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

January – June 2019

No. 57

September 2019

RSMC Tokyo
Lead Center for Monitoring Quality of Land Surface Observations

Japan Meteorological Agency
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Japan

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(No. 57)
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Summary

In its role as a Lead Center, RSMC Tokyo has issued the 57th report on the land surface observation quality monitoring for the period from January to June 2019. The report includes a consolidated list of stations suspected of producing low-quality observation data.

As a result of monitoring, five stations (38313, 38318, 40835, 40954, 41244) were excluded from the consolidated lists of the previous report (July – December 2018), and three stations (48952, 52866, 54027) 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	1655
MSLP	1827
GZ	81

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:

|O-G| >= 15 hPa for SLP and MSLP
|O-G| >= 100 gpm for GZ

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| >= 3 hPa for SLP and MSLP
	|BIAS| >= 30 gpm for GZ
- SD	SD >= 5 hPa for SLP and MSLP
	SD >= 40 gpm for GZ
- Percentage of gross errors (PGE)	PGE >= 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 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 January to June 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	666	0	1.8	5.1	5.4
					GZ850	658	0	9.5	-0.5	9.5
38262	43.0	59.8	93	59	SLP	724	0	1.2	4.0	4.2
					MSLP	724	0	1.2	0.8	1.4
38719	39.1	68.9	3373	3151	SLP	359	8	4.1	6.4	7.6
					GZ700	721	33	23.8	49.4	54.8
38880	38.0	58.4	312	319	SLP	724	0	1.1	12.0	12.1
					MSLP	724	0	1.0	0.2	1.0
38944	37.5	69.4	447	593	SLP	724	0	1.6	-5.8	6.0
					MSLP	724	0	2.4	-6.3	6.7
38947	37.2	69.1	327	495	SLP	363	1	2.1	-3.2	3.8
					MSLP	723	0	2.4	0.3	2.4
40713	37.4	46.2	1478	1535	SLP	724	2	0.7	13.1	13.1
					MSLP	724	0	2.6	-2.6	3.7
40741	36.5	61.2	235	289	SLP	723	0	1.1	-4.3	4.4
					MSLP	723	0	2.3	-0.1	2.3
40854	29.1	58.4	940	1157	SLP	715	8	0.7	-13.7	13.7
					MSLP	715	0	1.9	-1.5	2.4
40877	28.0	57.7	470	682	SLP	715	0	0.8	-3.5	3.6
					MSLP	715	0	1.4	-3.9	4.1
40942	33.5	65.3	2183	2453	SLP	335	0	1.4	-6.1	6.3
					MSLP	335	0	3.3	-1.9	3.8
40945	34.8	67.8	2550	3232	SLP	249	0	3.7	-4.8	6.1
					MSLP	249	9	6.2	-3.1	6.9
41263	22.9	57.3	592	684	SLP	592	0	0.6	8.4	8.4
					MSLP	591	0	0.9	-2.2	2.4
41265	22.8	58.5	469	592	SLP	721	2	0.6	-5.1	5.1
					MSLP	721	2	1.1	-1.4	1.8
42111	30.3	78.0	683	878	SLP	712	0	1.0	6.2	6.3
					MSLP	710	0	1.6	-1.0	1.9
43226	14.3	74.5	60	50	SLP	701	0	0.7	4.4	4.5
					MSLP	700	0	0.7	0.5	0.9
43418	8.6	81.3	79	8	SLP	534	0	0.6	4.6	4.6
					MSLP	534	0	0.6	-0.3	0.7
43479	7.0	81.1	670	862	SLP	354	1	0.6	-9.5	9.5
					-	-	-	-	-	-
44406	29.3	81.0	617	1547	SLP	485	1	1.8	5.2	5.5
					MSLP	481	0	2.8	-1.6	3.2

WMO IDENT	LAT (N)	LON (E)	H (m)	HM (m)	ELEM	NOBS	PGE (%)	SD	BIAS	RMS
44424	29.3	82.2	2300	3274	SLP	484	1	1.4	-5.9	6.1
					GZ700	478	0	14.2	-46.0	48.1
44429	28.1	82.5	634	883	SLP	470	1	0.9	-3.8	3.9
					MSLP	467	0	1.8	0.4	1.8
47102	38.0	124.7	146	2	SLP	724	0	0.7	12.2	12.2
					MSLP	724	0	0.6	-1.3	1.4
47145	36.8	127.3	26	110	SLP	724	0	0.6	-6.6	6.6
					MSLP	724	0	0.7	0.2	0.7
47152	35.6	129.3	36	125	SLP	724	0	0.6	-5.8	5.8
					MSLP	724	0	0.6	-0.2	0.6
48921	21.6	101.9	1360	1072	SLP	491	2	1.1	-4.3	4.4
					GZ850	489	100	*****	*****	*****
48935	19.5	103.1	1094	1196	SLP	506	1	0.9	-0.1	0.9
					GZ850	505	16	8.4	-88.7	89.1
50756	47.5	126.9	248	206	SLP	724	0	0.7	3.2	3.3
					MSLP	724	0	1.9	2.4	3.1

WMO IDENT:	WMO station identification number
LAT:	station latitude
LON:	station longitude
H:	station 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)

38947 - Negative bias of O-G at the station level (Figures 6 and 9)

TURKMENISTAN

38880 - Positive bias of O-G at the station level (Figures 4 and 10)

IRAN, ISLAMIC REPUBLIC OF

40713 - Positive bias of O-G at the station level (Figures 11 and 12)

40741 - Negative bias of O-G at the station level (Figures 4 and 13)

40854 - Negative bias of O-G at the station level (Figures 14 and 15)

40877 - Negative bias of O-G at the station level and at the mean sea level (Figures 14 and 16)

AFGHANISTAN

40942 - Negative bias of O-G at the station level (Figures 6 and 17)

40945 - Negative bias of O-G at the station level (Figures 6 and 18)

OMAN

41263 - Positive bias of O-G at the station level (Figures 19 and 20)

41265 - Negative bias of O-G at the station level (Figures 19 and 21)

INDIA

42111 - Positive bias of O-G at the station level (Figures 22 and 23)

43226 - Positive bias of O-G at the station level (Figures 24 and 25)

SRI LANKA

43418 - Positive bias of O-G at the station level (Figures 26 and 27)

43479 - Negative bias of O-G at the station level (Figures 26 and 28)

NEPAL

44406 - Positive bias of O-G at the station level (Figures 22 and 29)

44424 - Negative bias of O-G at the station level and at 700 hPa (Figures 22 and 30)

44429 - Negative bias of O-G at the station level (Figures 22 and 31)

REPUBLIC OF KOREA

47102 - Positive bias of O-G at the station level (Figures 32 and 33)

The positive bias of O-G at the station level appears to have been observed since May 2018.

47145 - Negative bias of O-G at the station level (Figures 32 and 34)

47152 - Negative bias of O-G at the station level (Figures 32 and 35)

LAO PEOPLE'S DEMOCRATIC REPUBLIC

48921 - Negative bias of O-G at the station level and at 850 hPa (Figures 36 and 37)

48935 - Negative bias of O-G at 850 hPa (Figure 38)

CHINA

50756 - Positive bias of O-G at the station level and at the mean sea level (Figures 39 and 40)

On the other hand, positive bias of O-G at the mean sea level has improved since May 2019.

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
48952	15.7	106.4	180	334	SLP	511	0	1.0	3.8	3.9
					MSLP	510	0	1.1	2.5	2.7
52866	36.6	101.8	2296	2458	SLP	724	0	0.9	-12.6	12.6
					-	-	-	-	-	-
54027	44.0	119.4	485	628	SLP	723	0	0.9	-11.8	11.8
					MSLP	723	0	1.2	0.3	1.2

LAO PEOPLE'S DEMOCRATIC REPUBLIC

48952 - Positive bias of O-G at the station level (Figures 41 and 42)

The positive bias of O-G at the station level appears to have been observed since November 2018.

CHINA

52866 - Negative bias of O-G at the station level (Figures 43 and 44)

The negative bias of O-G at the station level appears to have been observed since January 2019.

54027 - Negative bias of O-G at the station level (Figures 45 and 46)

The negative bias of O-G at the station level appears to have been observed since January 2019.

4.3 Stations improved and excluded from the previous consolidated list

OMAN

41244 - Although O-G at the station level and at the mean sea level were fluctuating wildly since October 2018, both have improved since March 2019. (Figure 47)

4.4 Stations removed from the previous consolidated list

KAZAKHSTAN

38313 - Although station 38313 still displays positive biases of O-G at the station level, it was removed from the consolidated list because the number of reports (27) was insufficient for quality check-

ing. (Figure 48)

38318 - Although station 38318 still displays negative biases of O-G at the station level, it was removed from the consolidated list because the number of reports (159) was insufficient for quality checking. (Figure 49)

IRAN, ISLAMIC REPUBLIC OF

40835 - Although station 40835 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 50)

AFGHANISTAN

40954 - Although station 40954 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 51)

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.

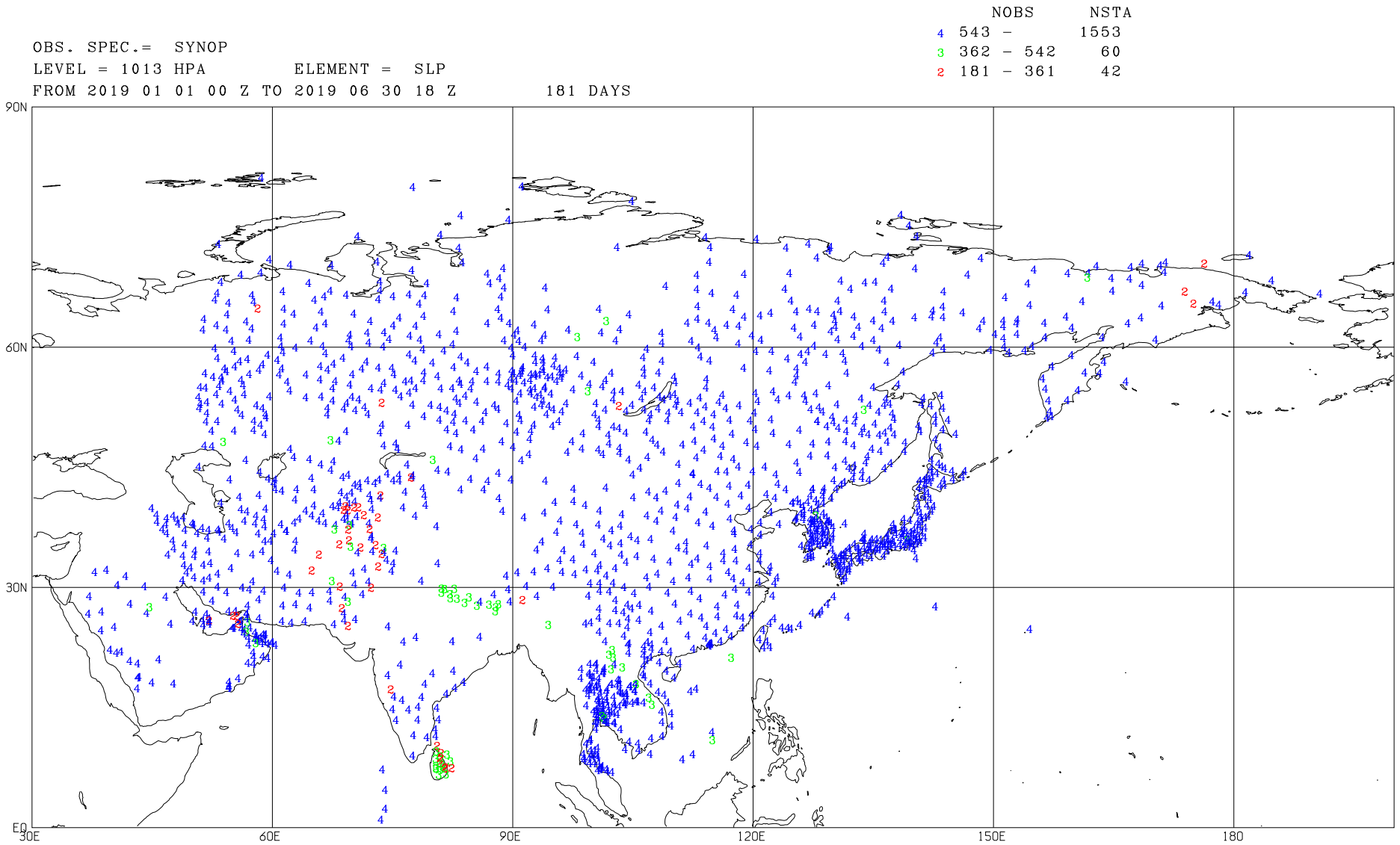

Figure 1(a) Location of all land surface stations reporting station level pressure (SLP) observations in Region II over the six-month period from January to June 2019. Numbers (2, 3, 4) show the total number of observations (NOBS) received at RSMC Tokyo. The total numbers of stations (NSTA) reporting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

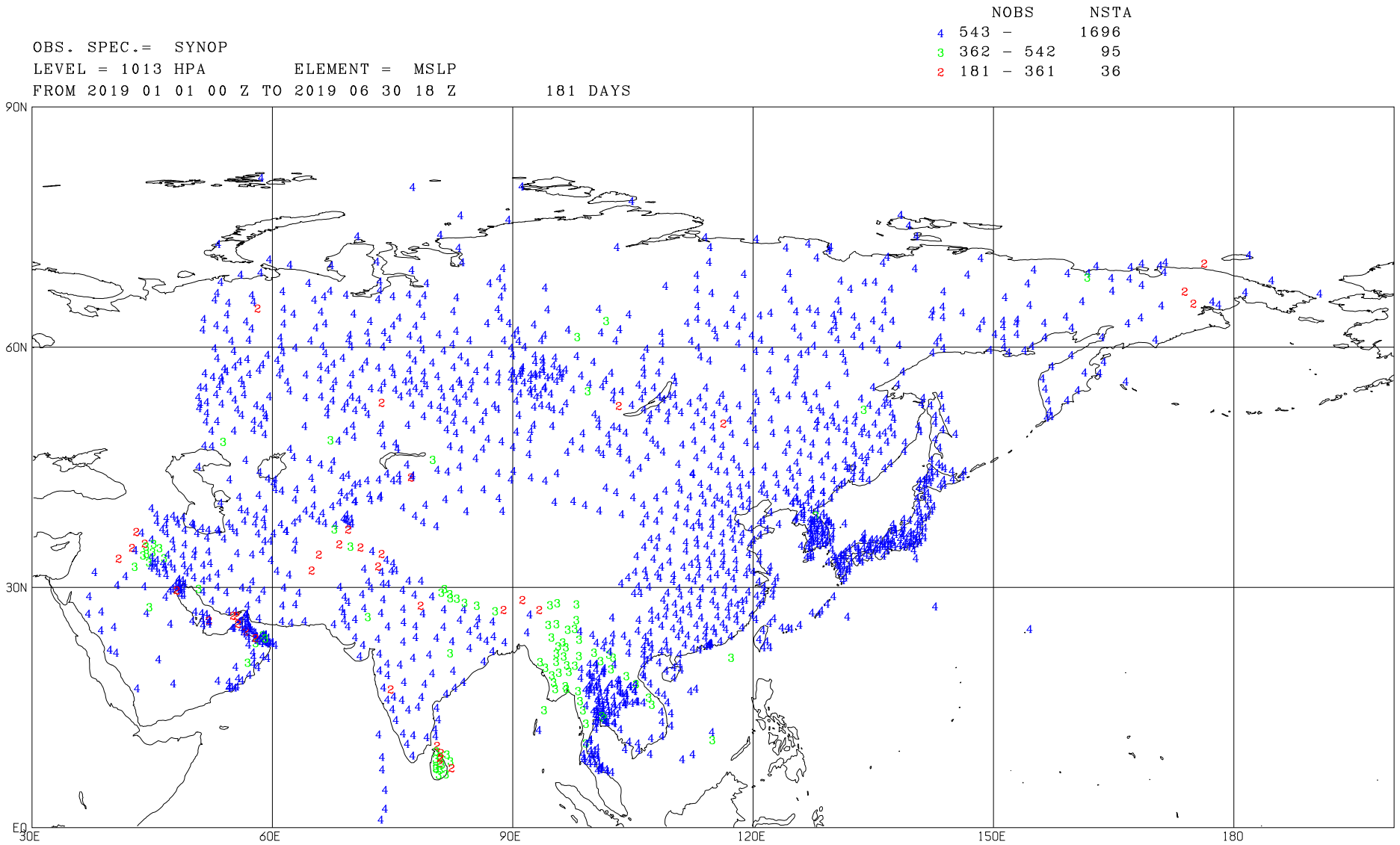

Figure 1(b) Location of all land surface stations reporting mean sea level pressure (MSLP) observations in Region II over the six-month period from January to June 2019. Numbers (2, 3, 4) show the total number of observations (NOBS) received at RSMC Tokyo. The total numbers of stations (NSTA) reporting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

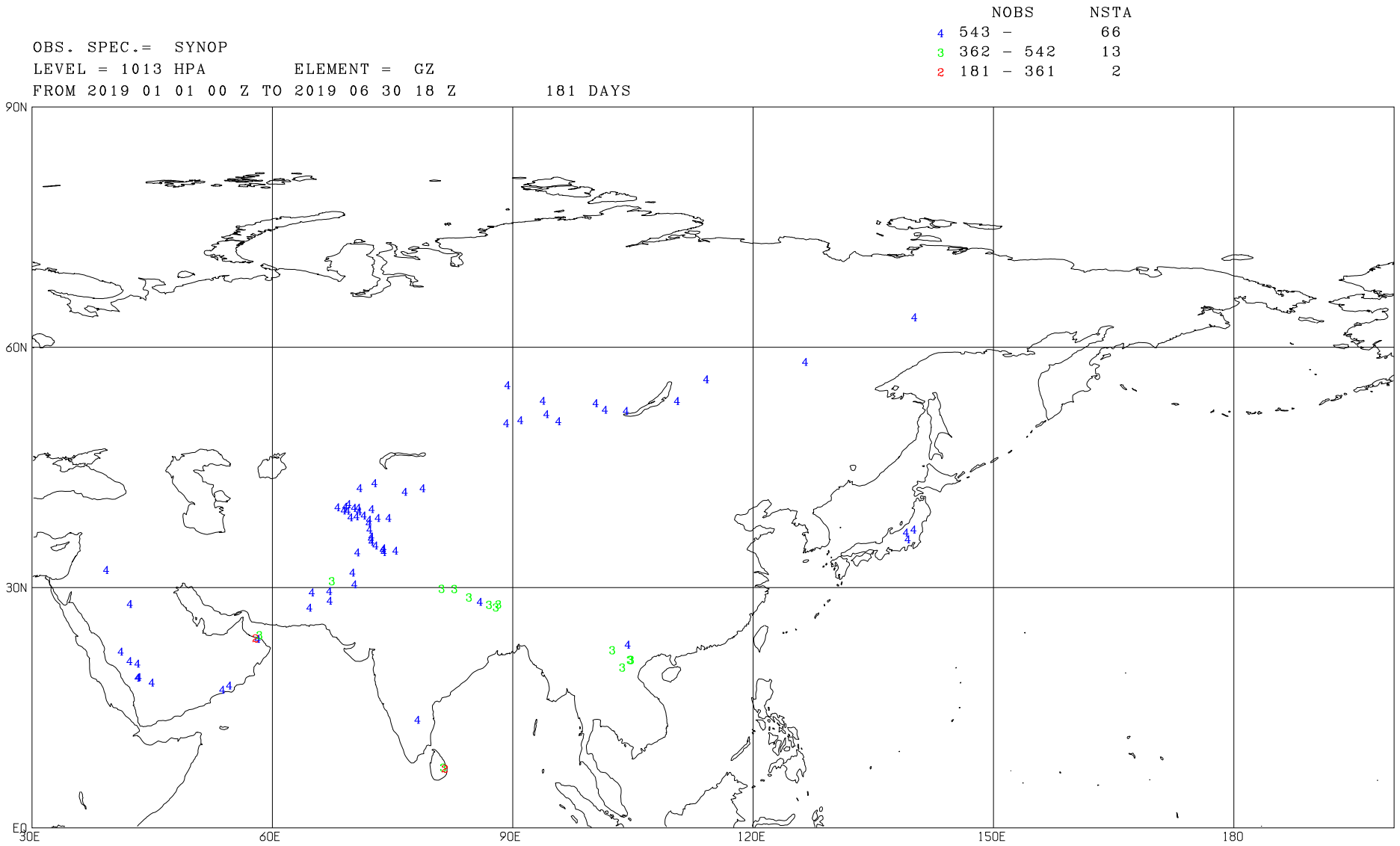

Figure 1(c) Location of all land surface stations reporting geopotential height (GZ) observations in Region II over the six-month period from January to June 2019. Numbers (2, 3, 4) show the total number of observations (NOBS) received at RSMC Tokyo. The total numbers of stations (NSTA) reporting GZ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

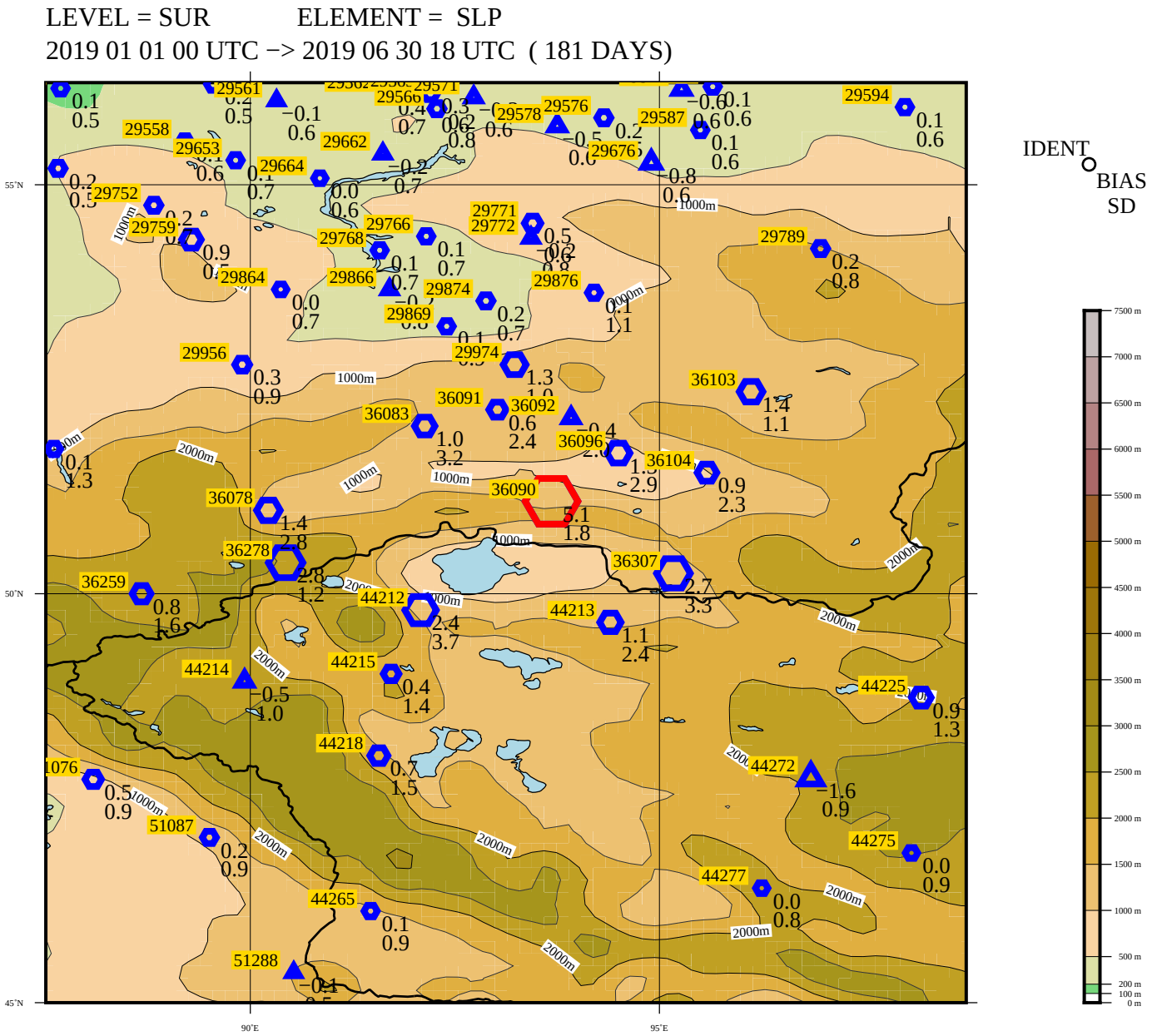

Figure 2 BIAS and SD of SLP for station 36090 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

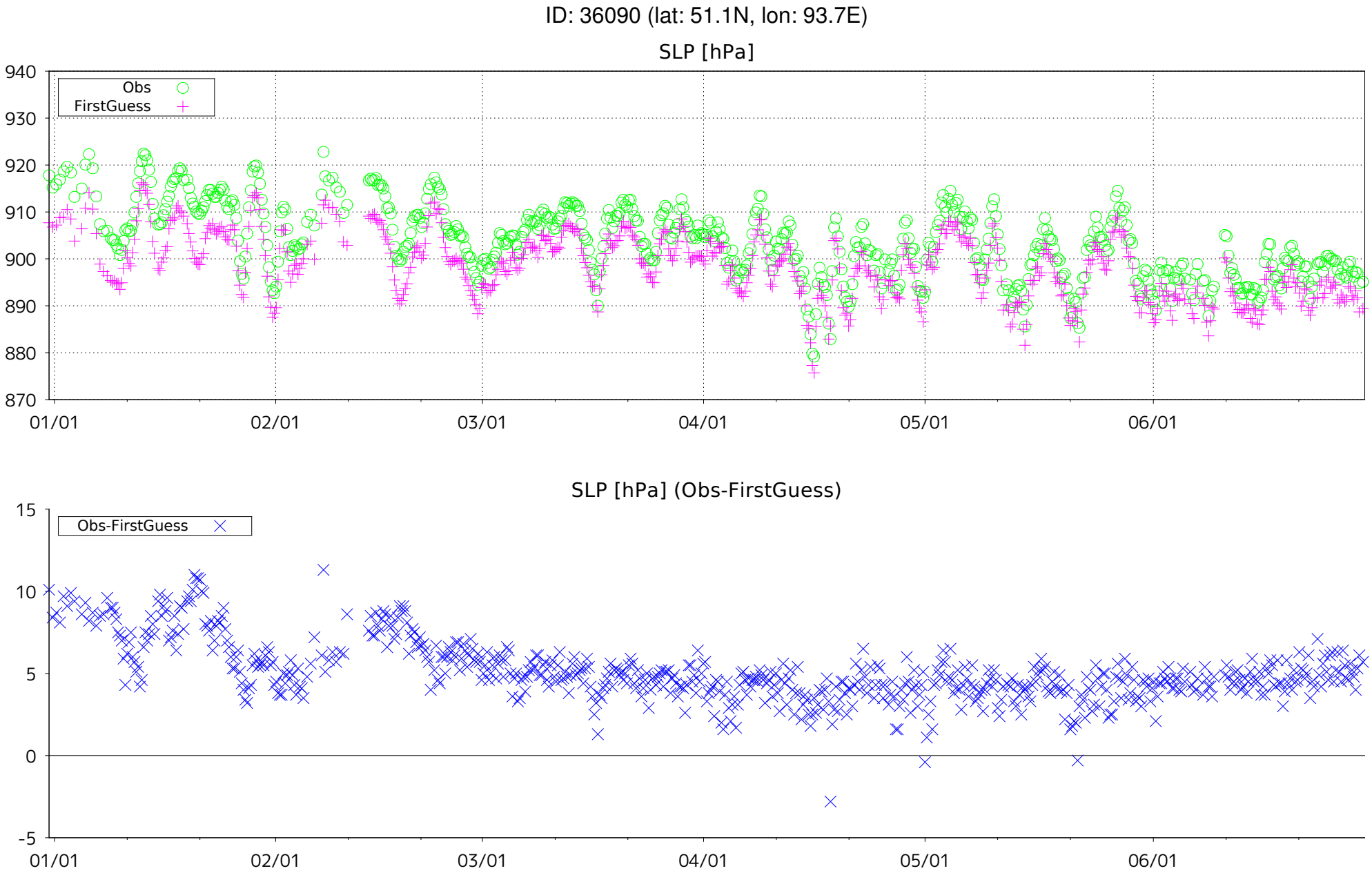

Figure 3 Time-series representation of SLP Obs minus FirstGuess for station 36090

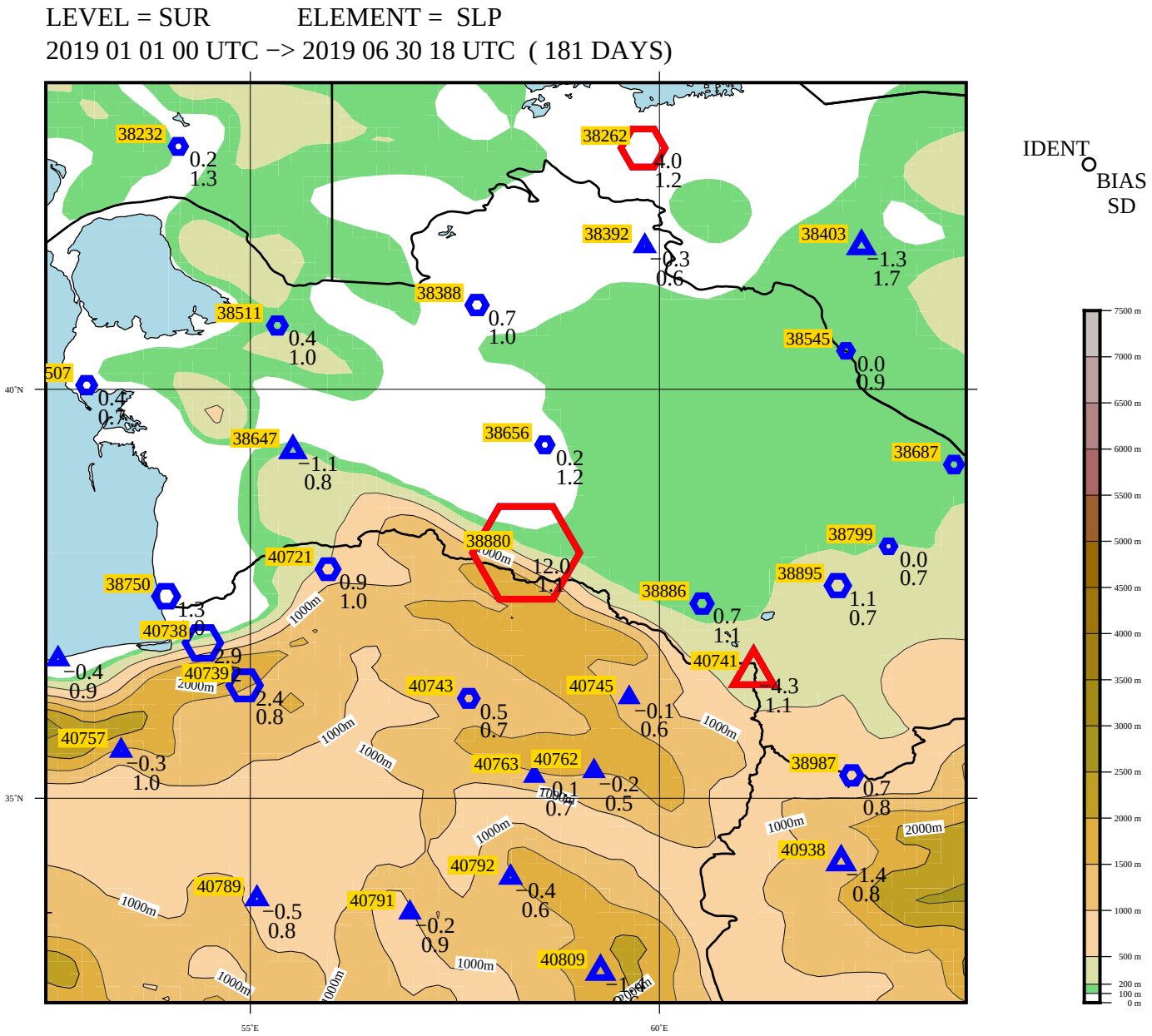

Figure 4 BIAS and SD of SLP for station 38262, 38880, 40741 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

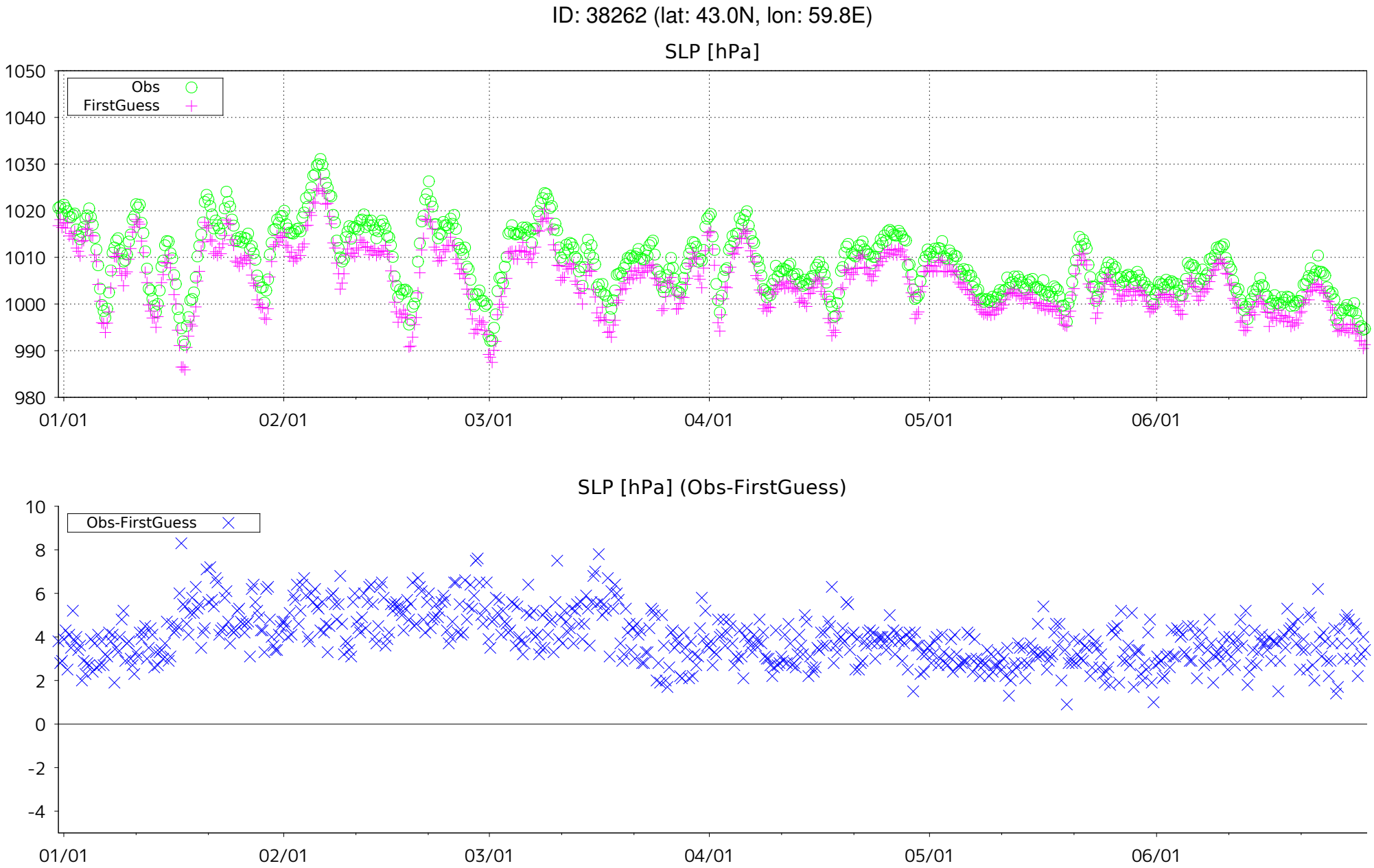

Figure 5 Time-series representation of SLP Obs minus FirstGuess for station 38262

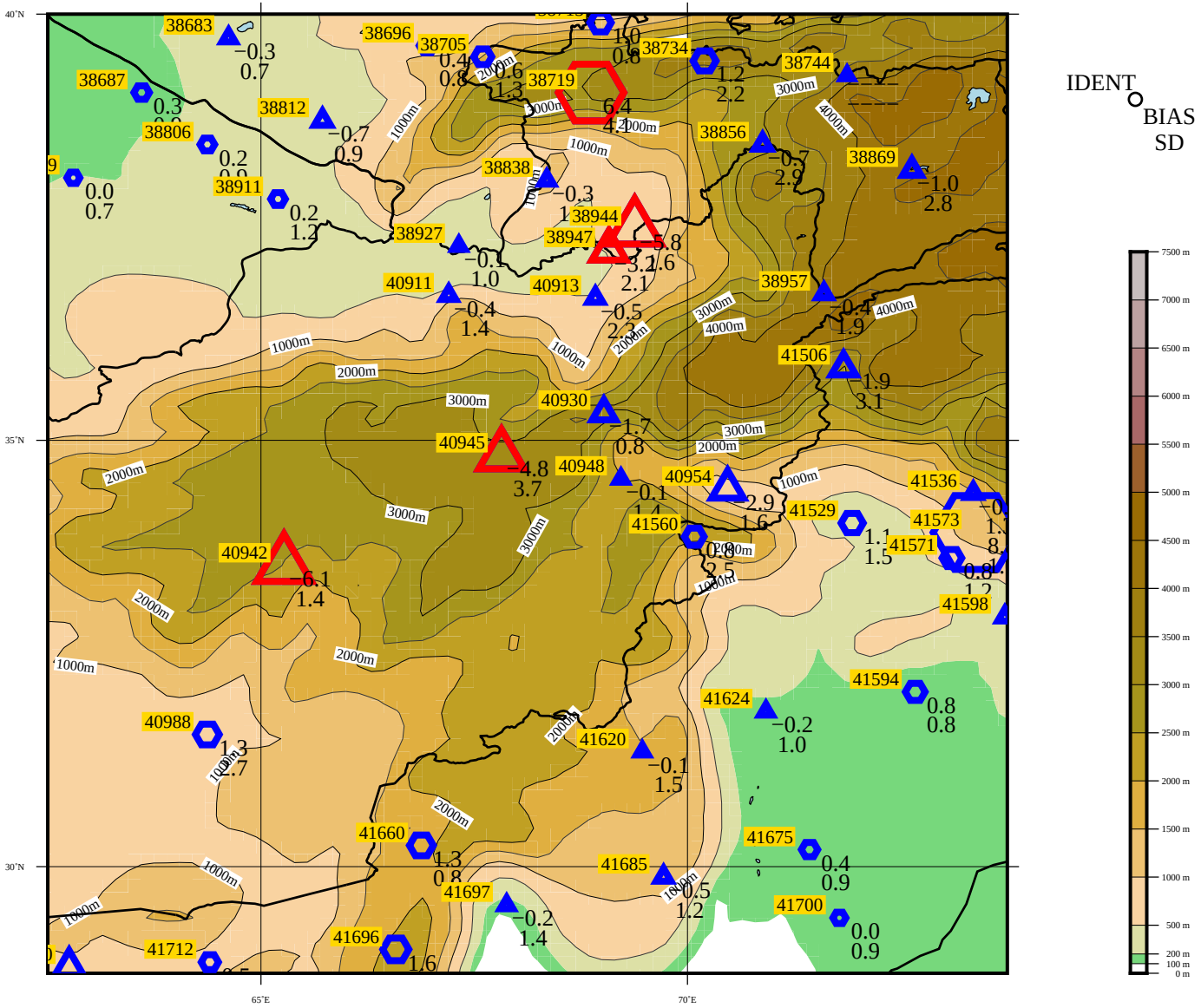

Figure 6 BIAS and SD of SLP for station 38719, 38944, 38947, 40942, 40945 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

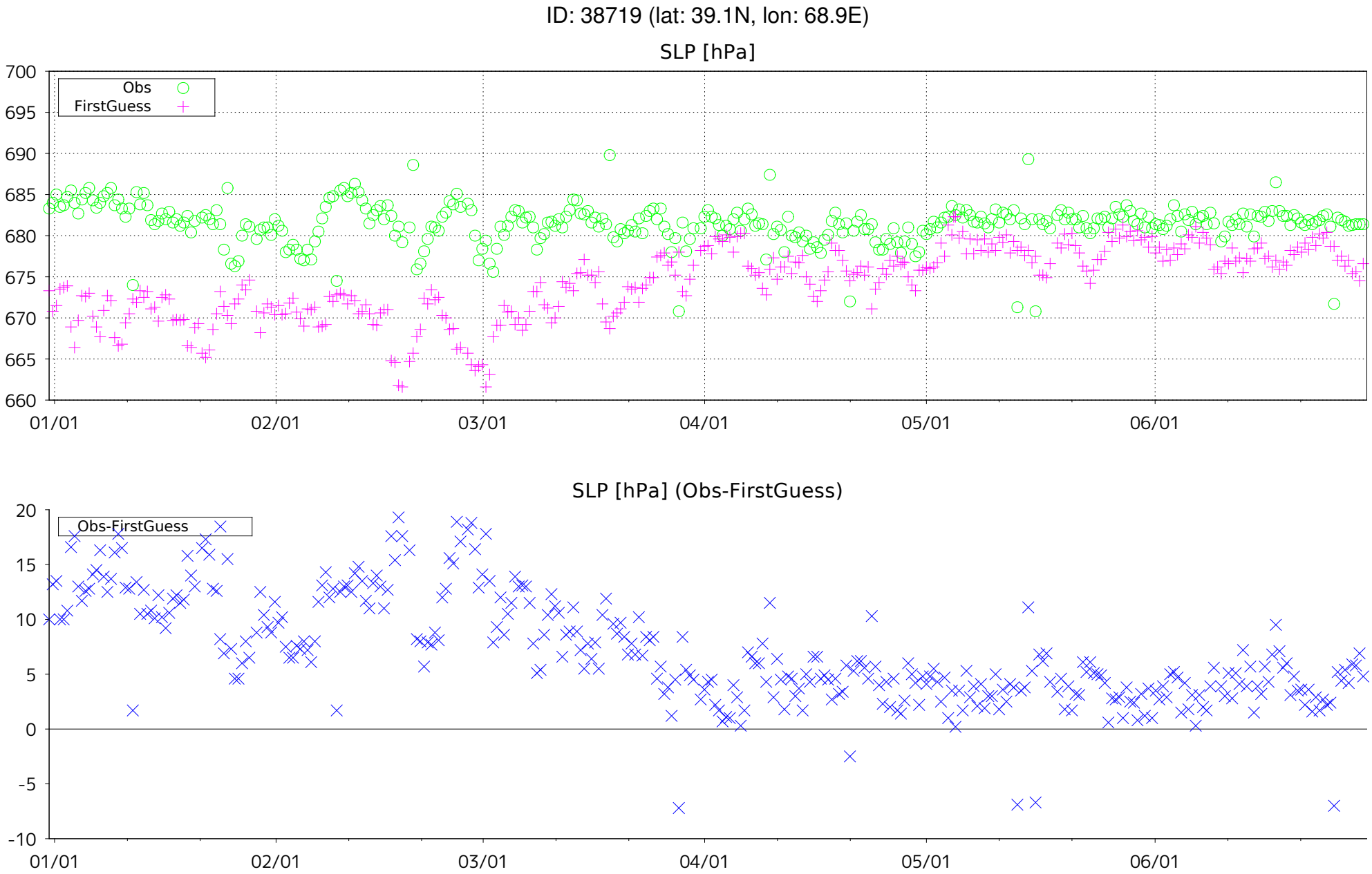

Figure 7(a) Time-series representation of SLP Obs minus FirstGuess for station 38719

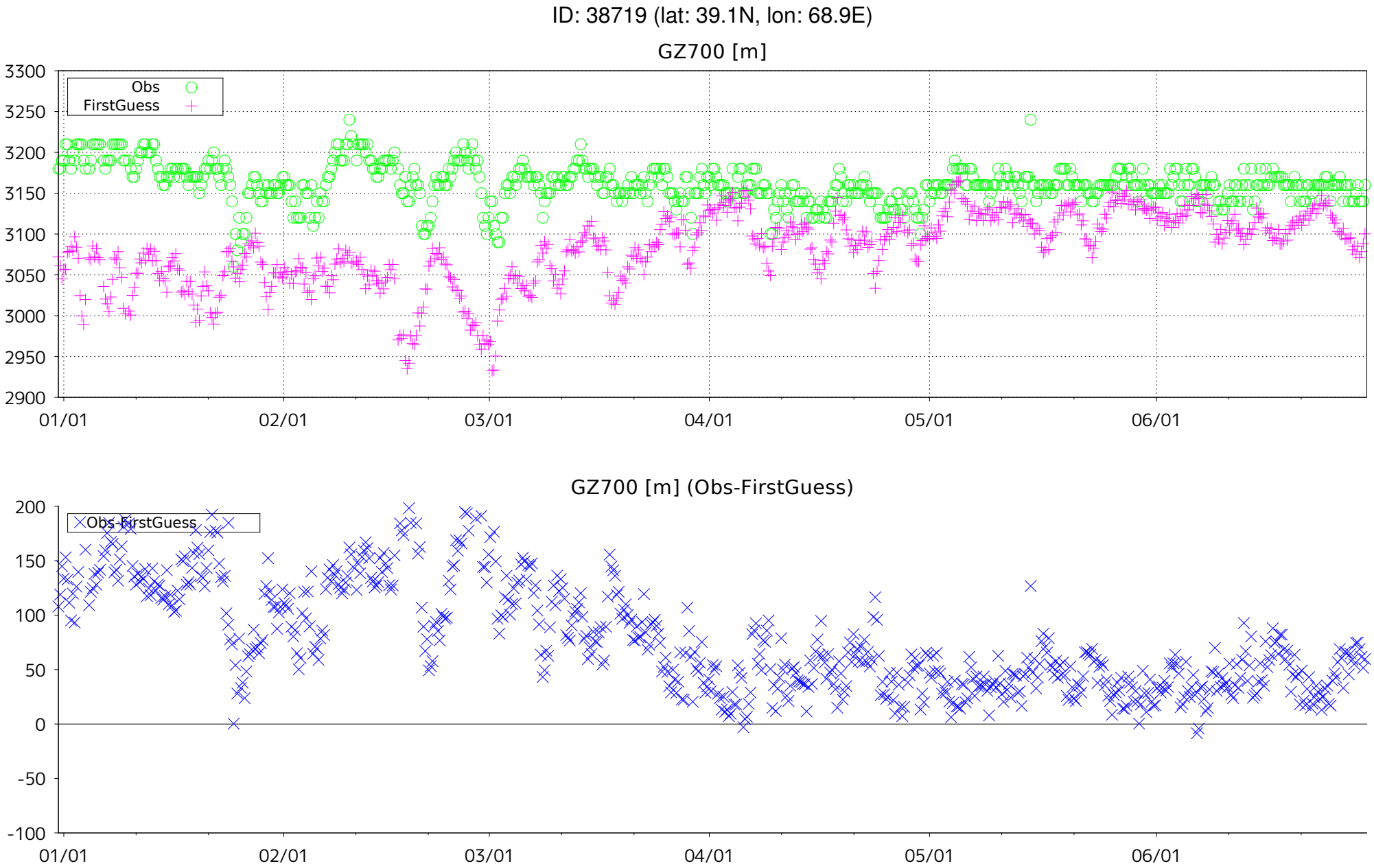

Figure 7(b) Time-series representation of GZ700 Obs minus FirstGuess for station 38719

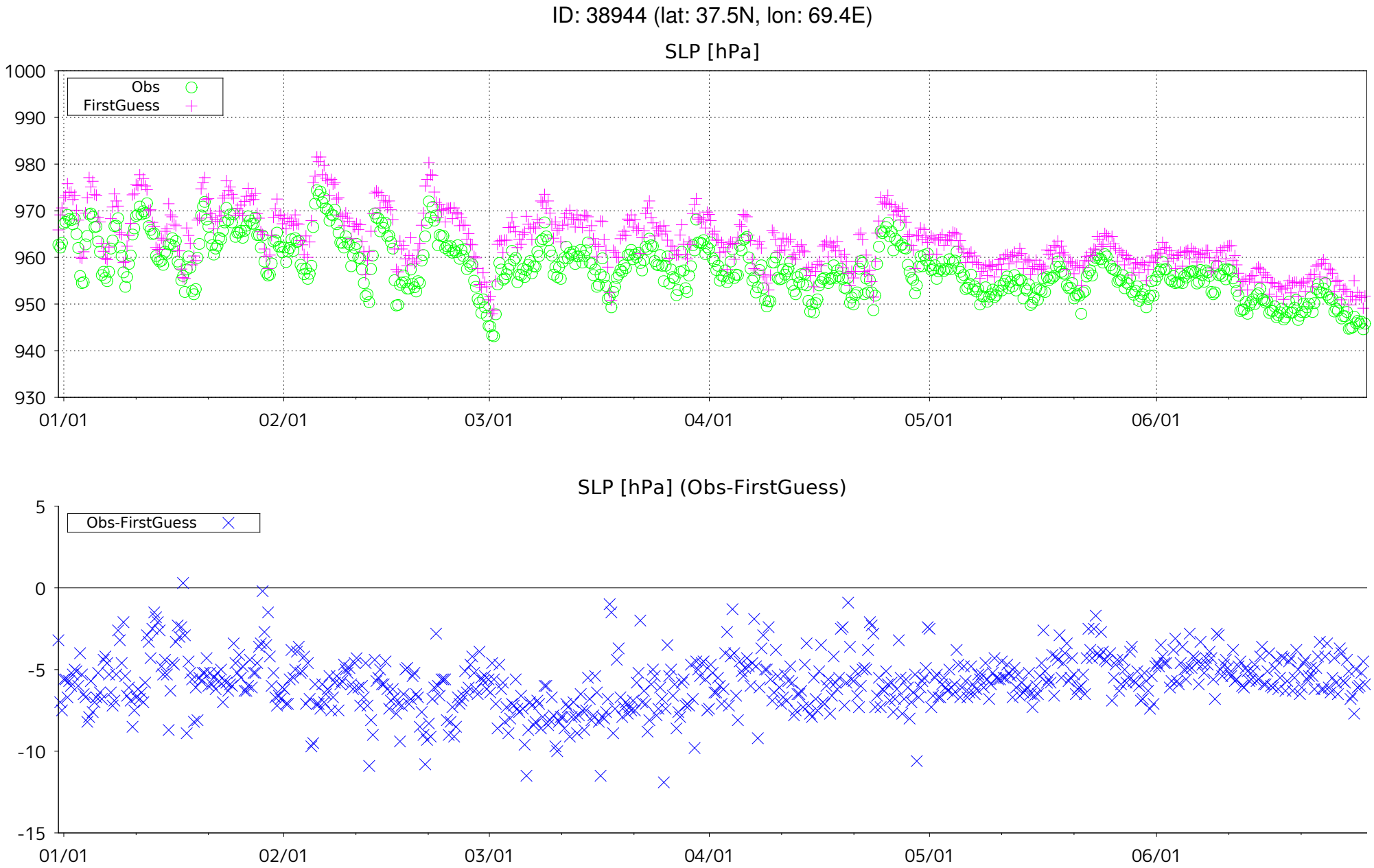

Figure 8(a) Time-series representation of SLP Obs minus FirstGuess for station 38944

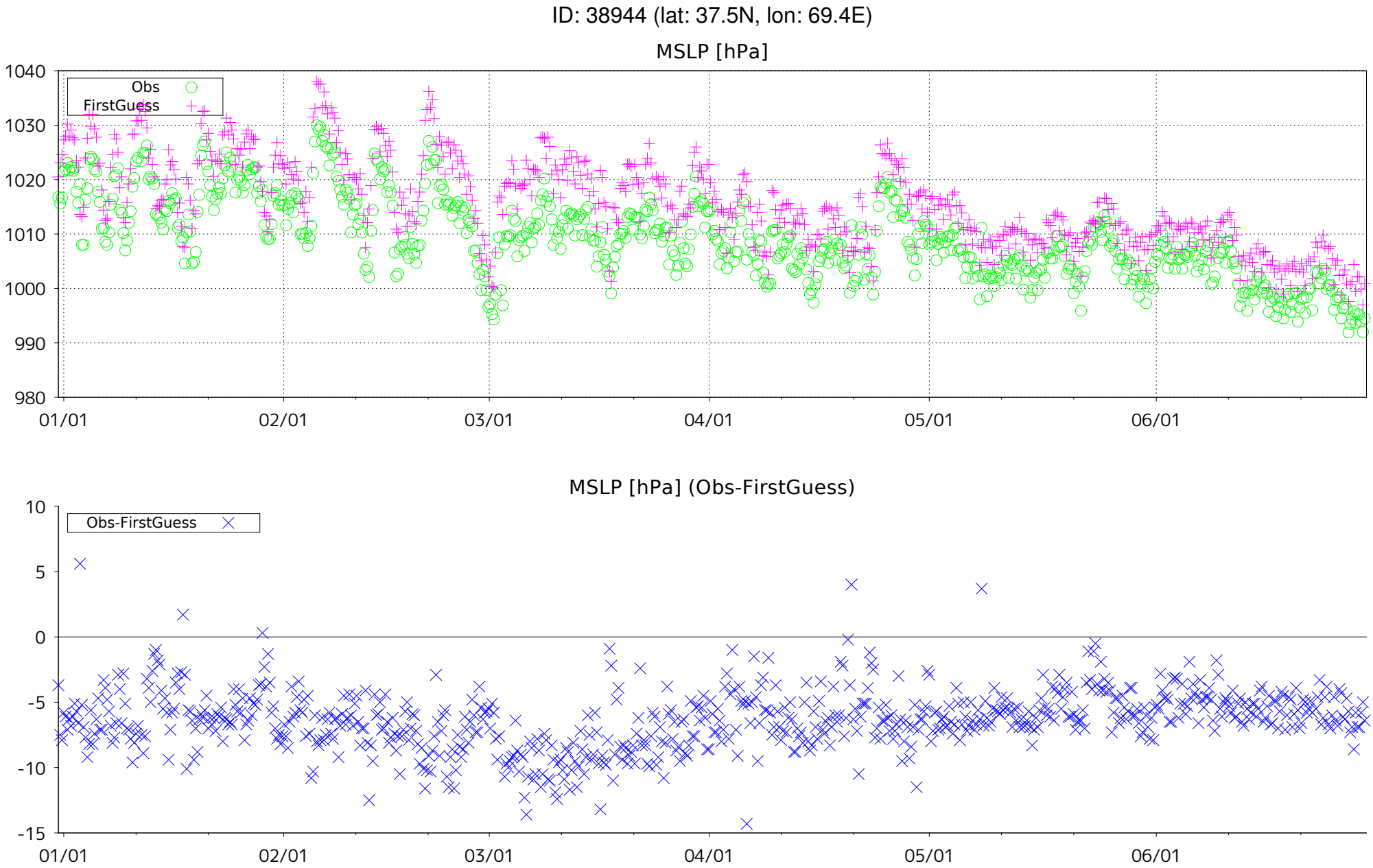

Figure 8(b) Time-series representation of MSLP Obs minus FirstGuess for station 38944

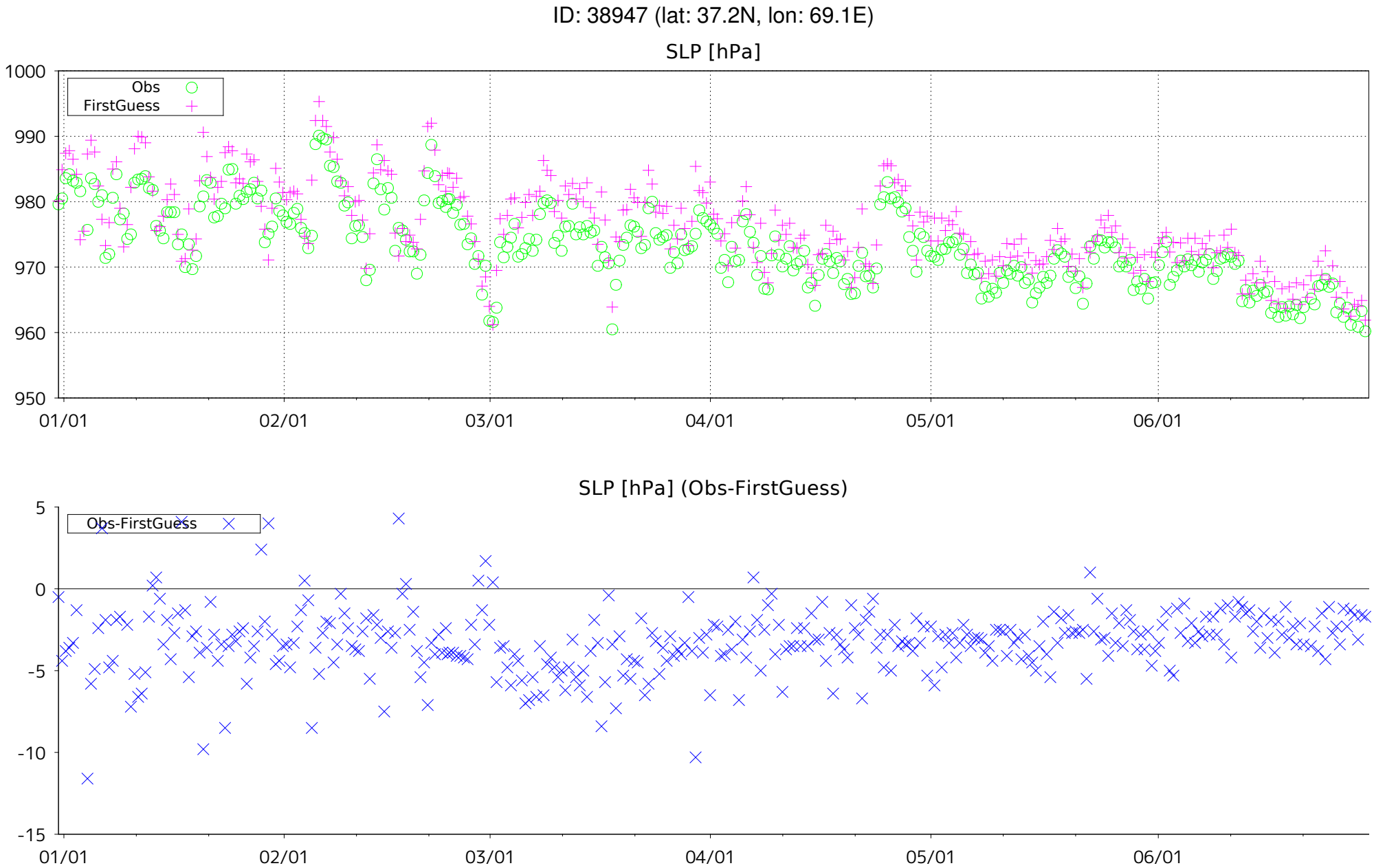

Figure 9 Time-series representation of SLP Obs minus FirstGuess for station 38947

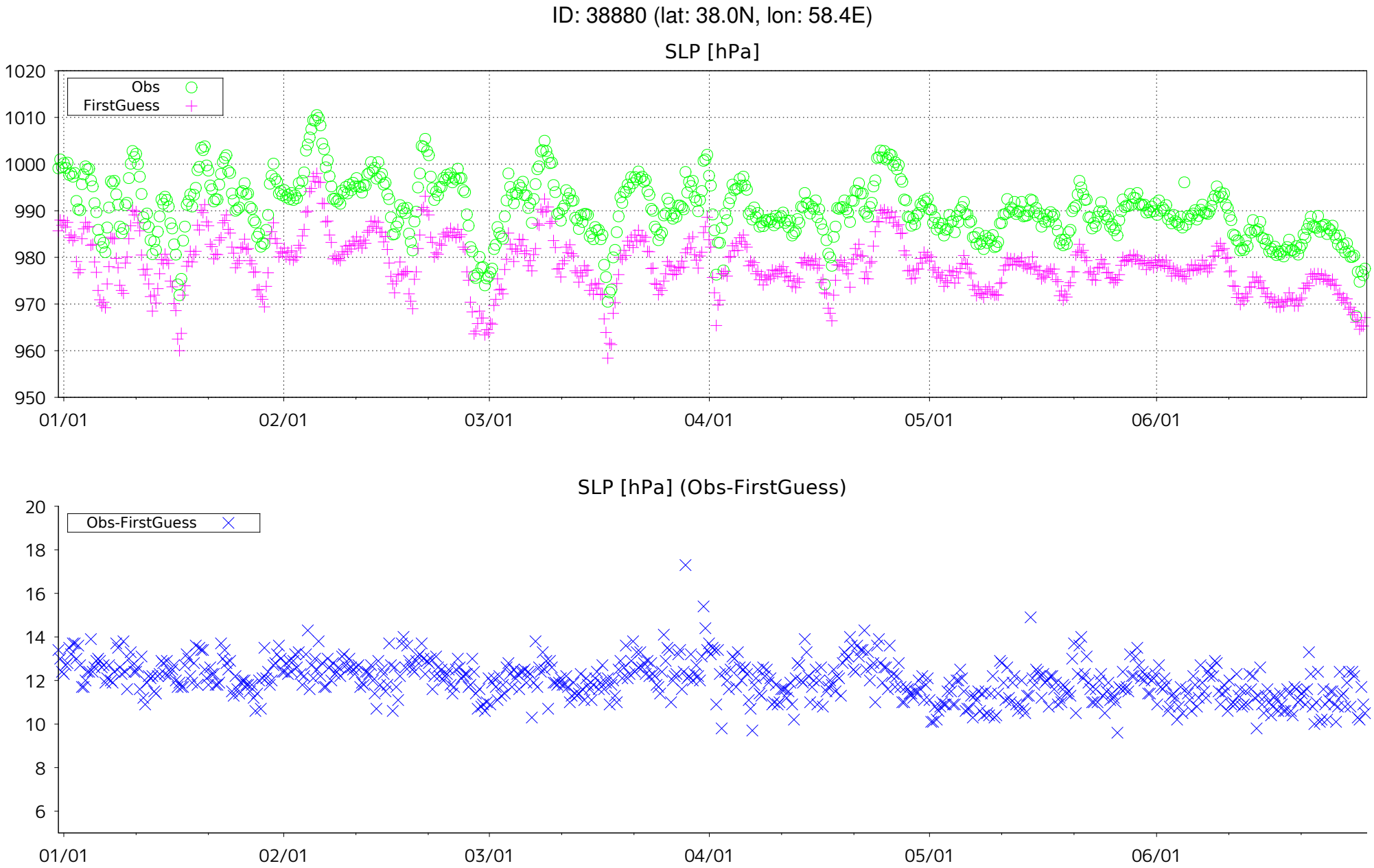

Figure 10 Time-series representation of SLP Obs minus FirstGuess for station 38880

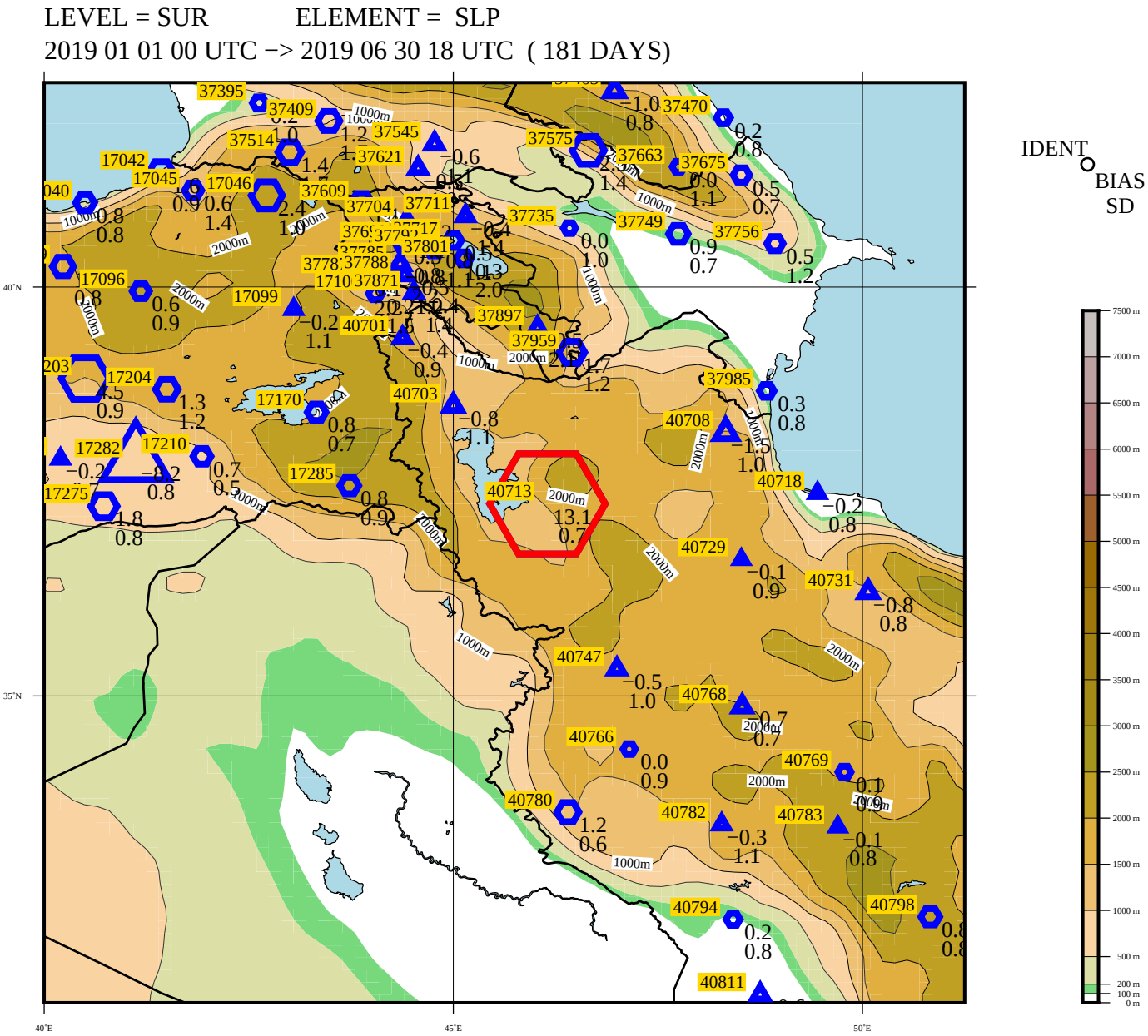

Figure 11 BIAS and SD of SLP for station 40713 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

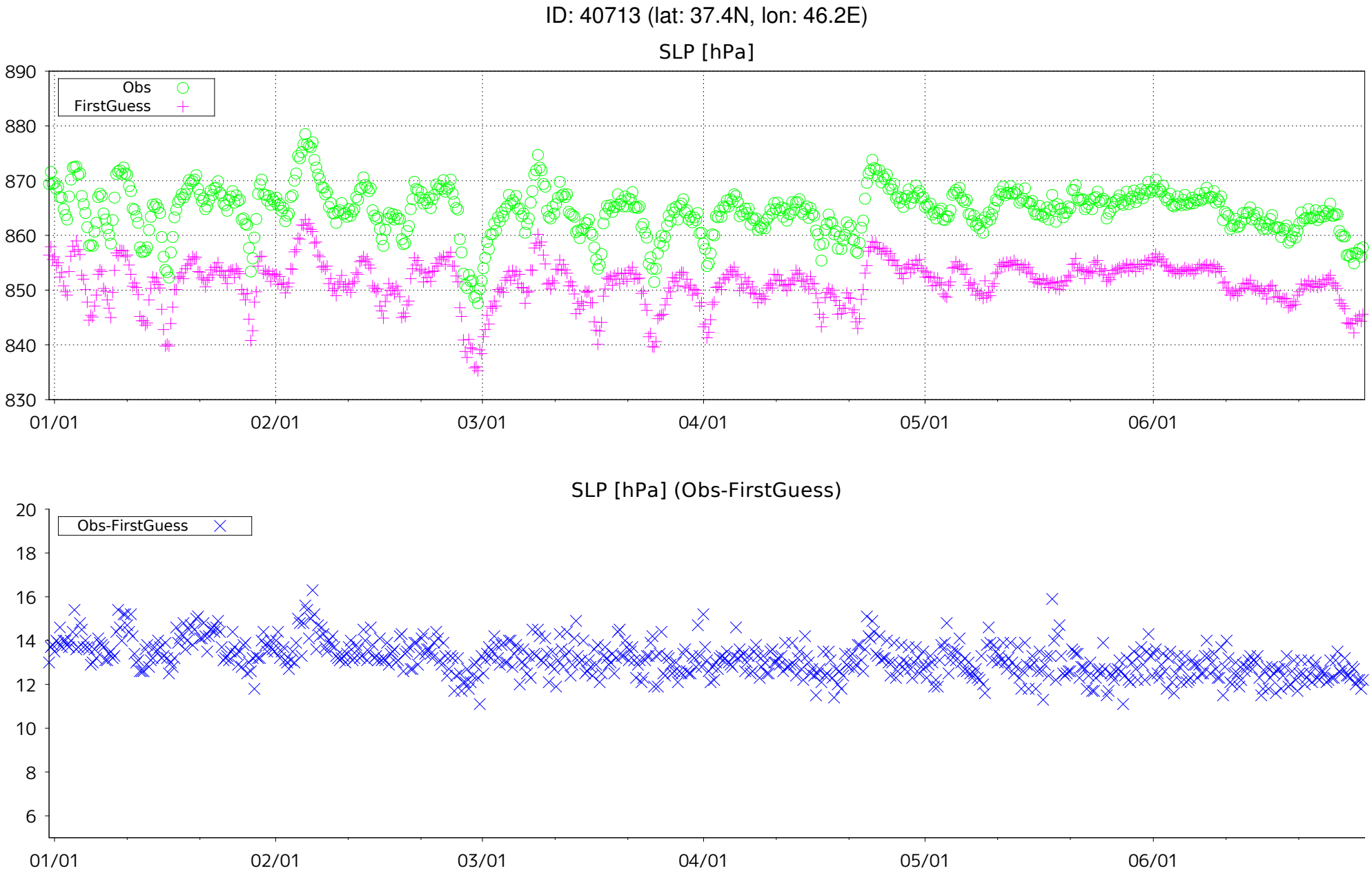

Figure 12 Time-series representation of SLP Obs minus FirstGuess for station 40713

Figure 13 Time-series representation of SLP Obs minus FirstGuess for station 40741

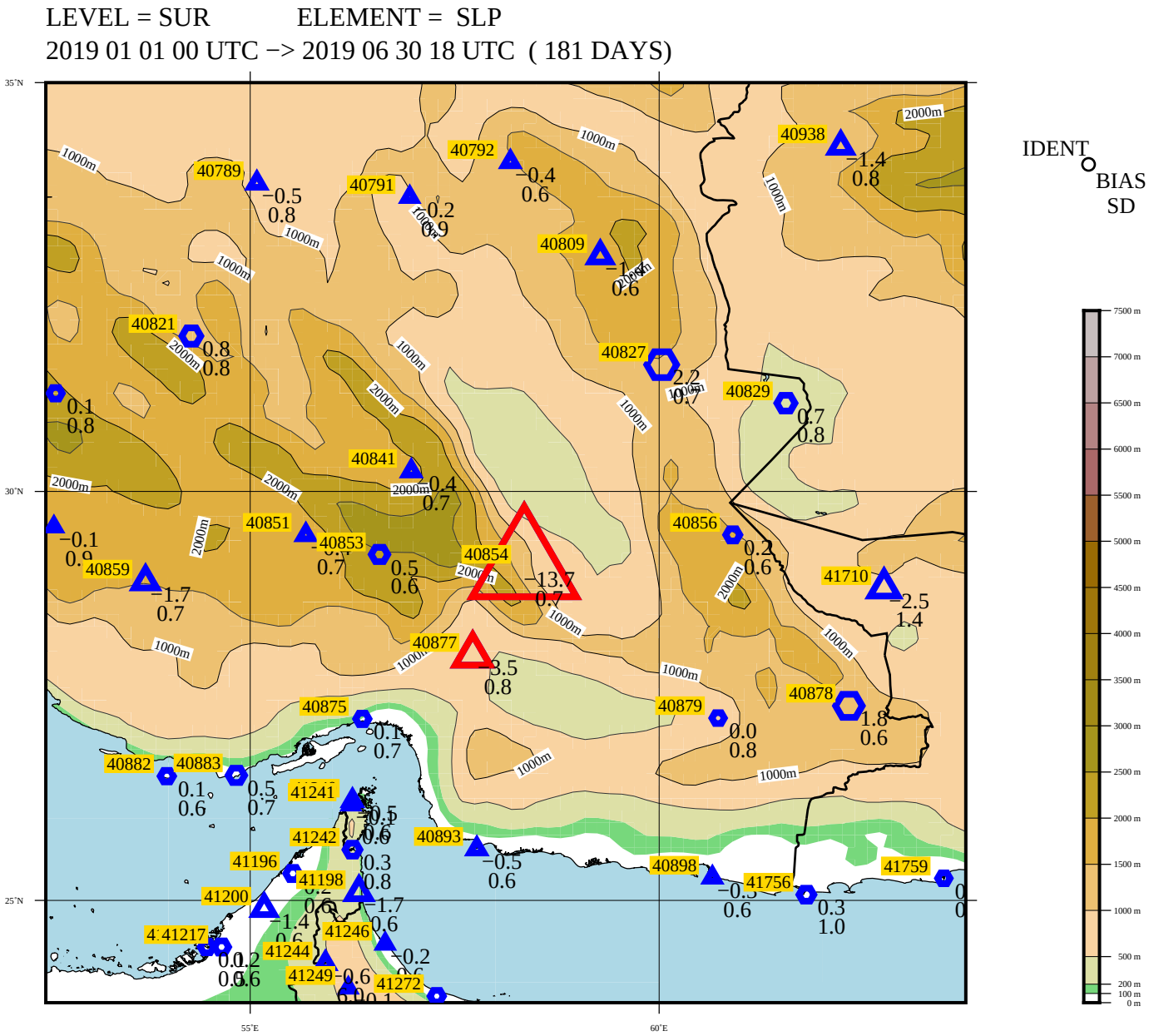

Figure 14 BIAS and SD of SLP for station 40854, 40877 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

Figure 15 Time-series representation of SLP Obs minus FirstGuess for station 40854

Figure 16(a) Time-series representation of SLP Obs minus FirstGuess for station 40877

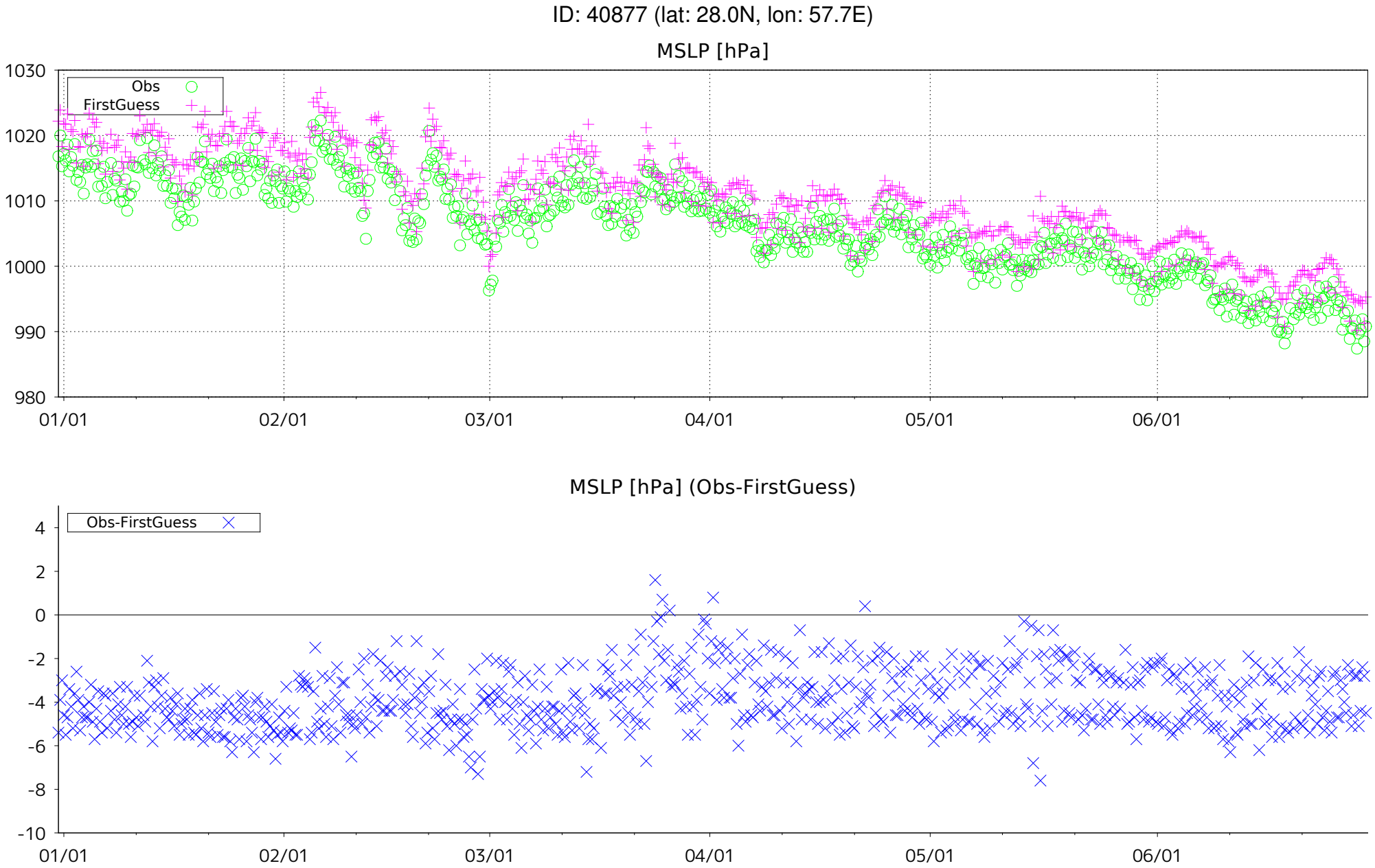

Figure 16(b) Time-series representation of MSLP Obs minus FirstGuess for station 40877

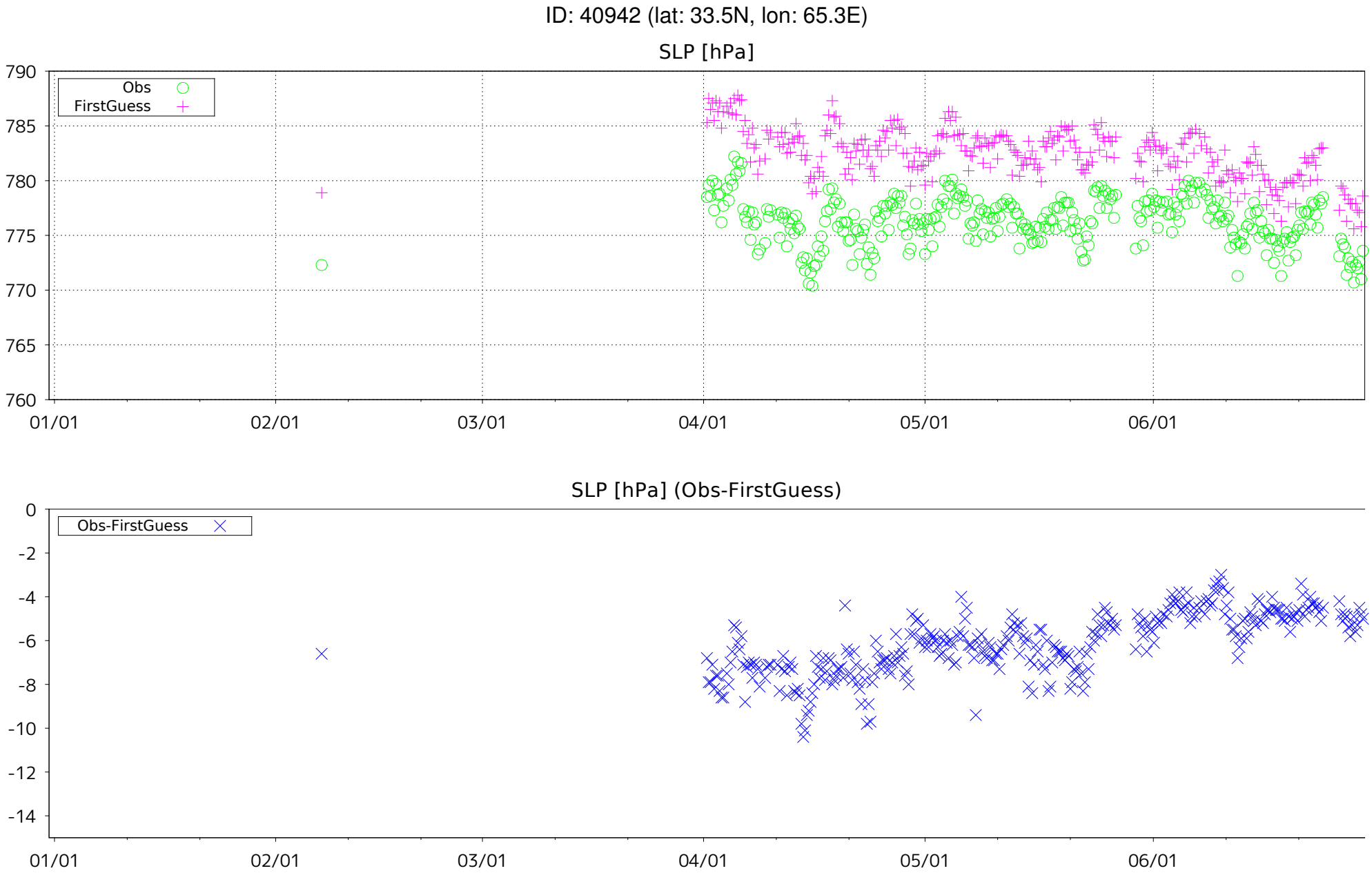

Figure 17 Time-series representation of SLP Obs minus FirstGuess for station 40942

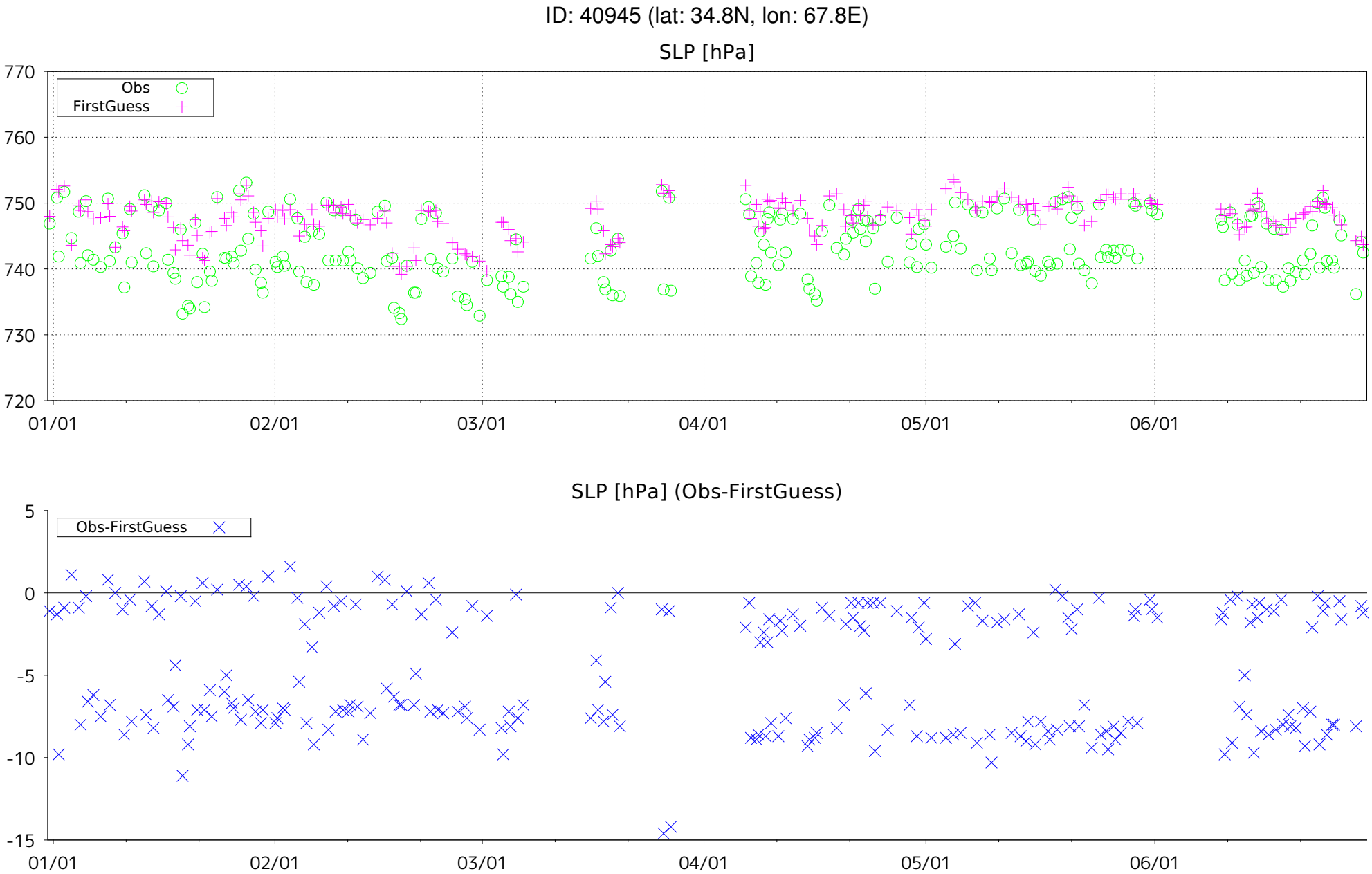

Figure 18 Time-series representation of SLP Obs minus FirstGuess for station 40945

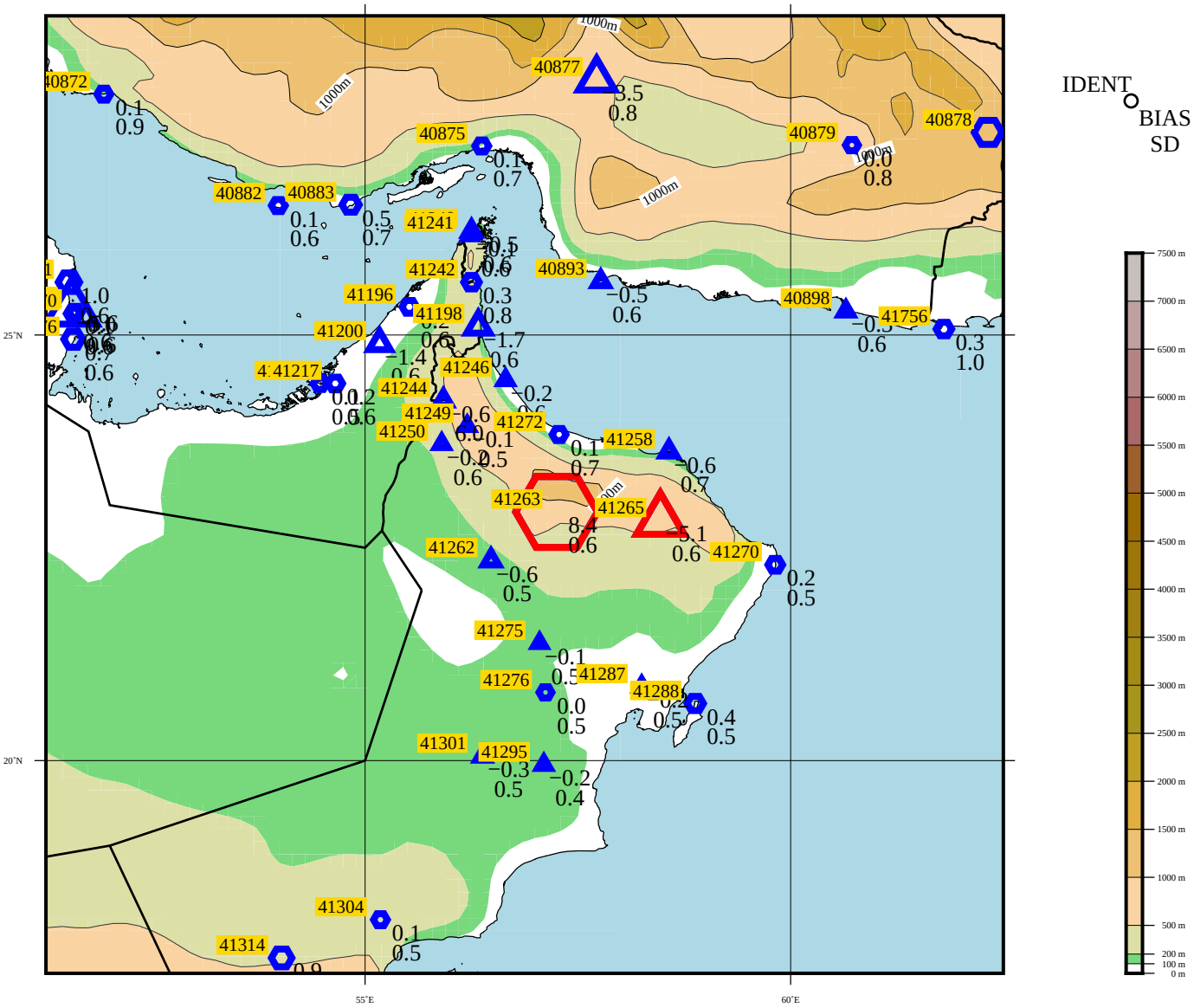

Figure 19 BIAS and SD of SLP for station 41263, 41265 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

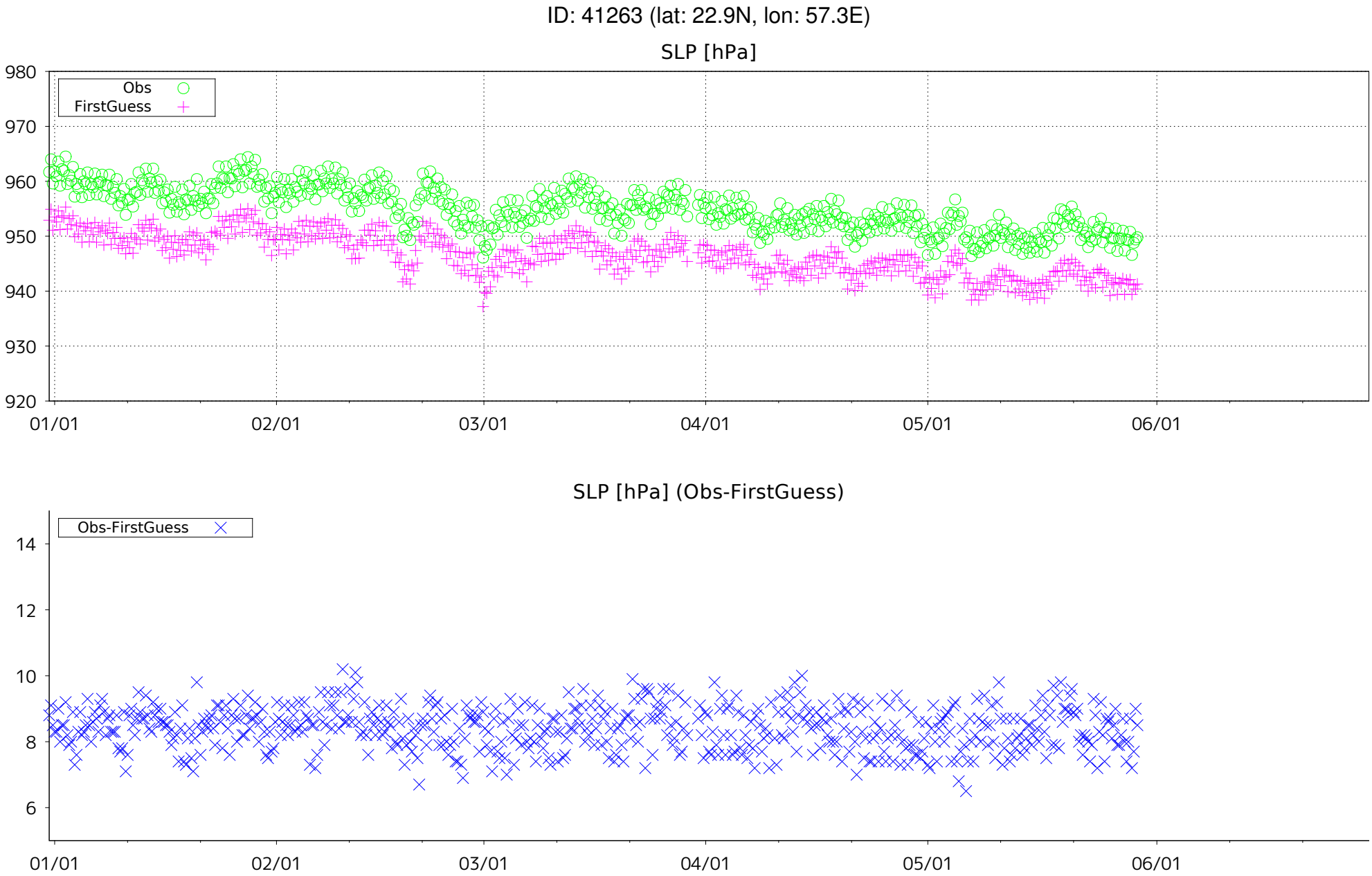

Figure 20 Time-series representation of SLP Obs minus FirstGuess for station 41263

Figure 21 Time-series representation of SLP Obs minus FirstGuess for station 41265

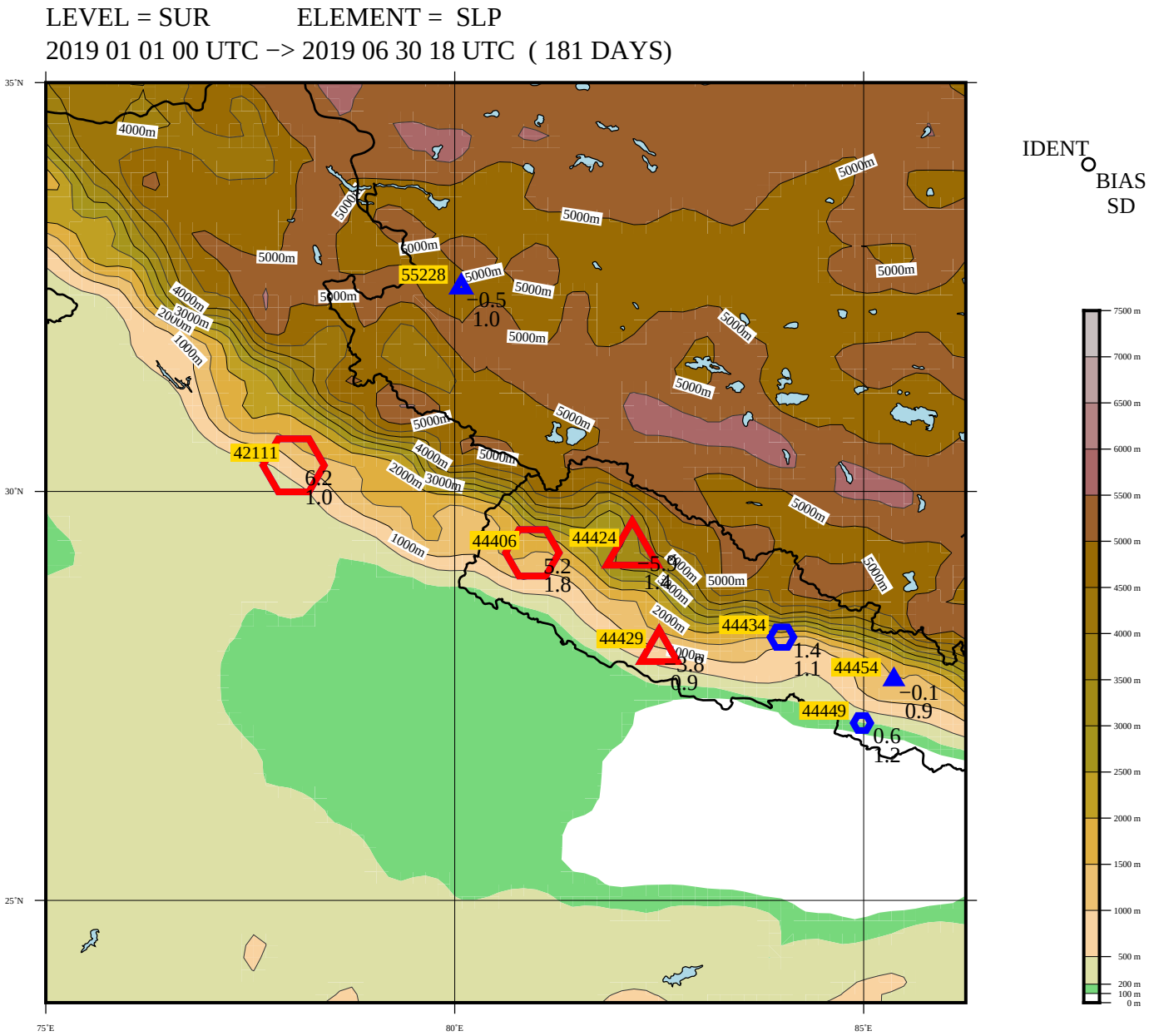

Figure 22 BIAS and SD of SLP for station 42111, 44406, 44424, 44429 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

Figure 23 Time-series representation of SLP Obs minus FirstGuess for station 42111

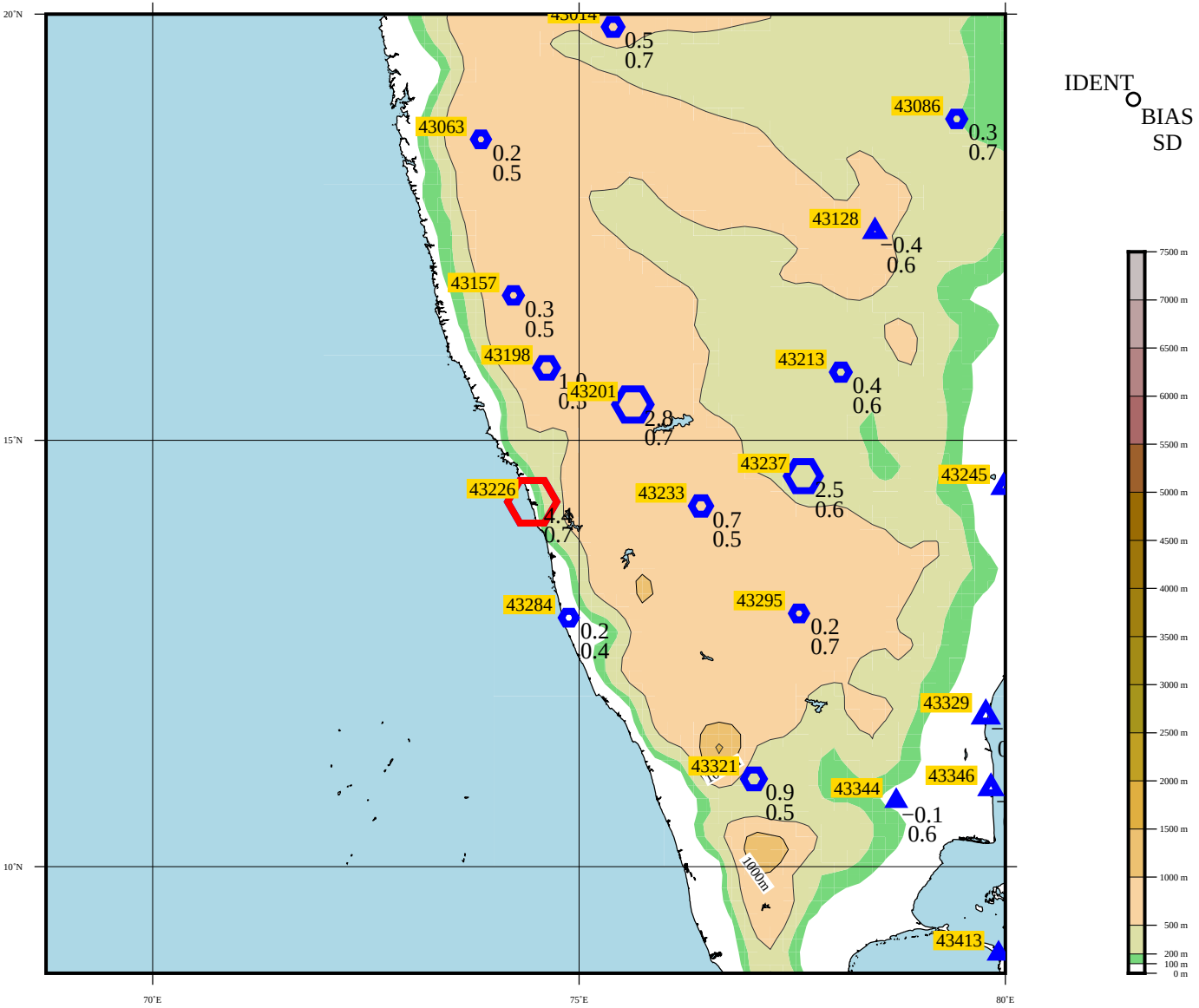

Figure 24 BIAS and SD of SLP for station 43226 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

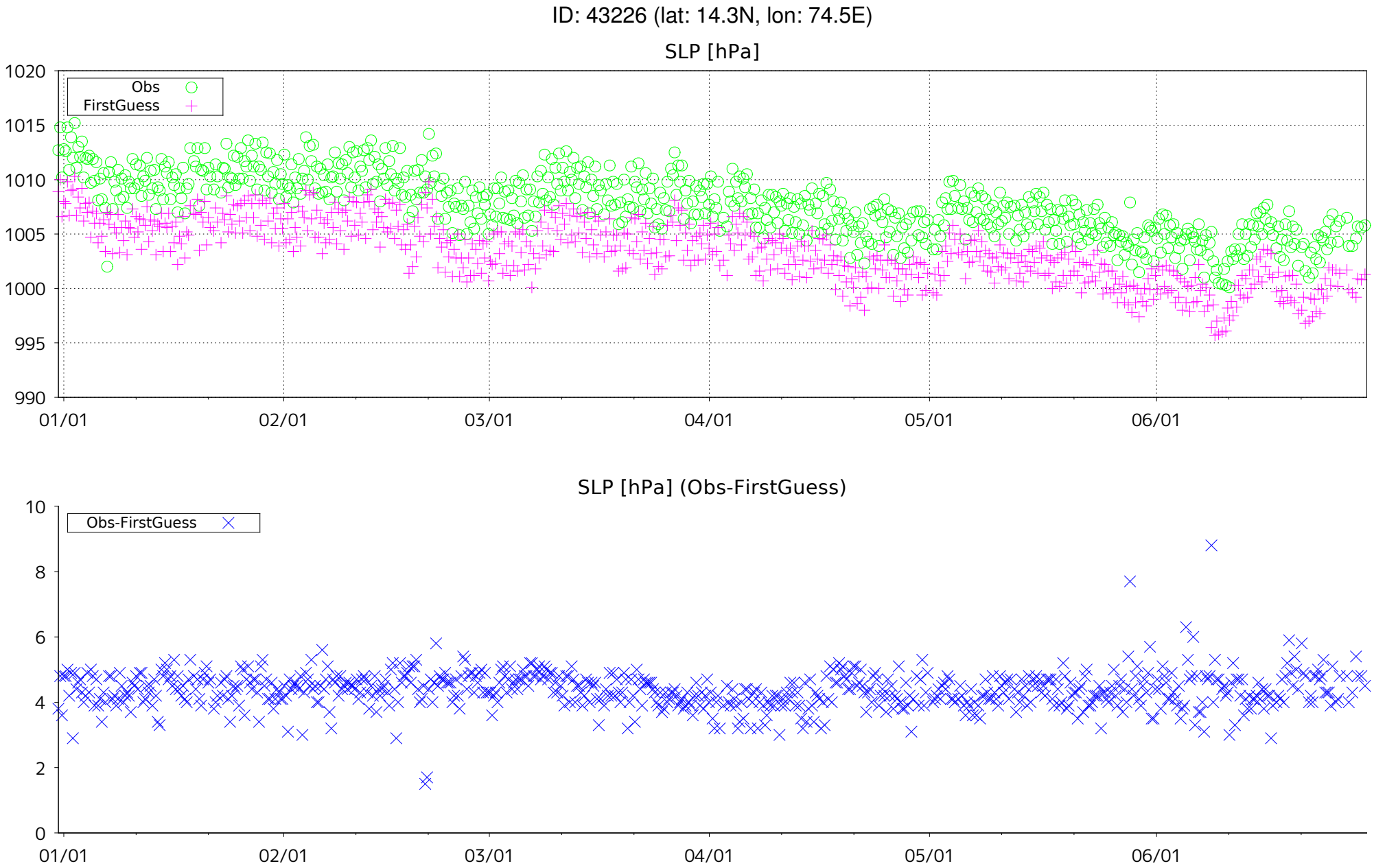

Figure 25 Time-series representation of SLP Obs minus FirstGuess for station 43226

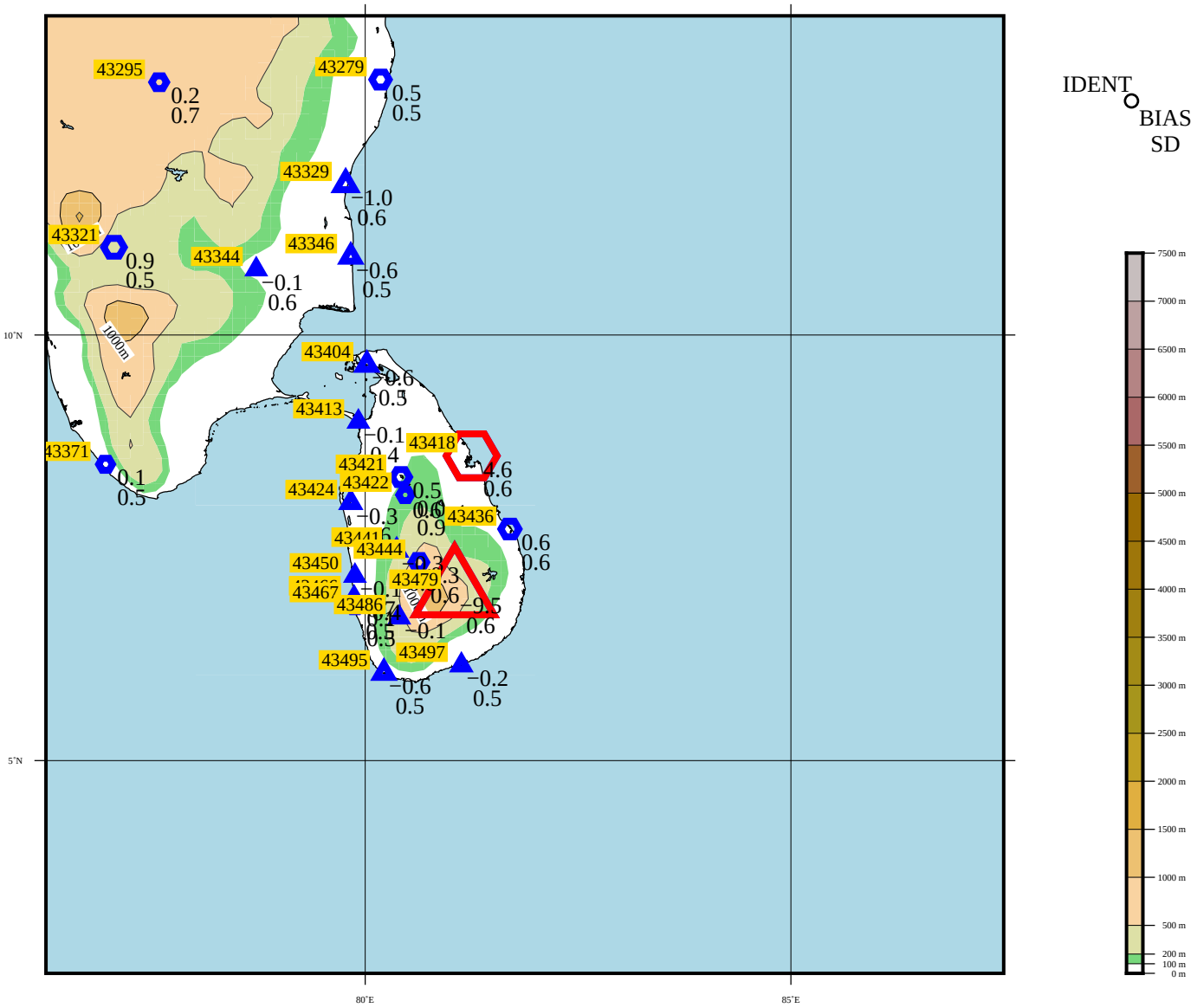

Figure 26 BIAS and SD of SLP for station 43418, 43479 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

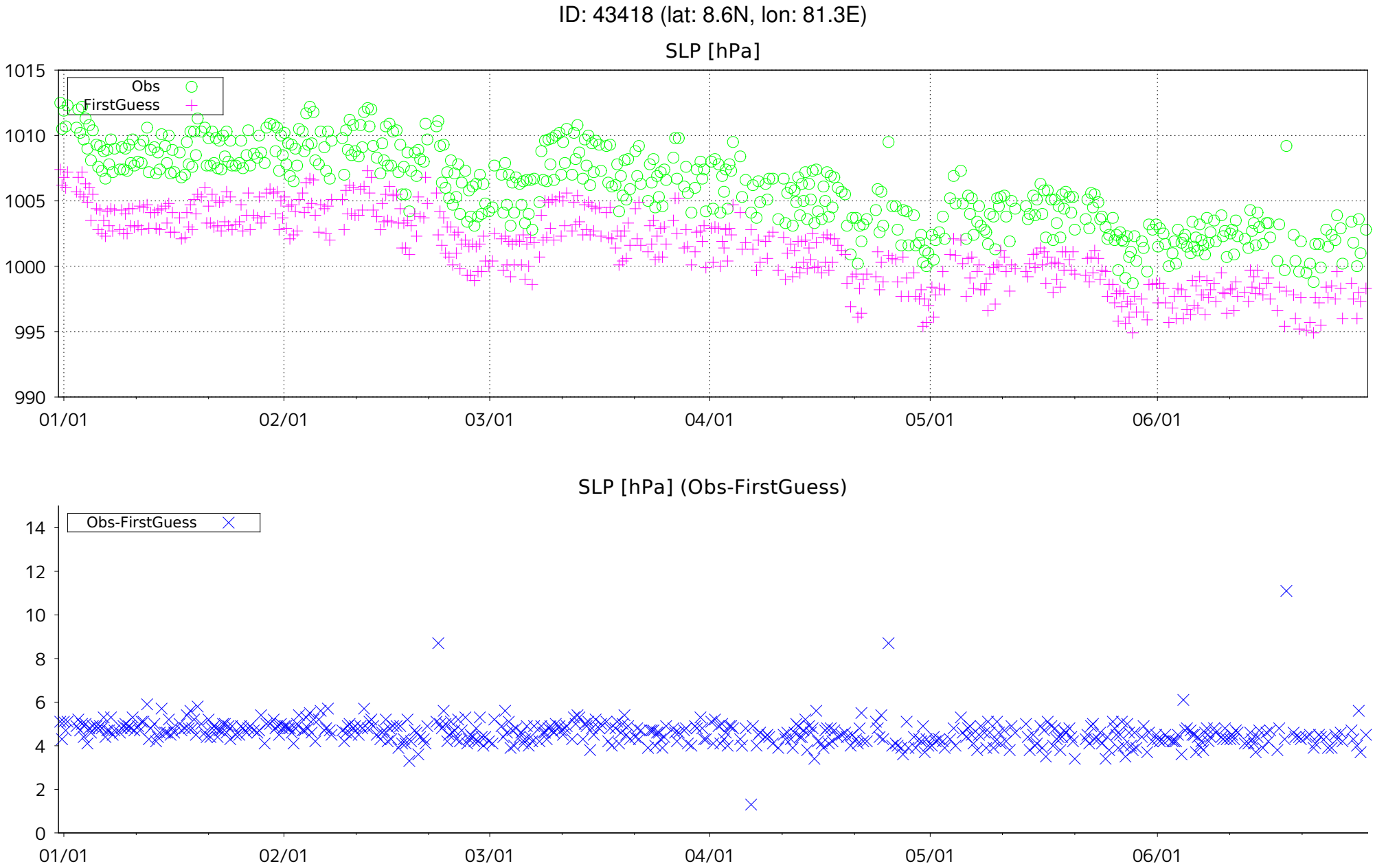

Figure 27 Time-series representation of SLP Obs minus FirstGuess for station 43418

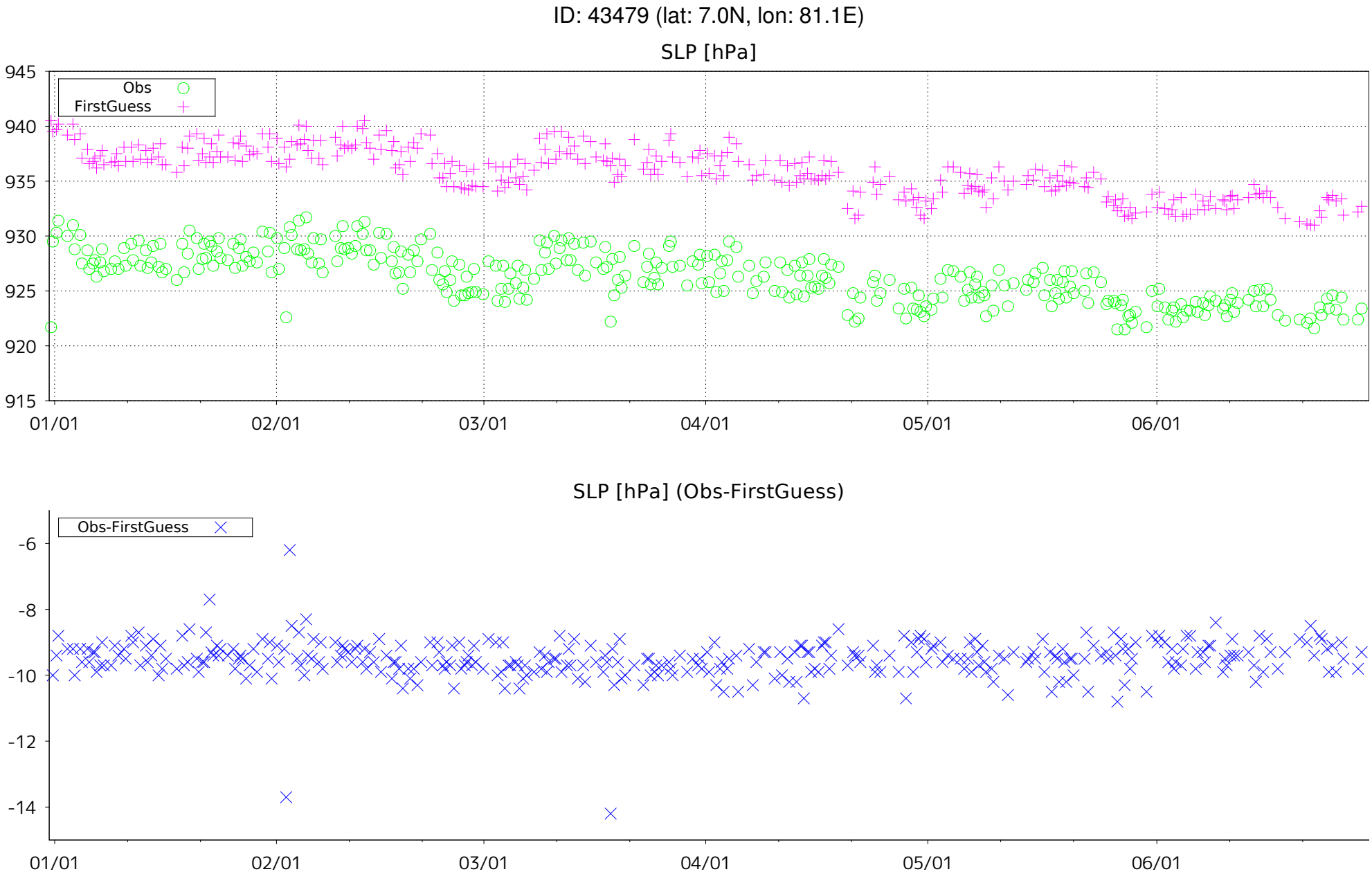

Figure 28 Time-series representation of SLP Obs minus FirstGuess for station 43479

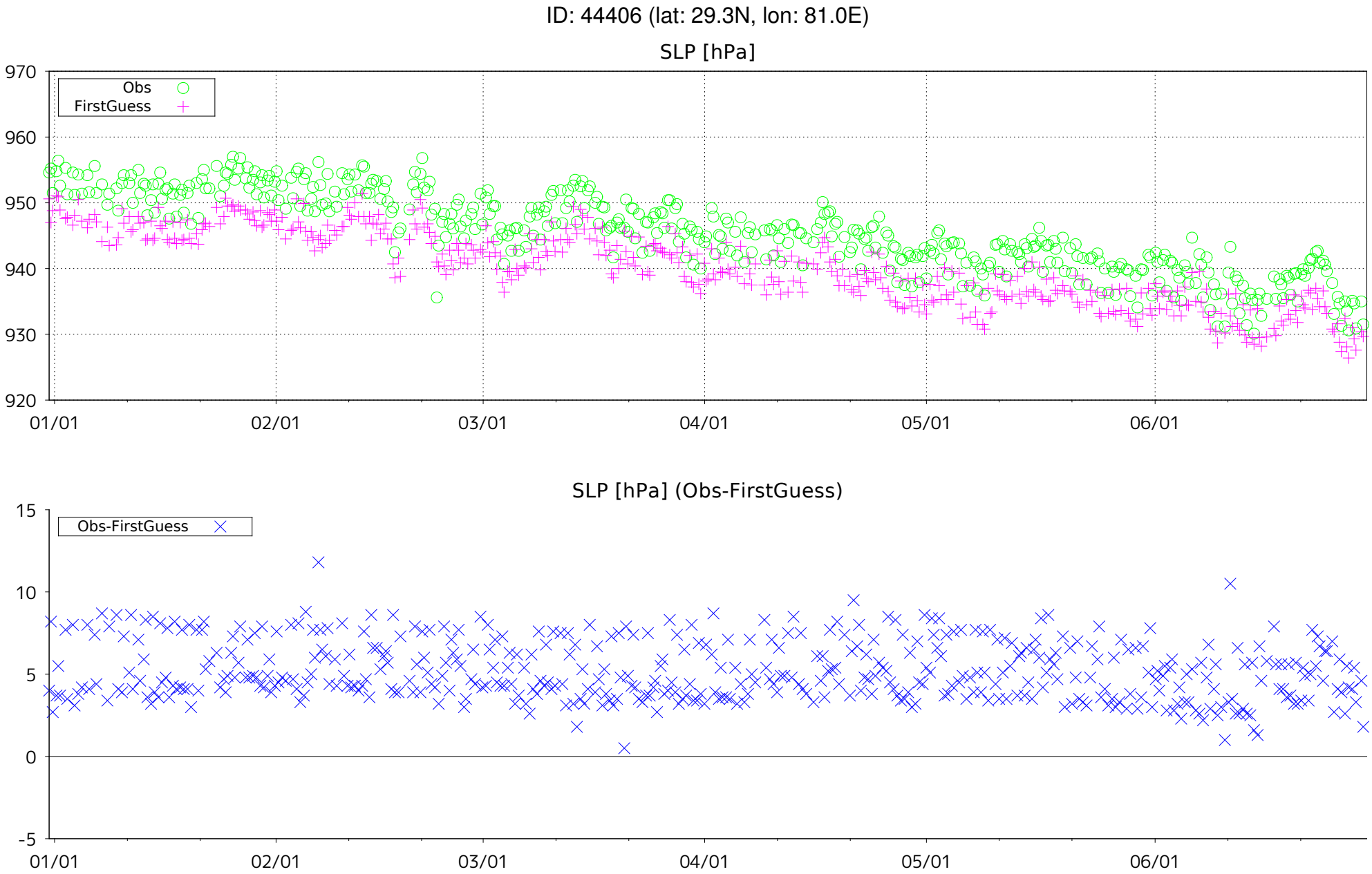

Figure 29 Time-series representation of SLP Obs minus FirstGuess for station 44406

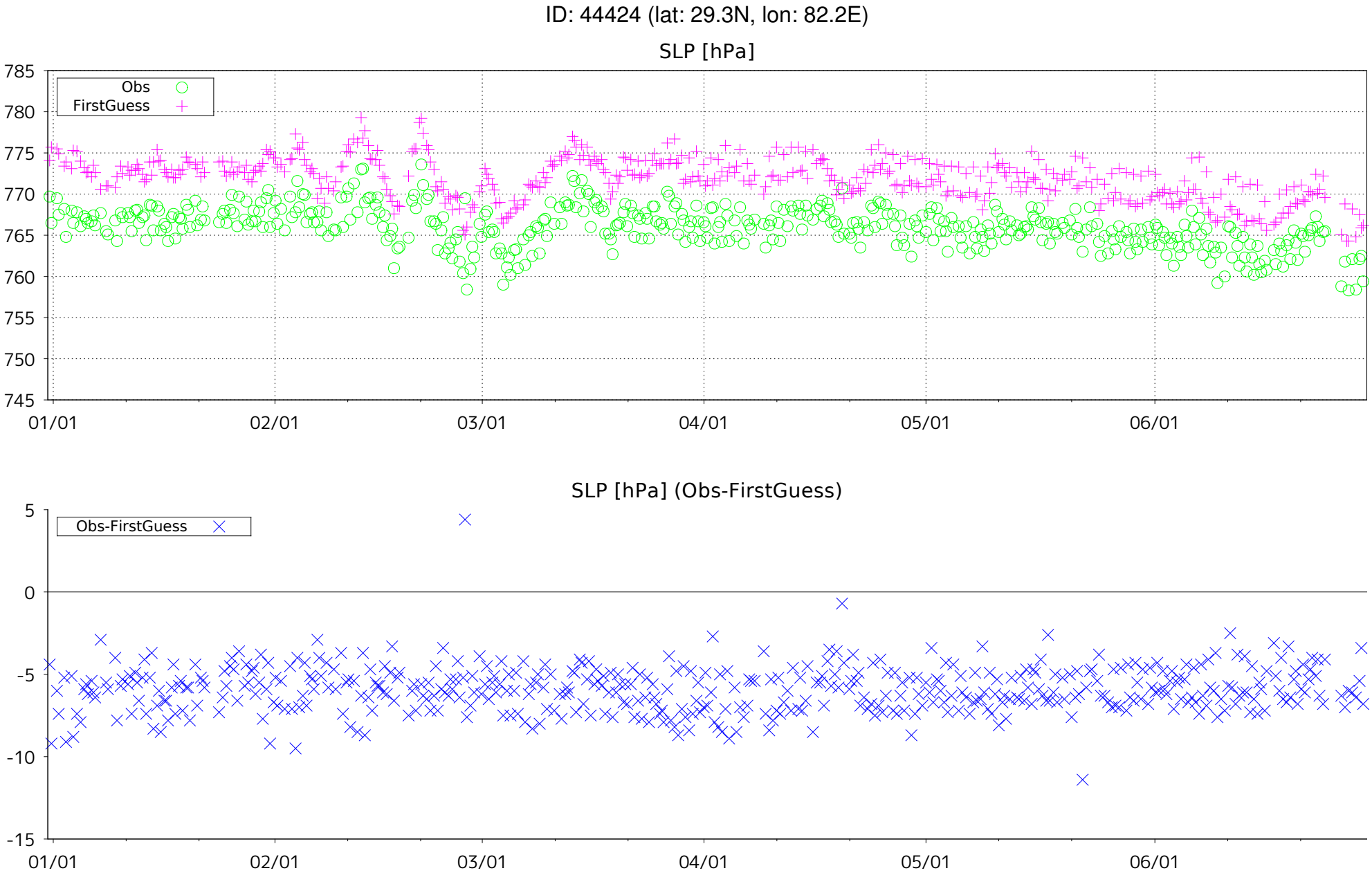

Figure 30(a) Time-series representation of SLP Obs minus FirstGuess for station 44424

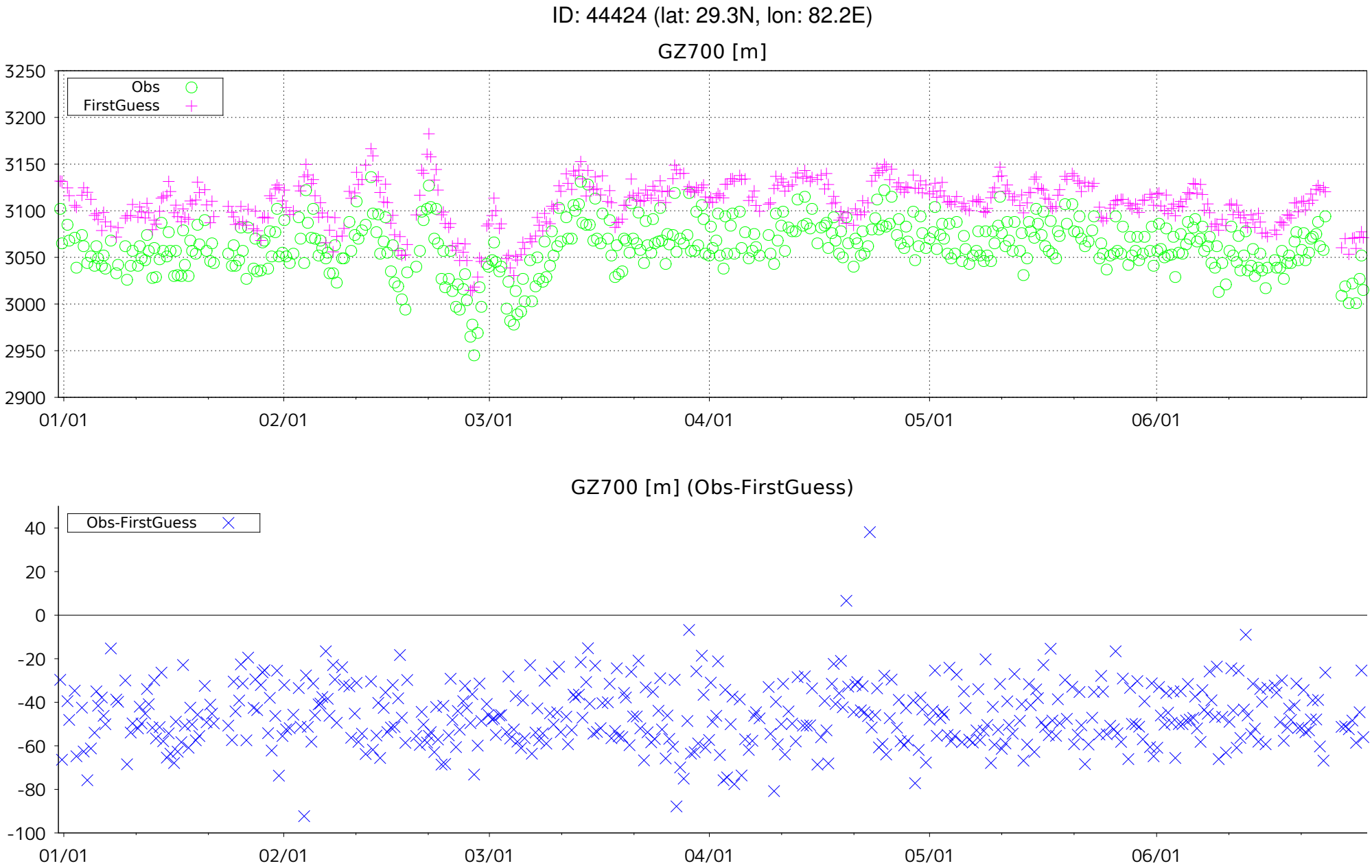

Figure 30(b) Time-series representation of GZ700 Obs minus FirstGuess for station 44424

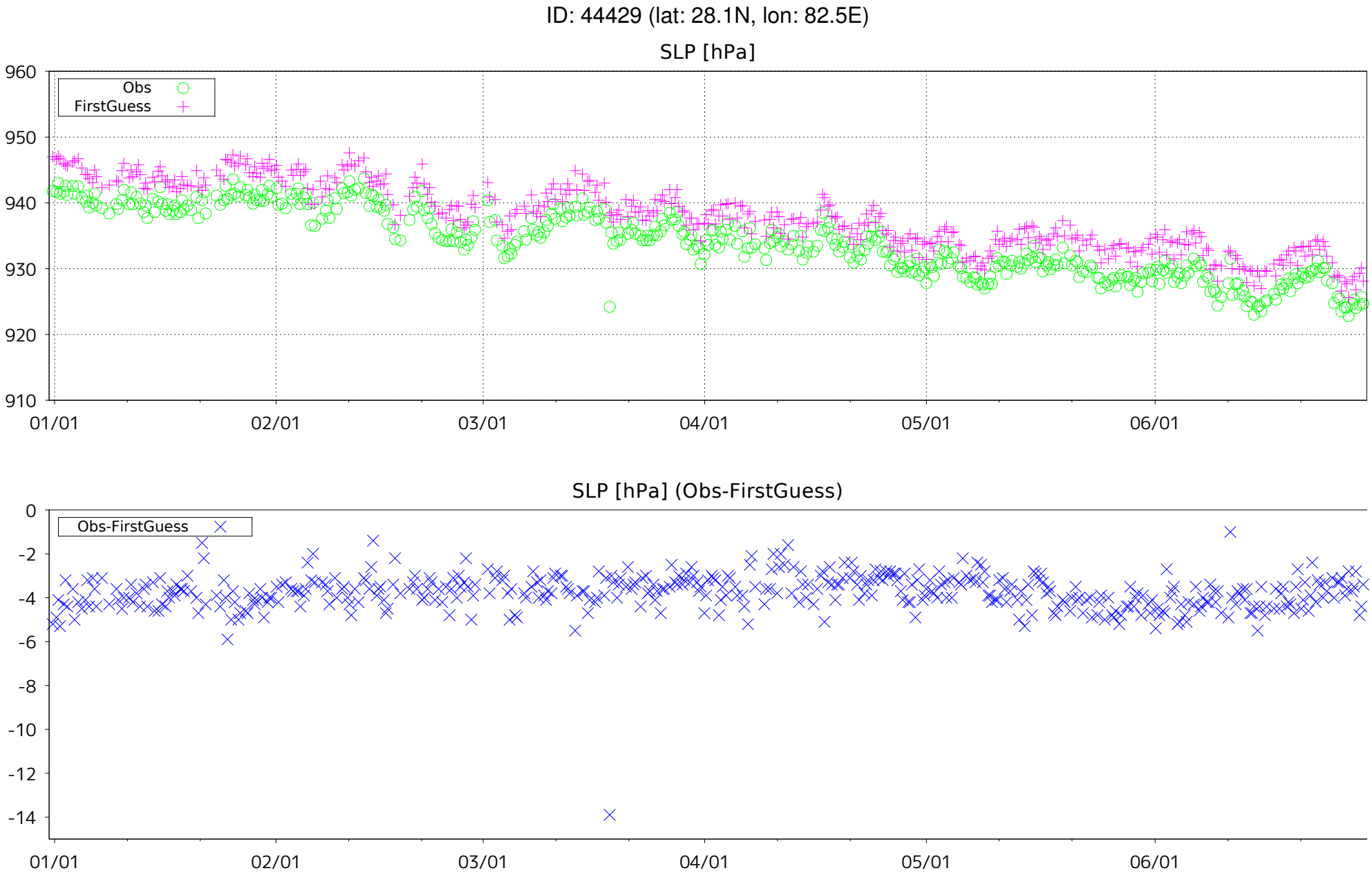

Figure 31 Time-series representation of SLP Obs minus FirstGuess for station 44429

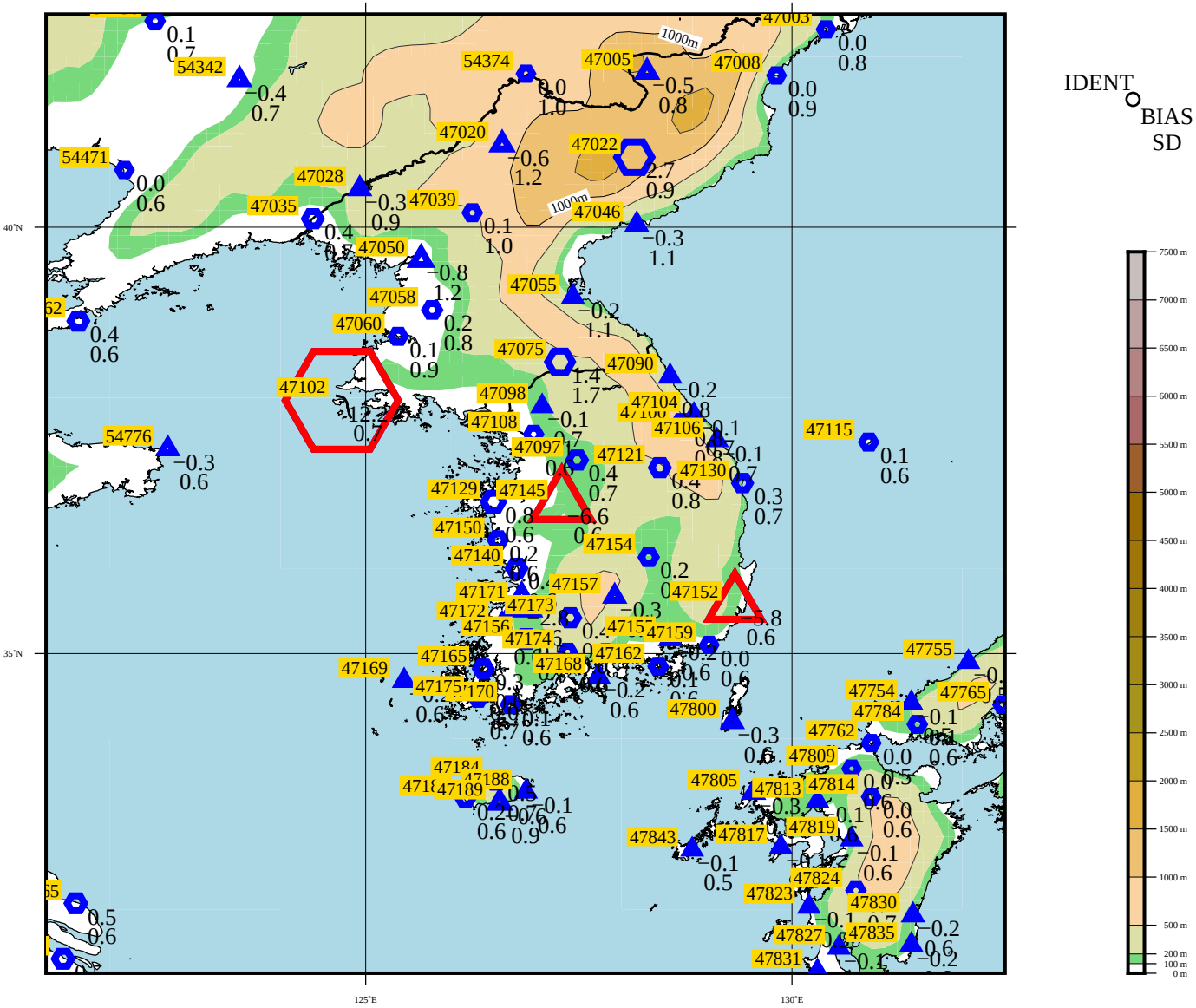

Figure 32 BIAS and SD of SLP for station 47102, 47145, 47152 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

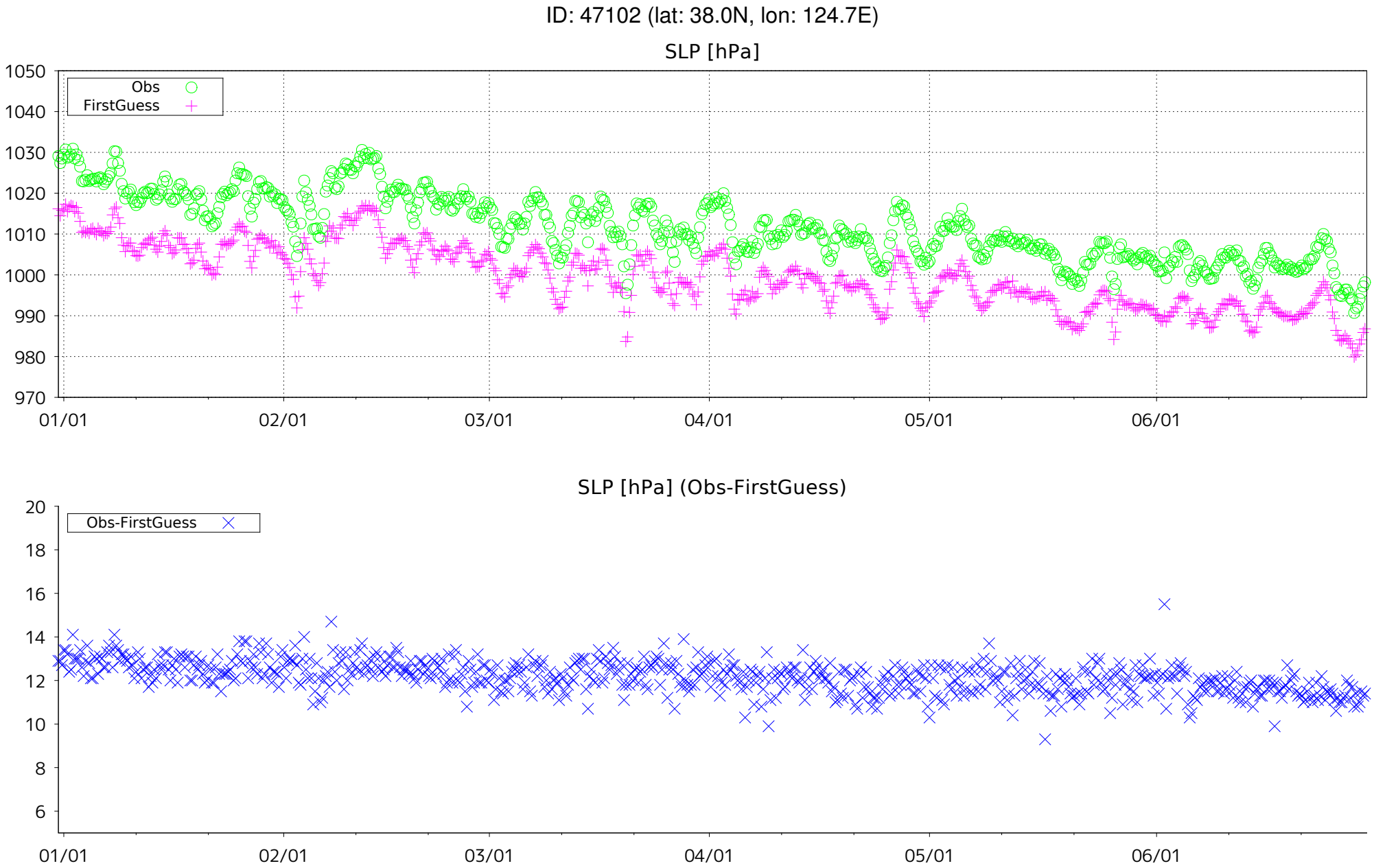

Figure 33 Time-series representation of SLP Obs minus FirstGuess for station 47102

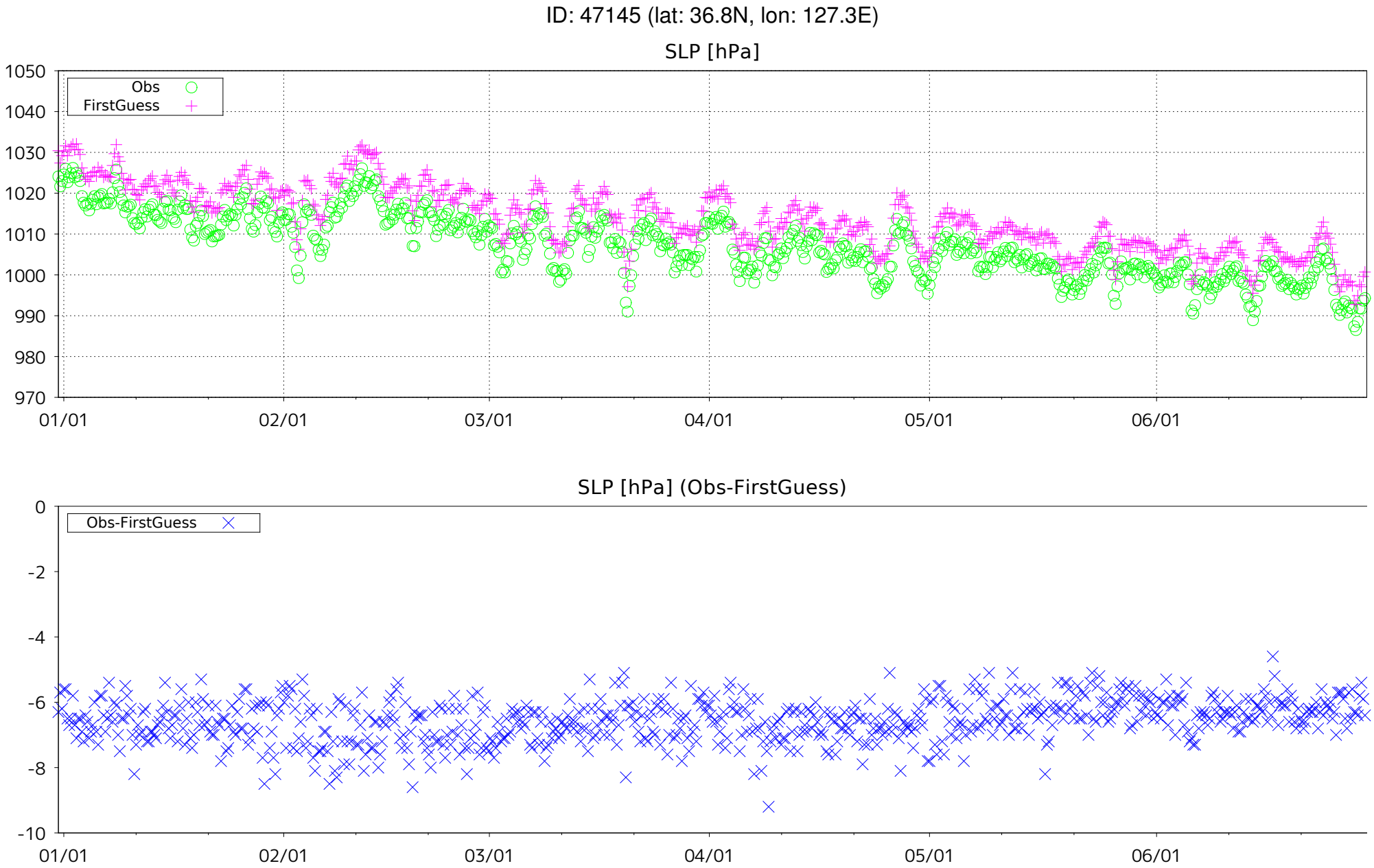

Figure 34 Time-series representation of SLP Obs minus FirstGuess for station 47145

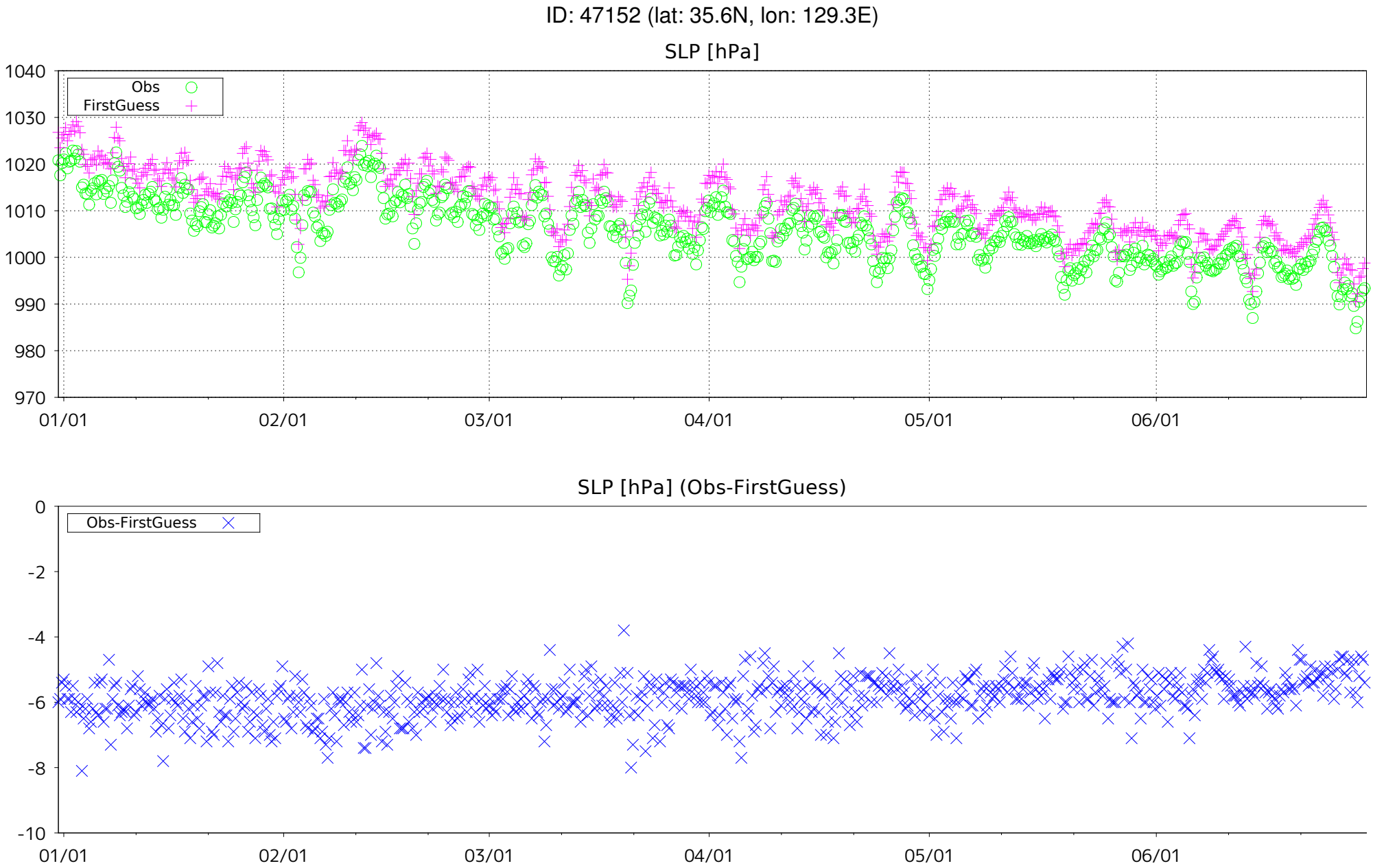

Figure 35 Time-series representation of SLP Obs minus FirstGuess for station 47152

LEVEL = SUR ELEMENT = SLP

2019 01 01 00 UTC −> 2019 06 30 18 UTC (181 DAYS)

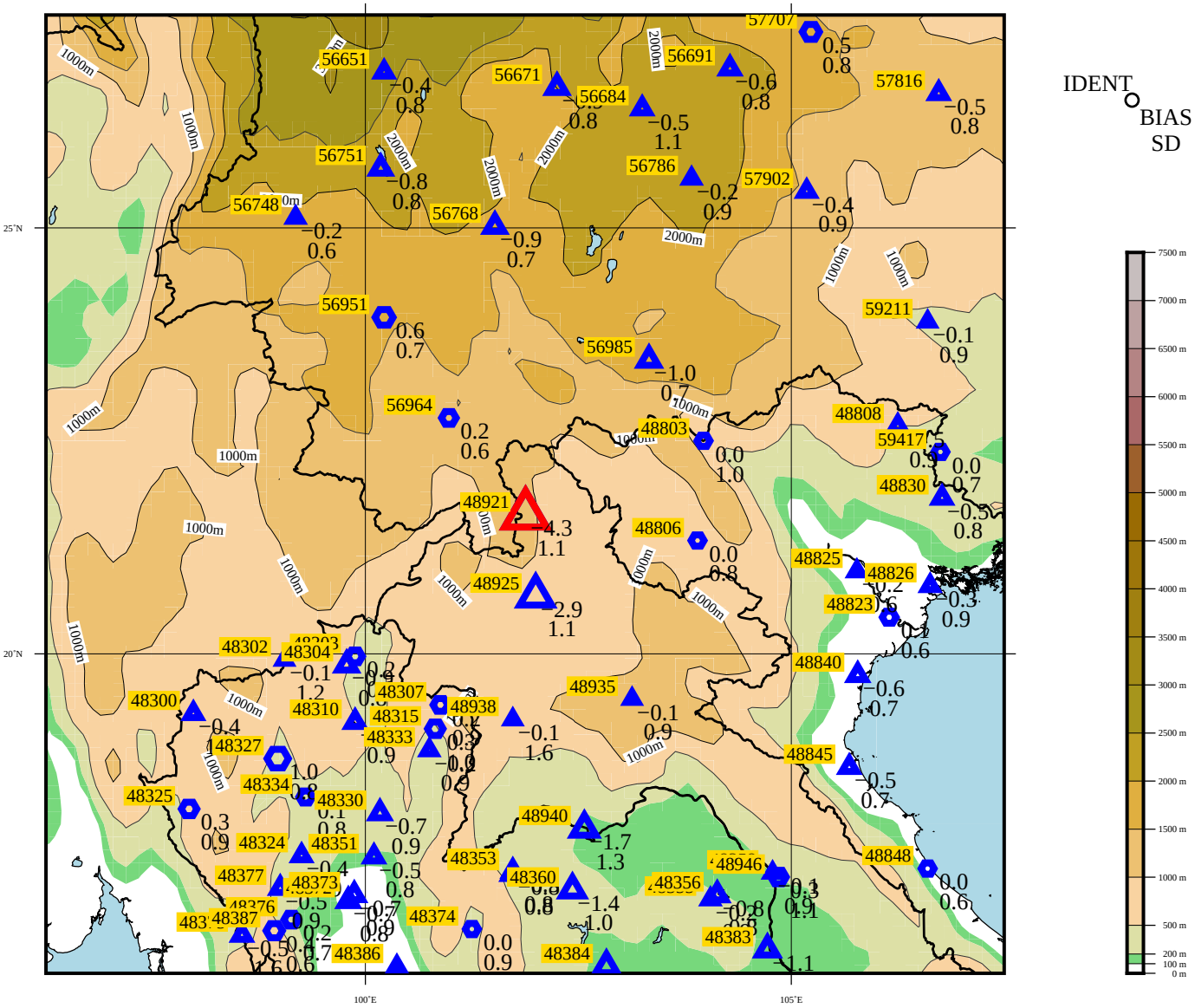

Figure 36 BIAS and SD of SLP for station 48921 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

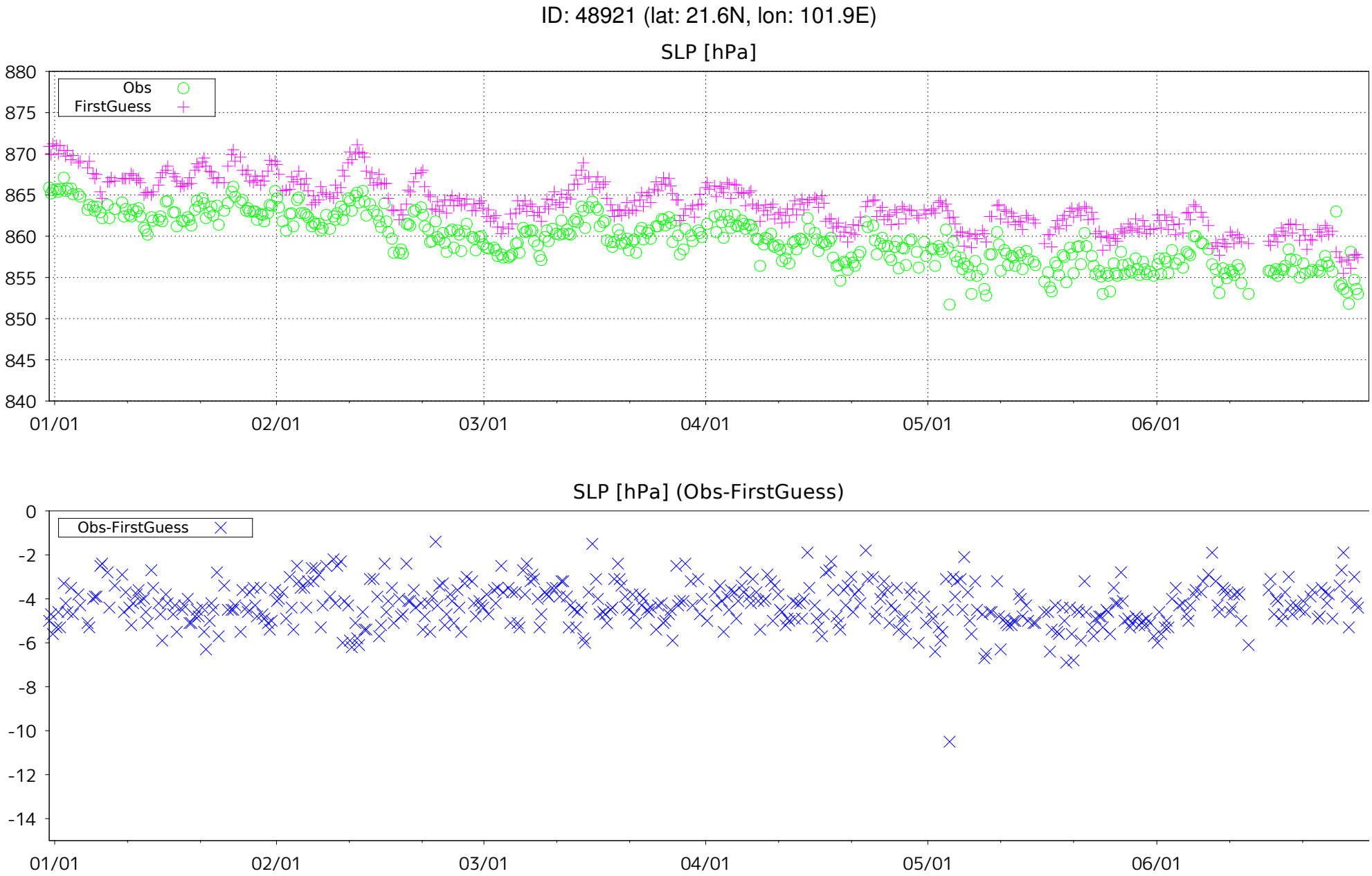

Figure 37(a) Time-series representation of SLP Obs minus FirstGuess for station 48921

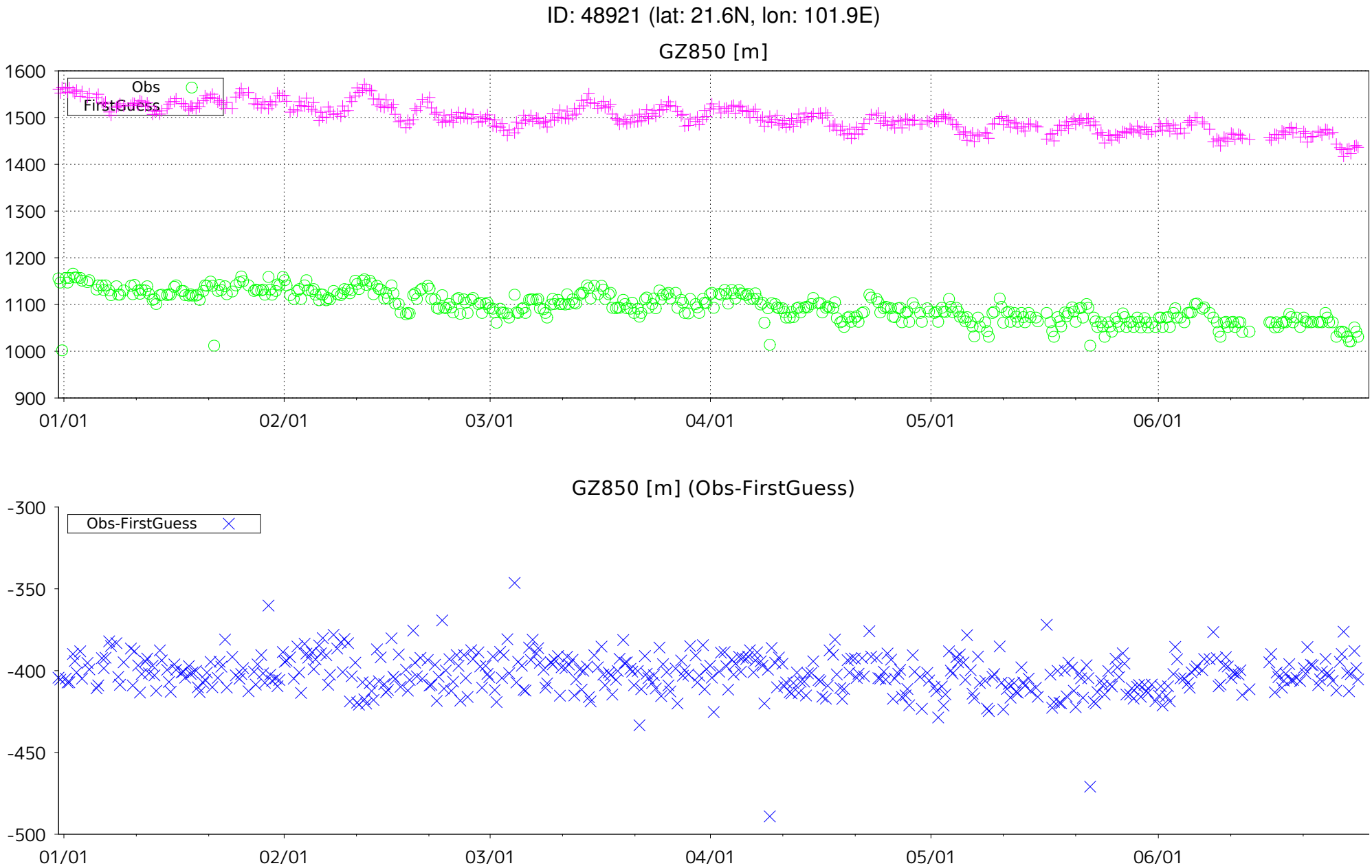

Figure 37(b) Time-series representation of GZ850 Obs minus FirstGuess for station 48921

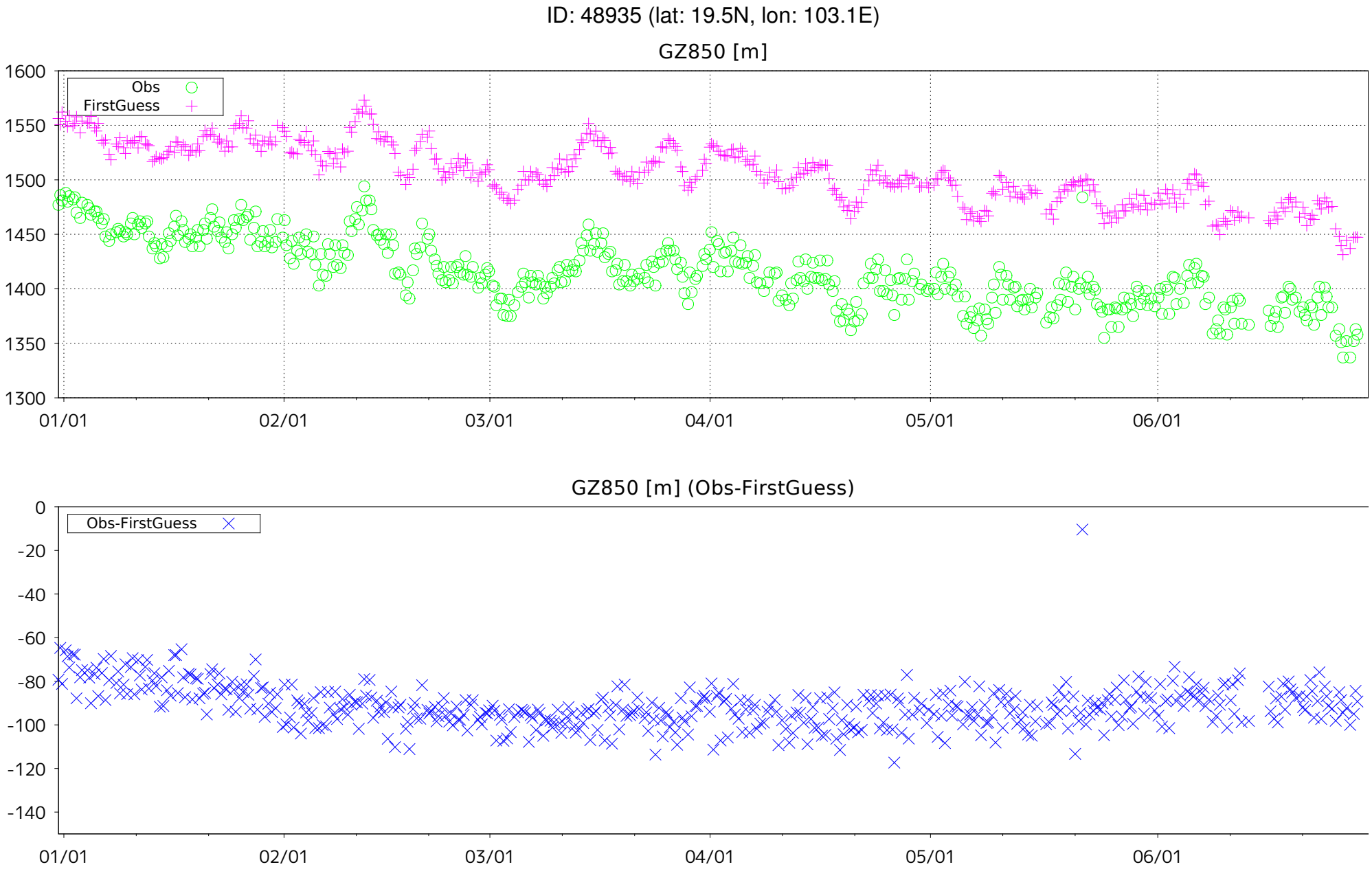

Figure 38 Time-series representation of GZ850 Obs minus FirstGuess for station 48935

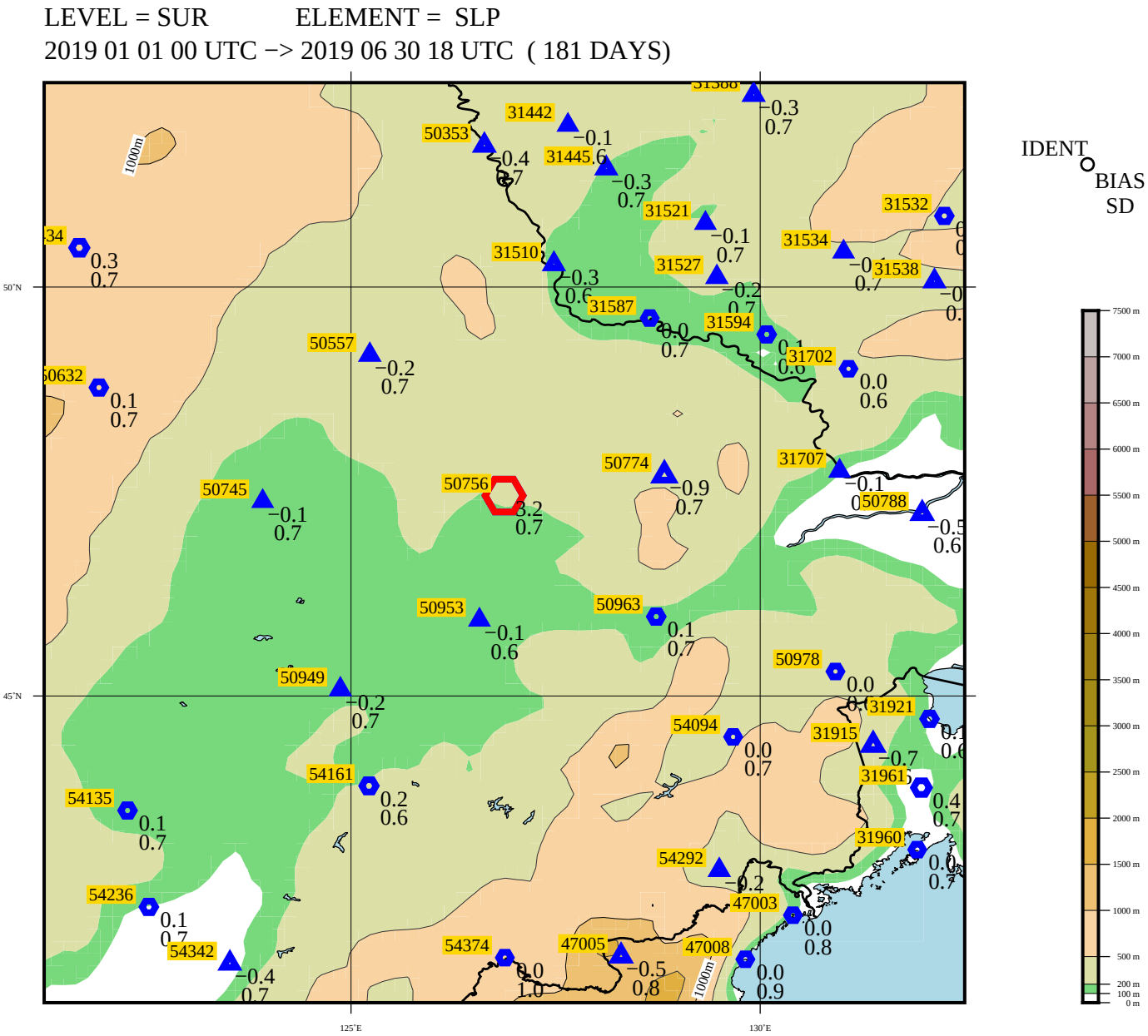

Figure 39 BIAS and SD of SLP for station 50756 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

Figure 40(a) Time-series representation of SLP Obs minus FirstGuess for station 50756

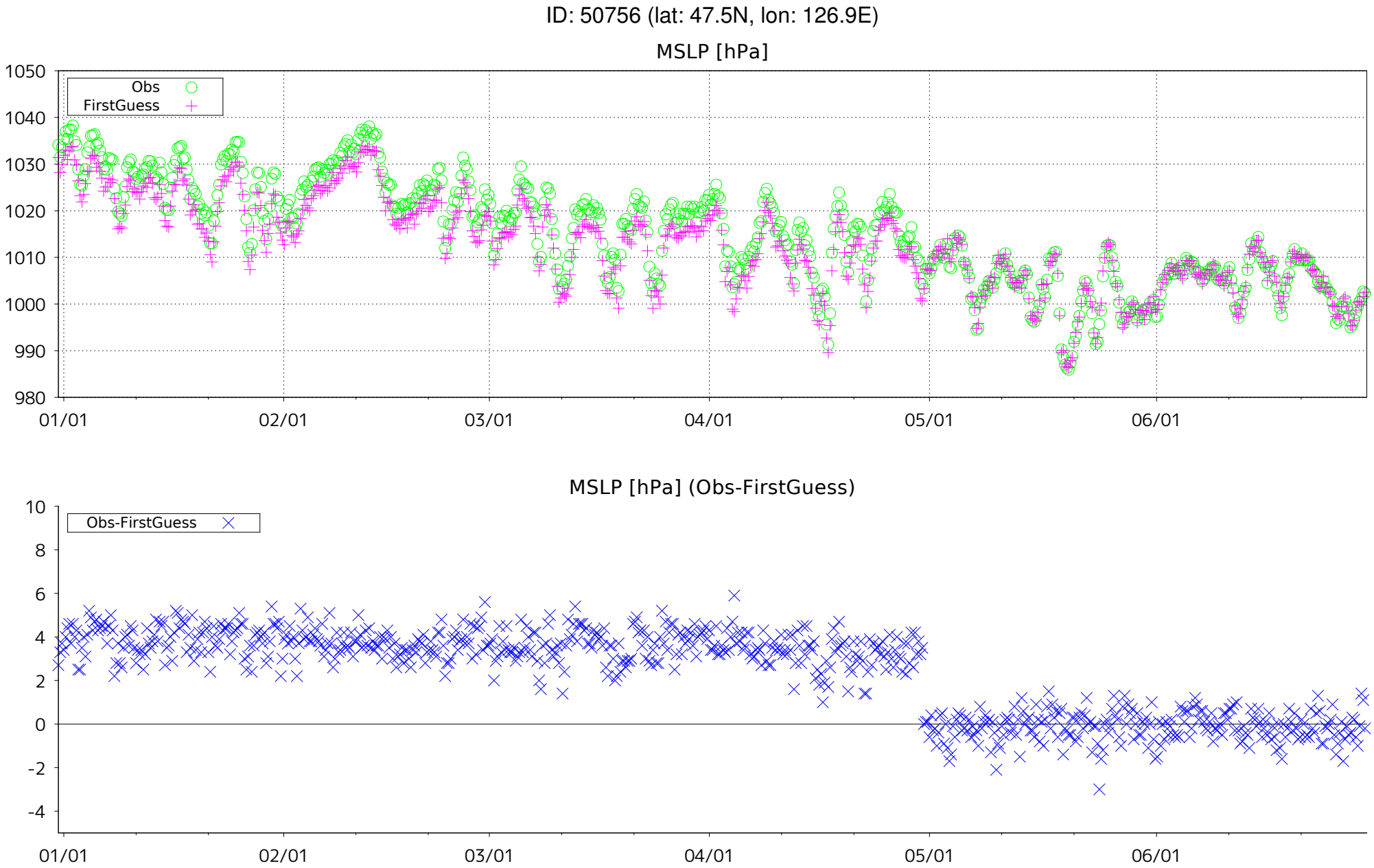

Figure 40(b) Time-series representation of MSLP Obs minus FirstGuess for station 50756

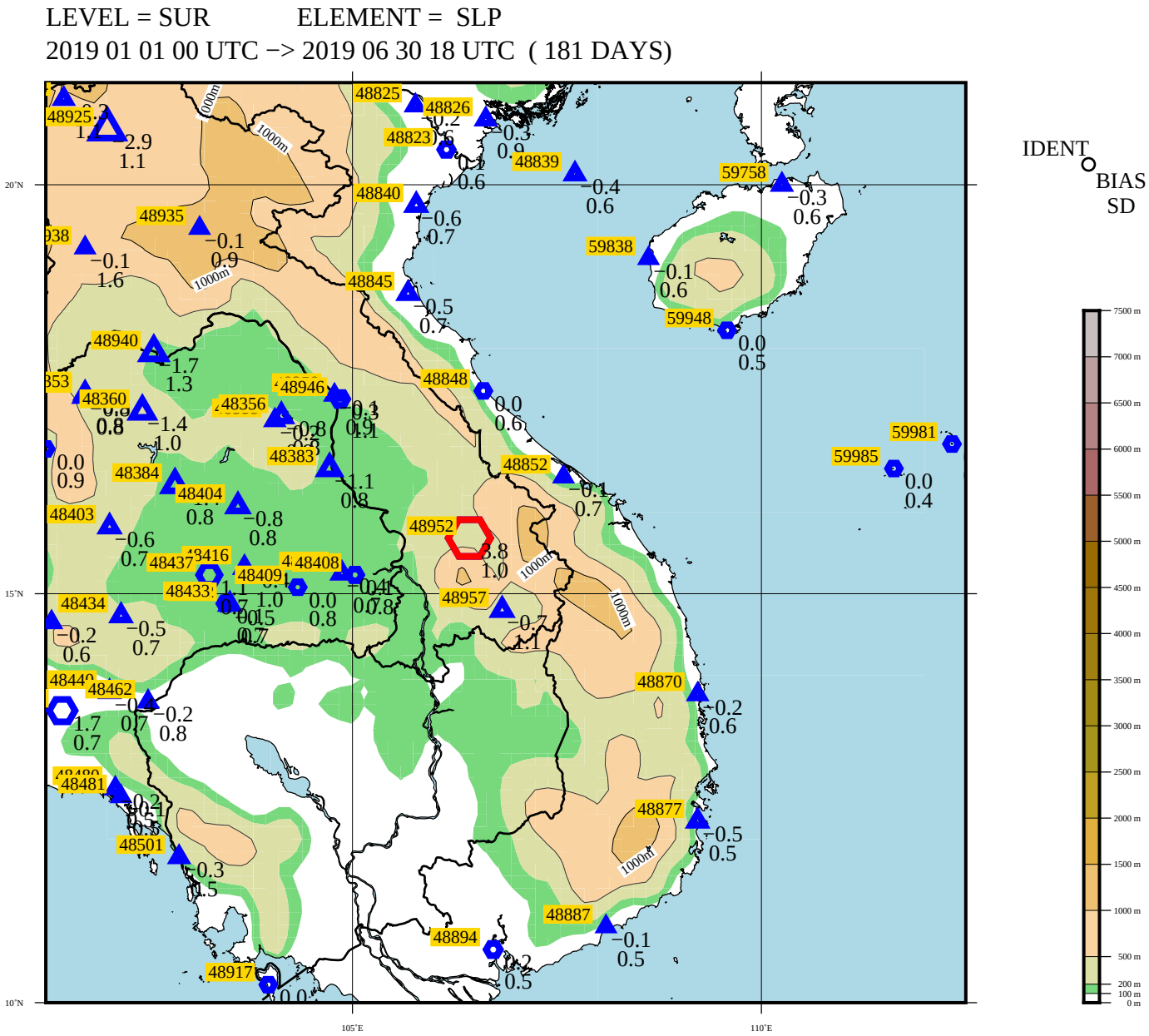

Figure 41 BIAS and SD of SLP for station 48952 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

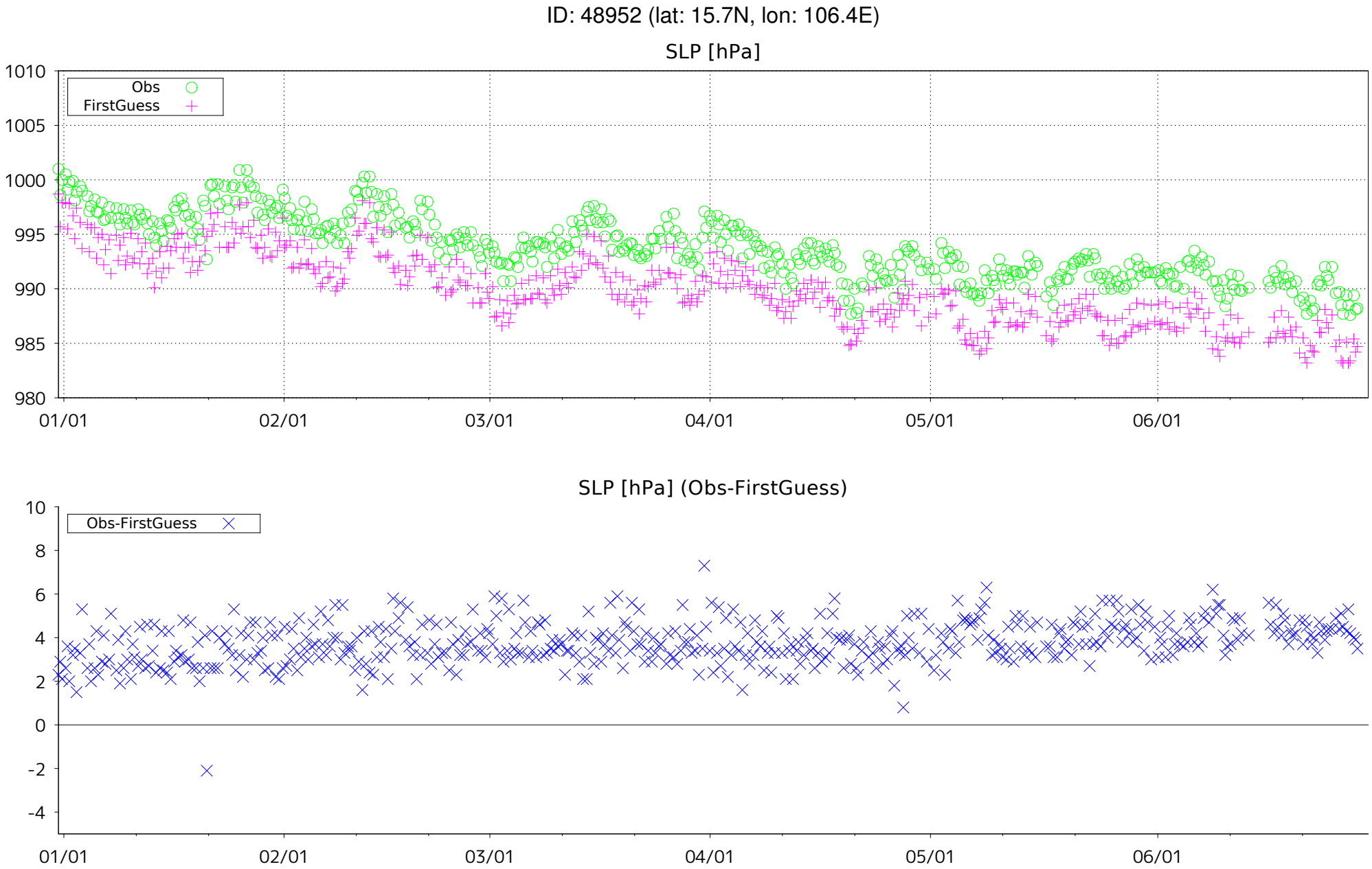

Figure 42 Time-series representation of SLP Obs minus FirstGuess for station 48952

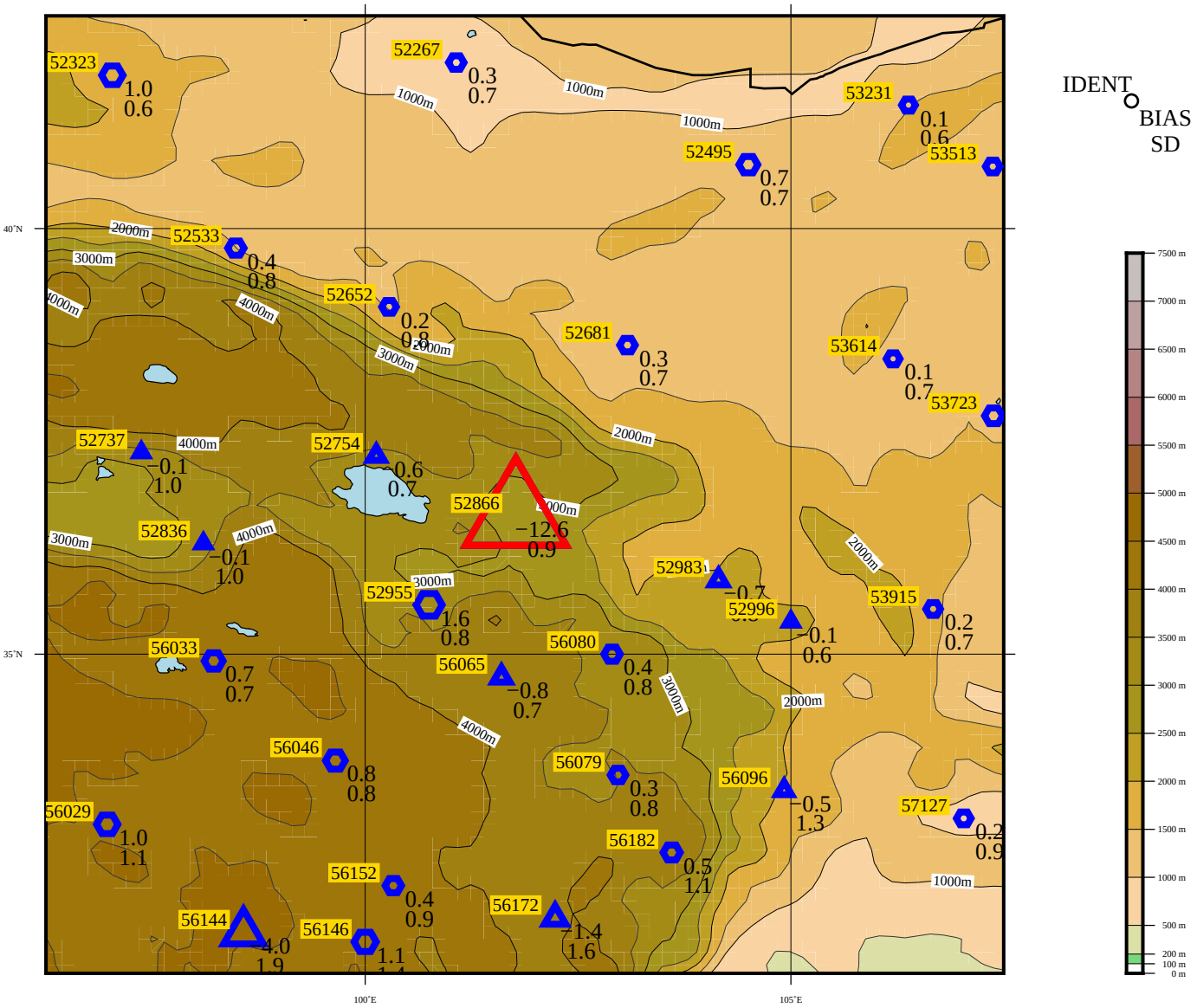

Figure 43 BIAS and SD of SLP for station 52866 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

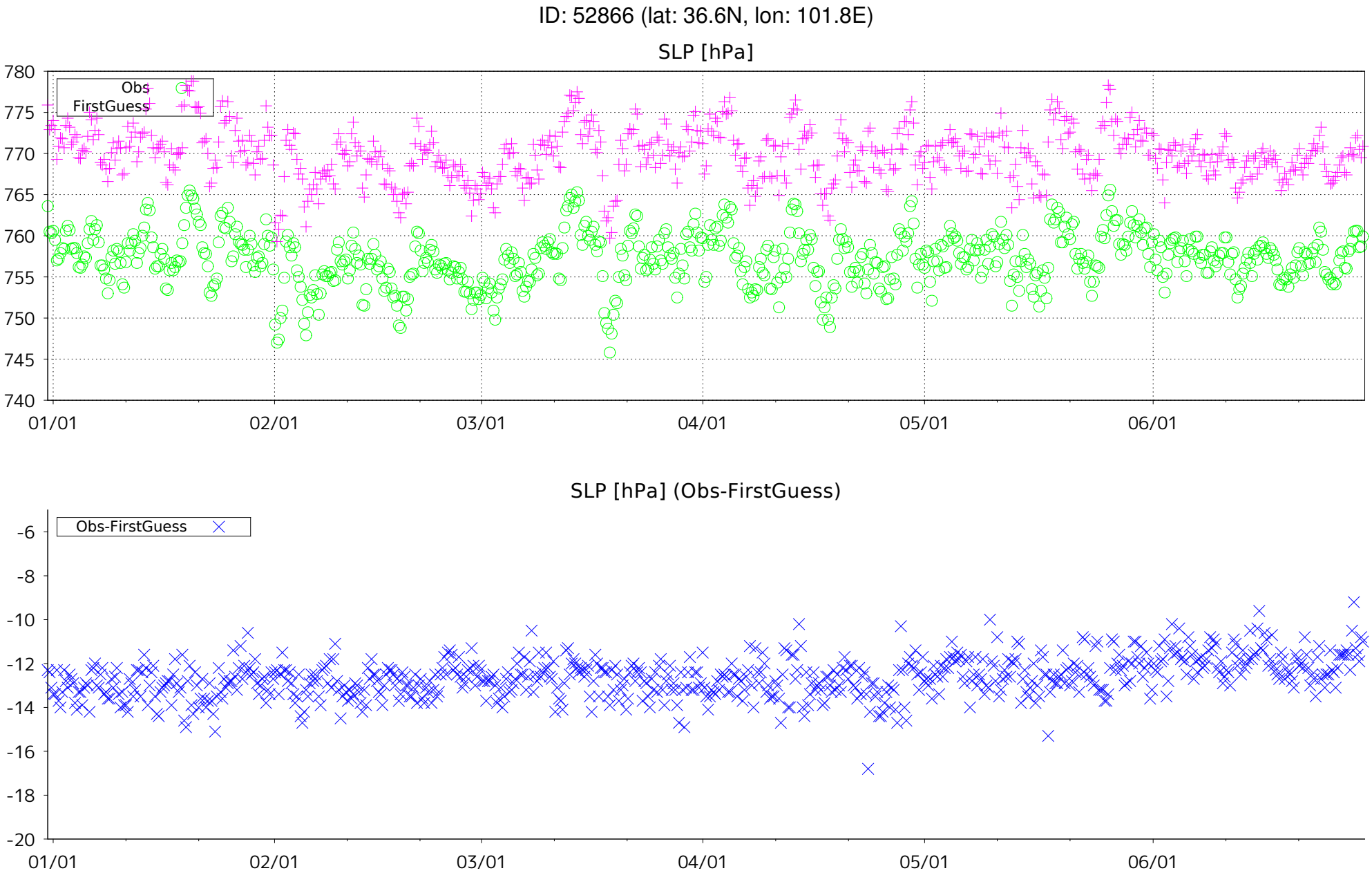

Figure 44 Time-series representation of SLP Obs minus FirstGuess for station 52866

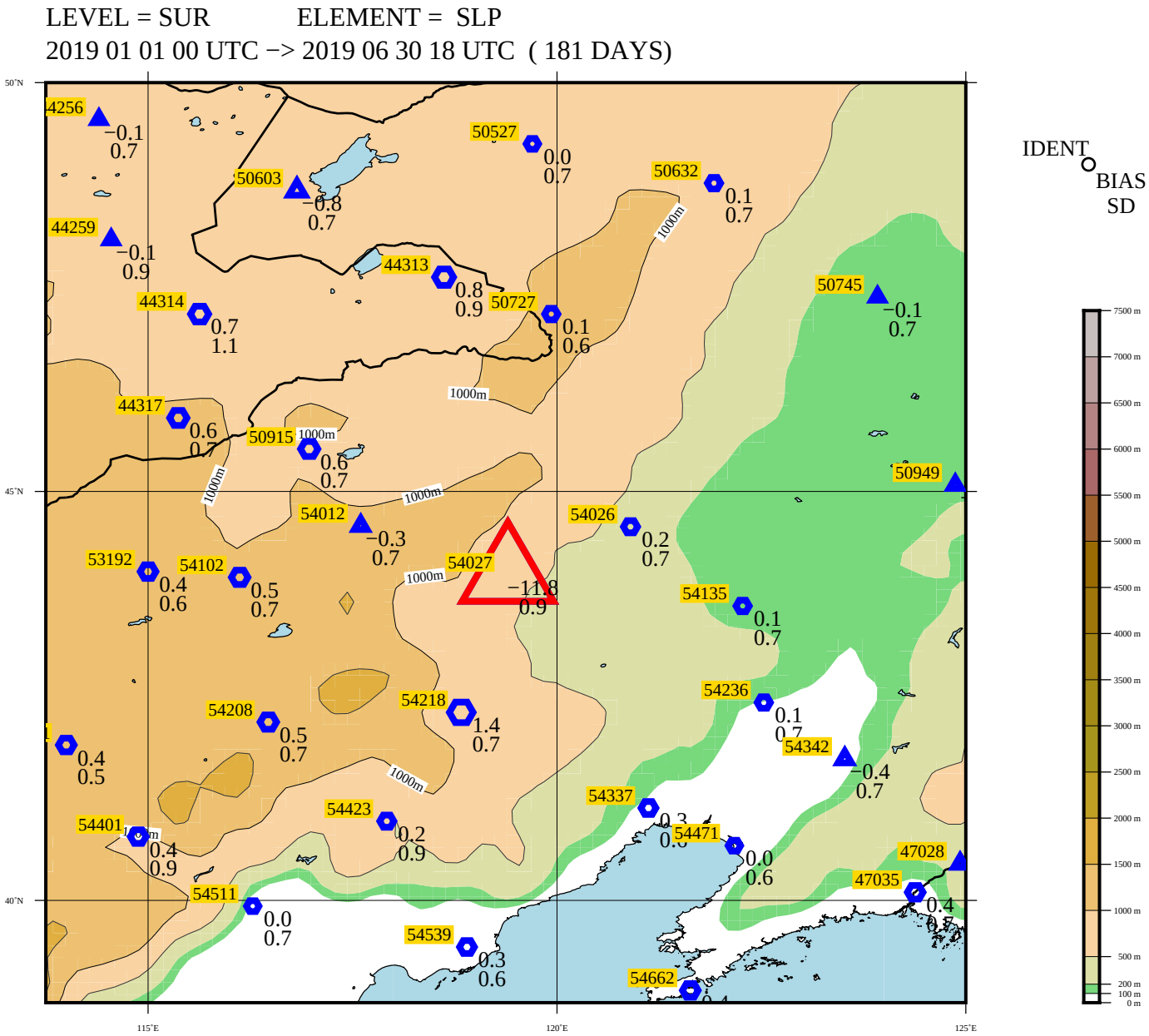

Figure 45 BIAS and SD of SLP for station 54027 (red) and surrounding stations (blue).
The number to the upper left of each symbol is the WMO IDENT, and those to the lower right are the values of BIAS and SD.
The size of each symbol is proportional to the value of BIAS, with hexagonal forms representing positive bias and triangular forms representing negative bias.

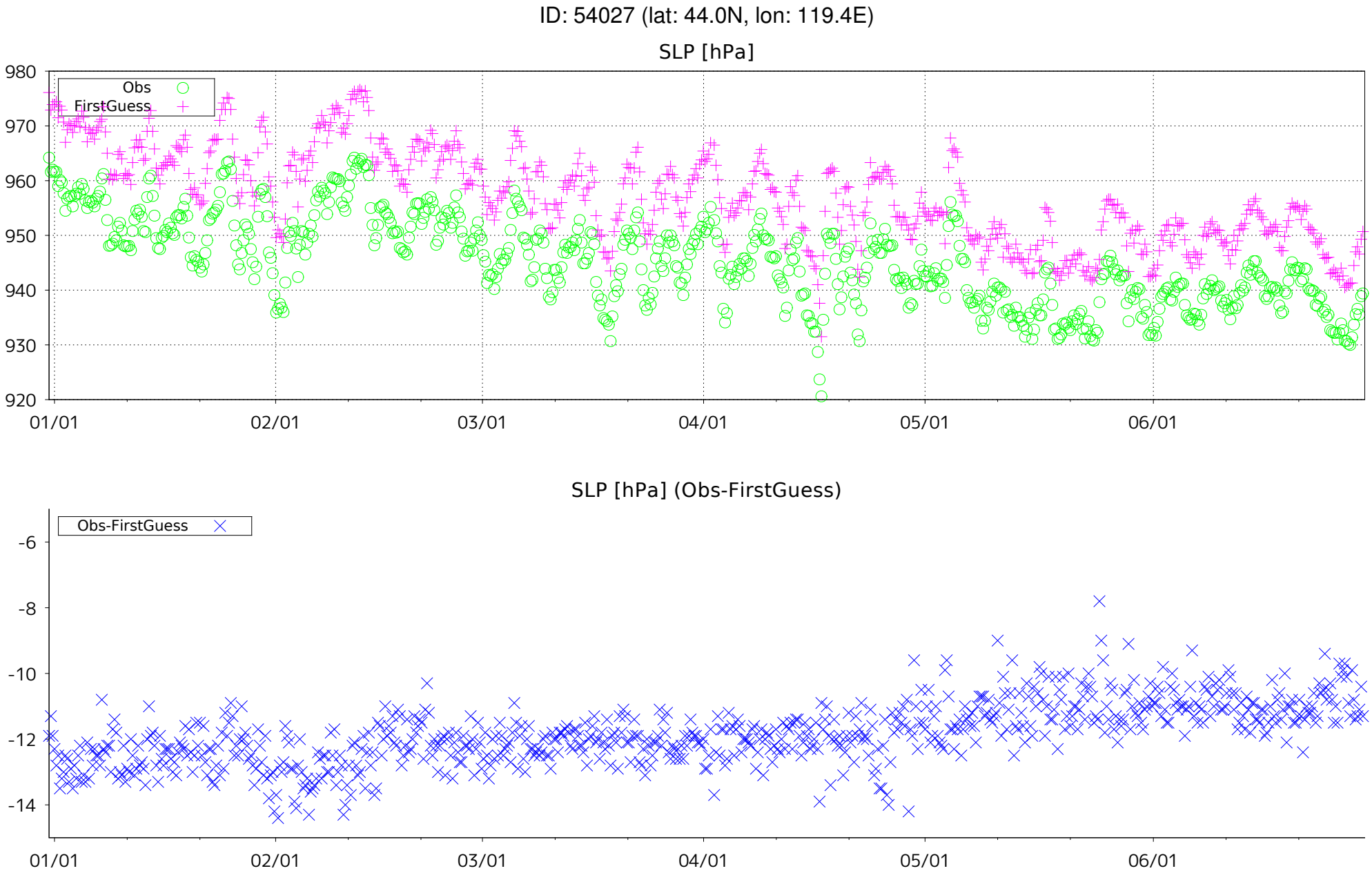

Figure 46 Time-series representation of SLP Obs minus FirstGuess for station 54027

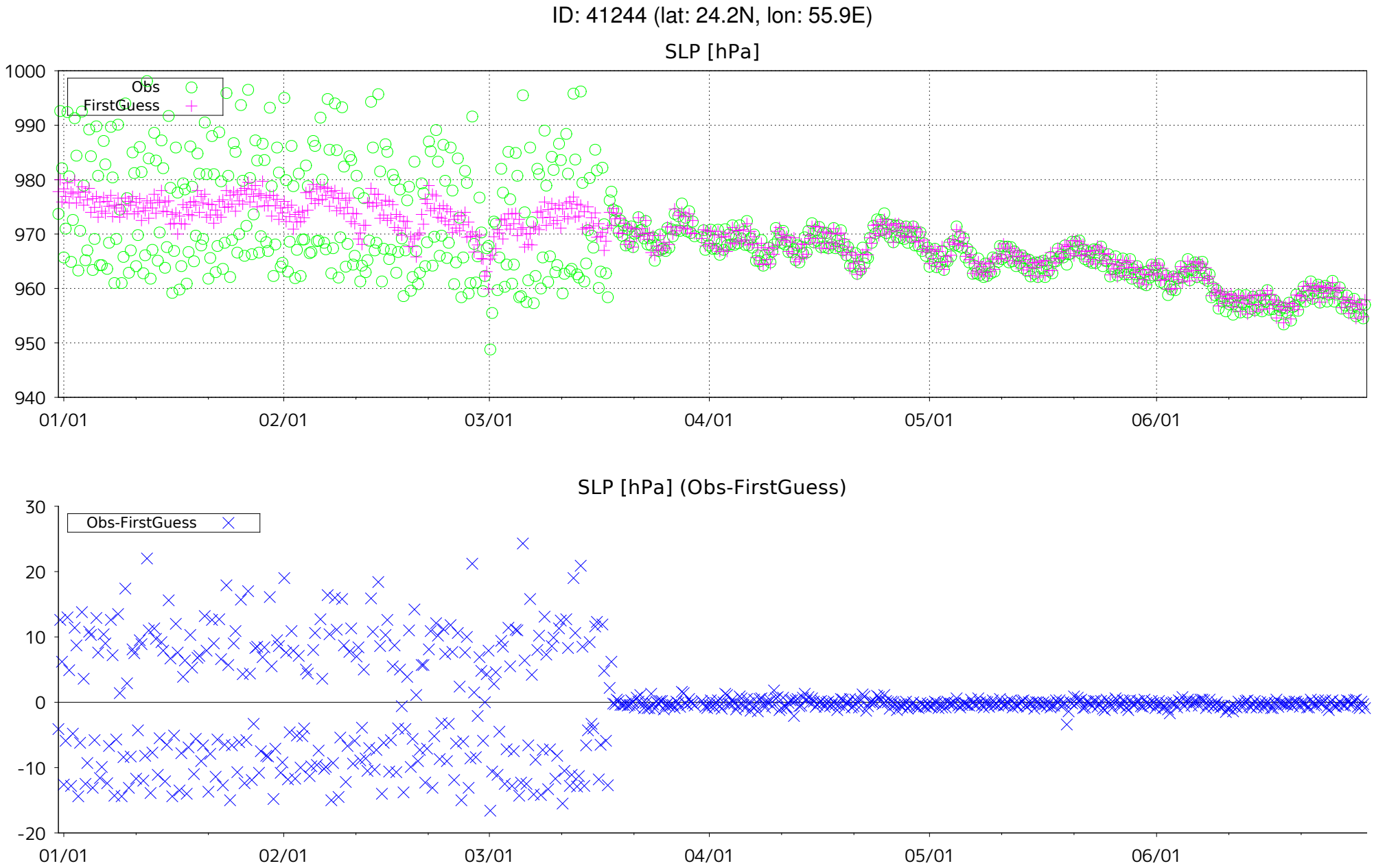

Figure 47(a) Time-series representation of SLP Obs minus FirstGuess for station 41244

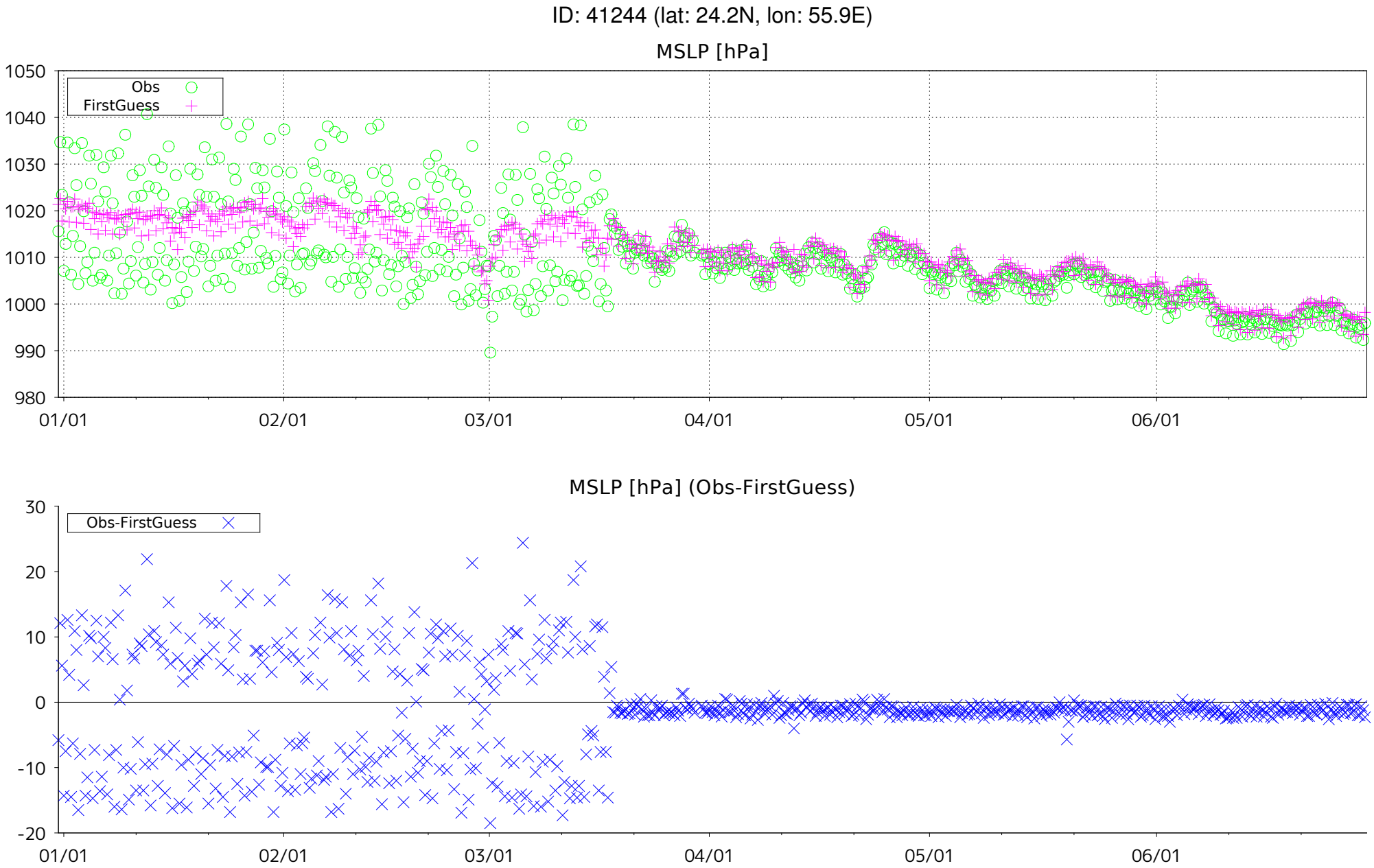

Figure 47(b) Time-series representation of MSLP Obs minus FirstGuess for station 41244

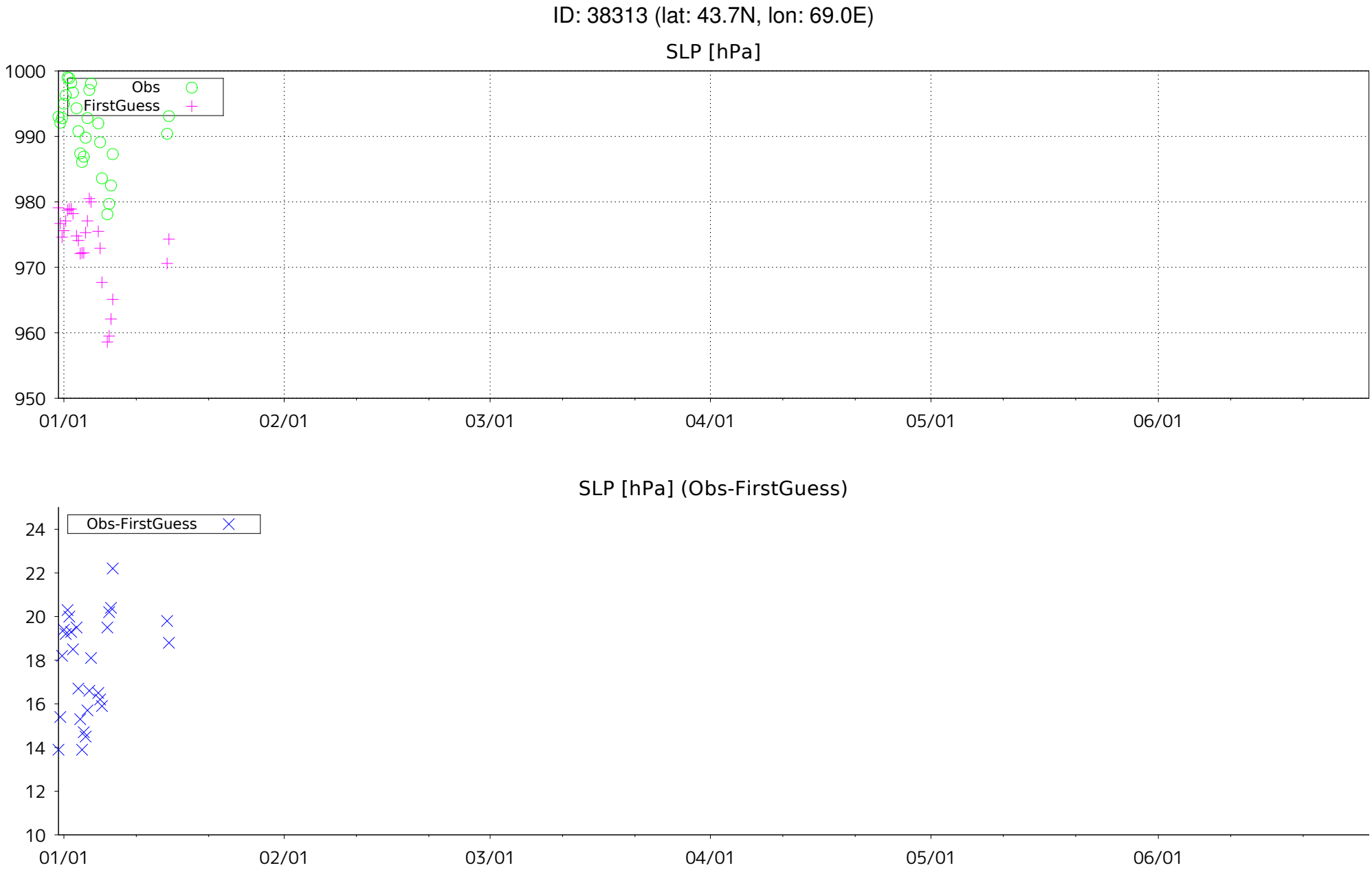

Figure 48 Time-series representation of SLP Obs minus FirstGuess for station 38313

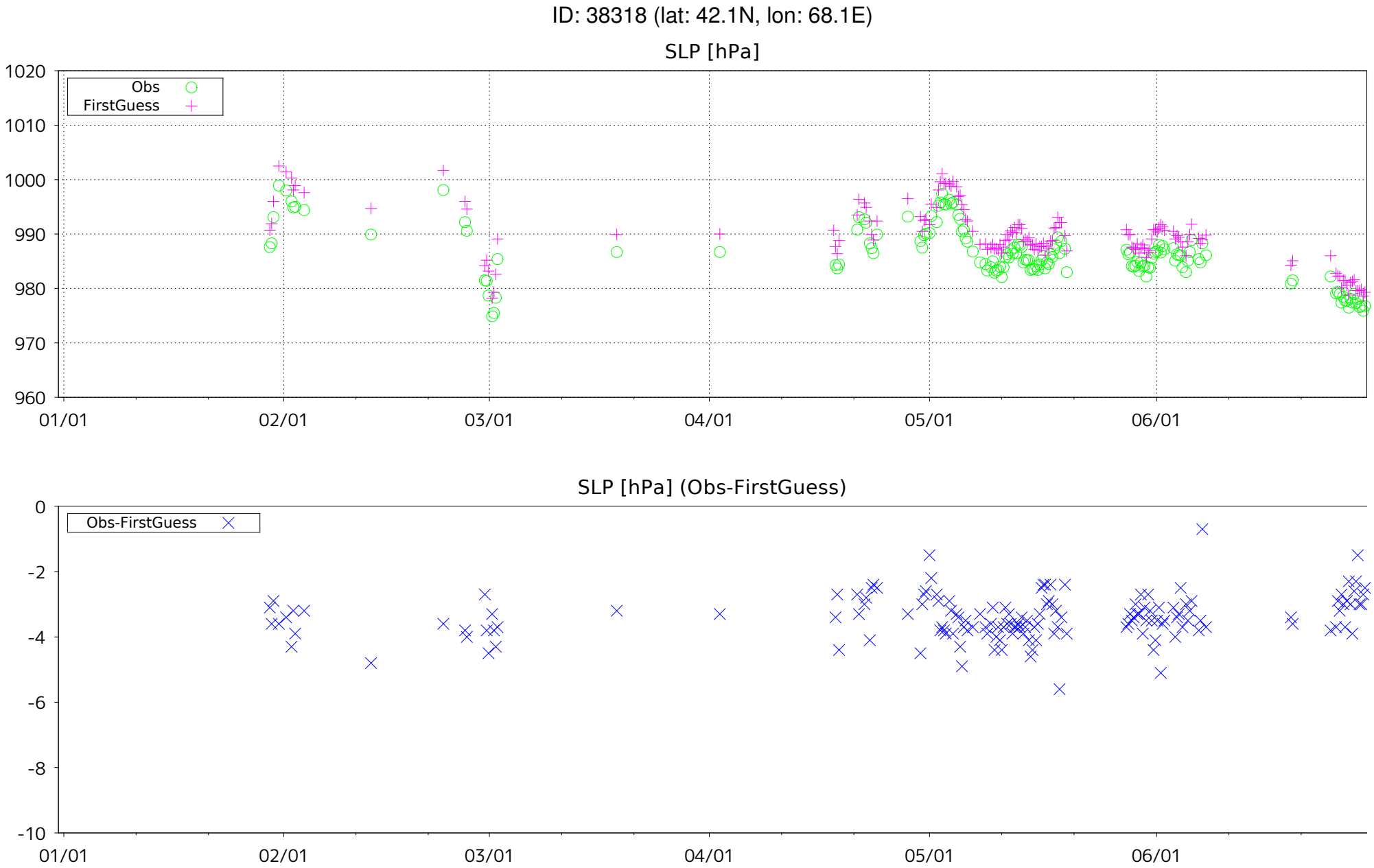

Figure 49 Time-series representation of SLP Obs minus FirstGuess for station 38318

Figure 50 Time-series representation of SLP Obs minus FirstGuess for station 40835

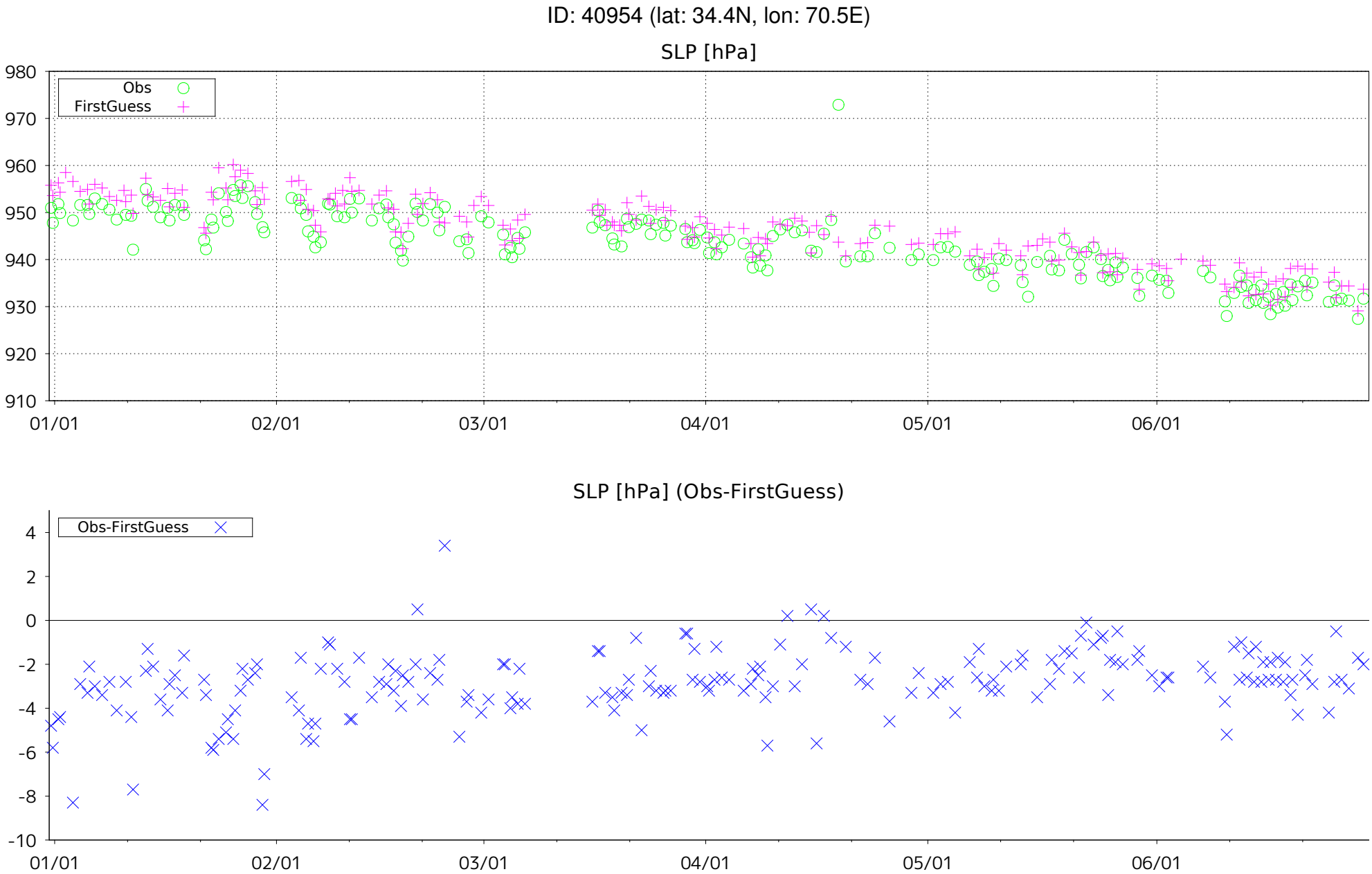

Figure 51 Time-series representation of SLP Obs minus FirstGuess for station 40954