

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

July – December 2019

No. 58

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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. 58)
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Summary

In its role as a Lead Center, RSMC Tokyo has issued the 58th report on the land surface observation quality monitoring for the period from July to December 2019. The report includes a consolidated list of stations suspected of producing low-quality observation data.

As a result of monitoring, five stations (52866, 54027, 38947, 41263, 41265) were excluded from the consolidated lists of the previous report (January – June 2019), and ten stations (40633, 40700, 40835, 40954, 41573, 42083, 42147, 42295, 42299, 47037) were newly added to the lists.

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	1733
MSLP	1900
GZ	86

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.

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

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 184 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 184 or the difference between H and HM 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.

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 July to December 2019

WMO IDENT	LAT (N)	LON (E)	H (m)	HM (m)	ELEM	NOBS	PGE (%)	SD	BIAS	RMS
36090	51.1	93.7	1043	1382	SLP	694	0	1.3	5.1	5.3
					GZ850	692	0	9.3	0.4	9.3
38262	43.0	59.8	93	59	SLP	732	0	1.0	4.0	4.1
					MSLP	732	0	1.0	0.9	1.3
38719	39.1	68.9	3373	3151	SLP	361	1	2.7	3.8	4.7
					GZ700	726	5	23.4	37.1	43.9
38880	38.0	58.4	312	319	SLP	732	1	0.9	12.0	12.0
					MSLP	732	0	0.8	0.3	0.9
38944	37.5	69.4	447	593	SLP	731	0	1.3	-5.6	5.7
					MSLP	730	0	1.6	-6.0	6.2
40713	37.4	46.2	1478	1535	SLP	729	1	0.9	12.9	12.9
					MSLP	729	0	2.1	-2.1	3.0
40741	36.5	61.2	235	289	SLP	727	0	1.0	-4.2	4.3
					MSLP	726	0	1.0	0.7	1.2
40854	29.1	58.4	940	1157	SLP	725	2	0.6	-13.7	13.7
					MSLP	725	0	1.9	-1.8	2.6
40877	28.0	57.7	470	682	SLP	725	0	0.7	-3.6	3.7
					MSLP	725	0	1.2	-4.0	4.2
40942	33.5	65.3	2183	2453	SLP	305	0	1.3	-5.7	5.8
					MSLP	305	0	3.6	-0.7	3.7
40945	34.8	67.8	2550	3232	SLP	331	1	3.7	-4.7	6.0
					MSLP	329	1	7.4	-1.4	7.5
42111	30.3	78.0	683	878	SLP	730	0	0.8	6.3	6.4
					MSLP	731	0	1.3	-1.0	1.6
43226	14.3	74.5	60	50	SLP	694	0	0.5	4.3	4.3
					MSLP	695	0	0.7	0.4	0.8
43418	8.6	81.3	79	8	SLP	625	0	0.5	4.5	4.5
					MSLP	625	0	0.5	-0.3	0.6
43479	7.0	81.1	670	862	SLP	428	1	0.5	-9.5	9.5
					-	-	-	-	-	-
44406	29.3	81.0	617	1547	SLP	421	2	1.8	4.8	5.1
					MSLP	418	0	2.2	-1.9	2.9
44424	29.3	82.2	2300	3274	SLP	411	1	1.3	-5.9	6.0
					GZ700	406	0	14.3	-49.7	51.7
44429	28.1	82.5	634	883	SLP	427	0	0.7	-3.7	3.8
					MSLP	426	0	1.2	0.7	1.4
47102	38.0	124.7	146	2	SLP	732	0	0.7	11.8	11.8
					MSLP	732	0	0.5	-1.2	1.3

WMO IDENT	LAT (N)	LON (E)	H (m)	HM (m)	ELEM	NOBS	PGE (%)	SD	BIAS	RMS
47145	36.8	127.3	26	110	SLP	728	0	0.5	-6.3	6.3
					MSLP	728	0	0.6	0.3	0.7
47152	35.6	129.3	36	125	SLP	732	0	0.6	-5.4	5.4
					MSLP	732	0	0.6	0.1	0.6
48921	21.6	101.9	1360	1072	SLP	454	3	1.3	-4.1	4.3
					GZ850	445	100	*****	*****	*****
48935	19.5	103.1	1094	1196	SLP	461	3	0.9	-0.5	1.0
					GZ850	459	27	5.8	-91.7	91.9
48952	15.7	106.4	180	334	SLP	457	1	0.9	3.9	4.0
					MSLP	457	0	1.3	2.6	2.9
50756	47.5	126.9	248	206	SLP	732	0	0.6	3.3	3.4
					MSLP	728	0	0.6	0.1	0.6

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)

RUSSIAN FEDERATION IN ASIA

36090 - Positive bias of O-G at the station level (Figures 2 and 3)

UZBEKISTAN

38262 - Positive bias of O-G at the station level (Figures 4 and 5)

TAJIKISTAN

38719 - Positive bias of O-G at the station level and at 700 hPa (Figures 6 and 7)

38944 - Negative bias of O-G at the station level and at the mean sea level (Figures 6 and 8)

TURKMENISTAN

38880 - Positive bias of O-G at the station level (Figures 4 and 9)

IRAN, ISLAMIC REPUBLIC OF

40713 - Positive bias of O-G at the station level (Figures 10 and 11)

40741 - Negative bias of O-G at the station level (Figures 4 and 12)

40854 - Negative bias of O-G at the station level (Figures 13 and 14)

40877 - Negative bias of O-G at the station level and at the mean sea level (Figures 13 and 15)

AFGHANISTAN

40942 - Negative bias of O-G at the station level (Figures 6 and 16)

40945 - Negative bias of O-G at the station level (Figures 6 and 17)

INDIA

42111 - Positive bias of O-G at the station level (Figures 18 and 19)

43226 - Positive bias of O-G at the station level (Figures 20 and 21)

SRI LANKA

43418 - Positive bias of O-G at the station level (Figures 22 and 23)

43479 - Negative bias of O-G at the station level (Figures 22 and 24)

NEPAL

44406 - Positive bias of O-G at the station level (Figures 18 and 25)

44424 - Negative bias of O-G at the station level and at 700 hPa (Figures 18 and 26)

44429 - Negative bias of O-G at the station level (Figures 18 and 27)

REPUBLIC OF KOREA

47102 - Positive bias of O-G at the station level (Figures 28 and 29)

47145 - Negative bias of O-G at the station level (Figures 28 and 30)

47152 - Negative bias of O-G at the station level (Figures 28 and 31)

LAO PEOPLE'S DEMOCRATIC REPUBLIC

48921 - Negative bias of O-G at the station level and at 850 hPa (Figures 32 and 33)

48935 - Negative bias of O-G at 850 hPa (Figure 34)

48952 - Positive bias of O-G at the station level (Figures 35 and 36)

CHINA

50756 - Positive bias of O-G at the station level (Figures 37 and 38)

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
40633	34.6	43.7	107	106	MSLP	466	0	2.1	4.1	4.6
					-	-	-	-	-	-

WMO IDENT	LAT (N)	LON (E)	H (m)	HM (m)	ELEM	NOBS	PGE (%)	SD	BIAS	RMS
40700	39.6	47.9	32	84	SLP	570	0	0.7	-6.0	6.0
					MSLP	570	0	0.7	-0.4	0.8
40835	30.4	50.8	699	995	SLP	729	0	1.8	-4.8	5.1
					MSLP	729	0	2.3	-2.3	3.3
40954	34.4	70.5	580	706	SLP	205	2	1.8	-3.7	4.1
					MSLP	205	0	3.3	-0.1	3.3
41573	33.9	73.4	2127	1335	SLP	697	0	0.9	8.6	8.6
					GZ850	697	0	8.0	-2.4	8.4
42083	31.1	77.2	2202	1570	SLP	209	15	0.4	14.3	14.3
					-	-	-	-	-	-
42147	29.5	79.7	2311	1563	SLP	213	0	0.4	5.0	5.0
					-	-	-	-	-	-
42295	27.1	88.3	2134	1270	SLP	314	89	0.7	14.7	14.7
					GZ850	314	100	*****	*****	*****
42299	27.3	88.6	1756	1989	SLP	315	0	0.8	-4.3	4.4
					GZ850	315	0	9.7	7.8	12.4
47037	40.0	125.3	99	228	SLP	732	0	1.4	-4.0	4.2
					MSLP	732	0	1.4	-4.0	4.2

IRAQ

40633 - Positive bias of O-G at the mean sea level (Figure 39)

The positive bias of O-G at the mean sea level appears to have been observed since July 2019.

IRAN, ISLAMIC REPUBLIC OF

40700 - Negative bias of O-G at the station level (Figures 10 and 40)

40835 - Negative bias of O-G at the station level (Figures 41 and 42)

AFGHANISTAN

40954 - Negative bias of O-G at the station level (Figures 6 and 43)

PAKISTAN

41573 - Positive bias of O-G at the station level (Figures 44 and 45)

INDIA

42083 - Positive bias of O-G at the station level (Figures 44 and 46)

42147 - Positive bias of O-G at the station level (Figures 18 and 47)

42295 - Positive bias of O-G at the station level and at 850 hPa (Figures 48 and 49)

42299 - Negative bias of O-G at the station level (Figures 48 and 50)

DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

47037 - Negative bias of O-G at the station level and at the mean sea level (Figures 28 and 51)

4.3 Stations improved and excluded from the previous consolidated list

CHINA

52866 - Since the station's elevation above sea level was changed from 2296 to 2435 m in December 2019 in JMA's records based on OSCAR/Surface, the negative bias of O-G at the station level has improved. (Figure 52)

54027 - Since the station's elevation above sea level was changed from 485 to 589 m in December 2019 in JMA's records based on OSCAR/Surface, the negative bias of O-G at the station level has improved. (Figure 53)

4.4 Stations removed from the previous consolidated list

TAJIKISTAN

38947 - Although station 38947 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 54)

OMAN

41263 - No reports during the period

41265 - Directorate General of Meteorology, Oman informed us the correct barometer height at this station. Therefore it was removed from the consolidated list.

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.

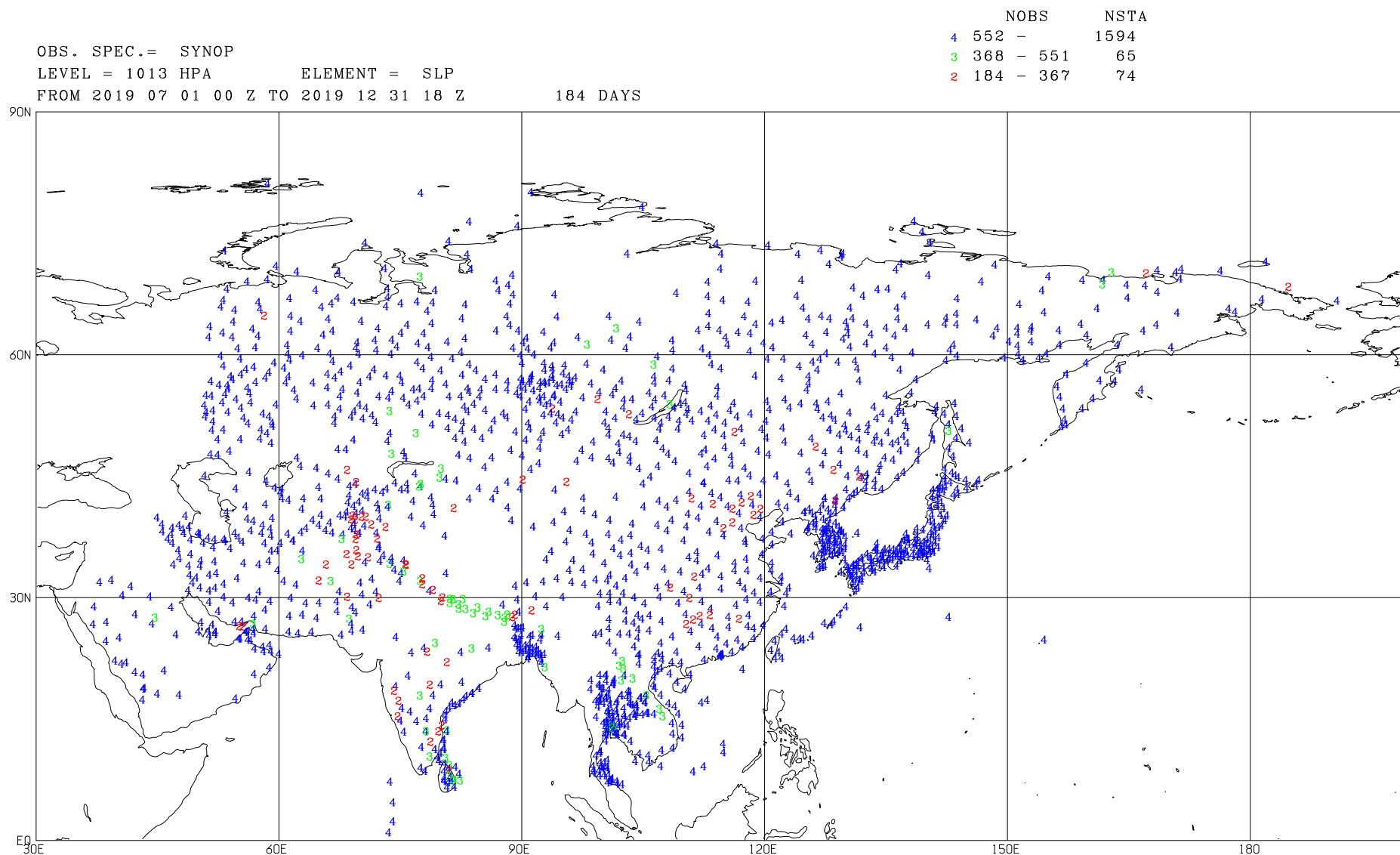


Figure 1(a) Location of all land surface stations reporting station level pressure (SLP) observations in Region II over the six-month period from July to December 2019. Numbers (2, 3, 4) show the total number of observations (NOBS) received at RSMC Tokyo. The total numbers of stations (NSTA) reporting SLP are shown at the top of the figure.

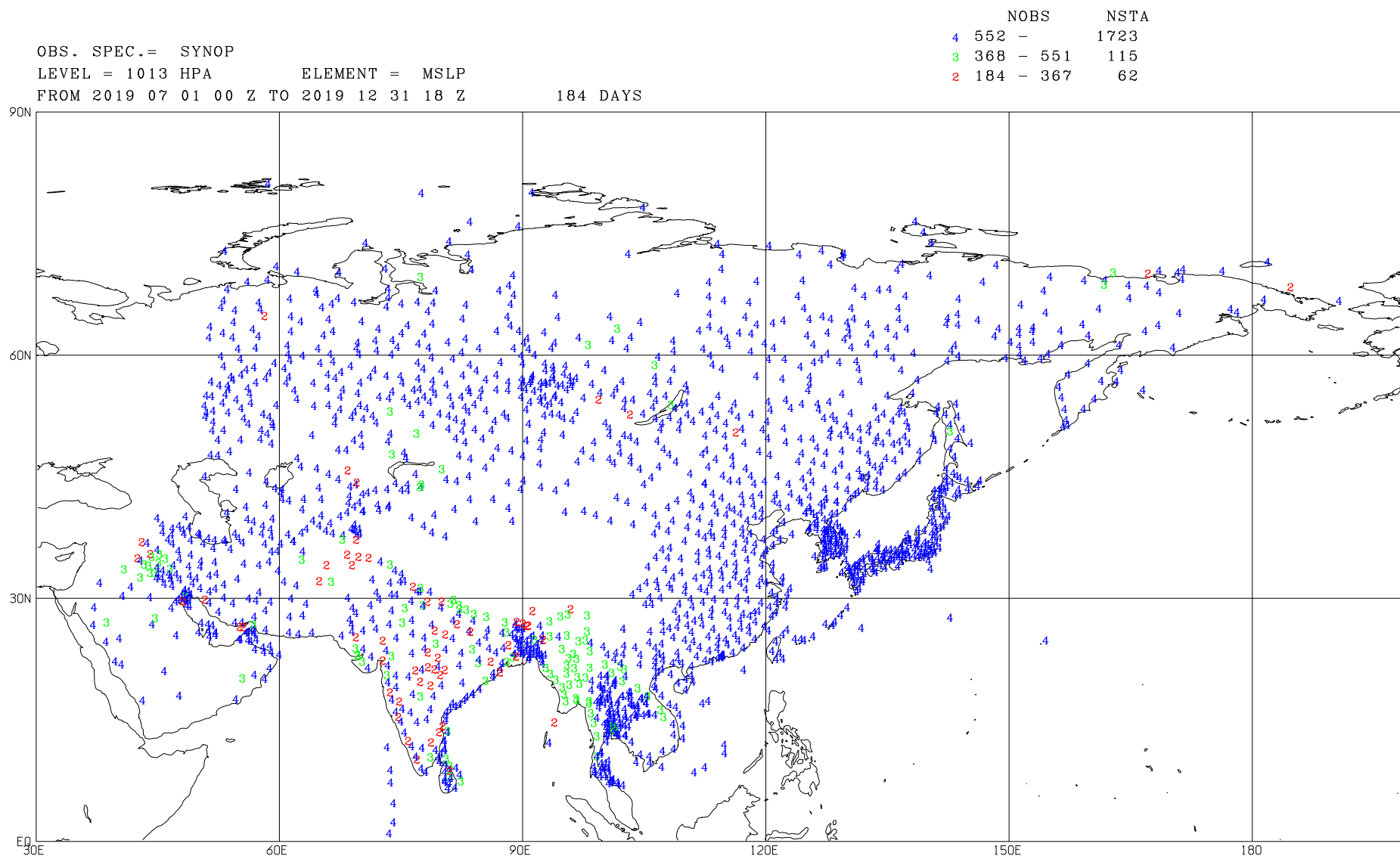


Figure 1(b) Location of all land surface stations reporting mean sea level pressure (MSLP) observations in Region II over the six-month period from July to December 2019. Numbers (2, 3, 4) show the total number of observations (NOBS) received at RSMC Tokyo. The total numbers of stations (NSTA) reporting MSLP are shown at the top of the figure.

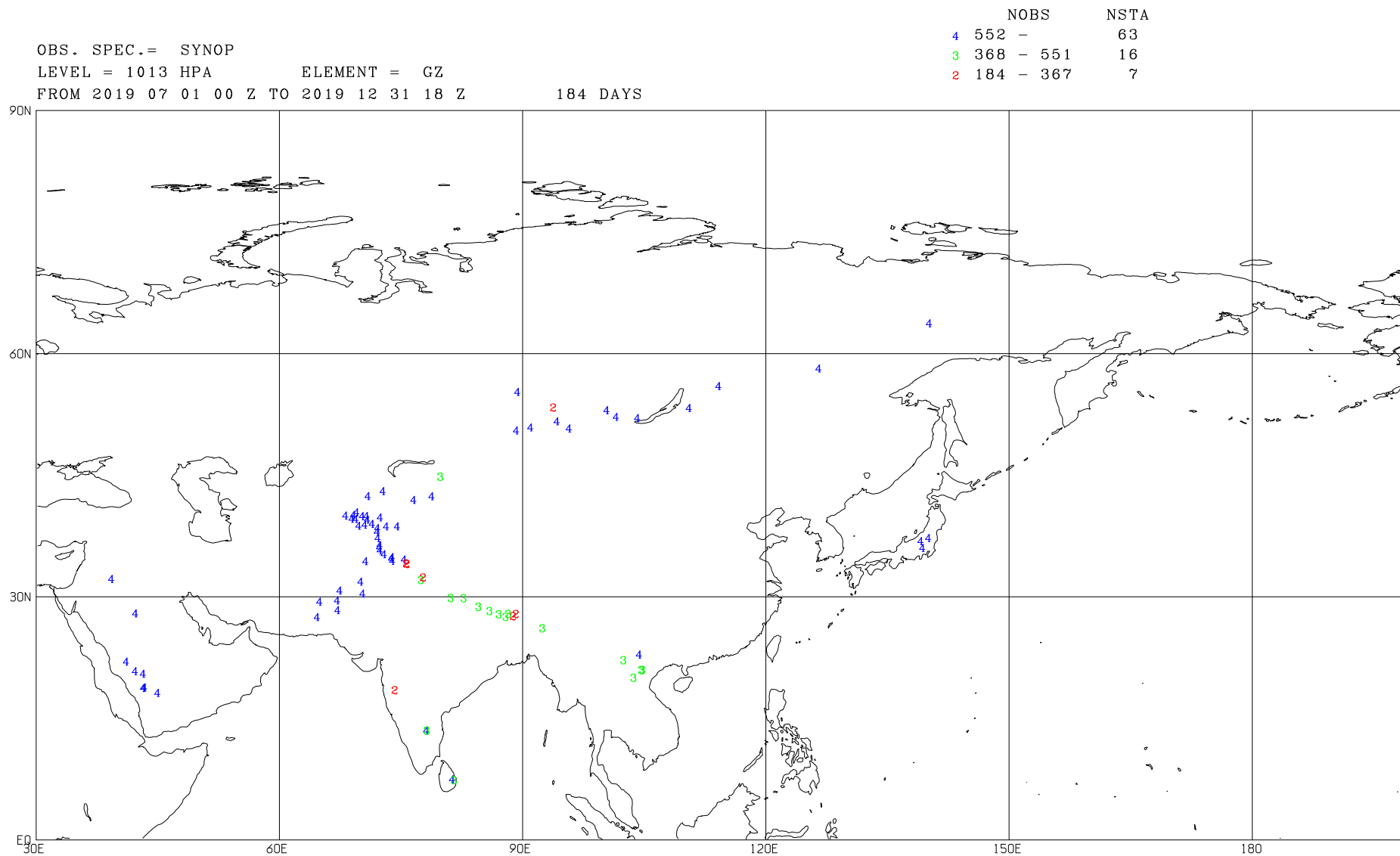


Figure 1(c) Location of all land surface stations reporting geopotential height (GZ) observations in Region II over the six-month period from July to December 2019. Numbers (2, 3, 4) show the total number of observations (NOBS) received at RSMC Tokyo. The total numbers of stations (NSTA) reporting GZ are shown at the top of the figure.

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

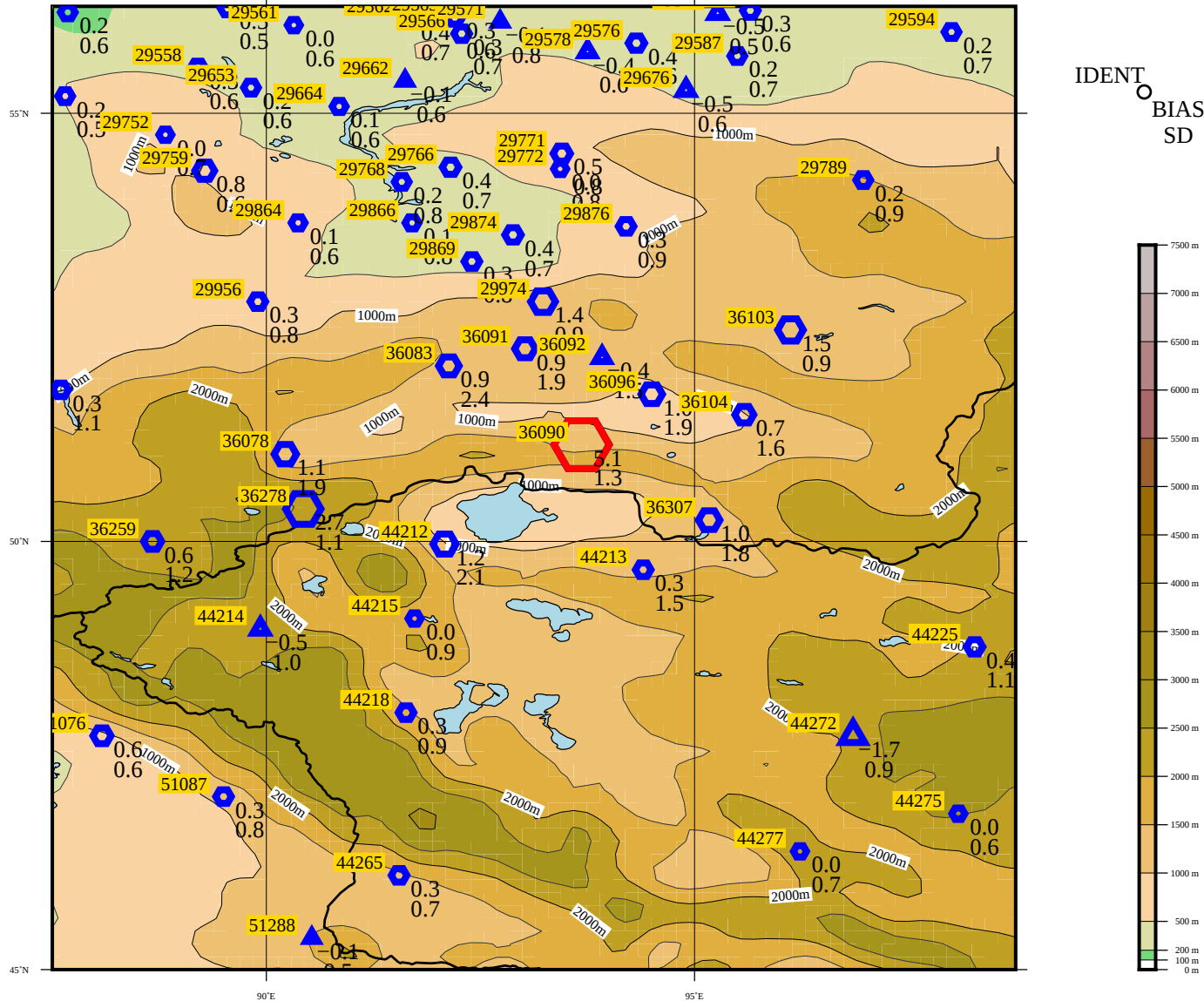


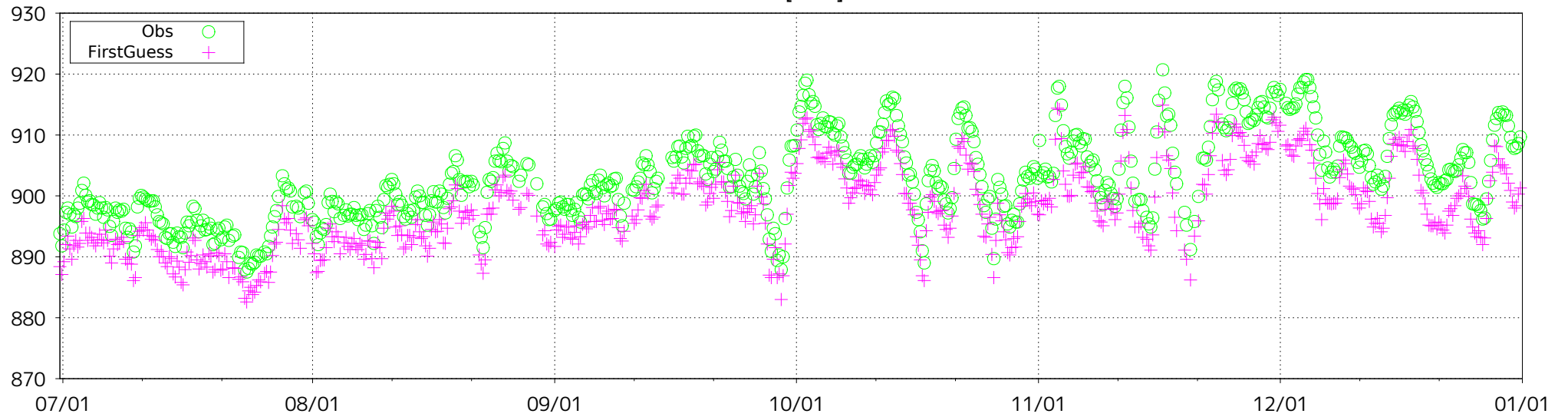
Figure 2 BIAS and SD of SLP for station 36090 (red) and surrounding stations (blue).

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: 36090 (lat: 51.1N, lon: 93.7E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

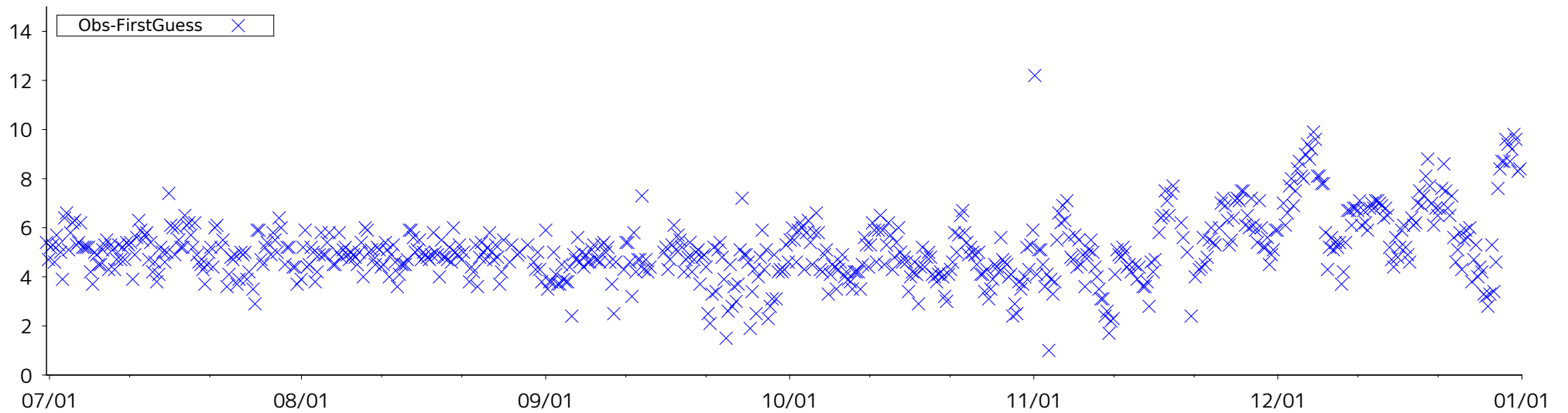


Figure 3 Time-series representation of SLP Obs minus FirstGuess for station 36090

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

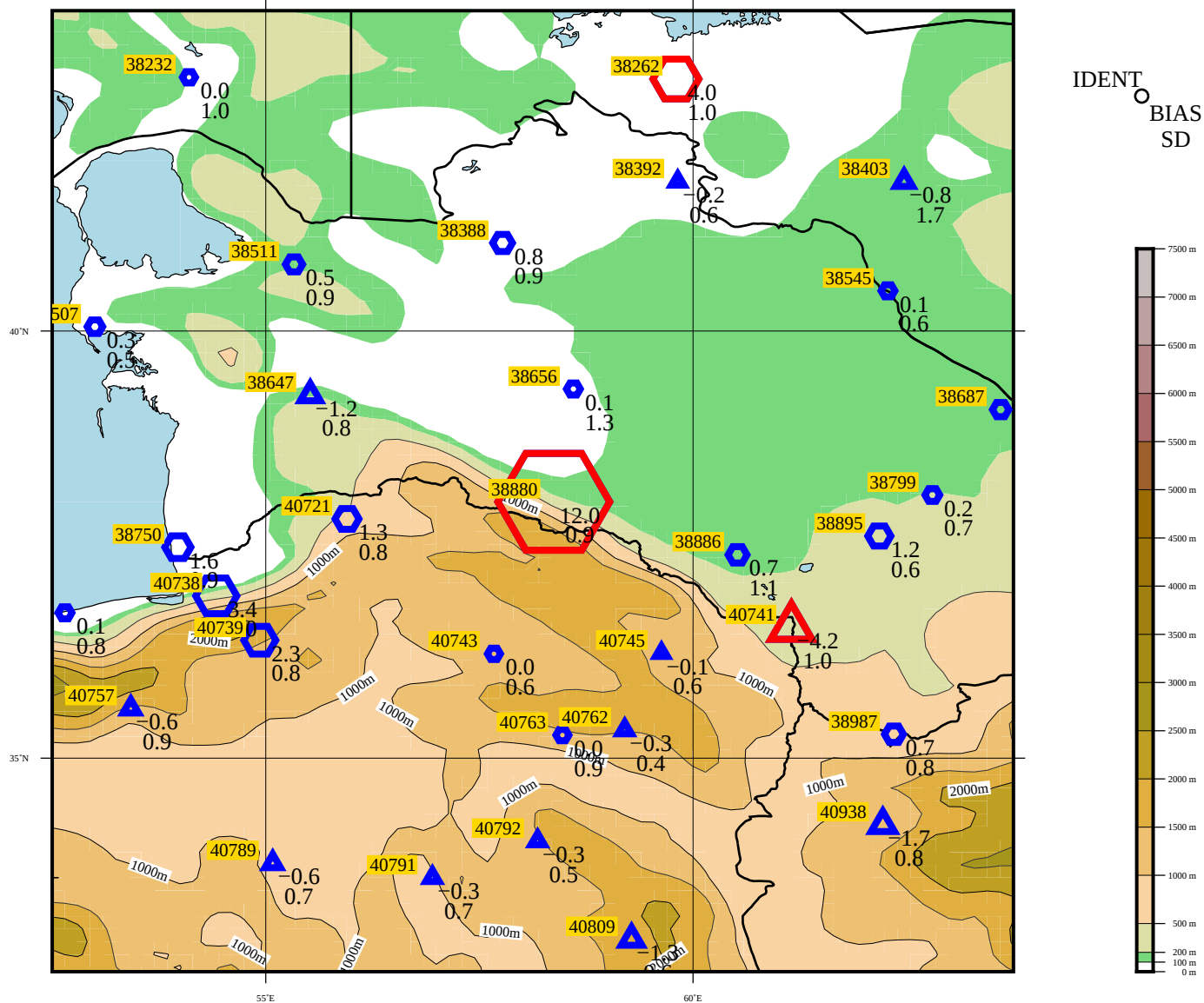


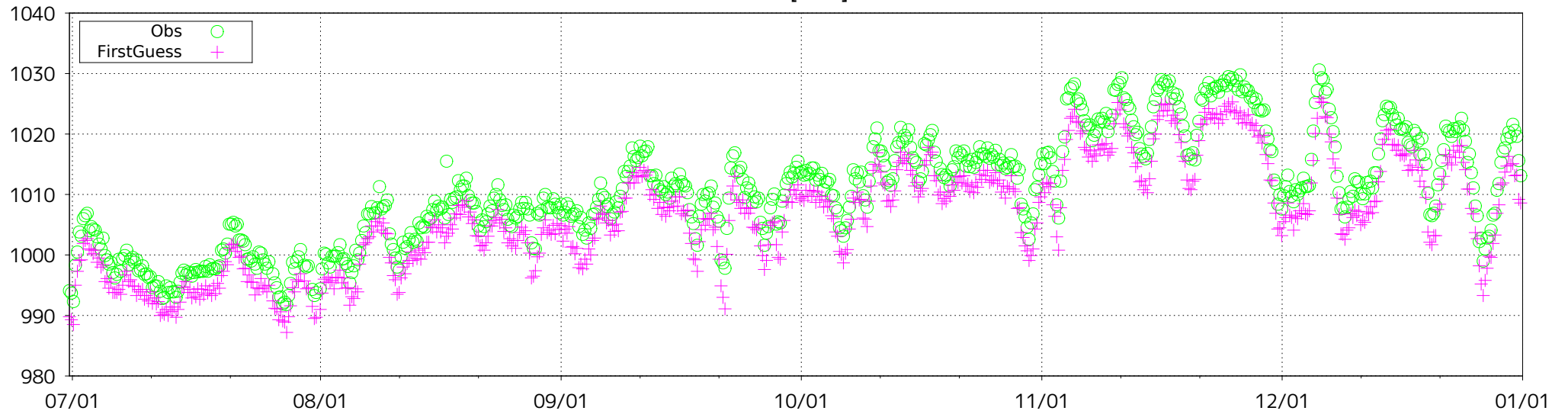
Figure 4 BIAS and SD of SLP for station 38262, 38880, 40741 (red) and surrounding stations (blue).

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)

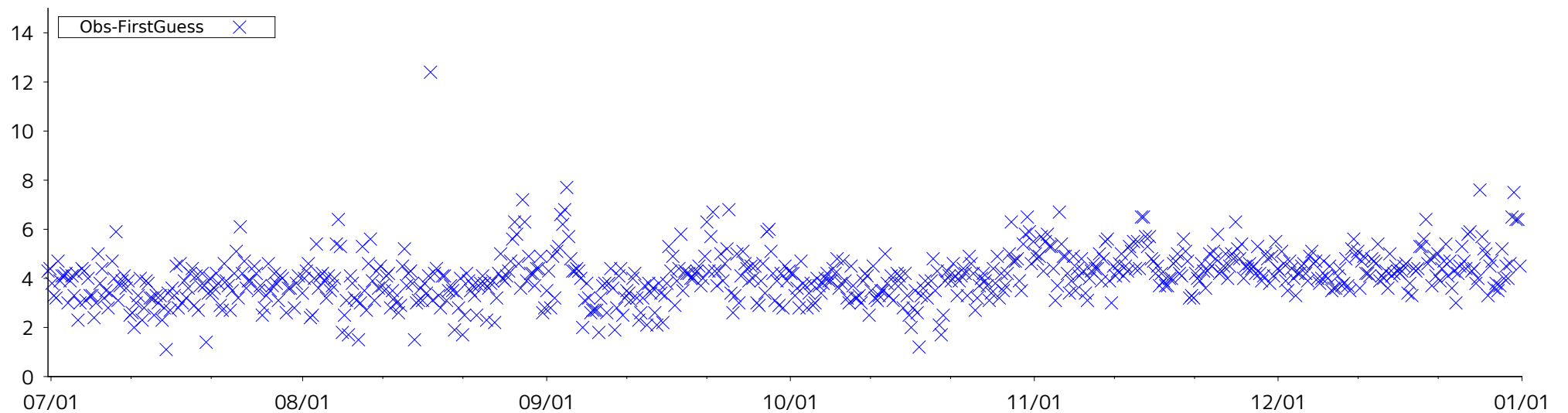


Figure 5 Time-series representation of SLP Obs minus FirstGuess for station 38262

LEVEL = SUR ELEMENT = SLP
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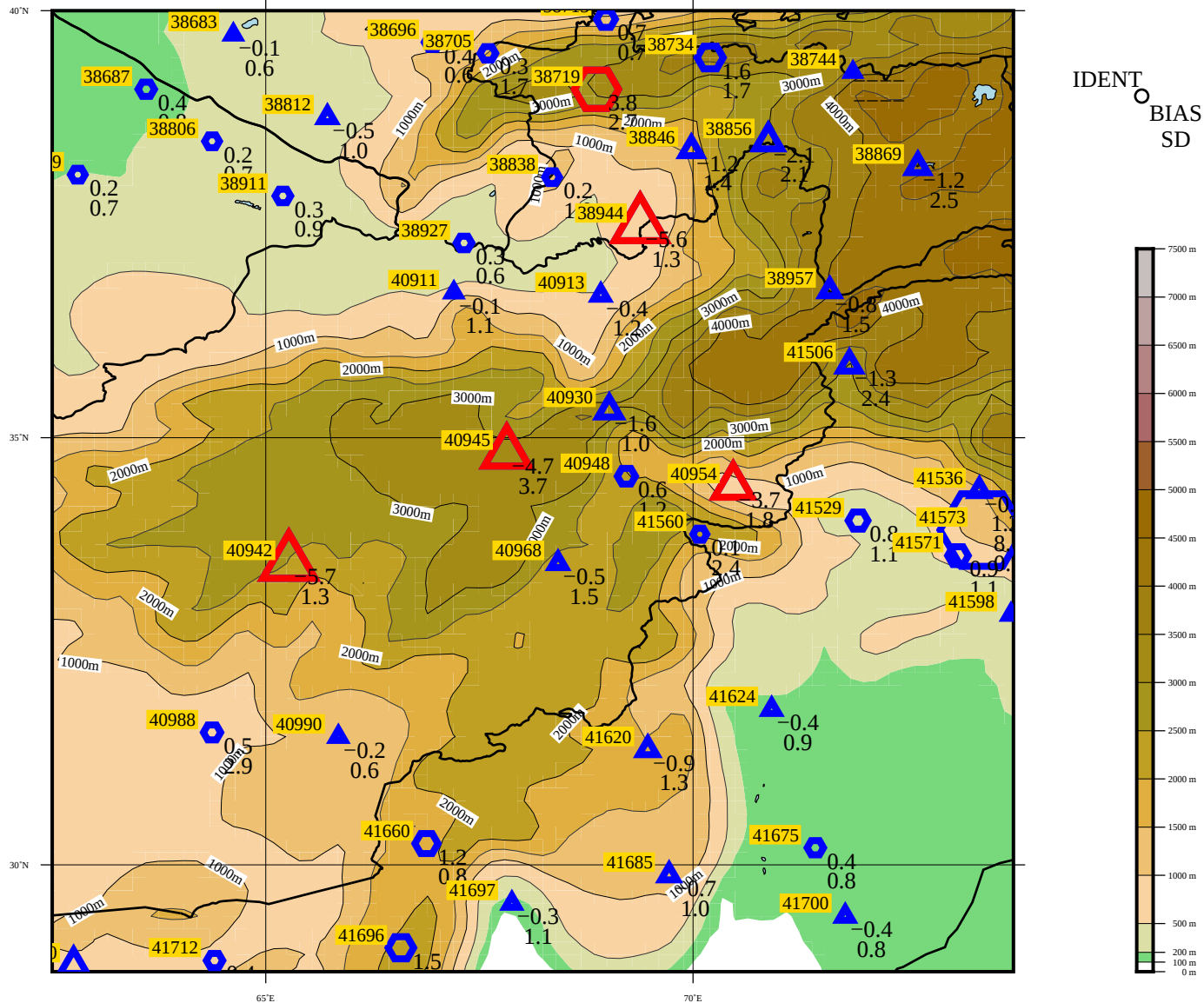
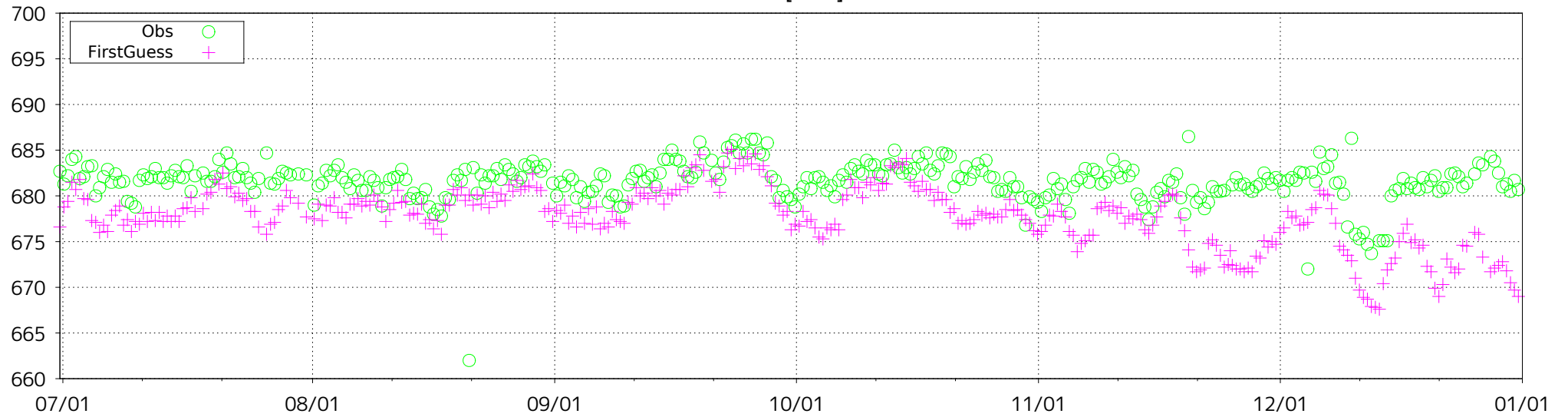


Figure 6 BIAS and SD of SLP for station 38719, 38944, 40942, 40945, 40954 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 38719 (lat: 39.1N, lon: 68.9E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

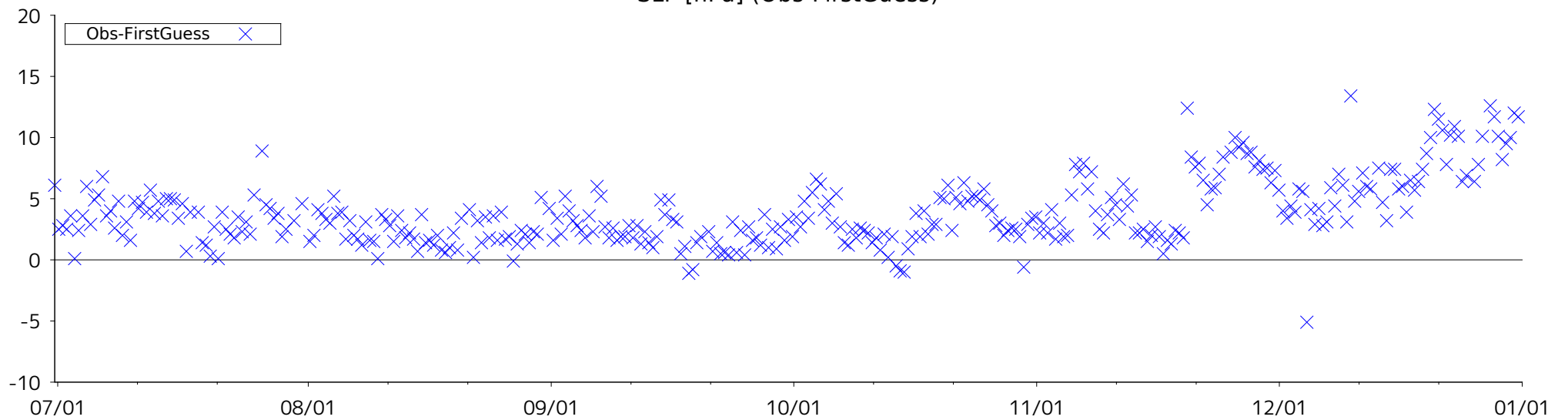
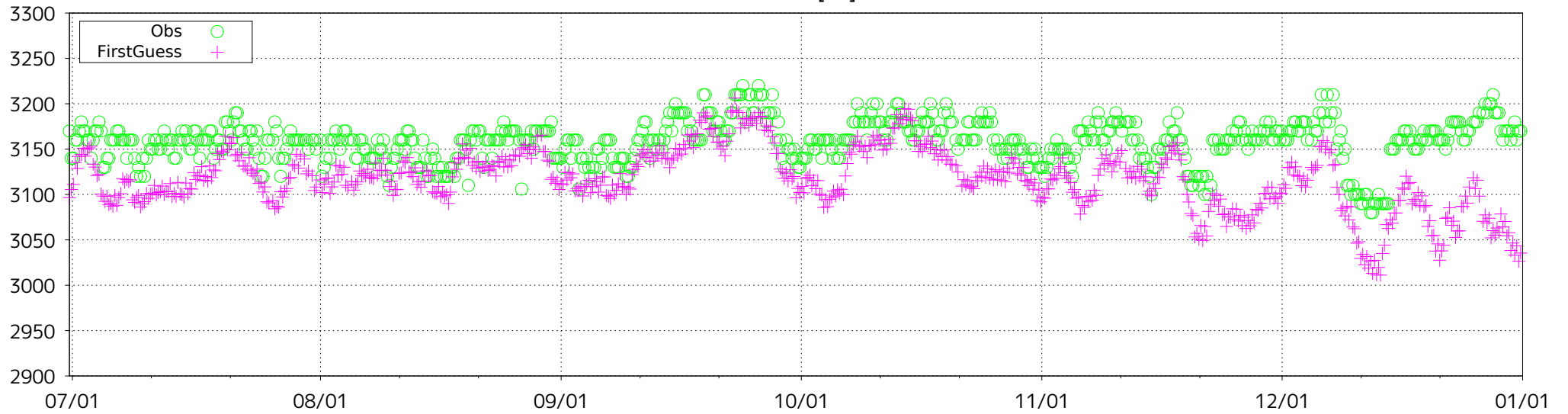


Figure 7(a) Time-series representation of SLP Obs minus FirstGuess for station 38719

ID: 38719 (lat: 39.1N, lon: 68.9E)

GZ700 [m]



GZ700 [m] (Obs-FirstGuess)

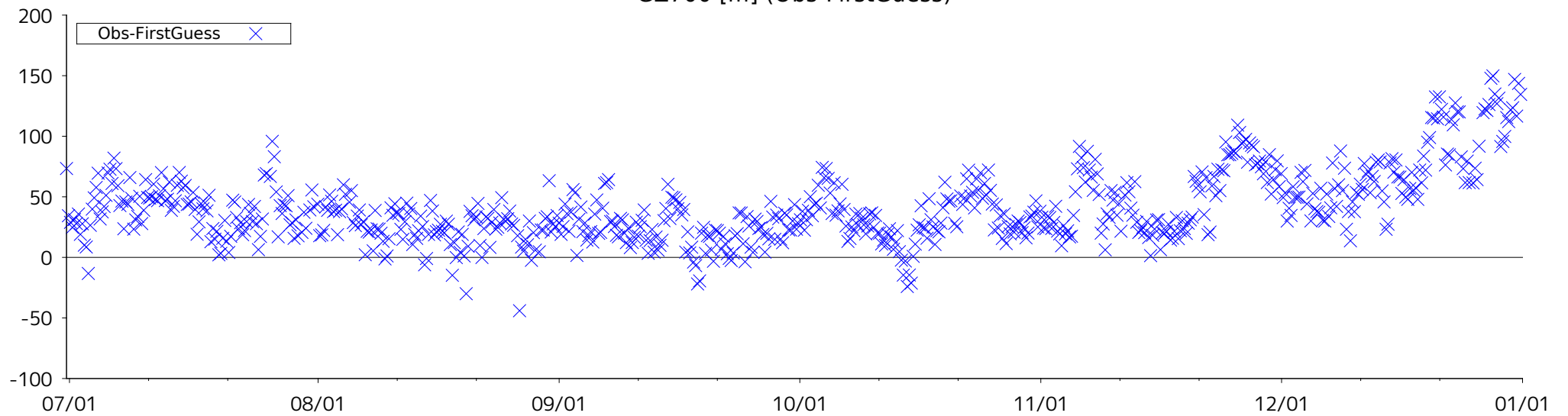
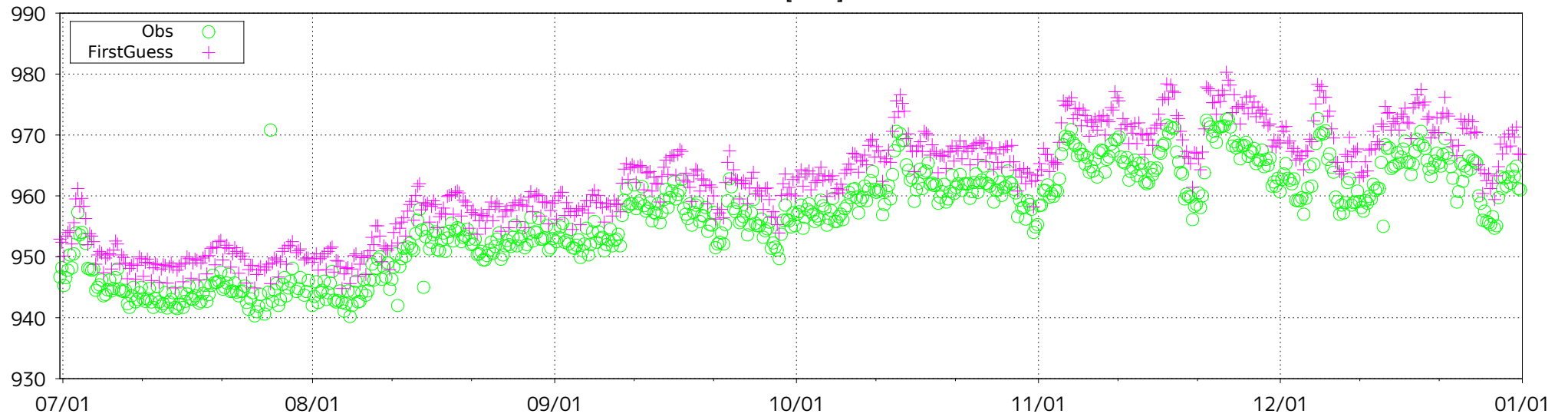


Figure 7(b) Time-series representation of GZ700 Obs minus FirstGuess for station 38719

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

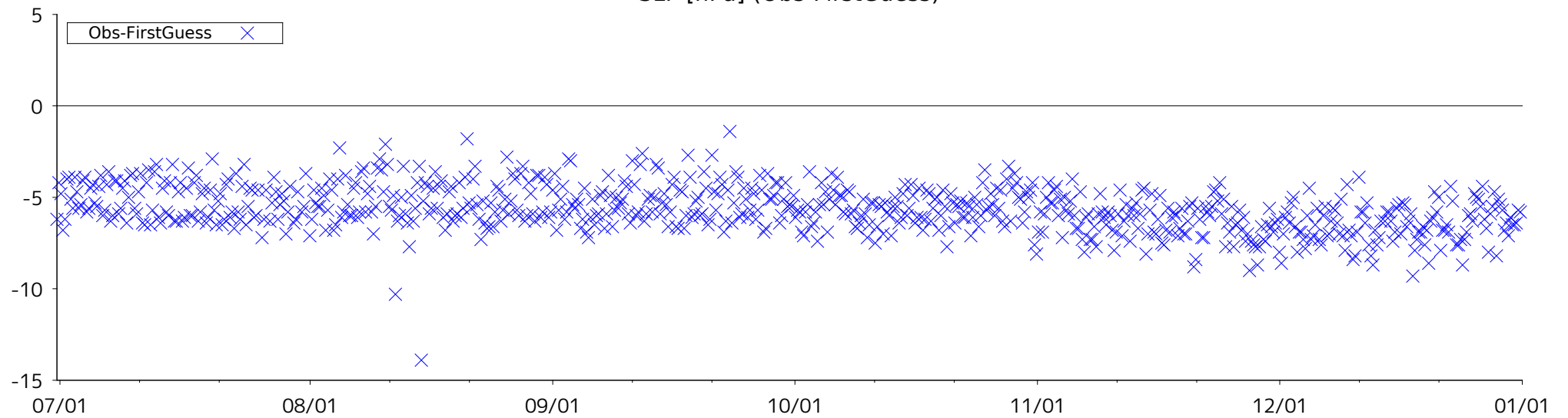
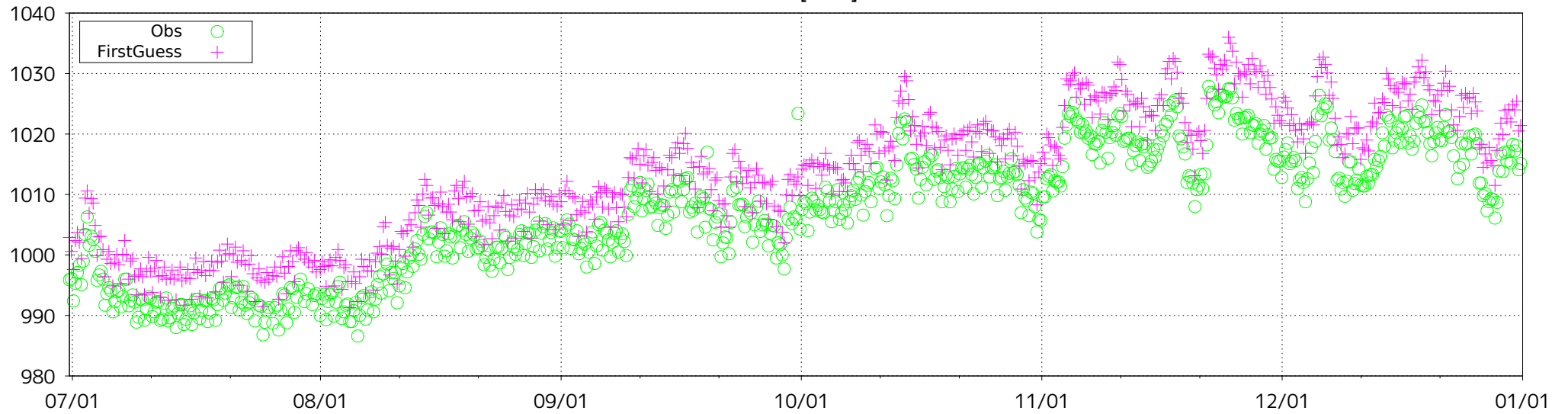


Figure 8(a) Time-series representation of SLP Obs minus FirstGuess for station 38944

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

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

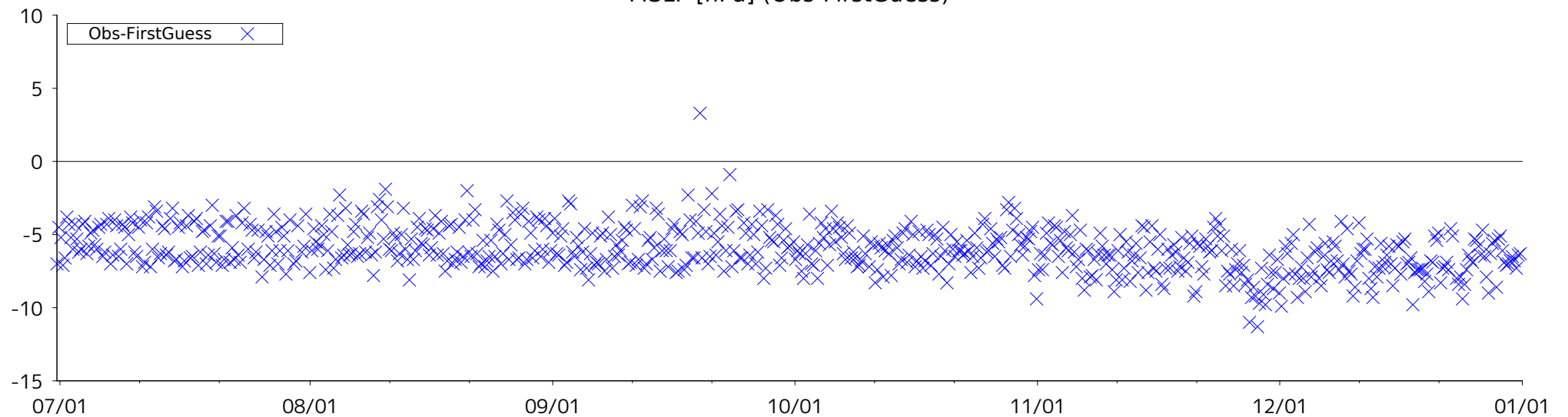
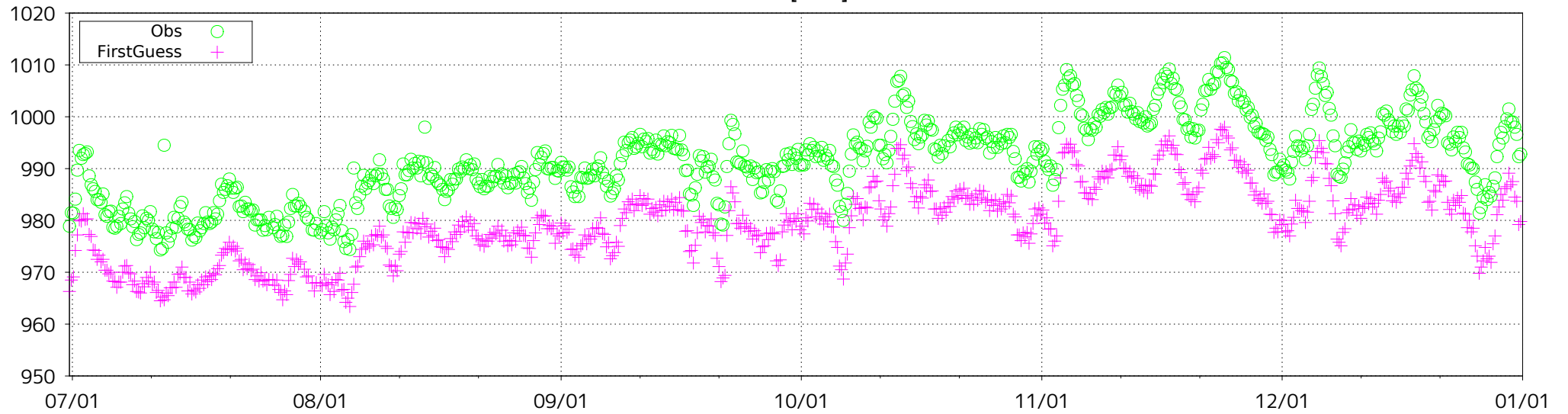


Figure 8(b) Time-series representation of MSLP Obs minus FirstGuess for station 38944

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

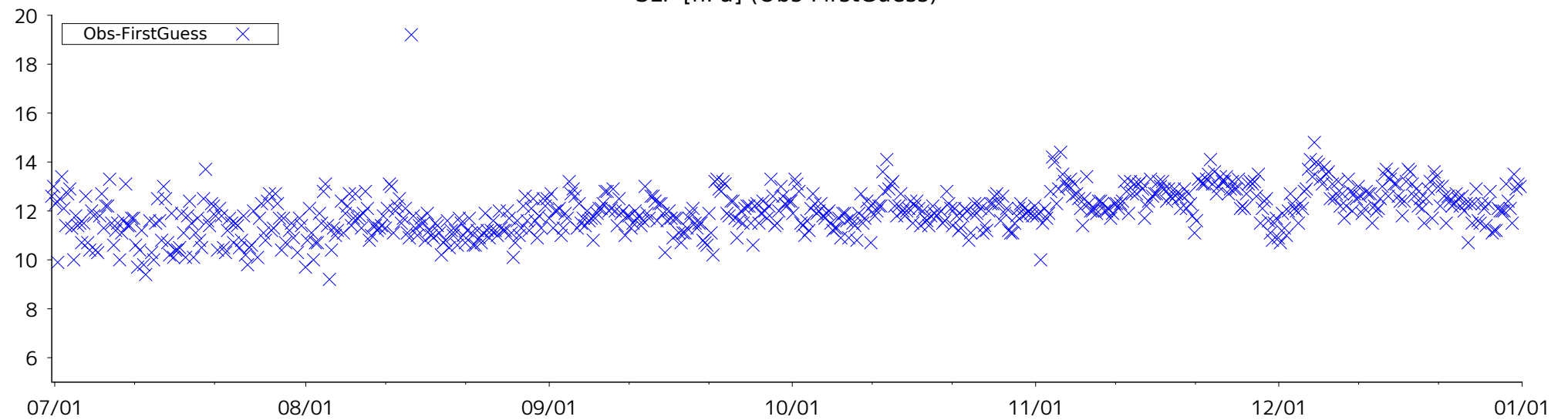


Figure 9 Time-series representation of SLP Obs minus FirstGuess for station 38880

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

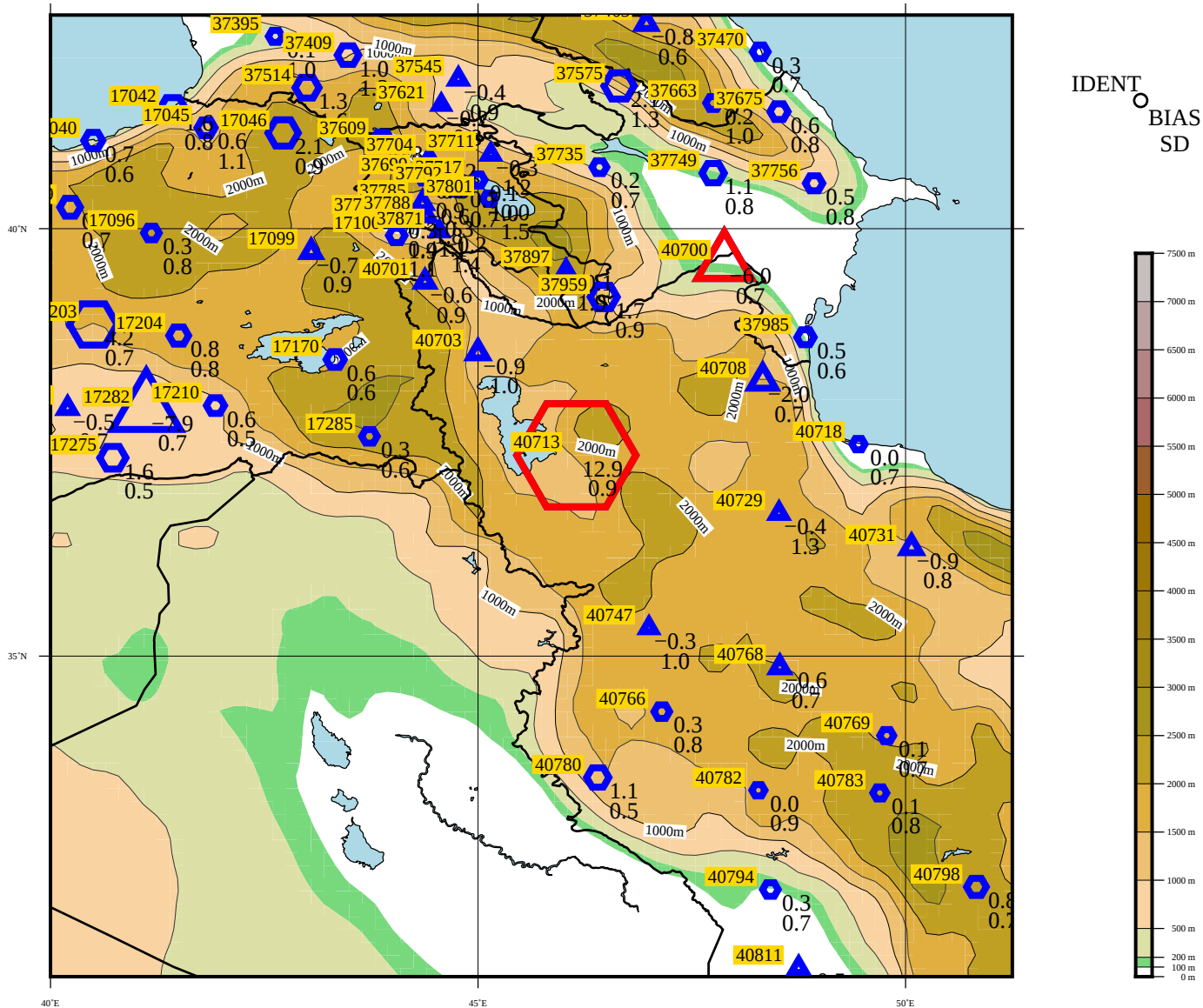
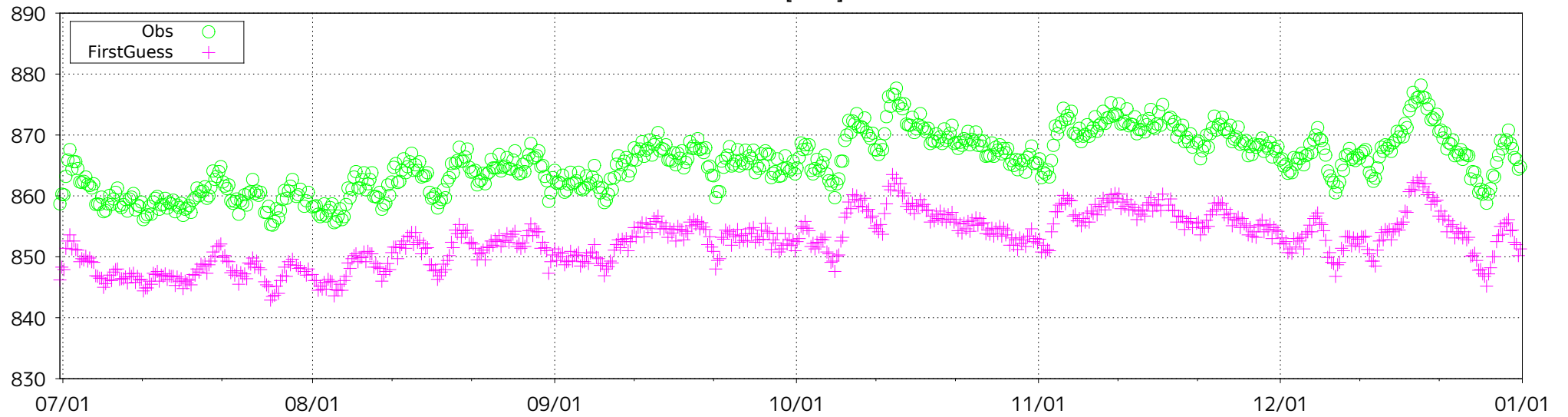


Figure 10 BIAS and SD of SLP for station 40700, 40713 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 40713 (lat: 37.4N, lon: 46.2E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

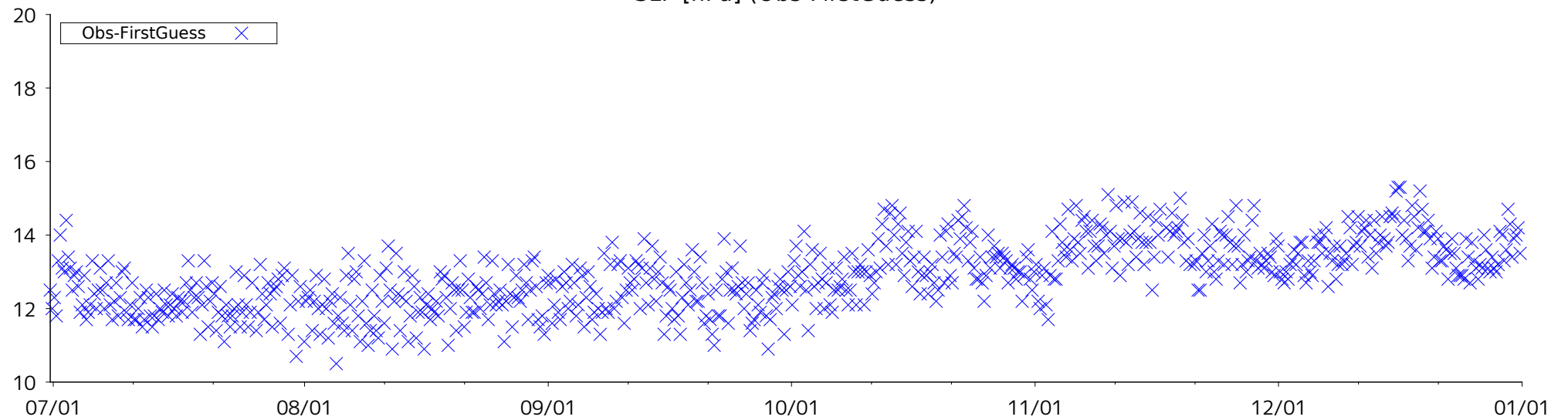
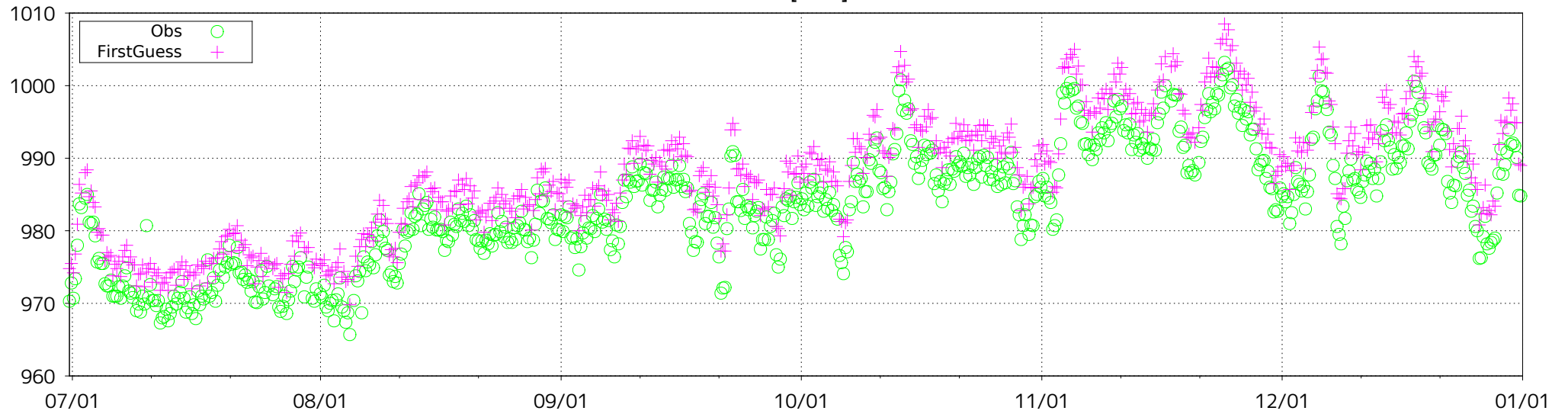


Figure 11 Time-series representation of SLP Obs minus FirstGuess for station 40713

ID: 40741 (lat: 36.5N, lon: 61.2E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

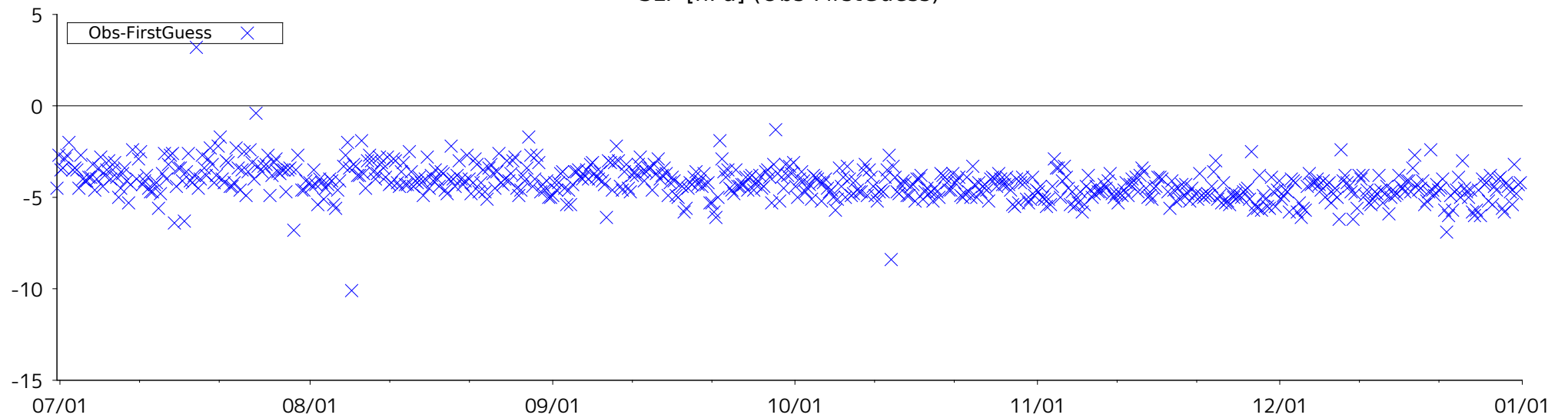
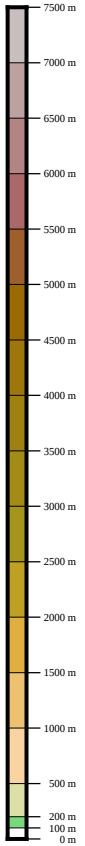


Figure 12 Time-series representation of SLP Obs minus FirstGuess for station 40741

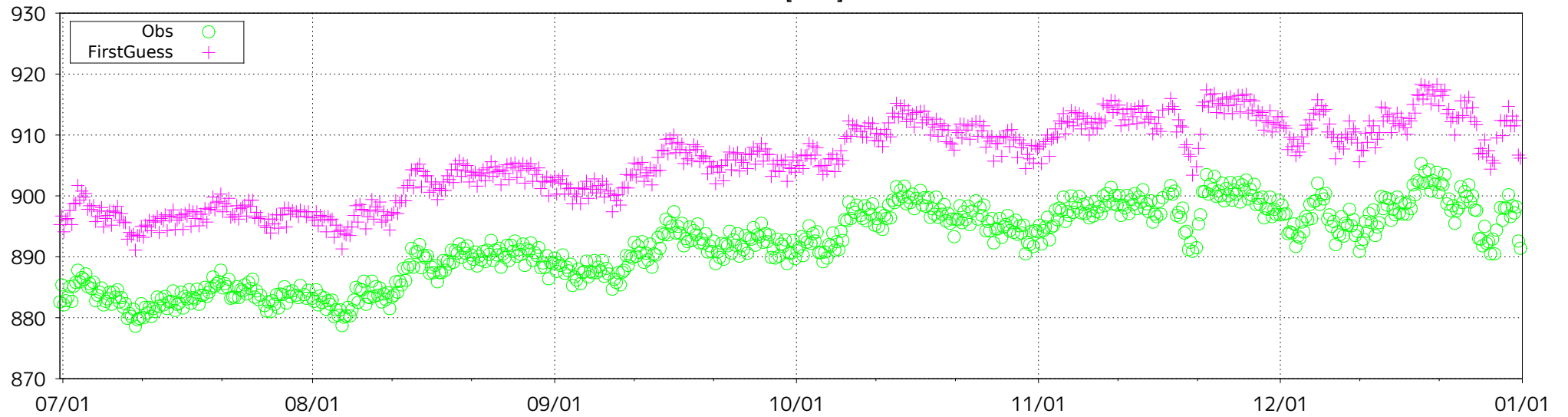
2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)



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: 40854 (lat: 29.1N, lon: 58.4E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

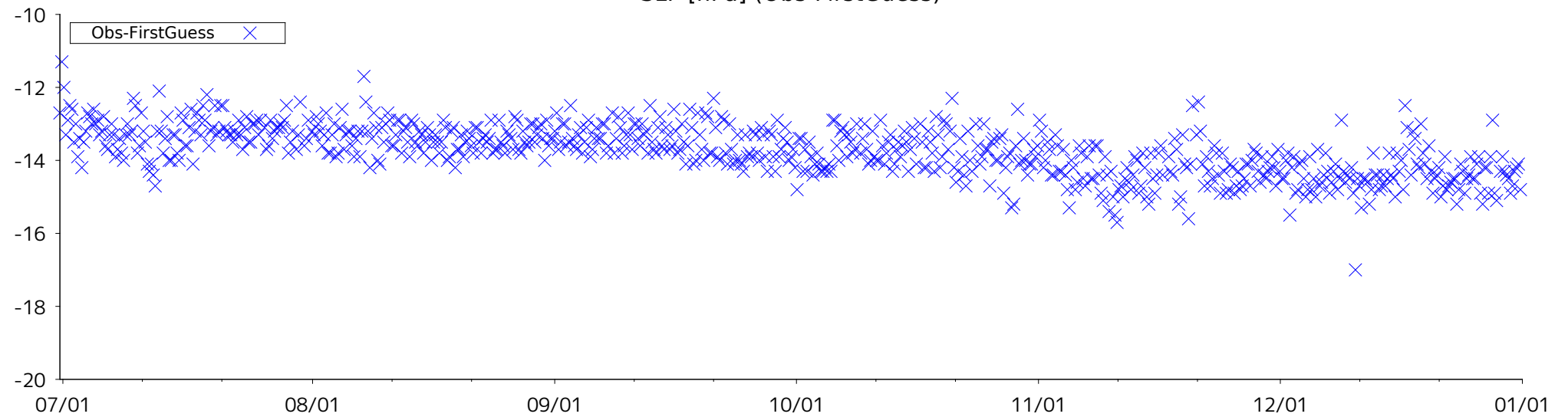
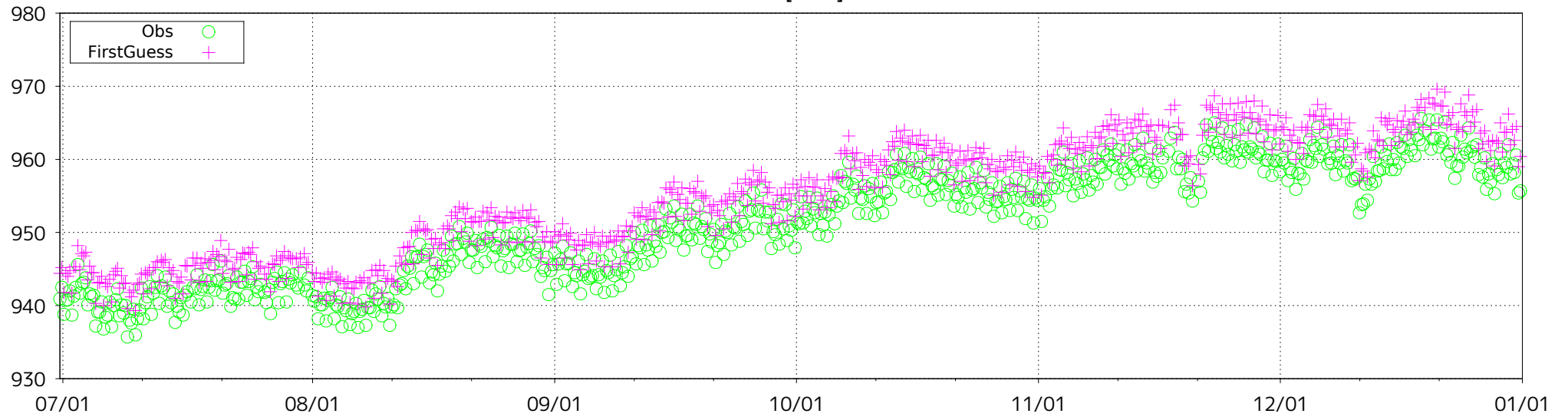


Figure 14 Time-series representation of SLP Obs minus FirstGuess for station 40854

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

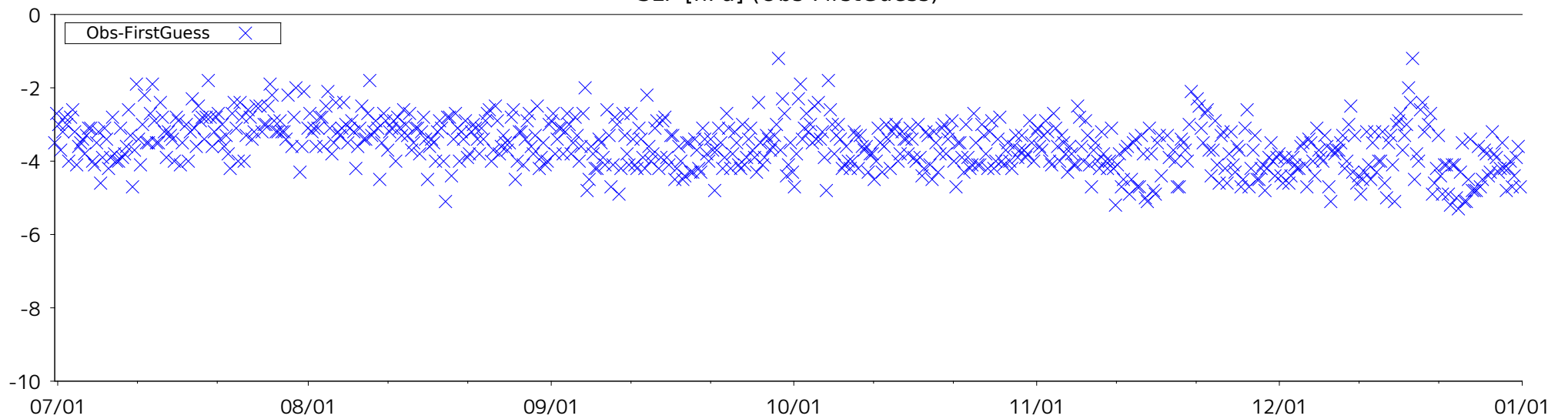
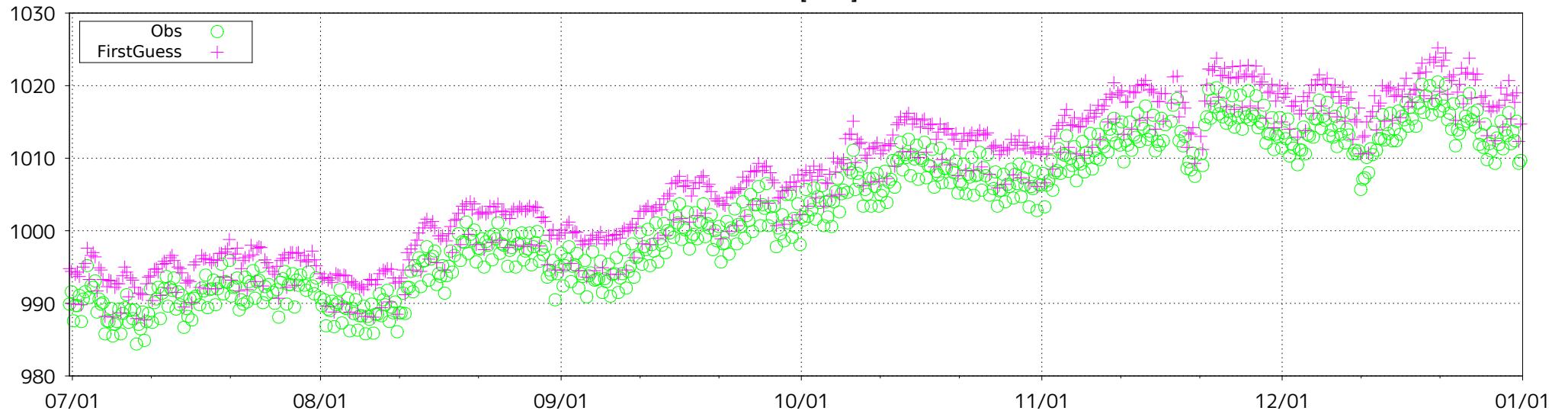


Figure 15(a) Time-series representation of SLP Obs minus FirstGuess for station 40877

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

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

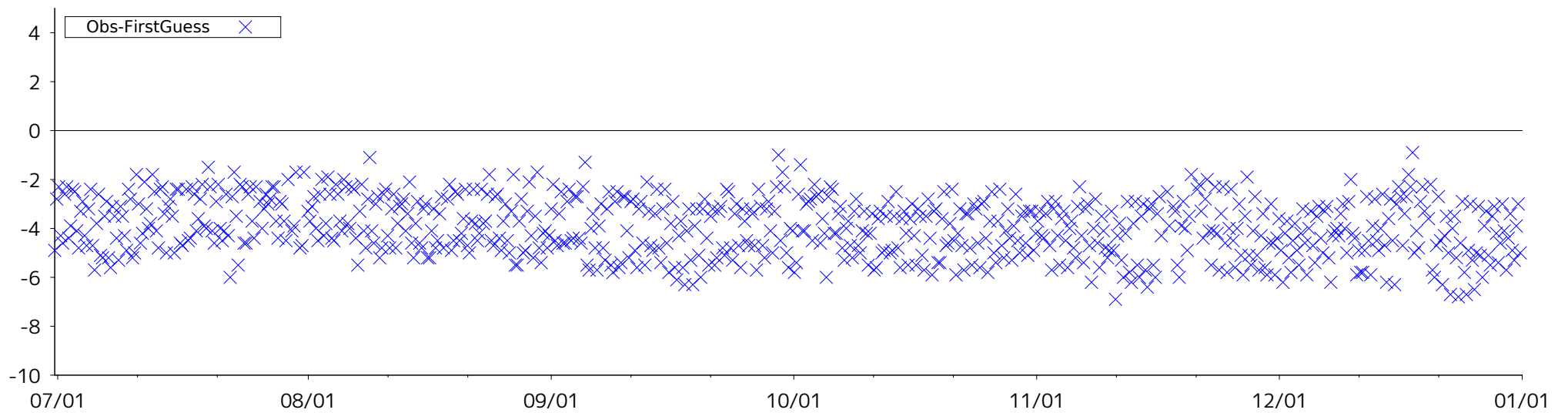
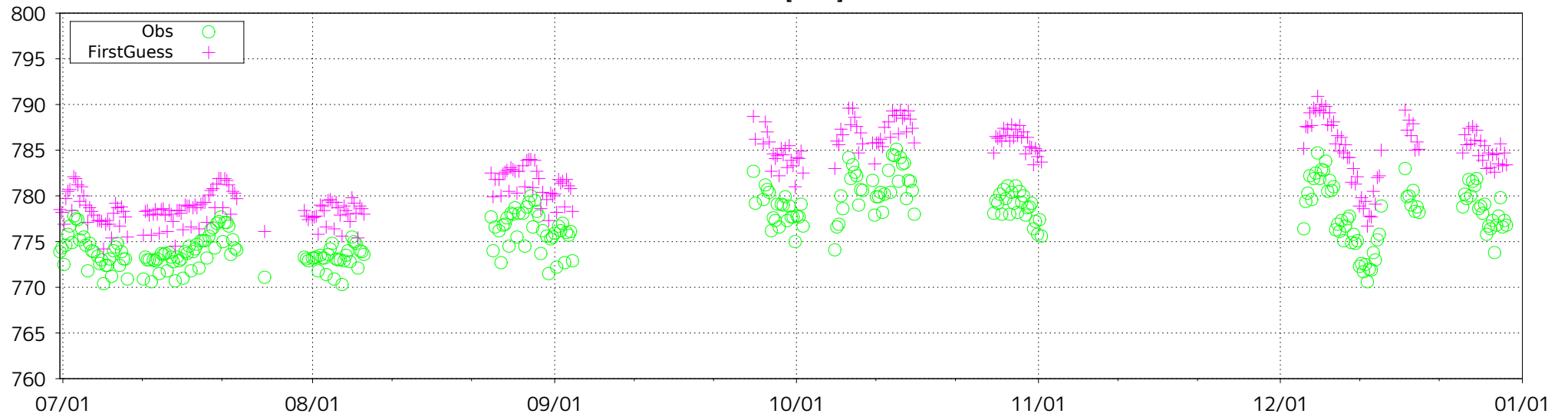


Figure 15(b) Time-series representation of MSLP Obs minus FirstGuess for station 40877

ID: 40942 (lat: 33.5N, lon: 65.3E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

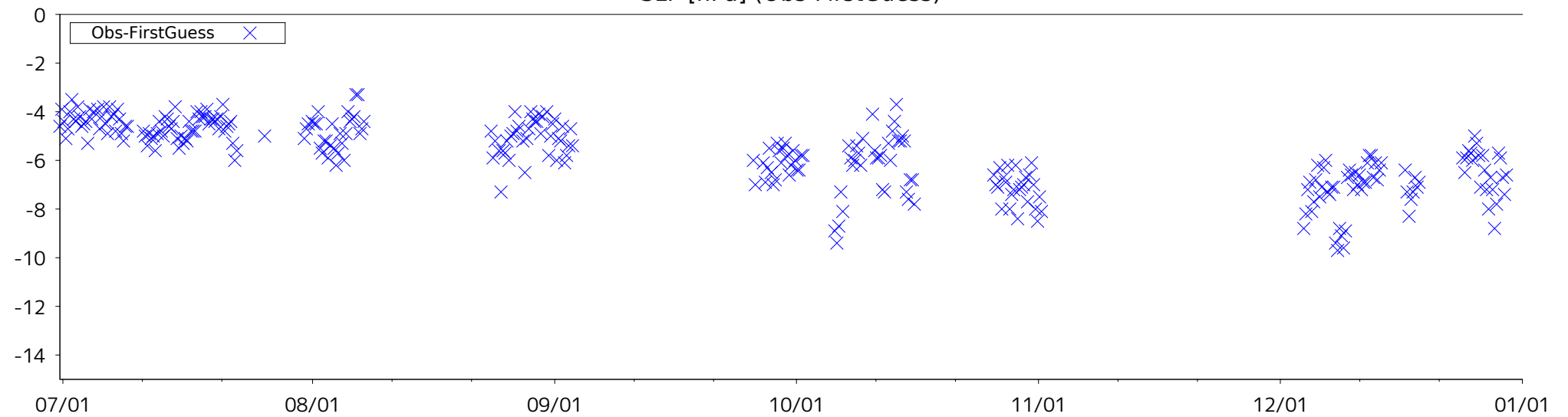
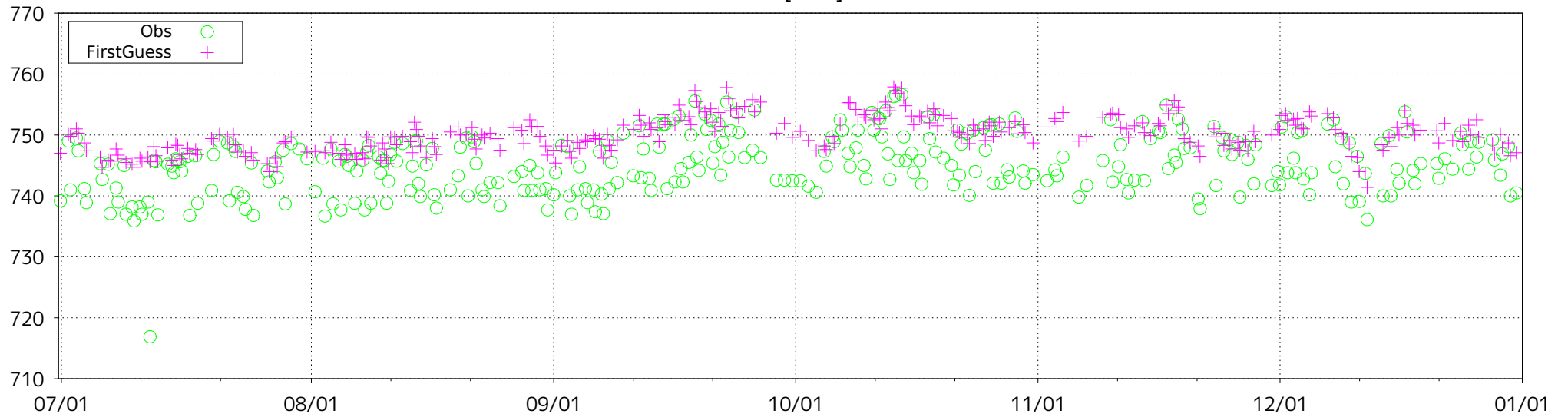


Figure 16 Time-series representation of SLP Obs minus FirstGuess for station 40942

ID: 40945 (lat: 34.8N, lon: 67.8E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

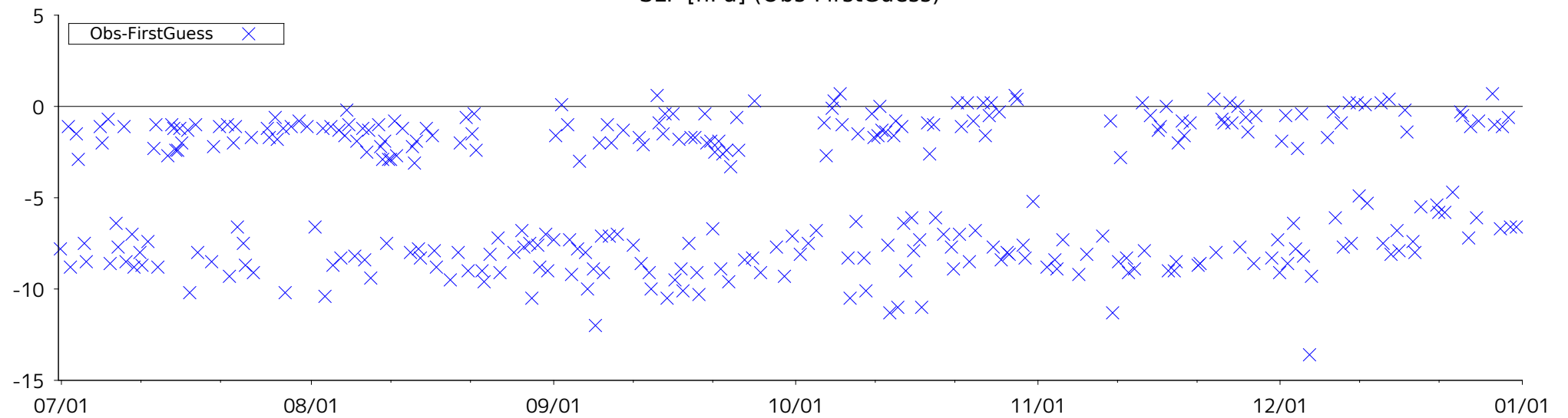


Figure 17 Time-series representation of SLP Obs minus FirstGuess for station 40945

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

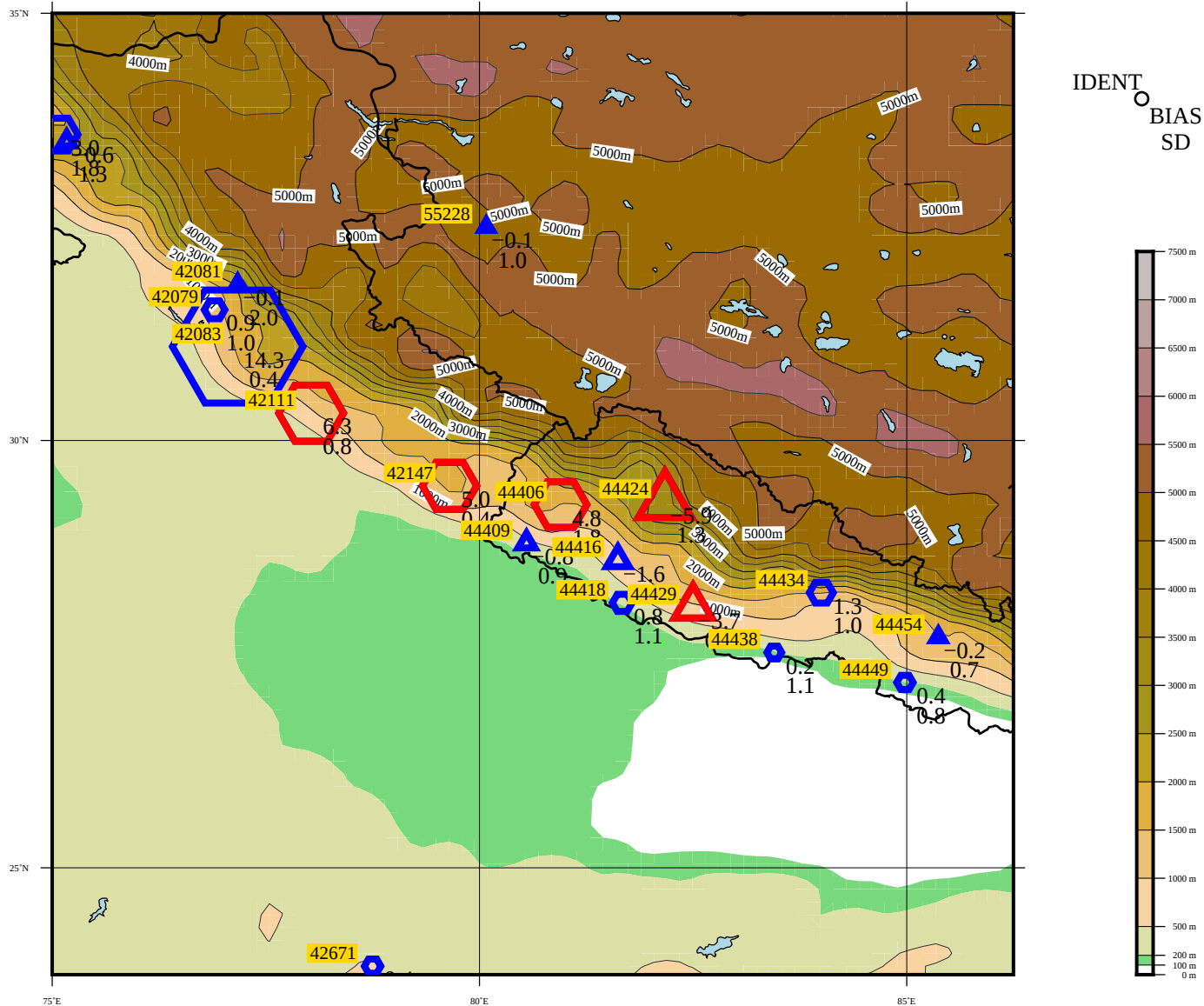
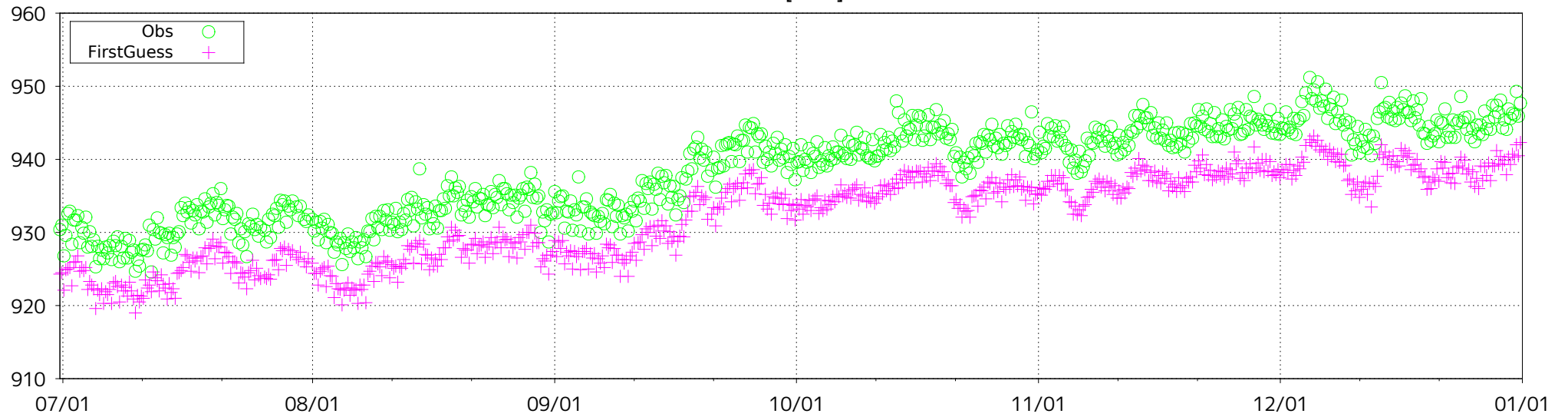


Figure 18 BIAS and SD of SLP for station 42111, 42147, 44406, 44424, 44429 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

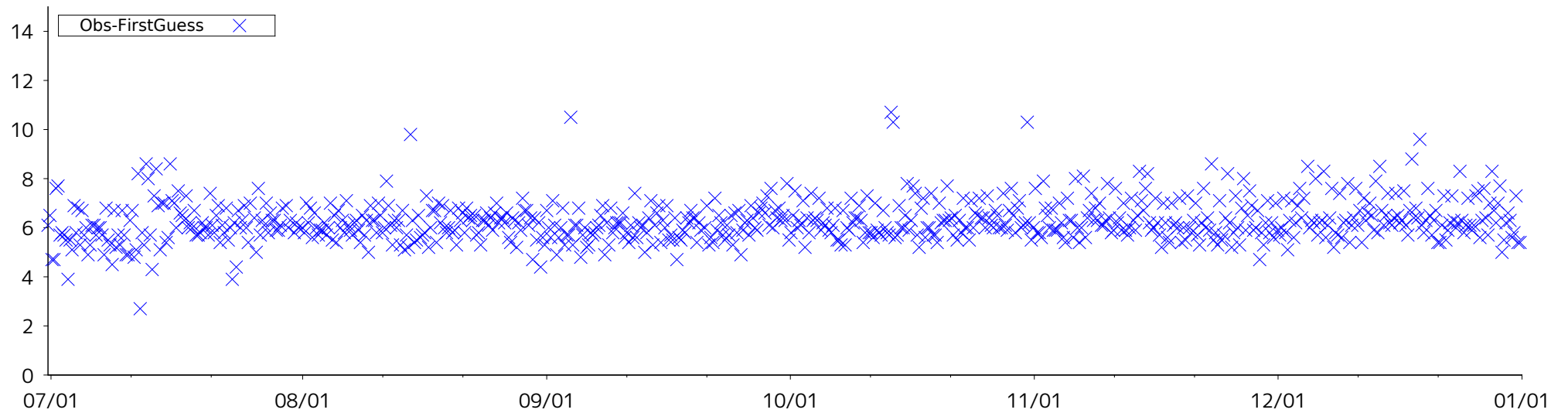


Figure 19 Time-series representation of SLP Obs minus FirstGuess for station 42111

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

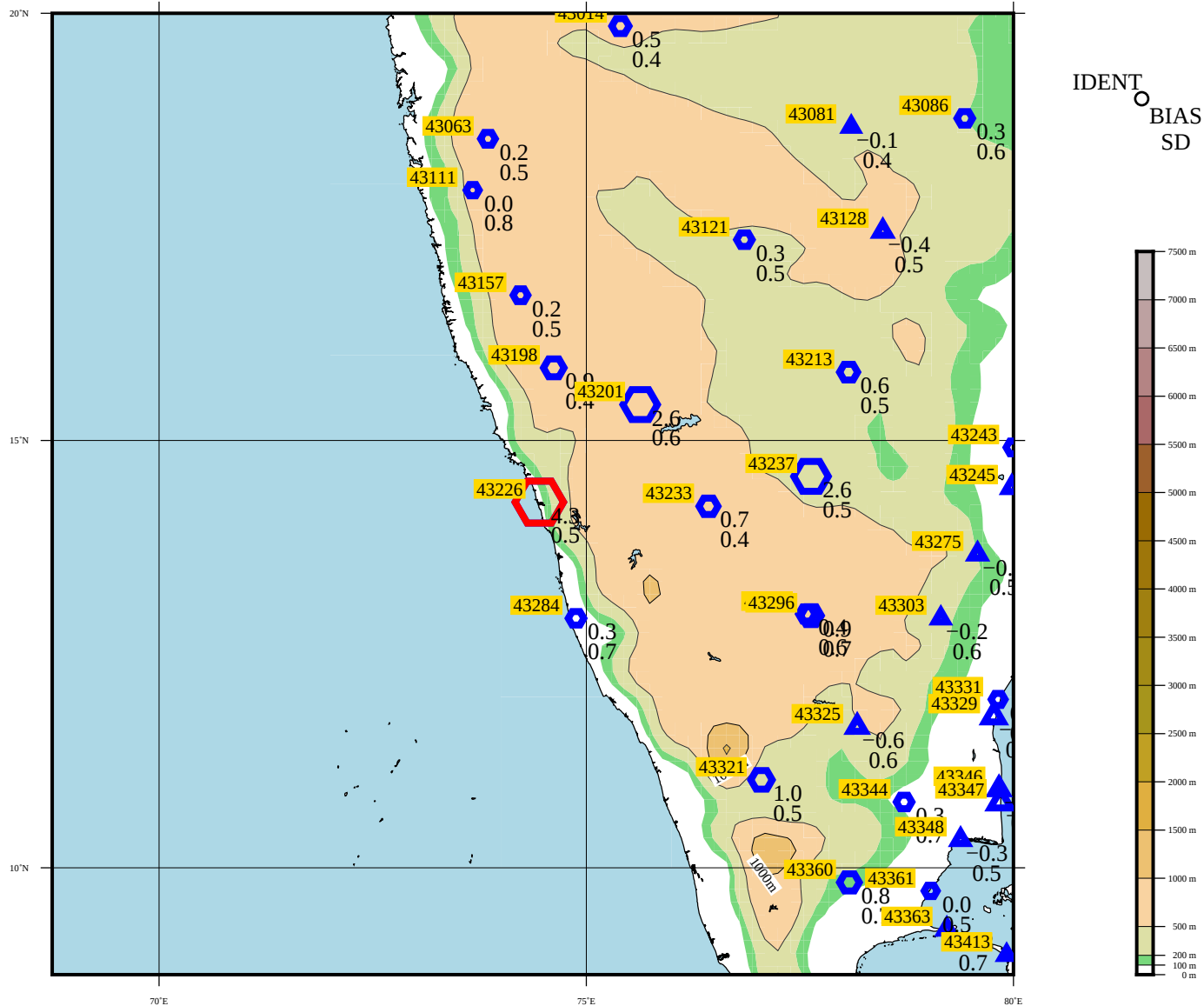
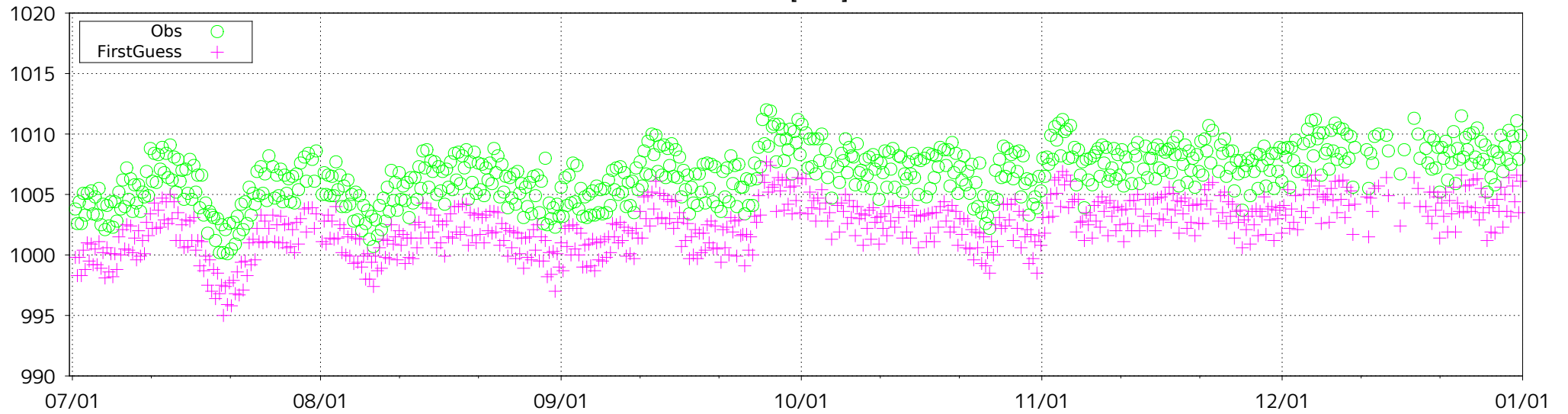


Figure 20 BIAS and SD of SLP for station 43226 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 43226 (lat: 14.3N, lon: 74.5E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

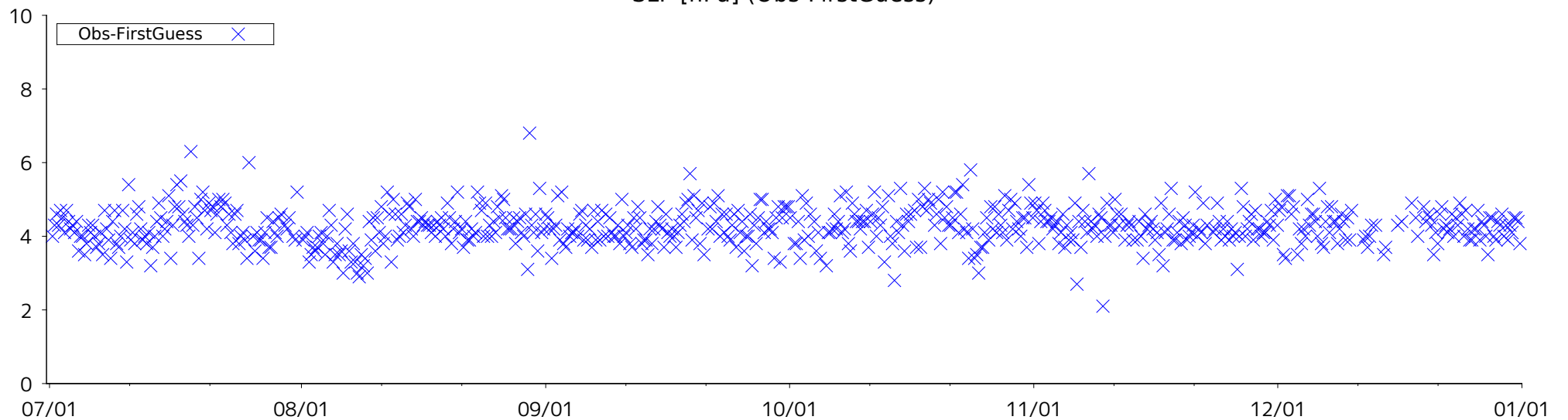


Figure 21 Time-series representation of SLP Obs minus FirstGuess for station 43226

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

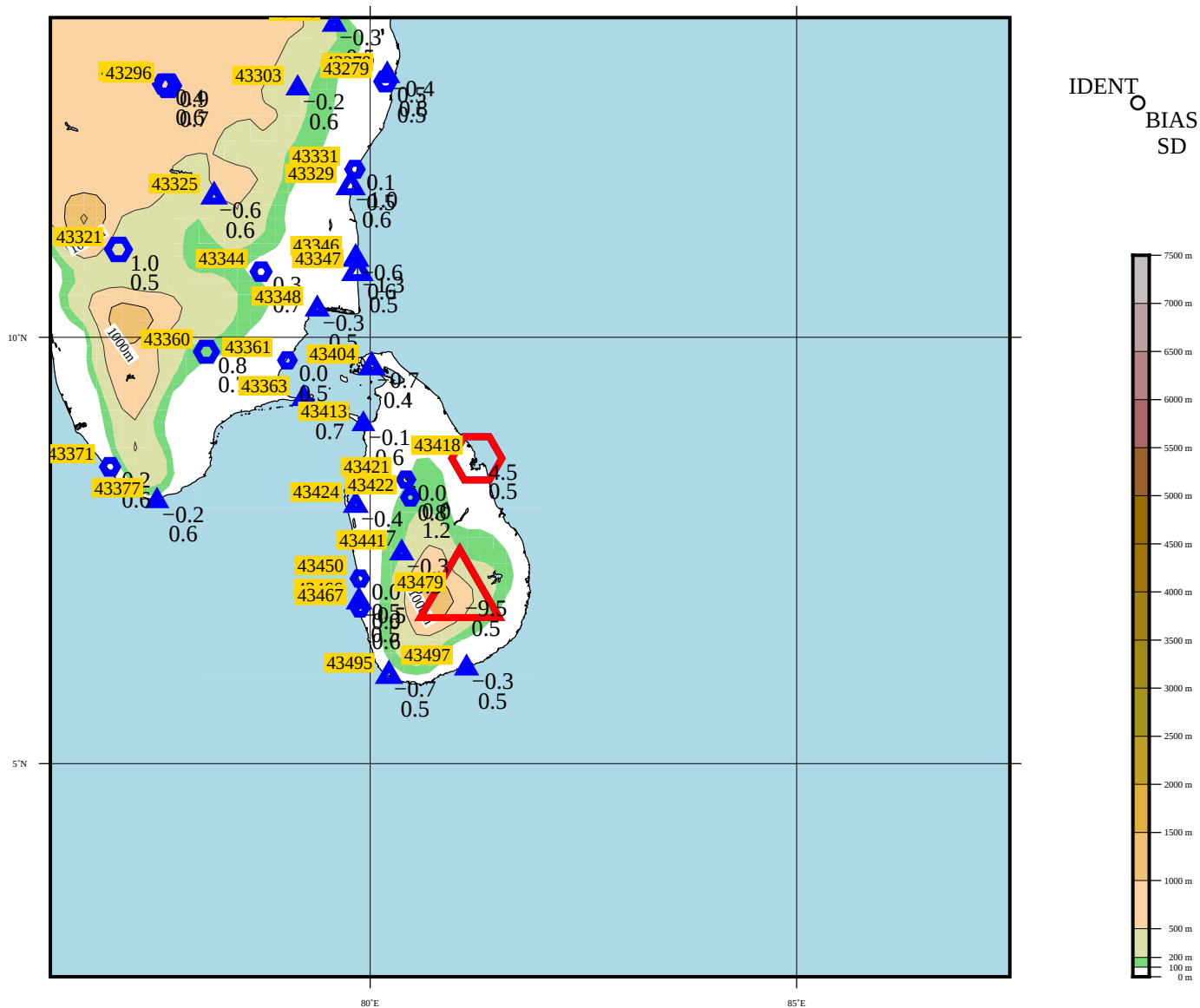
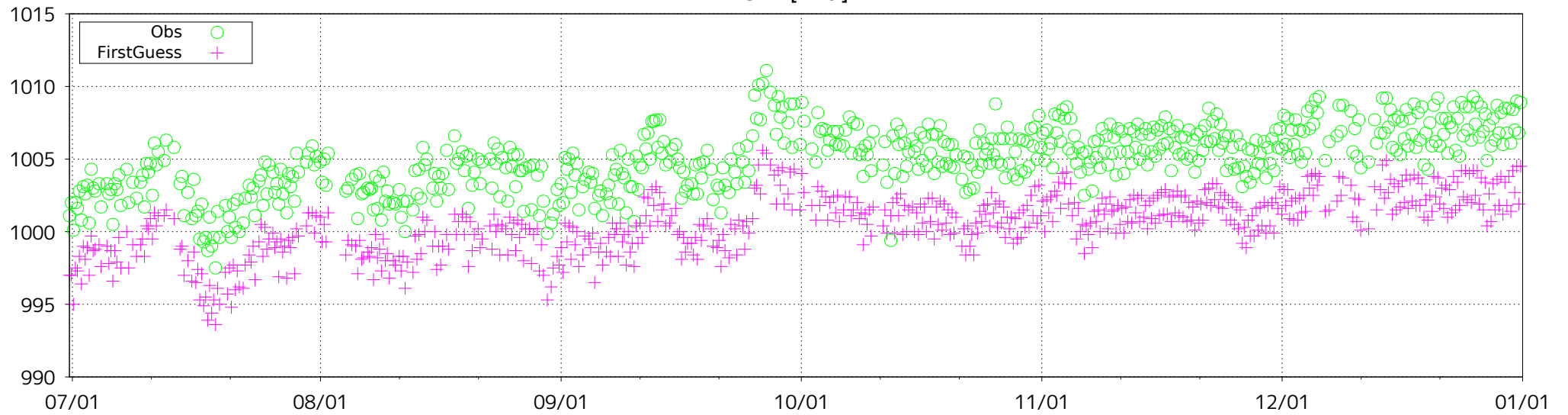


Figure 22 BIAS and SD of SLP for station 43418, 43479 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

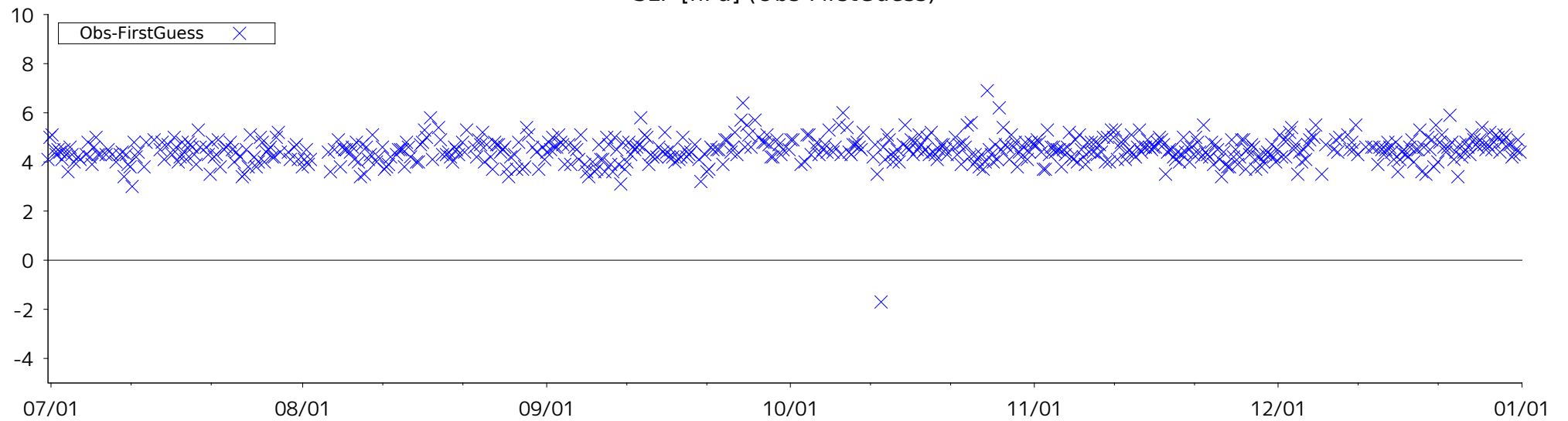
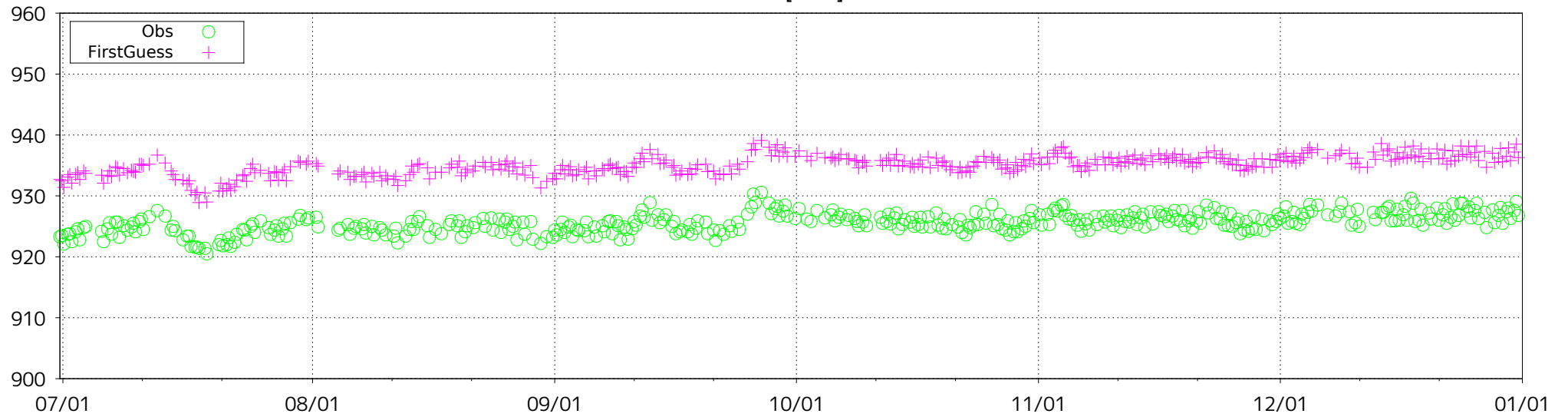


Figure 23 Time-series representation of SLP Obs minus FirstGuess for station 43418

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

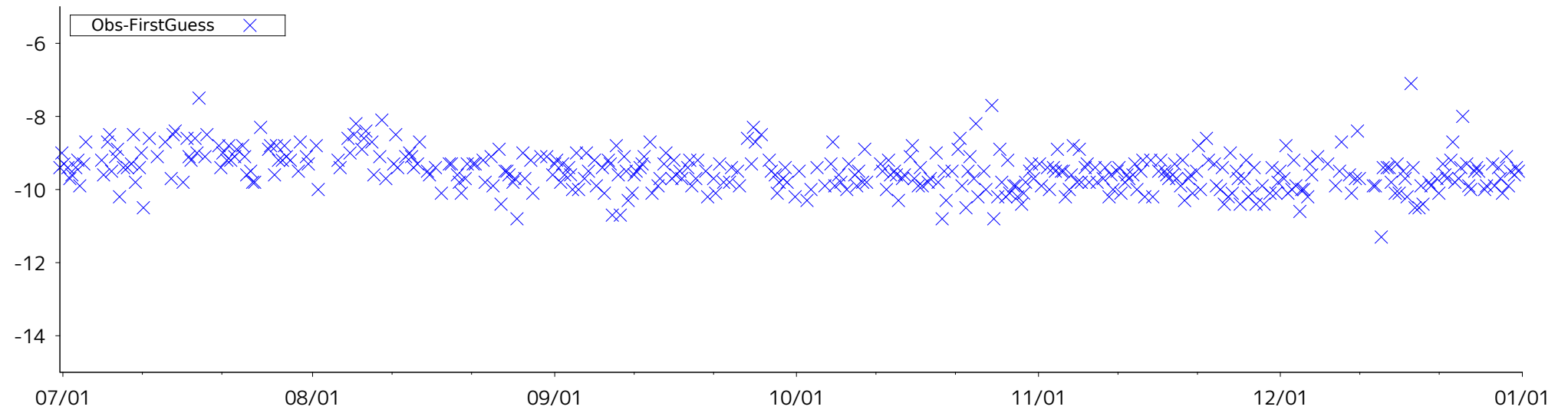
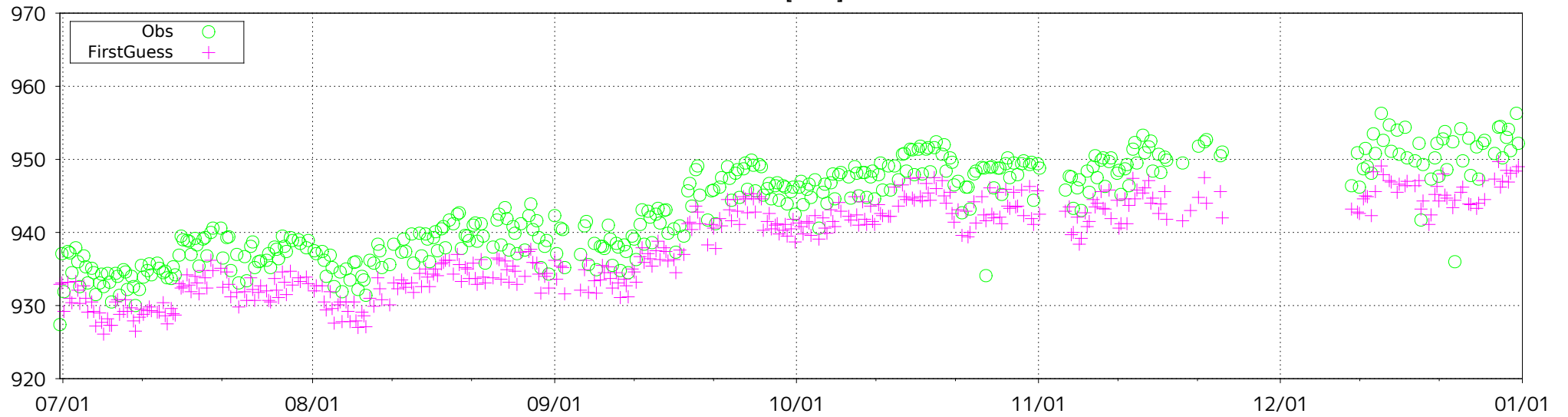


Figure 24 Time-series representation of SLP Obs minus FirstGuess for station 43479

ID: 44406 (lat: 29.3N, lon: 81.0E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

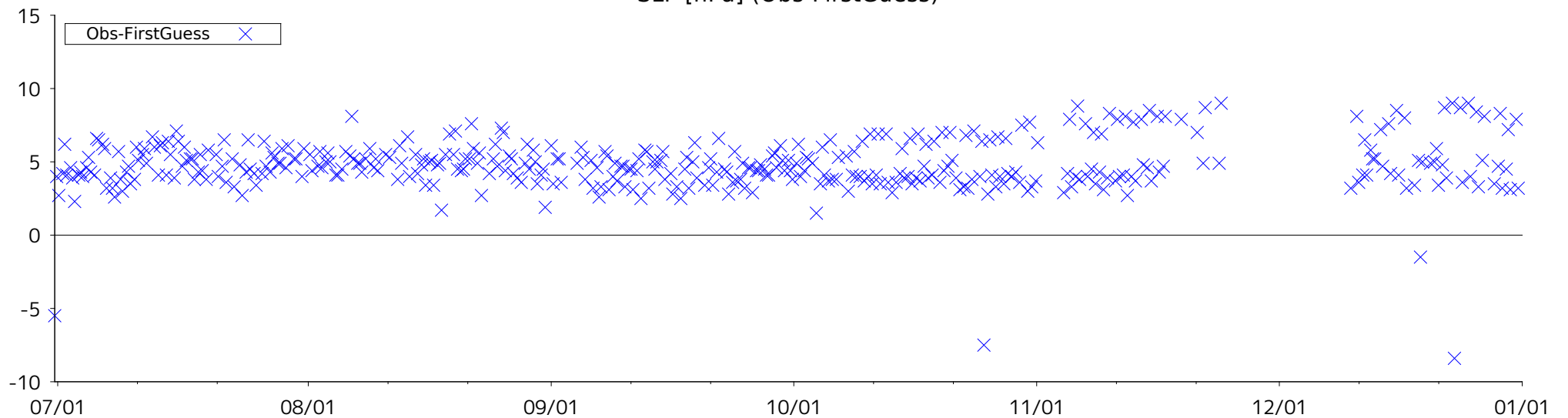
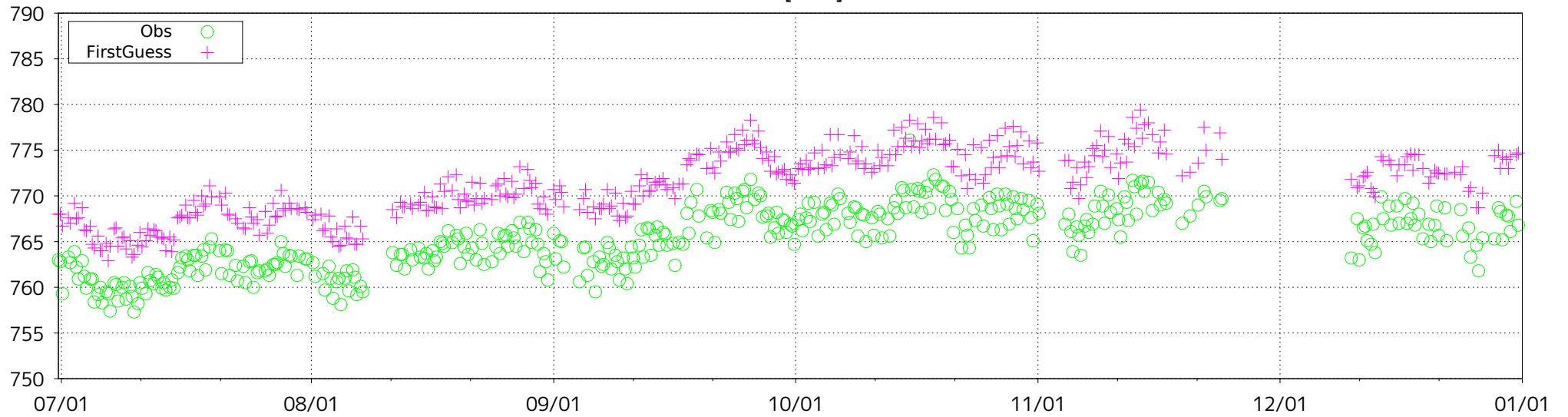


Figure 25 Time-series representation of SLP Obs minus FirstGuess for station 44406

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

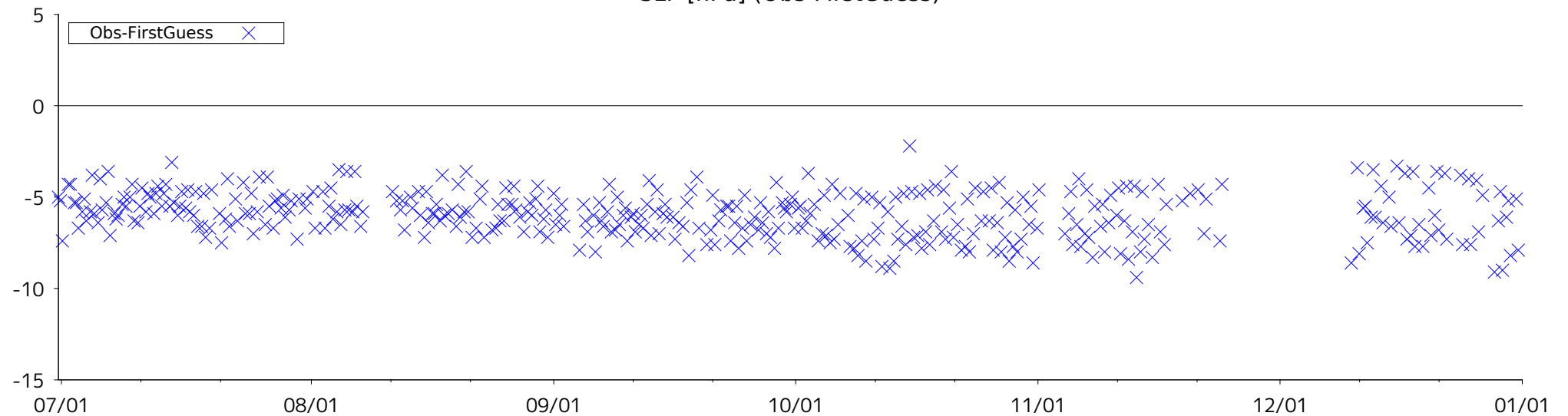
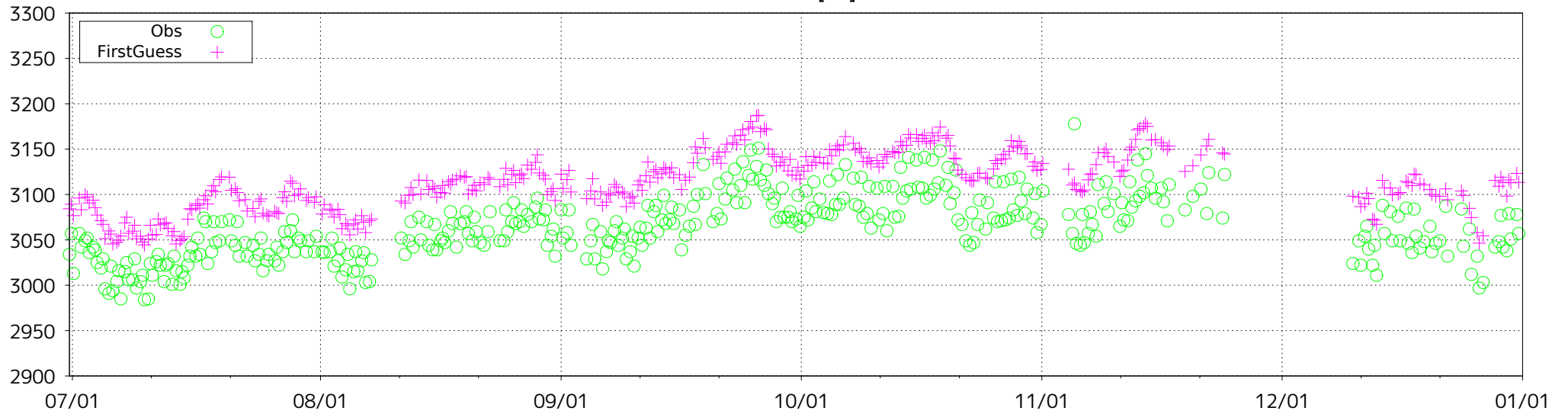


Figure 26(a) Time-series representation of SLP Obs minus FirstGuess for station 44424

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

GZ700 [m]



GZ700 [m] (Obs-FirstGuess)

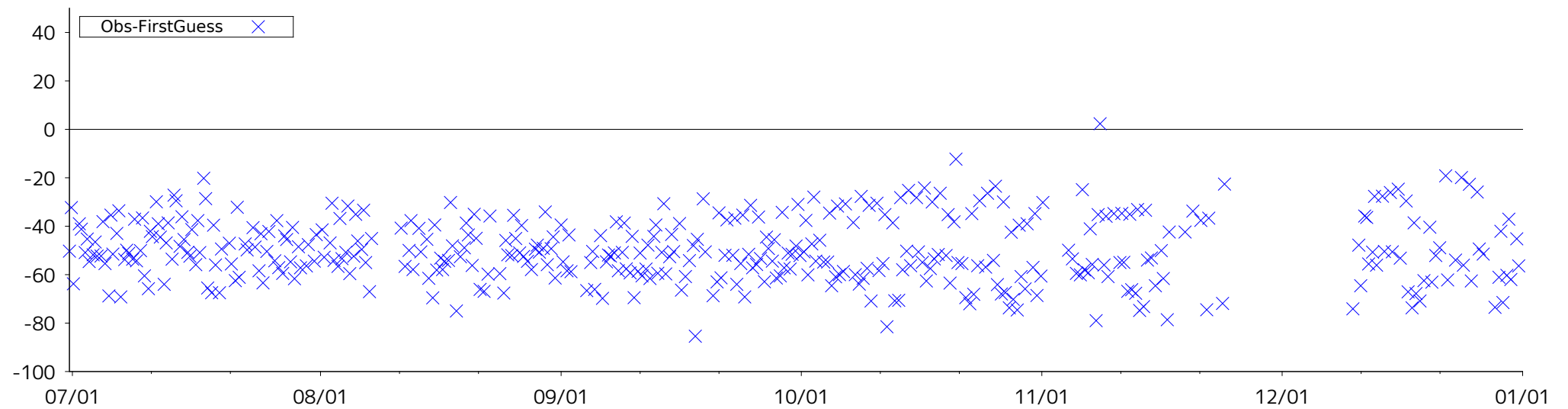
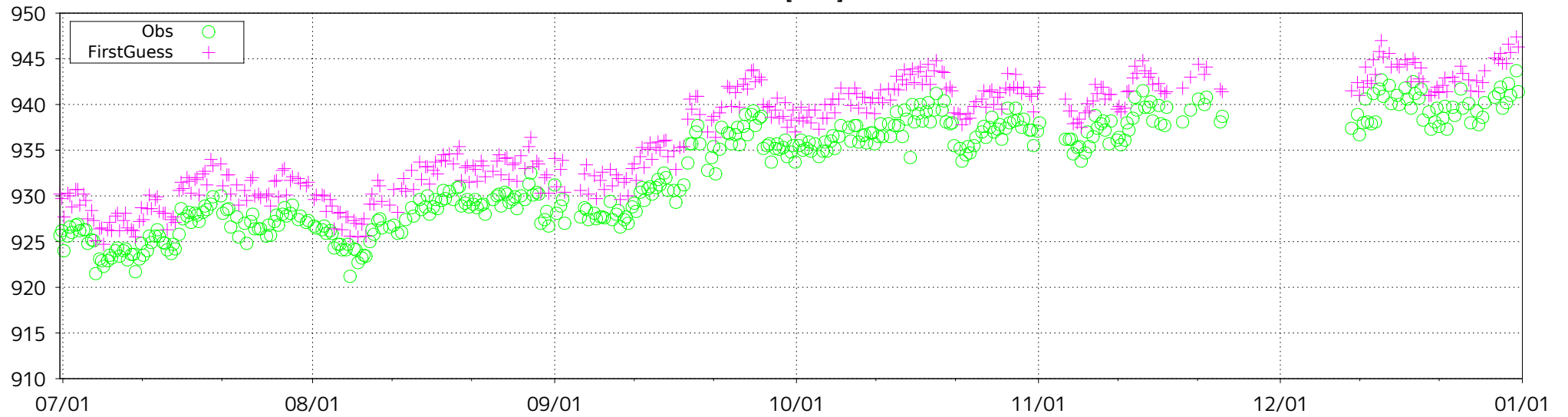


Figure 26(b) Time-series representation of GZ700 Obs minus FirstGuess for station 44424

ID: 44429 (lat: 28.1N, lon: 82.5E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

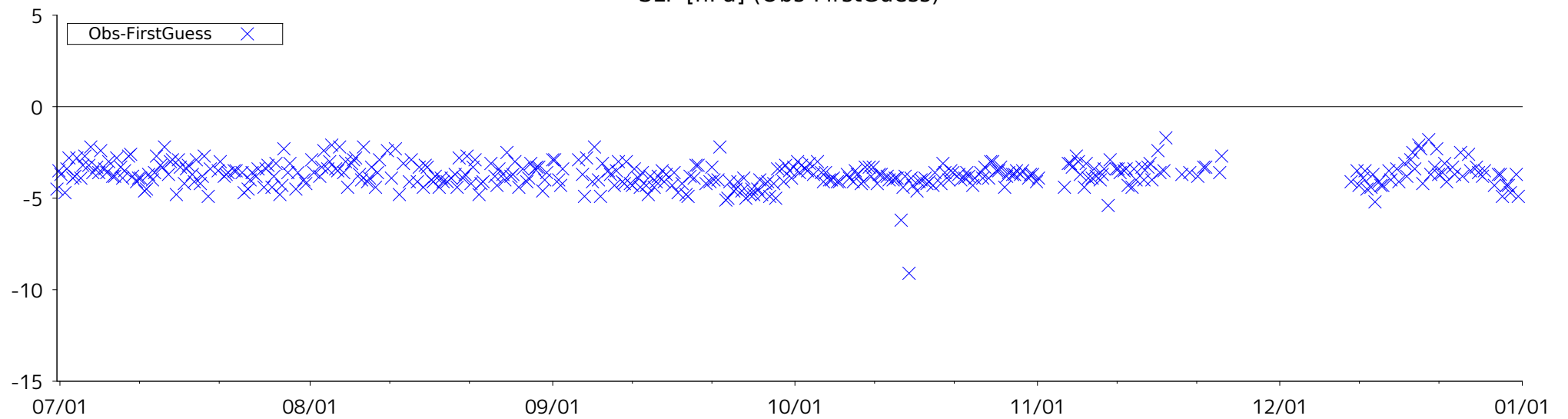


Figure 27 Time-series representation of SLP Obs minus FirstGuess for station 44429

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

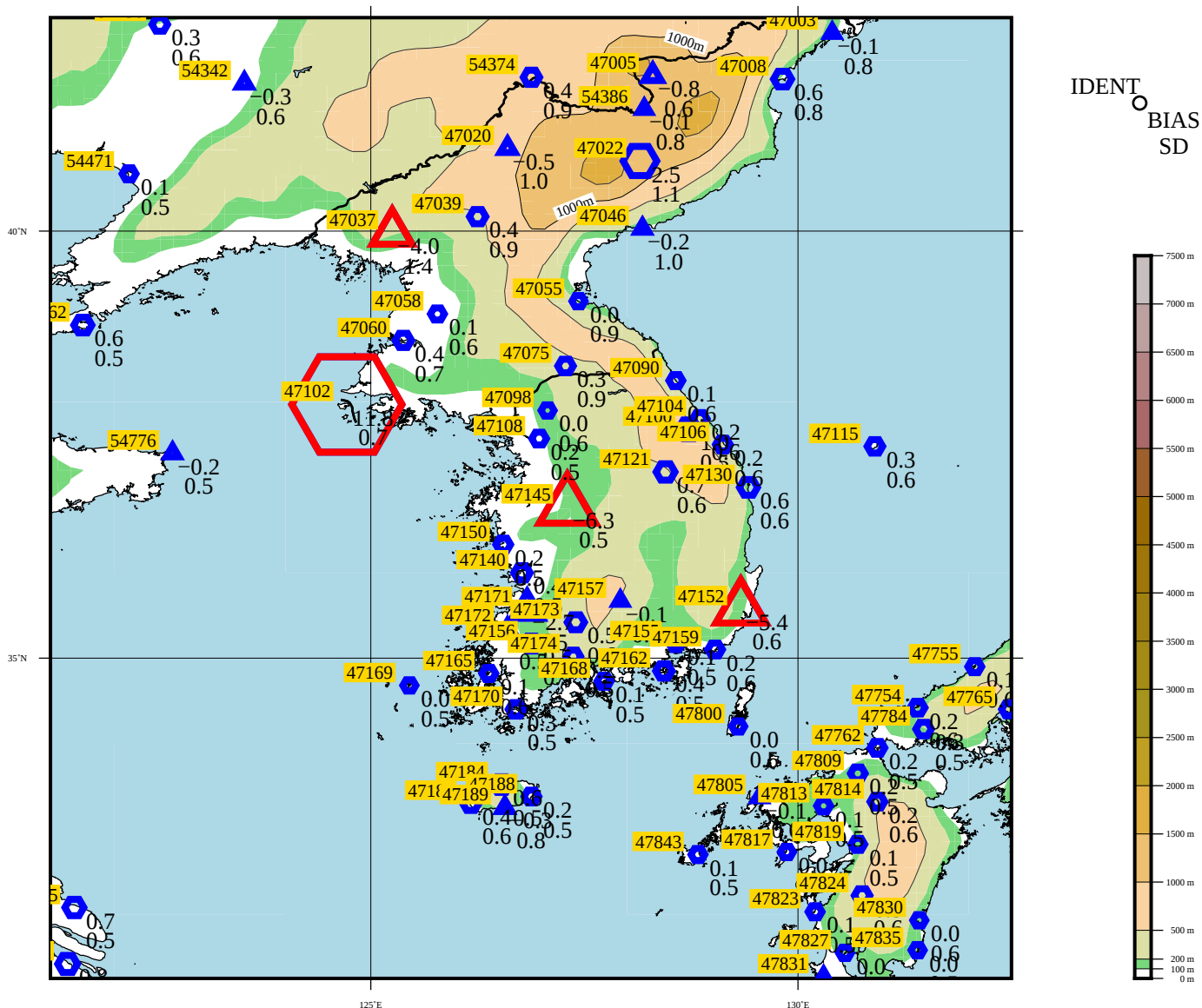
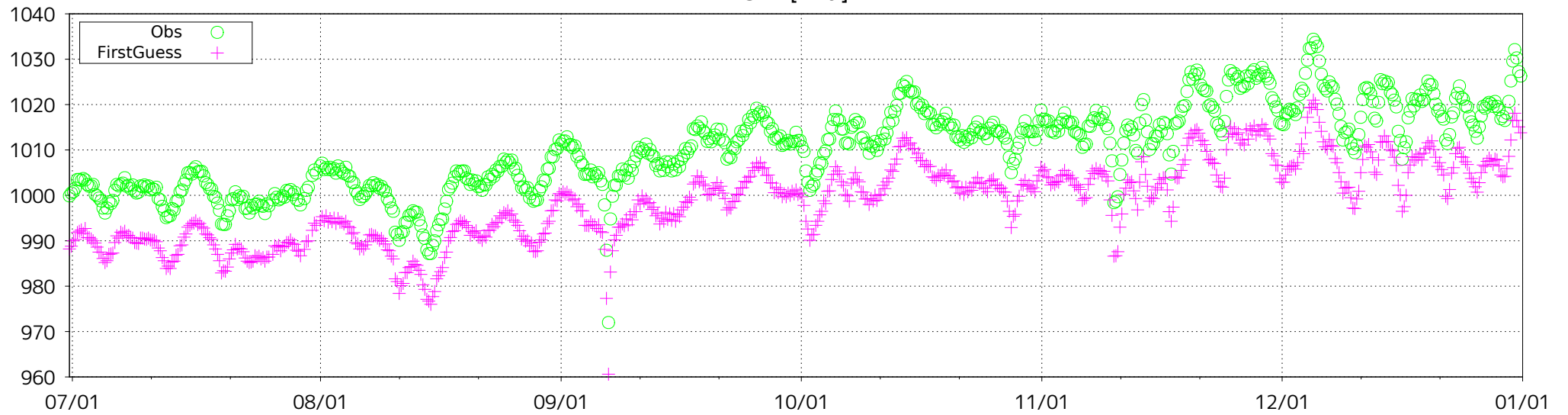


Figure 28 BIAS and SD of SLP for station 47037, 47102, 47145, 47152 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

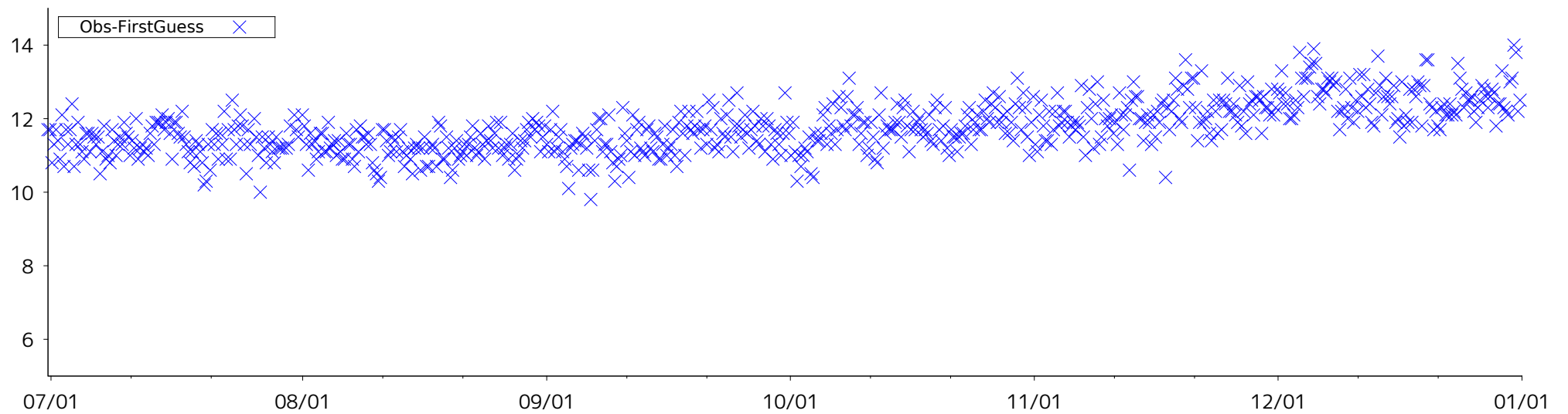
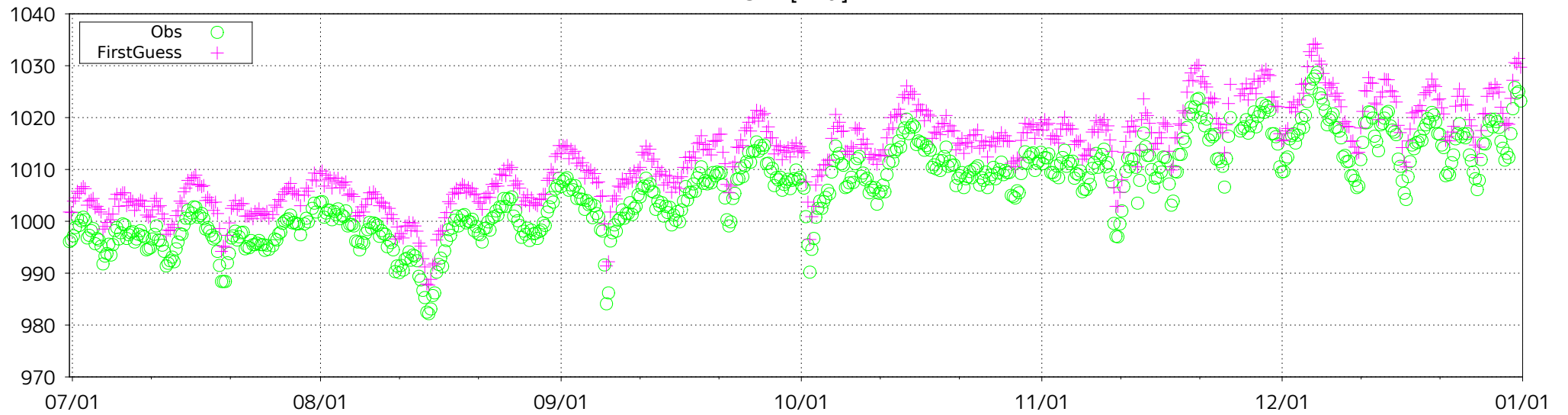


Figure 29 Time-series representation of SLP Obs minus FirstGuess for station 47102

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

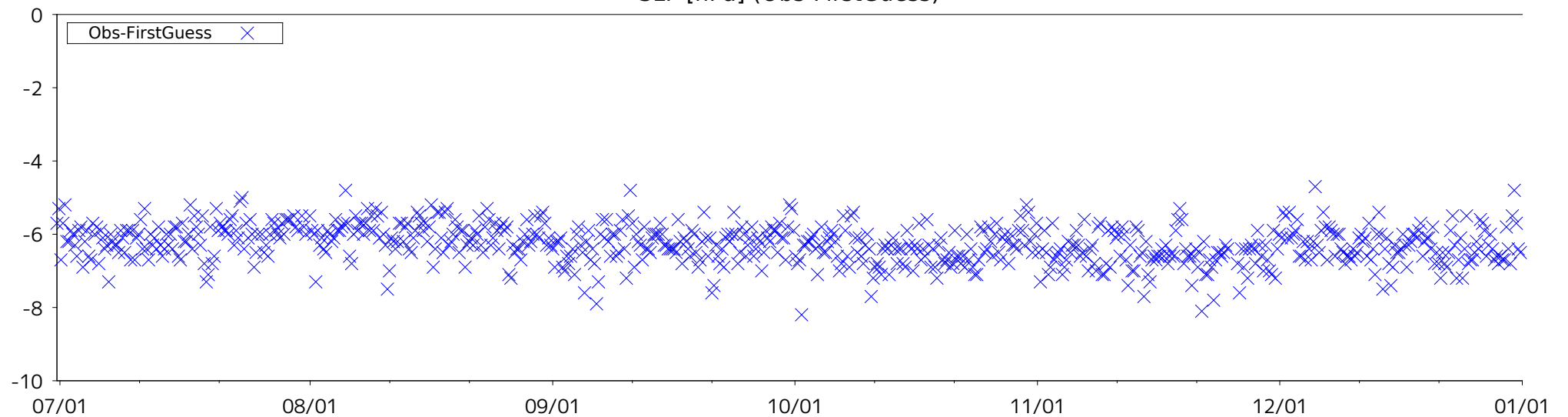
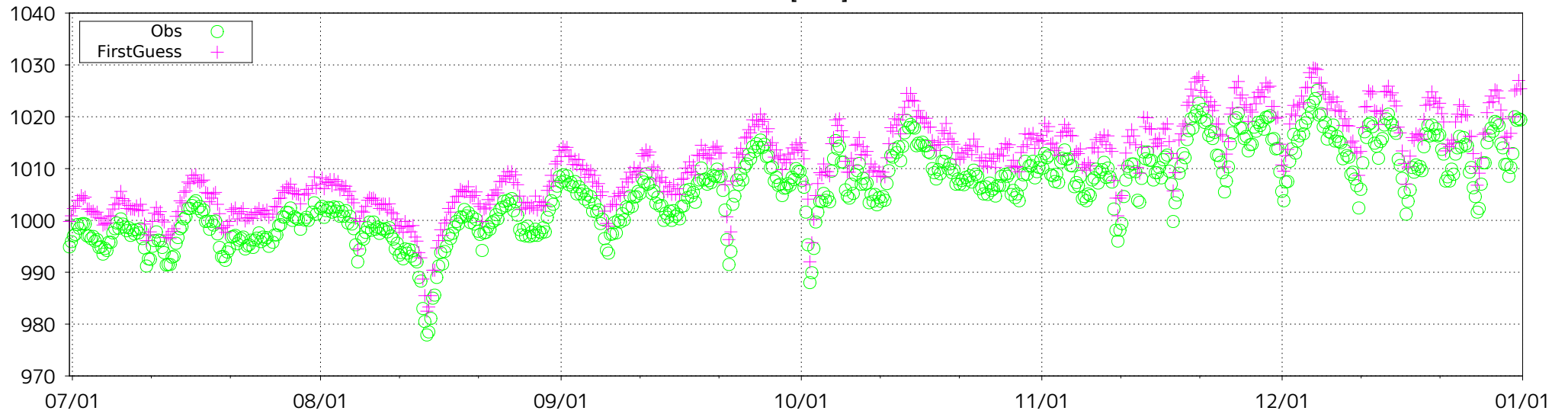


Figure 30 Time-series representation of SLP Obs minus FirstGuess for station 47145

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

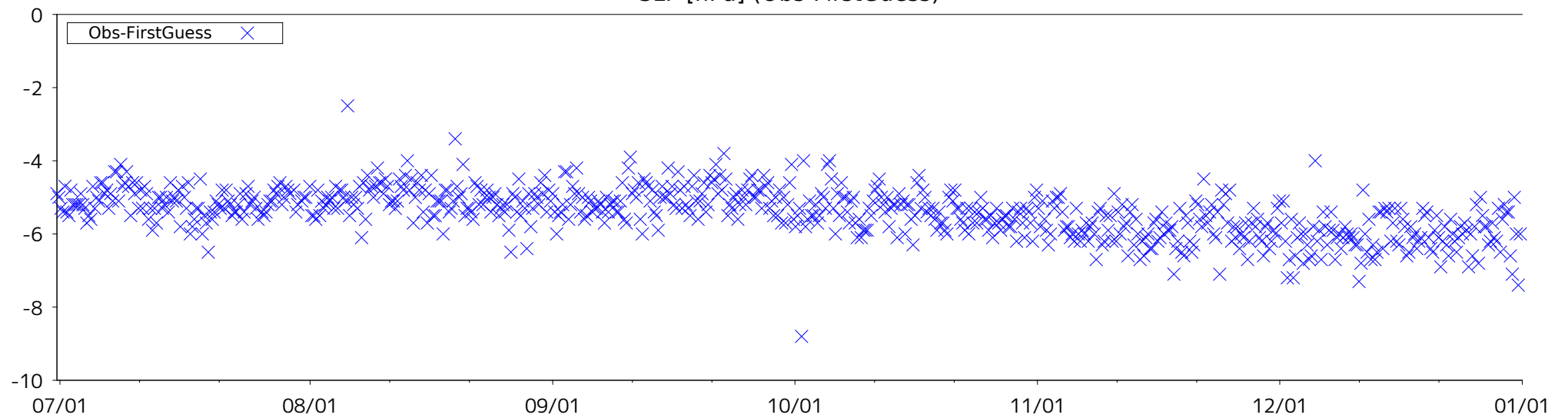


Figure 31 Time-series representation of SLP Obs minus FirstGuess for station 47152

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

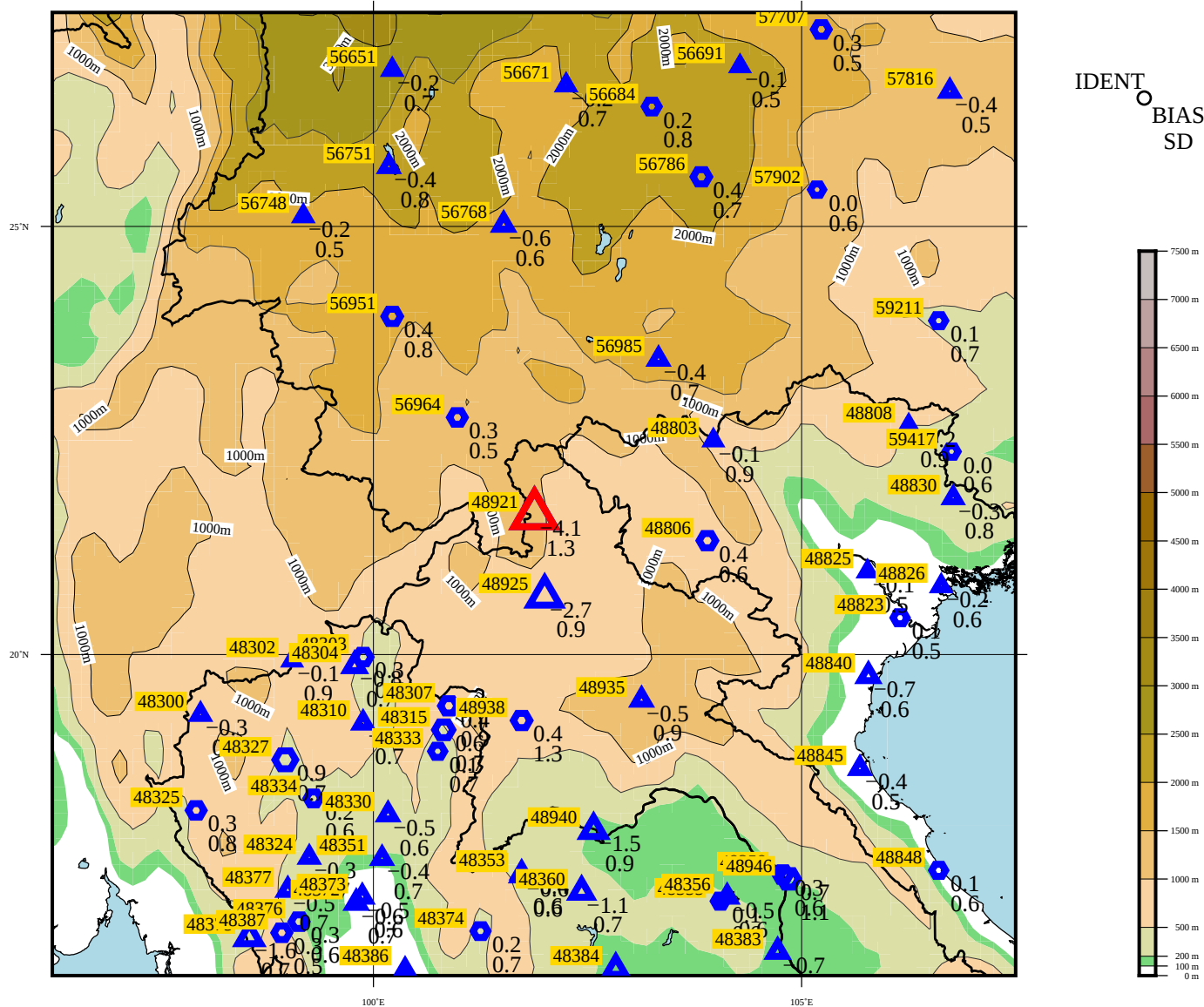
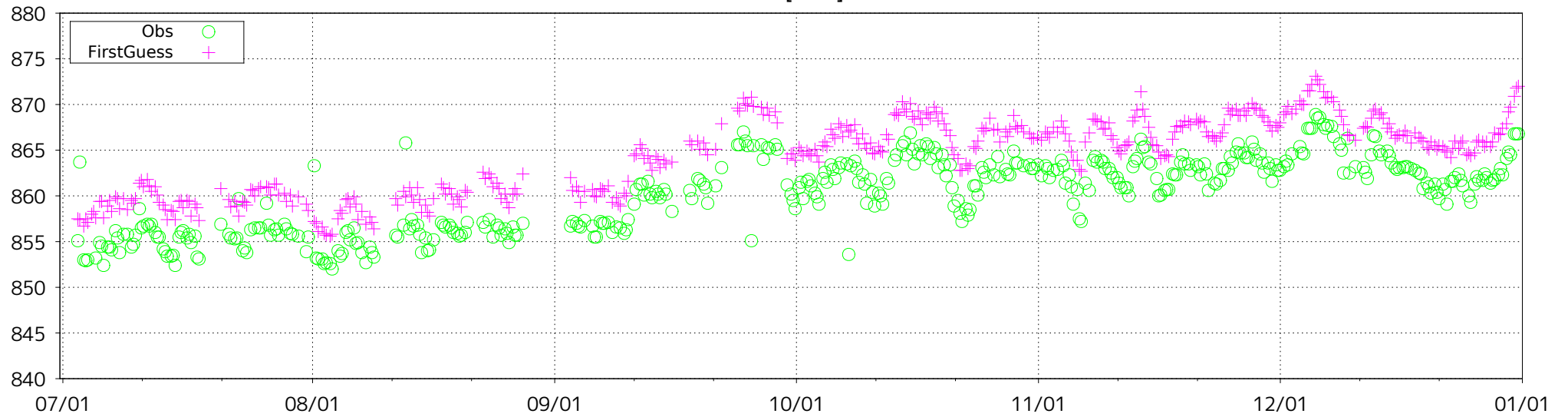


Figure 32 BIAS and SD of SLP for station 48921 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

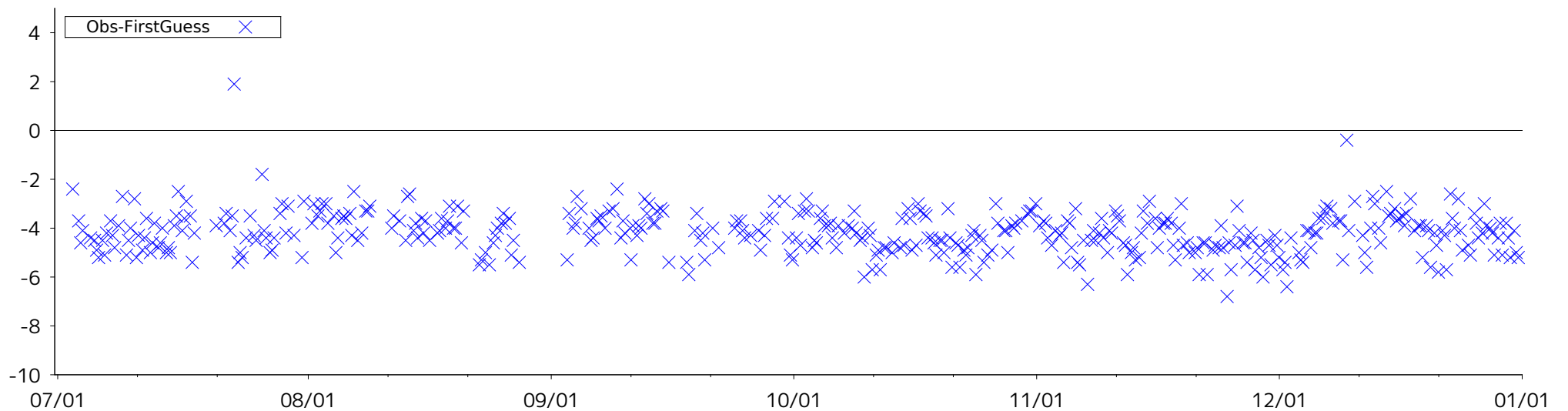
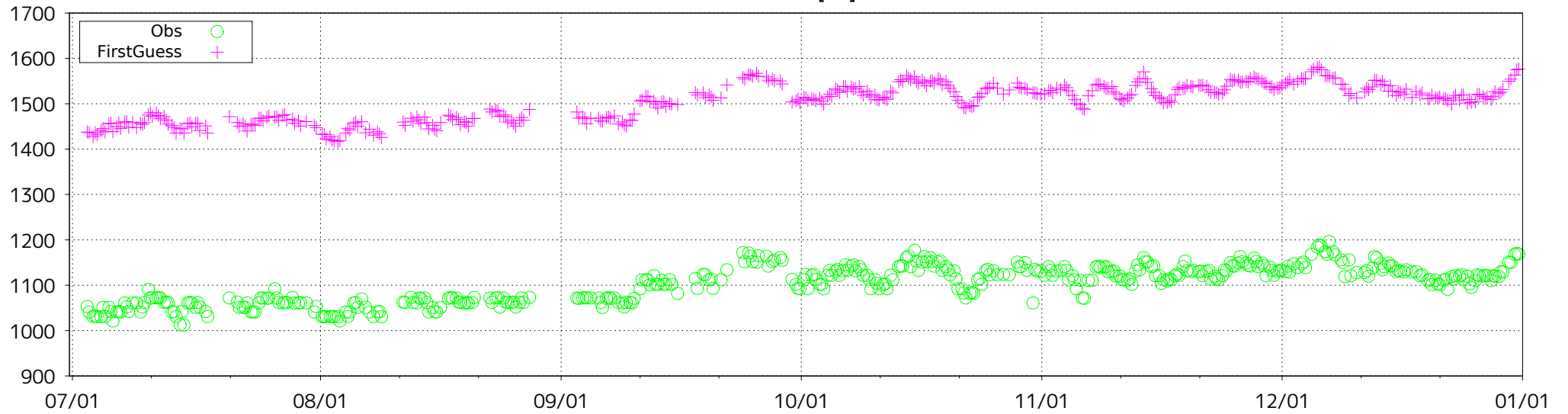


Figure 33(a) Time-series representation of SLP Obs minus FirstGuess for station 48921

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

GZ850 [m]



GZ850 [m] (Obs-FirstGuess)

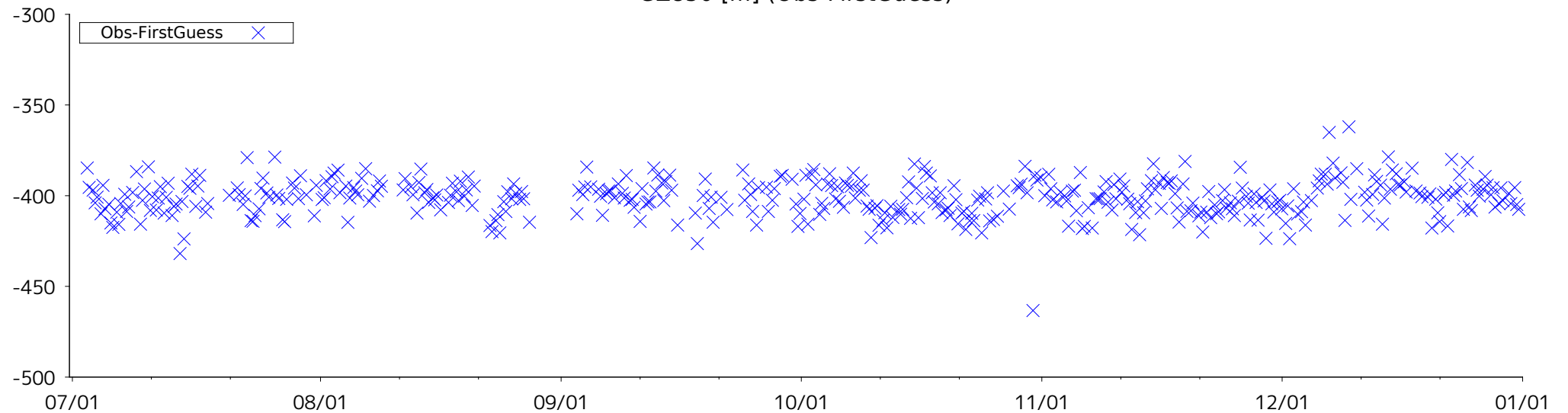
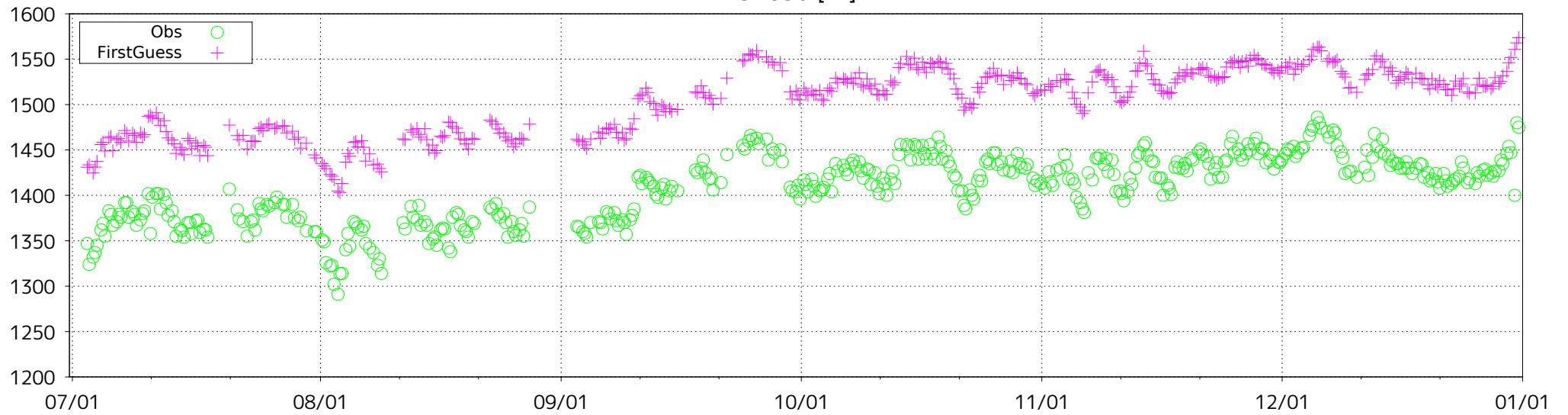


Figure 33(b) Time-series representation of GZ850 Obs minus FirstGuess for station 48921

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

GZ850 [m]



GZ850 [m] (Obs-FirstGuess)

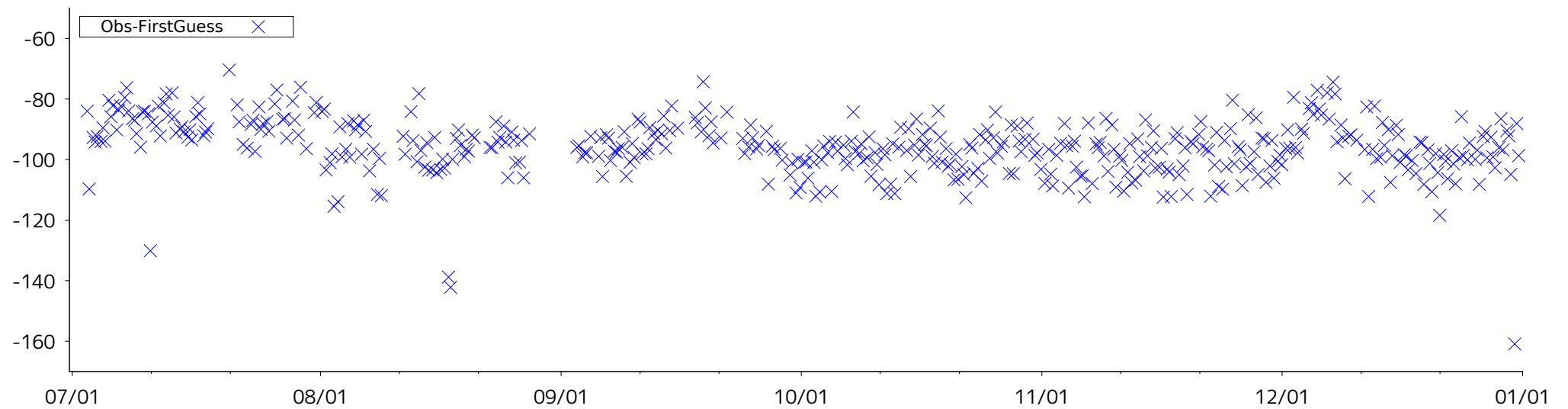


Figure 34 Time-series representation of GZ850 Obs minus FirstGuess for station 48935

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

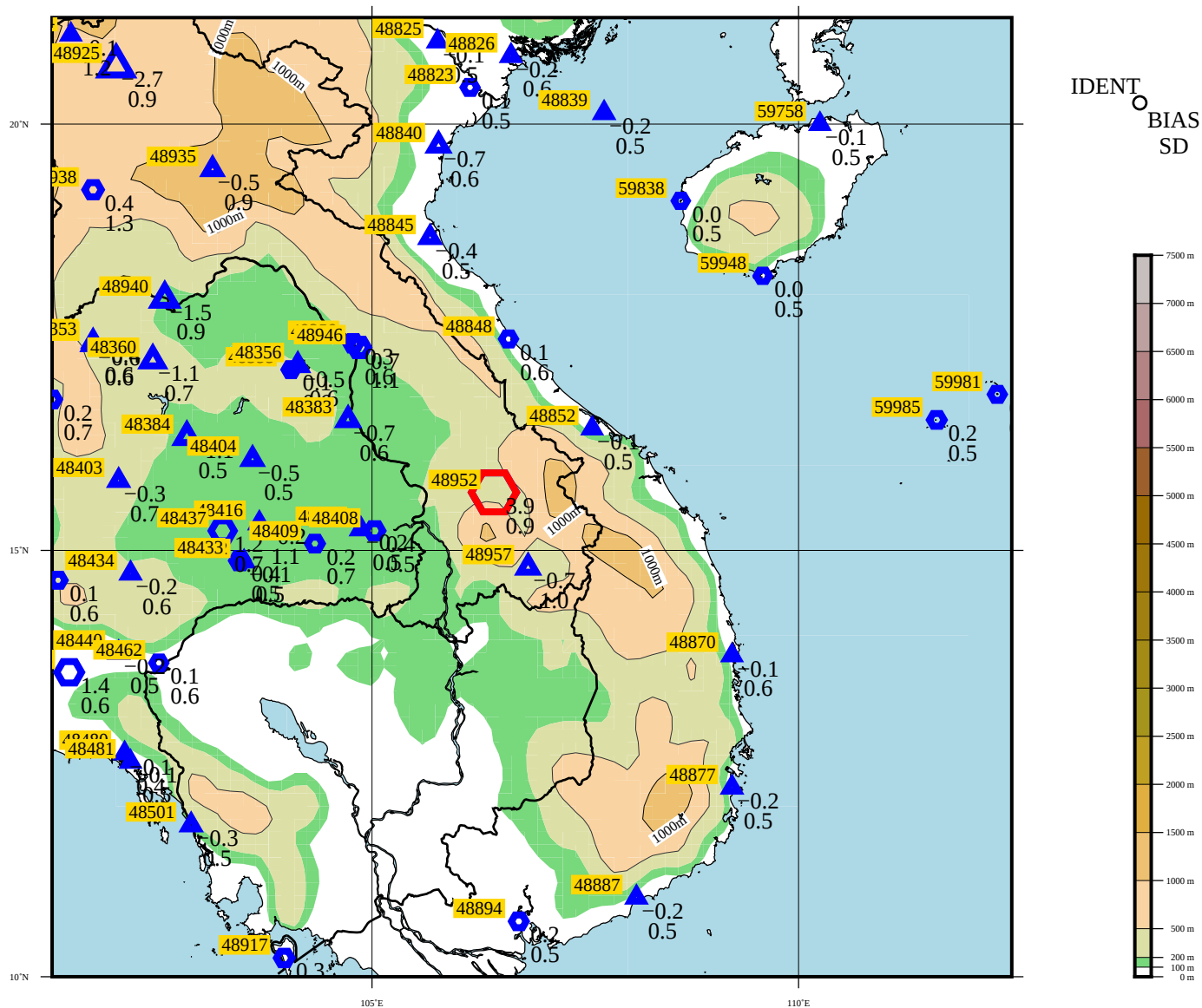
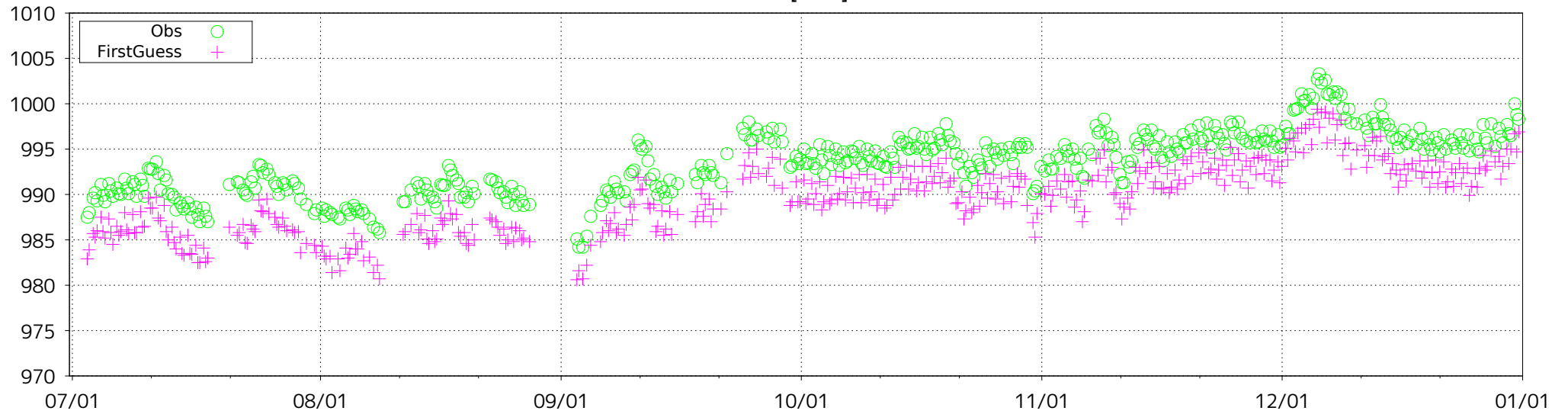


Figure 35 BIAS and SD of SLP for station 48952 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

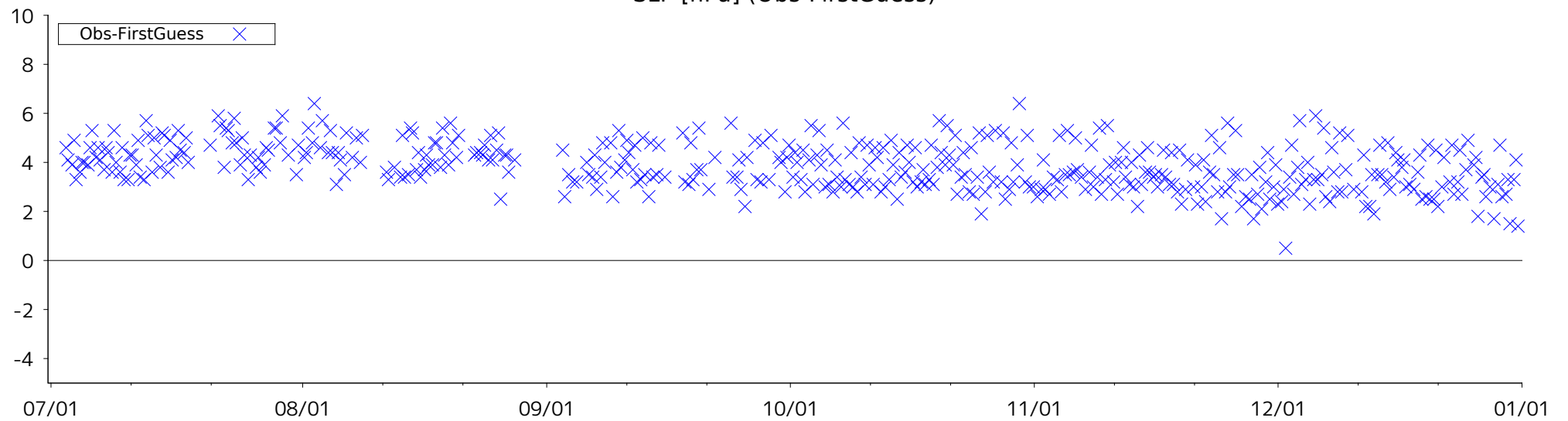


Figure 36 Time-series representation of SLP Obs minus FirstGuess for station 48952

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

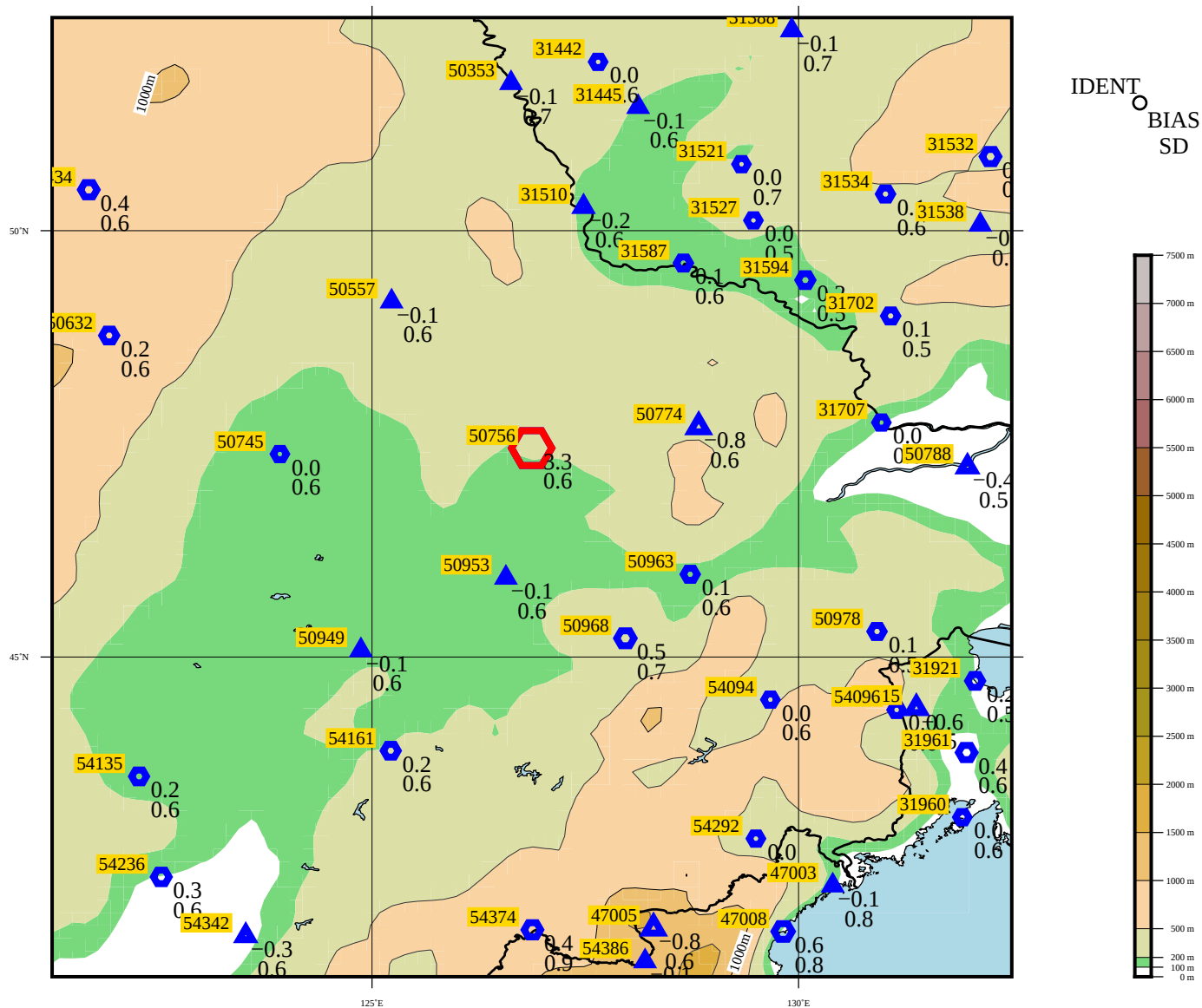


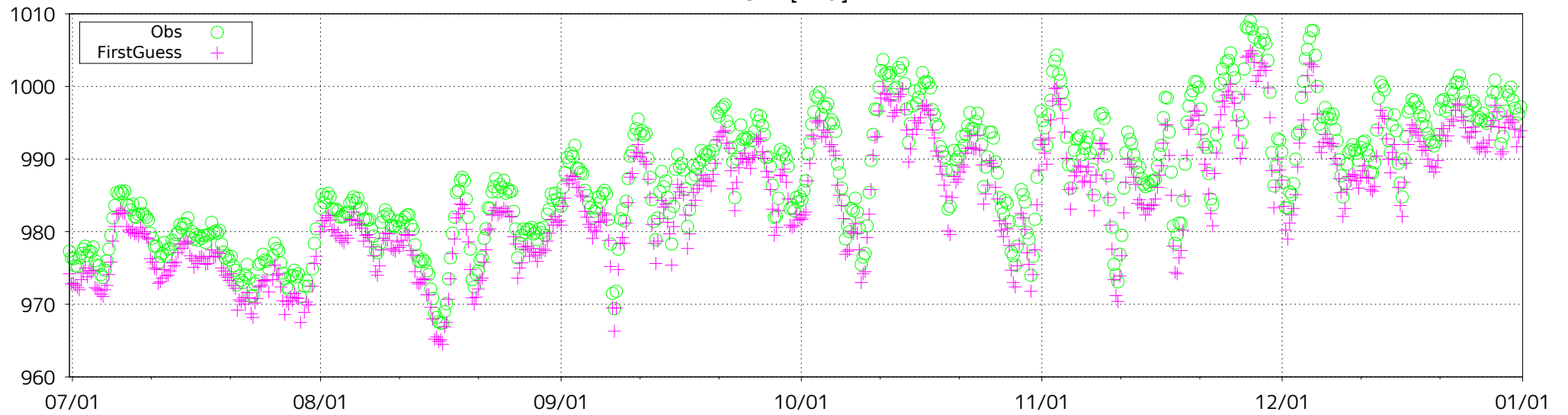
Figure 37 BIAS and SD of SLP for station 50756 (red) and surrounding stations (blue).

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: 50756 (lat: 47.5N, lon: 126.9E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

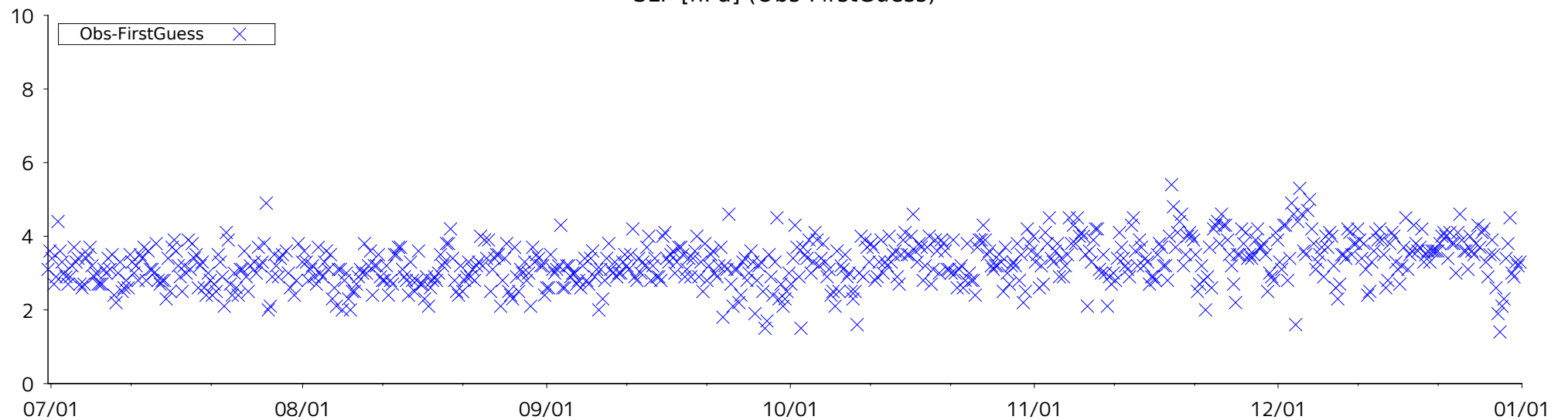
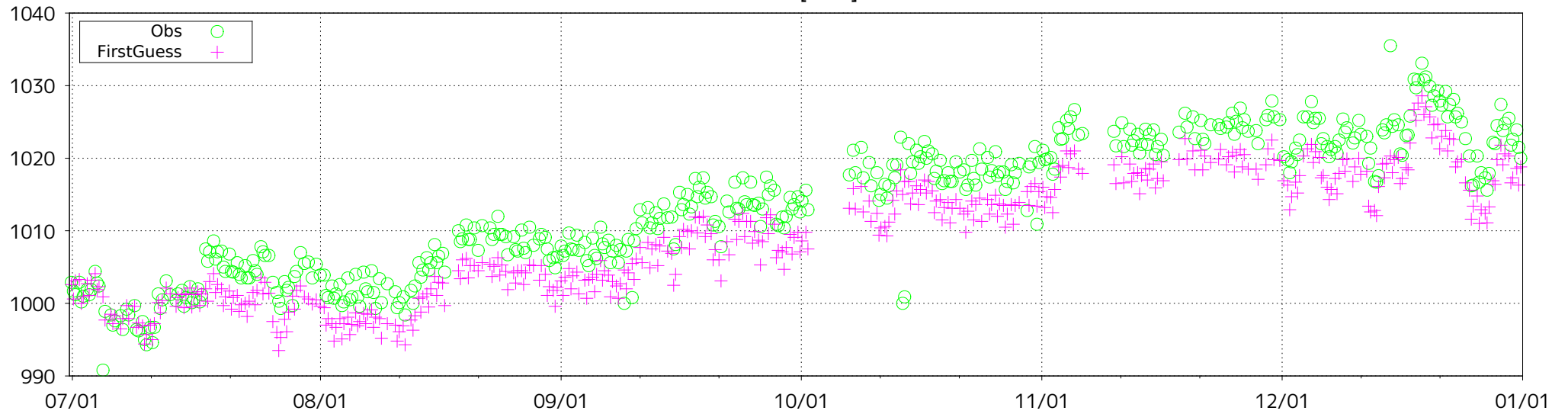


Figure 38 Time-series representation of SLP Obs minus FirstGuess for station 50756

ID: 40633 (lat: 34.6N, lon: 43.7E)

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

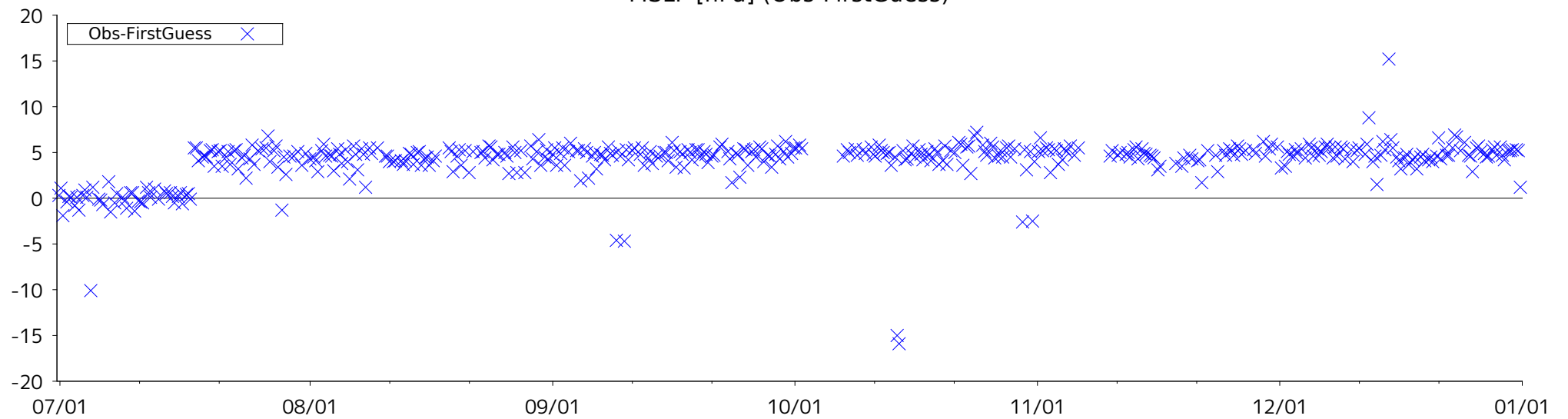
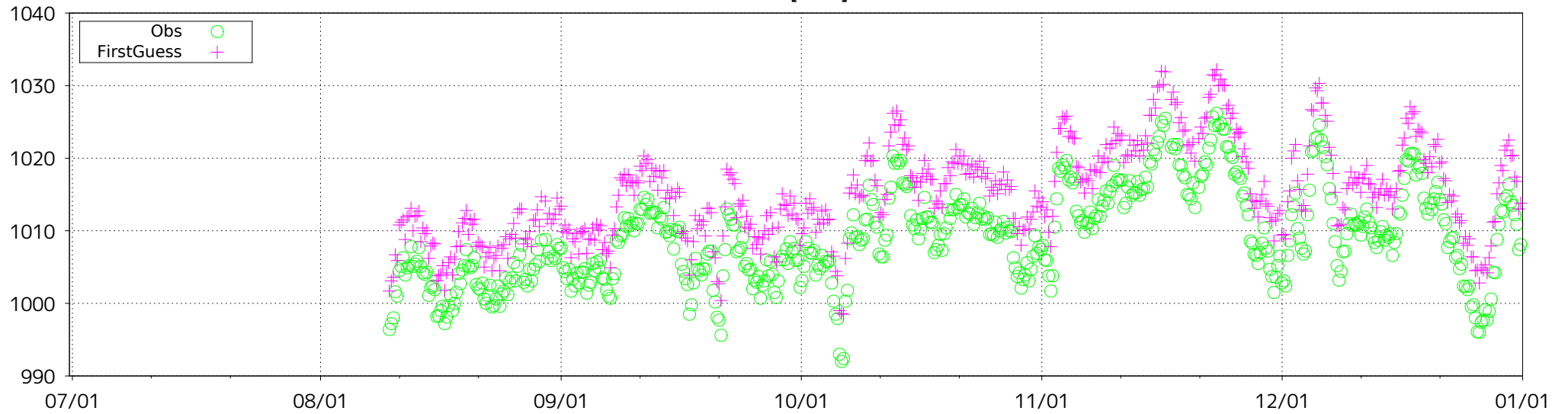


Figure 39 Time-series representation of MSLP Obs minus FirstGuess for station 40633

ID: 40700 (lat: 39.6N, lon: 47.9E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

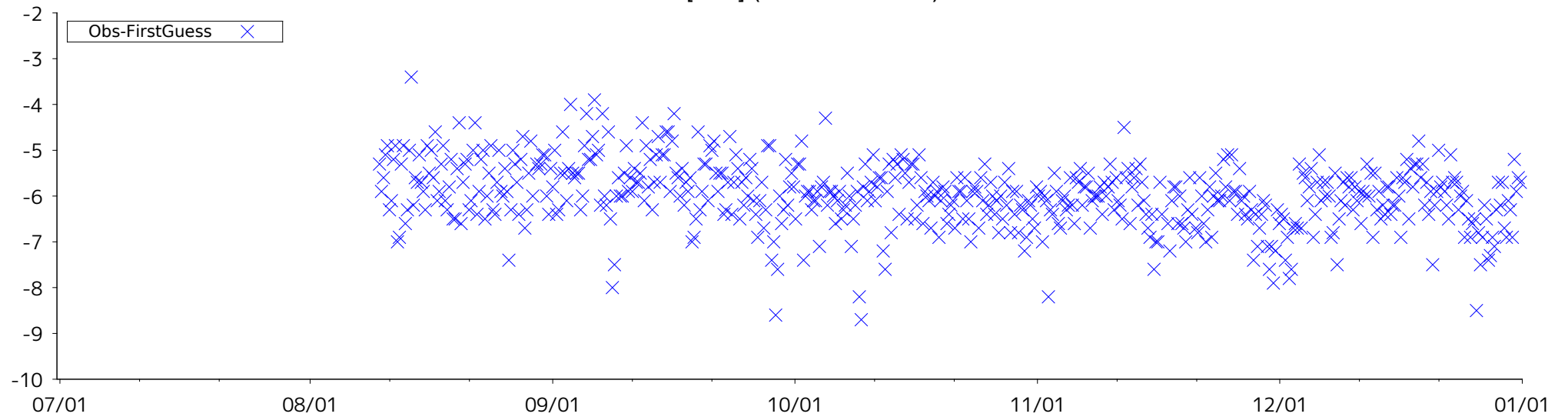


Figure 40 Time-series representation of SLP Obs minus FirstGuess for station 40700

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

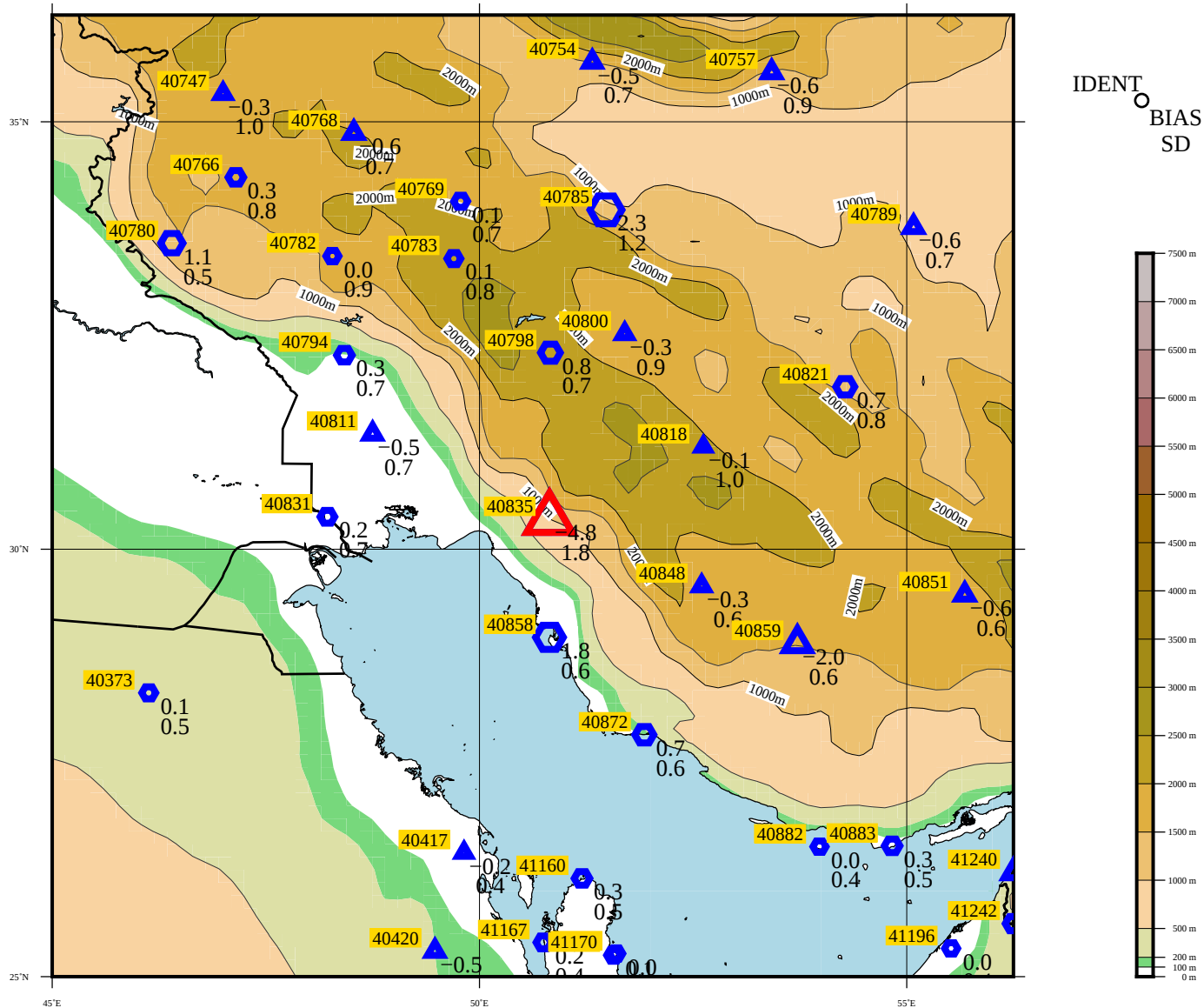
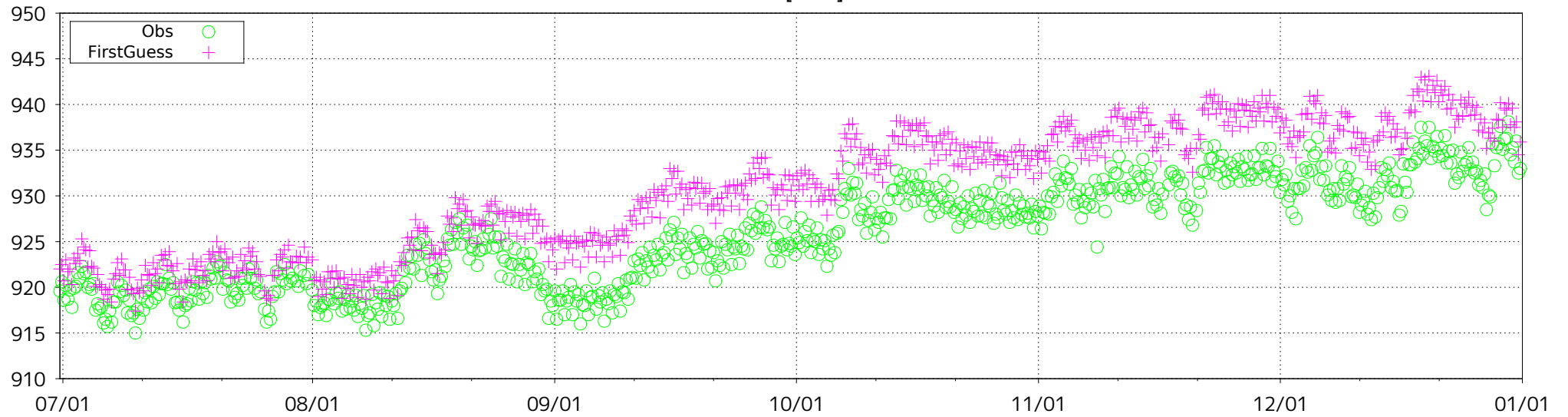


Figure 41 BIAS and SD of SLP for station 40835 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

ID: 40835 (lat: 30.4N, lon: 50.8E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

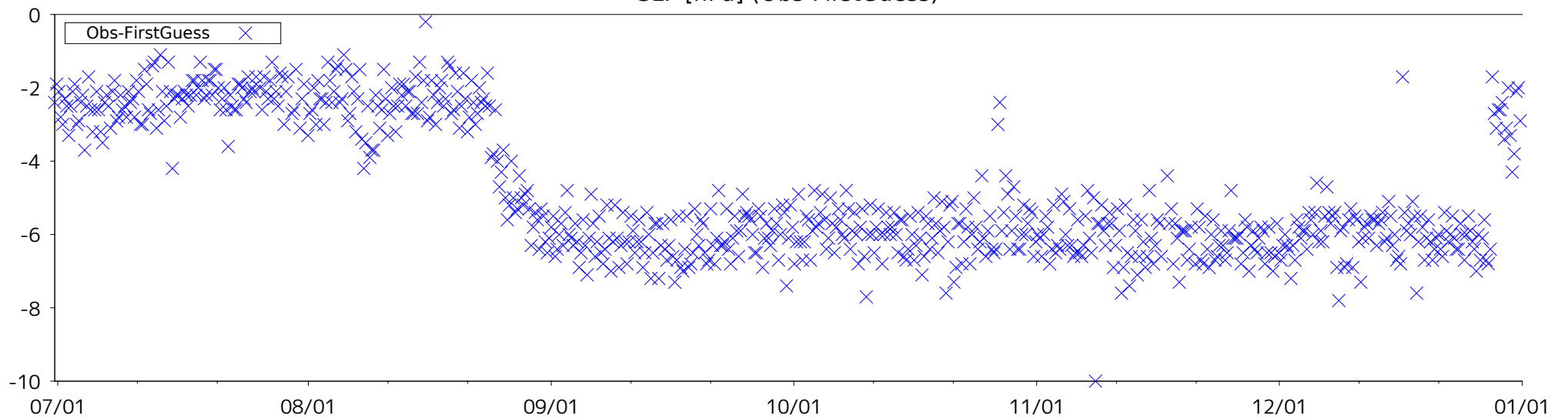
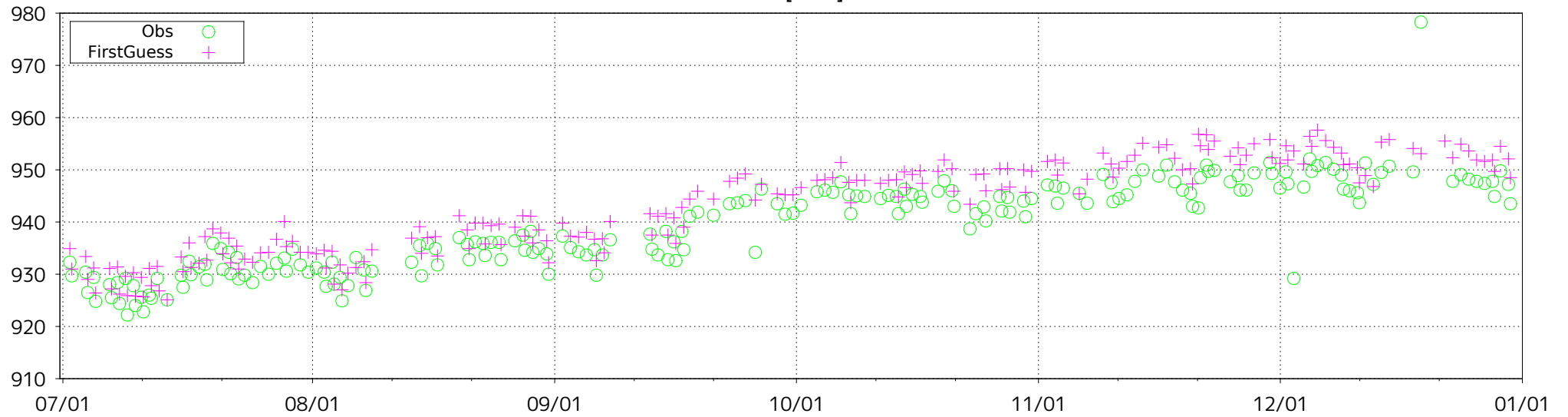


Figure 42 Time-series representation of SLP Obs minus FirstGuess for station 40835

ID: 40954 (lat: 34.4N, lon: 70.5E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

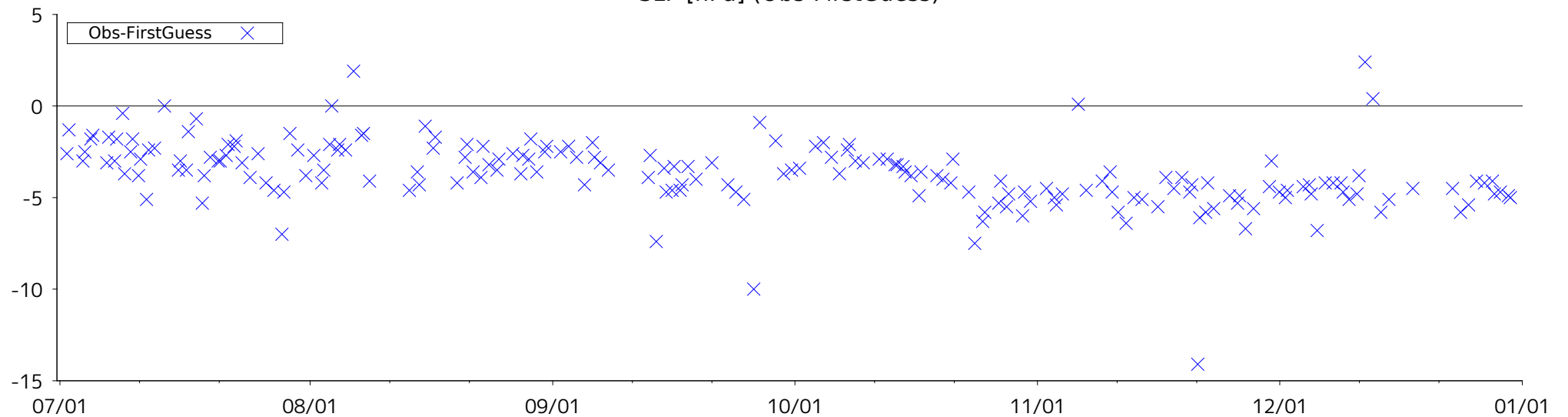


Figure 43 Time-series representation of SLP Obs minus FirstGuess for station 40954

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

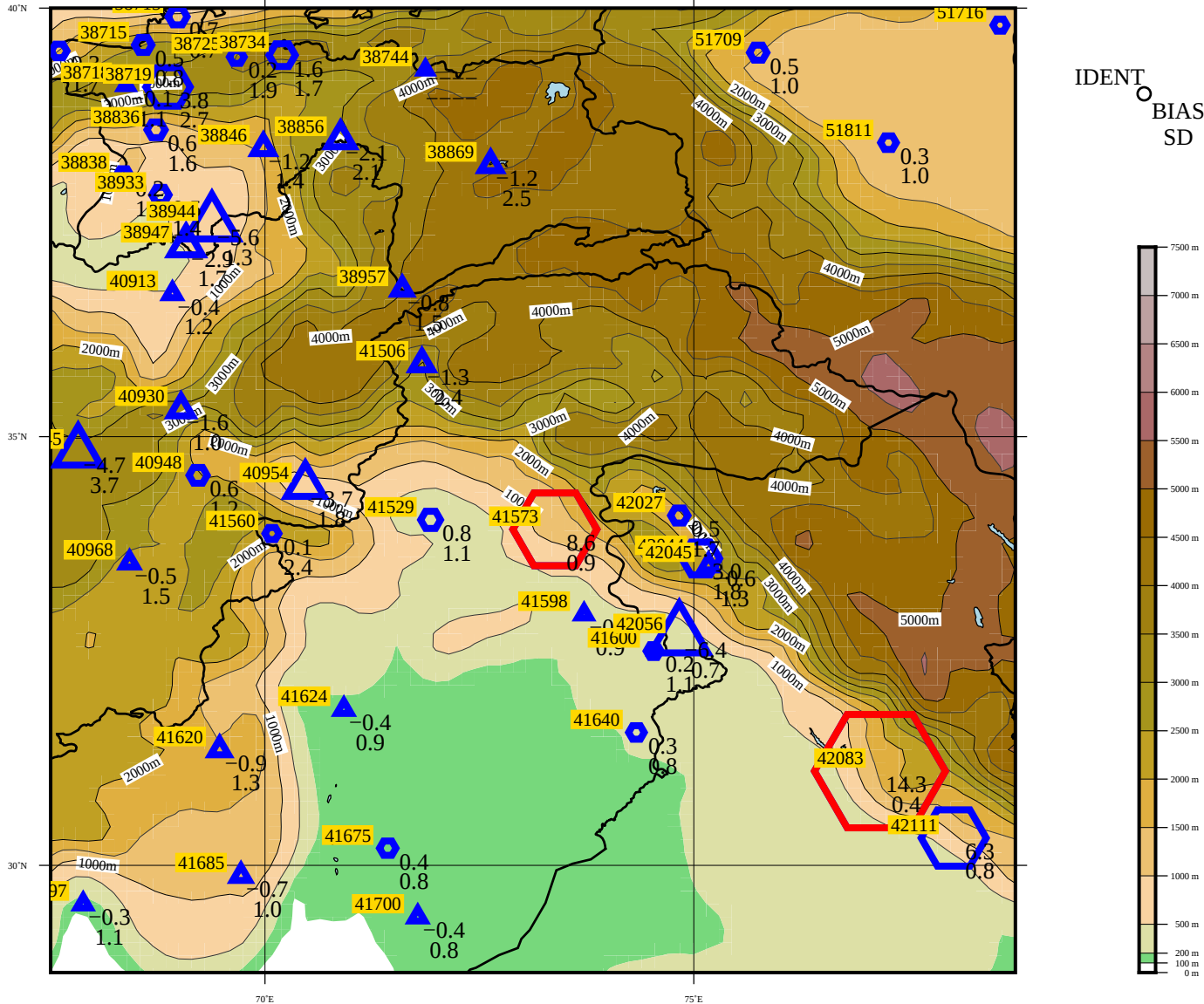
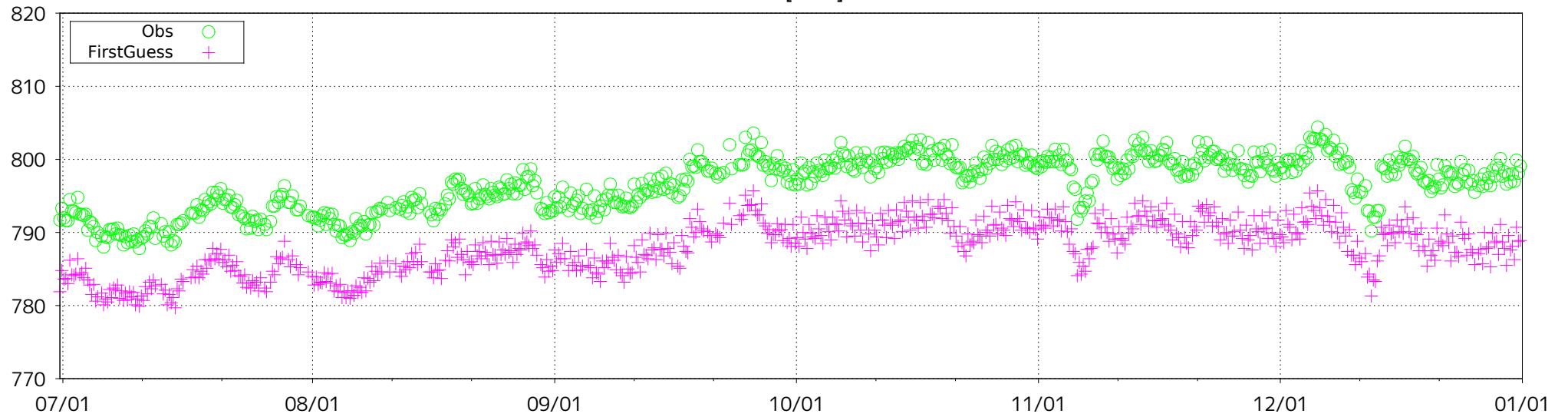


Figure 44 BIAS and SD of SLP for station 41573, 42083 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

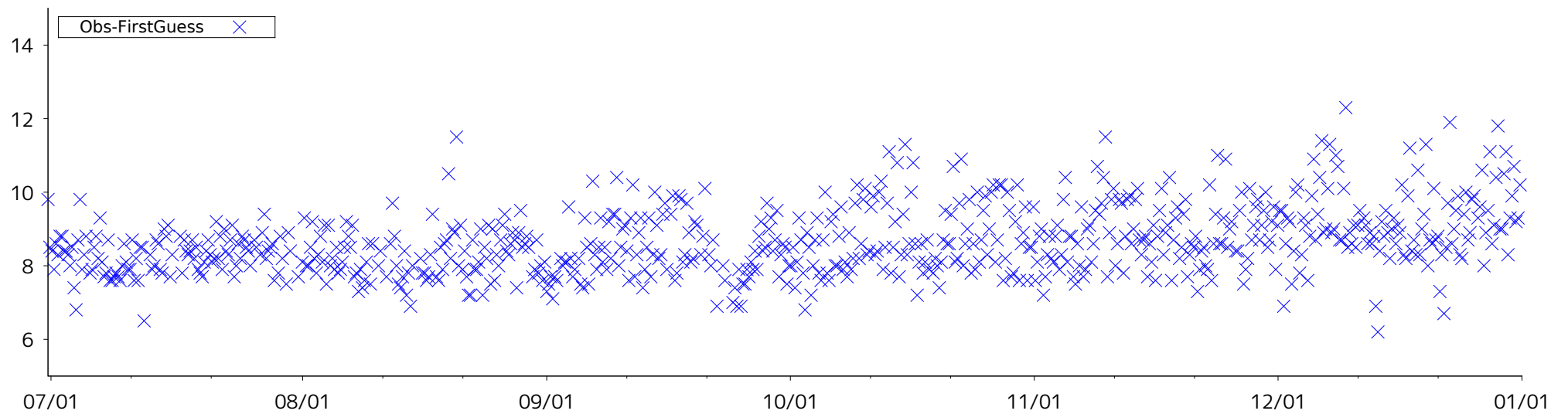
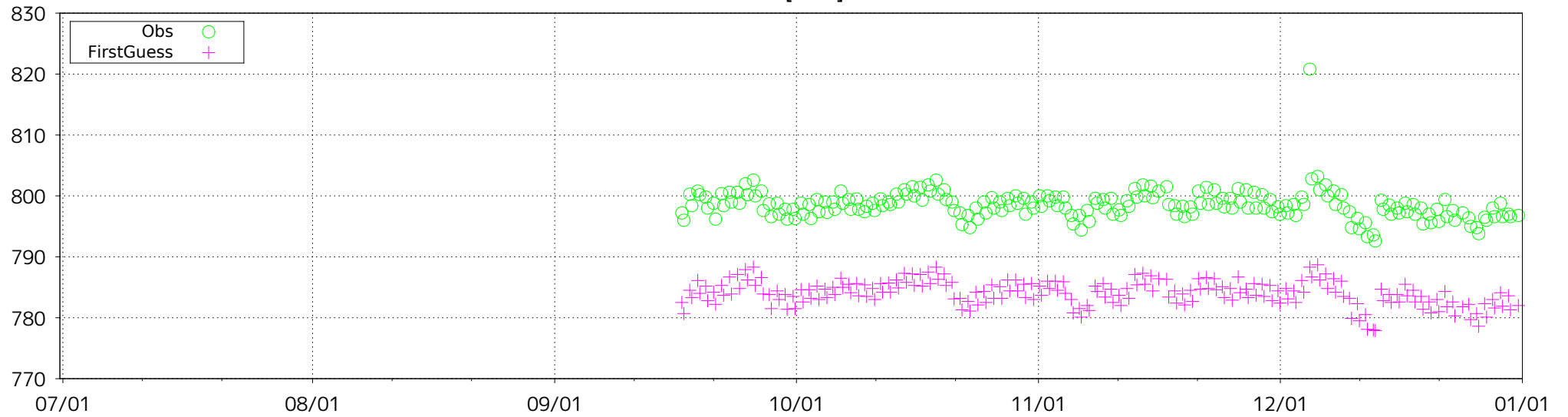


Figure 45 Time-series representation of SLP Obs minus FirstGuess for station 41573

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

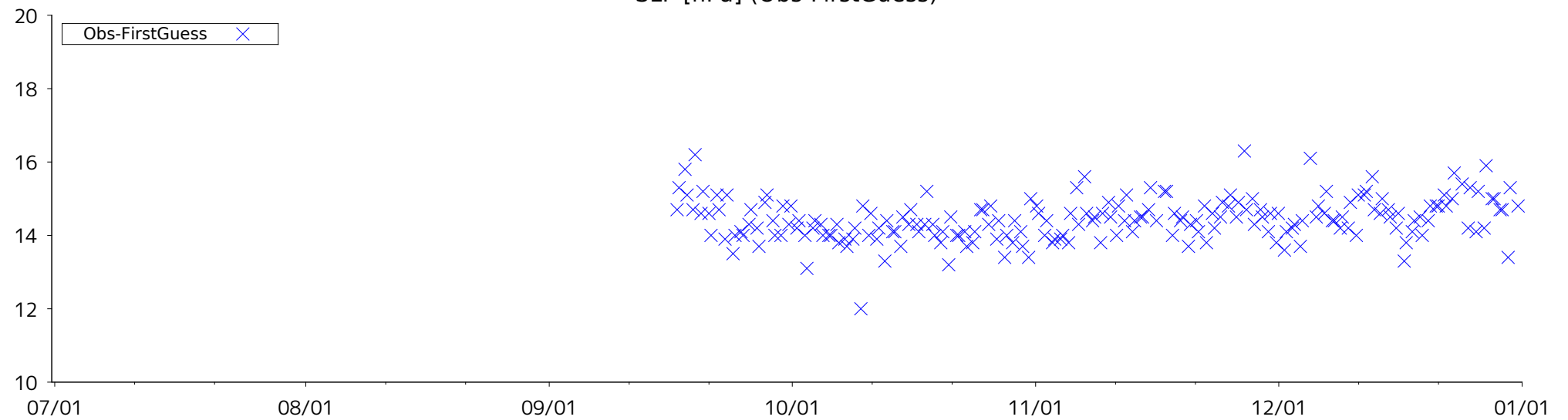
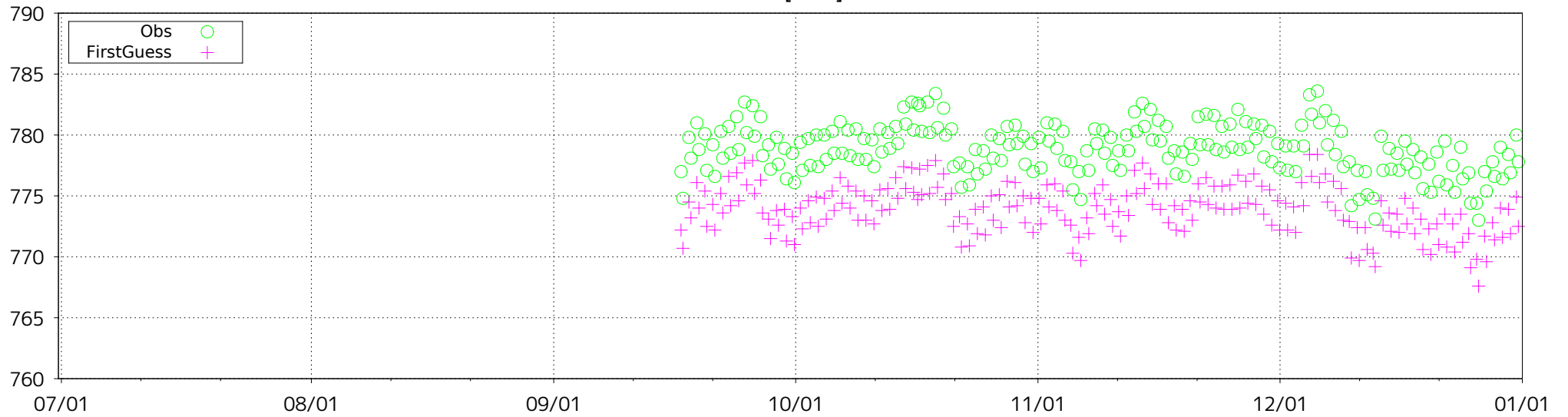


Figure 46 Time-series representation of SLP Obs minus FirstGuess for station 42083

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

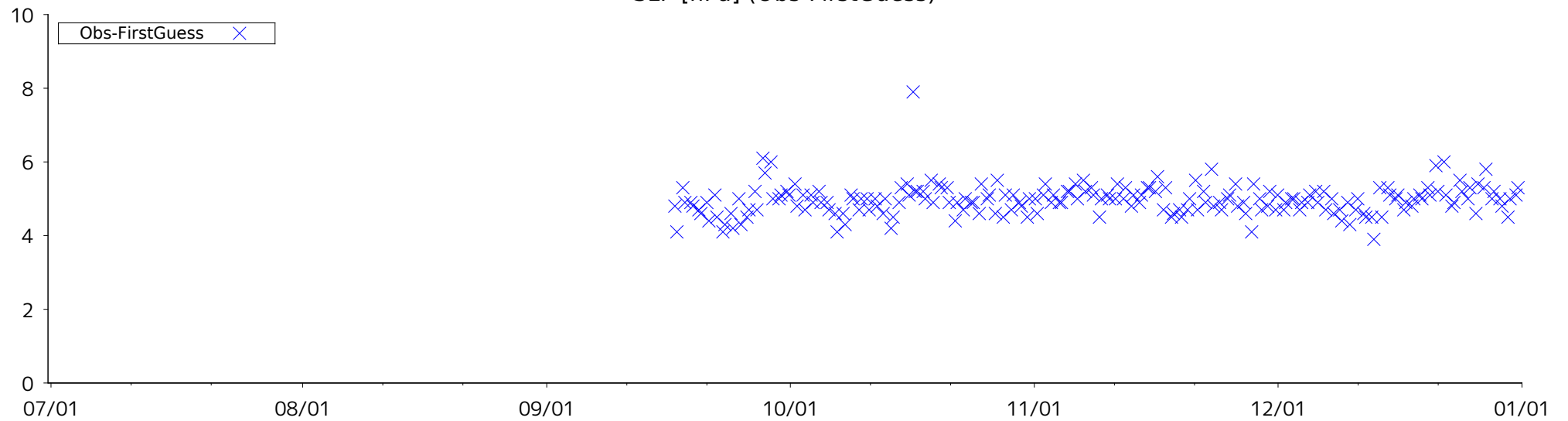


Figure 47 Time-series representation of SLP Obs minus FirstGuess for station 42147

LEVEL = SUR ELEMENT = SLP
 2019 07 01 00 UTC -> 2019 12 31 18 UTC (184 DAYS)

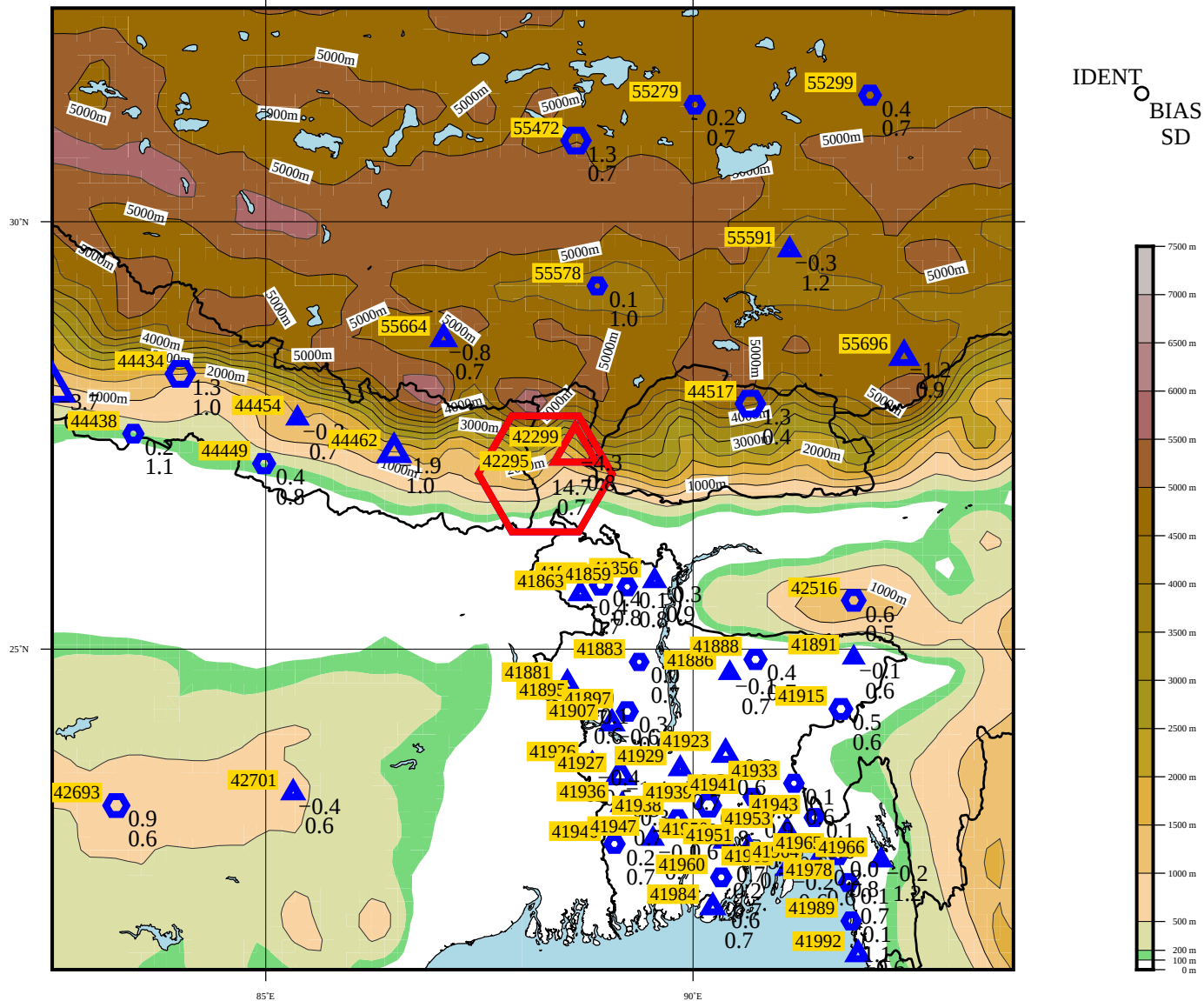
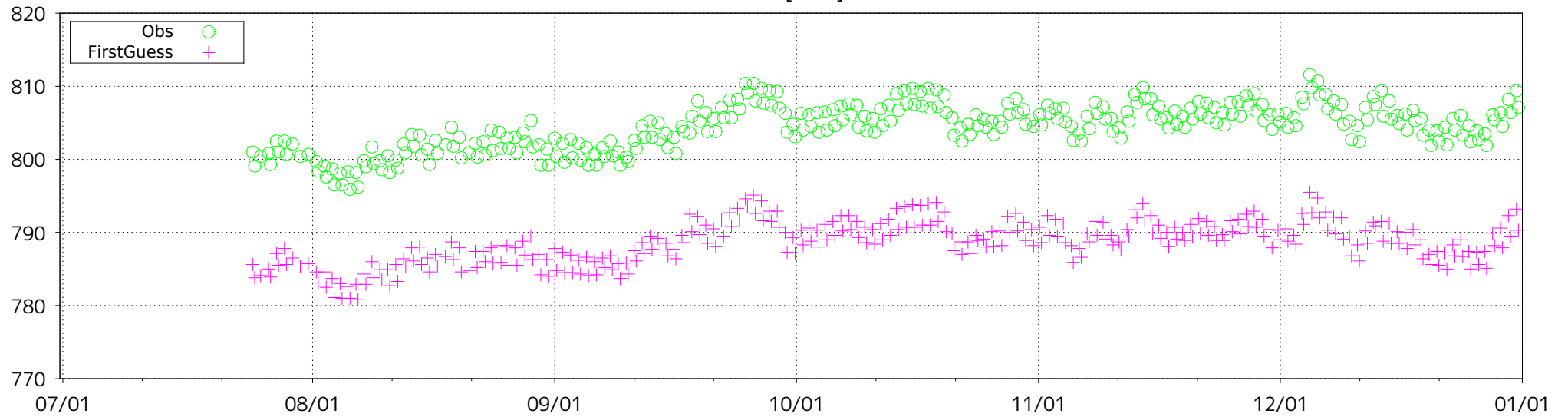


Figure 48 BIAS and SD of SLP for station 42295, 42299 (red) and surrounding stations (blue).
 The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
 The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

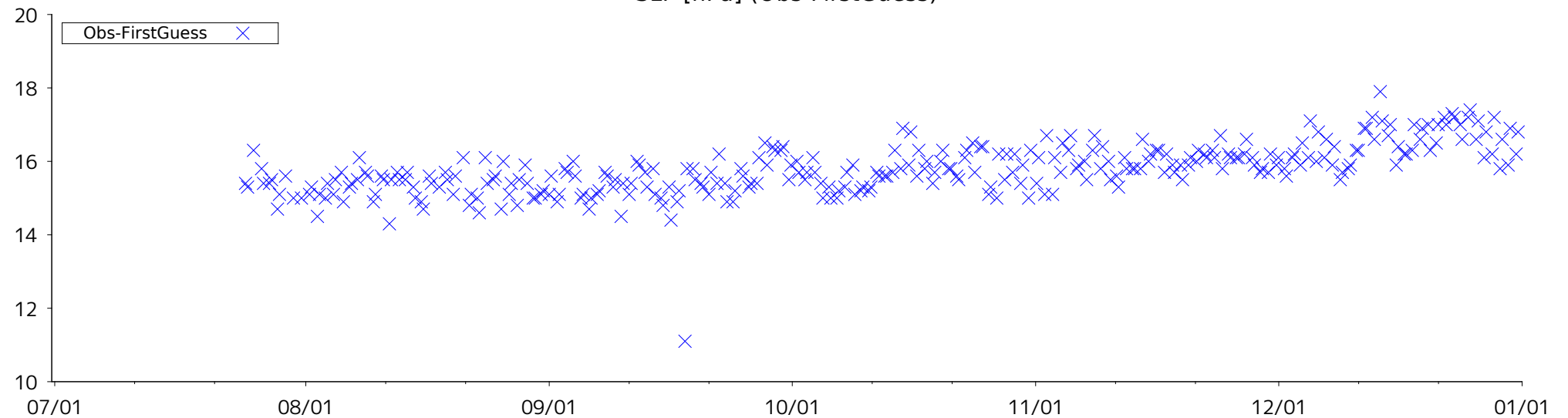
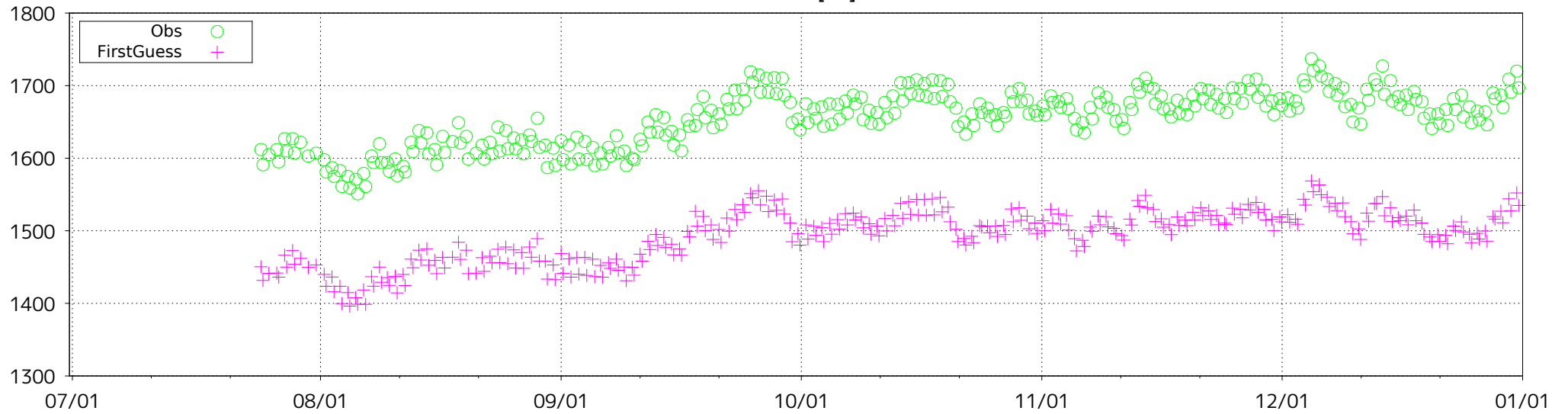


Figure 49(a) Time-series representation of SLP Obs minus FirstGuess for station 42295

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

GZ850 [m]



GZ850 [m] (Obs-FirstGuess)

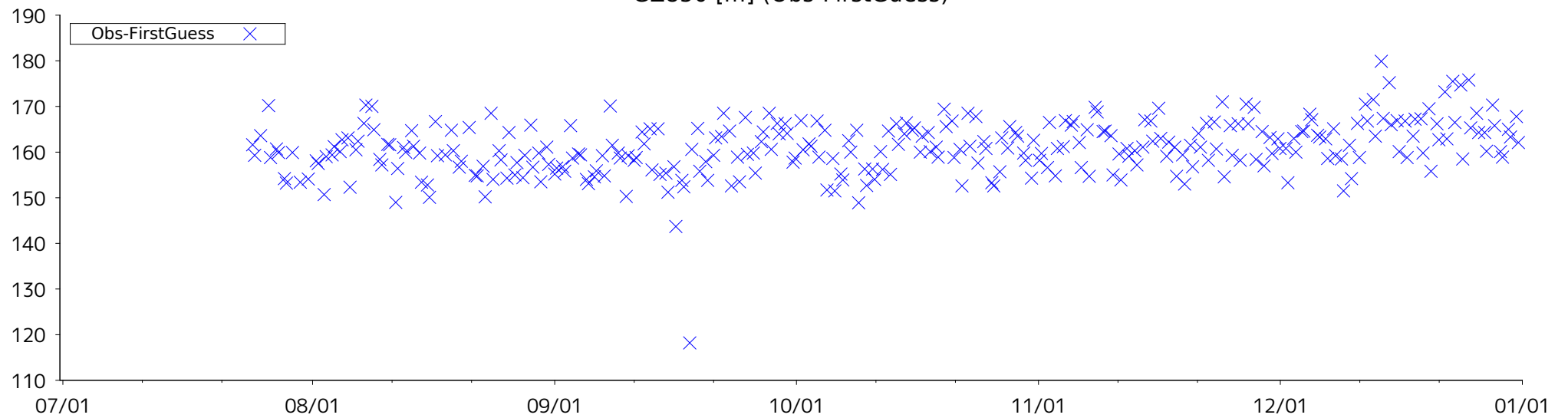
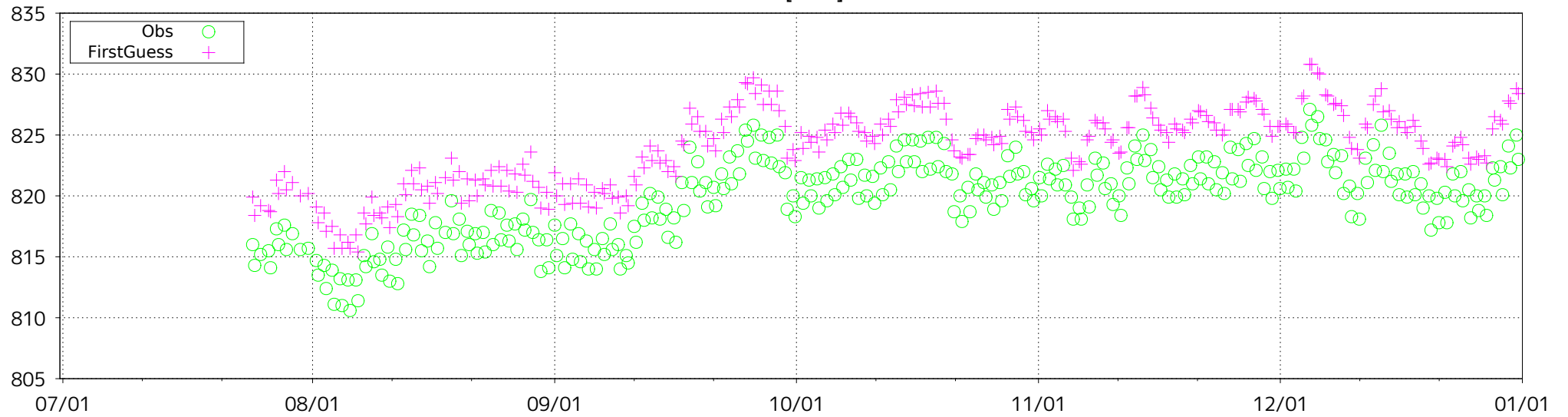


Figure 49(b) Time-series representation of GZ850 Obs minus FirstGuess for station 42295

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

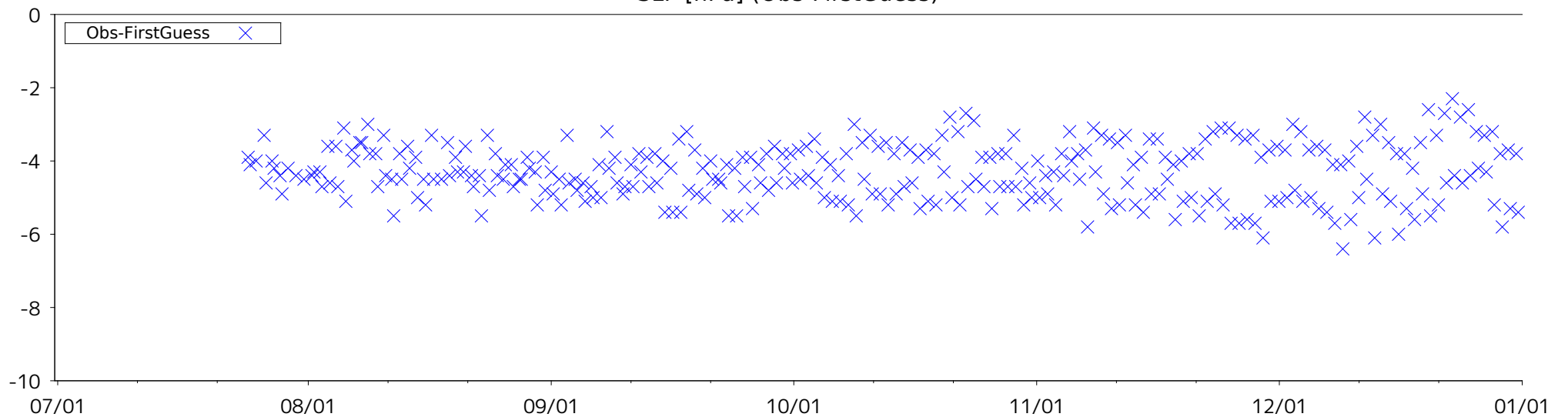
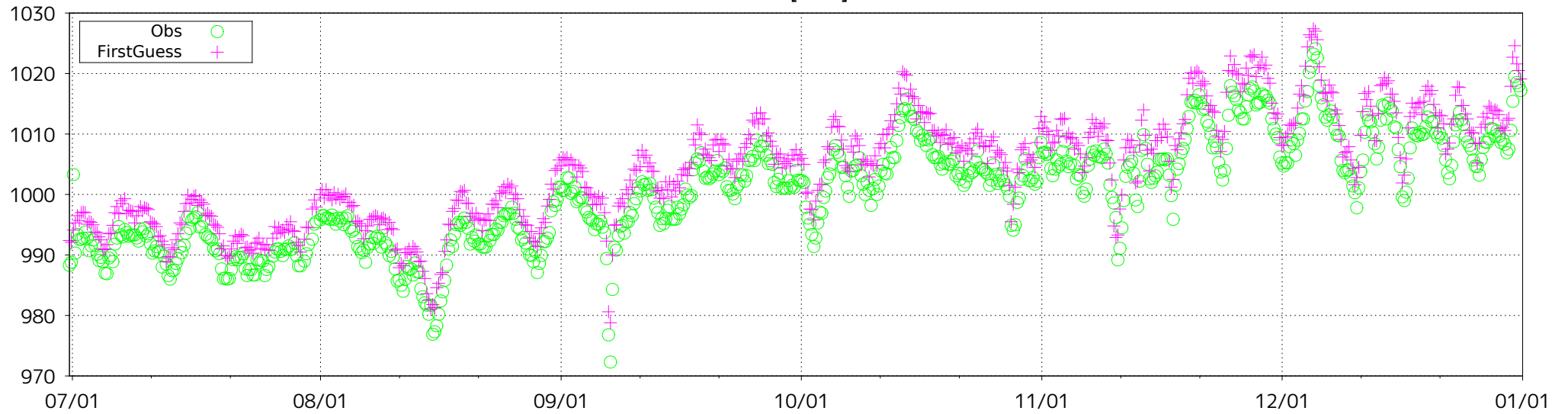


Figure 50 Time-series representation of SLP Obs minus FirstGuess for station 42299

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

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

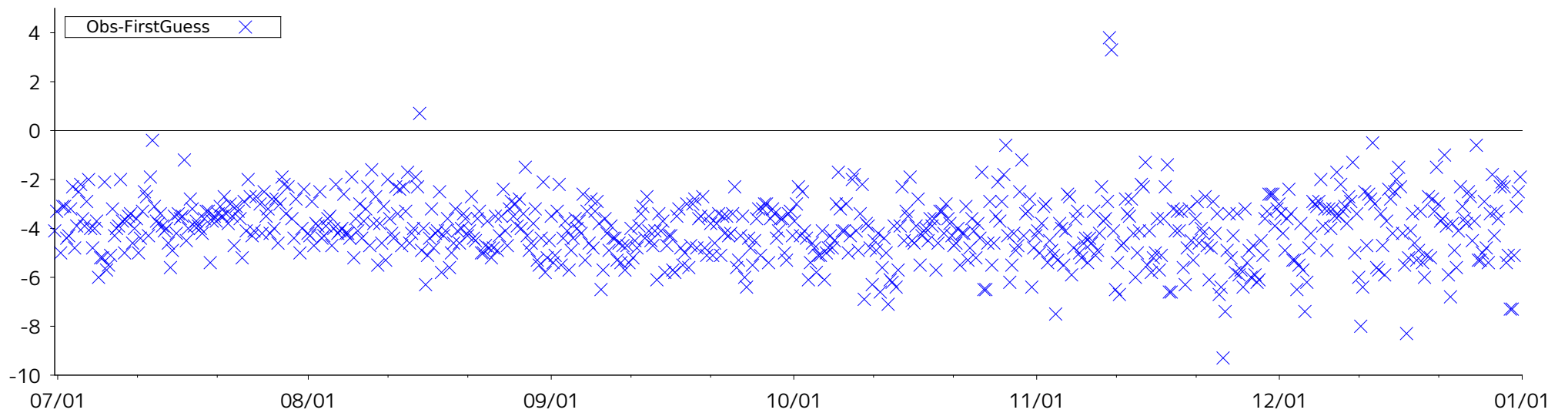
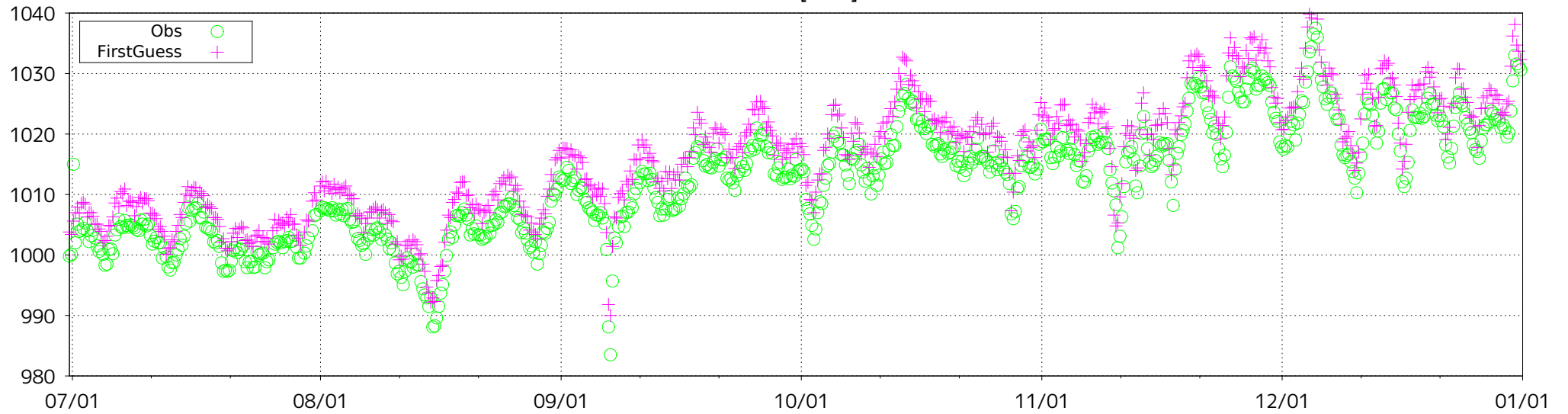


Figure 51(a) Time-series representation of SLP Obs minus FirstGuess for station 47037

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

MSLP [hPa]



MSLP [hPa] (Obs-FirstGuess)

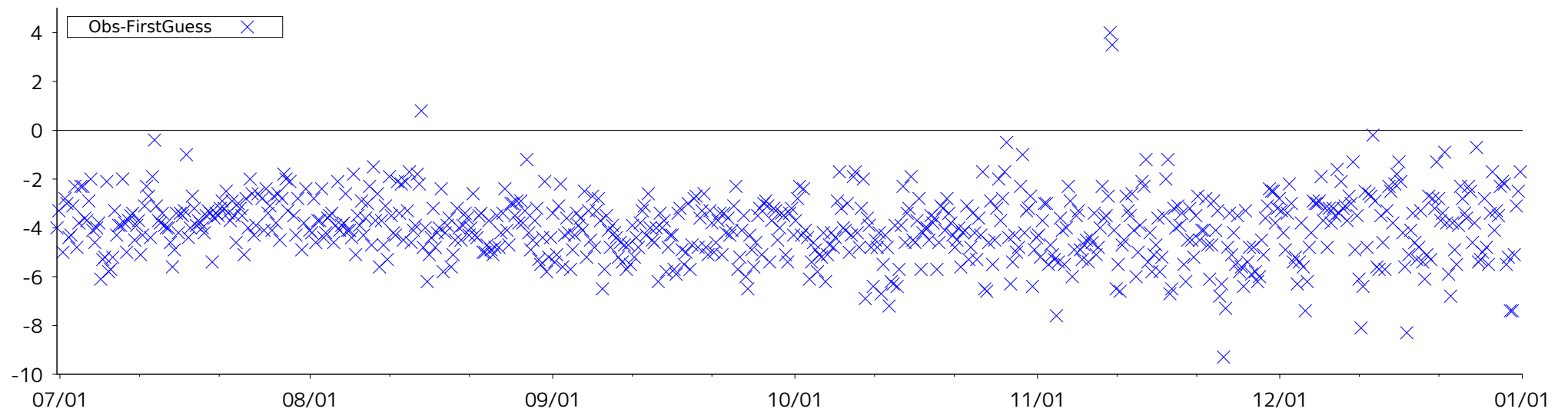
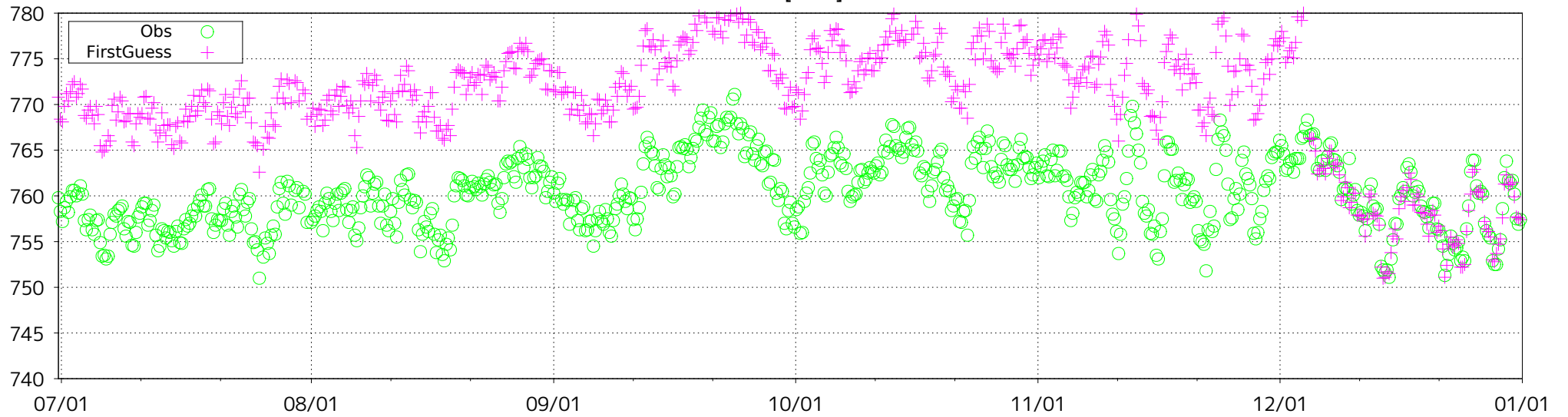


Figure 51(b) Time-series representation of MSLP Obs minus FirstGuess for station 47037

ID: 52866 (lat: 36.7N, lon: 101.7E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

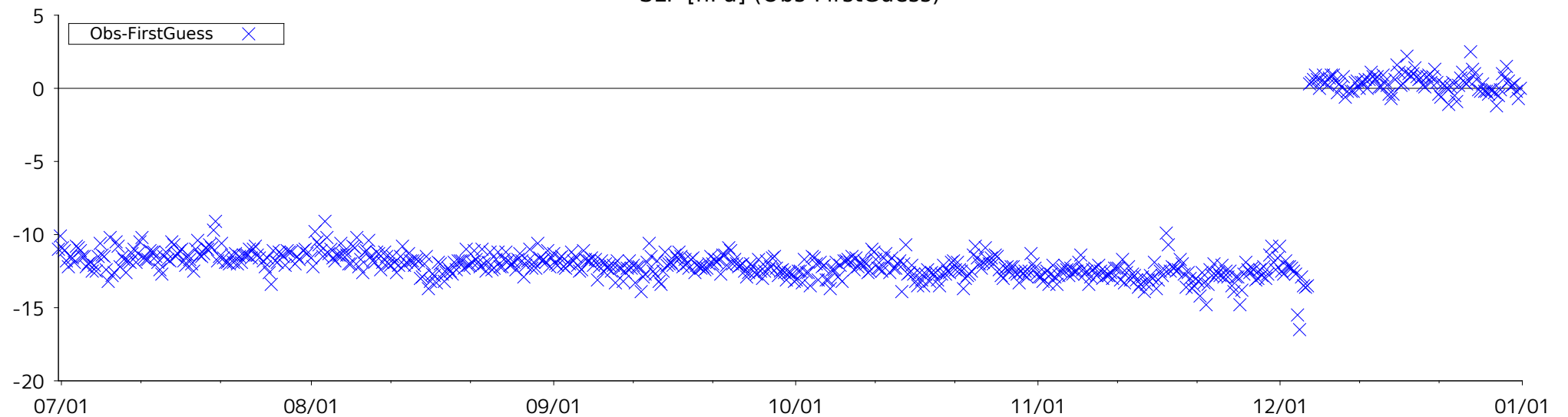
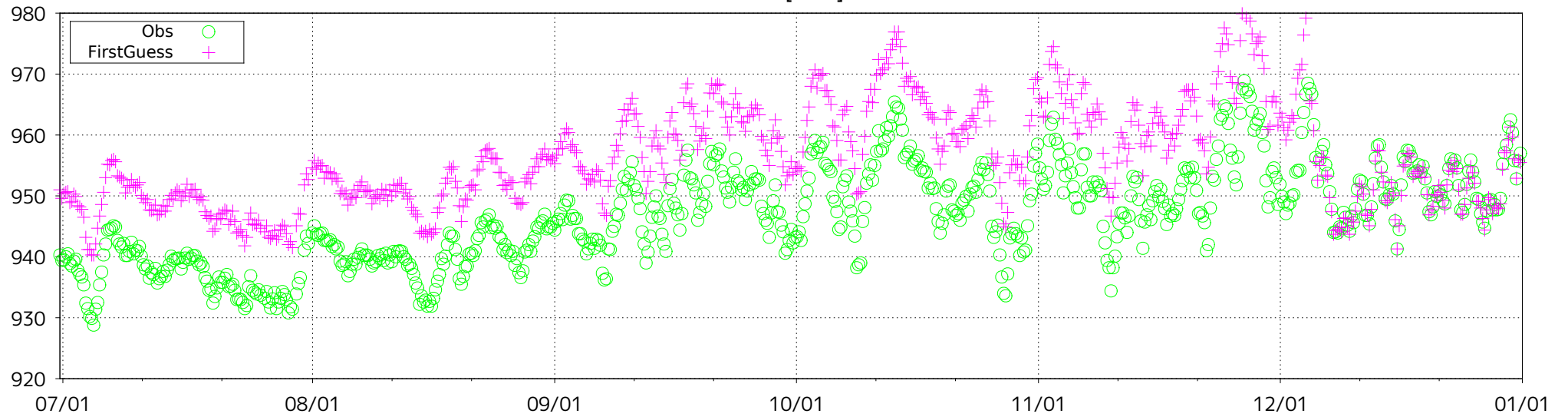


Figure 52 Time-series representation of SLP Obs minus FirstGuess for station 52866

ID: 54027 (lat: 44.0N, lon: 119.3E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

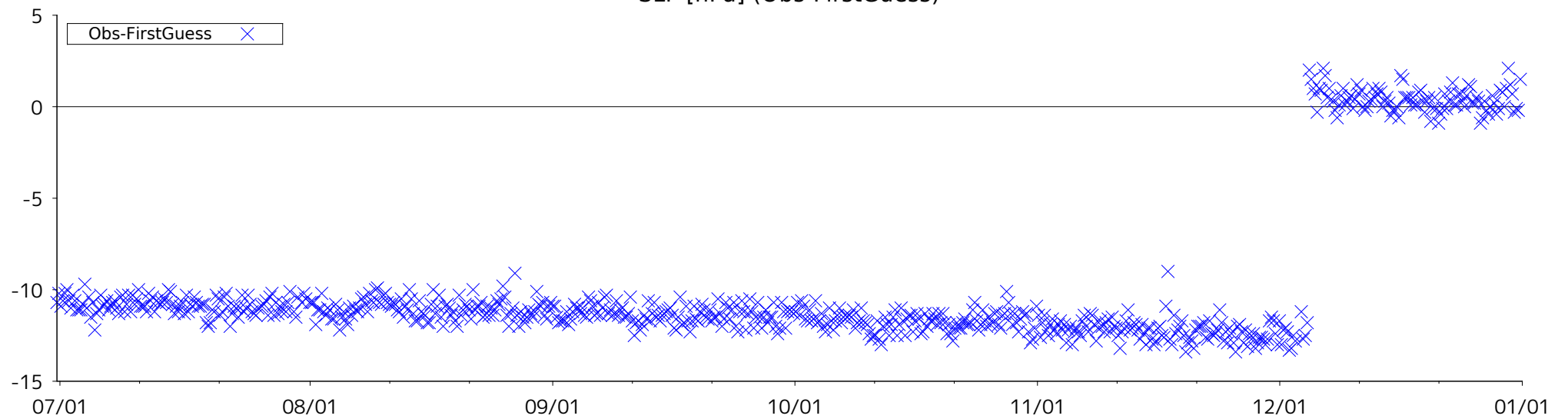
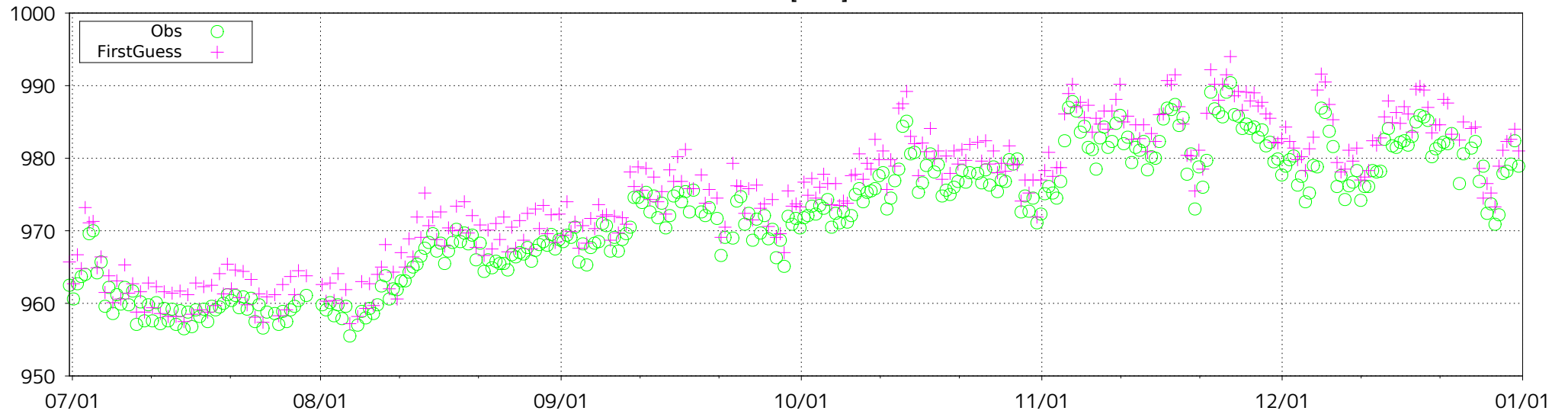


Figure 53 Time-series representation of SLP Obs minus FirstGuess for station 54027

ID: 38947 (lat: 37.2N, lon: 69.1E)

SLP [hPa]



SLP [hPa] (Obs-FirstGuess)

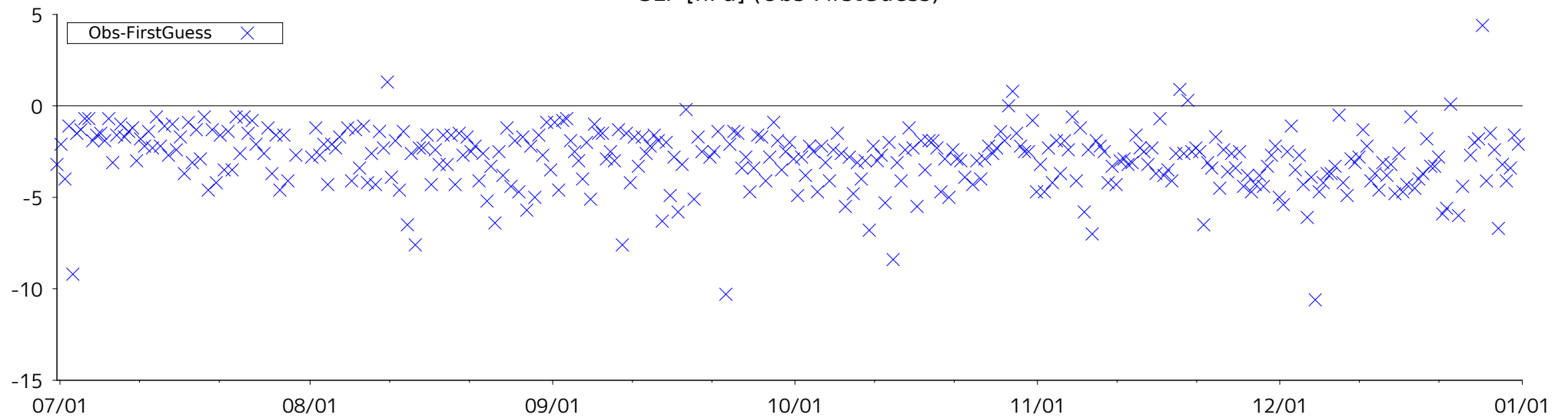


Figure 54 Time-series representation of SLP Obs minus FirstGuess for station 38947