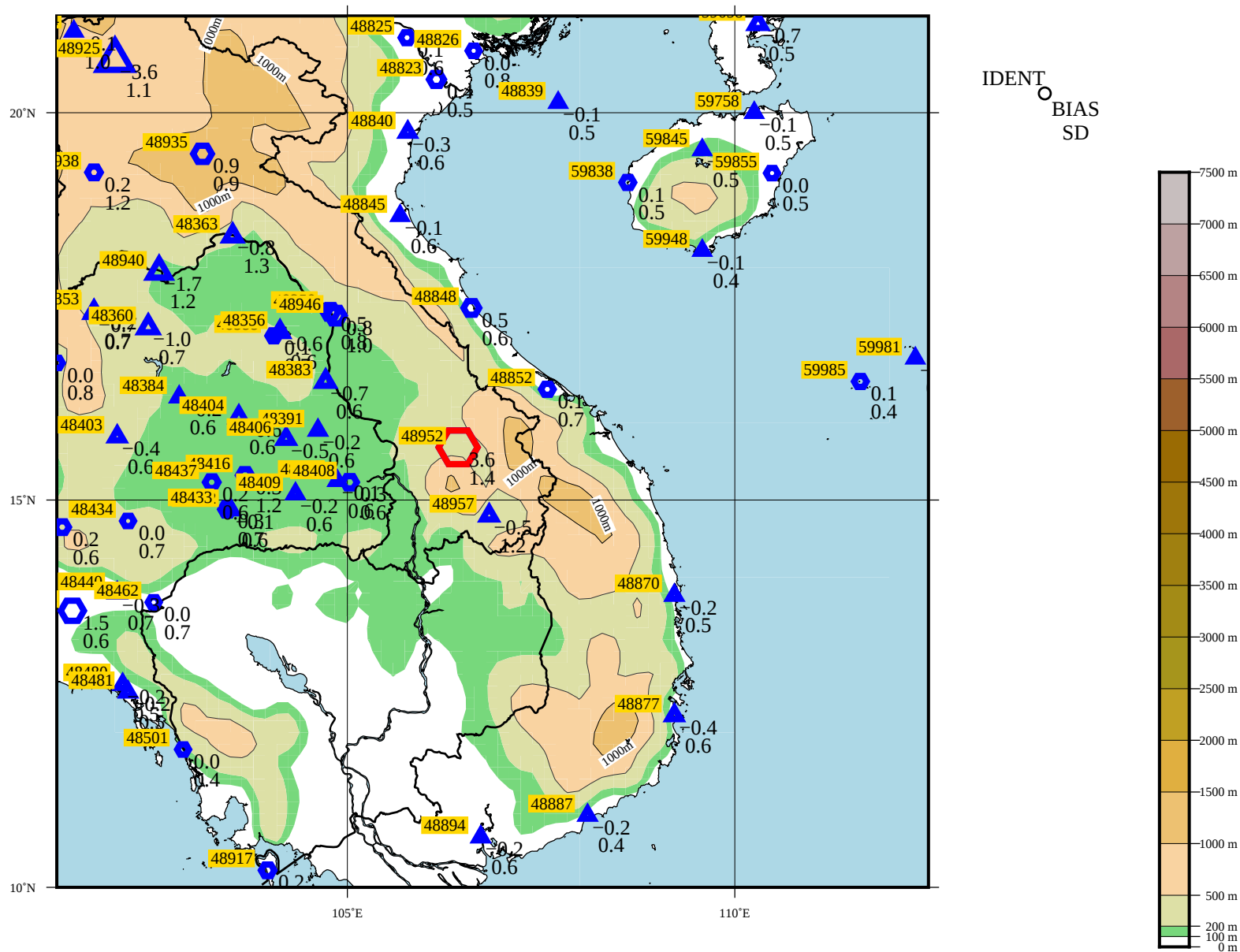


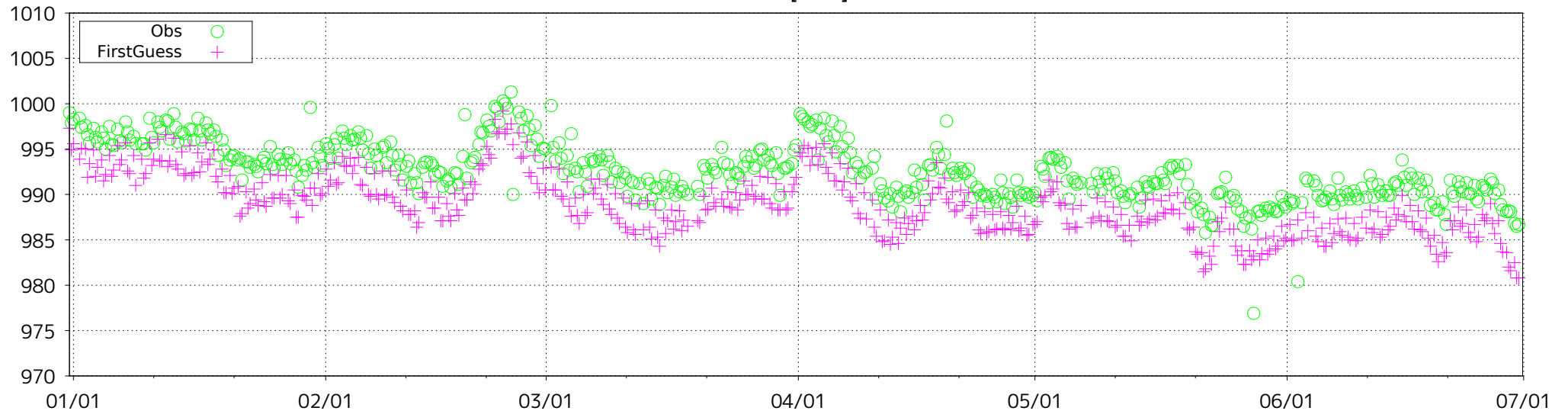
Figure 51 BIAS and SD of SLP for station 48952 (red) and surrounding stations (blue).

The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.

The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 48952 (lat: 15.7N, lon: 106.4E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

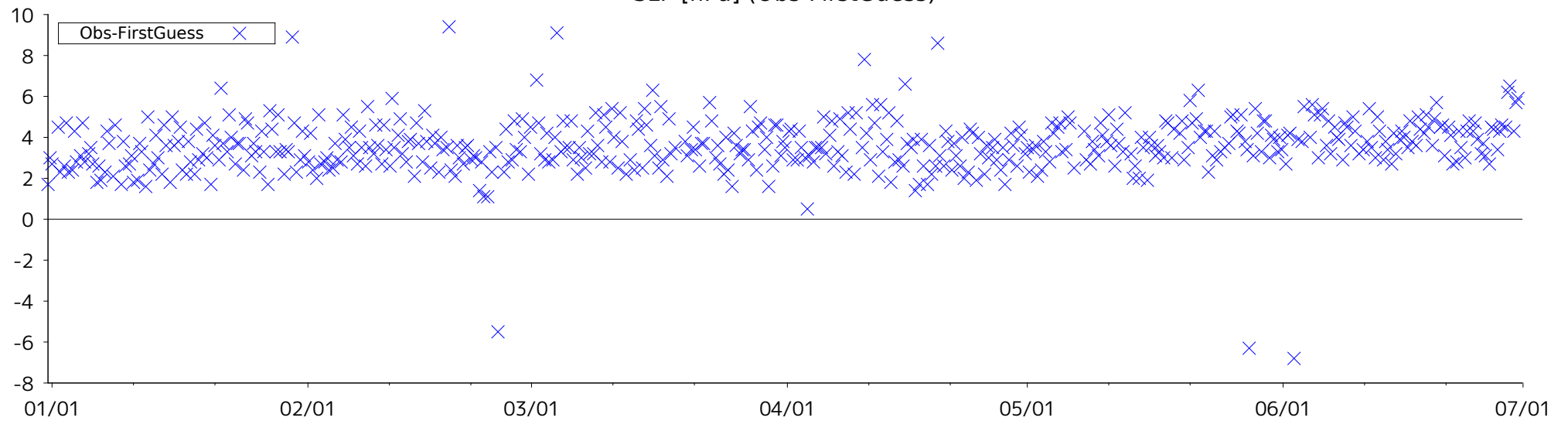
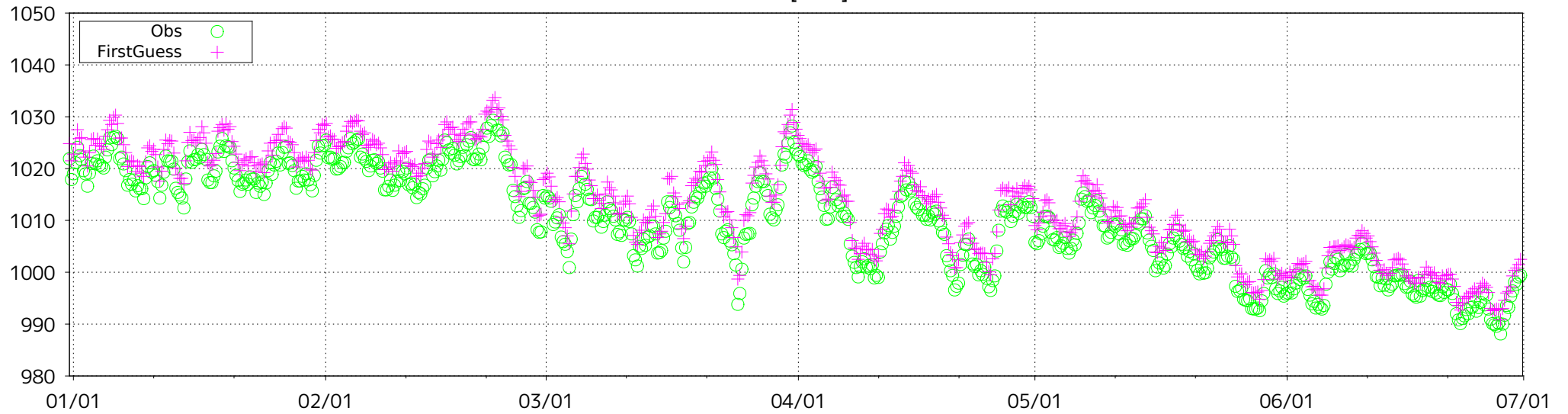


Figure 52 Time-series representation of SLP Obs minus FirstGuess for station 48952

ID: 54945 (lat: 35.5N, lon: 119.6E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

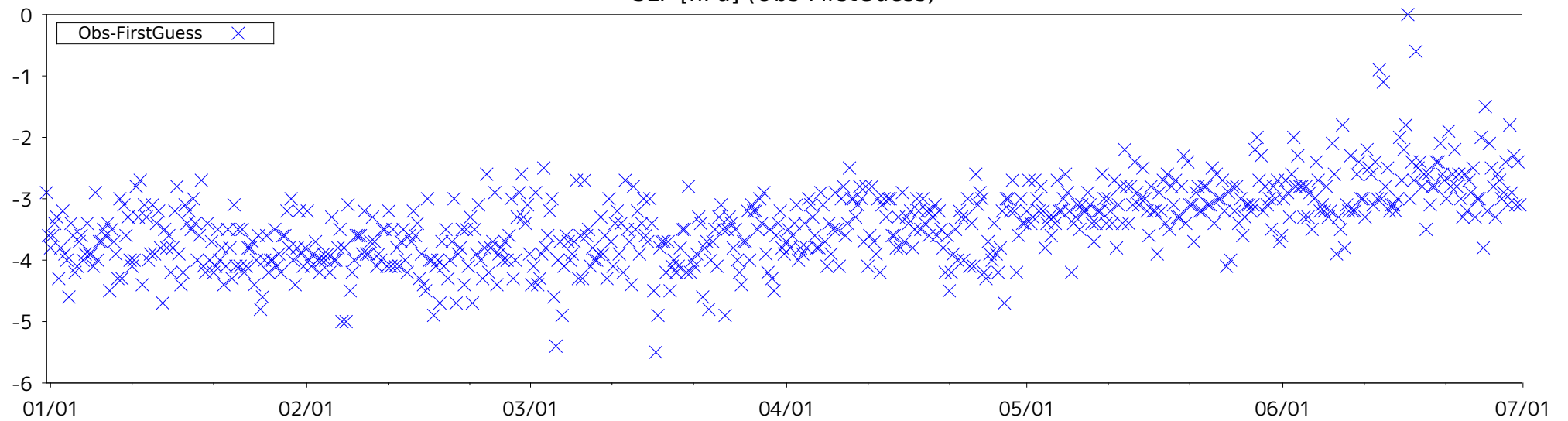
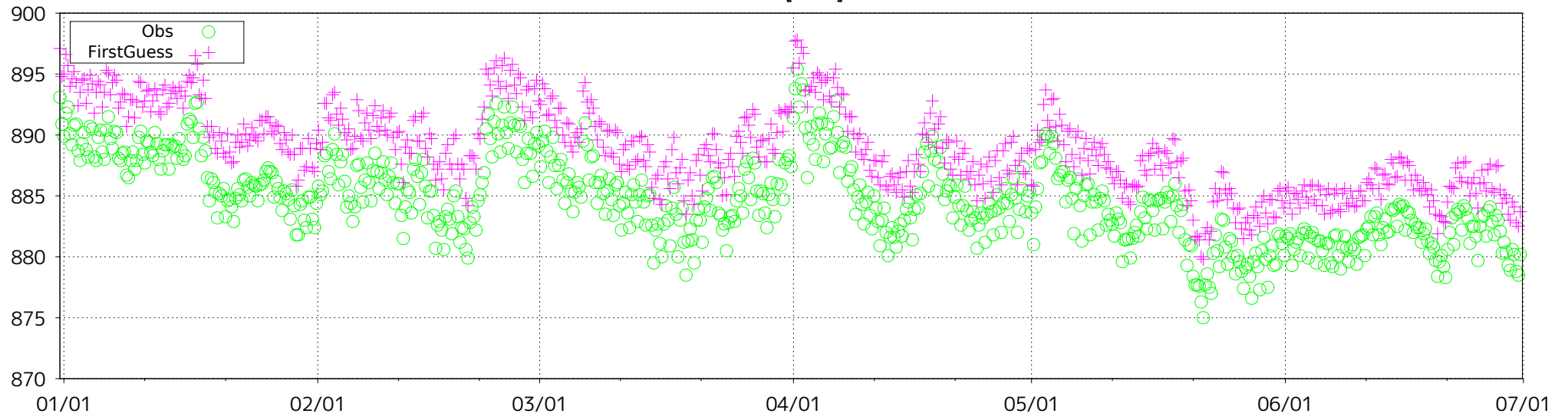


Figure 53 Time-series representation of SLP Obs minus FirstGuess for station 54945

ID: 56946 (lat: 23.6N, lon: 99.4E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

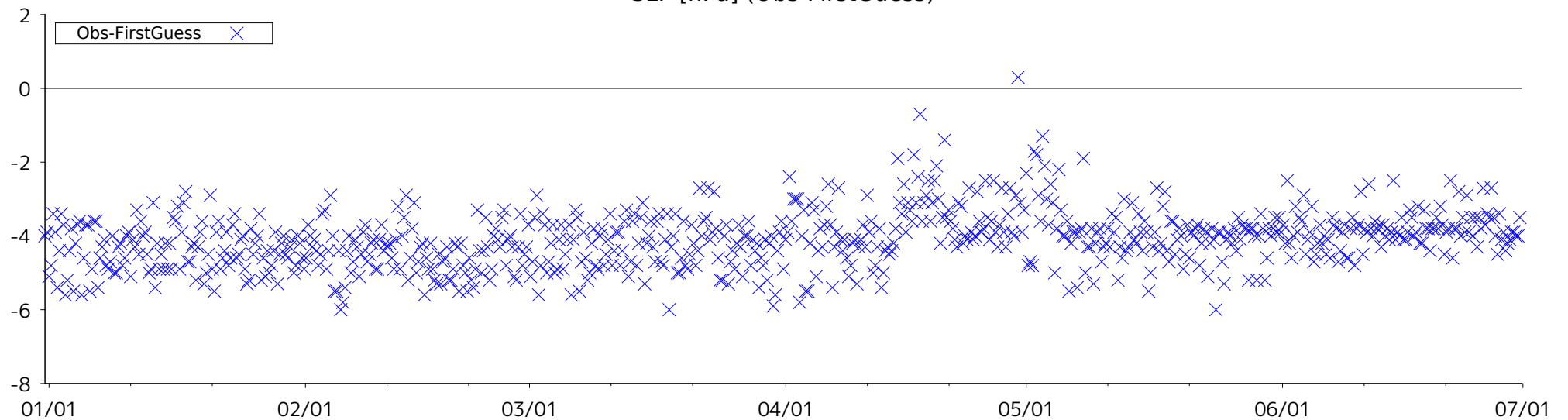
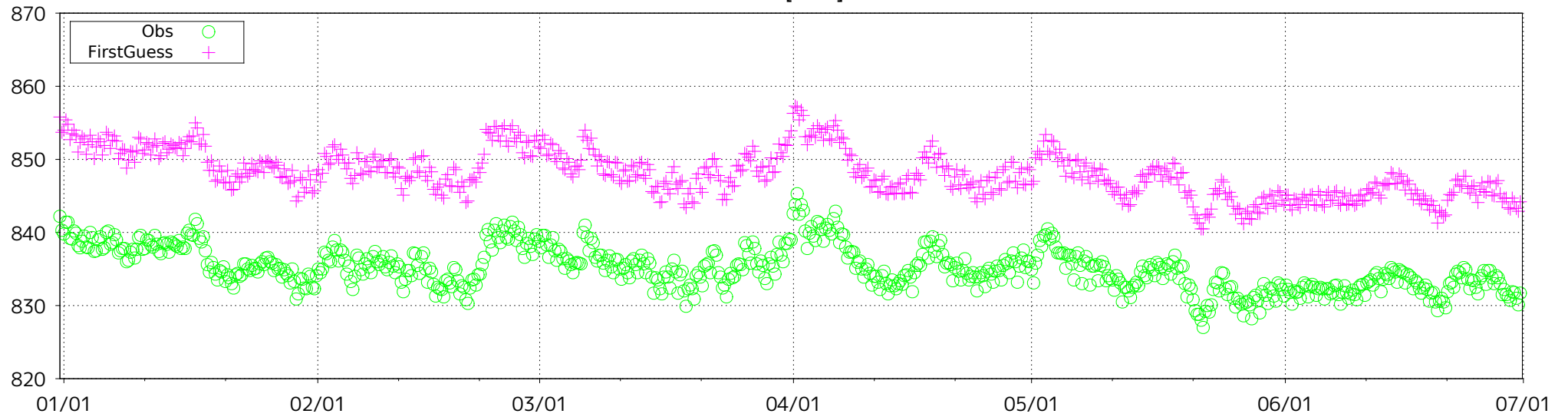


Figure 54 Time-series representation of SLP Obs minus FirstGuess for station 56946

ID: 56951 (lat: 24.0N, lon: 100.2E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

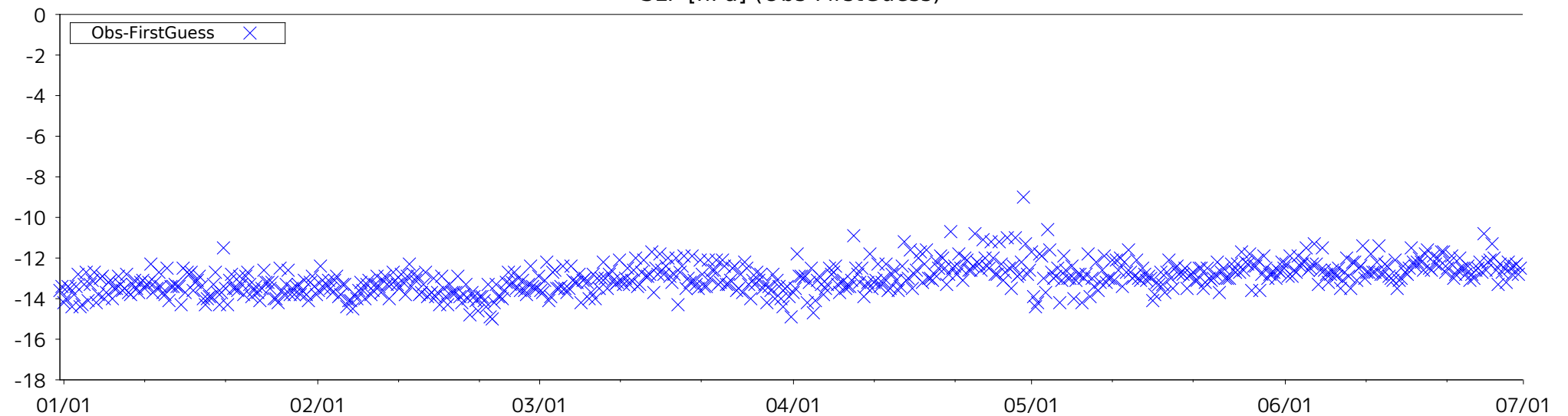


Figure 55 Time-series representation of SLP Obs minus FirstGuess for station 56951

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

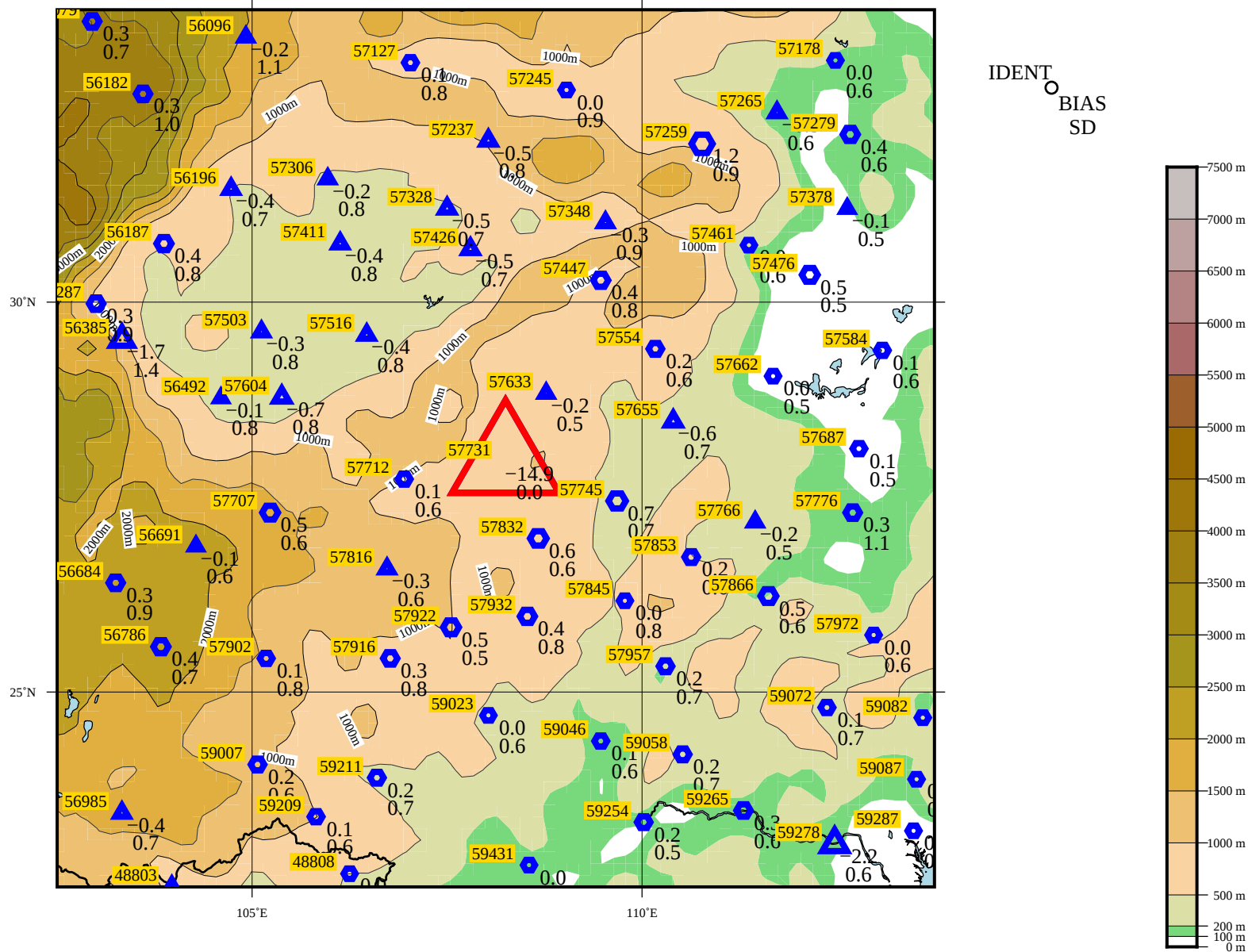
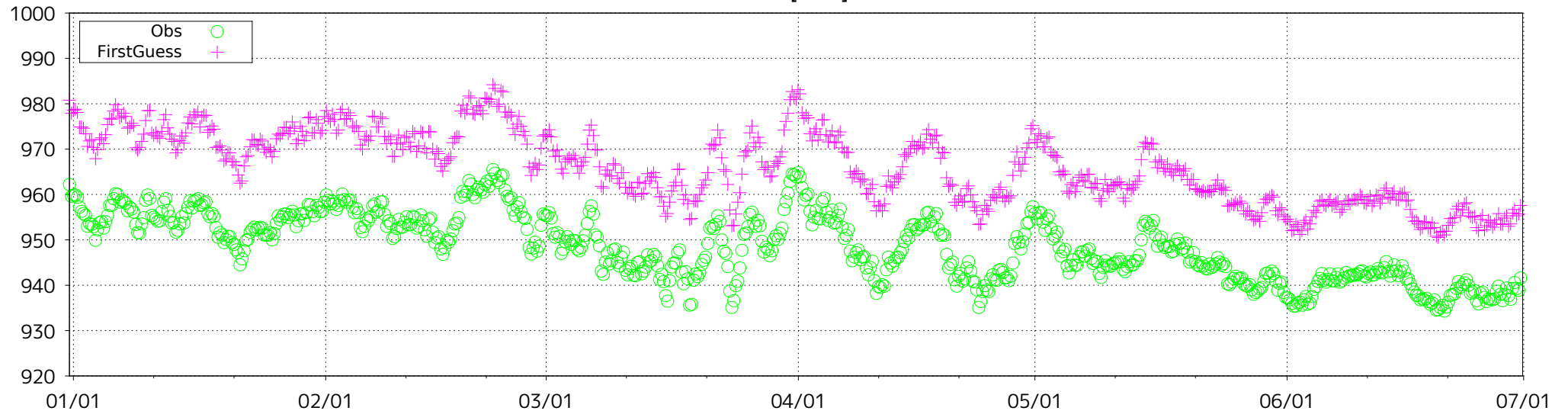


Figure 56 BIAS and SD of SLP for station 57731 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 57731 (lat: 28.0N, lon: 108.3E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

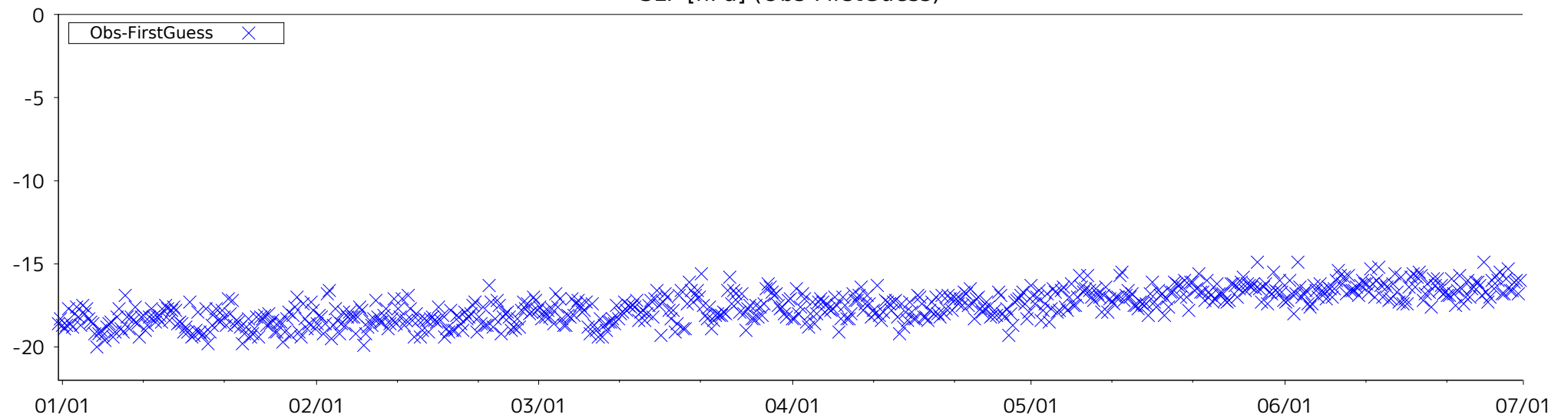


Figure 57 Time-series representation of SLP Obs minus FirstGuess for station 57731

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

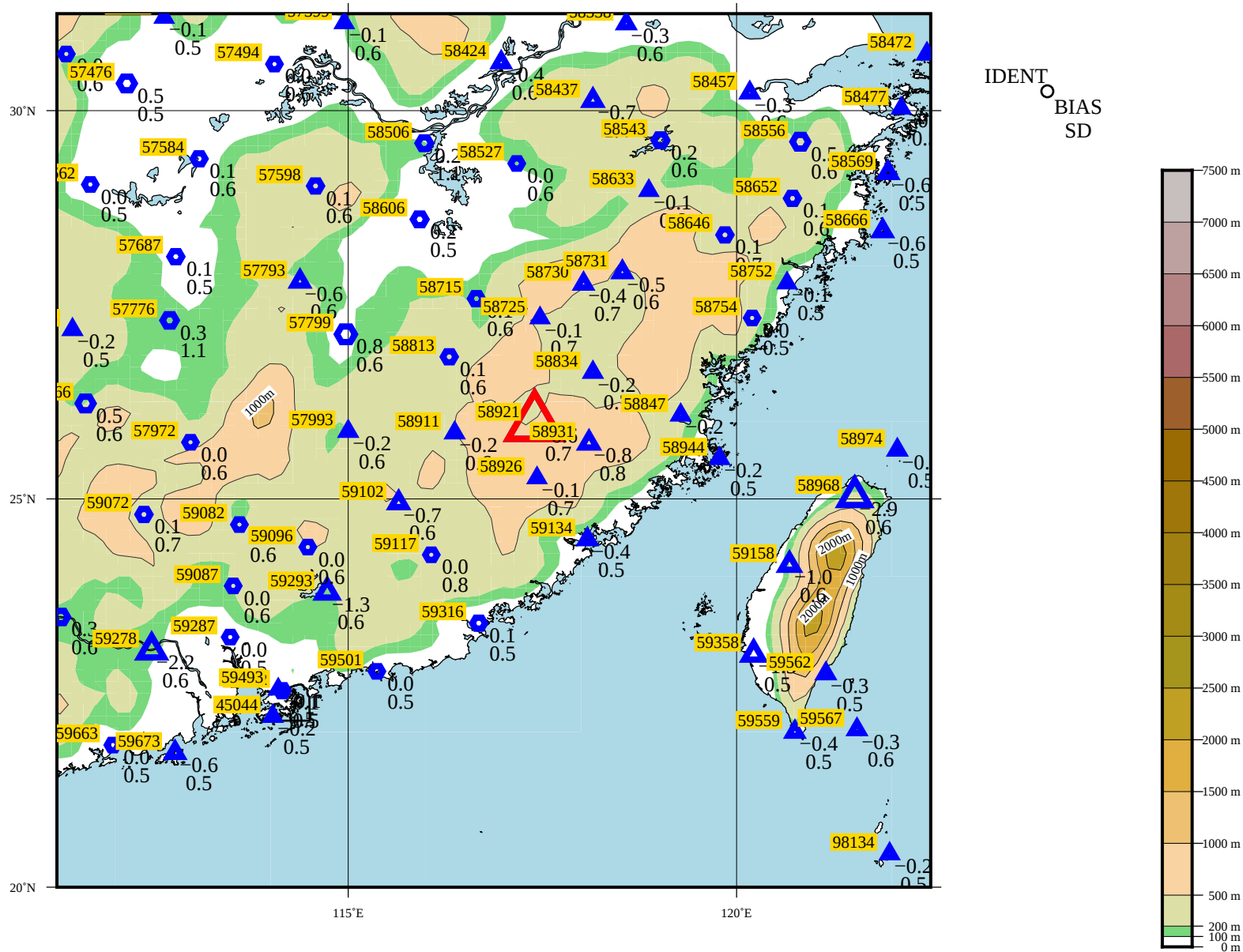
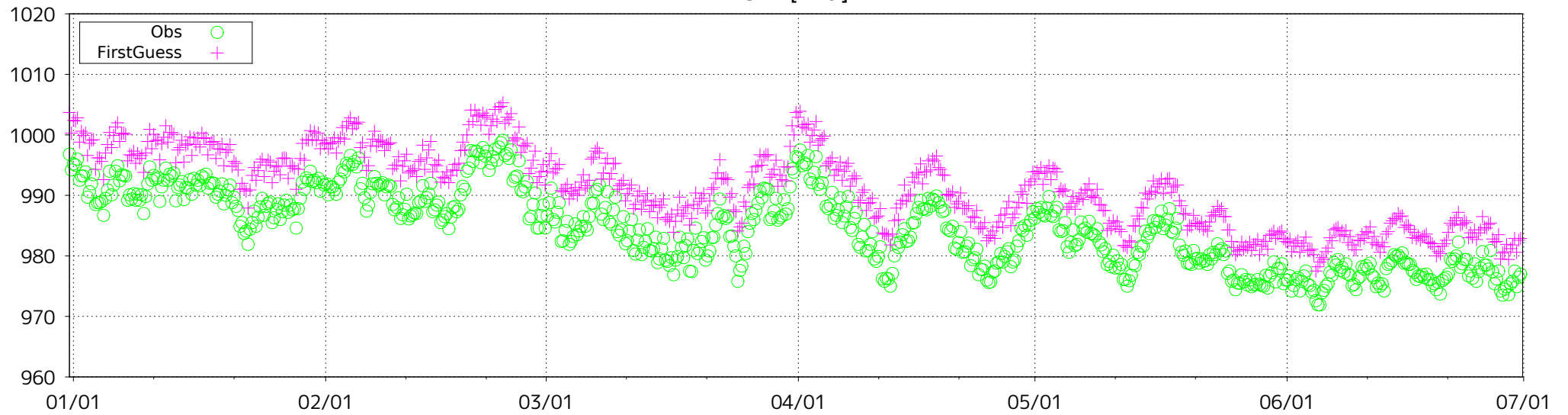


Figure 58 BIAS and SD of SLP for station 58921 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 58921 (lat: 26.0N, lon: 117.4E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

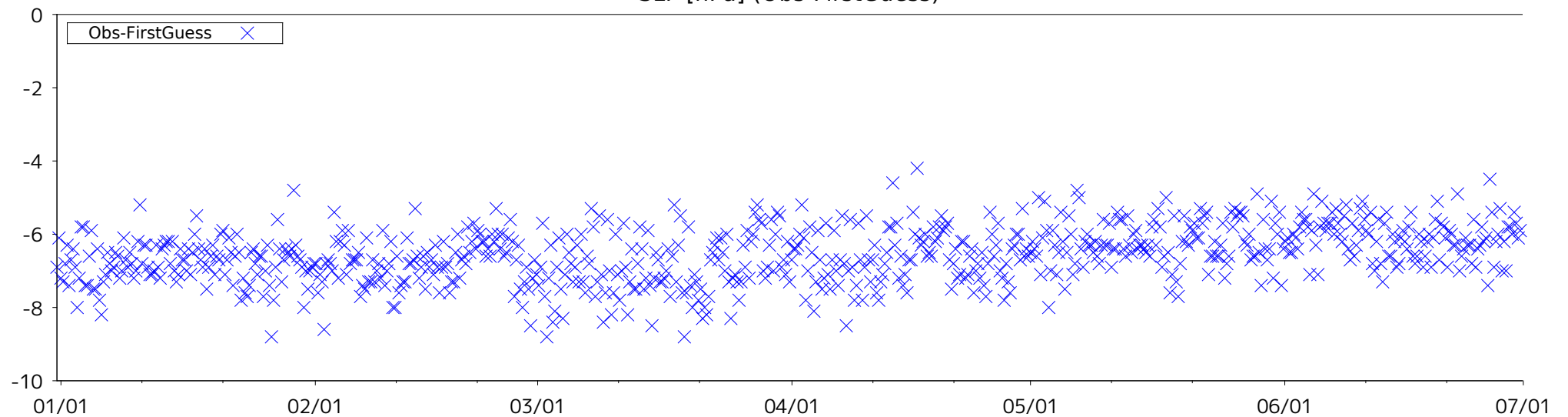


Figure 59 Time-series representation of SLP Obs minus FirstGuess for station 58921

LEVEL = SUR ELEMENT = SLP
 2022 01 01 00 UTC -> 2022 06 30 18 UTC (181 DAYS)

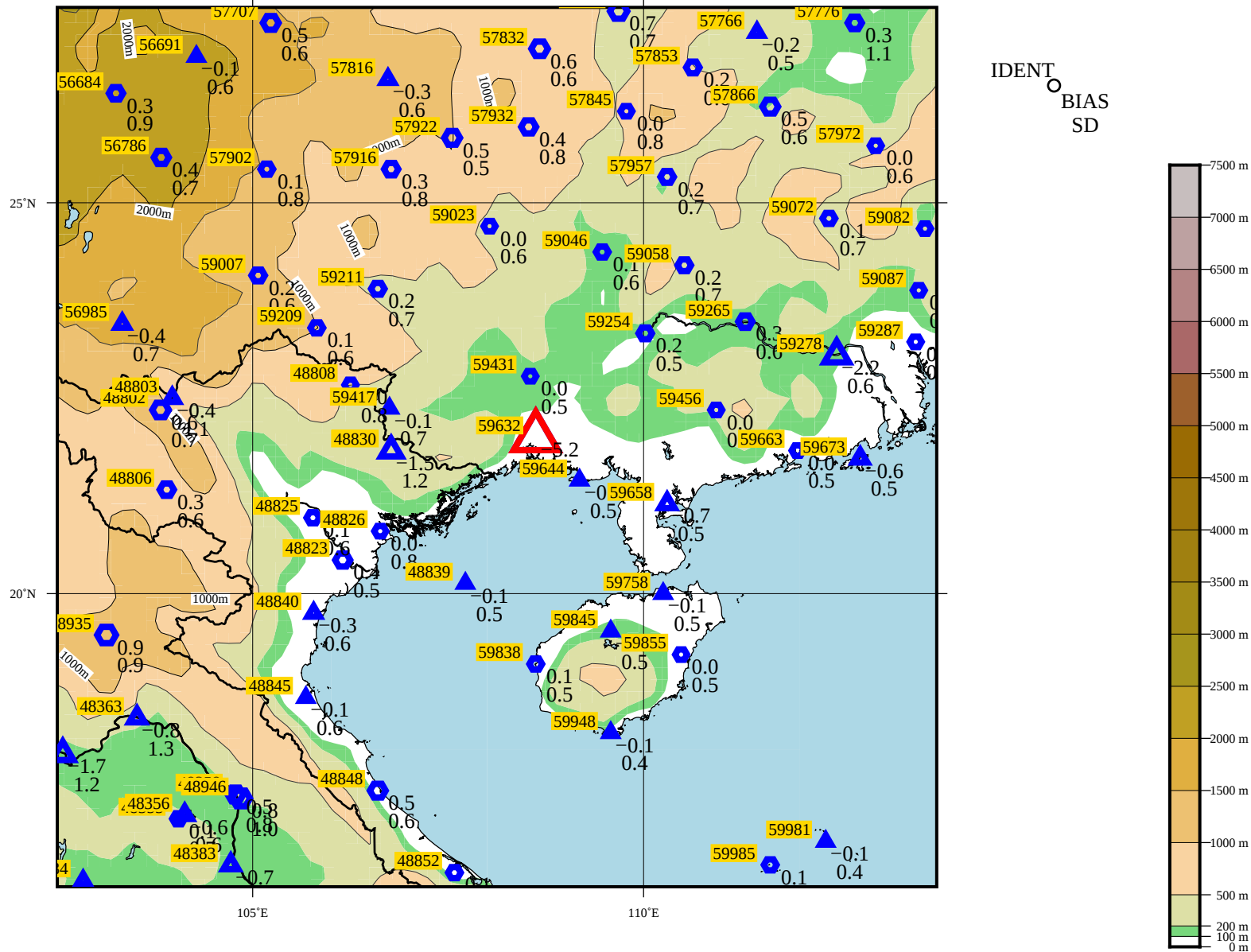
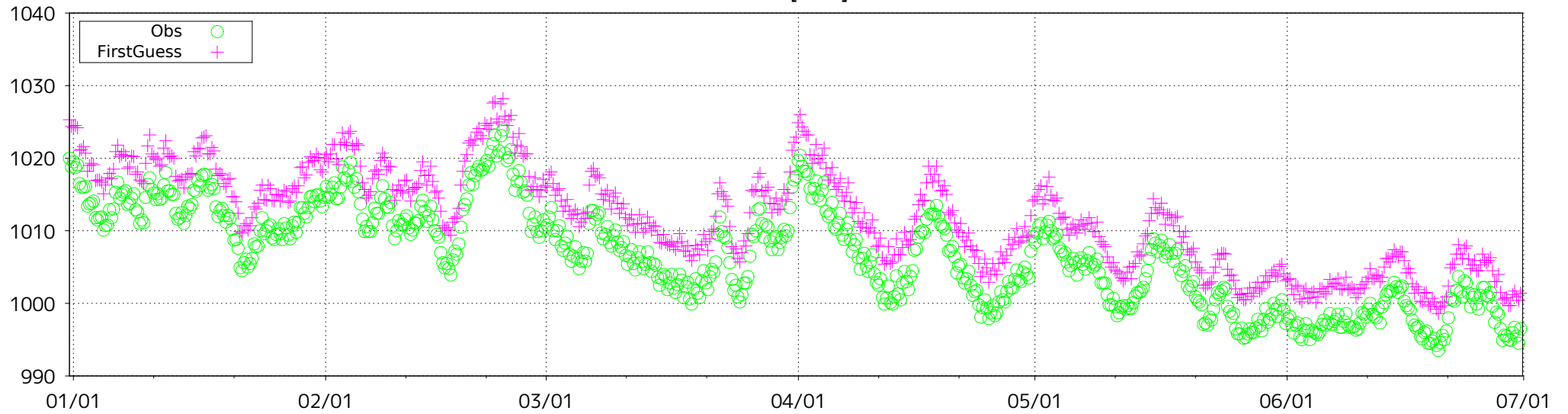


Figure 60 BIAS and SD of SLP for station 59632 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 59632 (lat: 22.0N, lon: 108.6E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

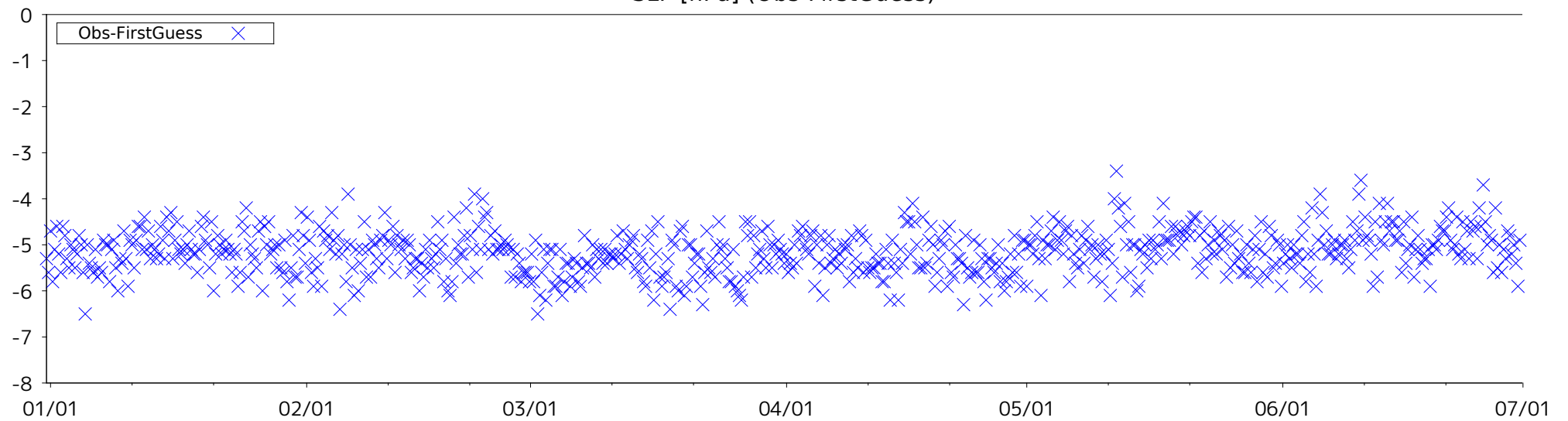
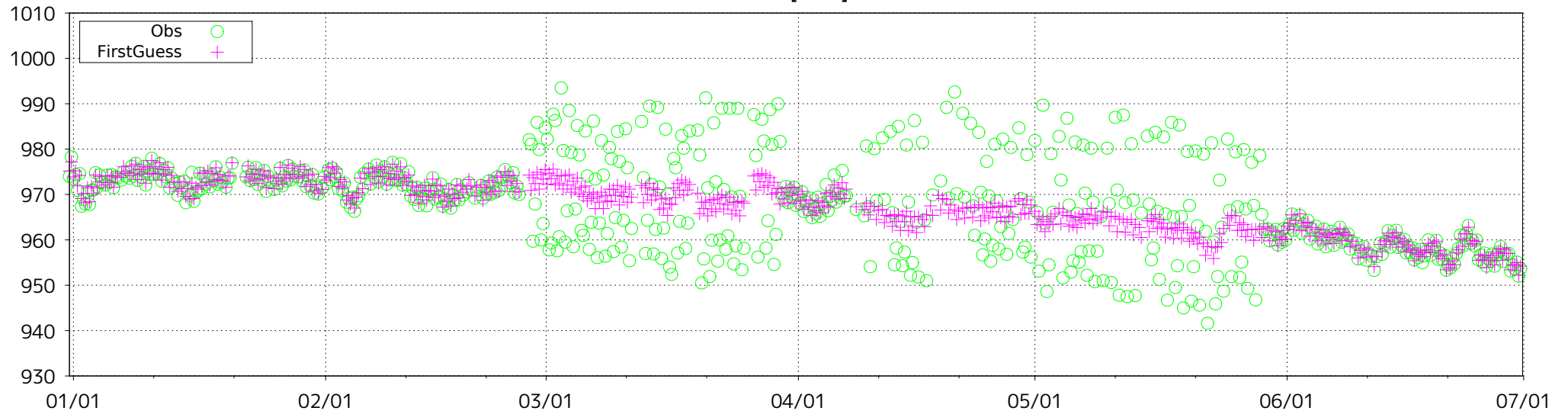


Figure 61 Time-series representation of SLP Obs minus FirstGuess for station 59632

ID: 41244 (lat: 24.2N, lon: 55.9E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

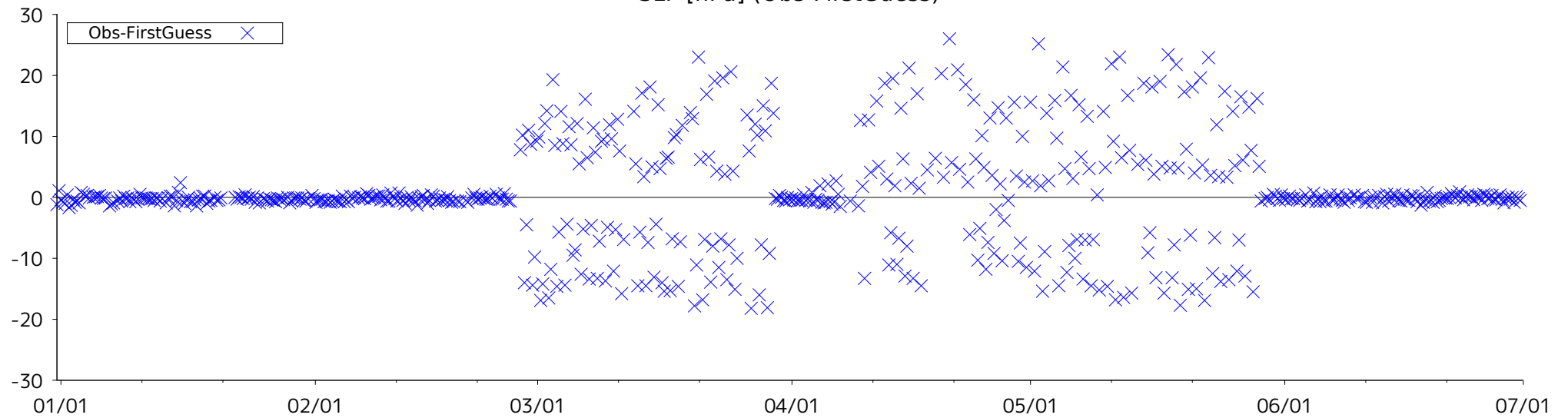
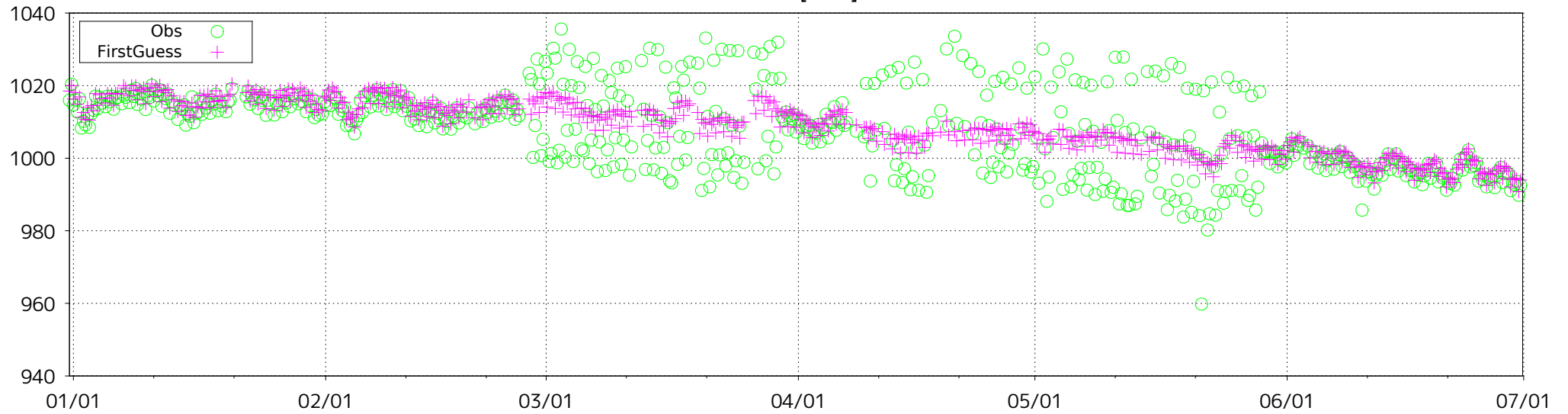


Figure 62(a) Time-series representation of SLP Obs minus FirstGuess for station 41244

ID: 41244 (lat: 24.2N, lon: 55.9E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

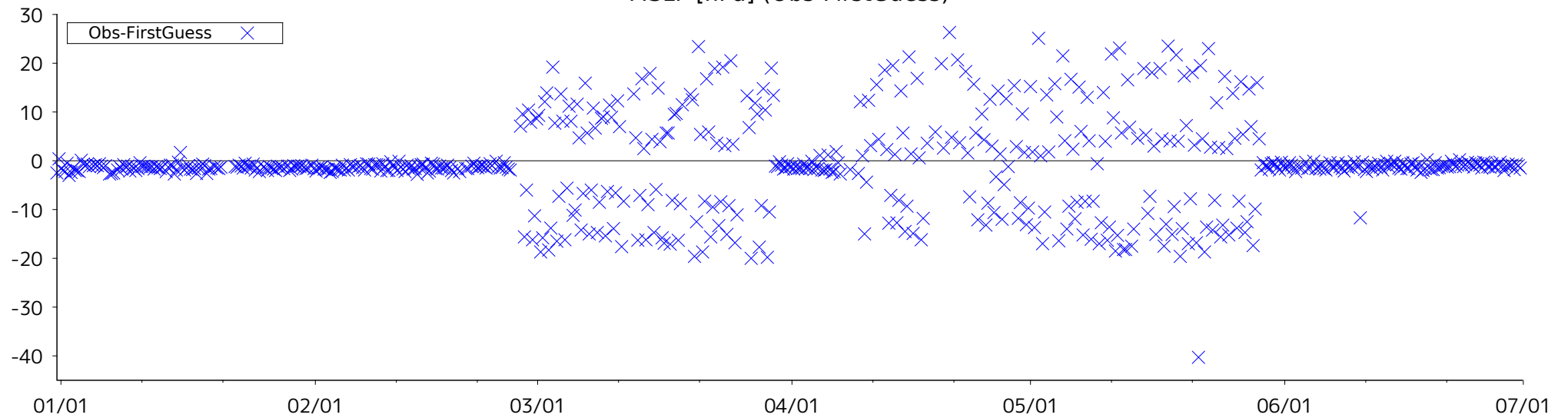
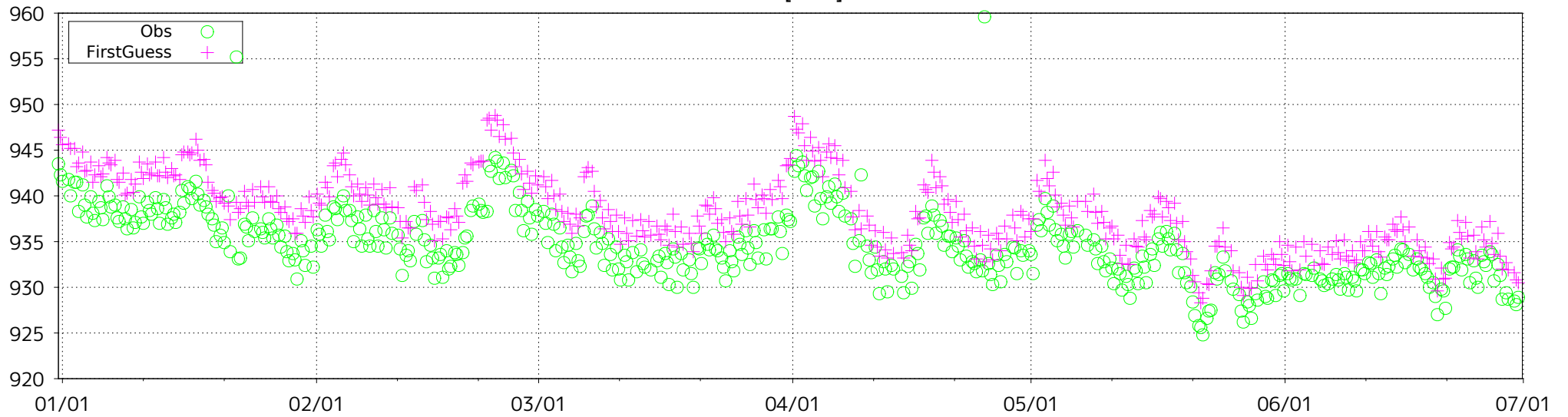


Figure 62(b) Time-series representation of MSLP Obs minus FirstGuess for station 41244

ID: 48925 (lat: 20.7N, lon: 102.0E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

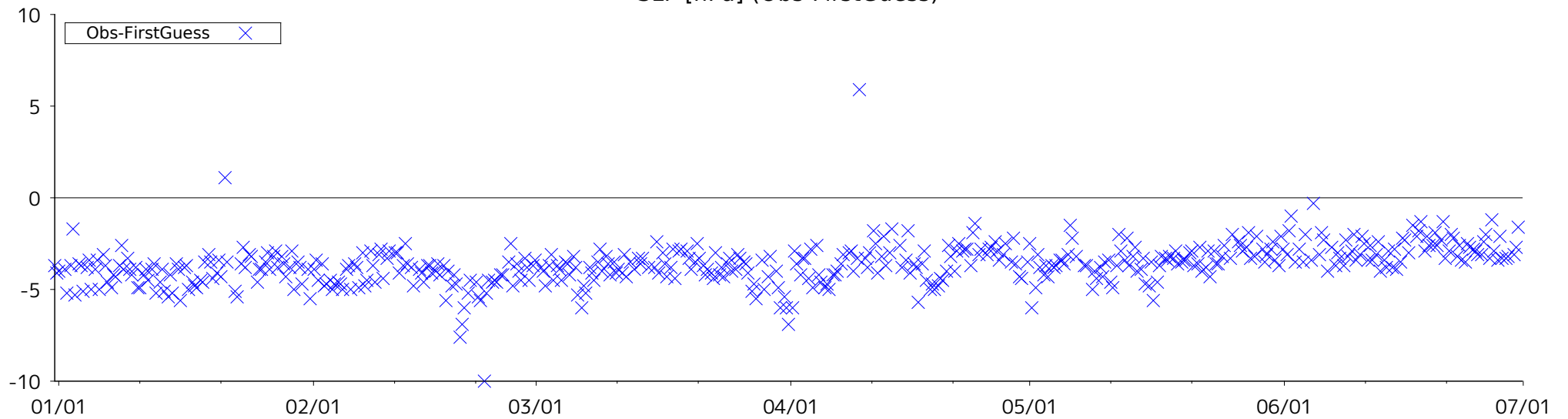
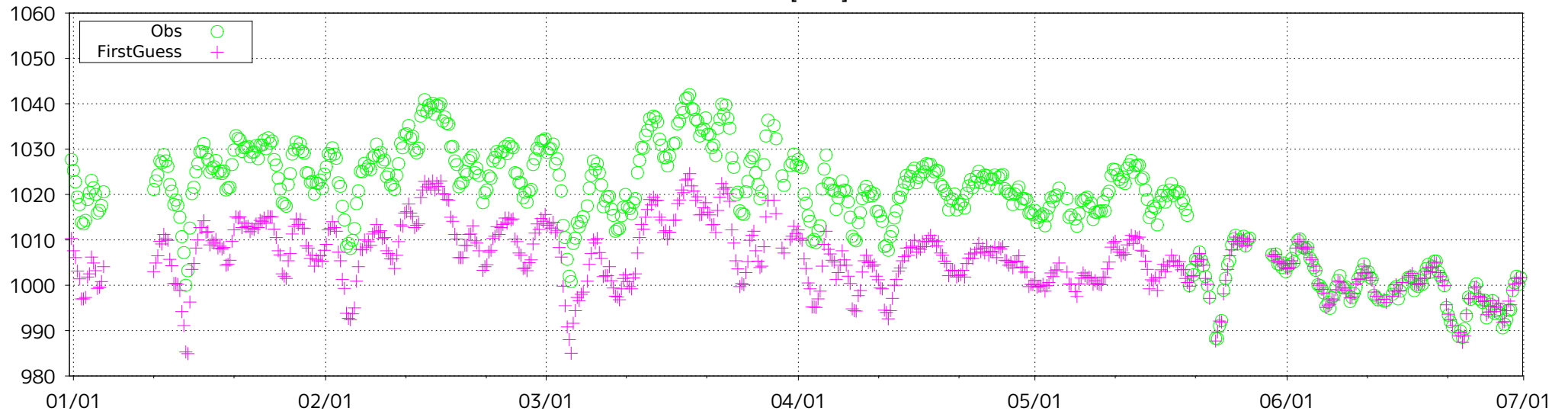


Figure 63 Time-series representation of SLP Obs minus FirstGuess for station 48925

ID: 38232 (lat: 43.0N, lon: 54.1E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

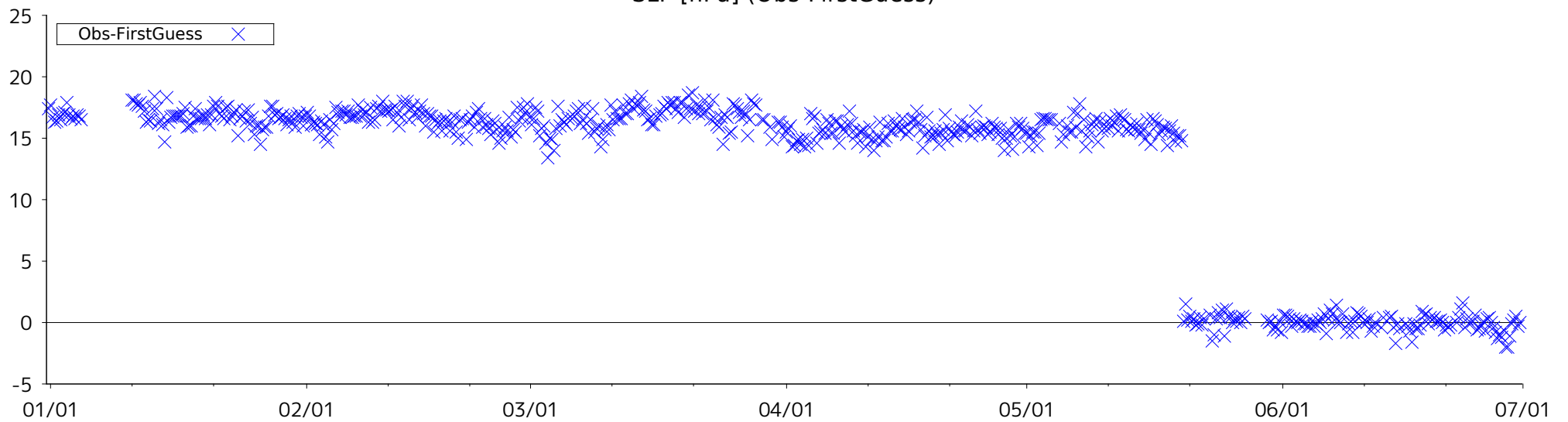
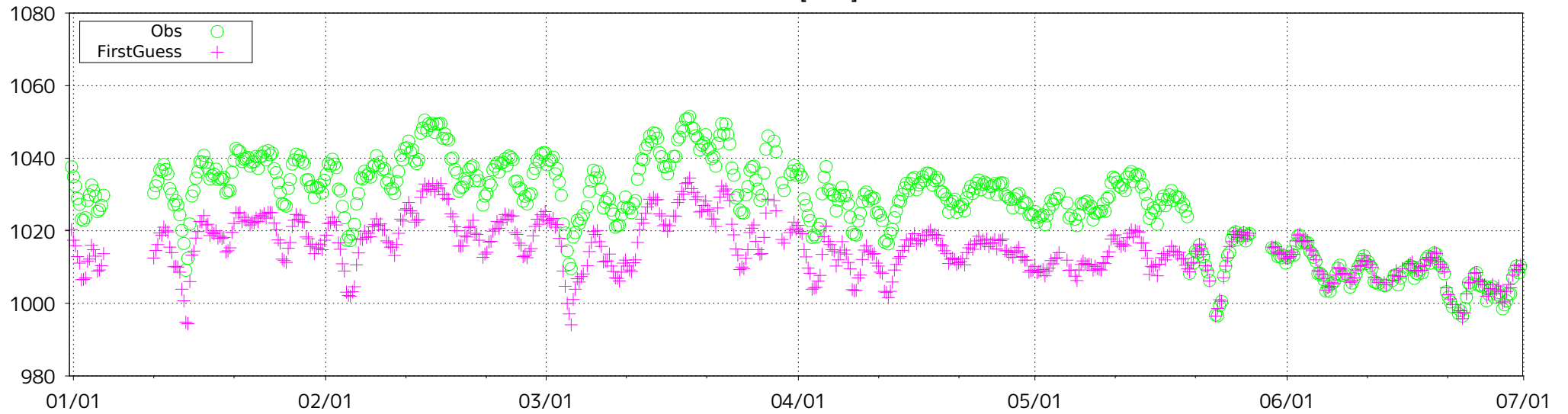


Figure 64(a) Time-series representation of SLP Obs minus FirstGuess for station 38232

ID: 38232 (lat: 43.0N, lon: 54.1E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

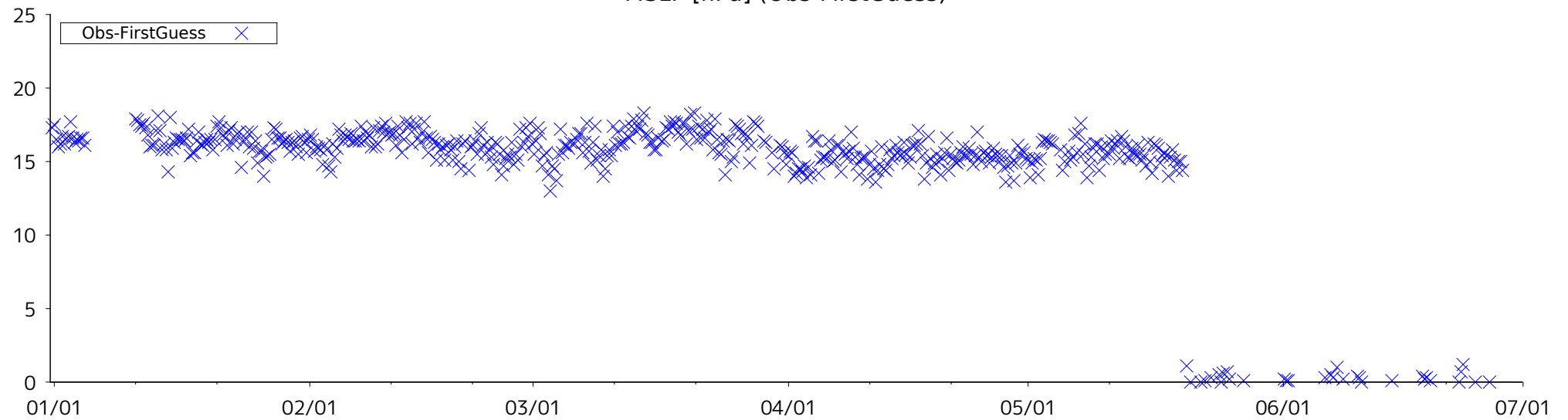
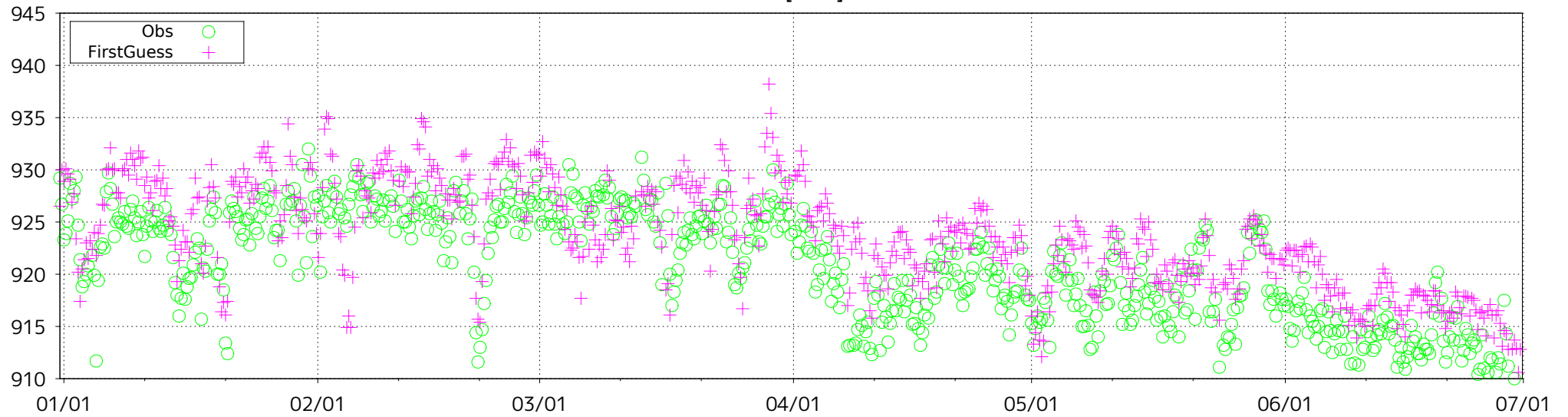


Figure 64(b) Time-series representation of MSLP Obs minus FirstGuess for station 38232

ID: 38836 (lat: 38.6N, lon: 68.7E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

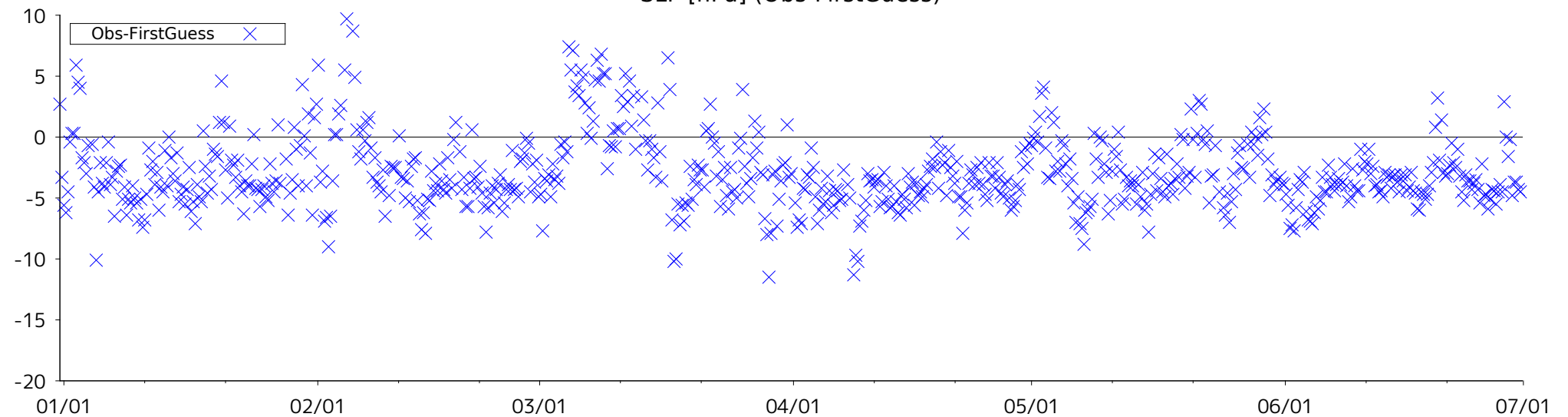
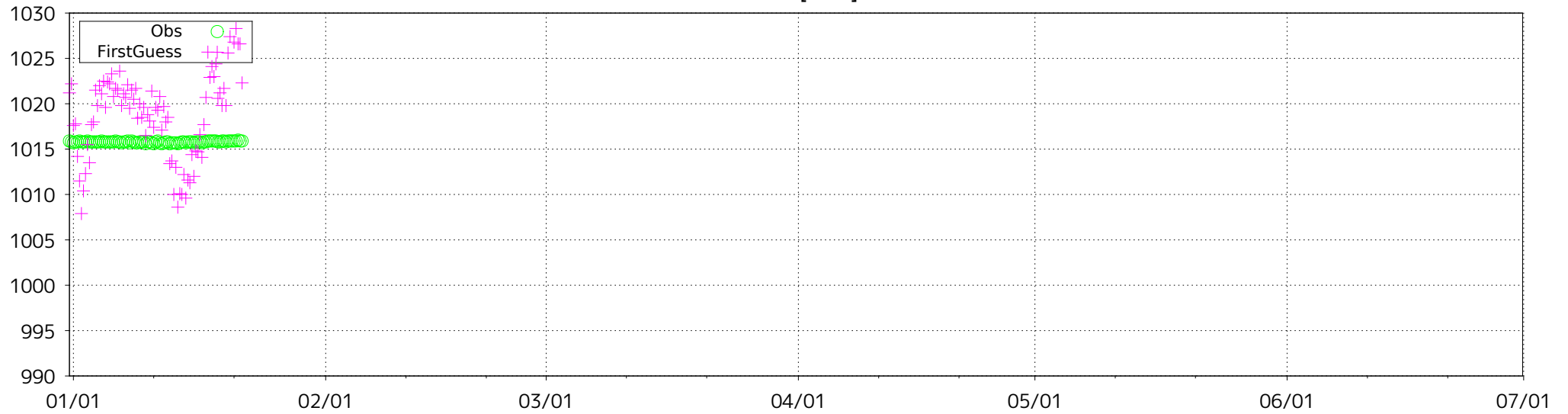


Figure 65 Time-series representation of SLP Obs minus FirstGuess for station 38836

ID: 40587 (lat: 29.3N, lon: 47.7E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

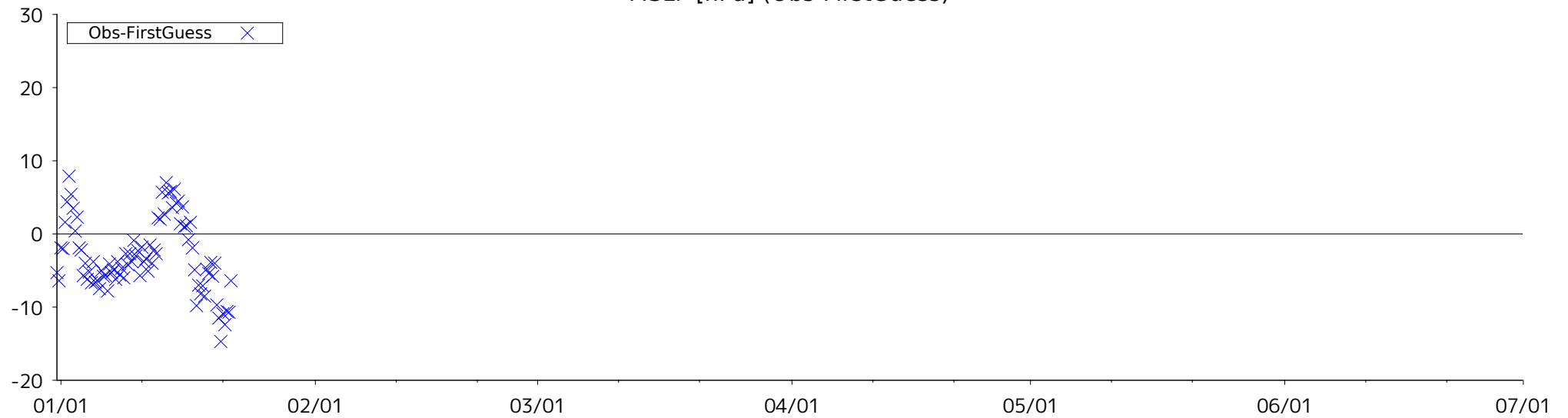
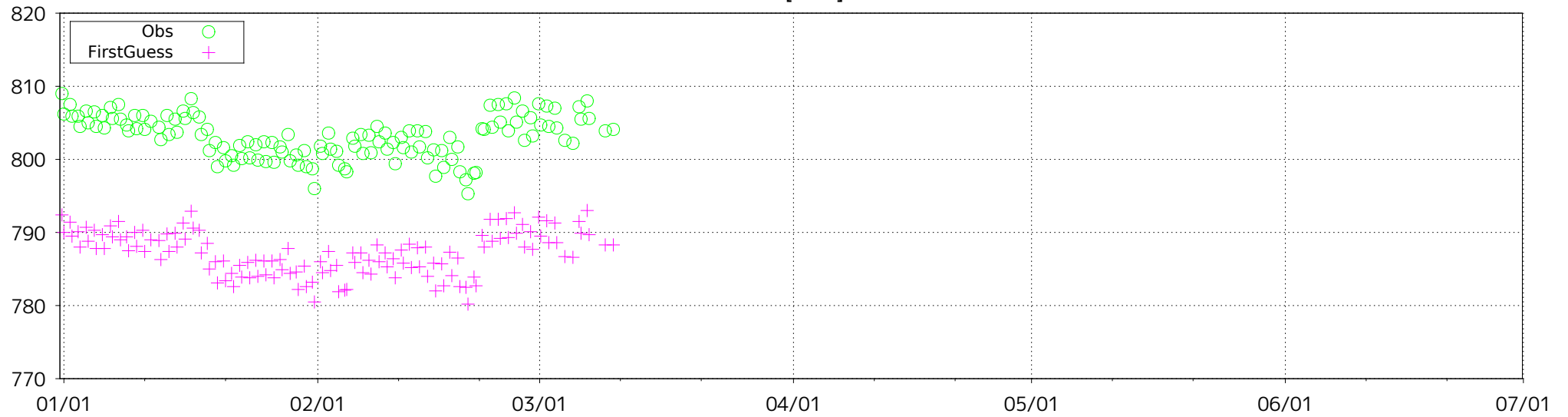


Figure 66 Time-series representation of MSLP Obs minus FirstGuess for station 40587

ID: 42295 (lat: 27.1N, lon: 88.3E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

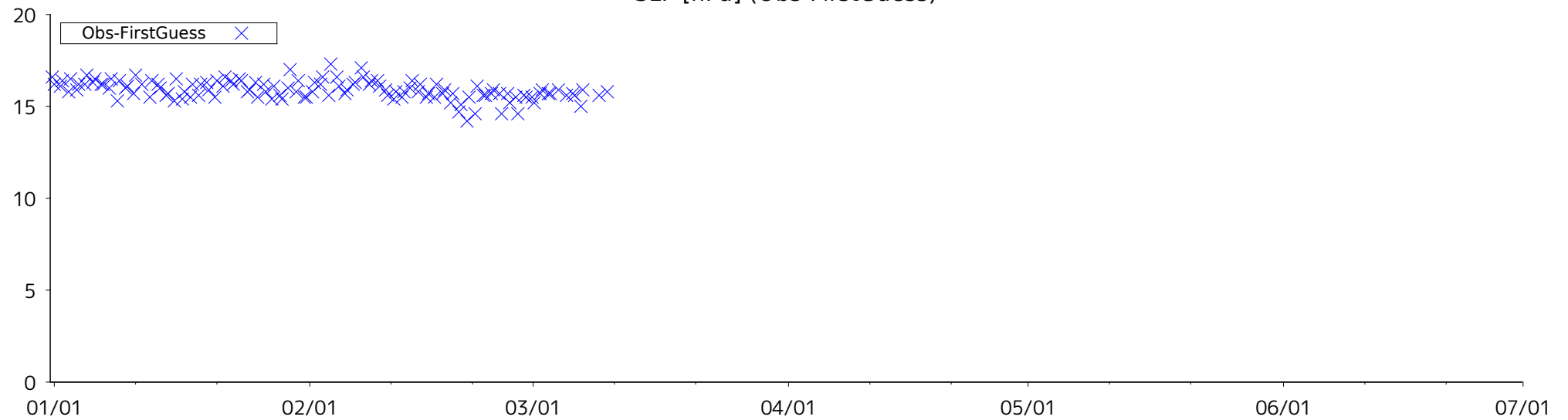
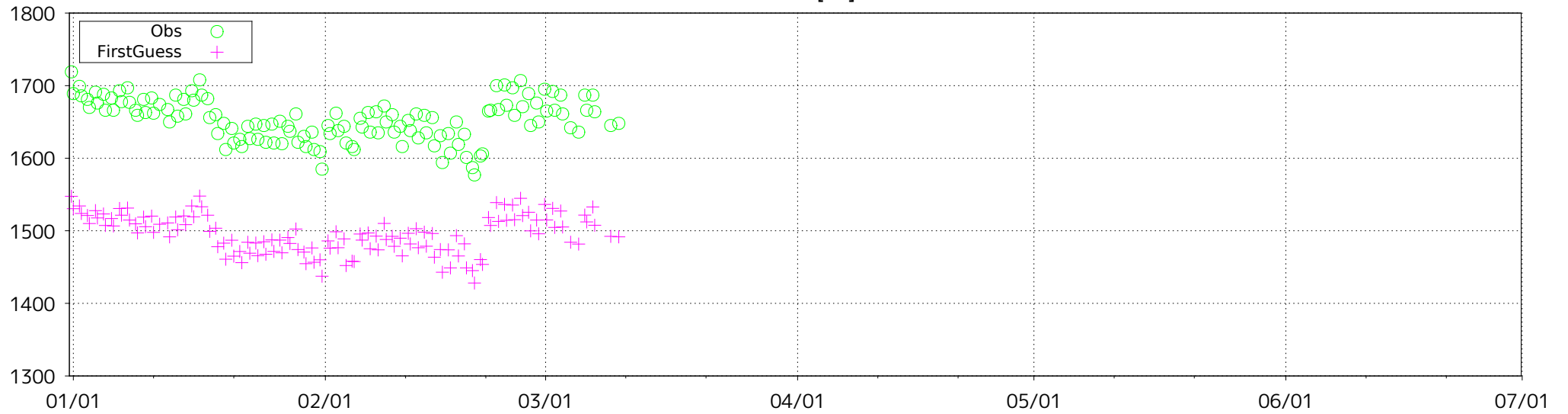


Figure 67(a) Time-series representation of SLP Obs minus FirstGuess for station 42295

ID: 42295 (lat: 27.1N, lon: 88.3E)

GZ850 [m]



GZ850 [m] (Obs-FirstGuess)

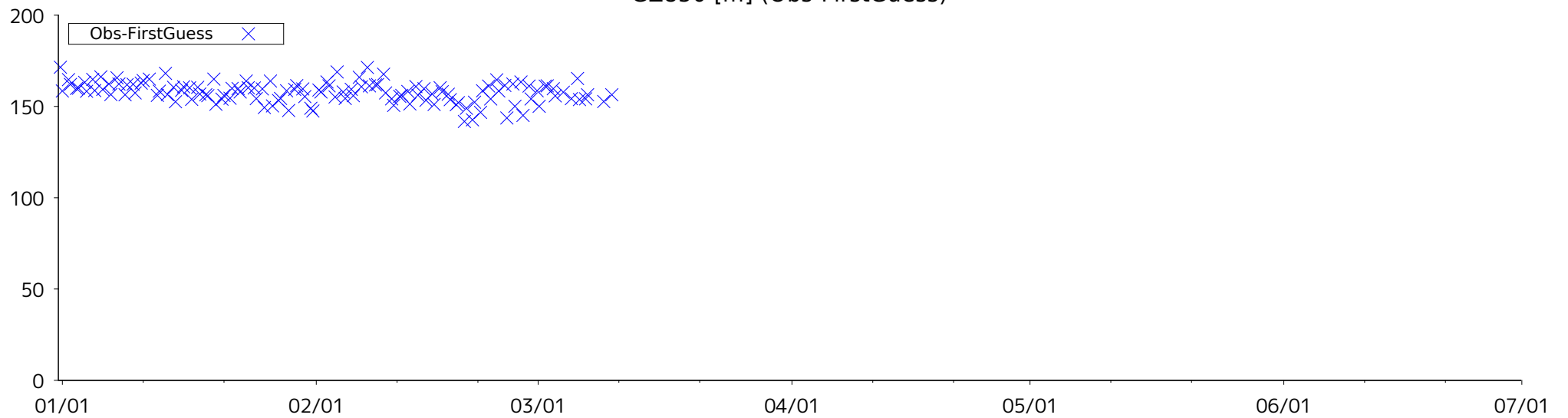
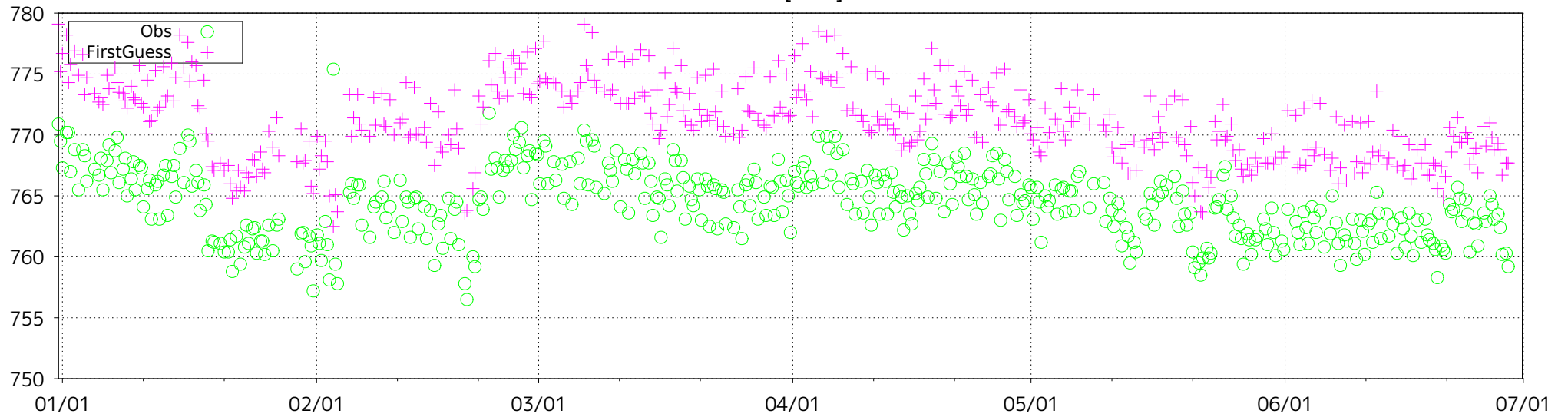


Figure 67(b) Time-series representation of GZ850 Obs minus FirstGuess for station 42295

ID: 44424 (lat: 29.3N, lon: 82.2E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

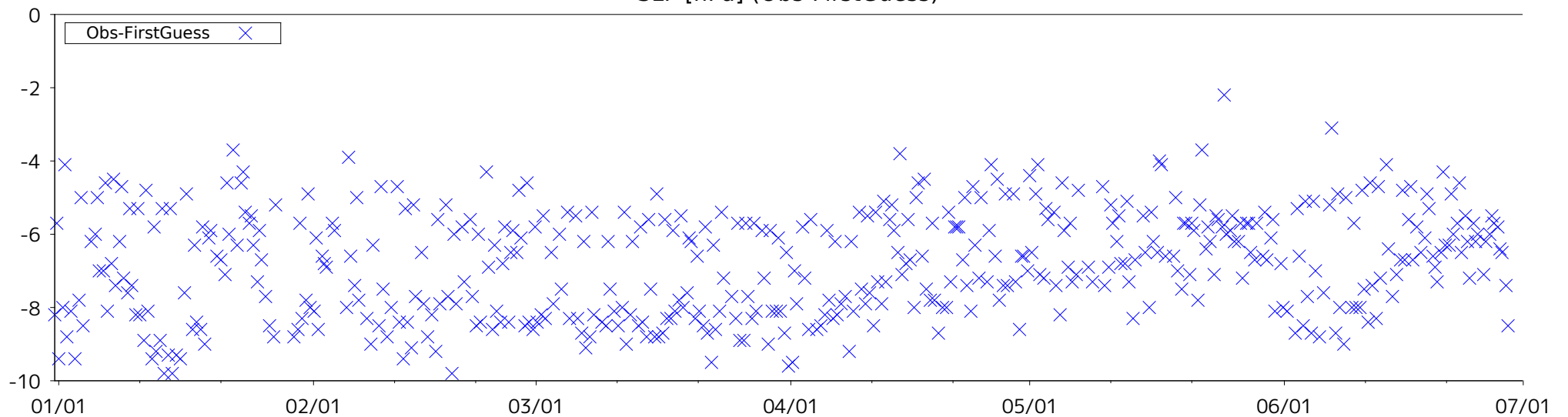
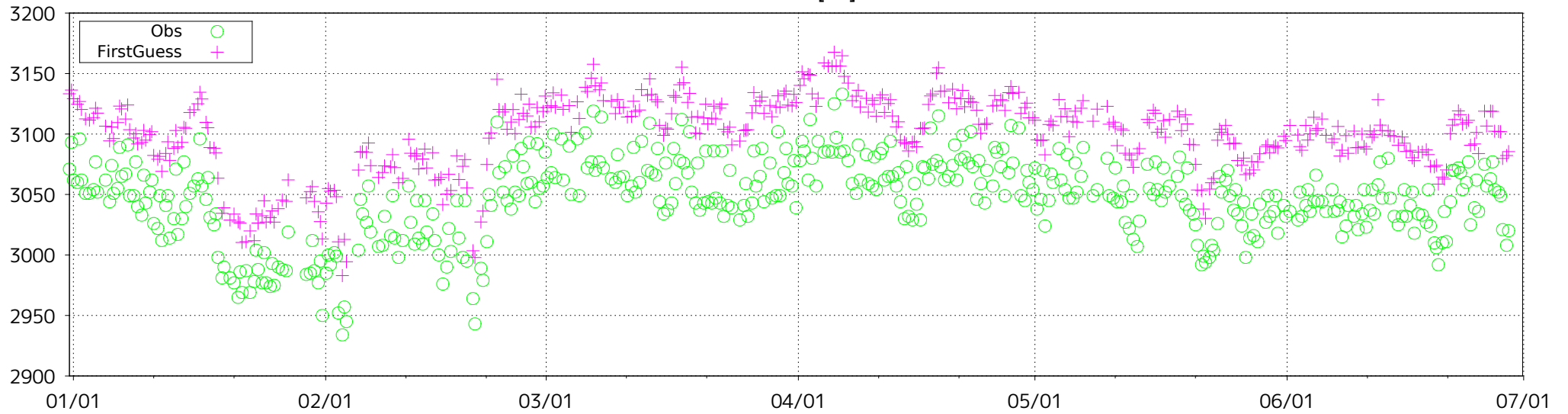


Figure 68(a) Time-series representation of SLP Obs minus FirstGuess for station 44424

ID: 44424 (lat: 29.3N, lon: 82.2E)

GZ700 [m]



GZ700 [m] (Obs-FirstGuess)

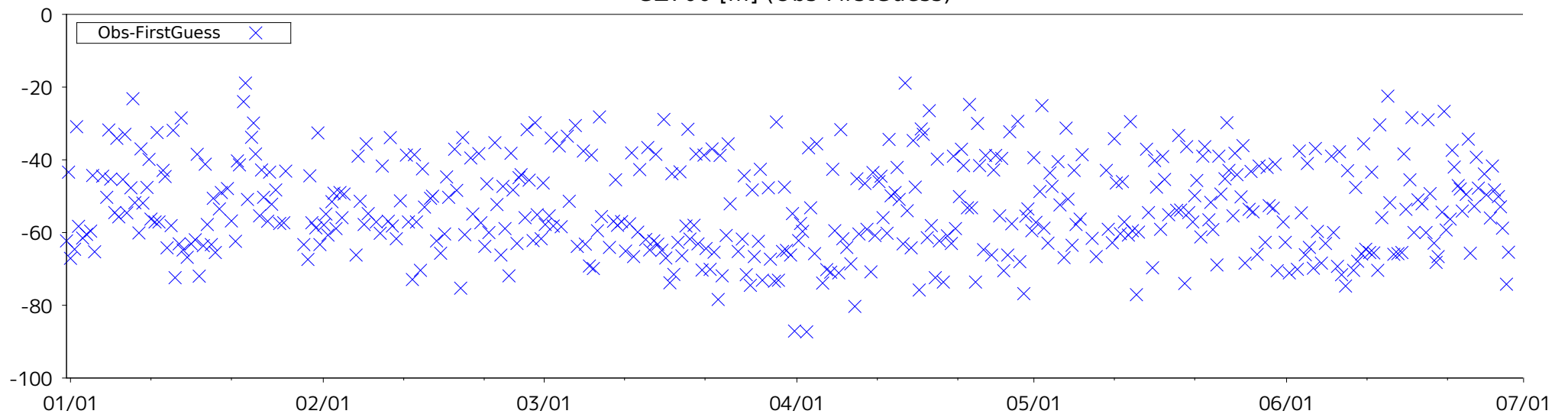


Figure 68(b) Time-series representation of GZ700 Obs minus FirstGuess for station 44424