

NATIONAL ANTARCTIC RESEARCH PROGRAM

Mario Zucchelli Station, Antarctica Geomagnetic Observatory

Magnetic Observation Results 2018-2019

L. Alfonsi, P. Bagiacchi, G. Benedetti, L. Cafarella, G. Carnevale, D. Di Mauro, S. Lepidi, L. Santarelli and A. Zirizzotti

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Introduction

This report deals with activities undertaken at the Antarctic Italian Geomagnetic Observatory during the austral summer 2018-2019.

The coordinates of the Observatory at OASI are the following:

Geographic latitude:	74.6936°S
Geographic longitude:	164.0975°E
Corrected Geomagnetic latitude (IGRF13):	79.9°S
Corrected Geomagnetic longitude (IGRF13):	306.0°E
Magnetic local time midnight:	08:20 UT

Where,CGM coordinates and MLT are from <https://omniweb.gsfc.nasa.gov/vitmo/cgm.html>.

This report describes the activities performed from November 14, 2018 to February 6, 2019.

For the present work H, D and Z data from a fluxgate magnetometer LEMI018, installed at the beginning of November 2018 and properly oriented along the magnetic meridian, have been used.

The proton precession magnetometers used to record F total values were Overhauser type; for a description of instruments we refer to geomagnetism text books, for example Parkinson (1983) and Wienert (1970).

Since the total intensity F time variations, at polar latitudes, where values of inclination is almost 90°, are very close to the vertical component Z time variations, the plots of total intensity time variations are not shown. They can however be obtained from the well known equation:

$$F^2=H^2+Z^2$$

Absolute measurements

For the normal absolute measurements-taking at the Observatory, a standard fluxgate magnetometer theodolite (THEO 010A) with decimal (400 grades) graduation for the determination of D and I angles has been used.

At OASI three different azimuth marks are available, for the computation of the Declination (please refer to the 2001/2002 report for details). The coordinates of geodetic points (mark piers and measuring location) were established on the basis of GPS measurements. From these coordinates the azimuth values 152° 44' 04'', 60° 13' 36'' and 338° 07' 59'' were found.

The proton magnetometer recordings, continuously undertaken during the execution of the DI measurements, have allowed the calculation of the absolute intensive elements.

Table 1 shows absolute measurement values for each element; the values of the intensive components H and Z (rounded off to the nT) were computed using the relations:

$$H = F \cdot \cos I$$

$$Z = F \cdot \sin I$$

H₀ and D₀ reference values computation

Since the fluxgate was magnetically oriented in the horizontal plane, as in the previous installations, it was necessary to compute H₀ and D₀ reference values, comparing absolute and relative measurements, at the same time. For the Z component, once the vertical levelling of the sensor was assured, it was assumed that the variations measured by fluxgate were actually the vertical component of the geomagnetic field variations.

In the description the mathematical procedure used for computation of H₀ and D₀, the following symbols are used:

H ₀ , D ₀	Reference values
H _{abs} , D _{abs}	Values of absolute measurements at time t
x,y	Instantaneous variations recorded by fluxgate system at time t

For each absolute measurement, the reference values were computed as:

$$H_0 = H_{abs} \cos(\varphi) - x$$

$$D_0 = D_{abs} - \varphi$$

where

$$\varphi = \arcsin (y/H_{abs})$$

In order to reduce this dispersion in the set, the Chauvenet criterion was used. The method, based on the hypothesis of a Gauss probability distribution for the data, consists in the elimination of measurements whose difference from the average is greater than a multiple of the standard deviation fixed by the sample dimension (in this case a value 3.03 σ , corresponding to a sample of about 152 data elements, was used). This method, however, cannot be applied more than once, since an iterative procedure could exclude most of the values up to the complete elimination of the data (Worthing and Jeffner, 1943).

The average values of H₀ and D₀ are:

$$H_0 = (41.0 \pm 20.3) \text{ nT}$$

$$D_0 = (133.52 \pm 0.14) \text{ deg}$$

Daily base lines computation

After H₀ and D₀ reference values are found, the computation of the base lines in relation to absolute measurements and then the computation of the daily base lines for all days, can follow. The

available data are the H, D and Z magnetic element variations recorded by fluxgate system (sampling rate 1 minute) and the absolute measurements recorded from November 14, 2018 to February 6, 2019.

The base lines computation was undertaken by two different procedures. In the case of Z, assuming that the fluxgate recordings show the variations of the vertical components, the base line (B_Z) was computed as the difference between the absolute measurements (Z_{abs}) and the fluxgate measurements (z). On the other hand, in the case of H and D, the magnetic orientation of the fluxgate system axes was taken into account. Using H_0 and D_0 reference values, the H and D base lines were computed for each absolute measurement as:

$$B_H = H_{abs} - [(H_0+x)^2 + y^2]^{1/2}$$
$$B_D = D_{abs} - D_0 - \arctg[y/(x+ H_0)]$$

Mean daily values of the base lines were obtained for those days in which more than one absolute measurement was available.

In order to have a daily base line for each magnetic element, a linear regression analysis using the least squares method has been undertaken. The results are shown in Fig. 1, where the experimental data, as well as the best fit lines are reported.

Using the daily base lines, one minute values for the three field elements H, D and Z were computed as:

$$H = [(H_0+x)^2 + y^2]^{1/2} + B_H$$
$$D = D_0 + \arctg[y/(x+ H_0)] + B_D$$
$$Z = z + B_Z$$

To reduce the measurements to the old site subtracting the following gradient:

$$\Delta H = -1.5 \text{ nT}$$
$$\Delta D = 13.0'$$
$$\Delta Z = 0.7 \text{ nT}$$

In Tables 2, 3, 4 all the hourly and daily averages and the total mean values for the H, D and Z elements on the entire measuring period (from November 14, 2018 to February 6, 2019) are reported; the relative plots are shown in Fig. 2. The plots of the one minute data follow in succession.

The geomagnetic field horizontal components in the geographic reference frame (X and Y) can be easily obtained from the H and D values using the well known equations:

$$X = H \cos(D) \quad Y = H \sin(D)$$

Geomagnetic field trend (1987-2019)

The availability of a long series of data since 1987 allows to evaluate the geomagnetic field trend. For each antarctic campaign we computed the average value of H, D, Z and F over the time period in which the absolute measurements were performed. In Fig. 88 we show these values together with the corresponding IGRF values obtained from the web site: <http://www.geomag.bgs.ac.uk>.

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Table captions

Table 1: Absolute measurement values 2018/2019

Table 2: Horizontal intensity hourly and daily means
(from November 14, 2018 to February 6, 2019)

Table 3: Declination hourly and daily means
(from November 14, 2018 to February 6, 2019)

Table 4: Vertical intensity hourly and daily means
(from November 14, 2018 to February 6, 2019)

Figure Captions

Fig 1: Scatter plot and linear regression for daily H, D and Z^1 base lines.

Fig 2: Hourly means of the H, D and Z^1 elements during the whole campaign.

Fig. 3 – 87: Daily plots of the one minute values of the H, D and Z^1 elements.

Fig. 88: Geomagnetic field trend since 1987.

¹ Z values must be considered negative

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Mean values

Campaign	H(nT)	D(deg min)		(-) Z(nT)	F(nT)
1986/1987	7391	136	49	64494	64916
1987/1988	7432	136	54	64452	64879
1988/1989	7444	136	40	64355	64784
1989/1990	7509	136	48	64325	64762
1990/1991	7522	136	45	64254	64693
1991/1992	7564	136	29	64228	64672
1992/1993	7582	136	40	64166	64612
1993/1994	7610	136	41	64148	64598
1994/1995	7643	136	46	64112	64566
1995/1996	7682	136	29	64062	64521
1996/1997	7716	136	33	64018	64481
1997/1998	7756	136	27	63979	64447
1998/1999	7789	136	24	63932	64405
1999/2000	7829	136	14	63886	64364
2000/2001	7861	136	18	63848	64330
2001/2002	7889	136	02	63794	64280
2002/2003	7916	135	58	63761	64251
2003/2004	7929	135	48	63729	64220
2004/2005	7976	135	47	63697	64194
2005/2006	8002	135	40	63624	64125
2006/2007	8027	135	44	63587	64092
2007/2008	8062	135	38	63521	64031
2008/2009	8102	135	20	63467	63981
2009/2010	8136	135	14	63417	63936
2010/2011	8181	135	09	63370	63897
2011/2012	8231	134	41	63306	63840
2012/2013	8264	134	42	63292	63828
2013/2014	8316	134	27	63235	63779
2014/2015	8355	134	14	63181	63732
2015/2016	8400	134	07	63150	63706
2016/2017	8432	134	00	63086	63647
2017/2018	8472	133	47	63048	63615
2018/2019	8526	133	33	62970	63544

Table 1

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Absolute measurements 2018/2019

date julian day	D		(+) D		I		(-) I		(+) F	(+) H	(-) Z
	beg	end	(deg	min)	beg	end	(deg	min)	(nT)	(nT)	(nT)
	(UT)				(UT)						
318	08:32	08:34	133	29.0	08:36	08:41	82	16.0	63581	8552	63003
318	08:44	08:46	133	16.0	08:48	08:51	82	16.0	63583	8550	63006
319	05:41	05:47	133	28.0	05:49	05:57	82	16.0	63553	8549	62976
319	06:02	06:09	133	29.0	06:11	06:17	82	16.0	63555	8543	62979
319	06:21	06:26	133	30.0	06:28	06:32	82	16.0	63563	8547	62986
320	05:26	05:30	133	36.0	05:32	05:35	82	16.0	63555	8540	62979
320	05:38	05:41	133	33.0	05:43	05:45	82	16.0	63559	8539	62983
320	05:48	05:51	133	44.0	05:53	05:55	82	19.0	63560	8487	62991
322	06:26	06:29	133	24.0	06:31	06:33	82	15.0	63553	8569	62973
322	06:30	06:39	133	21.0	06:40	06:43	82	14.0	63554	8573	62973
323	06:32	06:39	133	21.0	06:43	06:49	82	14.0	63550	8573	62969
323	06:55	07:02	133	18.0	07:07	07:12	82	15.0	63547	8553	62969
323	07:21	07:27	133	21.0	07:31	07:36	82	16.0	63551	8548	62974
324	05:41	05:49	133	32.0	05:52	05:59	82	09.0	63547	8665	62953
324	06:06	06:13	133	26.0	06:17	06:23	82	10.0	63540	8649	62949
324	06:31	06:37	133	20.0	06:41	06:47	82	15.0	63530	8566	62950
325	05:40	05:46	133	25.0	05:49	05:56	82	13.0	63516	8594	62932
325	06:03	06:09	133	23.0	06:13	06:19	82	13.0	63523	8590	62939
325	06:27	06:35	133	23.0	06:38	06:45	82	15.0	63522	8559	62942
326	06:43	06:49	133	27.0	06:52	06:59	82	14.0	63550	8572	62969
326	07:04	07:09	133	24.0	07:12	07:18	82	21.0	63551	8448	62987
326	07:28	07:33	133	28.0	07:35	07:41	82	15.0	63548	8554	62970
328	10:14	10:19	133	26.0	10:22	10:26	82	18.0	63572	8512	63000
328	10:32	10:38	133	27.0	10:42	10:53	82	18.0	63571	8515	62998
328	10:58	11:03	133	31.0	11:11	11:16	82	18.0	63576	8517	63003
329	08:26	08:32	133	22.0	08:35	08:41	82	16.0	63547	8546	62970
329	08:47	08:52	133	19.0	08:56	09:01	82	16.0	63553	8537	62977
329	09:08	09:15	133	18.0	09:18	09:24	82	17.0	63555	8534	62980
330	09:23	09:28	133	23.0	09:31	09:37	82	16.0	63566	8552	62988
330	09:43	09:48	133	22.0	09:51	09:56	82	16.0	63571	8547	62994
330	10:00	10:05	133	23.0	10:08	10:13	82	16.0	63573	8540	62997
331	09:32	09:36	133	21.0	09:38	09:44	82	14.0	63575	8576	62994
331	09:55	10:00	133	17.0	10:02	10:06	82	16.0	63561	8547	62984
331	10:11	10:17	133	20.0	10:21	10:26	82	17.0	63548	8523	62974
332	06:09	06:11	133	28.0	06:13	06:16	82	15.0	63561	8561	62982
332	06:20	06:23	133	26.0	06:25	06:29	82	15.0	63565	8568	62985
332	06:31	06:34	133	26.0	06:36	06:38	82	16.0	63564	8550	62986
333	05:55	05:58	133	30.0	06:03	06:06	82	18.0	63541	8510	62968
333	06:09	06:11	133	27.0	06:13	06:16	82	15.0	63543	8556	62964
333	06:22	06:25	133	30.0	06:27	06:30	82	15.0	63545	8557	62966
334	05:45	05:49	133	26.0	05:53	05:57	82	15.0	63536	8565	62956
334	06:00	06:03	133	30.0	06:05	06:08	82	15.0	63544	8564	62964
334	06:11	06:14	133	29.0	06:16	06:19	82	15.0	63552	8560	62973
335	05:50	05:53	133	25.0	05:55	05:58	82	11.0	63522	8622	62934
335	06:00	06:02	133	23.0	06:04	06:06	82	11.0	63519	8621	62932
335	06:09	06:11	133	20.0	06:12	06:15	82	12.0	63523	8606	62937

336	08:55	08:58	133	14.0	09:01	09:04	82	16.0	63583	8538	63007
336	09:07	09:09	133	15.0	09:11	09:14	82	16.0	63588	8552	63011
337	05:46	05:50	133	42.0	05:52	05:54	82	11.0	63525	8631	62936
337	05:55	05:58	133	49.0	05:59	06:02	82	14.0	63530	8577	62949
337	06:04	06:06	133	36.0	06:08	06:11	82	11.0	63537	8639	62947
340	08:52	08:55	133	28.0	08:56	08:58	82	16.0	63564	8542	62987
340	09:01	09:03	133	26.0	09:05	09:07	82	16.0	63567	8542	62990
340	09:09	09:12	133	27.0	09:14	09:16	82	16.0	63568	8537	62992
5	03:29	03:33	134	11.0	03:37	03:43	82	07.0	63511	8698	62912
5	03:52	03:56	133	23.0	03:58	04:03	82	09.0	63531	8672	62936
5	04:11	04:14	133	10.0	04:17	04:22	82	02.0	63588	8805	62975
6	04:01	04:04	133	17.0	04:06	04:11	82	12.0	63511	8608	62925
6	04:13	04:17	133	27.0	04:20	04:25	82	12.0	63513	8616	62926
6	04:28	04:31	133	26.0	04:34	04:38	82	11.0	63527	8635	62937
7	03:50	03:53	134	04.0	03:55	03:59	82	14.0	63528	8578	62946
7	04:02	04:05	134	06.0	04:08	04:12	82	13.0	63528	8596	62944
7	04:23	04:26	134	00.0	04:28	04:32	82	10.0	63543	8651	62951
8	04:28	04:31	133	47.0	04:34	04:38	82	15.0	63537	8561	62958
8	04:39	04:44	133	21.0	04:46	04:50	82	15.0	63544	8564	62964
8	04:52	04:56	133	29.0	04:58	05:01	82	13.0	63557	8594	62973
9	04:57	05:01	133	31.0	05:03	05:07	82	13.0	63525	8587	62942
9	05:08	05:12	133	27.0	04:14	05:18	82	17.0	63512	8525	62937
9	05:20	05:23	133	24.0	05:26	05:30	82	15.0	63525	8556	62946
10	05:19	05:23	133	42.0	05:24	05:29	82	15.0	63541	8560	62962
10	05:31	05:34	133	34.0	05:37	05:42	82	15.0	63546	8564	62966
10	05:44	05:47	133	36.0	05:50	05:54	82	15.0	63548	8568	62968
11	05:02	05:05	133	35.0	05:07	05:11	82	16.0	63506	8537	62930
11	05:23	05:27	133	30.0	05:29	05:33	82	15.0	63502	8556	62923
11	05:35	05:39	133	29.0	05:41	05:45	82	15.0	63534	8552	62955
12	04:54	04:57	133	26.0	05:00	05:04	82	15.0	63495	8556	62915
12	05:05	05:08	133	26.0	05:10	05:14	82	14.0	63499	8575	62917
12	05:15	05:19	133	26.0	05:21	05:25	82	14.0	63511	8581	62928
13	05:22	05:26	133	22.0	05:28	05:32	82	11.0	63558	8640	62968
13	05:40	05:45	133	29.0	05:47	05:52	82	12.0	63544	8611	62958
13	05:54	05:57	133	17.0	06:00	06:06	82	13.0	63552	8607	62967
14	05:11	05:15	133	42.0	05:18	05:22	82	15.0	63482	8561	62902
14	05:24	05:27	133	39.0	05:30	05:34	82	15.0	63494	8556	62915
14	05:35	05:39	133	43.0	05:41	05:45	82	17.0	63505	8509	62932
15	05:09	05:13	133	27.0	05:16	05:20	82	14.0	63528	8580	62946
15	05:22	05:25	133	27.0	05:27	05:31	82	16.0	63530	8535	62954
15	05:32	05:36	133	28.0	05:39	05:43	82	17.0	63534	8526	62959
16	05:11	05:14	133	33.0	05:17	05:20	82	16.0	63535	8539	62959
16	05:22	05:25	133	31.0	05:27	05:32	82	15.0	63544	8567	62964
16	05:34	05:38	133	30.0	05:40	05:44	82	16.0	63543	8536	62967
17	05:11	05:14	133	43.0	05:17	05:22	82	16.0	63537	8541	62961
17	05:24	05:27	133	44.0	05:29	05:33	82	16.0	63536	8549	62958
17	05:35	05:38	133	45.0	05:40	05:44	82	18.0	63534	8510	62962
18	05:09	05:13	133	30.0	05:15	05:19	82	18.0	63528	8501	62956
18	05:21	05:25	133	35.0	05:27	05:32	82	12.0	63519	8609	62933
18	05:33	05:37	133	35.0	05:39	05:43	82	12.0	63517	8615	62930
19	04:36	04:39	133	51.0	04:41	04:46	82	15.0	63513	8563	62933
19	04:48	04:52	133	54.0	04:54	04:58	82	14.0	63525	8575	62943
19	04:59	05:03	133	54.0	05:05	05:10	82	20.0	63525	8470	62958
20	04:59	05:03	133	39.0	05:06	05:10	82	15.0	63525	8550	62947
20	05:11	05:16	133	38.0	05:18	05:22	82	17.0	63529	8512	62956
20	05:24	05:28	133	37.0	05:30	05:34	82	18.0	63523	8505	62952
21	04:41	04:45	133	27.0	04:47	04:52	82	15.0	63535	8563	62955
21	04:54	04:57	133	28.0	05:00	05:04	82	15.0	63537	8555	62959
21	05:06	05:10	133	27.0	05:12	05:16	82	15.0	63544	8562	62964
22	05:10	05:14	133	21.0	05:16	05:20	82	15.0	63530	8566	62950
22	05:26	05:29	133	23.0	05:26	05:29	82	18.0	63528	8496	62957
22	05:44	05:47	133	30.0	05:50	05:53	82	17.0	63524	8521	62950
23	04:26	04:30	133	37.0	04:32	04:36	82	13.0	63483	8586	62900
23	04:39	04:43	133	31.0	04:45	04:49	82	13.0	63489	8594	62905

23	04:51	04:55	133	22.0	04:58	05:02	82	16.0	63489	8531	62914
24	04:29	04:32	134	18.0	04:35	04:39	82	14.0	63493	8575	62911
24	04:50	04:54	134	24.0	04:56	05:00	82	15.0	63513	8556	62934
24	05:02	05:05	134	09.0	05:07	05:11	82	18.0	63531	8504	62959
25	05:04	05:09	134	02.0	05:11	05:15	82	12.0	63543	8622	62955
25	05:18	05:21	133	51.0	05:25	05:29	82	15.0	63536	8564	62956
25	05:53	05:57	134	04.0	06:00	06:04	82	12.0	63547	8607	62962
26	04:08	04:12	134	10.0	04:15	04:19	82	14.0	63549	8572	62969
26	04:21	04:27	134	09.0	04:30	04:33	82	16.0	63550	8537	62974
26	04:35	04:39	134	06.0	04:42	04:46	82	16.0	63557	8538	62981
27	04:58	05:01	133	53.0	05:03	05:07	82	14.0	63519	8583	62936
27	05:09	05:15	133	43.0	05:17	05:21	82	13.0	63520	8595	62936
27	05:26	05:30	133	36.0	05:32	05:35	82	13.0	63516	8600	62931
28	04:27	04:30	133	36.0	04:33	04:36	82	16.0	63517	8542	62940
28	04:38	04:41	133	31.0	04:44	04:47	82	16.0	63510	8536	62934
28	04:49	04:55	133	28.0	04:57	05:01	82	15.0	63507	8548	62929
29	04:49	04:52	134	07.0	04:54	04:58	82	15.0	63524	8555	62945
29	05:00	05:03	133	55.0	05:06	05:10	82	15.0	63533	8551	62955
30	04:27	04:32	133	37.0	04:34	04:37	82	15.0	63526	8558	62947
30	04:42	04:47	133	35.0	04:49	04:53	82	15.0	63532	8563	62952
30	04:54	05:01	133	35.0	05:05	05:08	82	18.0	63533	8508	62961
31	04:22	04:26	133	37.0	04:28	04:31	82	15.0	63515	8559	62936
31	04:39	04:43	133	37.0	04:45	04:48	82	15.0	63507	8558	62928
31	04:57	05:06	133	34.0	05:03	05:06	82	14.0	63523	8569	62943
32	04:12	04:14	133	25.0	04:16	04:20	82	10.0	63517	8648	62926
32	04:22	04:25	133	26.0	04:27	04:30	82	07.0	63545	8712	62945
32	04:32	04:39	133	27.0	04:42	04:45	82	05.0	63523	8739	62919
33	04:57	05:00	133	57.0	05:02	05:06	82	10.0	63517	8640	62927
33	05:08	05:11	133	49.0	05:13	05:17	82	12.0	63515	8605	62929
33	05:19	05:22	133	55.0	05:25	05:29	82	09.0	63570	8682	62975
34	05:17	05:20	133	37.0	05:23	05:26	82	15.0	63581	8572	63000
34	05:28	05:33	133	35.0	05:35	05:39	82	16.0	63566	8547	62989
34	05:41	05:44	133	32.0	05:46	05:51	82	15.0	63582	8562	63003
35	04:42	04:45	133	31.0	04:47	04:50	82	14.0	63519	8577	62938
35	04:52	04:55	133	33.0	04:58	05:03	82	14.0	63520	8575	62939
35	05:12	05:15	133	32.0	05:18	05:22	82	17.0	63531	8523	62957
36	04:50	04:55	133	25.0	04:58	05:02	82	13.0	63526	8595	62942
36	05:03	05:07	133	25.0	05:09	05:12	82	14.0	63526	8585	62944
36	05:14	05:17	133	23.0	05:20	05:24	82	14.0	63529	8578	62947
37	04:29	04:33	133	59.0	04:36	04:39	82	14.0	63530	8581	62948
37	04:41	04:43	133	55.0	04:45	04:49	82	13.0	63530	8586	62947
37	04:50	04:54	133	57.0	04:57	05:01	82	15.0	63520	8557	62941

Table 2

TNB Antarctica, Italian Geomagnetic Observatory

Hourly H values (nT) from Nov 14, 2018 to Feb 06, 2019

UT	0	1	2	3	4	5	6	7	8	9	10	11	DAILY MEAN
	12	13	14	15	16	17	18	19	20	21	22	23	
julian day													
318	8537	8544	8549	8554	8560	8570	8561	8559	8548	8539	8517	8518	
	8505	8512	8501	8491	8520	8516	8518	8510	8487	8486	8494	8502	8525
319	8527	8549	8551	8567	8564	8549	8544	8533	8537	8528	8514	8520	
	8513	8508	8503	8509	8494	8503	8510	8508	8494	8492	8516	8507	8522
320	8528	8524	8555	8560	8552	8539	8539	8534	8528	8530	8520	8523	
	8514	8510	8495	8485	8499	8509	8514	8511	8506	8499	8511	8527	8521
321	8540	8537	8535	8572	8589	9999	9999	9999	9999	9999	9999	9999	
	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	8548
322	8538	8516	8544	8546	8559	8555	8569	8557	8549	8560	8535	8509	
	8505	8506	8500	8501	8507	8519	8518	8514	8500	8494	8507	8525	8526
323	8548	8547	8558	8602	8625	8601	8575	8547	8543	8528	8514	8502	
	8499	8507	8506	8474	8446	8428	8426	8445	8440	8449	8448	8466	8509
324	8506	8556	8601	8607	8652	8638	8612	8563	8546	8551	8533	8511	
	8503	8497	8497	8503	8513	8504	8509	8516	8513	8501	8502	8518	8540
325	8530	8581	8590	8608	8696	8644	8572	8559	8583	8534	8504	8507	
	8486	8517	8514	8508	8511	8508	8508	8499	8495	8501	8544	8514	8542
326	8549	8564	8557	8552	8553	8558	8564	8559	8541	8532	8517	8508	
	8503	8505	8495	8504	8515	8525	8522	8509	8496	8494	8510	8529	8527
327	8546	8540	8557	8573	8573	8571	8565	8554	8547	8527	8523	8512	
	8510	8513	8499	8501	8505	8502	8514	8515	8501	8516	8501	8517	8528
328	8527	8536	8546	8549	8557	8562	8558	8555	8546	8531	8512	8520	
	8528	8506	8506	8502	8513	8520	8515	8508	8515	8516	8507	8513	8527
329	8526	8542	8557	8520	8539	8554	8544	8552	8550	8541	8525	8524	
	8488	8498	8487	8496	8494	8503	8505	8508	8493	8513	8475	8526	8519
330	8556	8563	8557	8567	8583	8574	8565	8556	8551	8553	8537	8524	
	8518	8513	8515	8516	8519	8521	8497	8498	8506	8490	8505	8515	8533
331	8533	8541	8539	8555	8557	8566	8555	8541	8549	8568	8530	8518	
	8525	8490	8501	8489	8490	8522	8533	8534	8552	8452	8532	8474	8527
332	8497	8505	8509	8551	8557	8564	8556	8535	8541	8536	8528	8520	
	8518	8512	8514	8516	8513	8528	8523	8508	8474	8512	8485	8489	8521
333	8488	8505	8553	8562	8571	8569	8557	8564	8542	8536	8529	8527	
	8506	8498	8507	8507	8499	8503	8507	8499	8493	8485	8497	8494	8519
334	8507	8536	8544	8552	8546	8561	8556	8548	8537	8535	8537	8524	
	8515	8516	8508	8499	8507	8513	8521	8505	8512	8510	8511	8519	8526
335	8524	8541	8571	8601	8636	8628	8615	8585	8566	8540	8530	8509	
	8519	8491	8436	8447	8429	8399	8344	8368	8379	8426	8487	8490	8502
336	8486	8511	8528	8542	8552	8555	8617	8593	8546	8558	8541	8508	
	8519	8479	8474	8451	8422	8415	8405	8397	8506	8404	8421	8426	8495
337	8476	8552	8559	8566	8566	8581	8610	8598	8556	8545	8516	8537	
	8493	8485	8474	8445	8420	8459	8459	8486	8480	8445	8488	8529	8514
338	8543	8566	8573	8622	8620	8578	8590	8581	8554	8529	8527	8517	
	8517	8505	8512	8498	8473	8400	8458	8484	8461	8401	8489	8468	8519
339	8506	8530	8571	8551	8548	8554	8556	8554	8545	8519	8522	8531	
	8523	8510	8481	8484	8492	8499	8505	8503	8433	8422	8452	8491	8511
340	8492	8526	8520	8525	8571	8602	8605	8568	8553	8534	8526	8530	
	8499	8497	8494	8470	8461	8421	8460	8474	8462	8475	8487	8503	8511
341	8511	8536	8554	8571	8592	8625	8621	8612	8587	8539	8514	8536	
	8490	8466	8508	8474	8502	8483	8409	8397	8408	8567	8513	8506	8522
342	8512	8523	8591	8564	8614	8610	8614	8701	8635	8564	8523	8496	
	8494	8513	8520	8429	8414	8452	8504	8502	8534	8503	8504	8493	8534
343	8530	8546	8547	8539	8585	8537	8563	8546	8549	8536	8535	8522	
	8516	8513	8495	8494	8462	8440	8420	8444	8483	8455	8519	8476	8510
344	8500	8566	8560	8558	8531	8575	8615	8633	8581	8591	8544	8513	
	8504	8503	8505	8502	8521	8505	8505	8518	8446	8439	8471	8503	8529
345	8495	8531	8539	8548	8563	8604	8623	8656	8614	8565	8522	8493	
	8506	8524	8510	8528	8526	8423	8432	8518	8481	8464	8474	8540	8528

346	8538	8558	8578	8563	8565	8557	8555	8564	8556	8524	8543	8533	
	8508	8504	8515	8511	8508	8509	8502	8542	8522	8477	8514	8519	8532
347	8536	8531	8559	8578	8543	8567	8560	8578	8559	8540	8531	8556	
	8542	8528	8520	8525	8526	8523	8531	8518	8503	8499	8506	8519	8537
348	8524	8541	8571	8557	8547	8553	8551	8545	8564	8543	8537	8537	
	8521	8521	8527	8520	8512	8512	8515	8541	8523	8490	8509	8499	8532
349	8519	8538	8547	8554	8564	8561	8564	8570	8560	8543	8530	8527	
	8517	8515	8518	8503	8494	8499	8505	8513	8514	8502	8505	8510	8528
350	8513	8526	8547	8563	8588	8583	8581	8562	8545	8524	8518	8523	
	8522	8524	8520	8513	8509	8514	8518	8503	8511	8532	8529	8534	8533
351	8536	8543	8556	8557	8564	8563	8556	8580	8543	8520	8553	8545	
	8515	8501	8511	8509	8502	8485	8467	8530	8491	8545	8469	8429	8524
352	8469	8579	8600	8590	8613	8615	8589	8566	8552	8556	8553	8536	
	8508	8501	8508	8465	8497	8491	8458	8481	8500	8491	8470	8487	8528
353	8544	8543	8562	8593	8543	8592	8599	8600	8591	8574	8540	8532	
	8501	8505	8517	8513	8495	8482	8481	8465	8495	8538	8526	8501	8535
354	8529	8538	8551	8563	8589	8610	8660	8613	8581	8538	8519	8514	
	8531	8505	8496	8494	8508	8488	8474	8492	8404	8390	8486	8508	8524
355	8533	8552	8540	8571	8579	8577	8587	8573	8551	8546	8548	8526	
	8523	8536	8522	8511	8515	8524	8508	8479	8438	8465	8472	8501	8528
356	8506	8517	8540	8561	8554	8554	8554	8539	8525	8541	8551	8539	
	8525	8522	8519	8519	8524	8520	8507	8488	8524	8526	8514	8524	8529
357	8527	8537	8548	8565	8566	8565	8571	8570	8538	8534	8525	8522	
	8512	8513	8521	8530	8520	8504	8495	8522	8516	8518	8531	8532	8533
358	8530	8546	8561	8558	8565	8568	8580	8569	8555	8544	8538	8548	
	8526	8517	8523	8520	8522	8527	8526	8508	8504	8488	8460	8481	8532
359	8490	8503	8551	8576	8567	8579	8599	8568	8539	8537	8521	8515	
	8519	8540	8516	8496	8504	8501	8481	8472	8473	8479	8517	8525	8524
360	8524	8544	8575	8560	8572	8564	8581	8587	8569	8564	8545	8541	
	8543	8491	8477	8497	8507	8495	8500	8522	8518	8511	8515	8520	8534
361	8537	8563	8569	8559	8553	8555	8564	8561	8557	8537	8524	8534	
	8520	8511	8505	8512	8509	8506	8521	8532	8521	8430	8535	8513	8530
362	8457	8480	8541	8502	8558	8581	8619	8686	8638	8611	8562	8485	
	8498	8492	8414	8407	8423	8455	8451	8446	8414	8498	8540	8562	8513
363	8536	8527	8538	8584	8613	8595	8619	8623	8643	8594	8555	8521	
	8498	8498	8480	8473	8437	8489	8451	8493	8474	8419	8428	8433	8522
364	8470	8509	8526	8544	8595	8594	8591	8638	8638	8617	8566	8525	
	8497	8512	8504	8483	8495	8461	8451	8452	8422	8415	8482	8486	8520
365	8526	8540	8535	8570	8603	8586	8575	8573	8573	8576	8559	8576	
	8513	8498	8479	8501	8493	8509	8528	8519	8509	8508	8488	8498	8535
1	8509	8495	8497	8508	8539	8591	8624	8618	8614	8587	8559	8522	
	8501	8489	8491	8500	8487	8512	8515	8518	8508	8519	8536	8511	8531
2	8512	8542	8548	8553	8549	8565	8551	8550	8550	8554	8535	8537	
	8533	8513	8519	8495	8488	8468	8480	8493	8499	8477	8474	8513	8521
3	8511	8550	8537	8548	8561	8573	8577	8565	8555	8547	8538	8531	
	8518	8511	8501	8488	8486	8492	8494	8463	8475	8494	8500	8493	8521
4	8490	8498	8512	8532	8559	8567	8571	8576	8580	8590	8562	8527	
	8530	8484	8485	8459	8446	8392	8429	8388	8484	8464	8489	8460	8503
5	8484	8524	8604	8672	8734	8606	8653	8590	8594	8559	8518	8553	
	8511	8506	8513	8503	8466	8465	8513	8509	8490	8478	8427	8435	8538
6	8493	8543	8580	8618	8624	8601	8640	8600	8563	8590	8542	8526	
	8485	8519	8451	8492	8518	8497	8412	8437	8522	8520	8454	8501	8530
7	8499	8518	8523	8561	8611	8602	8595	8618	8607	8585	8560	8512	
	8508	8518	8485	8502	8469	8490	8489	8497	8468	8468	8497	8496	8528
8	8525	8533	8540	8569	8568	8581	8583	8570	8556	8554	8516	8536	
	8520	8521	8513	8509	8511	8475	8488	8497	8503	8535	8520	8560	8533
9	8569	8574	8552	8544	8575	8598	8596	8592	8586	8578	8562	8530	
	8531	8509	8511	8506	8511	8511	8500	8482	8455	8502	8497	8523	8537
10	8539	8541	8546	8560	8571	8570	8581	8577	8566	8535	8521	8523	
	8549	8512	8483	8496	8501	8502	8516	8518	8512	8509	8501	8520	8531
11	8584	8559	8555	8497	8539	8567	8619	8660	8632	8571	8535	8521	
	8524	8506	8506	8510	8516	8532	8511	8519	8509	8503	8514	8524	8542
12	8525	8539	8555	8553	8573	8574	8570	8563	8548	8530	8525	8542	
	8532	8529	8520	8520	8515	8526	8510	8492	8517	8522	8528	8536	8535
13	8536	8533	8563	8590	8593	8630	8594	8581	8553	8543	8538	8540	
	8524	8519	8519	8523	8522	8511	8505	8504	8506	8509	8508	8515	8540
14	8572	8572	8608	8560	8573	8562	8550	8564	8584	8565	8553	8537	
	8539	8501	8507	8508	8506	8517	8534	8561	8531	8488	8500	8496	8541
15	8514	8539	8554	8575	8580	8585	8595	8564	8560	8549	8529	8563	
	8521	8522	8513	8512	8527	8529	8520	8535	8516	8497	8486	8513	8537

16	8538	8546	8556	8566	8608	8597	8624	8600	8573	8545	8540	8518	
	8514	8523	8516	8517	8516	8516	8497	8487	8426	8430	8400	8480	8526
17	8572	8557	8575	8587	8580	8553	8558	8559	8550	8532	8515	8531	
	8505	8521	8531	8521	8472	8465	8529	8570	8547	8541	8497	8465	8535
18	8515	8532	8558	8560	8575	8608	8588	8598	8564	8563	8545	8542	
	8537	8515	8507	8493	8519	8495	8493	8485	8500	8508	8524	8516	8535
19	8531	8546	8556	8556	8569	8586	8583	8573	8580	8574	8564	8546	
	8518	8510	8509	8518	8531	8496	8482	8469	8481	8487	8496	8475	8531
20	8474	8554	8568	8568	8575	8548	8555	8563	8570	8566	8552	8533	
	8510	8513	8518	8516	8492	8523	8503	8500	8499	8558	8570	8557	8537
21	8563	8559	8580	8565	8574	8554	8555	8549	8546	8544	8533	8533	
	8517	8519	8513	8506	8502	8484	8496	8512	8518	8504	8486	8507	8530
22	8535	8556	8568	8577	8568	8564	8563	8539	8541	8527	8531	8528	
	8536	8520	8523	8518	8514	8510	8472	8443	8446	8508	8544	8552	8528
23	8519	8517	8552	8593	8578	8599	8615	8580	8548	8540	8567	8535	
	8527	8526	8486	8449	8454	8479	8512	8448	8367	8505	8396	8430	8513
24	8536	8447	8517	8566	8585	8586	8629	8712	8641	8571	8533	8507	
	8505	8506	8501	8487	8490	8463	8427	8390	8436	8289	8436	8459	8509
25	8477	8480	8530	8558	8571	8610	8595	8617	8580	8573	8534	8539	
	8504	8469	8483	8447	8456	8466	8505	8507	8406	8461	8491	8450	8513
26	8495	8509	8538	8557	8582	8596	8579	8591	8573	8560	8548	8519	
	8507	8520	8445	8466	8475	8497	8463	8475	8467	8480	8478	8488	8517
27	8468	8463	8510	8545	8589	8587	8590	8584	8572	8555	8547	8521	
	8521	8510	8514	8498	8497	8489	8480	8523	8459	8445	8455	8488	8517
28	8493	8485	8513	8537	8546	8564	8564	8560	8560	8550	8535	8530	
	8508	8518	8513	8505	8495	8494	8474	8461	8505	8469	8482	8497	8515
29	8502	8523	8526	8547	8569	8549	8555	8549	8549	8546	8544	8540	
	8521	8522	8518	8520	8506	8510	8513	8506	8507	8525	8520	8515	8528
30	8530	8541	8550	8553	8558	8560	8552	8552	8549	8541	8534	8520	
	8523	8521	8517	8513	8505	8490	8493	8497	8511	8488	8482	8508	8524
31	8527	8542	8561	8566	8563	8585	8589	8607	8581	8565	8559	8530	
	8500	8441	8435	8444	8448	8476	8436	8561	8478	8415	8439	8495	8514
32	8507	8568	8602	8645	8681	8713	8699	8661	8616	8586	8540	8505	
	8518	8525	8474	8428	8398	8424	8469	8505	8562	8478	8490	8540	8547
33	8564	8541	8552	8621	8645	8640	8609	8655	8623	8598	8544	8511	
	8510	8495	8506	8426	8436	8449	8460	8385	8498	8516	8525	8510	8534
34	8542	8510	8586	8577	8647	8675	8656	8617	8566	8542	8533	8544	
	8528	8511	8499	8501	8501	8503	8490	8502	8504	8497	8481	8513	8543
35	8537	8531	8537	8544	8583	8578	8575	8574	8580	8569	8546	8544	
	8519	8498	8467	8452	8455	8491	8499	8480	8504	8466	8463	8486	8520
36	8555	8554	8577	8597	8566	8583	8578	8556	8544	8554	8544	8532	
	8527	8525	8519	8509	8509	8479	8439	8414	8452	8499	8526	8531	8528
37	8534	8559	8583	8589	8568	8561	8581	8596	8593	8540	8589	8515	
	8498	8486	8498	8512	8514	8506	8515	8500	8499	8458	8478	8520	8533

TOTAL MEAN = 8526 nT

9999 indicates missing value

Table 3

TNB Antarctica, Italian Geomagnetic Observatory

*Hourly D values from Nov 14, 2018 to Feb 06, 2019
(deg: first three digit, minutes: second two digits)*

UT	0	1	2	3	4	5	6	7	8	9	10	11	DAILY MEAN
	12	13	14	15	16	17	18	19	20	21	22	23	
julian day													
318	13345	13345	13343	13346	13347	13345	13344	13341	13341	13338	13343	13342	
	13343	13341	13339	13343	13340	13340	13328	13346	13352	13361	13366	13359	13345
319	13353	13348	13352	13352	13348	13346	13344	13342	13342	13343	13344	13344	
	13345	13345	13346	13343	13343	13347	13346	13347	13345	13335	13341	13353	13346
320	13353	13356	13342	13342	13344	13346	13343	13342	13344	13344	13345	13344	
	13343	13342	13344	13348	13350	13339	13341	13345	13350	13344	13339	13337	13344
321	13339	13341	13354	13346	13343	99999	99999	99999	99999	99999	99999	99999	
	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	13345
322	13353	13365	13355	13352	13348	13344	13338	13335	13334	13336	13338	13337	
	13338	13337	13340	13337	13336	13337	13342	13347	13350	13365	13352	13343	13344
323	13344	13352	13349	13354	13340	13342	13340	13338	13335	13341	13341	13344	
	13344	13342	13339	13341	13345	13352	13367	13373	13370	13381	13373	13364	13350
324	13363	13365	13367	13347	13339	13342	13339	13338	13339	13340	13334	13337	
	13339	13343	13344	13342	13339	13341	13342	13347	13352	13360	13356	13349	13346
325	13351	13339	13338	13338	13331	13341	13343	13343	13334	13334	13337	13341	
	13348	13343	13340	13343	13340	13345	13349	13353	13352	13332	13316	13344	13341
326	13352	13357	13349	13340	13341	13341	13343	13344	13346	13346	13345	13344	
	13344	13347	13349	13347	13344	13336	13343	13348	13353	13344	13344	13341	13345
327	13344	13347	13345	13342	13344	13345	13343	13340	13339	13342	13340	13342	
	13342	13341	13343	13345	13344	13346	13344	13343	13339	13352	13359	13353	13344
328	13358	13356	13346	13348	13348	13346	13346	13344	13343	13345	13344	13345	
	13340	13343	13338	13339	13340	13338	13343	13353	13333	13343	13352	13360	13345
329	13350	13351	13360	13357	13349	13344	13341	13339	13339	13338	13335	13337	
	13337	13344	13349	13353	13353	13350	13351	13348	13339	13329	13349	13348	13345
330	13349	13348	13351	13353	13351	13345	13341	13340	13341	13341	13341	13343	
	13343	13345	13345	13345	13341	13340	13348	13350	13353	13344	13345	13343	13345
331	13340	13342	13350	13348	13348	13347	13343	13343	13342	13341	13340	13340	
	13340	13343	13332	13336	13340	13333	13320	13323	13330	13334	13349	13360	13340
332	13371	13366	13369	13355	13358	13349	13344	13341	13342	13341	13341	13344	
	13345	13347	13346	13343	13343	13339	13343	13348	13345	13338	13348	13363	13349
333	13373	13361	13348	13345	13349	13347	13345	13340	13340	13338	13340	13341	
	13345	13349	13348	13347	13349	13346	13346	13354	13355	13362	13351	13363	13349
334	13357	13351	13353	13352	13350	13346	13347	13348	13349	13346	13346	13345	
	13346	13344	13344	13350	13346	13338	13342	13353	13352	13353	13350	13344	13348
335	13349	13349	13357	13365	13359	13349	13339	13337	13334	13337	13339	13342	
	13344	13346	13350	13342	13346	13370	13379	13387	13384	13403	13390	13385	13357
336	13383	13373	13383	13373	13368	13367	13354	13355	13343	13346	13345	13341	
	13341	13350	13343	13346	13349	13355	13363	13374	13375	13377	13387	13385	13361
337	13362	13350	13346	13350	13352	13357	13352	13346	13340	13335	13340	13340	
	13345	13342	13332	13349	13341	13368	13361	13348	13360	13377	13362	13350	13350
338	13364	13412	13384	13365	13370	13365	13351	13344	13343	13342	13342	13347	
	13347	13350	13348	13346	13350	13365	13365	13356	13368	13374	13380	13380	13361
339	13357	13362	13377	13374	13363	13355	13349	13349	13344	13345	13344	13340	
	13339	13338	13344	13345	13350	13351	13347	13355	13360	13366	13380	13363	13354
340	13382	13382	13372	13356	13367	13357	13349	13348	13346	13344	13345	13348	
	13348	13347	13349	13349	13352	13359	13361	13353	13355	13356	13363	13370	13357
341	13369	13362	13367	13363	13365	13344	13337	13327	13344	13336	13334	13333	
	13329	13341	13332	13349	13330	13333	13350	13369	13357	13319	13336	13346	13345
342	13355	13360	13365	13358	13345	13333	13328	13344	13332	13328	13332	13330	
	13345	13335	13338	13341	13333	13331	13344	13355	13349	13356	13358	13358	13344
343	13342	13347	13372	13368	13351	13356	13334	13337	13334	13335	13340	13340	
	13343	13346	13352	13346	13344	13362	13365	13363	13340	13323	13346	13359	13348
344	13379	13356	13360	13359	13388	13376	13365	13346	13336	13334	13348	13346	
	13343	13351	13349	13343	13335	13336	13334	13358	13388	13383	13375	13373	13357

345	13384	13368	13382	13381	13355	13350	13353	13355	13351	13338	13355	13351	
	13353	13351	13351	13342	13335	13342	13340	13334	13371	13369	13358	13322	13354
346	13346	13361	13358	13351	13352	13355	13349	13347	13346	13345	13345	13348	
	13351	13352	13351	13352	13354	13351	13336	13332	13338	13340	13340	13356	13348
347	13350	13348	13344	13346	13360	13356	13349	13347	13342	13341	13343	13341	
	13342	13343	13345	13343	13337	13333	13342	13352	13350	13352	13353	13359	13347
348	13360	13343	13351	13345	13354	13362	13352	13344	13346	13345	13344	13344	
	13343	13345	13345	13346	13347	13348	13343	13332	13349	13354	13357	13362	13348
349	13361	13352	13358	13364	13354	13349	13346	13344	13344	13344	13347	13349	
	13351	13354	13351	13354	13354	13357	13353	13344	13343	13342	13346	13350	13351
350	13350	13355	13363	13362	13360	13353	13351	13350	13349	13347	13347	13348	
	13351	13350	13348	13348	13347	13339	13336	13332	13323	13318	13339	13350	13347
351	13349	13347	13351	13347	13346	13347	13350	13340	13345	13348	13340	13337	
	13339	13346	13345	13345	13349	13344	13342	13337	13328	13320	13339	13379	13344
352	13393	13372	13344	13347	13345	13342	13342	13350	13353	13346	13341	13339	
	13339	13339	13329	13339	13340	13339	13345	13346	13361	13371	13383	13378	13351
353	13337	13363	13372	13355	13359	13349	13344	13341	13338	13331	13331	13338	
	13341	13344	13347	13347	13351	13347	13351	13348	13341	13327	13344	13371	13346
354	13365	13362	13371	13378	13369	13354	13336	13338	13346	13347	13347	13347	
	13343	13346	13349	13345	13351	13341	13337	13330	13348	13349	13367	13364	13351
355	13349	13369	13360	13353	13355	13355	13347	13351	13350	13347	13349	13353	
	13354	13349	13350	13351	13353	13335	13341	13346	13362	13354	13361	13378	13353
356	13371	13364	13379	13365	13365	13358	13353	13352	13348	13350	13350	13351	
	13352	13352	13354	13354	13348	13345	13352	13355	13355	13356	13361	13351	13356
357	13356	13356	13358	13358	13355	13355	13354	13350	13349	13352	13351	13352	
	13354	13355	13353	13346	13348	13352	13351	13345	13344	13336	13350	13356	13351
358	13349	13347	13362	13366	13354	13352	13350	13340	13347	13353	13354	13347	
	13343	13348	13346	13348	13348	13347	13346	13356	13356	13347	13352	13359	13351
359	13358	13377	13375	13365	13352	13349	13347	13342	13343	13341	13347	13353	
	13350	13347	13342	13346	13344	13340	13346	13357	13365	13360	13362	13365	13353
360	13374	13352	13352	13351	13353	13354	13355	13351	13350	13346	13343	13342	
	13341	13339	13335	13343	13348	13359	13364	13363	13370	13375	13374	13358	13354
361	13356	13360	13372	13360	13365	13367	13363	13356	13348	13349	13351	13351	
	13350	13351	13352	13352	13351	13350	13350	13353	13340	13338	13348	13382	13355
362	13409	13310	13388	13310	13370	13353	13359	13359	13361	13343	13334	13337	
	13346	13339	13349	13350	13366	13354	13354	13351	13359	13356	13358	13360	13361
363	13357	13362	13396	13383	13374	13367	13361	13341	13363	13356	13350	13347	
	13345	13353	13352	13353	13363	13362	13367	13352	13370	13394	13402	13310	13365
364	13401	13387	13391	13384	13393	13392	13381	13356	13348	13345	13346	13348	
	13346	13348	13345	13355	13349	13359	13361	13360	13384	13398	13382	13388	13368
365	13371	13379	13381	13387	13388	13378	13368	13361	13352	13352	13341	13339	
	13339	13351	13359	13353	13358	13353	13351	13352	13356	13353	13375	13381	13362
1	13383	13392	13387	13382	13380	13380	13372	13362	13360	13348	13345	13345	
	13344	13354	13357	13363	13363	13362	13359	13360	13350	13347	13332	13347	13361
2	13356	13355	13357	13363	13359	13357	13358	13354	13354	13353	13353	13355	
	13354	13355	13355	13359	13361	13364	13362	13362	13360	13368	13367	13381	13359
3	13381	13373	13363	13369	13370	13369	13367	13360	13357	13352	13353	13355	
	13353	13356	13358	13362	13365	13367	13366	13363	13370	13375	13382	13388	13366
4	13393	13386	13377	13381	13383	13371	13368	13365	13352	13345	13348	13351	
	13348	13355	13351	13355	13359	13346	13364	13387	13330	13352	13398	13408	13366
5	13395	13386	13370	13376	13351	13354	13342	13343	13337	13325	13351	13352	
	13349	13350	13347	13345	13340	13366	13357	13356	13346	13341	13375	13407	13357
6	13383	13365	13358	13356	13357	13360	13356	13347	13346	13344	13340	13349	
	13347	13345	13349	13343	13345	13338	13346	13356	13342	13359	13371	13370	13353
7	13382	13384	13379	13381	13374	13363	13358	13345	13336	13344	13346	13342	
	13354	13354	13362	13355	13367	13359	13360	13361	13360	13362	13391	13389	13363
8	13385	13384	13376	13369	13360	13354	13354	13348	13346	13347	13325	13342	
	13357	13352	13349	13352	13354	13356	13362	13364	13348	13350	13336	13322	13354
9	13343	13356	13367	13364	13360	13360	13361	13356	13352	13342	13354	13356	
	13351	13354	13357	13358	13358	13357	13351	13360	13366	13359	13362	13367	13357
10	13372	13365	13366	13368	13364	13363	13361	13356	13362	13351	13354	13355	
	13350	13349	13353	13357	13358	13357	13357	13361	13370	13373	13380	13356	13361
11	13328	13369	13384	13380	13366	13359	13360	13344	13351	13347	13349	13353	
	13354	13352	13357	13354	13344	13342	13341	13341	13363	13354	13352	13336	13353
12	13355	13360	13360	13363	13358	13355	13357	13357	13359	13359	13359	13357	
	13351	13350	13349	13351	13352	13347	13351	13349	13349	13363	13361	13359	13355
13	13363	13362	13364	13366	13360	13354	13352	13352	13348	13350	13352	13354	
	13357	13357	13356	13353	13348	13351	13351	13351	13353	13354	13373	13356	13356
14	13319	13335	13347	13370	13360	13366	13371	13366	13356	13355	13351	13354	
	13348	13356	13352	13355	13347	13344	13347	13342	13353	13354	13360	13358	13353

15	13368	13370	13372	13375	13363	13360	13358	13355	13351	13353	13356	13348	
	13349	13350	13353	13352	13341	13340	13343	13335	13329	13385	13391	13374	13357
16	13370	13361	13360	13366	13373	13364	13358	13354	13353	13356	13358	13359	
	13360	13356	13357	13356	13350	13348	13345	13343	13355	13372	13377	13384	13360
17	13367	13381	13373	13367	13360	13367	13363	13359	13358	13358	13360	13358	
	13361	13358	13351	13342	13354	13340	13339	13337	13326	13345	13378	13376	13357
18	13369	13382	13370	13354	13355	13360	13361	13353	13351	13347	13344	13337	
	13355	13356	13349	13362	13348	13352	13351	13362	13369	13362	13369	13376	13358
19	13371	13363	13358	13366	13376	13369	13361	13356	13353	13339	13351	13356	
	13359	13362	13363	13360	13348	13355	13354	13346	13348	13349	13358	13372	13358
20	13380	13359	13368	13372	13363	13364	13363	13364	13360	13353	13356	13356	
	13355	13358	13359	13358	13354	13351	13353	13361	13335	13326	13328	13341	13356
21	13358	13364	13366	13361	13362	13359	13360	13359	13361	13360	13356	13358	
	13360	13361	13361	13360	13360	13363	13356	13350	13349	13362	13390	13381	13361
22	13368	13366	13366	13363	13359	13357	13358	13358	13357	13357	13359	13361	
	13360	13356	13355	13357	13361	13358	13351	13370	13373	13359	13348	13346	13359
23	13372	13382	13370	13380	13363	13361	13373	13362	13357	13358	13355	13334	
	13347	13352	13358	13363	13367	13364	13349	13379	13390	13387	13405	13413	13368
24	13382	13394	13389	13310	13394	13379	13369	13363	13342	13353	13355	13355	
	13354	13357	13355	13363	13363	13353	13373	13390	13415	13398	13415	13426	13376
25	13418	13405	13380	13379	13382	13381	13369	13360	13344	13343	13358	13355	
	13351	13346	13357	13364	13368	13373	13361	13363	13388	13394	13386	13399	13372
26	13386	13391	13386	13383	13386	13379	13367	13358	13347	13354	13357	13355	
	13359	13353	13359	13361	13370	13367	13371	13375	13381	13384	13395	13393	13371
27	13403	13397	13394	13391	13372	13368	13360	13355	13354	13359	13353	13352	
	13358	13363	13364	13366	13368	13362	13361	13360	13375	13384	13385	13383	13370
28	13372	13381	13380	13378	13367	13368	13368	13363	13362	13362	13361	13361	
	13360	13362	13363	13364	13367	13367	13371	13371	13374	13381	13387	13386	13370
29	13384	13384	13376	13368	13378	13374	13368	13364	13360	13361	13362	13359	
	13356	13357	13363	13360	13365	13366	13366	13367	13364	13366	13367	13370	13367
30	13367	13368	13367	13365	13368	13367	13366	13365	13363	13361	13361	13361	
	13362	13363	13364	13365	13366	13363	13362	13370	13376	13379	13379	13375	13367
31	13373	13373	13370	13368	13369	13362	13356	13347	13347	13346	13346	13348	
	13349	13341	13341	13358	13352	13367	13389	13371	13358	13364	13395	13372	13361
32	13384	13366	13373	13370	13364	13368	13353	13345	13337	13351	13352	13359	
	13361	13355	13346	13359	13357	13363	13378	13355	13357	13355	13381	13375	13361
33	13387	13403	13374	13382	13393	13377	13362	13360	13342	13338	13350	13352	
	13351	13356	13350	13362	13361	13353	13365	13391	13358	13360	13360	13370	13365
34	13376	13402	13394	13391	13380	13370	13363	13348	13354	13361	13359	13355	
	13358	13355	13356	13357	13363	13353	13357	13352	13348	13366	13373	13367	13365
35	13368	13365	13367	13367	13365	13366	13366	13364	13360	13357	13359	13356	
	13353	13348	13350	13350	13360	13362	13351	13358	13354	13357	13372	13374	13360
36	13381	13369	13356	13359	13362	13361	13358	13360	13363	13357	13355	13359	
	13362	13364	13363	13367	13363	13368	13375	13392	13384	13374	13365	13374	13366
37	13360	13370	13362	13379	13385	13369	13364	13360	13351	13356	13356	13337	
	13344	13357	13366	13361	13364	13356	13366	13345	13352	13349	13334	13354	13358

TOTAL MEAN = 133° 33'

99999 indicates missing value

Table 4

TNB Antarctica, Italian Geomagnetic Observatory

Hourly Z values (nT) from Nov 14, 2018 to Feb 06, 2019 (values must be considered negative)

UT	0	1	2	3	4	5	6	7	8	9	10	11	DAILY MEAN
	12	13	14	15	16	17	18	19	20	21	22	23	
julian day													
318	62971	62957	62950	62967	62973	62969	62976	62985	62998	63000	63007	63001	
	63008	62998	63006	63007	63019	63013	62996	62985	62972	62966	62964	62949	62985
319	62945	62950	62941	62950	62956	62965	62982	62986	63000	63001	63002	63001	
	63004	63005	63006	63020	63010	62996	62998	63006	63003	62987	62988	62954	62986
320	62942	62951	62975	62966	62963	62982	62994	62999	62999	63001	63003	63002	
	63005	63004	63012	63027	63022	63030	63028	63028	63019	63010	62977	62941	62995
321	62947	62951	62975	62954	62949	99999	99999	99999	99999	99999	99999	99999	
	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	99999	62956
322	62947	62949	62949	62943	62950	62968	62975	62980	62996	62999	63001	62999	
	63005	63003	62998	63006	63004	62990	62967	62993	62991	62978	62980	62916	62979
323	62909	62900	62899	62900	62937	62942	62964	62974	62978	62980	62989	63003	
	62997	63000	63000	62992	63028	63046	63072	62977	62967	62955	62936	62906	62969
324	62858	62841	62860	62918	62941	62951	62951	62962	62981	62995	62991	62983	
	62992	63000	62998	63001	63015	62998	62992	62979	62985	62967	62991	62976	62963
325	62971	62907	62919	62930	62968	62934	62944	62973	62981	62977	62999	63002	
	62998	62995	62994	62992	63007	63000	62990	62979	62972	62999	62893	62889	62967
326	62870	62890	62882	62919	62949	62957	62964	62971	62981	63004	63020	63019	
	63012	63021	63019	63011	63021	63012	63009	63005	62990	63023	62938	62925	62976
327	62921	62930	62913	62922	62952	62963	62967	62978	62980	62986	62991	63000	
	62997	63013	63009	63003	62999	62991	63002	63023	62999	62993	62972	62939	62977
328	62950	62938	62928	62944	62956	62958	62972	62981	62991	62998	62999	63000	
	63005	62996	62993	62987	63009	63008	62997	62992	63026	63019	62968	62925	62981
329	62921	62904	62906	62935	62949	62968	62979	62981	62970	62982	62985	62999	
	63015	63062	63055	63023	63013	63005	62996	62987	62991	62983	62911	62865	62974
330	62858	62881	62892	62924	62931	62937	62951	62968	62980	62989	62999	62996	
	62997	62994	63002	63003	63012	63017	63011	63008	63002	62977	62953	62927	62967
331	62911	62920	62928	62944	62957	62959	62970	62973	62993	62994	62978	62986	
	62993	62992	63009	62999	62958	62979	62979	62954	62967	62836	62916	62951	62960
332	62911	62897	62949	62976	62977	62985	62985	62984	62983	62998	62994	62999	
	63007	63004	63004	62999	62990	62993	62976	62993	62969	62982	62931	62937	62976
333	62953	62897	62912	62941	62941	62956	62967	62973	62971	62975	62983	62986	
	62988	62996	62996	62995	63001	63004	62992	62975	62947	62921	62927	62951	62965
334	62923	62907	62929	62928	62937	62954	62977	62983	62991	62986	62988	62994	
	62992	63000	63000	63000	63024	63019	63000	62989	62974	62965	62941	62927	62972
335	62943	62950	62944	62922	62926	62933	62940	62950	62958	62966	62981	62999	
	63008	63007	63004	63066	63077	63053	63032	63016	63010	62992	62949	62932	62982
336	62955	62973	62958	62957	62957	62977	63013	63006	63006	63015	63022	63024	
	63032	63026	63049	63062	63014	63079	63070	62998	62980	62933	62985	62953	63003
337	62938	62930	62935	62912	62918	62935	62960	62980	62990	62985	62983	62994	
	63013	63013	63063	63045	63037	63011	62979	62993	62956	62925	62898	62902	62971
338	62878	62865	62868	62902	62918	62935	62962	62978	62975	62986	62993	62994	
	62997	62991	62992	63006	63005	63032	62935	62931	62895	62911	62999	62891	62952
339	62942	62962	62936	62943	62949	62960	62977	62989	62993	62997	62983	62983	
	62981	62985	62982	63016	63020	63006	62985	62974	62928	62955	62960	62969	62974
340	62893	62925	62935	62950	62940	62959	62964	62971	62984	62996	63007	63017	
	63020	63028	63049	63079	63062	63056	63010	62972	62936	62917	62912	62927	62979
341	62909	62895	62900	62937	62940	62953	62948	62956	62966	62994	62992	62989	
	62998	62989	62998	62967	62992	62946	63026	63062	62942	62999	62954	62920	62965
342	62946	62933	62866	62886	62920	62927	62940	63022	63033	63005	62985	63000	
	63024	63038	63028	62987	63004	62966	62958	62961	62964	62986	62988	62936	62971
343	62943	62916	62933	62968	62976	62995	62972	62961	62965	62969	62970	62998	
	63001	62993	63003	63004	62992	62976	62975	62972	62917	62835	62711	62843	62950
344	62880	62853	62898	62932	62945	62980	62991	62990	62991	63043	63039	63021	
	63012	62997	63025	62992	62981	62958	62941	62929	62913	62940	62948	62909	62963
345	62880	62922	62915	62932	62960	62953	62967	63019	63012	63082	63065	63028	
	63006	63012	63010	63023	62989	62977	62987	62953	62946	62948	62954	62881	62976

346	62922	62875	62887	62902	62931	62949	62978	62974	62977	62976	62986	63004	
	62996	63000	63007	63012	63001	63005	62983	62983	62986	62980	62963	62951	62968
347	62925	62904	62913	62921	62936	62956	62972	62977	62977	62970	62971	63000	
	63010	63015	63012	63008	63000	62992	63016	63014	62986	62988	62981	62955	62975
348	62936	62943	62923	62920	62954	62969	62987	62988	62980	62975	62978	62981	
	62984	62995	62992	62989	62994	62996	63012	63008	62985	62973	62938	62902	62971
349	62928	62930	62945	62954	62967	62967	62964	62959	62966	62972	62983	62985	
	62992	62999	63007	63009	63021	63005	62998	63005	63018	62984	62947	62920	62976
350	62896	62888	62900	62918	62933	62950	62958	62966	62980	62988	62991	62987	
	63000	63007	62993	63004	63010	63027	63008	62990	62976	62973	63004	62990	62972
351	62953	62933	62935	62937	62940	62936	62948	62950	62954	62967	62978	62980	
	62974	62989	62992	62988	62993	62988	62975	62912	62962	62950	62844	62866	62952
352	62862	62870	62861	62875	62912	62937	62941	62938	62965	62991	62980	62973	
	62980	62994	63032	62997	62991	62974	62922	62930	62947	62955	62920	62930	62945
353	62879	62931	62951	62927	62950	62960	62976	62973	62968	62980	62990	62990	
	62992	62994	63006	63013	62986	62993	62975	62972	62930	62878	62826	62883	62955
354	62906	62911	62878	62924	62938	62946	62974	62986	63008	63004	63008	62985	
	62987	62985	62983	62987	63002	63001	62963	62914	62926	62858	62934	62898	62954
355	62873	62886	62905	62907	62927	62956	62968	62962	62974	62982	62986	62995	
	62985	62991	62996	63004	63011	63021	62975	62968	62965	62937	62914	62933	62959
356	62933	62920	62928	62961	62951	62952	62958	62974	62975	62981	62985	62974	
	62984	62991	62992	63006	63005	62998	63008	62999	62982	62974	62939	62935	62971
357	62918	62929	62922	62929	62945	62946	62956	62968	62970	62978	62984	62995	
	62992	62993	62996	63010	62993	62997	63012	63014	63014	62992	62983	62940	62974
358	62922	62906	62919	62907	62931	62951	62966	62960	62958	62970	62988	62996	
	62985	62984	62991	62989	62995	63006	62986	62999	62984	62949	62911	62877	62960
359	62884	62884	62892	62907	62918	62920	62934	62952	62957	62963	62963	62977	
	62979	62996	62977	62960	62980	62993	62978	62953	62953	62946	62934	62962	62948
360	62928	62936	62913	62917	62939	62948	62952	62963	62970	62978	62981	62980	
	63003	63004	63024	63023	63013	63012	62971	62958	62938	62912	62920	62930	62963
361	62952	62915	62900	62905	62923	62944	62971	62981	62989	62988	62989	62986	
	62999	62995	62992	62992	63000	63005	62981	62990	63024	62948	62925	62981	62970
362	62951	62964	62932	62938	62928	62941	62961	62971	63047	63077	63068	63087	
	63040	63034	63031	63091	63086	62989	62999	62962	62888	62868	62882	62855	62983
363	62922	62930	62922	62949	62951	62962	62967	62993	63037	63029	63043	63039	
	63037	63070	63059	63041	63037	63004	62971	63000	62954	62921	62945	62950	62989
364	62948	62958	62938	62949	62956	62956	62972	63003	63009	63024	63026	63027	
	63031	63054	63017	63004	62986	62997	62954	62940	62896	62966	62946	62947	62979
365	62929	62905	62928	62974	62975	62981	62980	62987	62997	63015	63084	63082	
	63063	63061	63040	63021	63025	63006	62989	62996	62981	62944	62925	62954	62993
1	62932	62921	62959	62967	62975	62981	62992	63009	63011	63018	63031	63043	
	63045	63030	63051	63018	63019	62993	62990	62989	63001	62992	62917	62899	62991
2	62920	62930	62937	62942	62954	62945	62963	62983	62981	62982	62984	62987	
	63006	63004	63007	63012	63009	63025	63008	62982	62960	62906	62910	62928	62969
3	62910	62885	62932	62918	62925	62946	62965	62978	62992	63001	63007	63012	
	63011	63009	63024	63027	63019	63006	63001	62991	62942	62928	62919	62931	62970
4	62935	62947	62924	62908	62934	62966	62986	62994	62996	63004	63013	63021	
	63034	63031	63017	63025	63041	63081	63052	62991	62922	62915	62970	62911	62984
5	62890	62975	62901	62903	62954	62926	62958	62948	62965	62992	62999	63033	
	63012	62996	62999	62980	62979	62943	62929	62961	62986	62895	62903	62986	62959
6	62987	62912	62920	62934	62932	62941	62942	62963	62975	63009	62995	62983	
	62991	62984	62997	63071	63032	62988	62967	62930	62912	63009	62914	62921	62967
7	62903	62906	62934	62943	62947	62949	62959	62983	63004	63017	63014	63005	
	63029	63042	63030	63021	62996	62983	62964	62967	62951	62950	62982	62923	62975
8	62926	62925	62941	62935	62953	62964	62963	62964	62959	62971	63016	63026	
	63028	63009	62992	62980	63005	63006	62982	62987	63014	63044	62995	62915	62979
9	62910	62904	62891	62903	62923	62938	62936	62963	62971	63007	63011	63014	
	63013	63002	62989	62995	62997	62998	63004	62963	62941	62935	62903	62916	62960
10	62903	62884	62908	62951	62956	62964	62970	62970	62975	62989	62995	62988	
	62992	62983	62998	63006	63013	63015	62990	62970	62946	62933	62923	62932	62965
11	62865	62929	62915	62921	62916	62937	62953	63006	63025	63014	62996	62993	
	62992	62990	63004	63010	63001	62984	62969	62986	63017	62990	62972	62919	62971
12	62918	62914	62896	62920	62932	62926	62937	62963	62980	62981	62985	62981	
	62982	62993	63002	63008	63007	63001	63014	62998	62991	62967	62949	62932	62966
13	62930	62904	62900	62925	62940	62960	62958	62960	62963	62964	62964	62980	
	62998	63003	63002	62999	62991	62979	62991	63002	62995	62981	62950	62894	62964
14	62895	62932	62866	62868	62906	62916	62946	62971	62989	63000	63004	62997	
	63009	63003	62995	62990	62990	62957	62941	62982	62967	62921	62928	62860	62951
15	62922	62949	62934	62942	62957	62949	62968	62955	62966	62974	62989	62976	
	62972	62999	63003	63017	63011	62979	62971	62977	62929	62962	62944	62925	62965

16	62908	62953	62948	62968	62942	62954	62968	62965	62979	62990	62988	62991	
	62991	62982	62986	62986	62995	62977	62975	62955	62939	62900	62881	62846	62957
17	62852	62906	62916	62918	62930	62953	62946	62966	62974	62981	62987	62984	
	62991	62991	63006	62984	62941	62987	62953	62932	62955	62917	62986	62914	62953
18	62962	62970	62945	62960	62952	62938	62944	62962	62966	62973	62969	63018	
	63017	63014	63015	63015	63005	62974	62979	62979	62940	62933	62945	62925	62971
19	62920	62922	62914	62919	62932	62957	62960	62965	62968	63003	63005	63012	
	63013	62998	62994	62998	63005	62977	62933	62956	62949	62905	62875	62898	62957
20	62902	62863	62869	62893	62918	62947	62963	62971	62981	62996	62992	63000	
	62989	62996	63000	62993	63012	63004	63020	63022	62956	62914	62961	62900	62961
21	62920	62895	62900	62908	62942	62970	62967	62973	62980	62978	62986	62987	
	62994	62983	62992	63004	63009	63009	63003	63001	62976	62950	62925	62925	62966
22	62940	62943	62940	62941	62940	62946	62952	62961	62978	62987	62981	62985	
	62988	62984	62983	62993	62995	62993	63016	62994	62966	62979	62989	62981	62973
23	62885	62839	62852	62851	62900	62913	62917	62954	62976	62983	62993	63029	
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37	62959	62950	62870	62896	62935	62935	62950	62959	62970	62979	62998	63011	
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TOTAL MEAN = 62970 nT

99999 indicates missing value

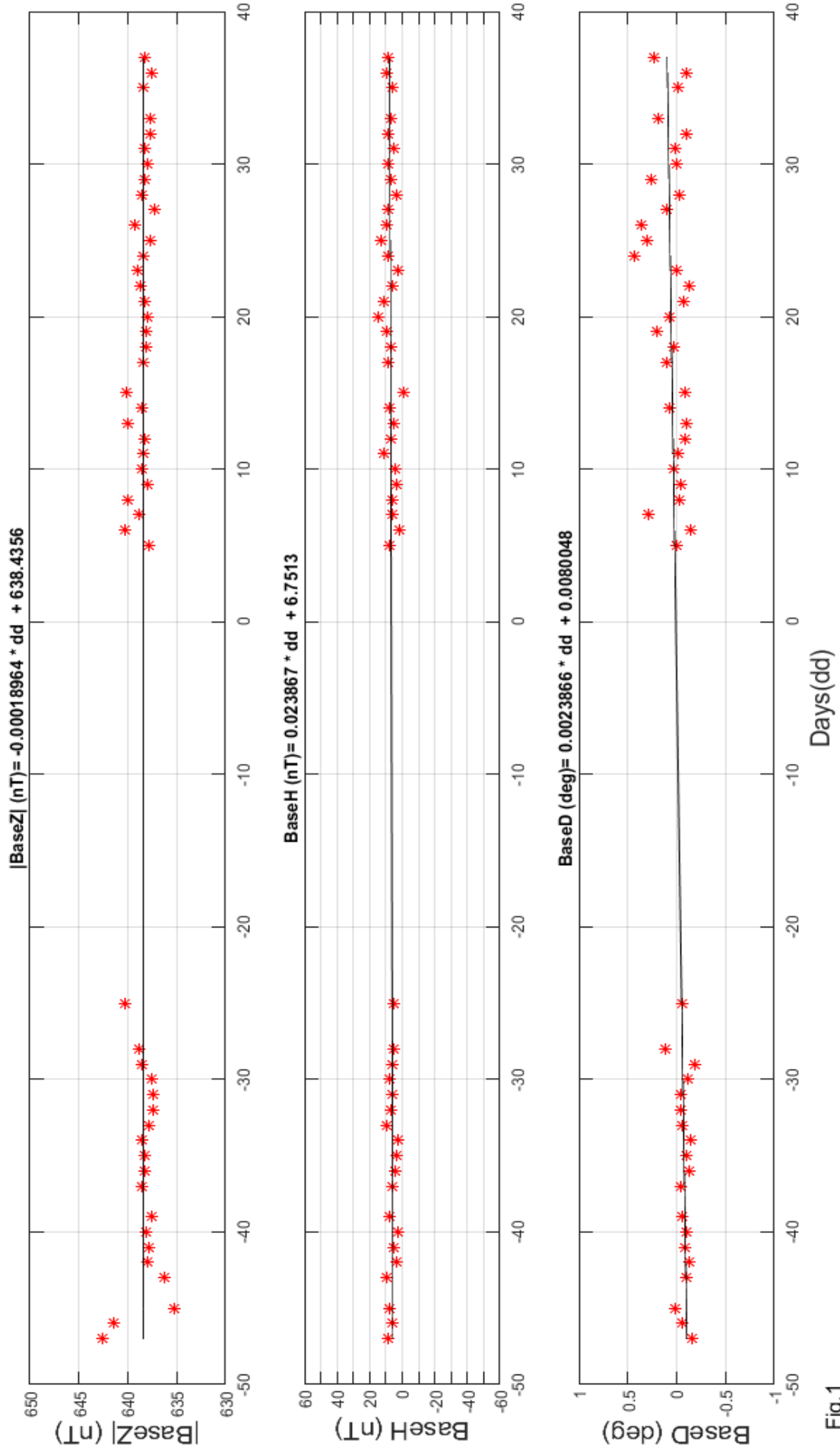


Fig.1

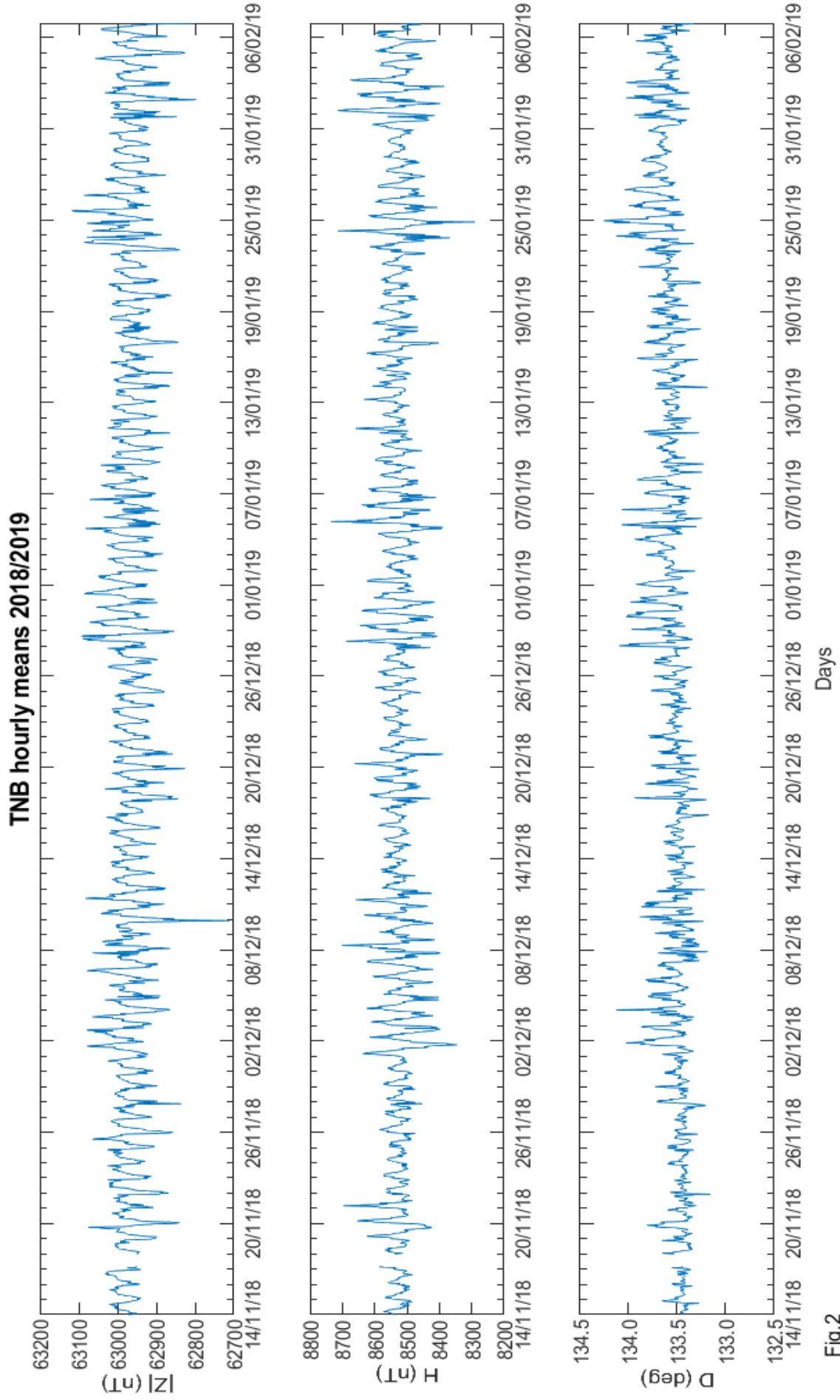
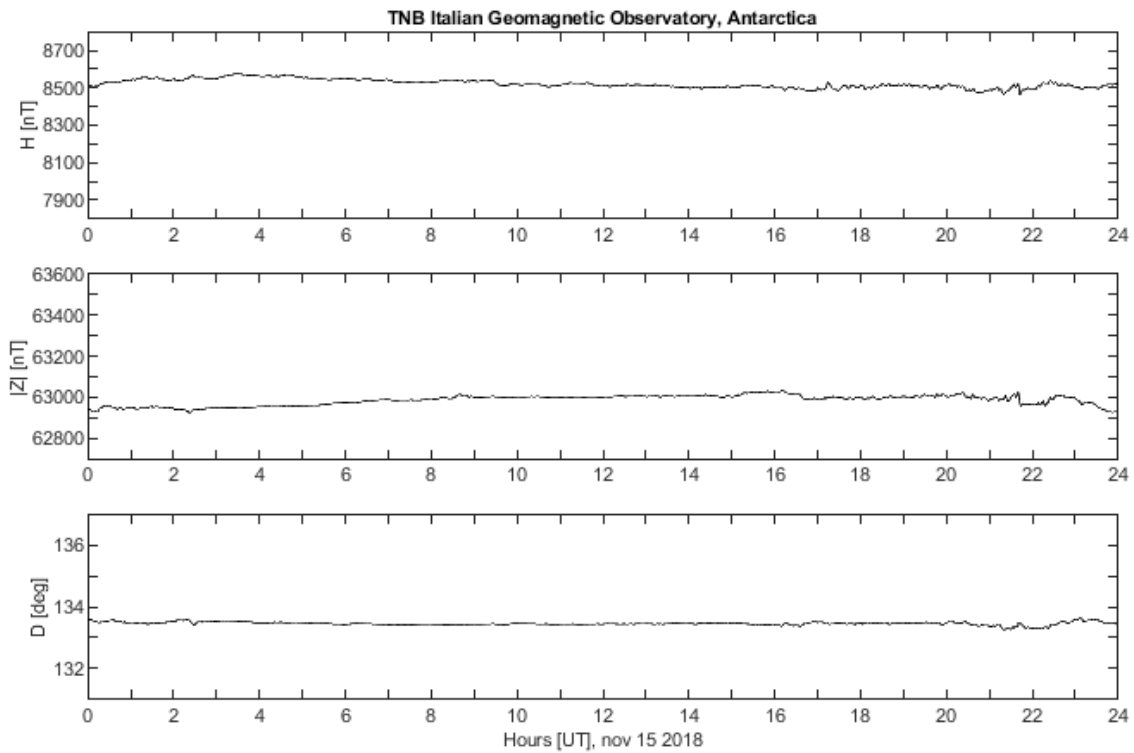
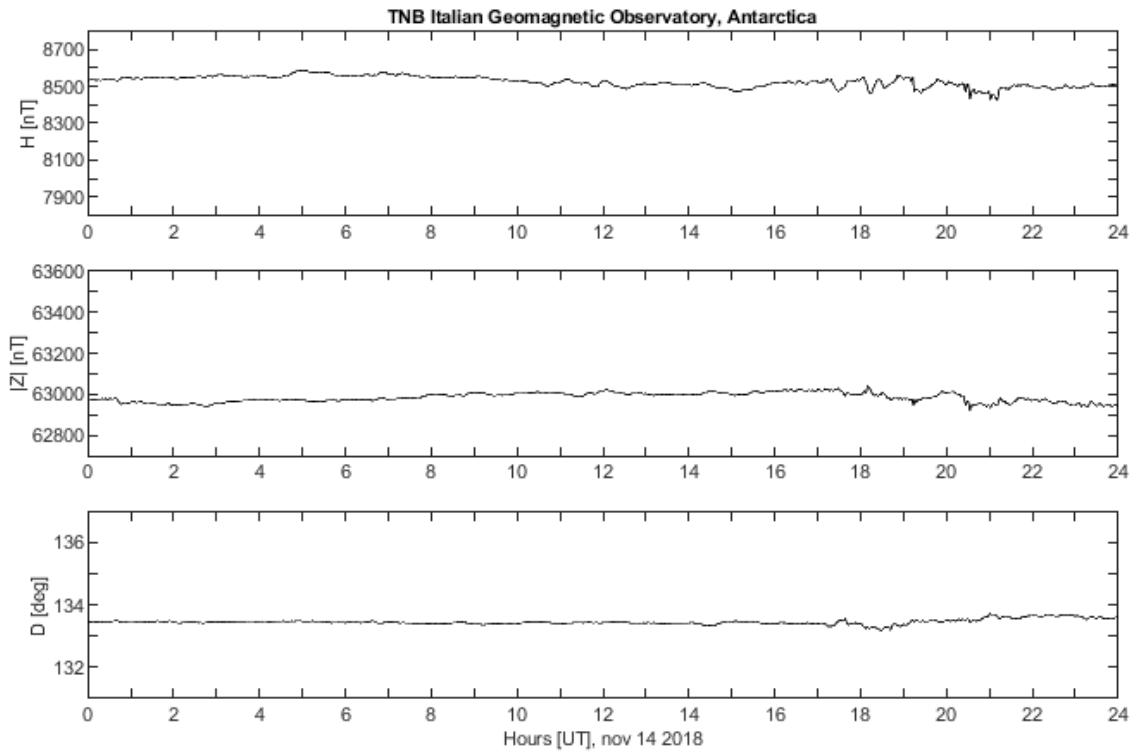
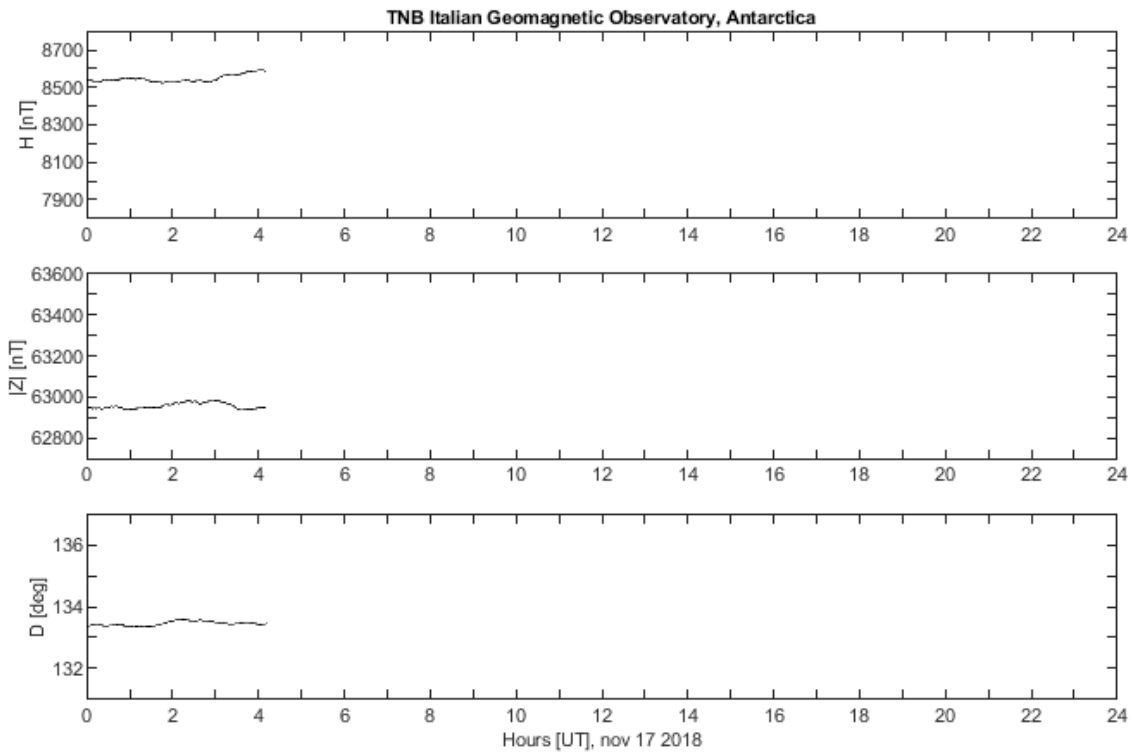
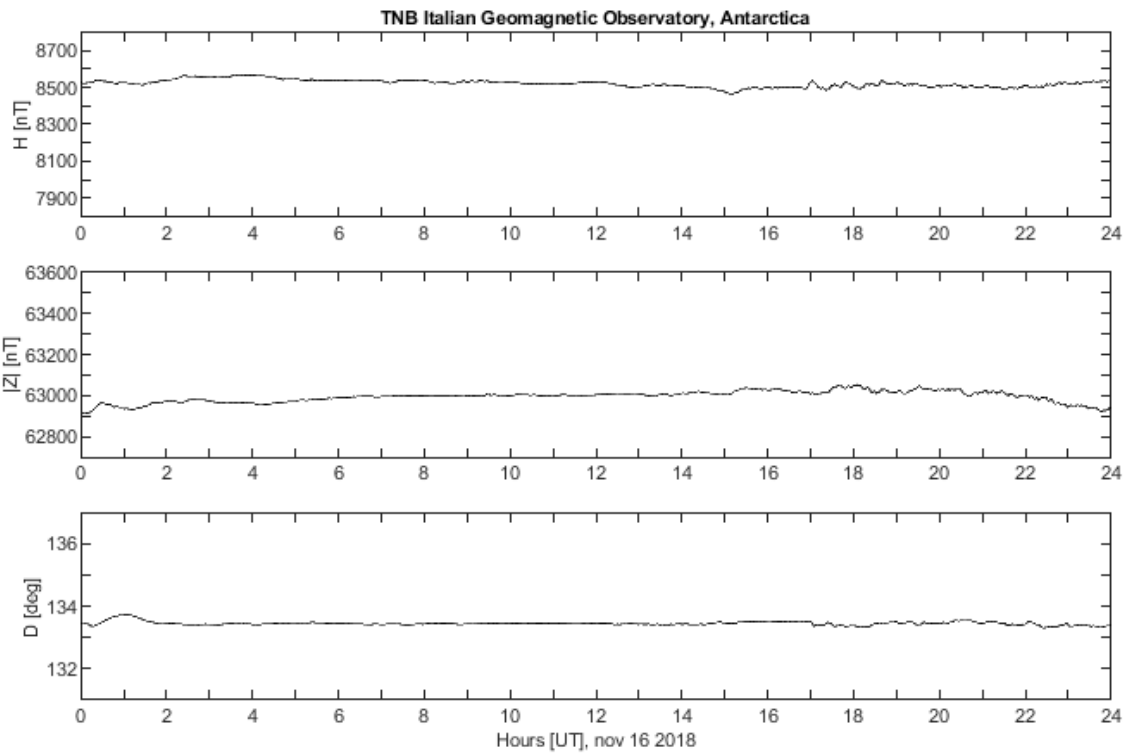
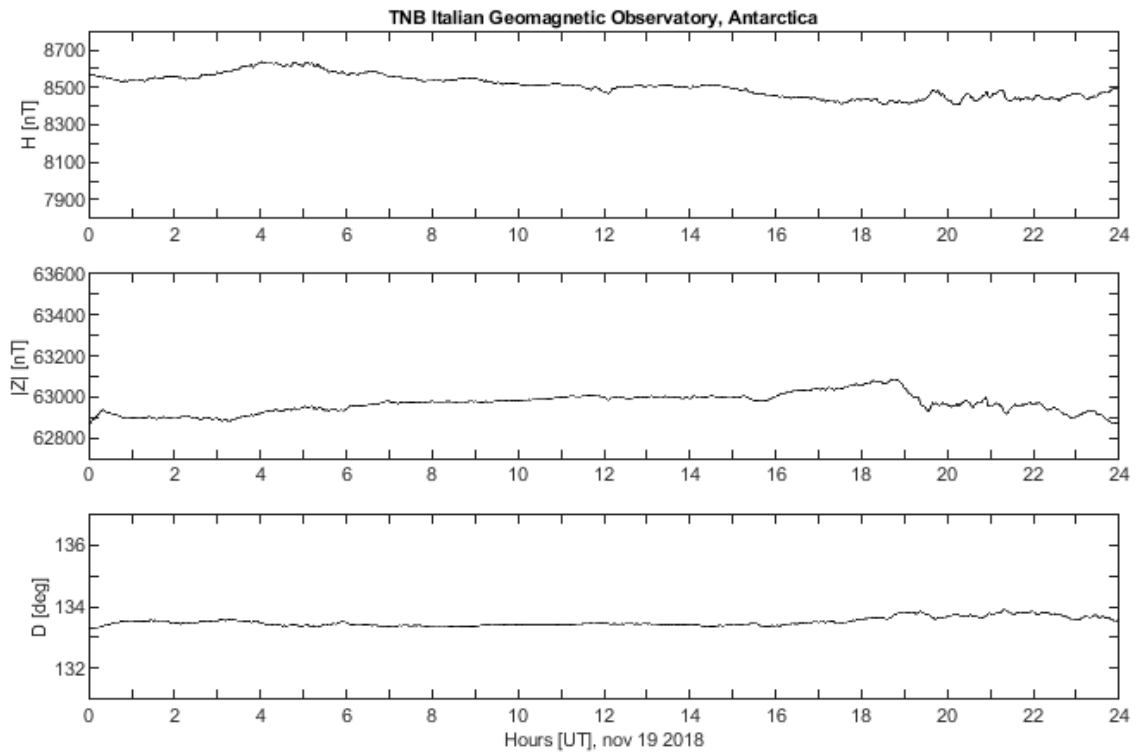
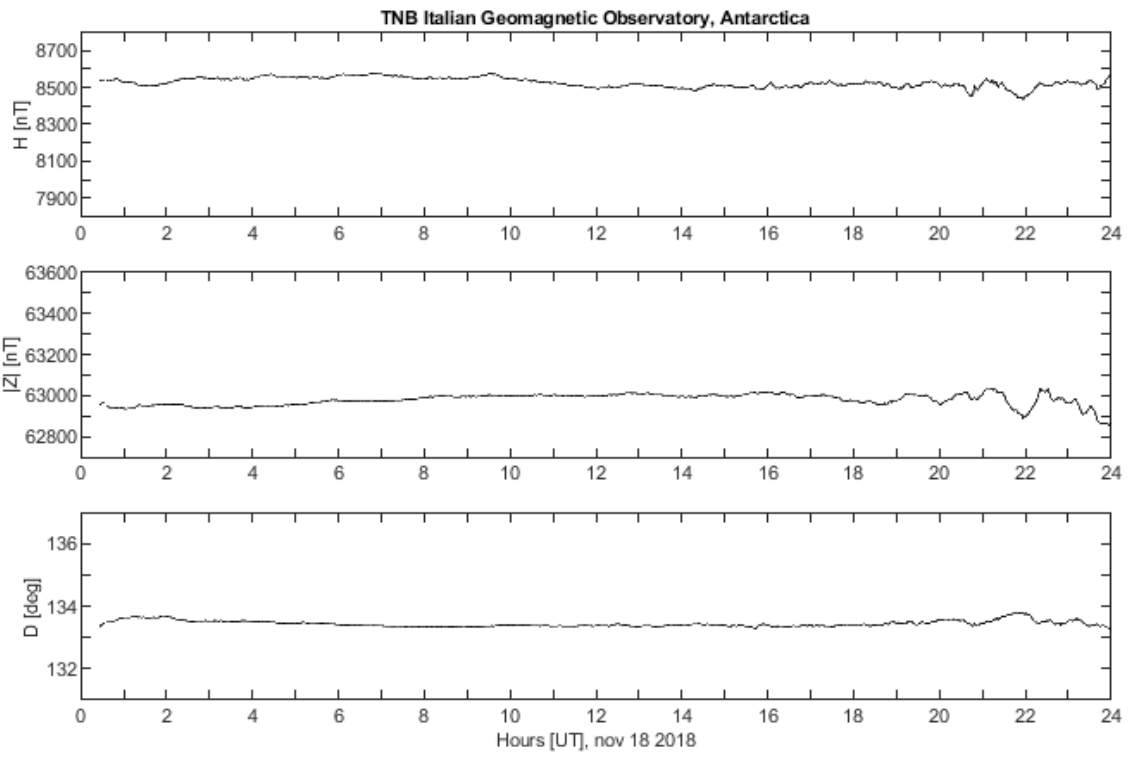


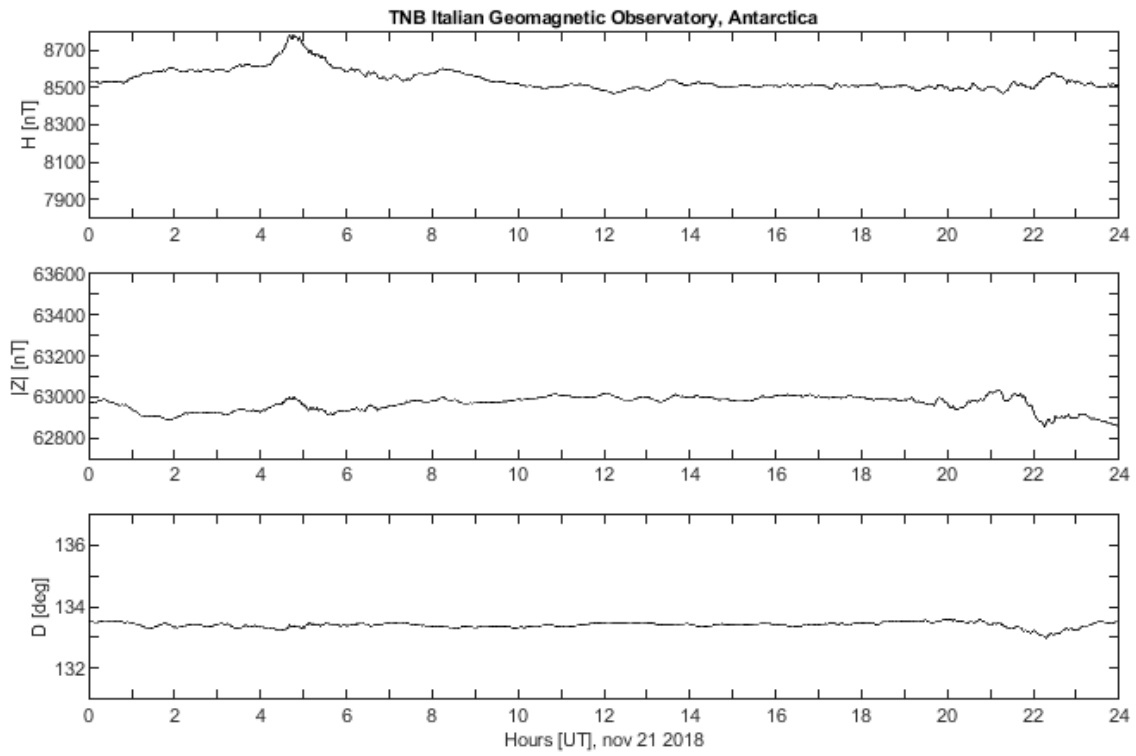
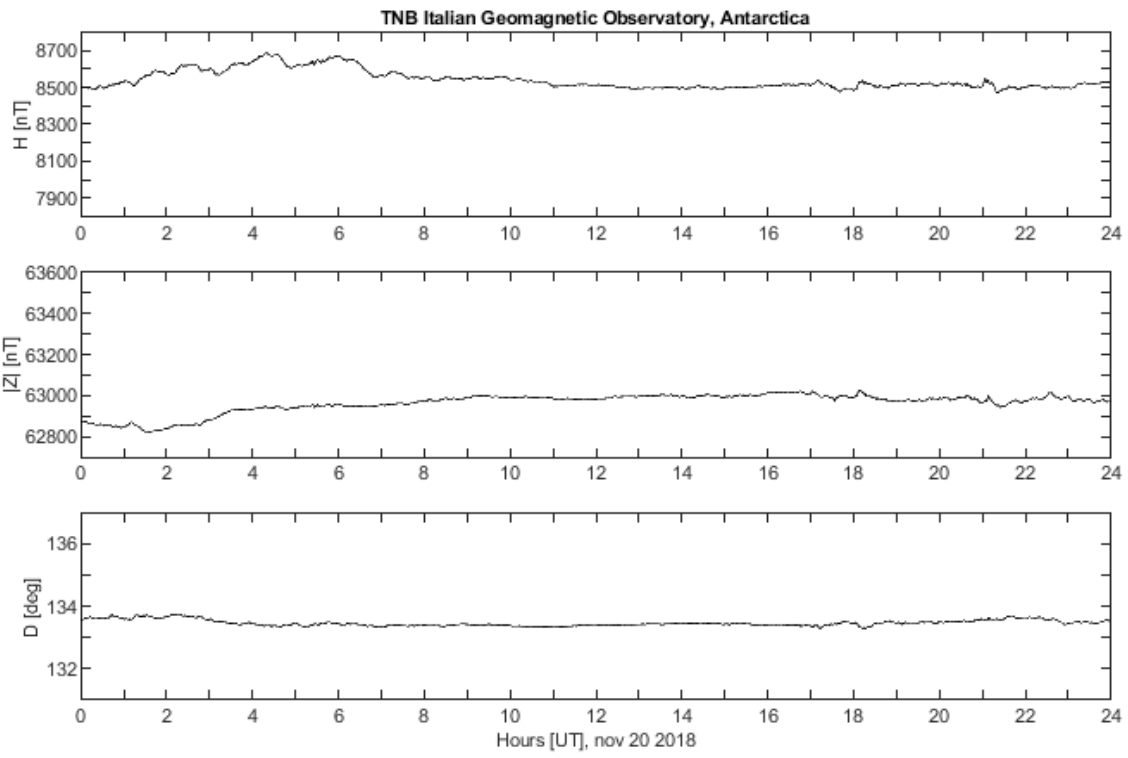
Fig.2

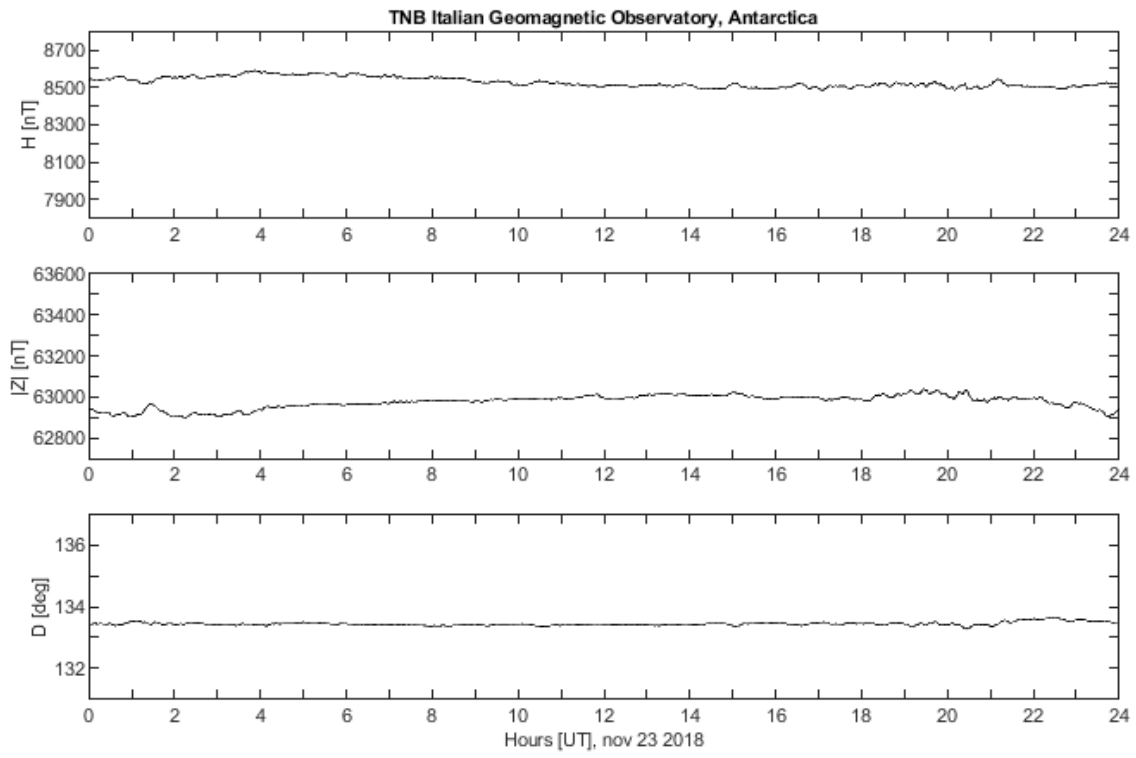
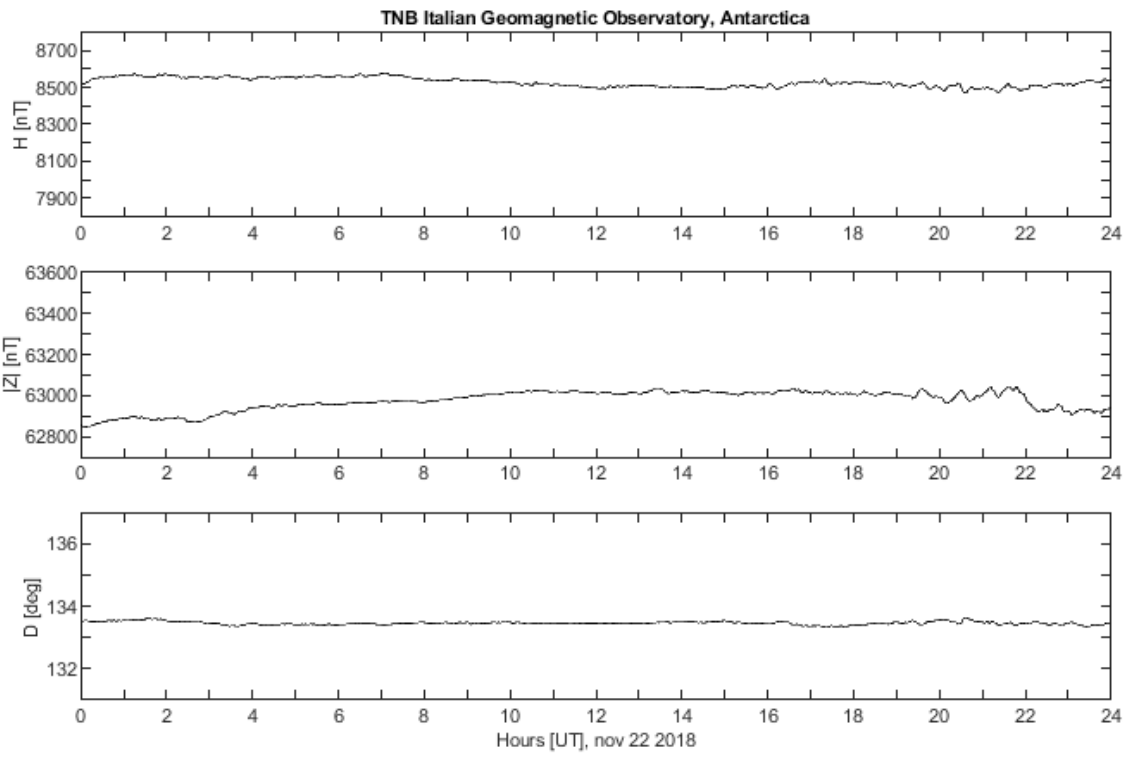
Fig. 3-87

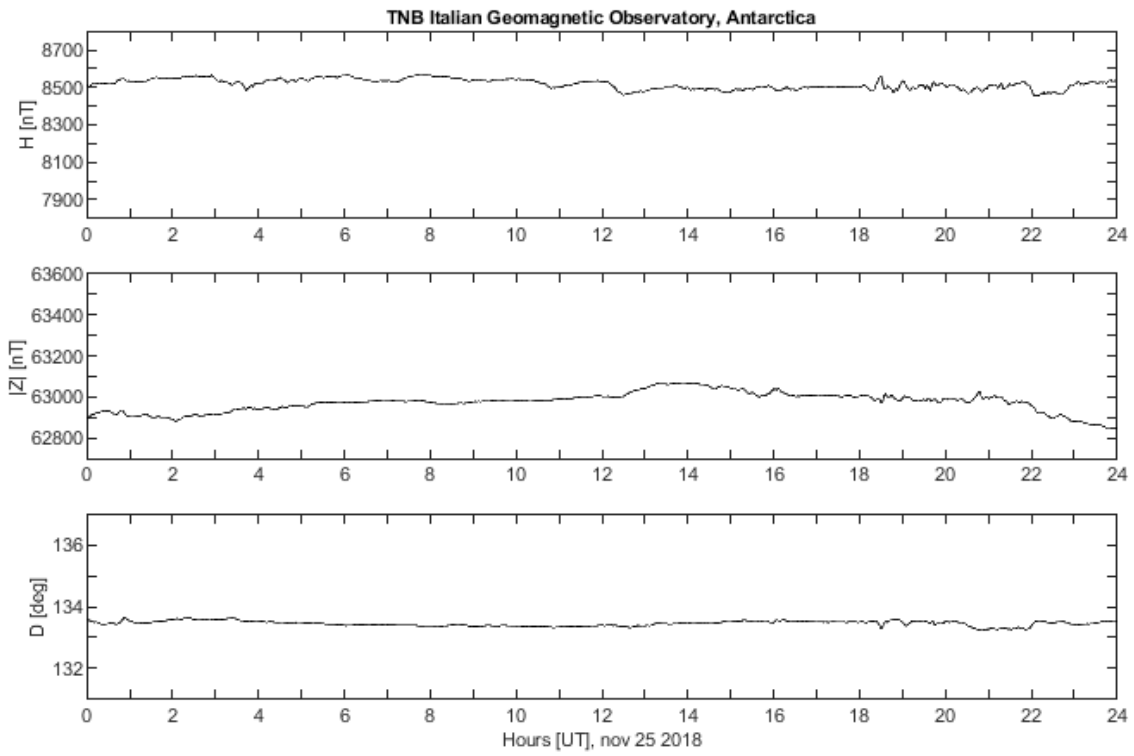
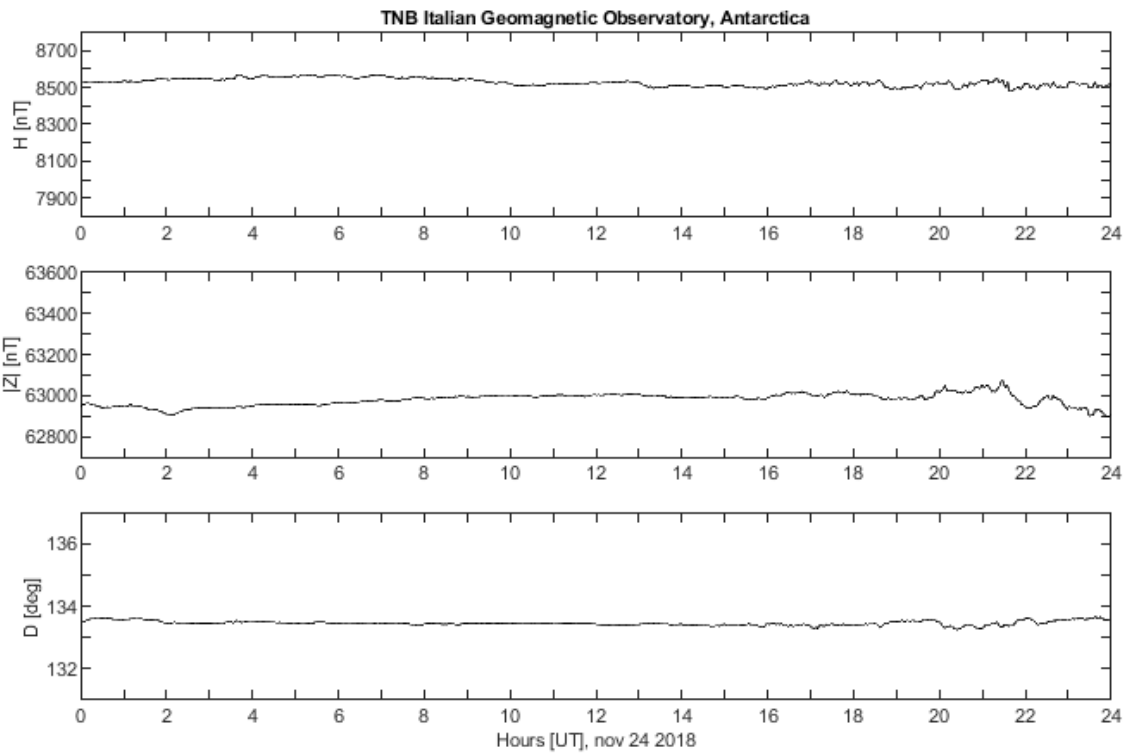


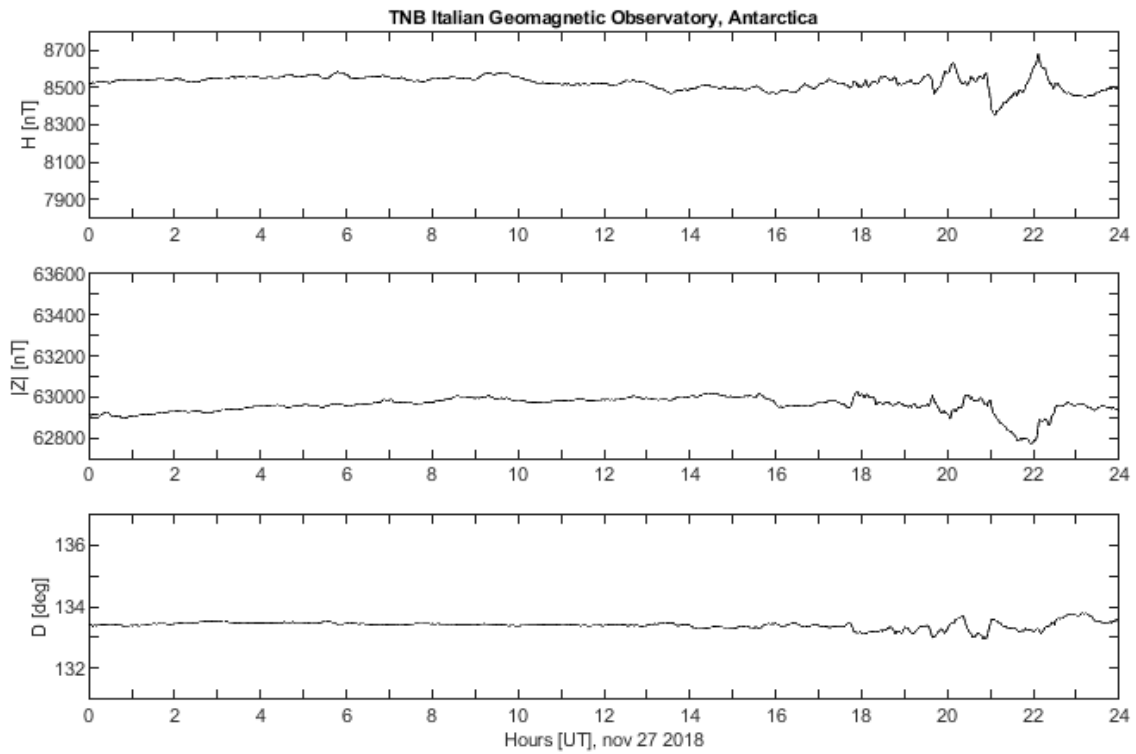
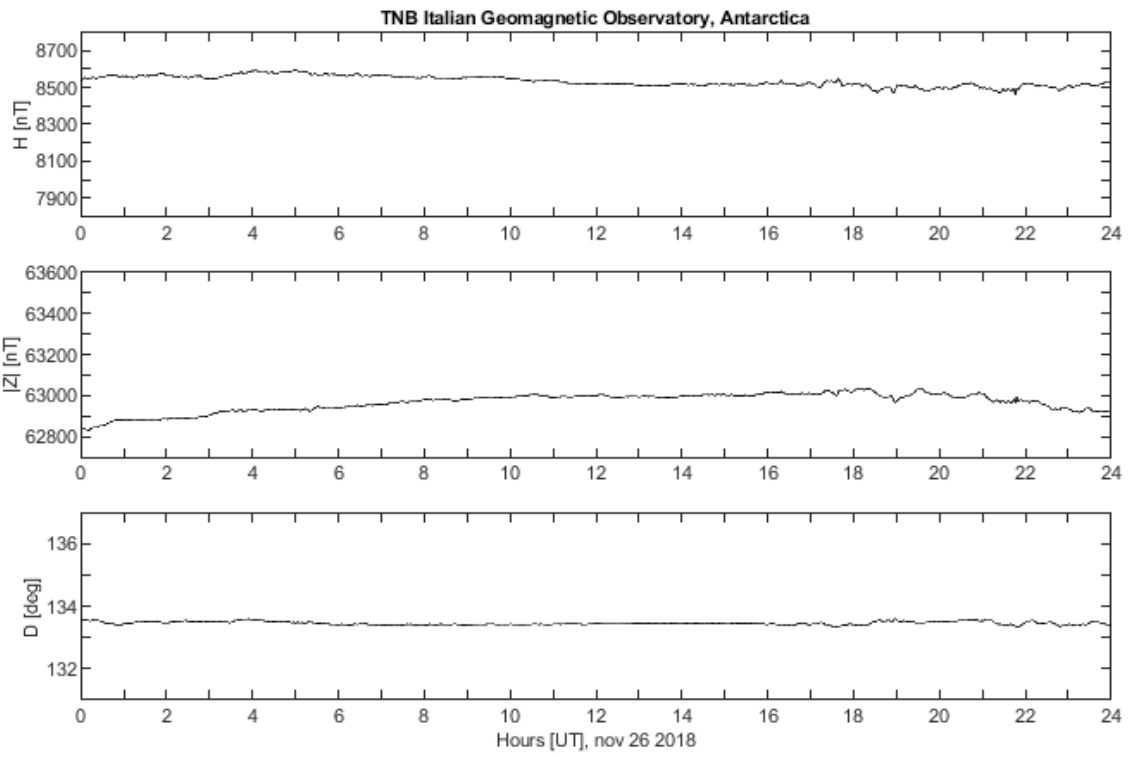


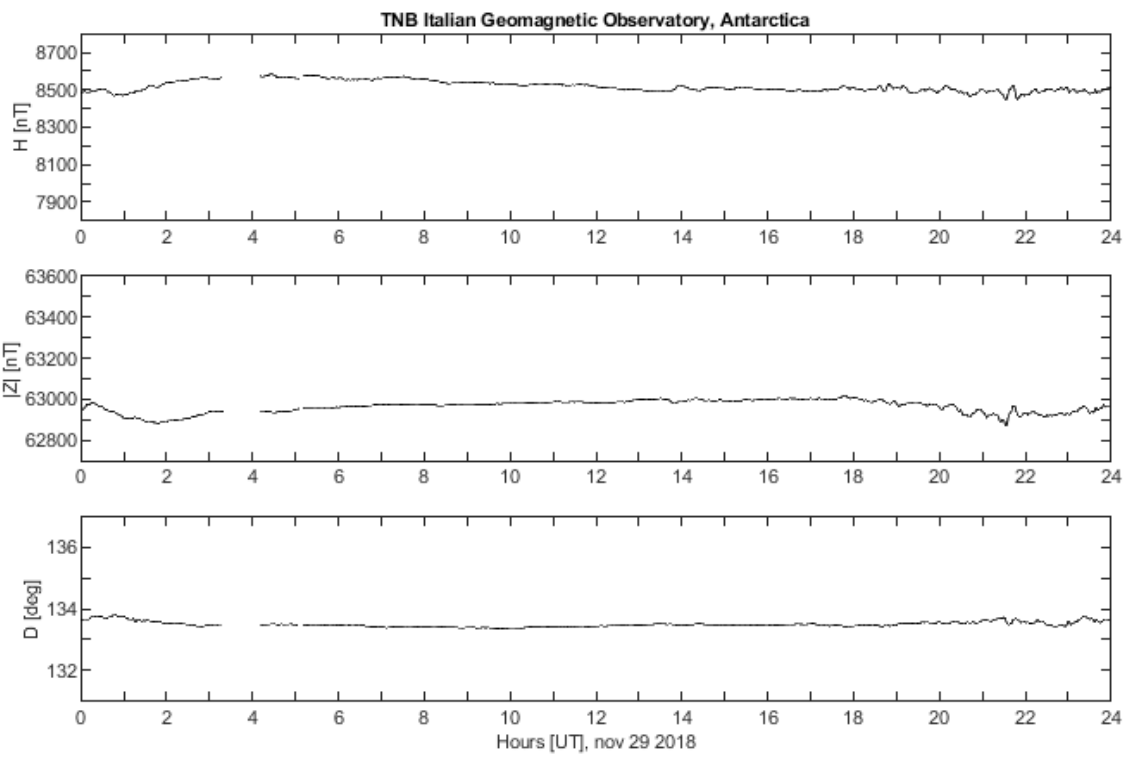
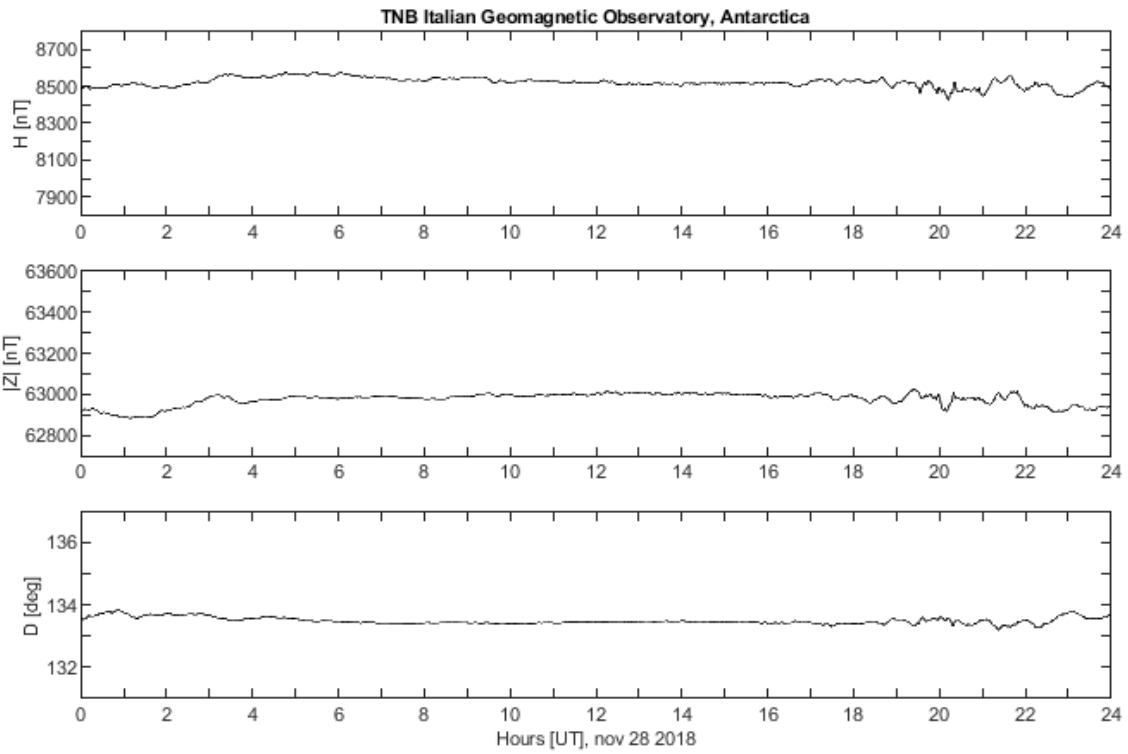


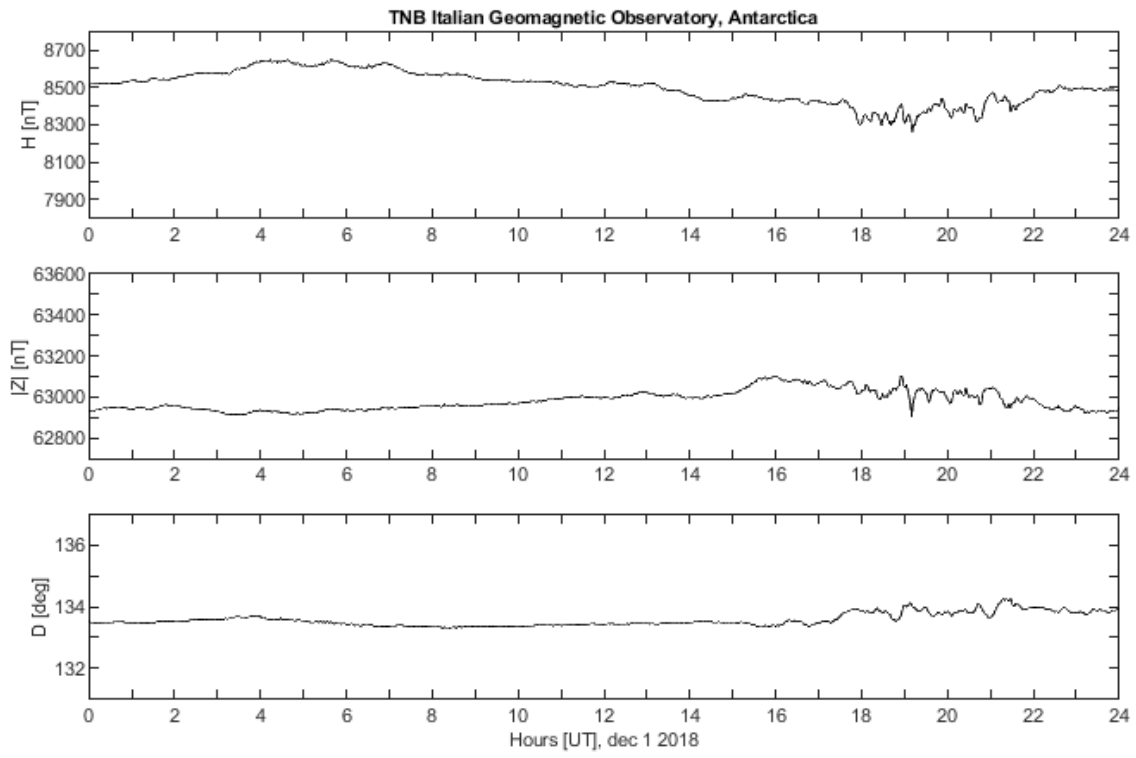
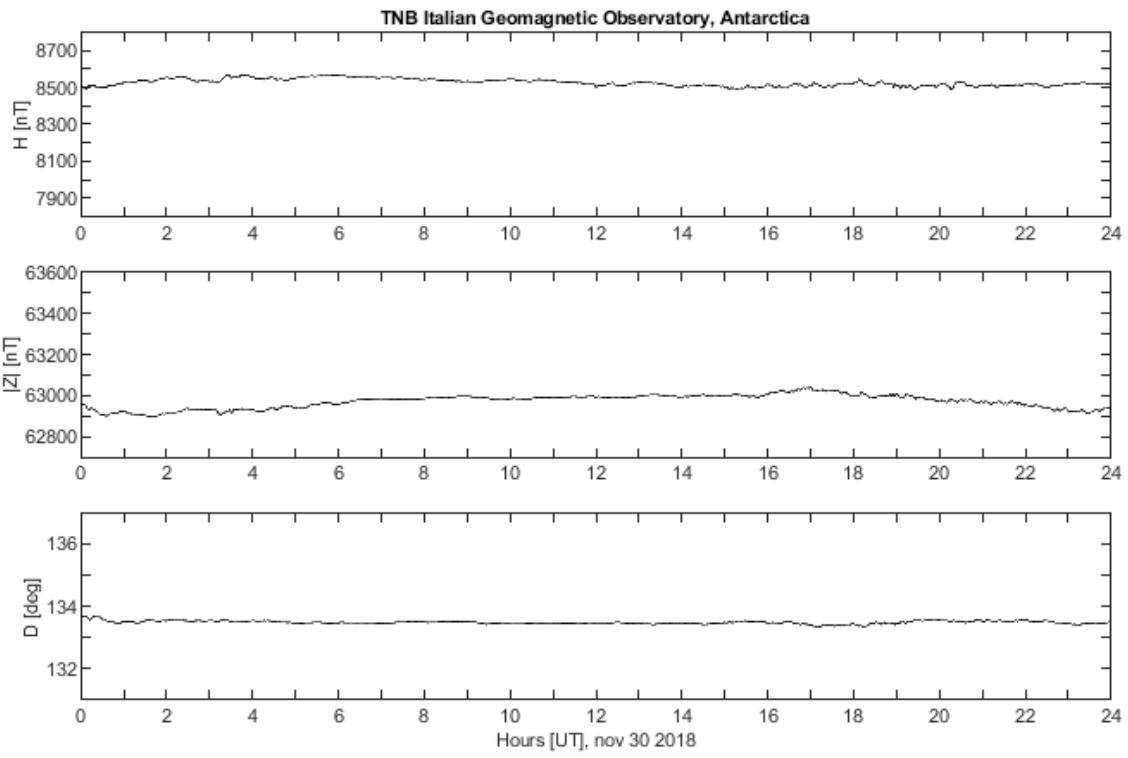


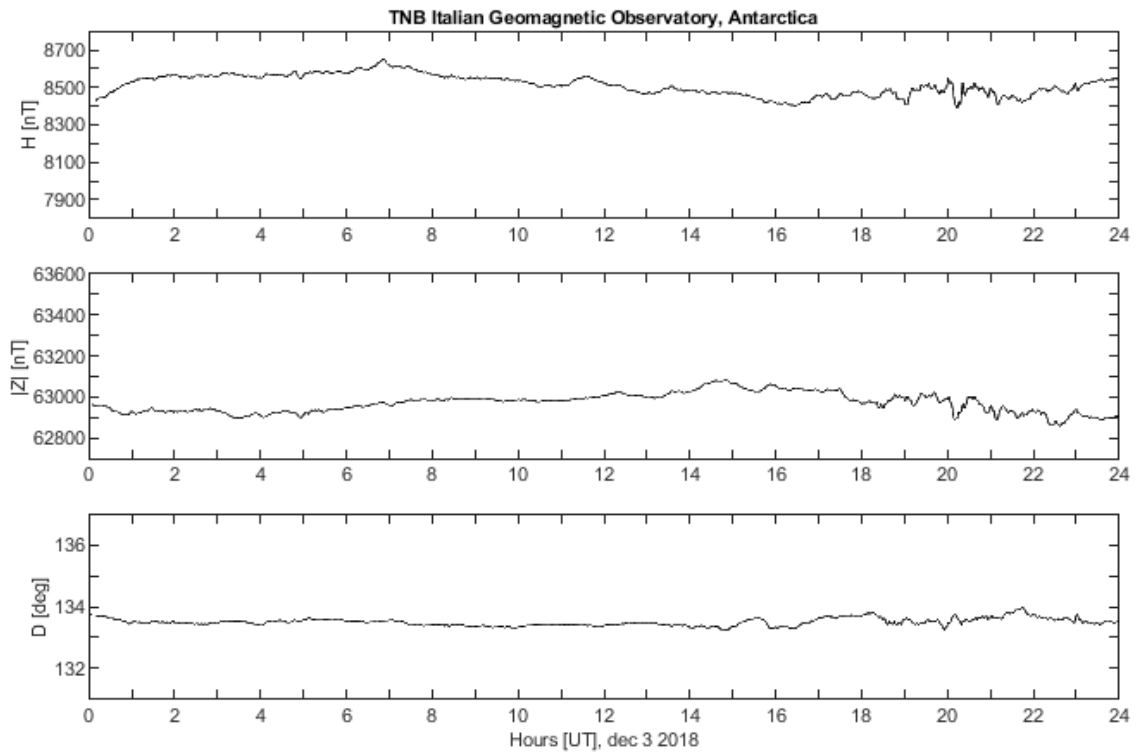
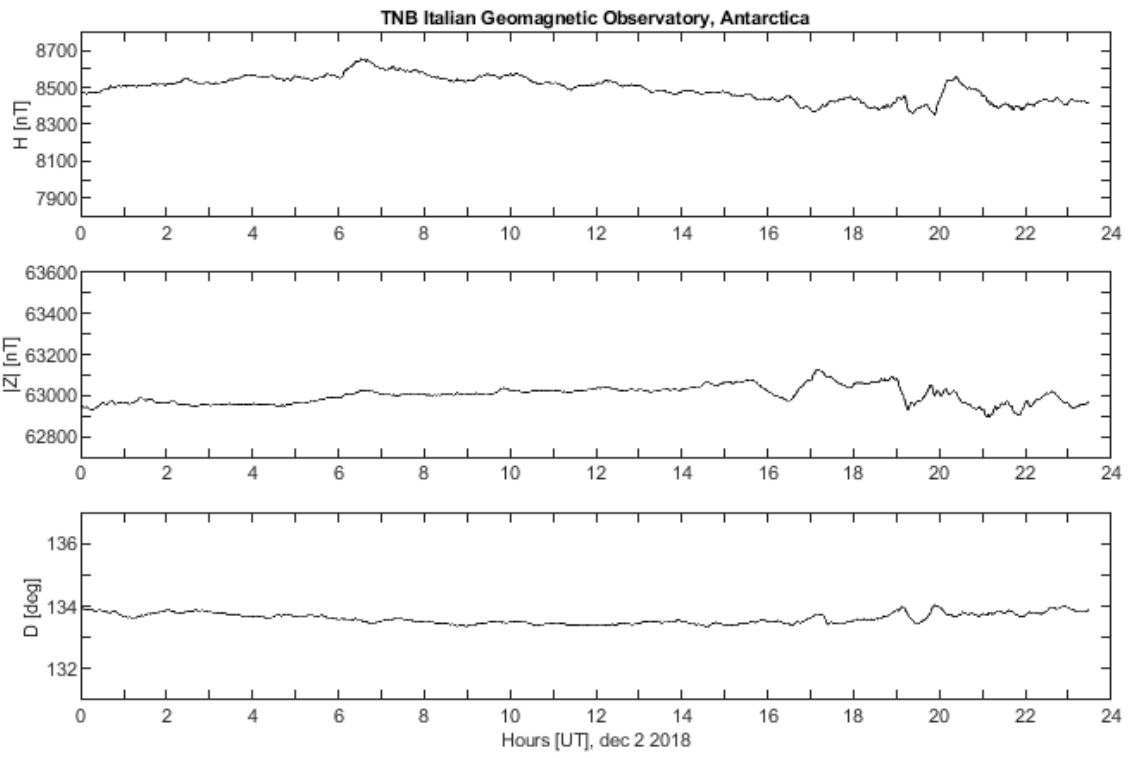


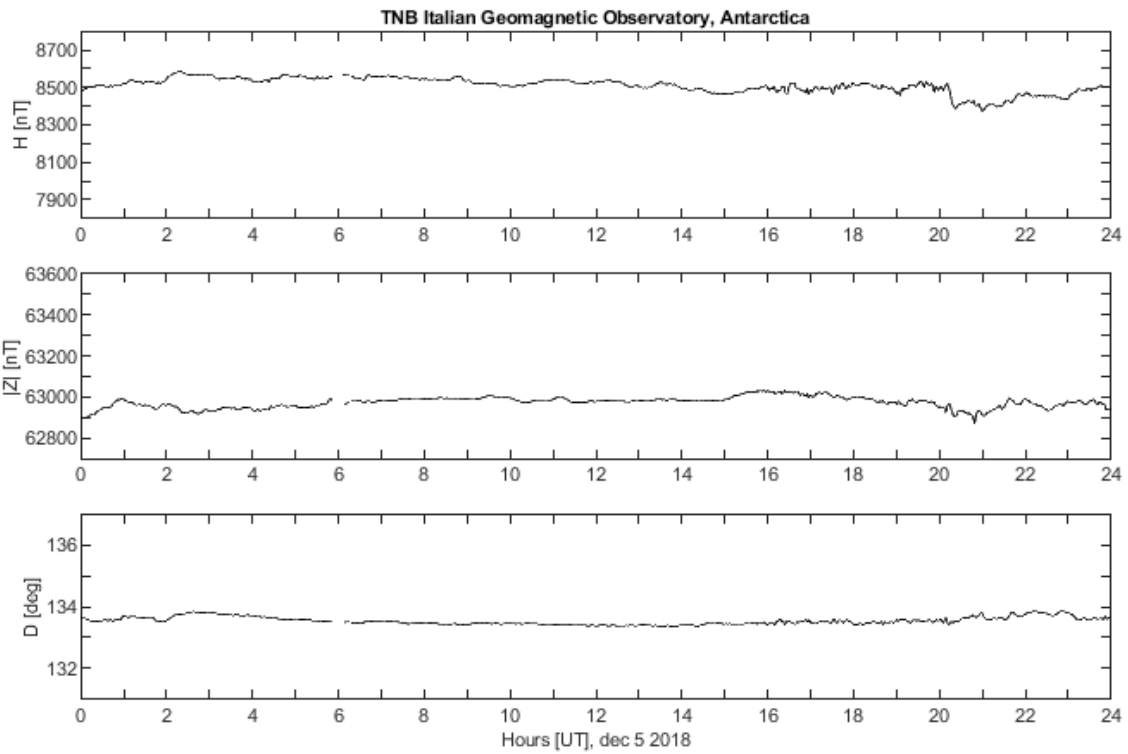
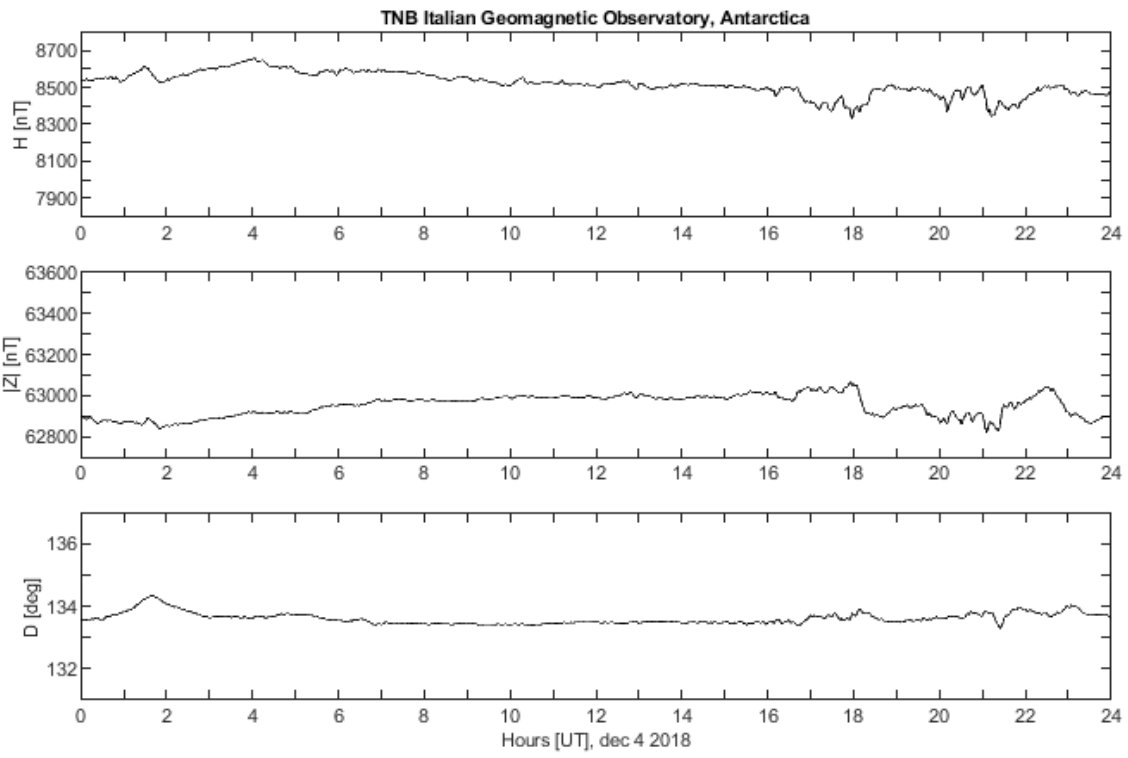


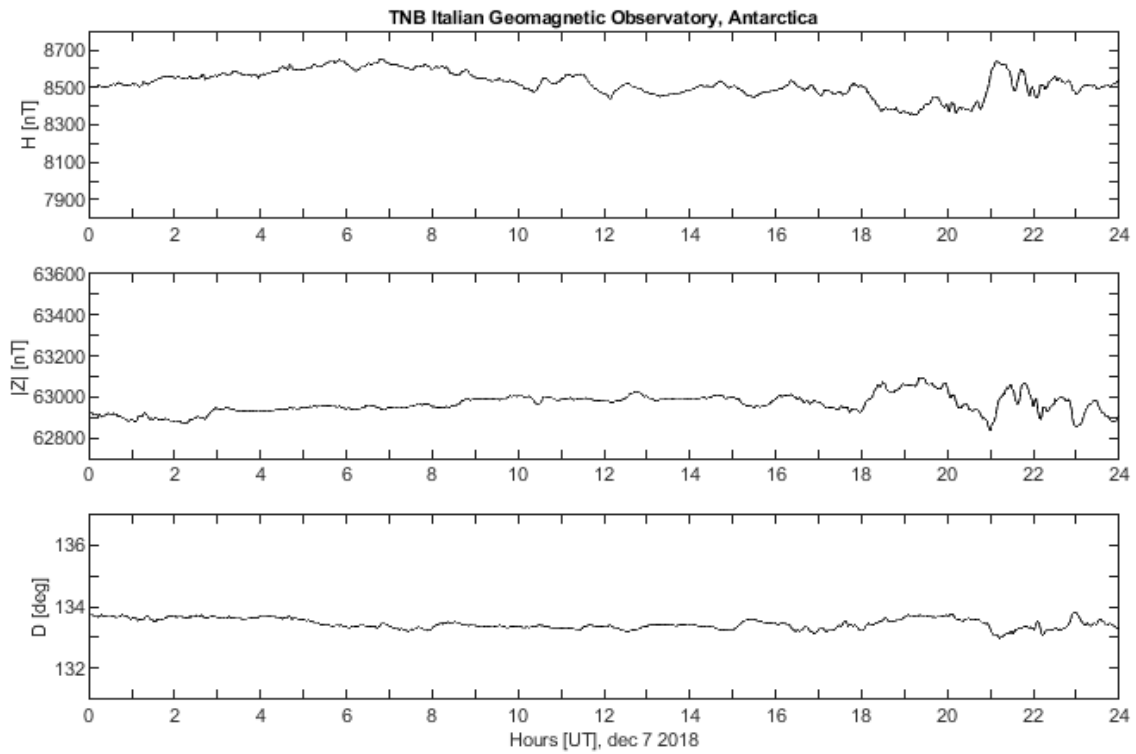
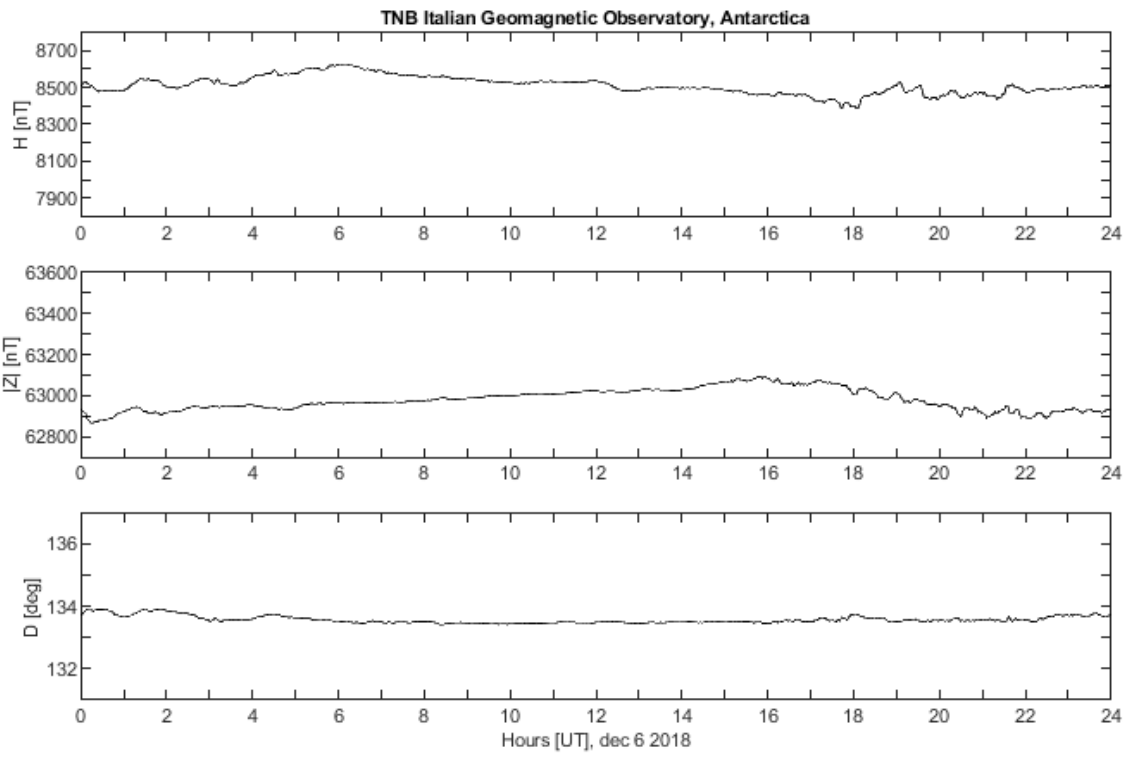


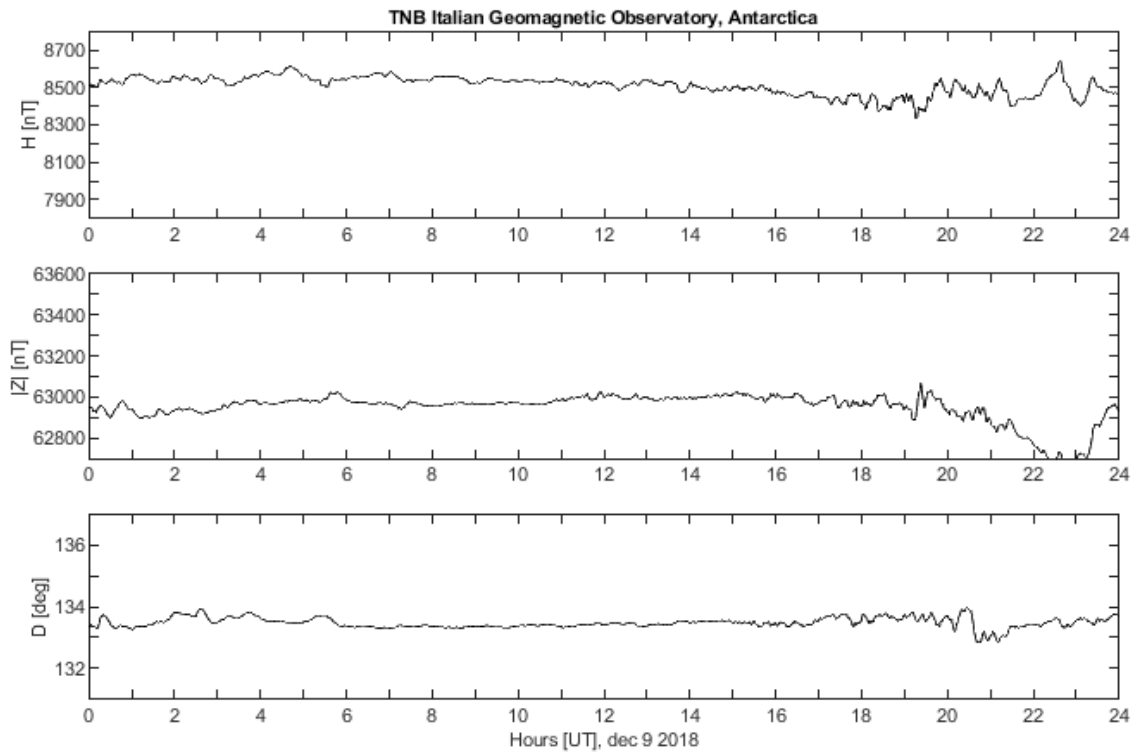
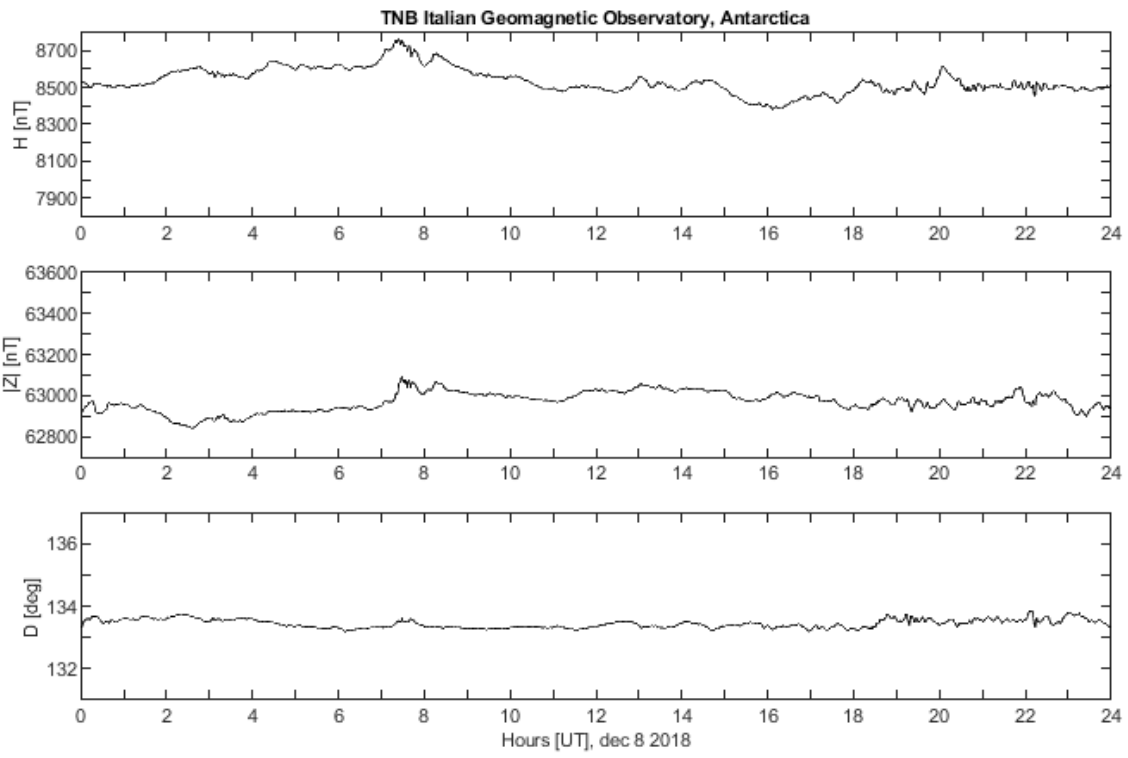


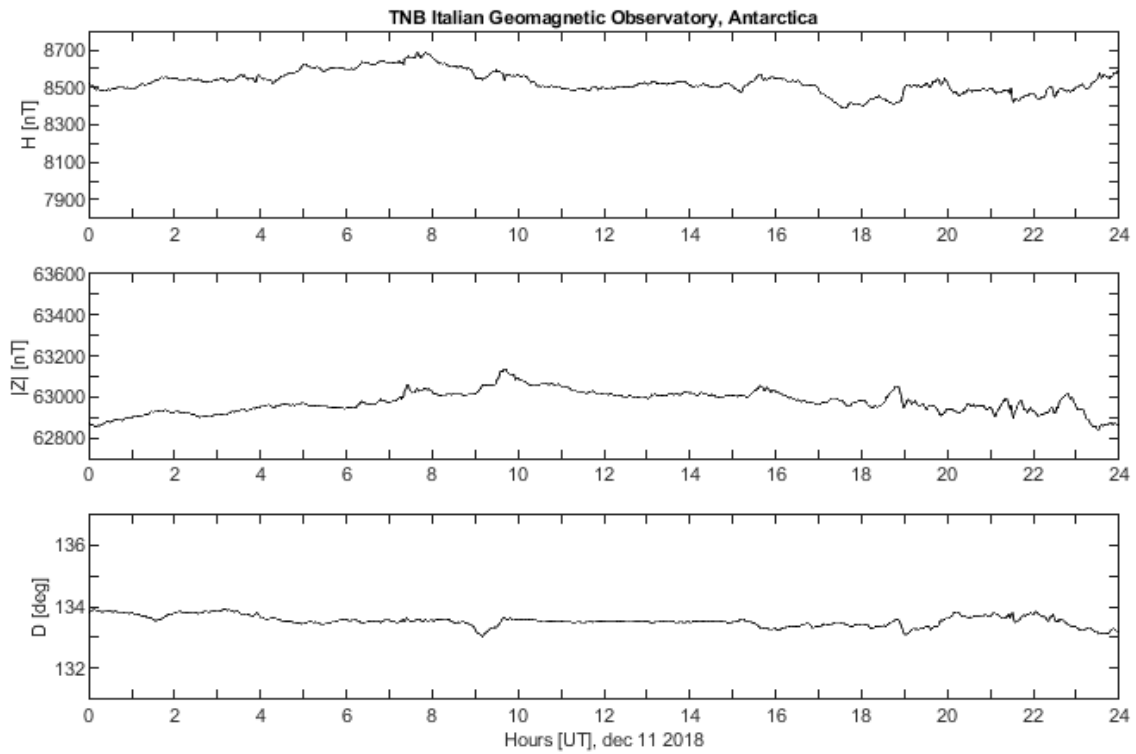
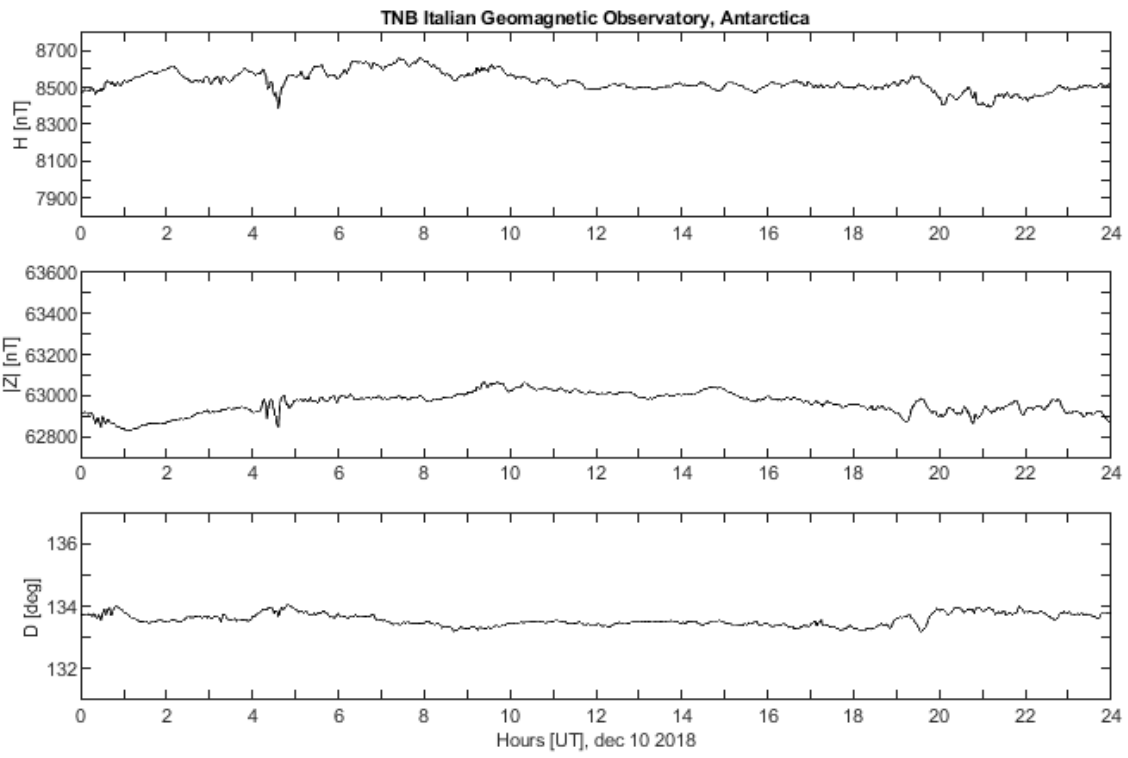


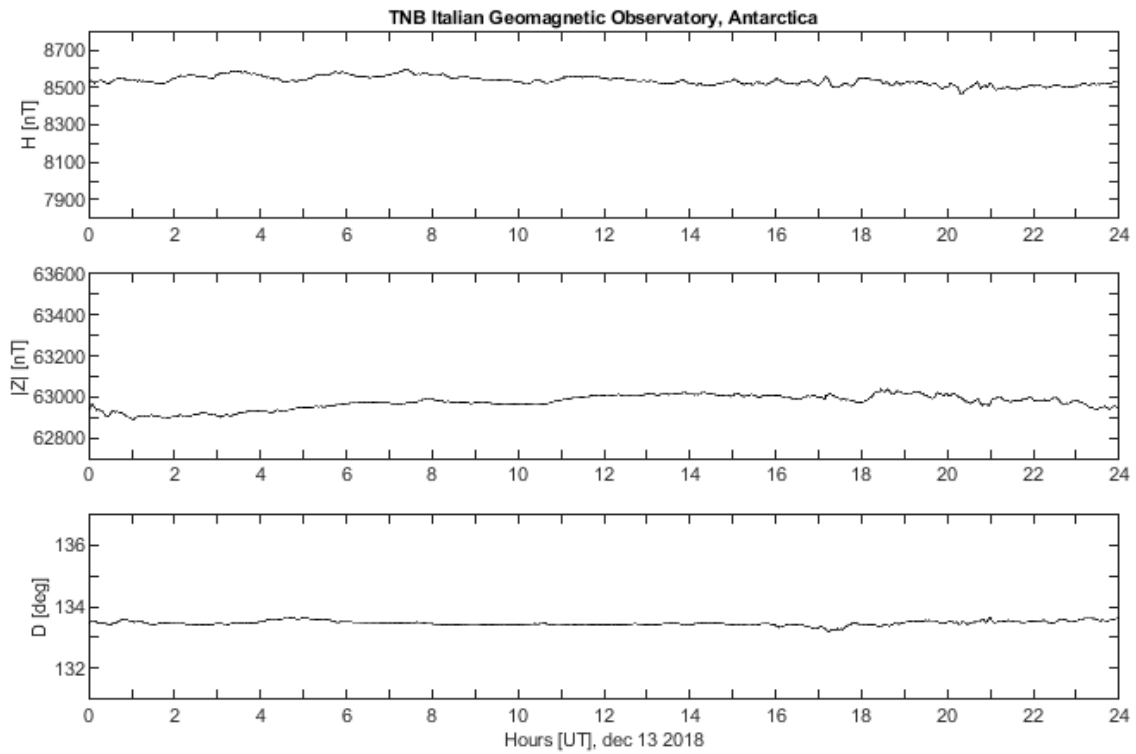
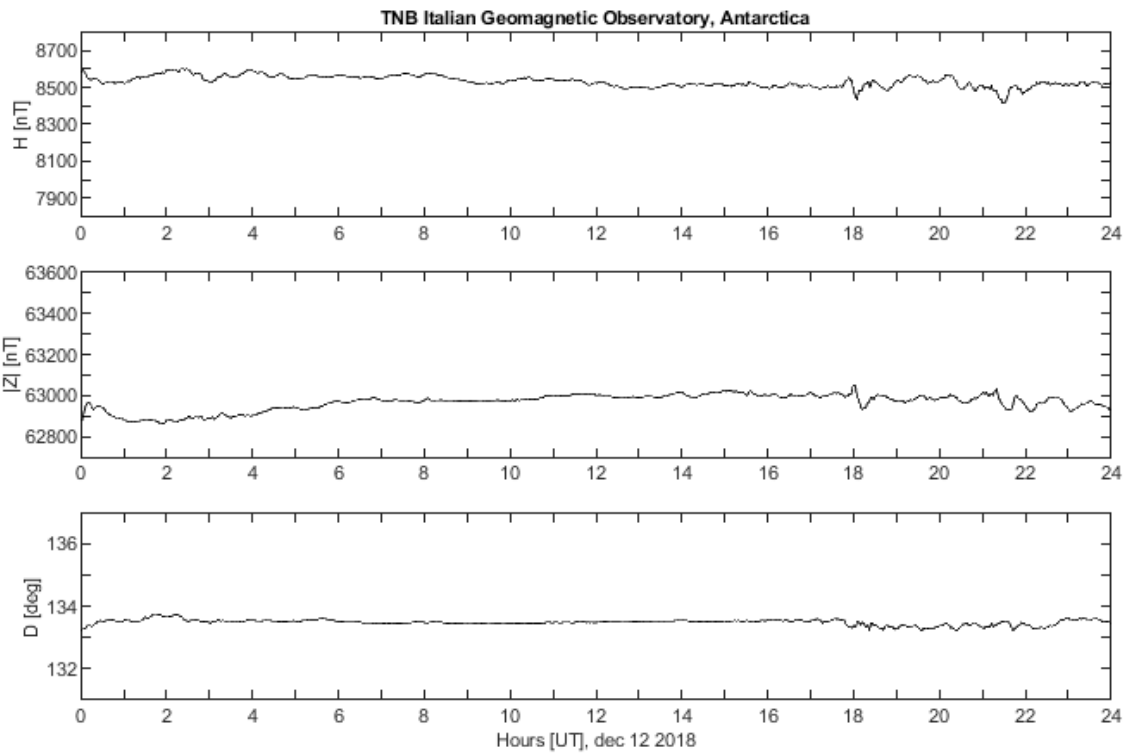


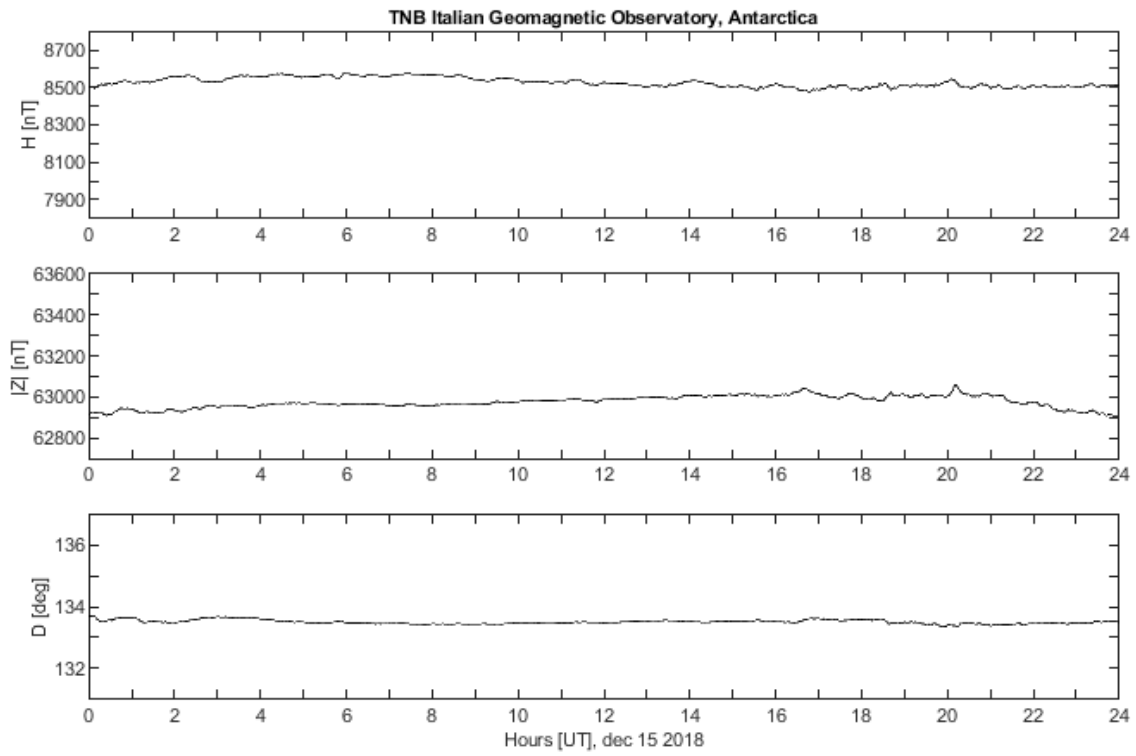
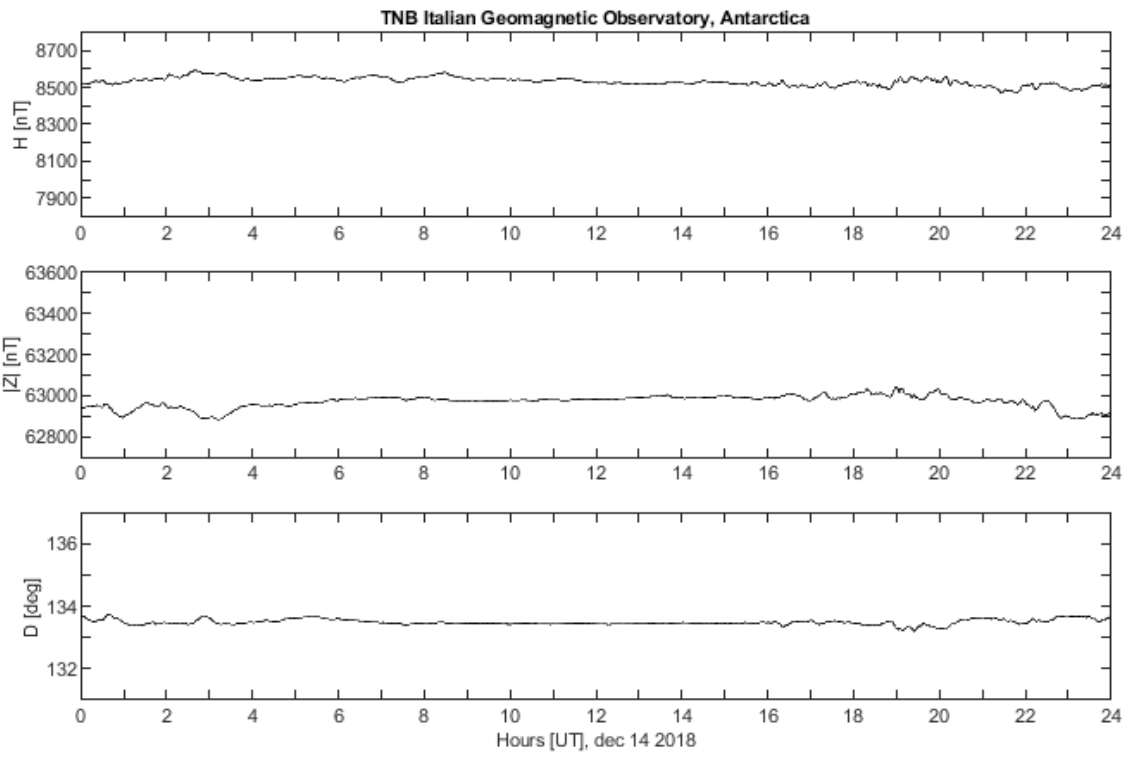


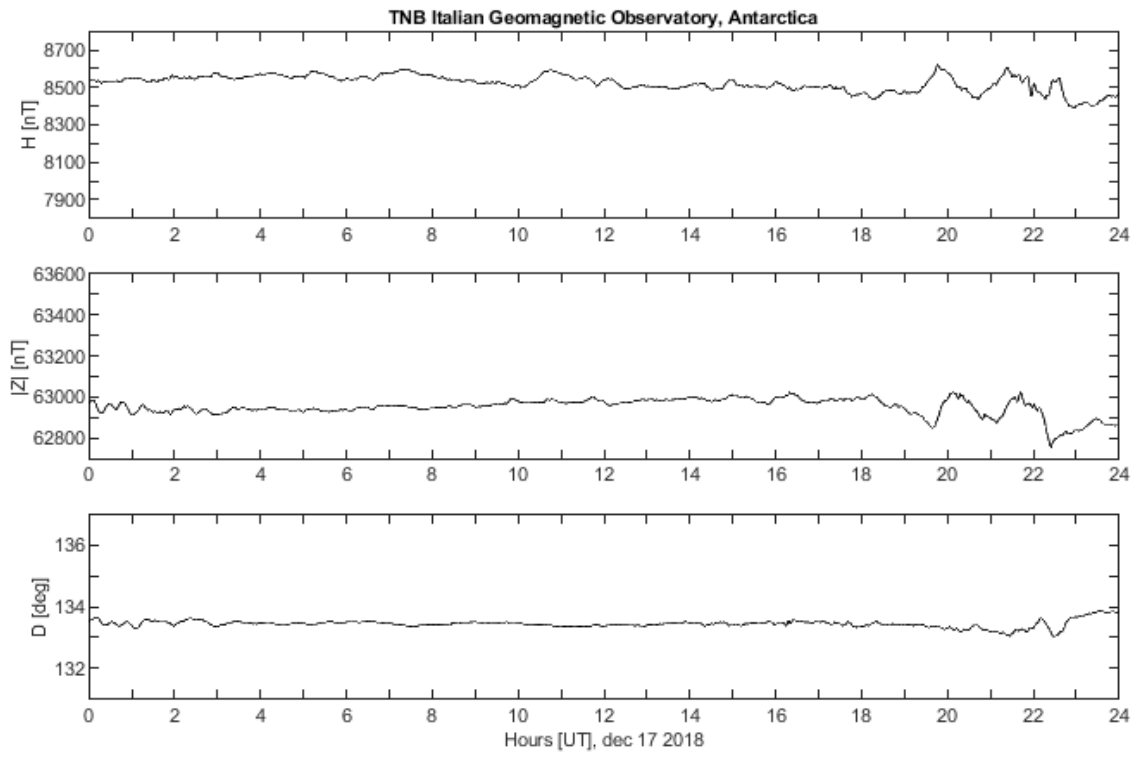
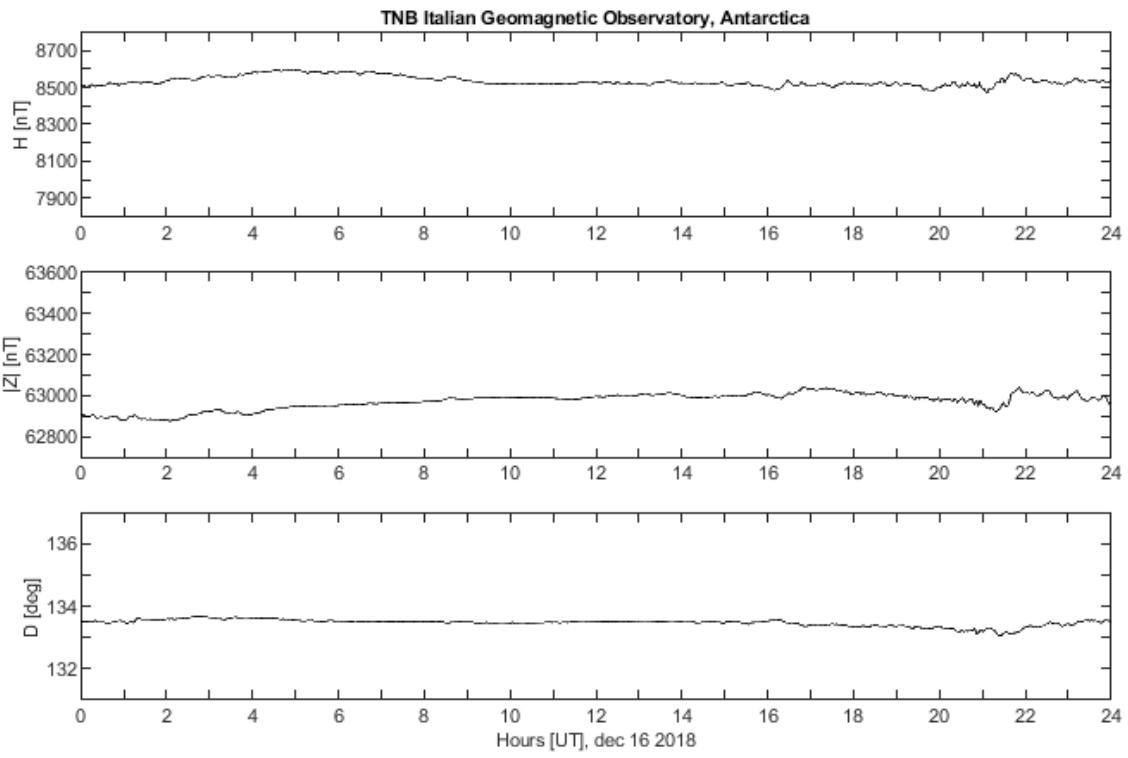


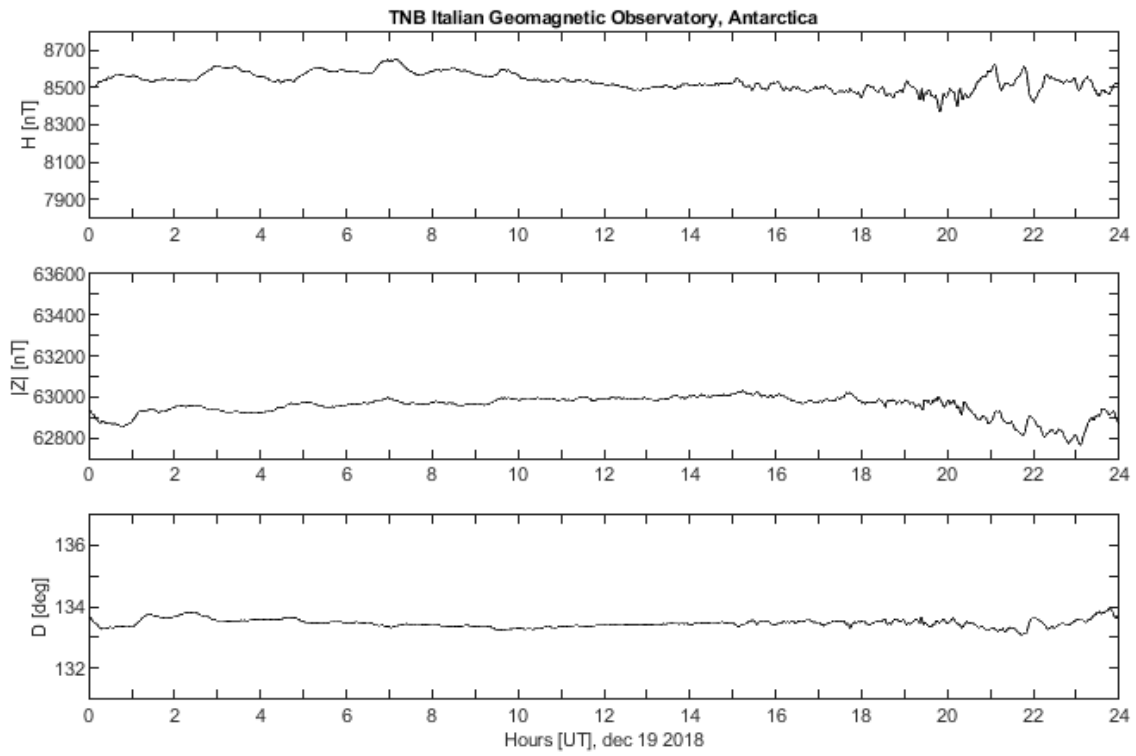
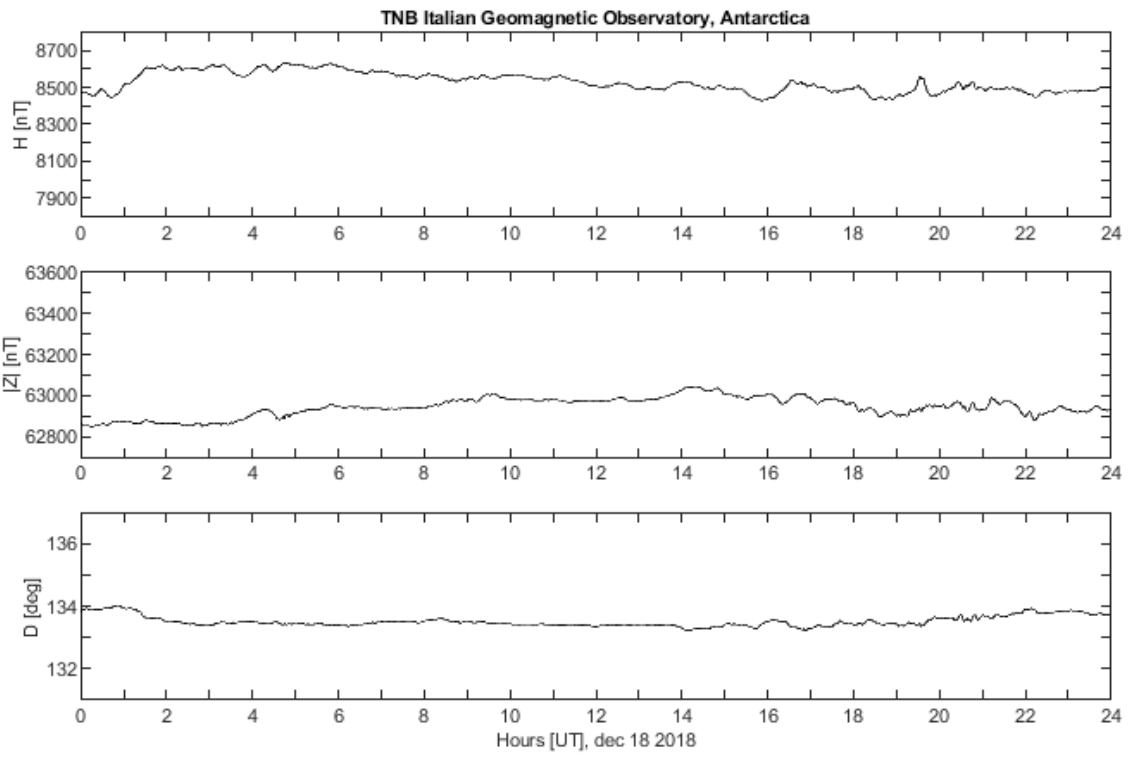


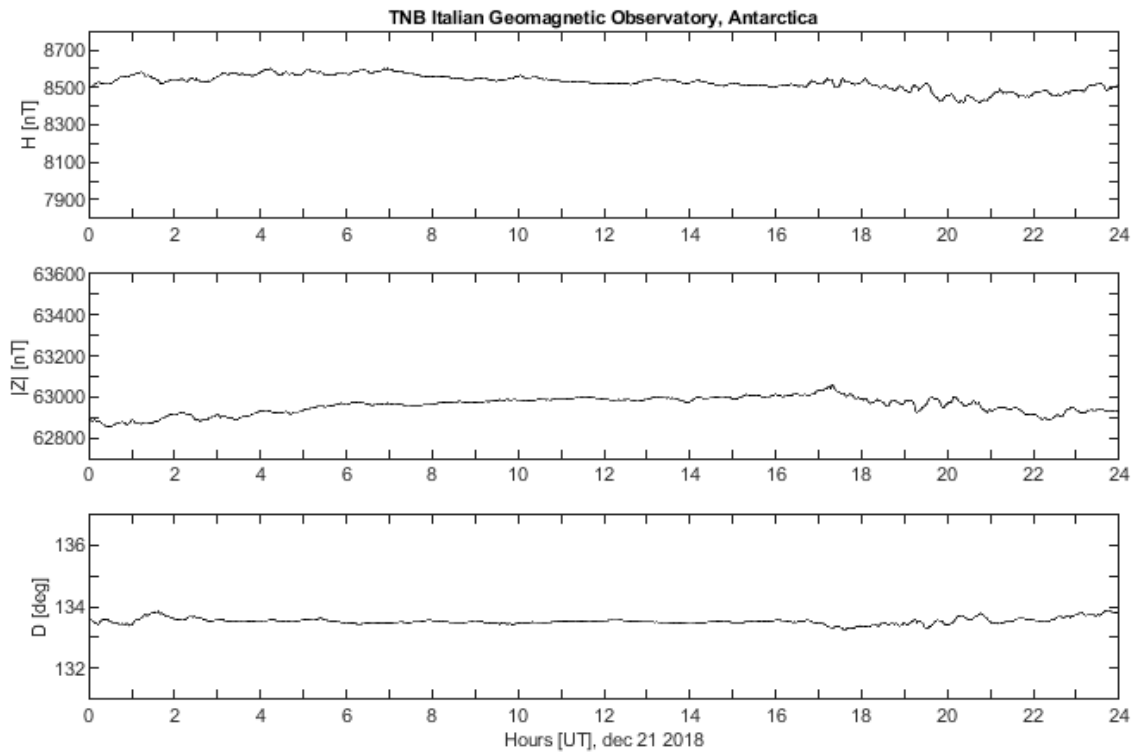
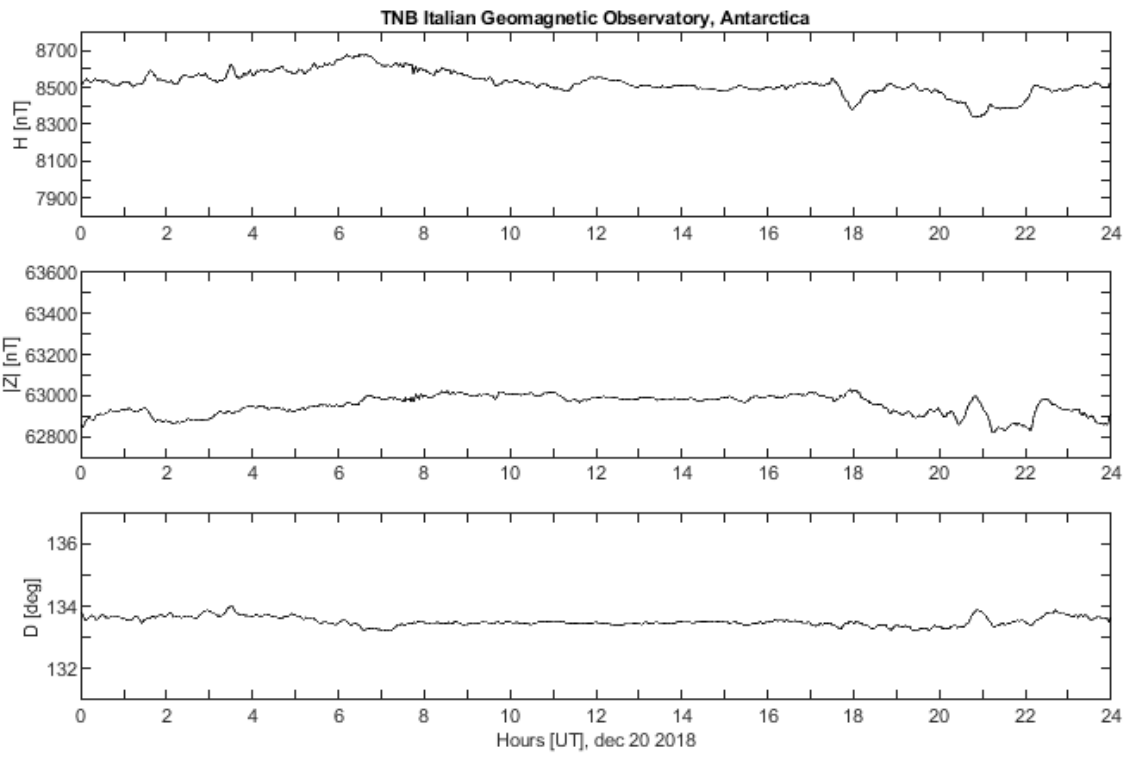


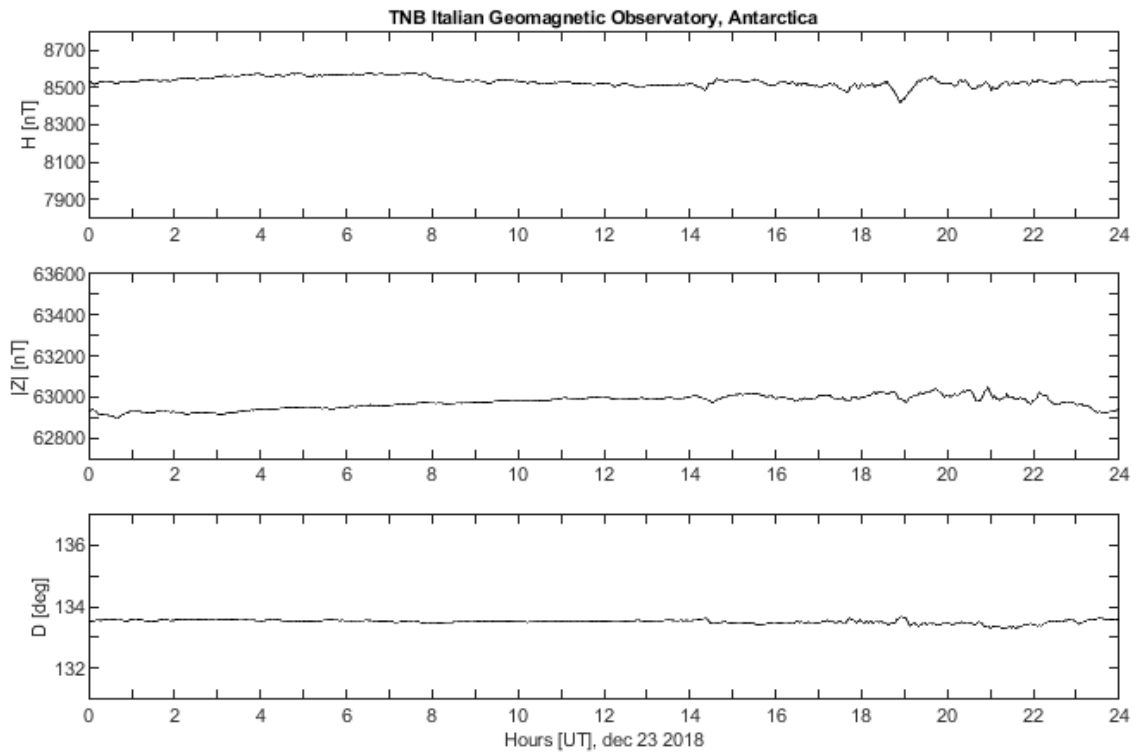
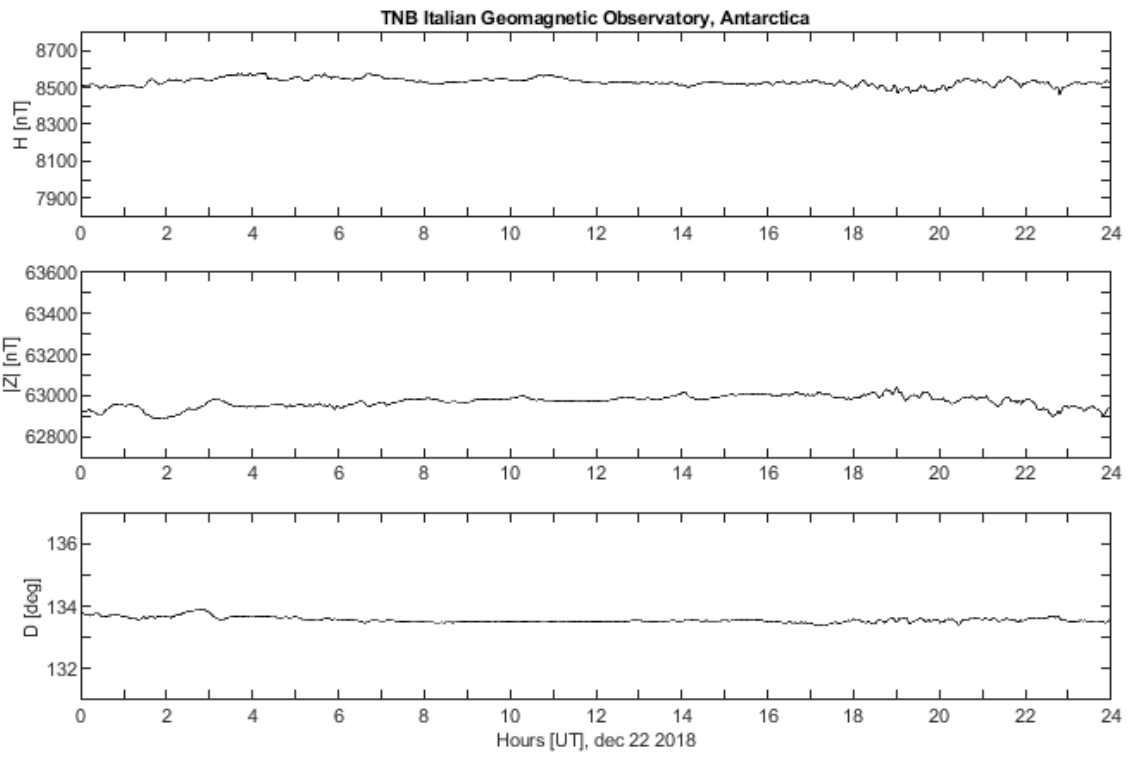


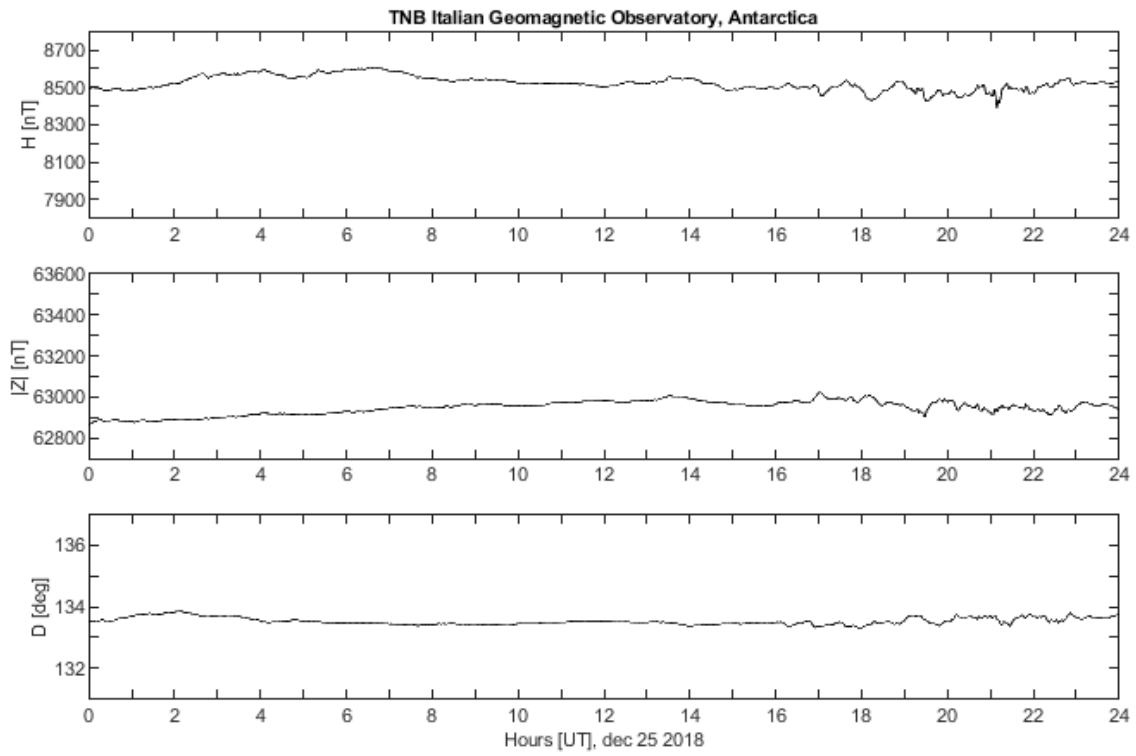
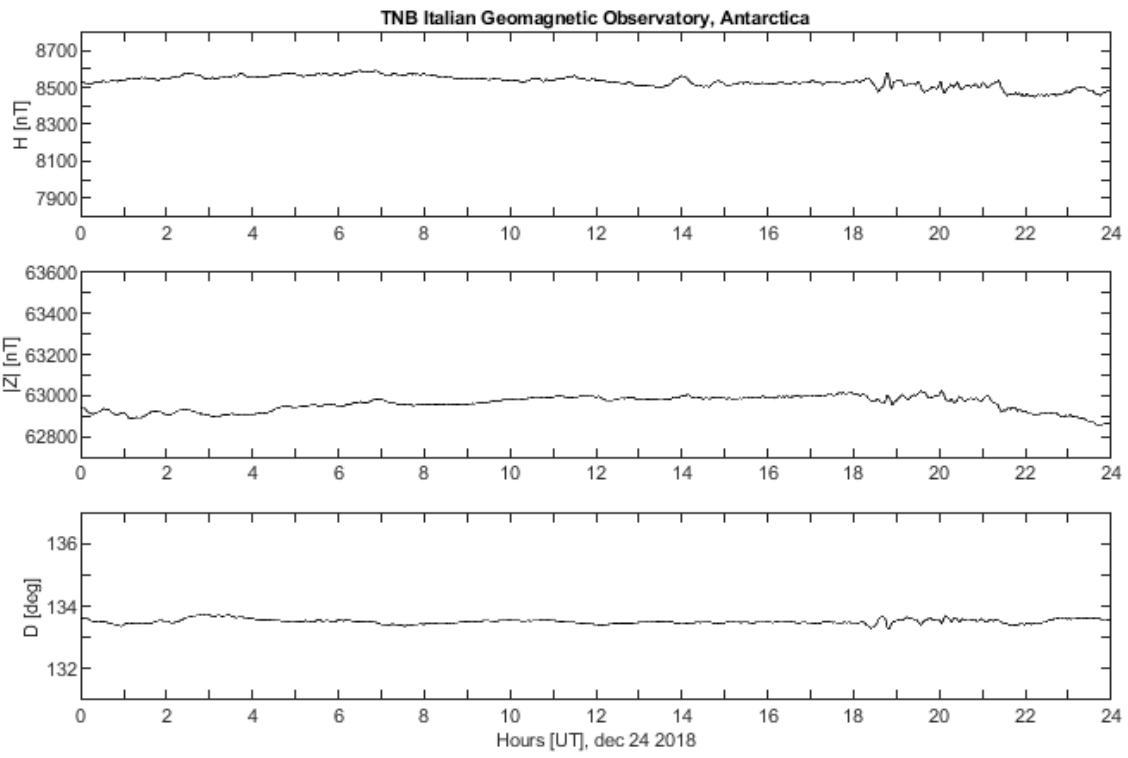


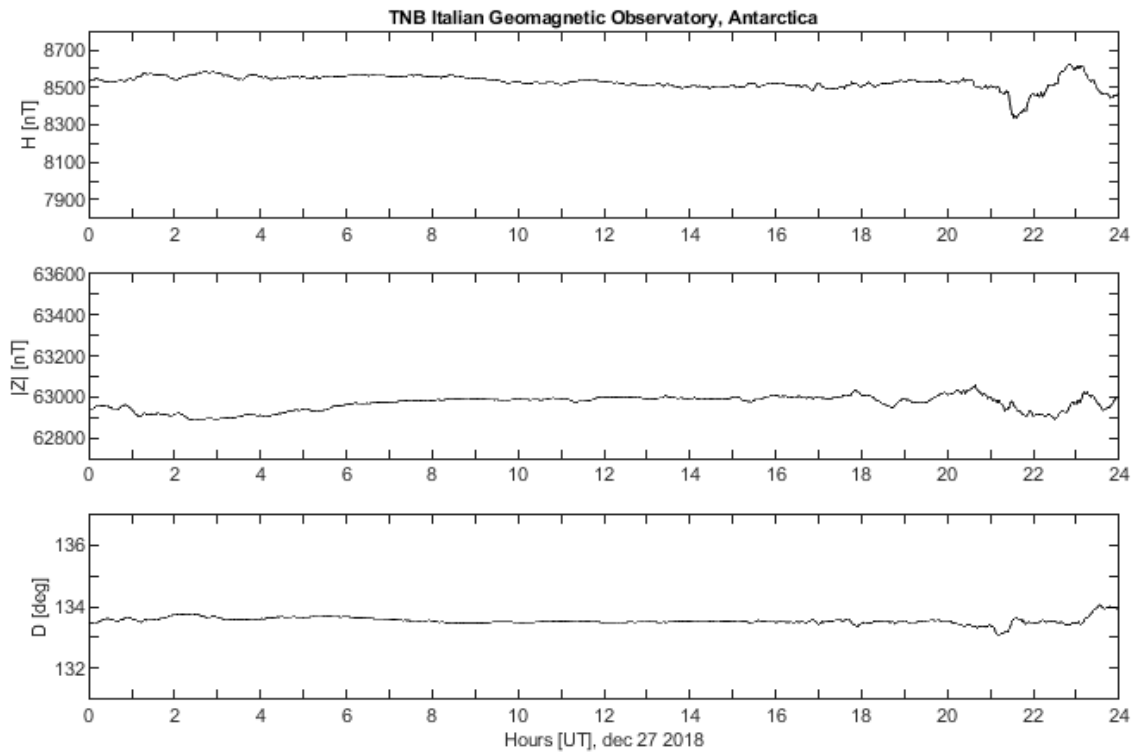
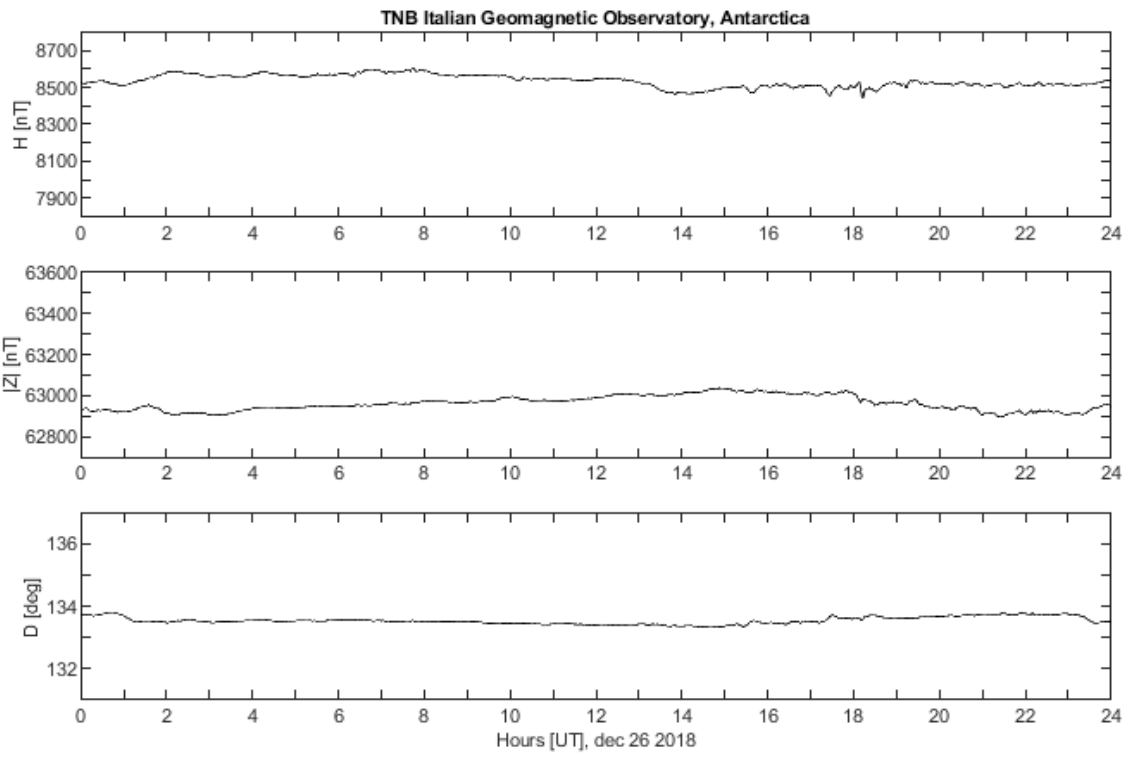


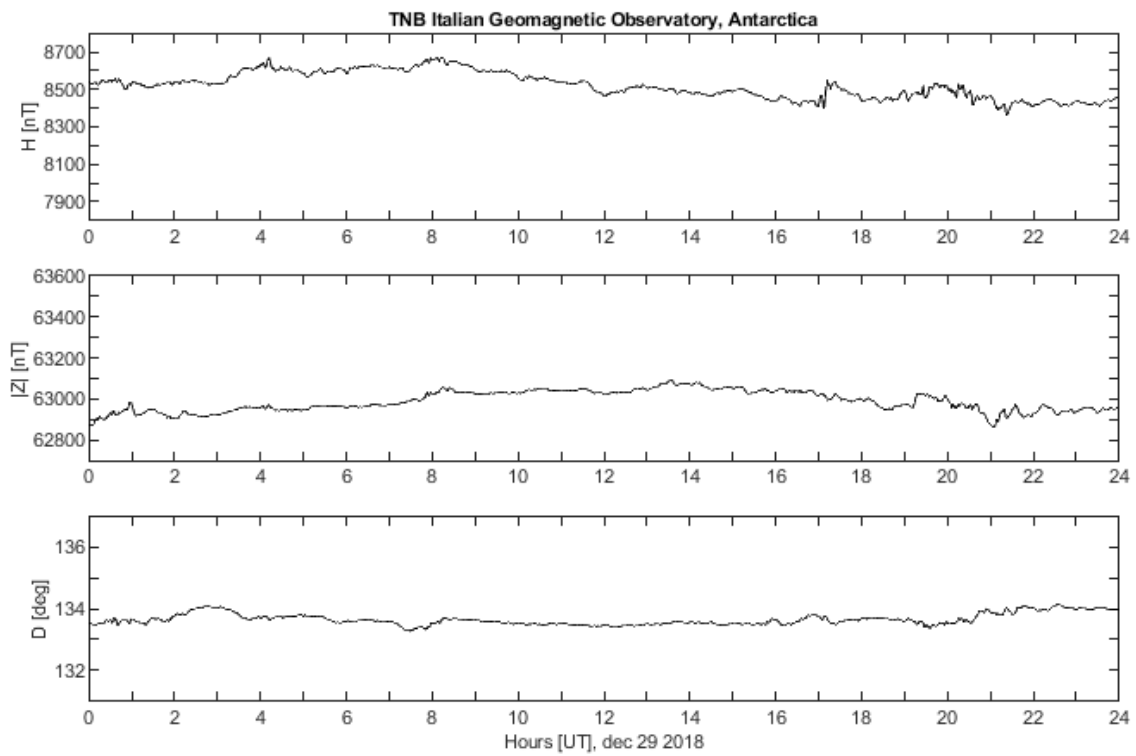
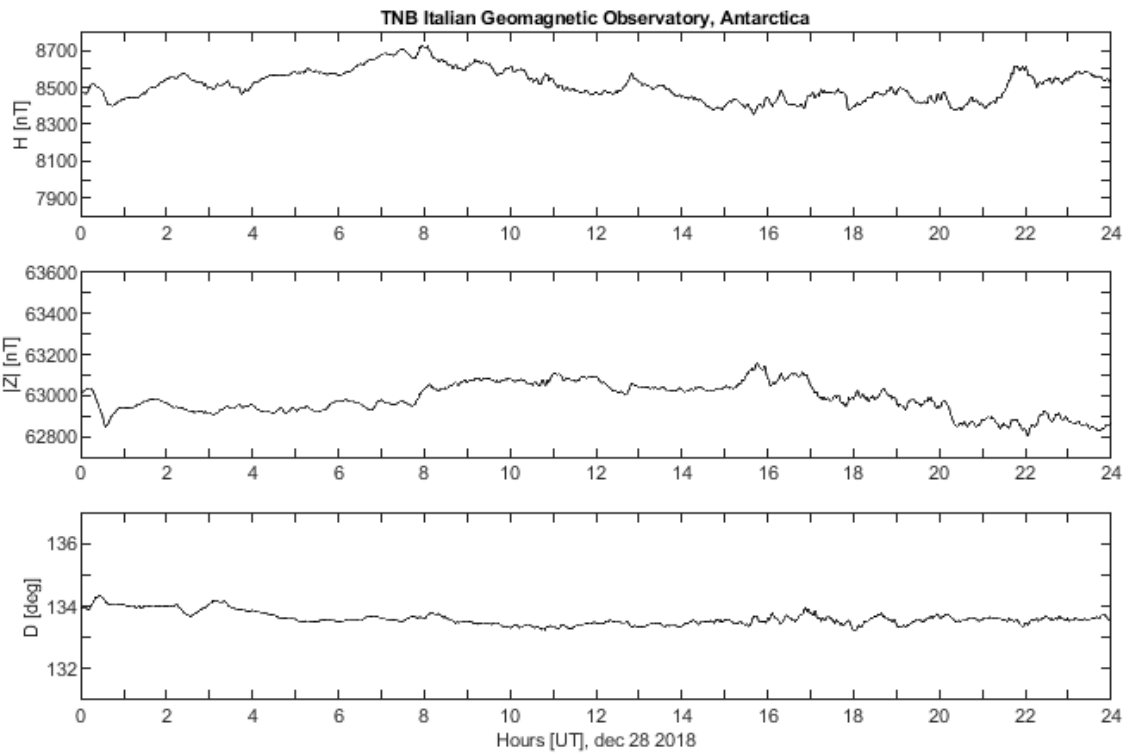


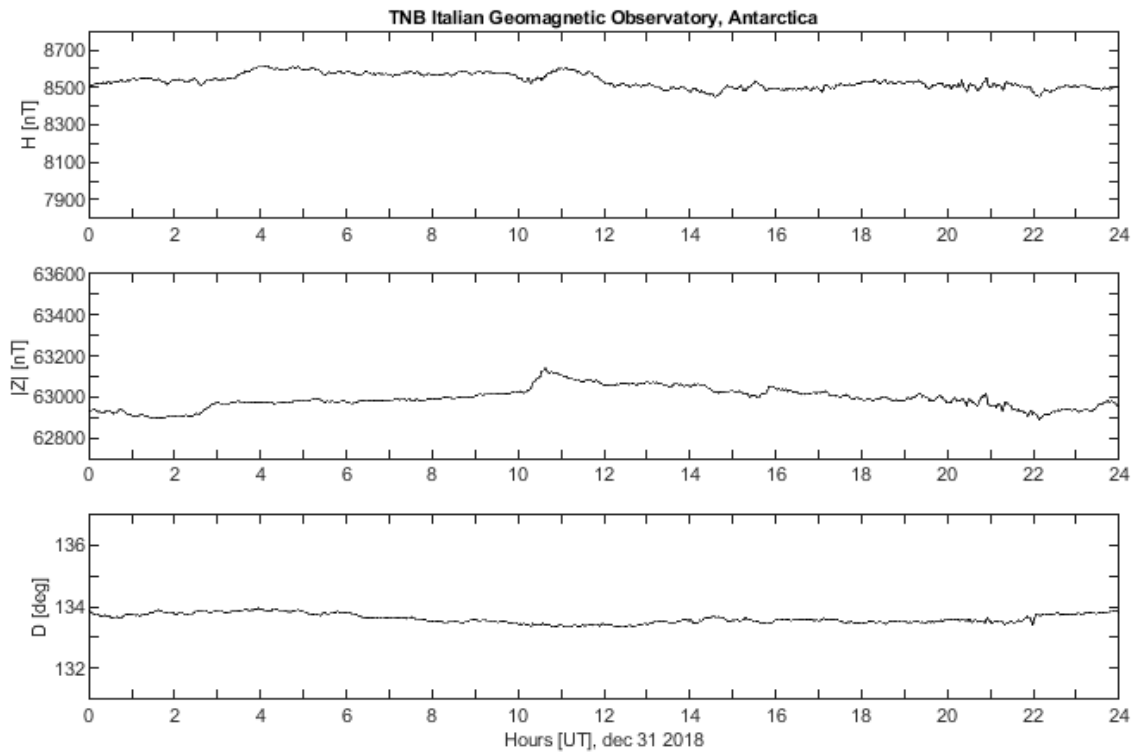
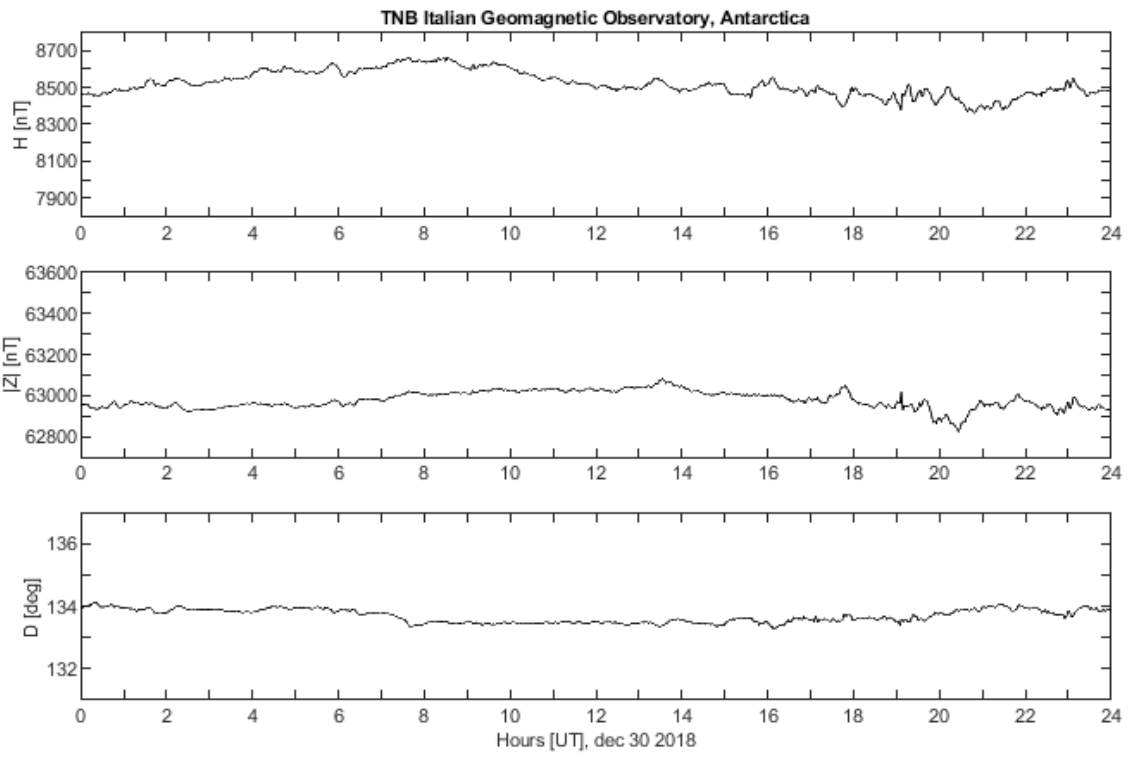


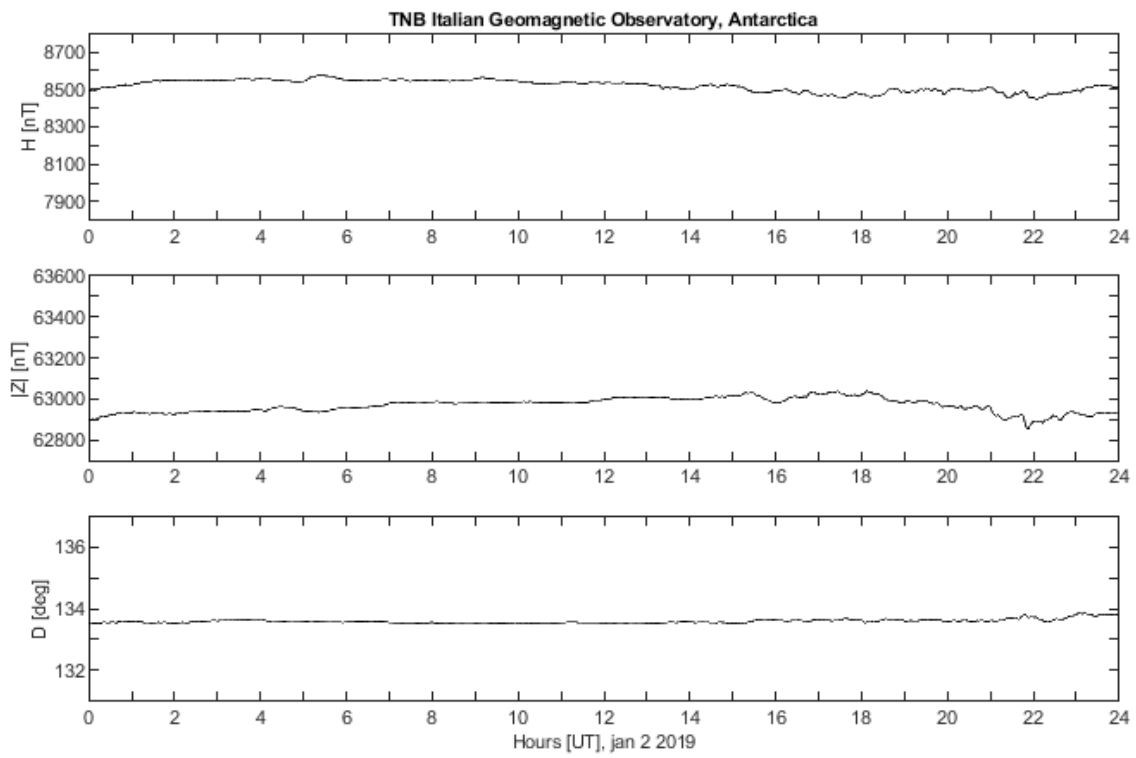
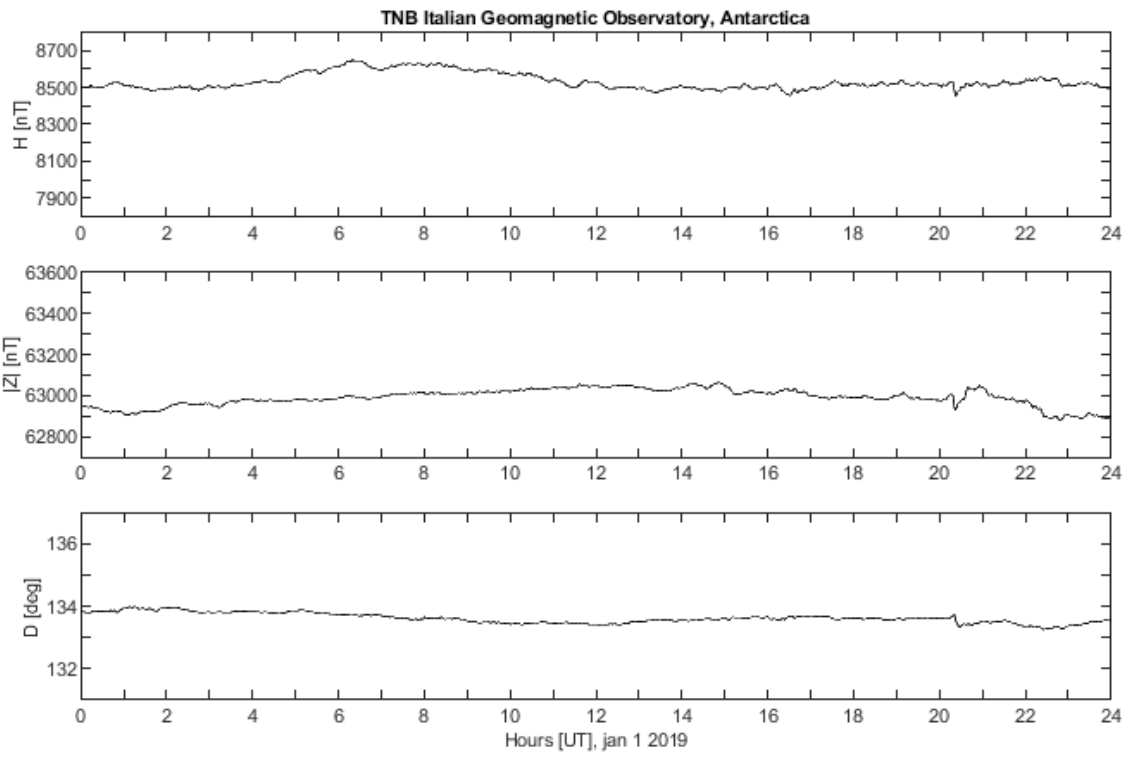


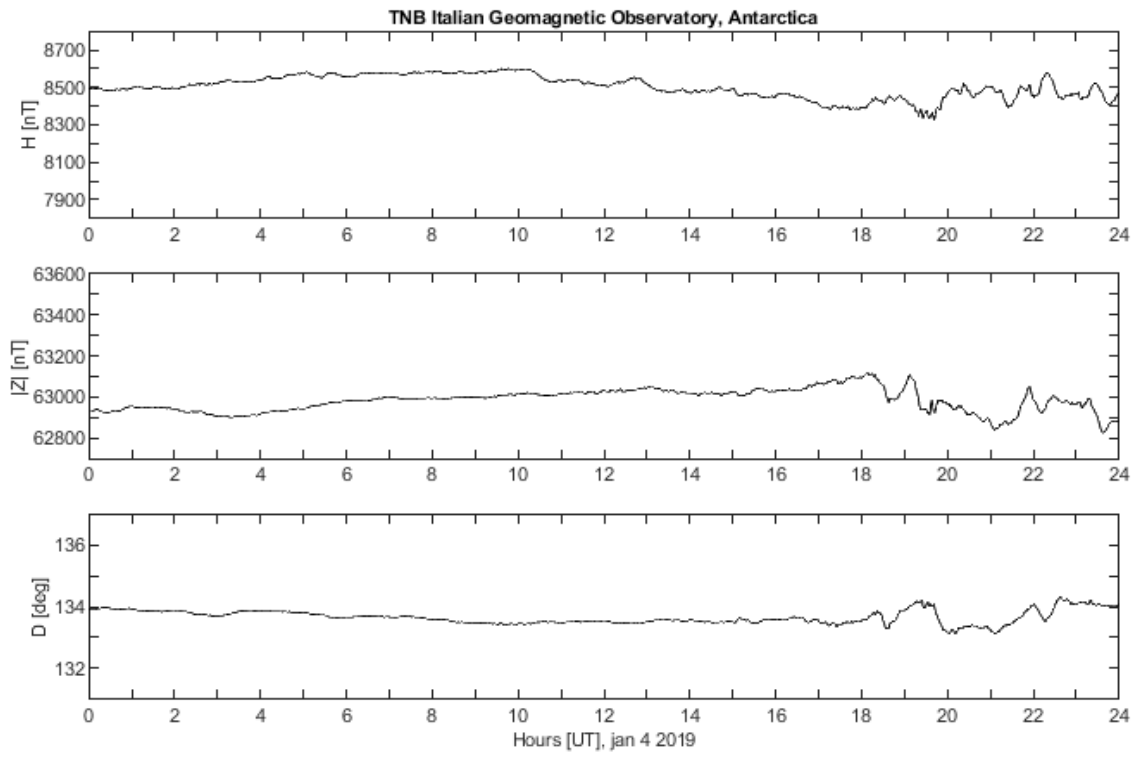
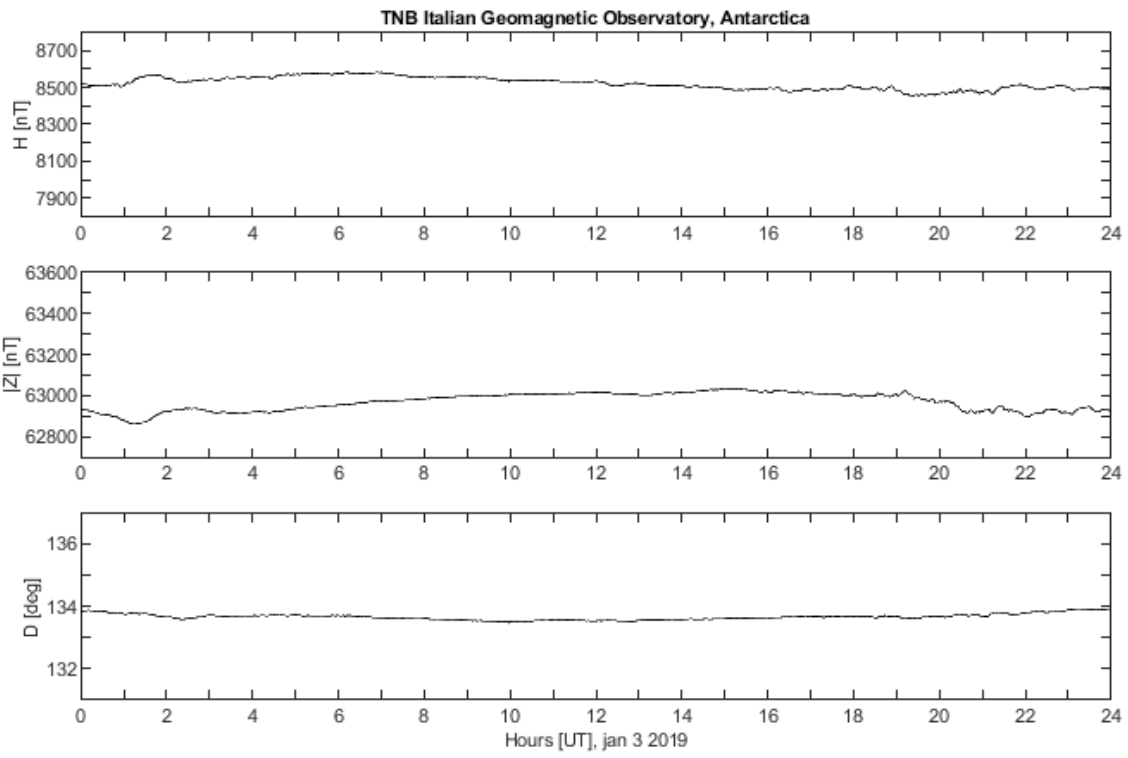


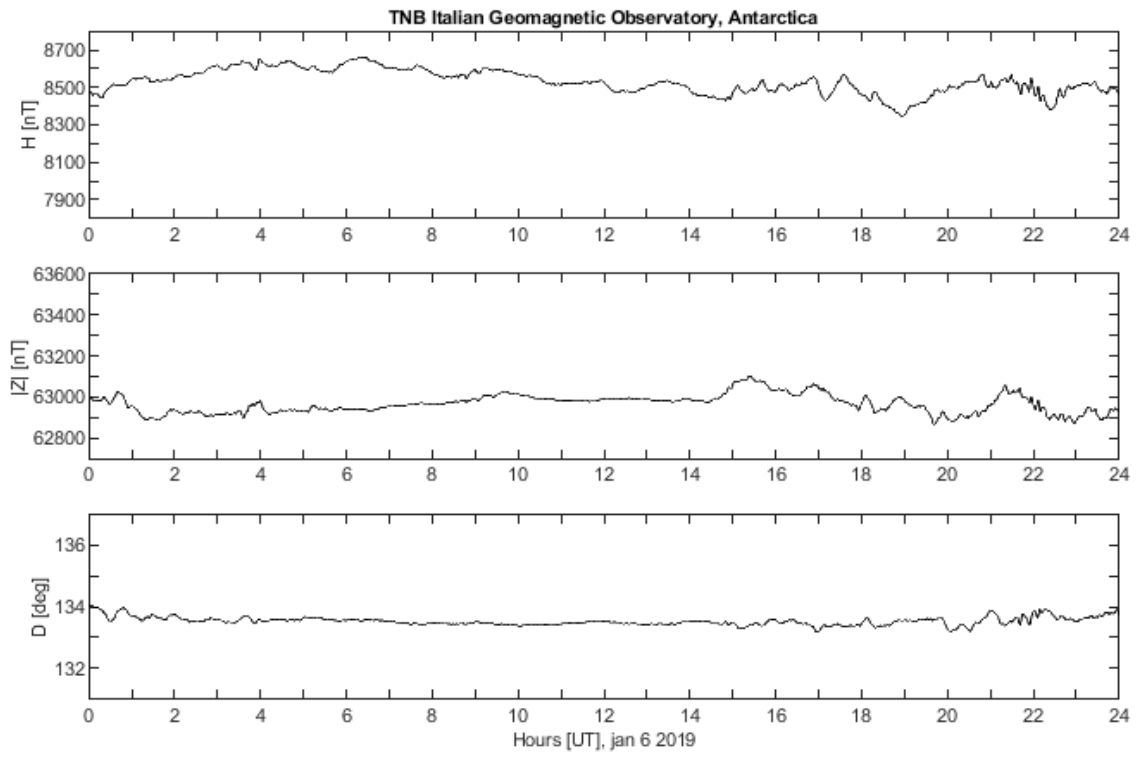
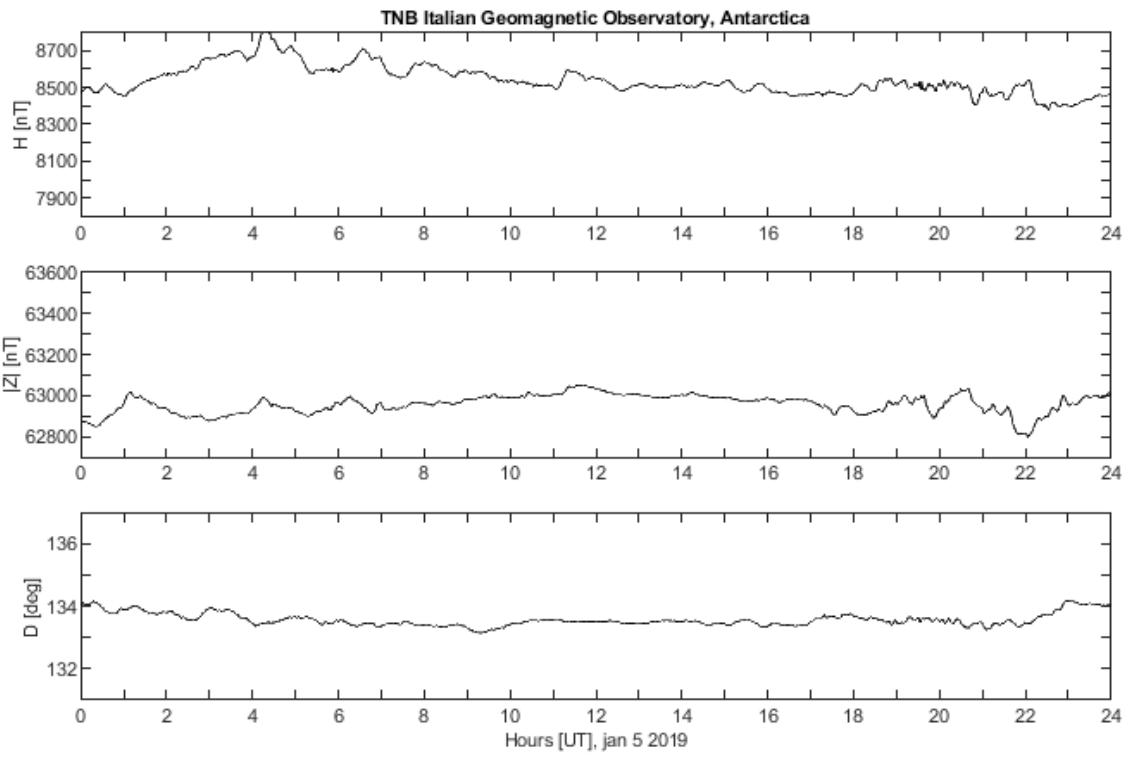


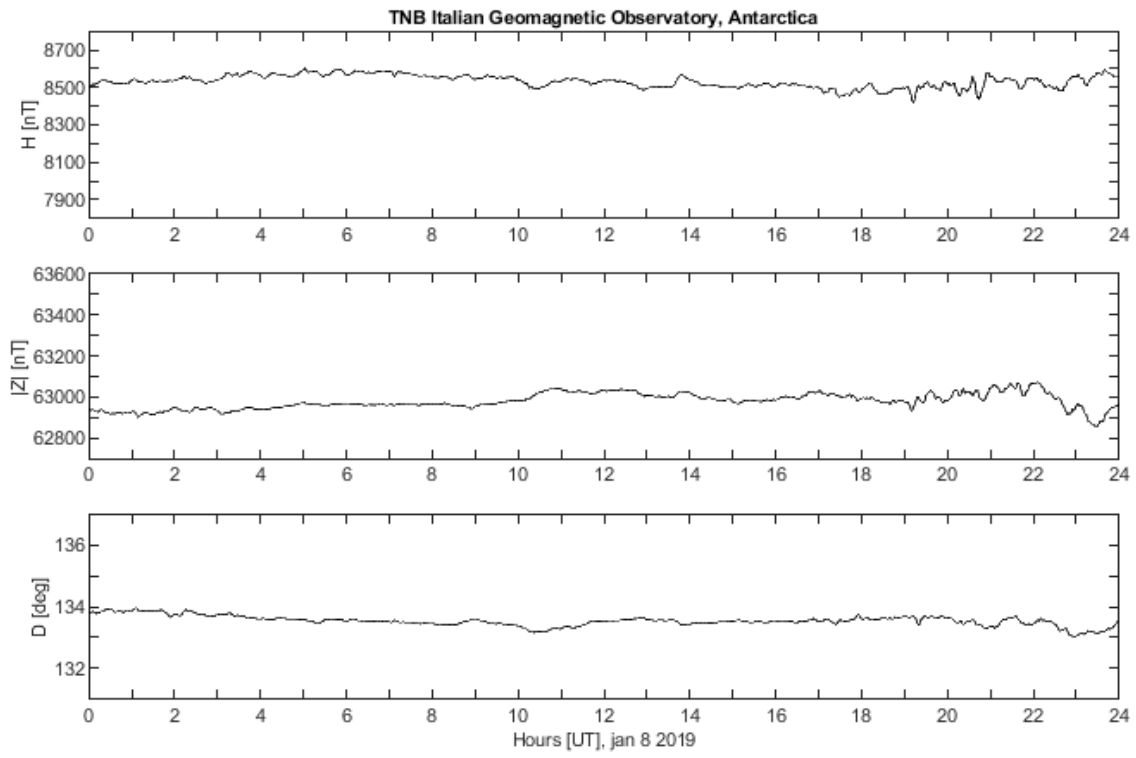
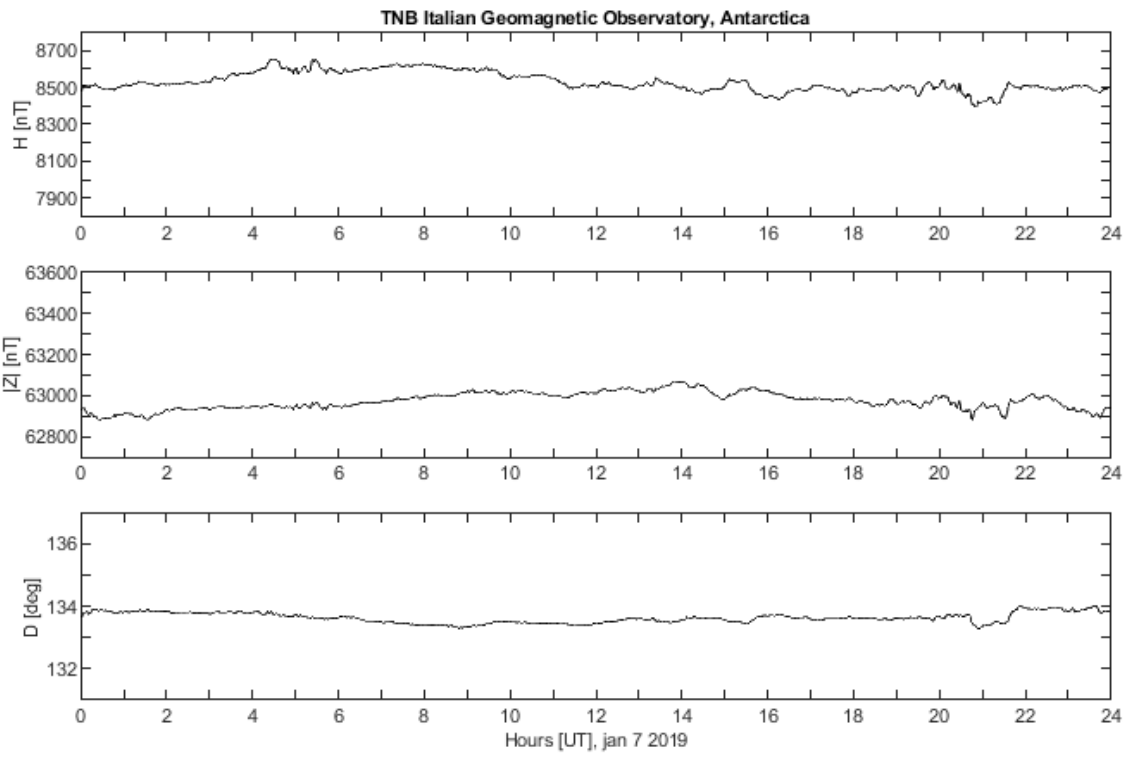


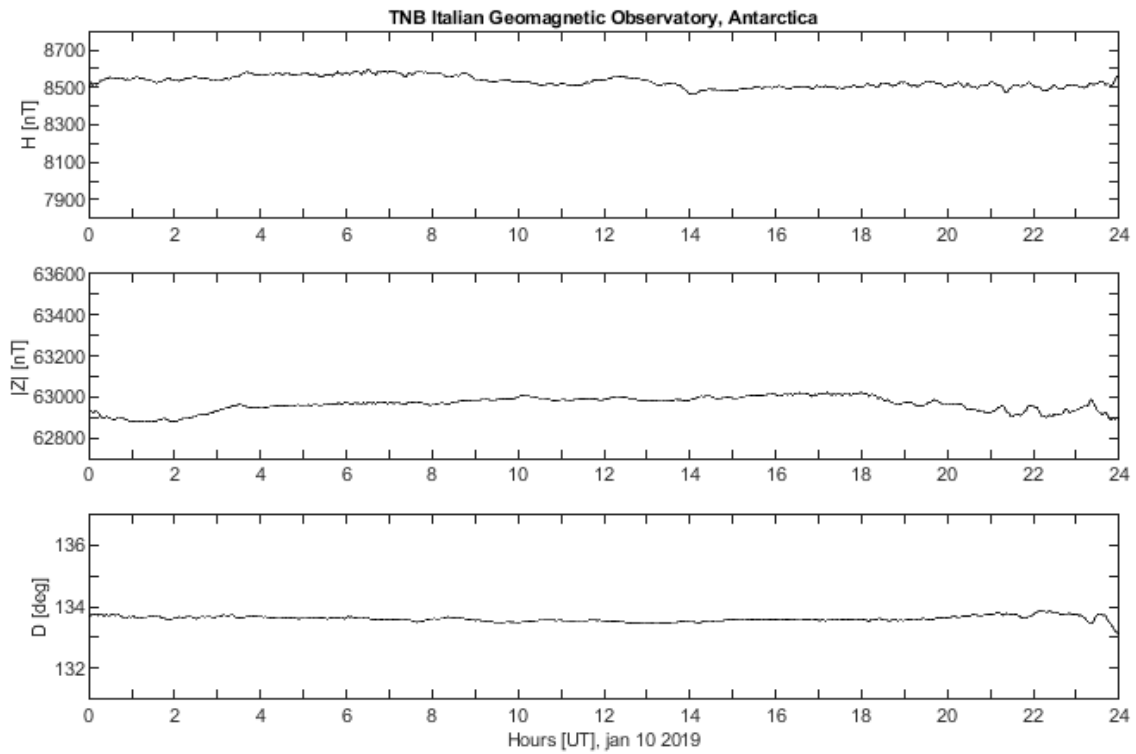
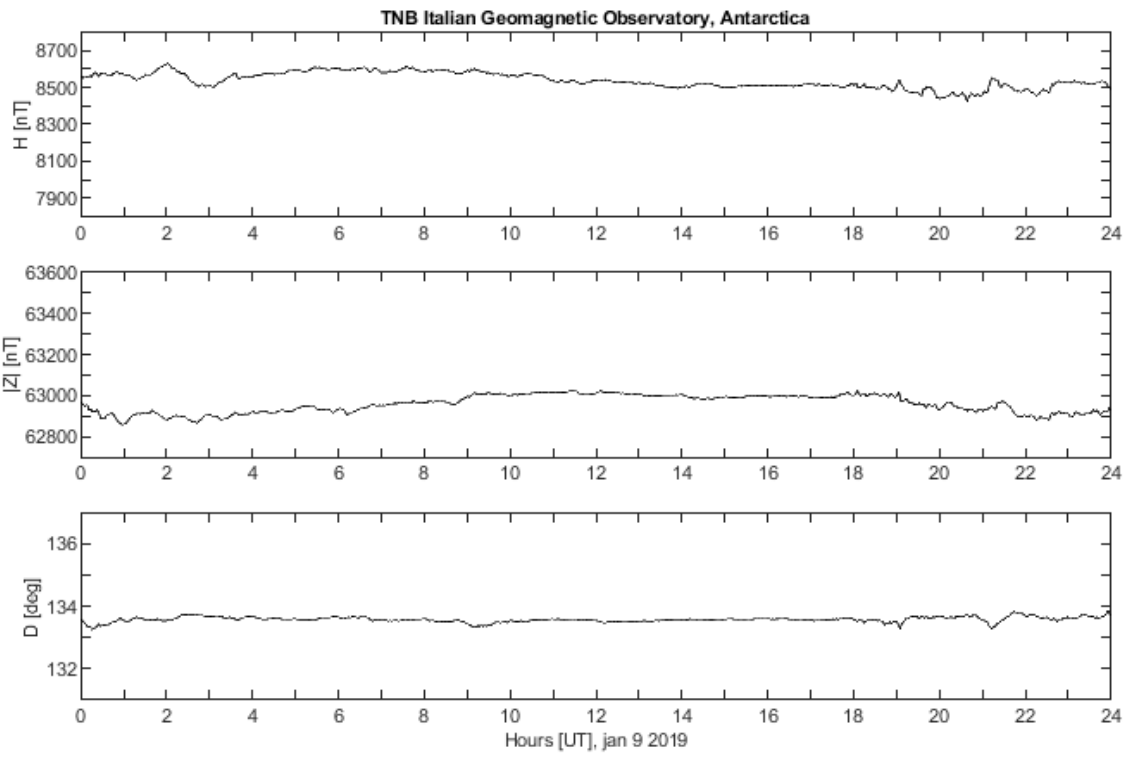


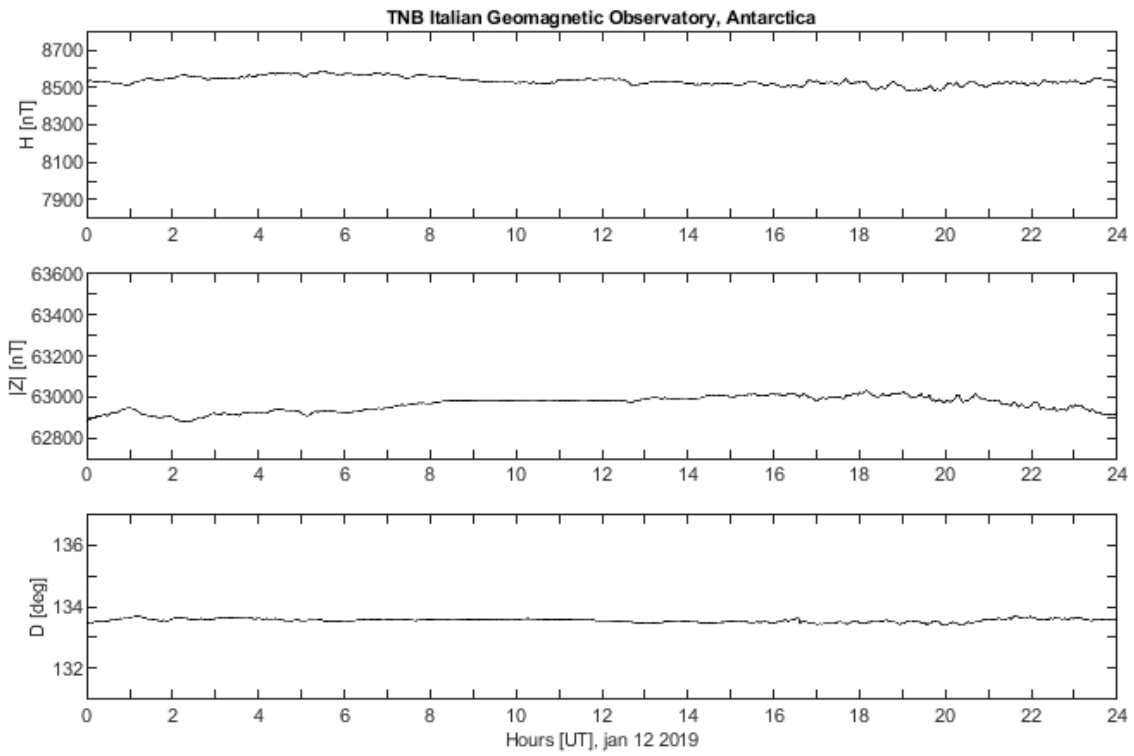
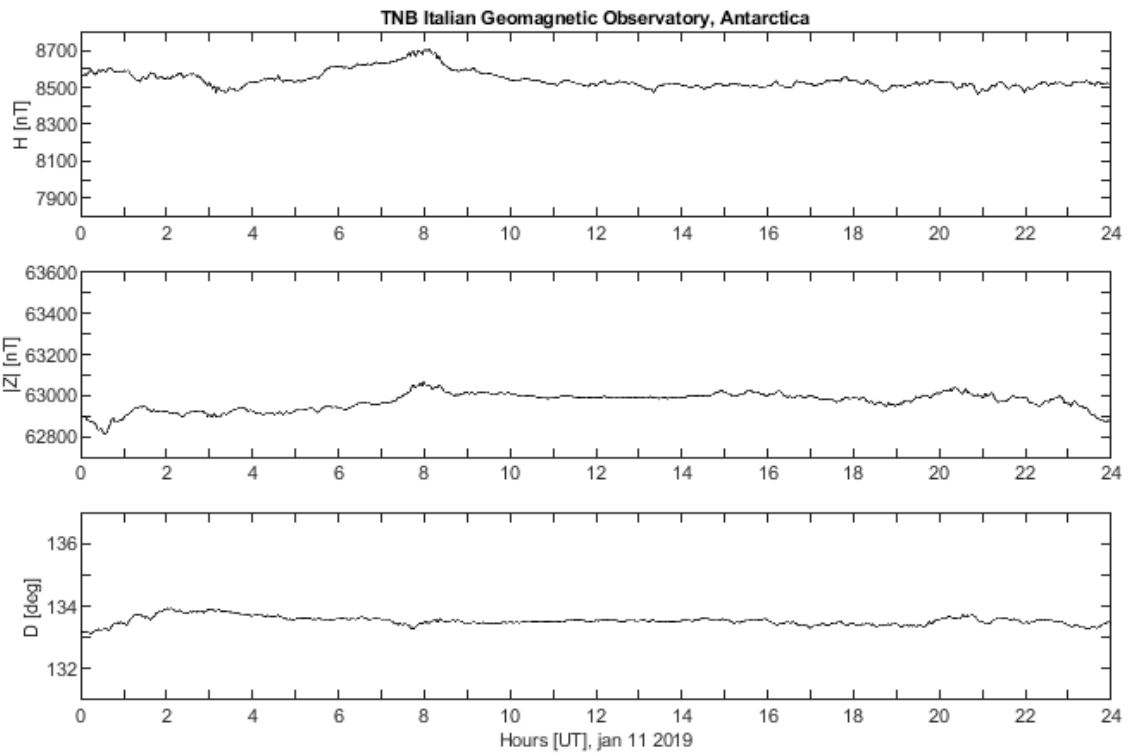


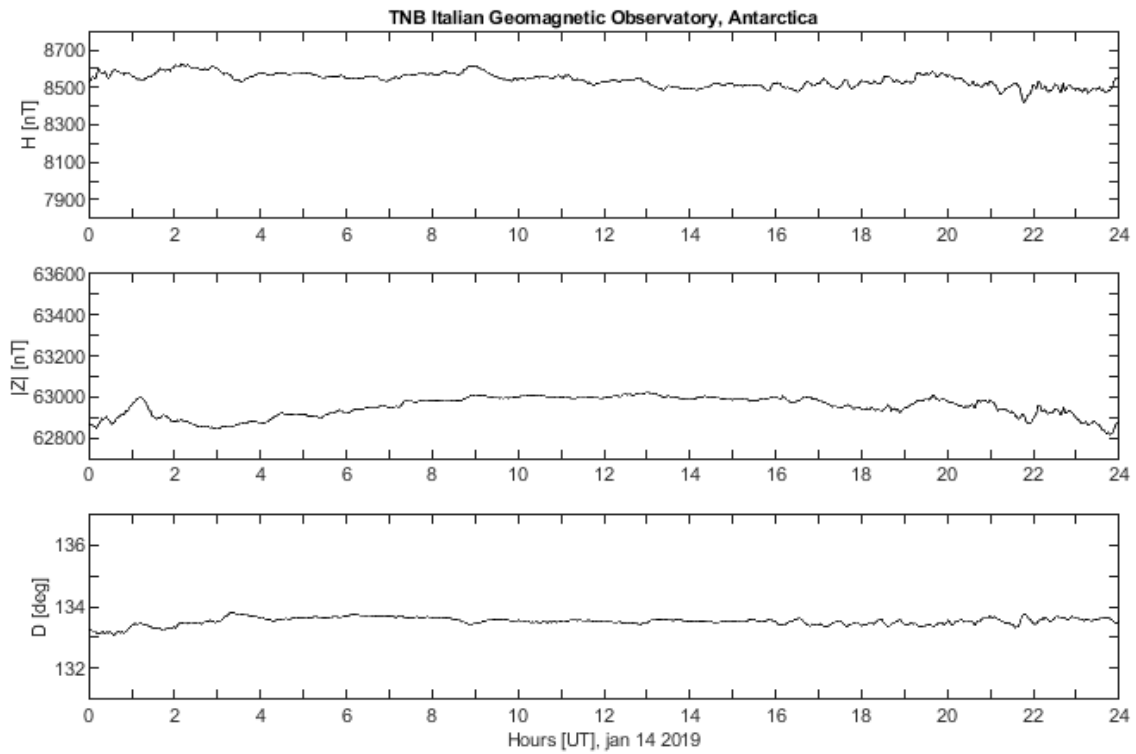
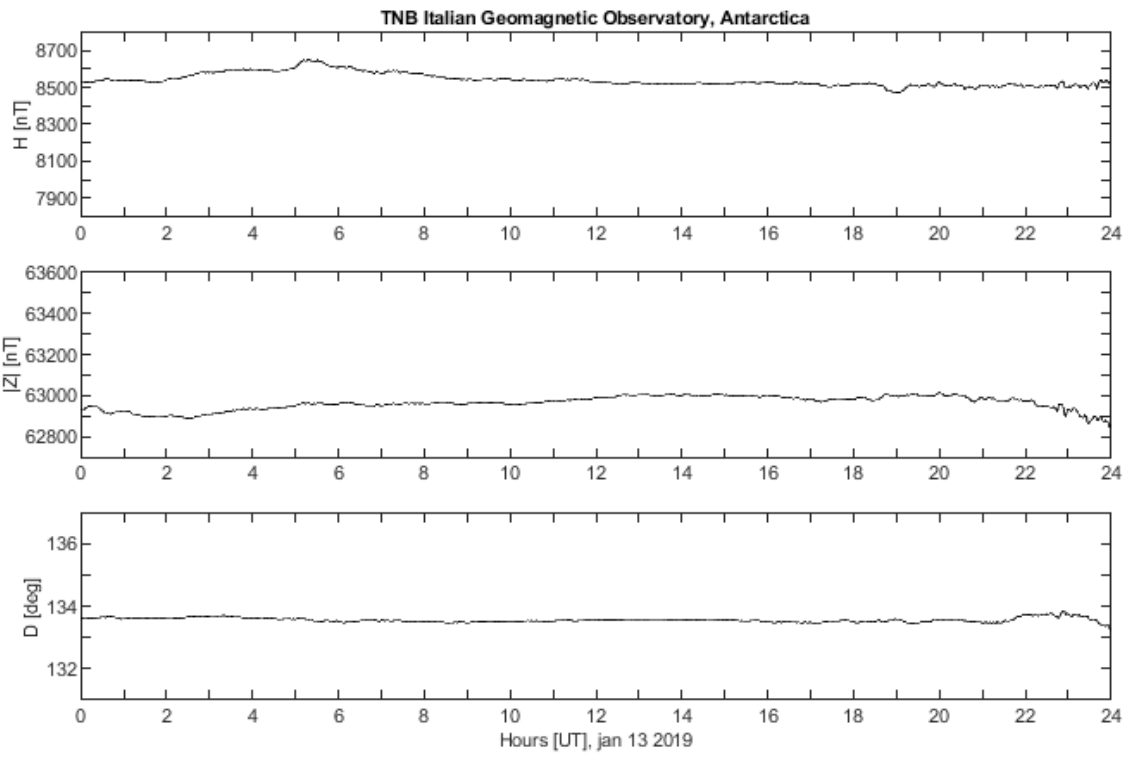


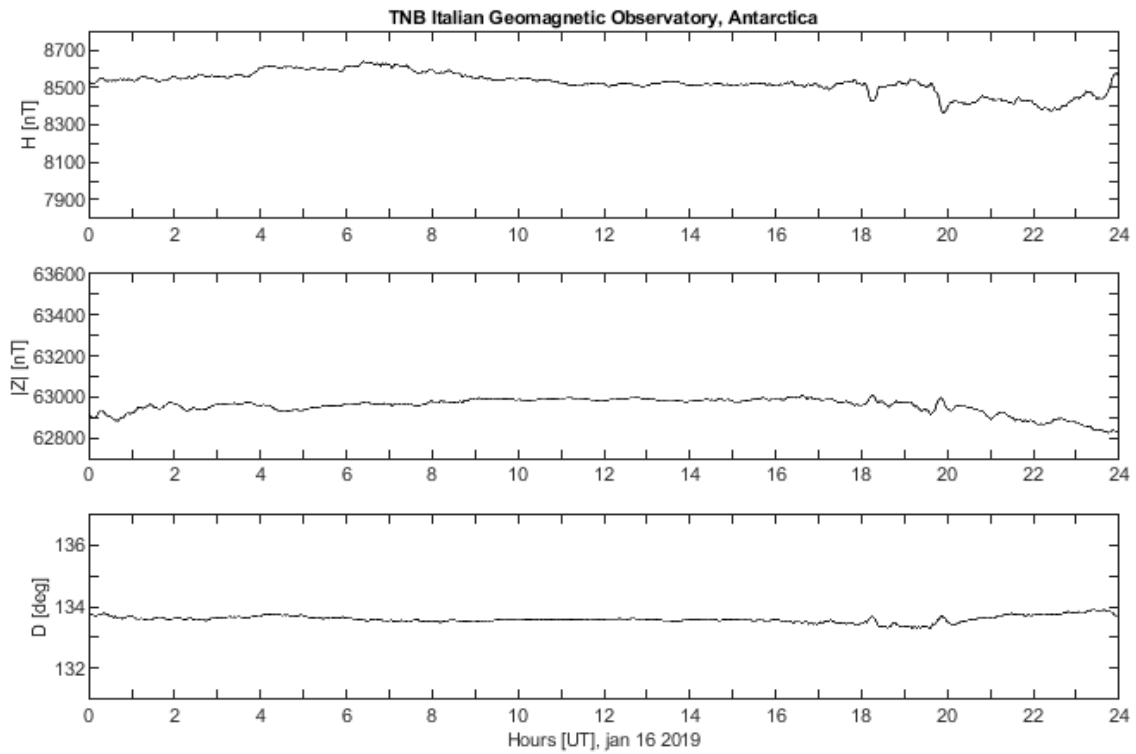
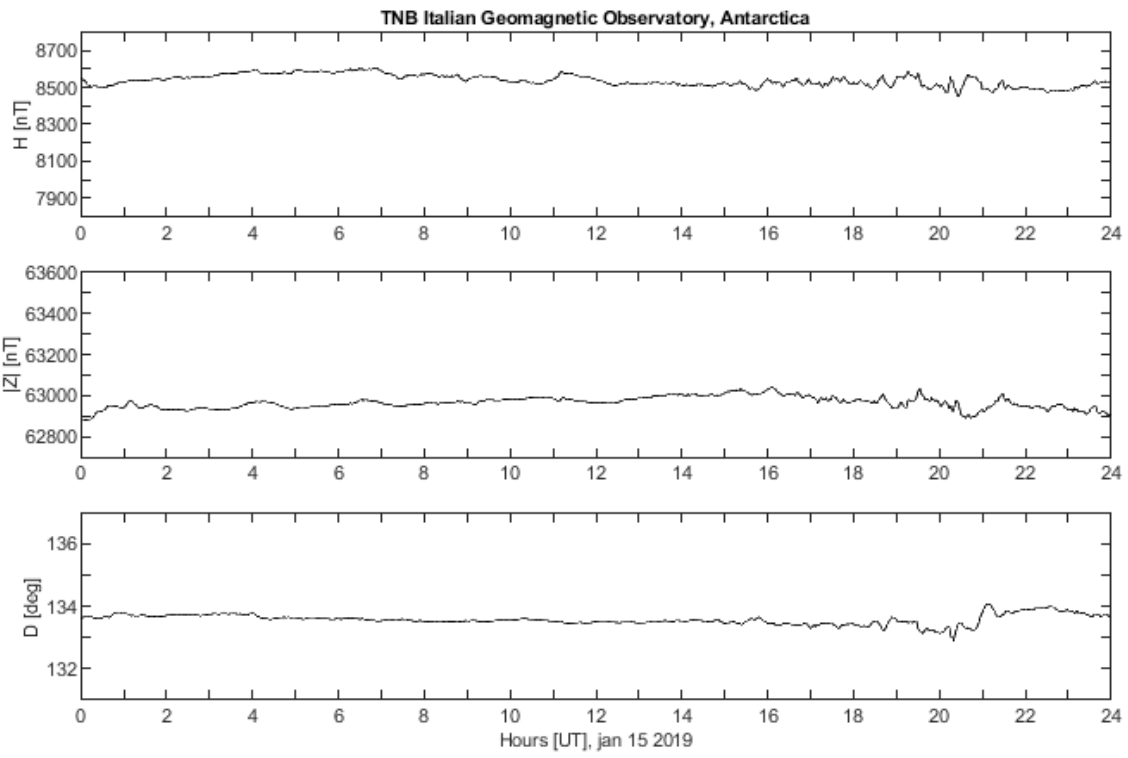


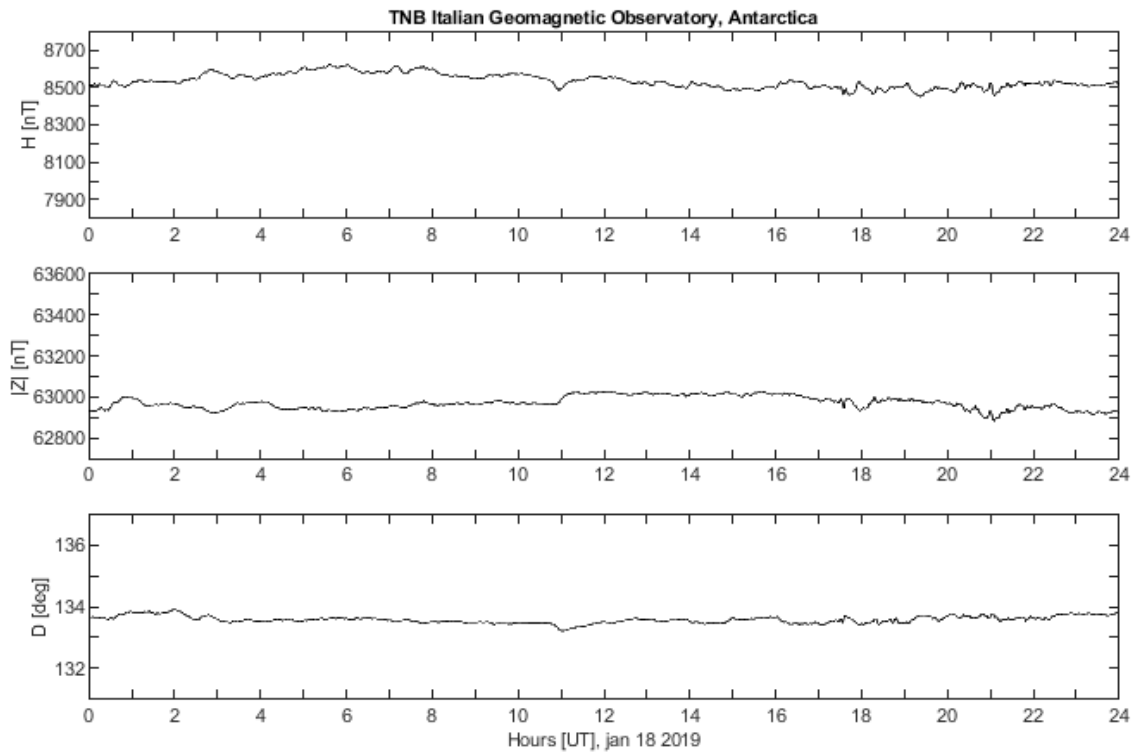
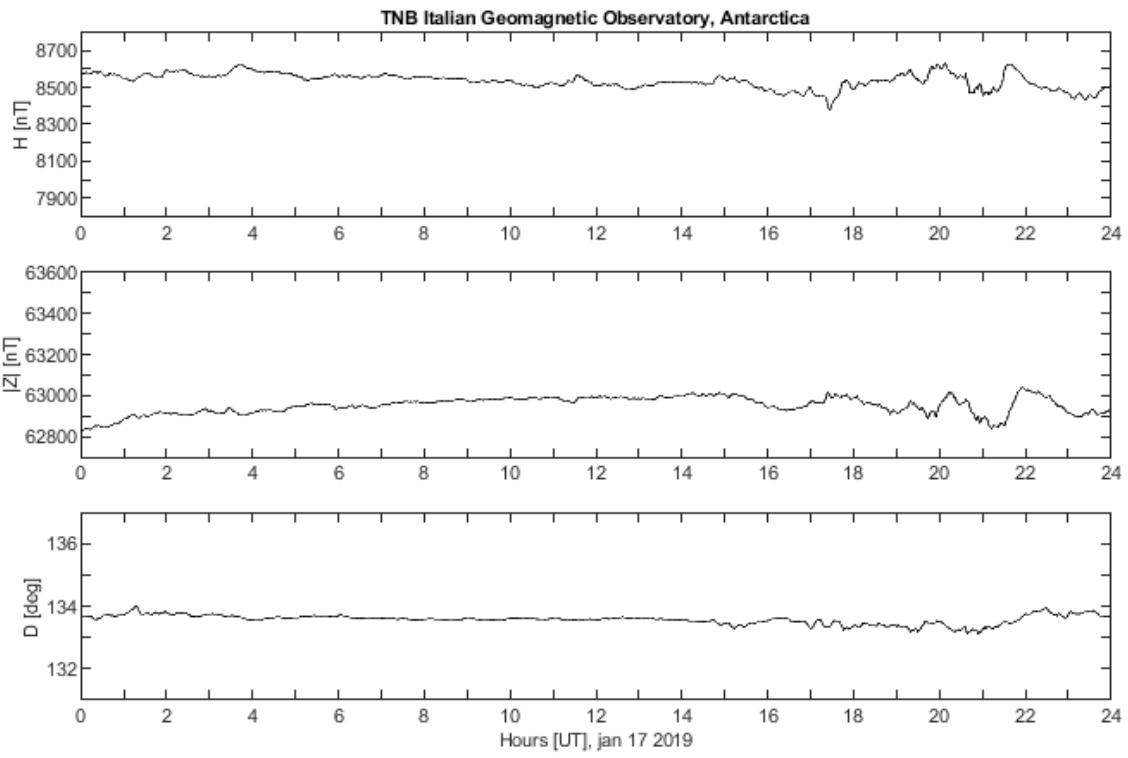


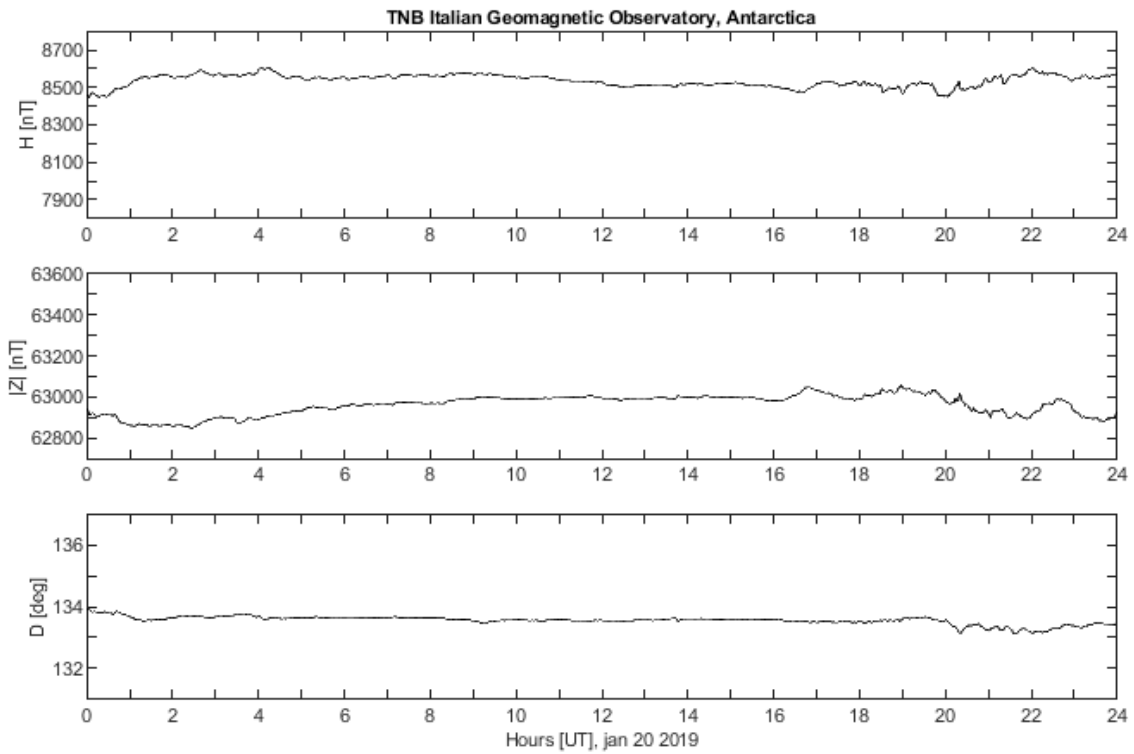
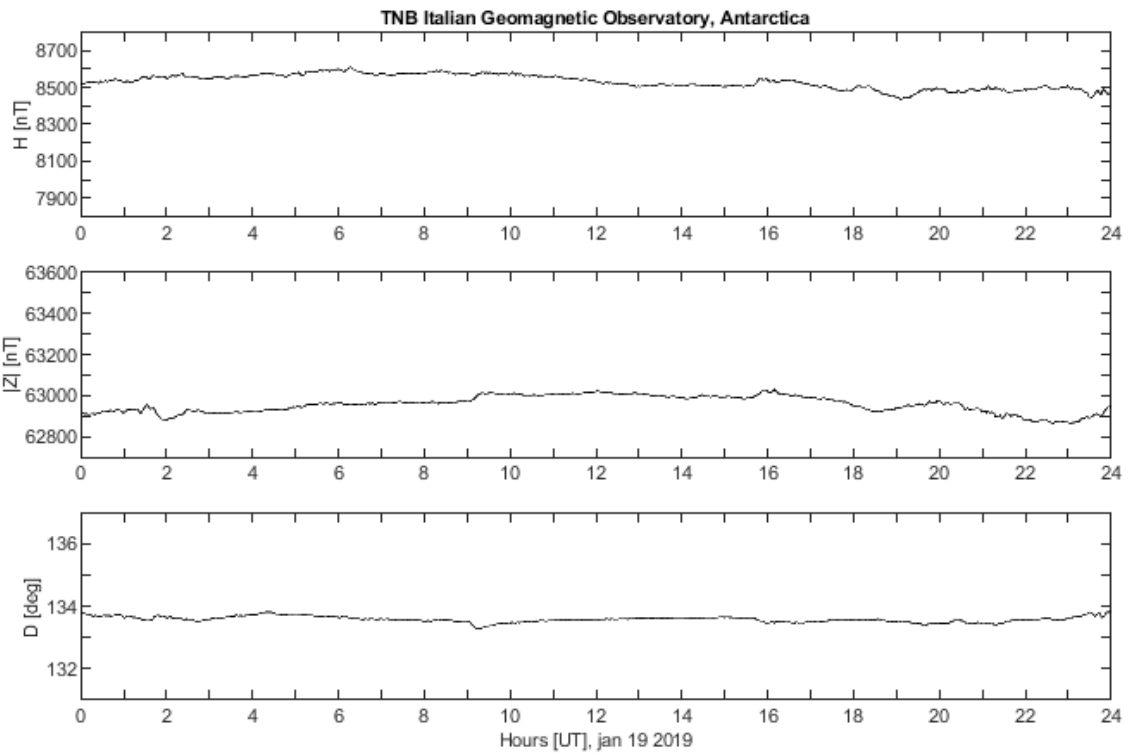


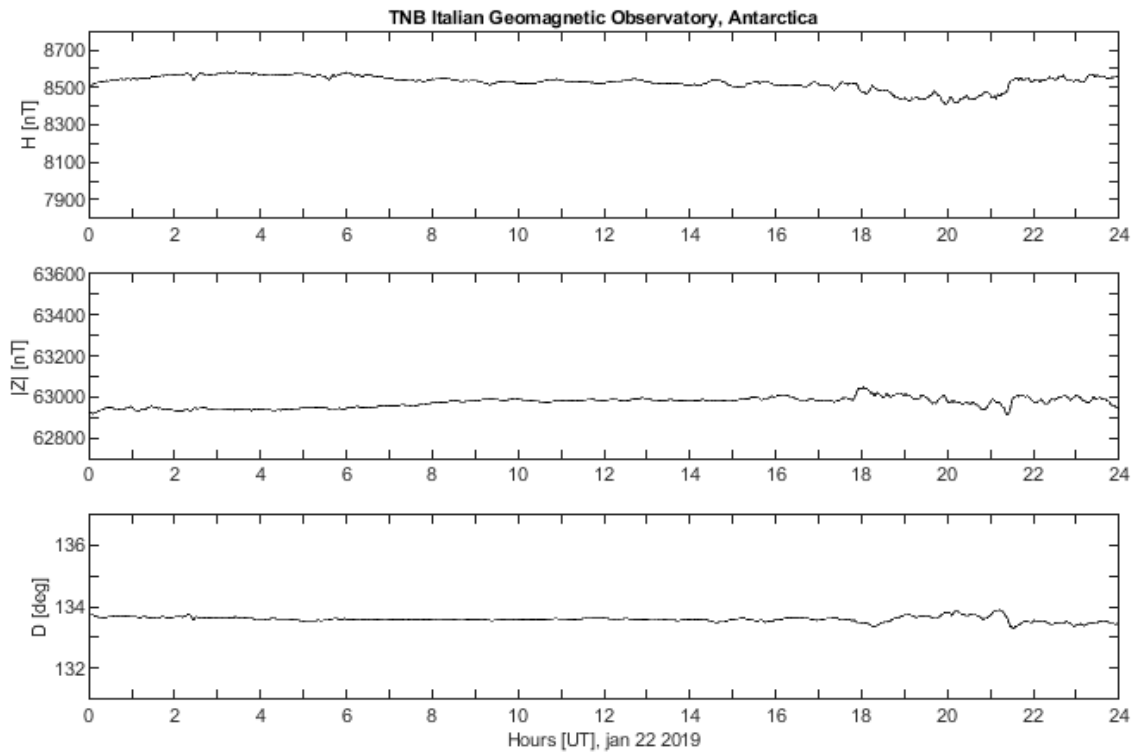
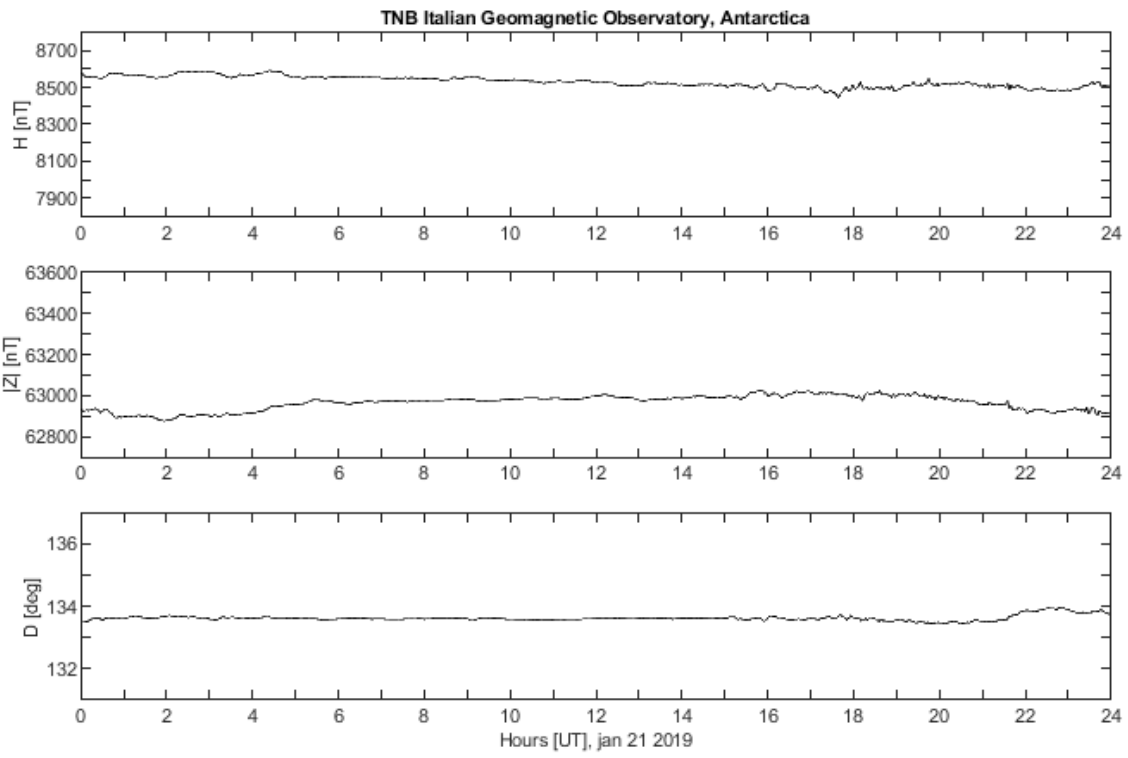


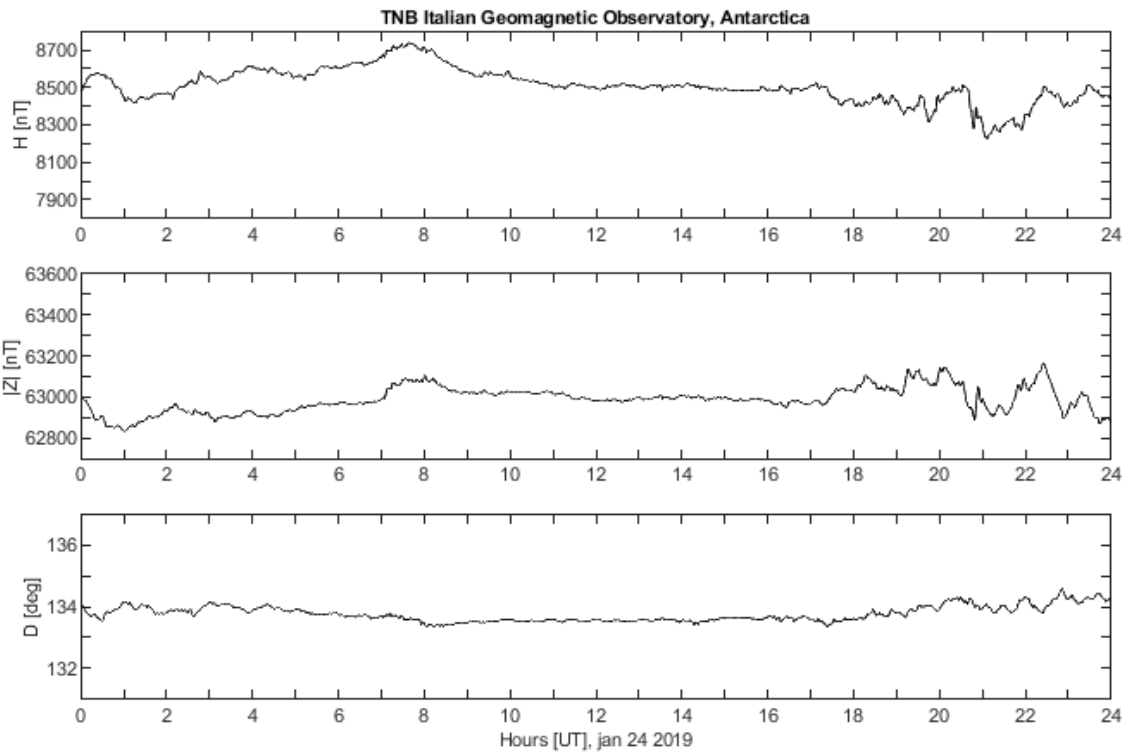
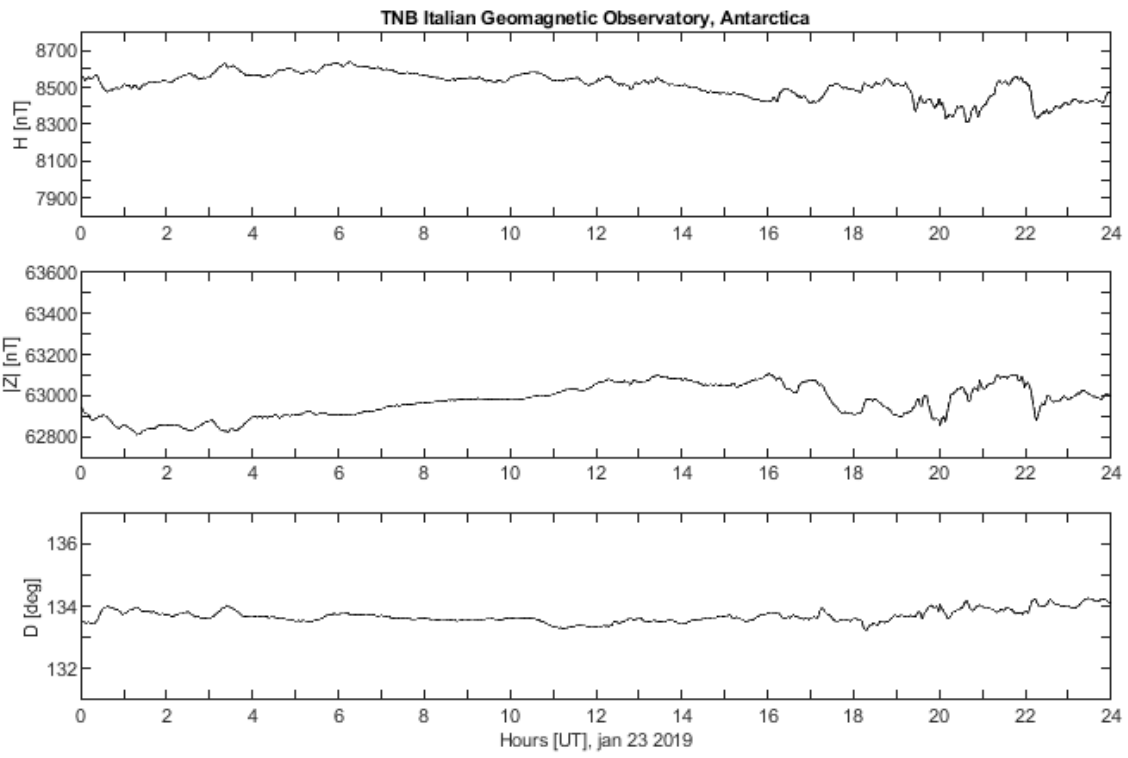


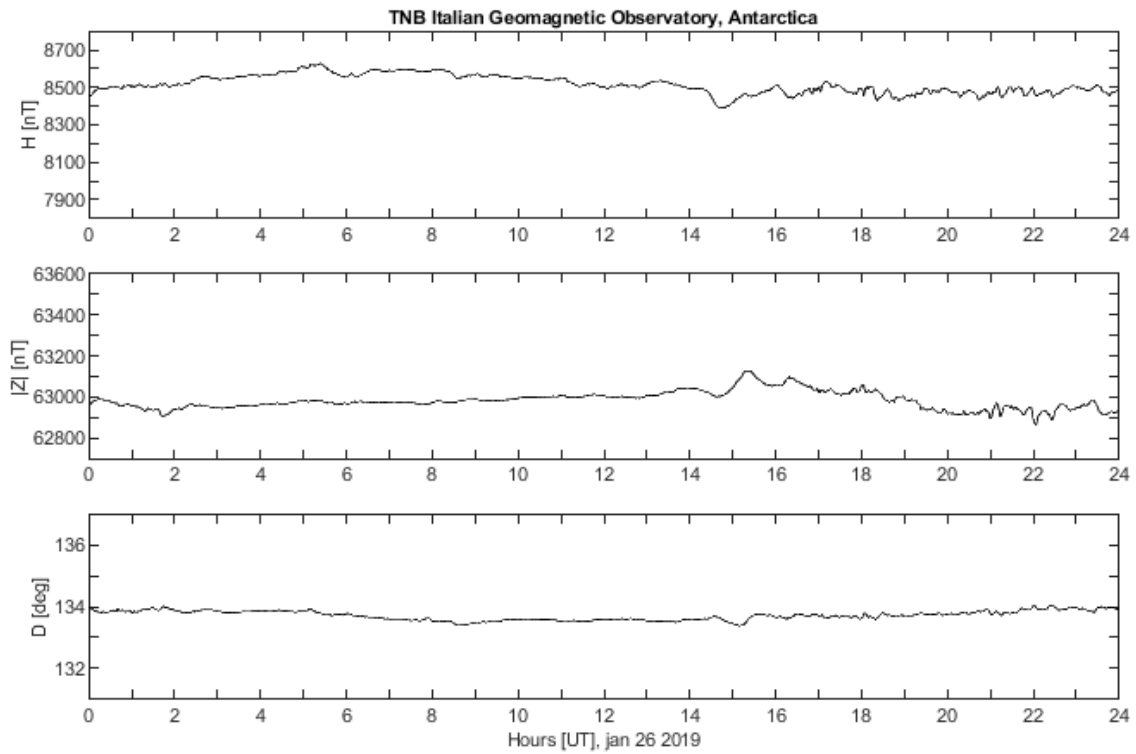
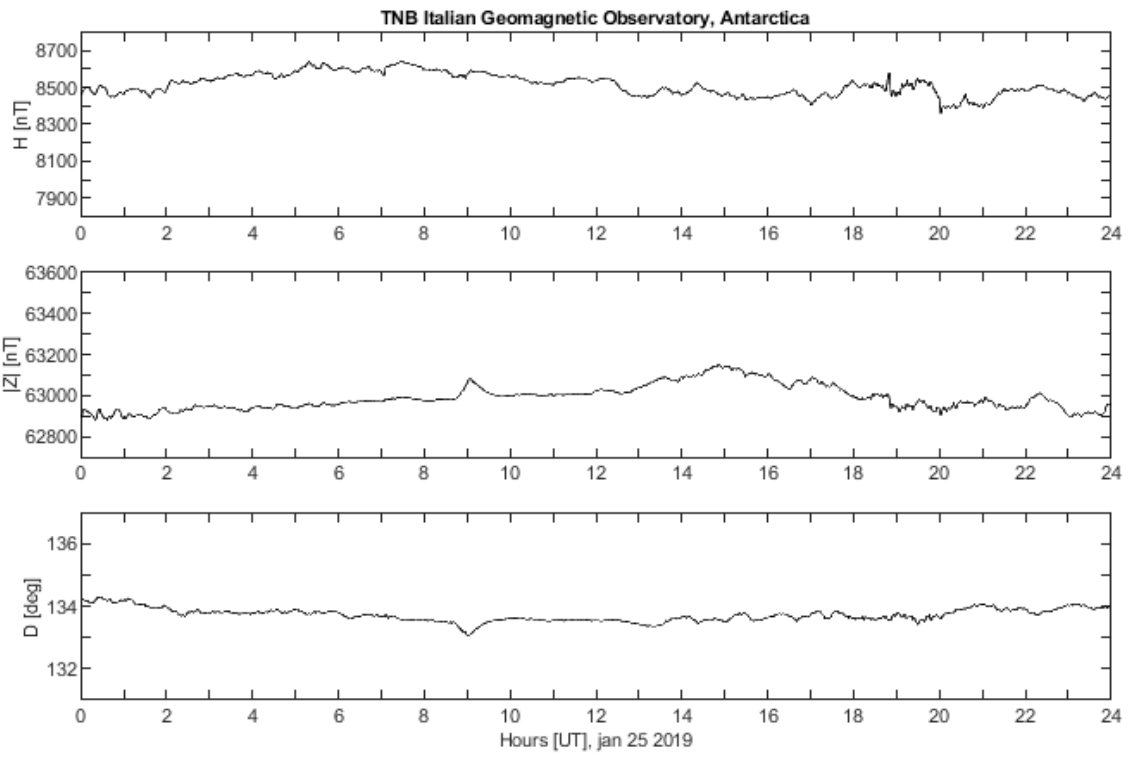


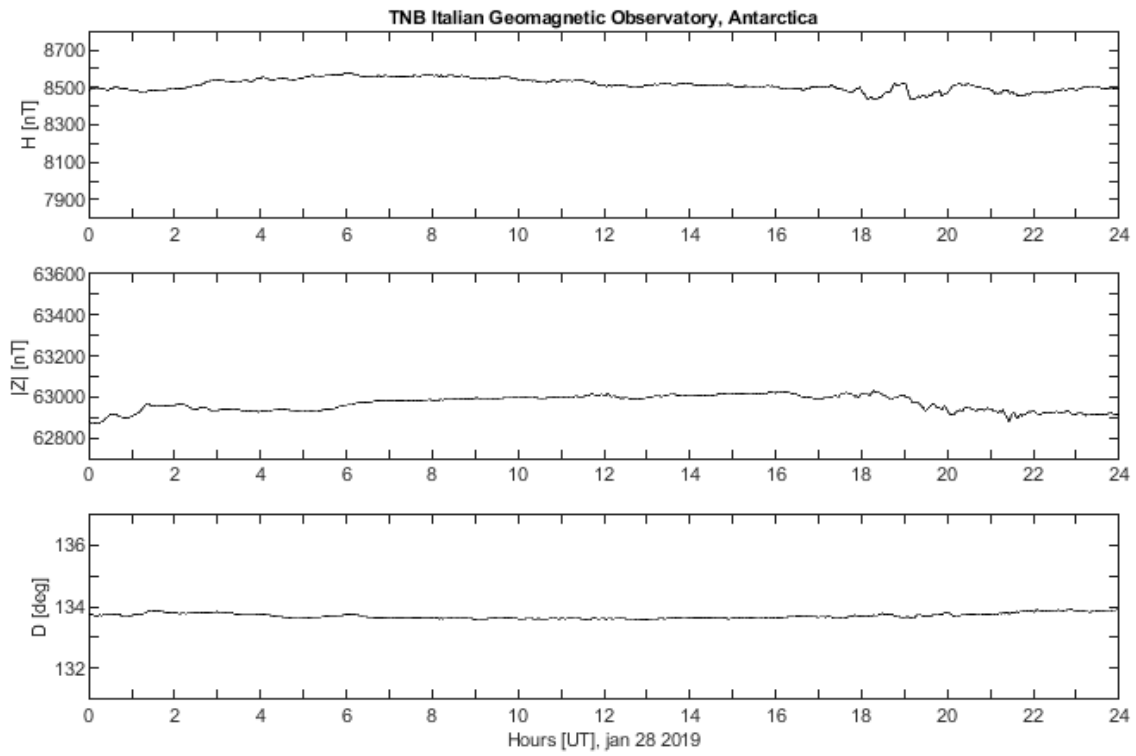
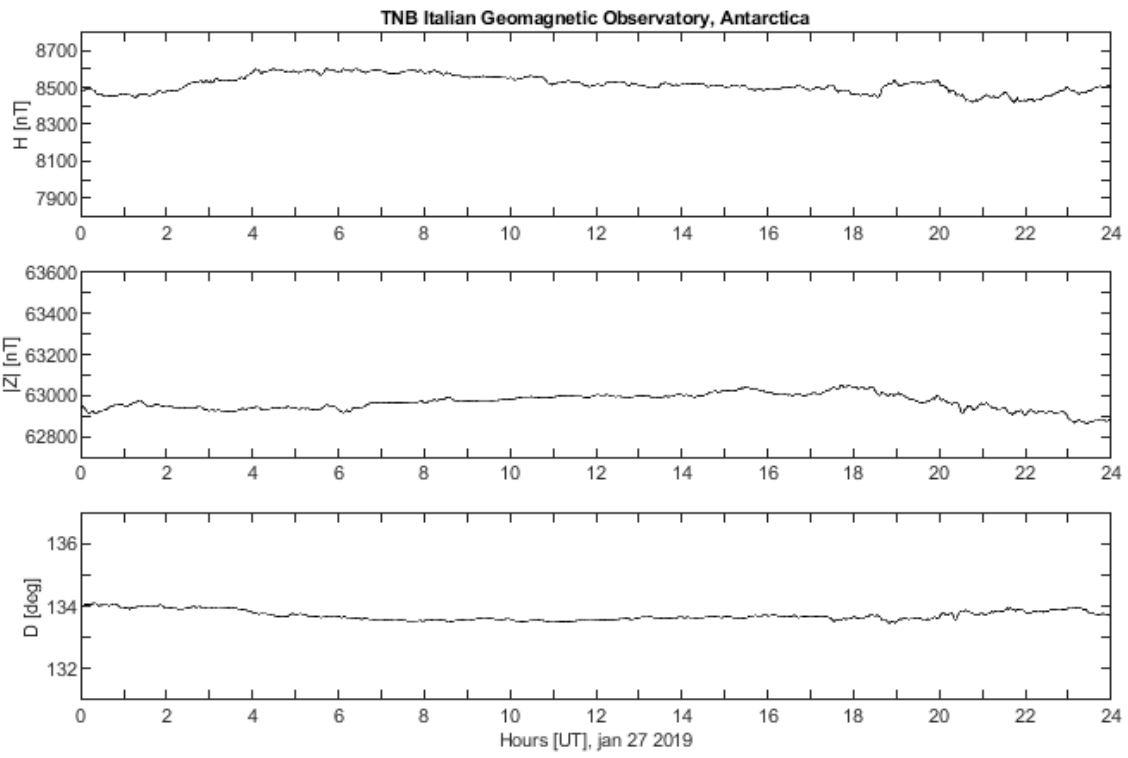


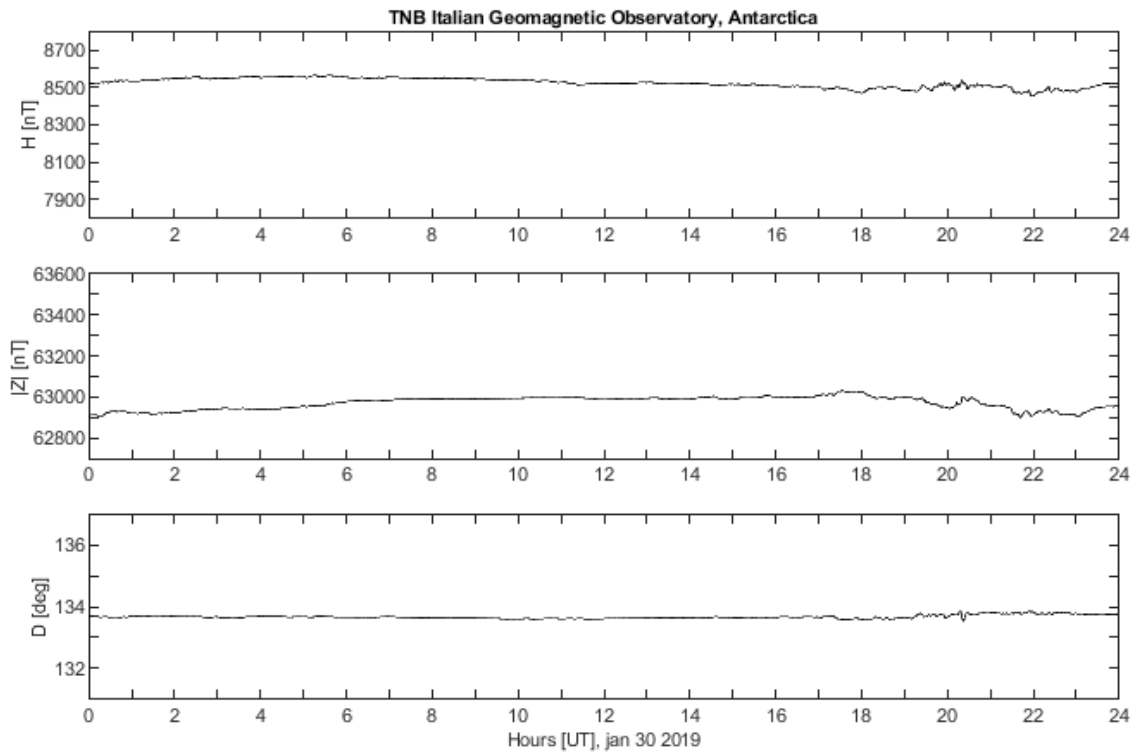
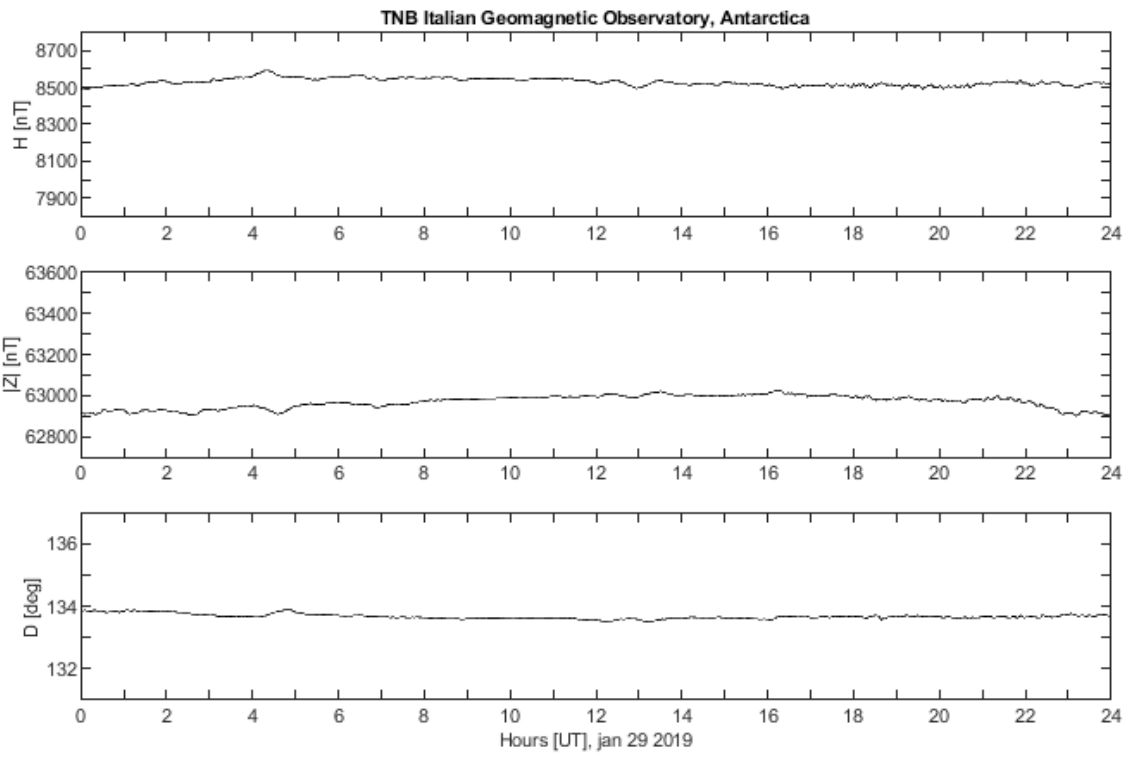


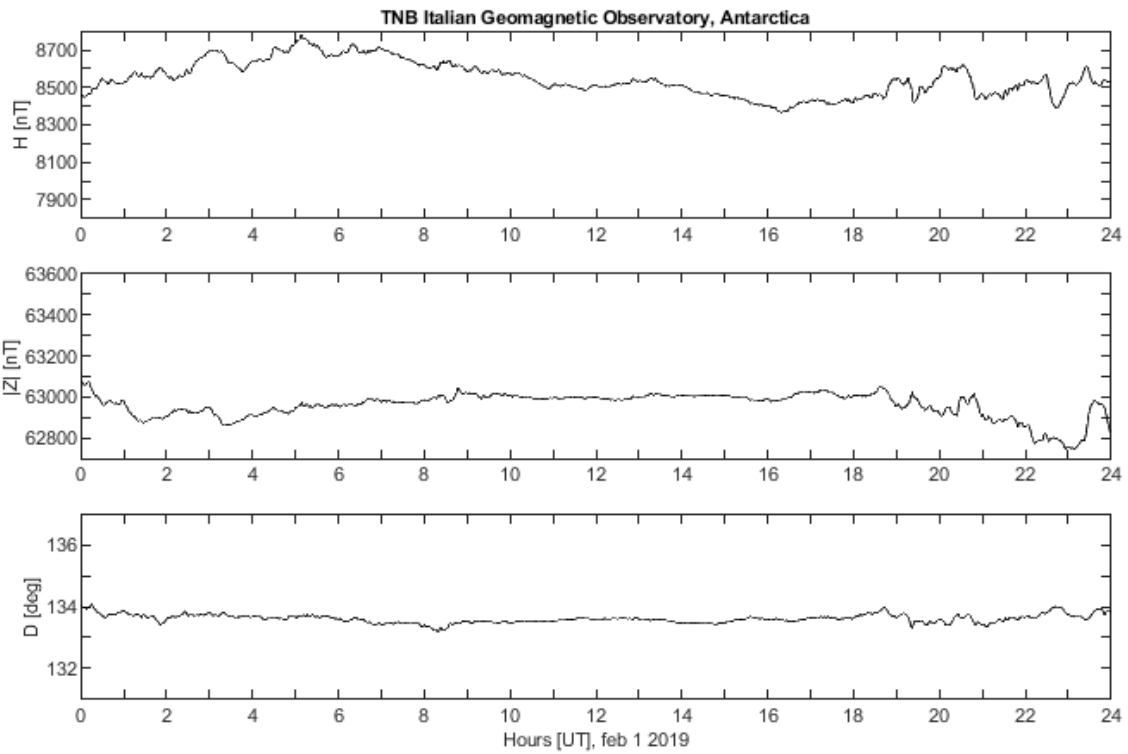
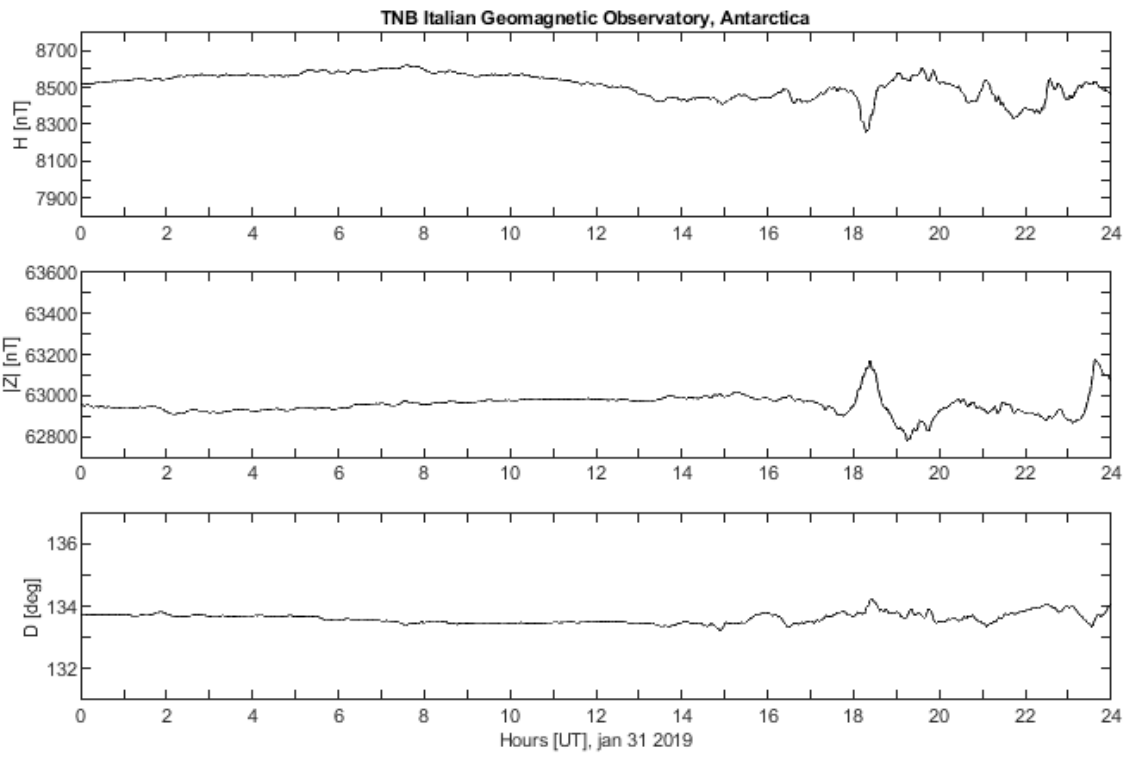


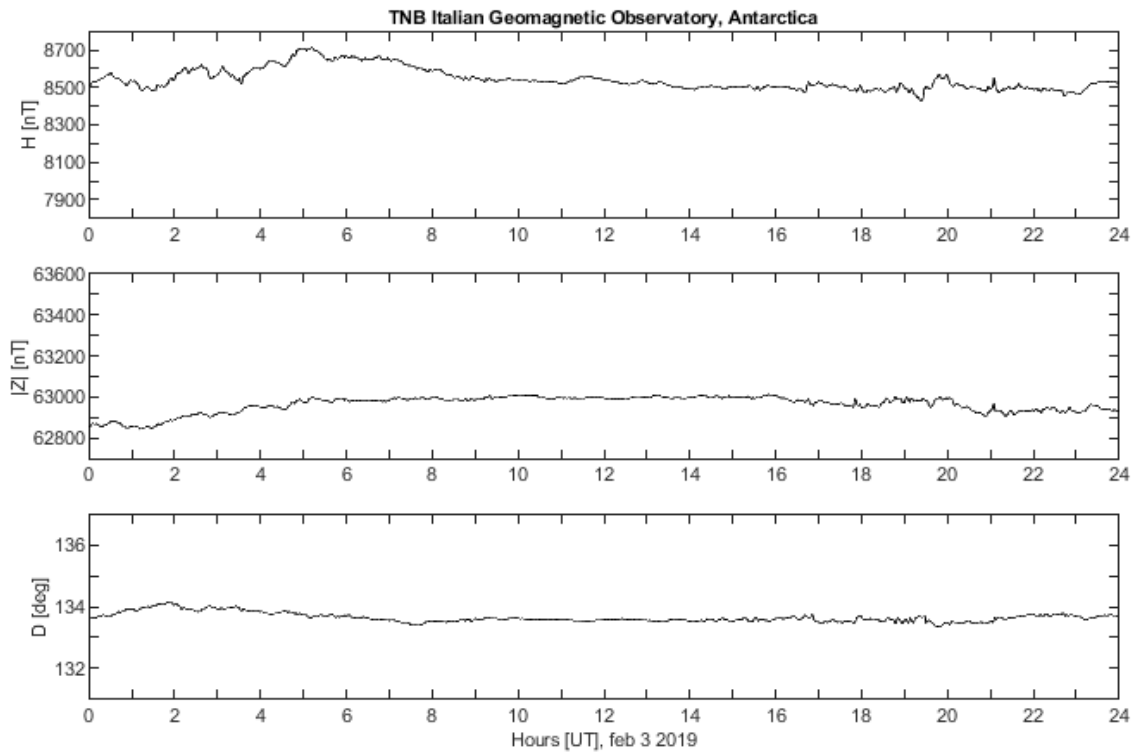
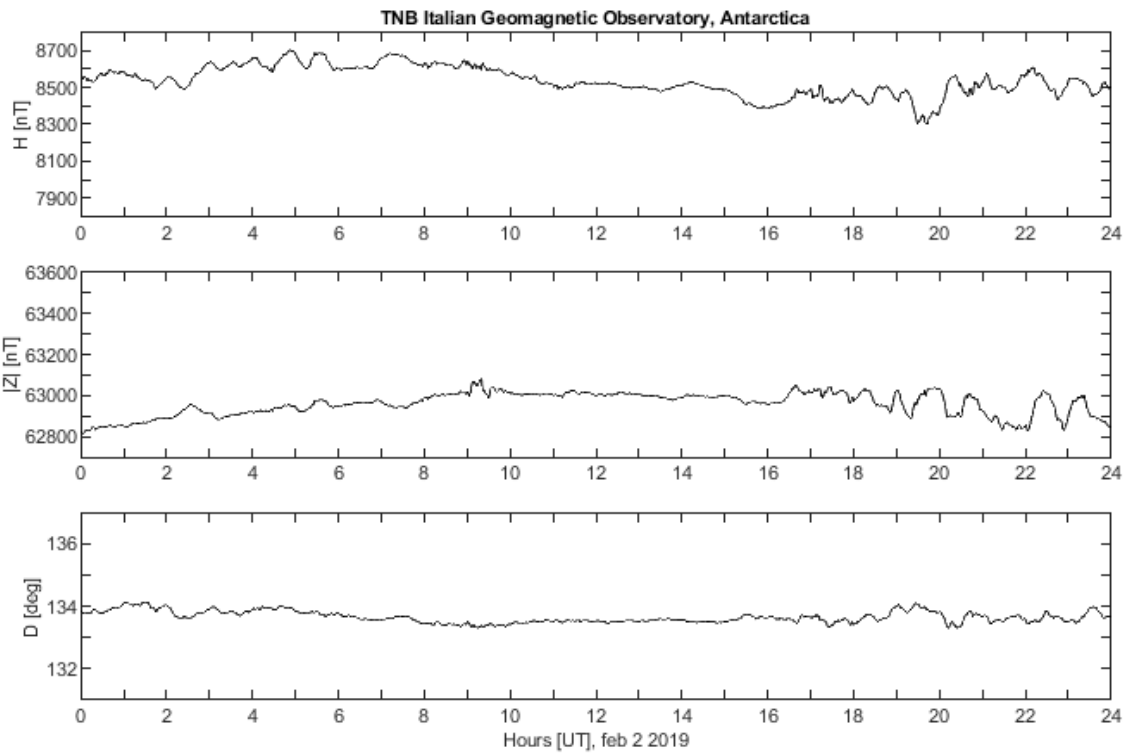


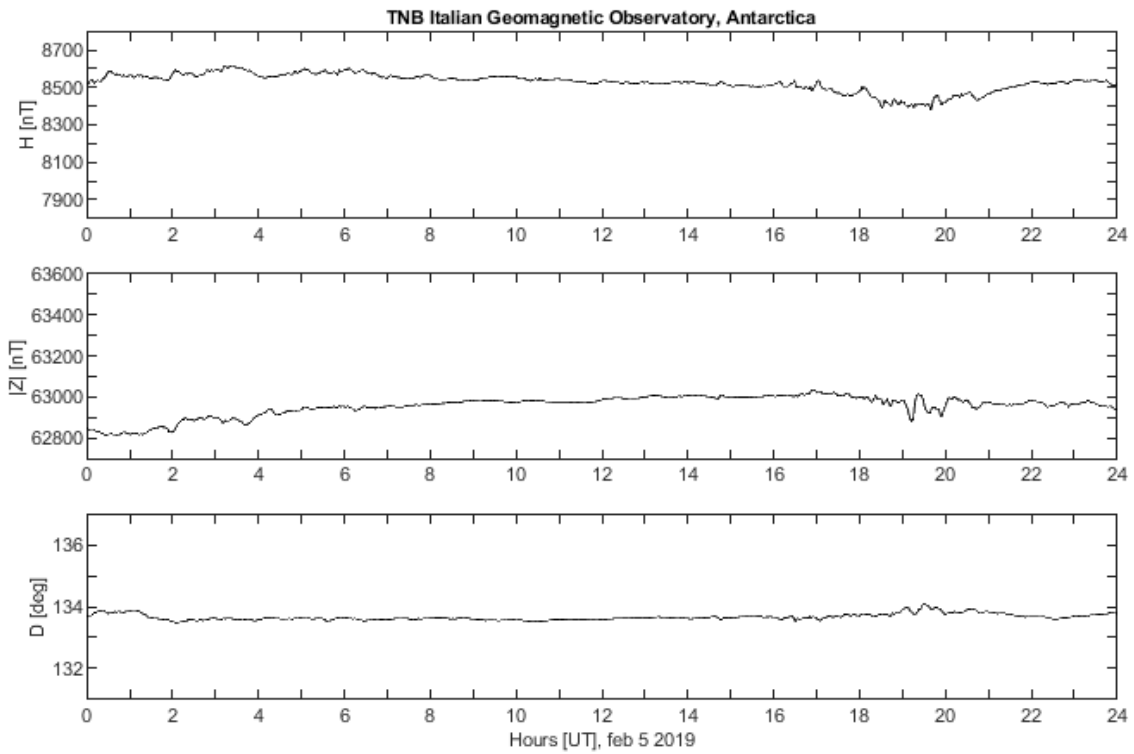
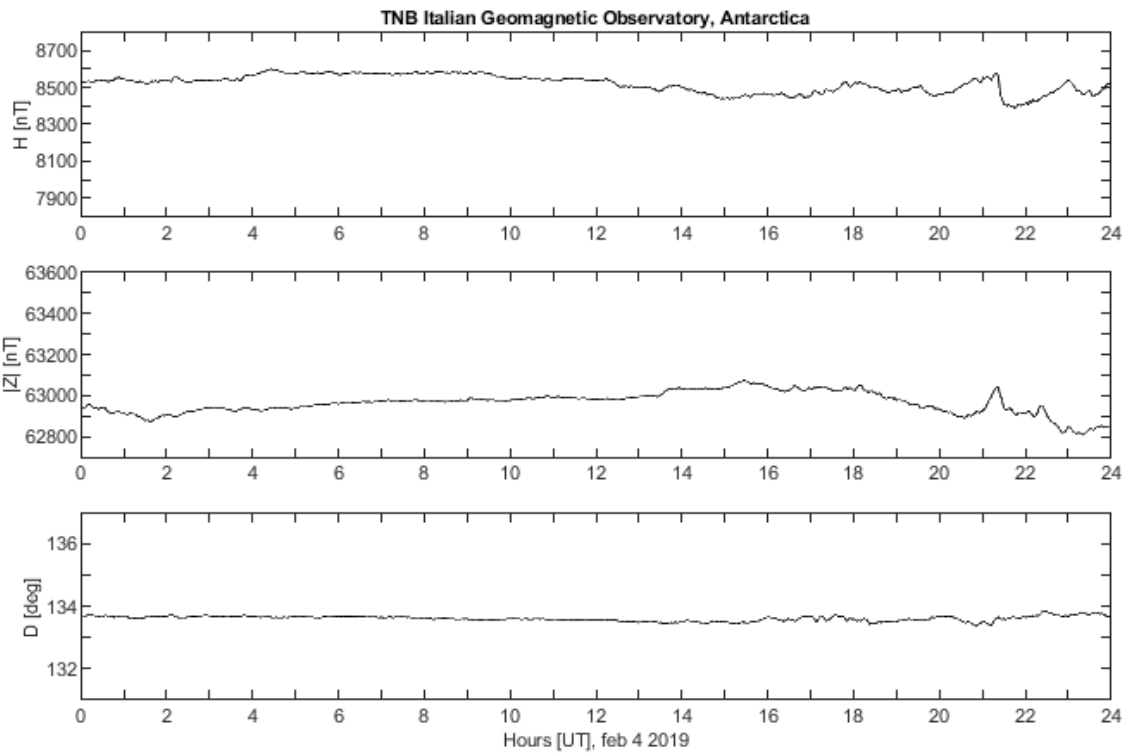












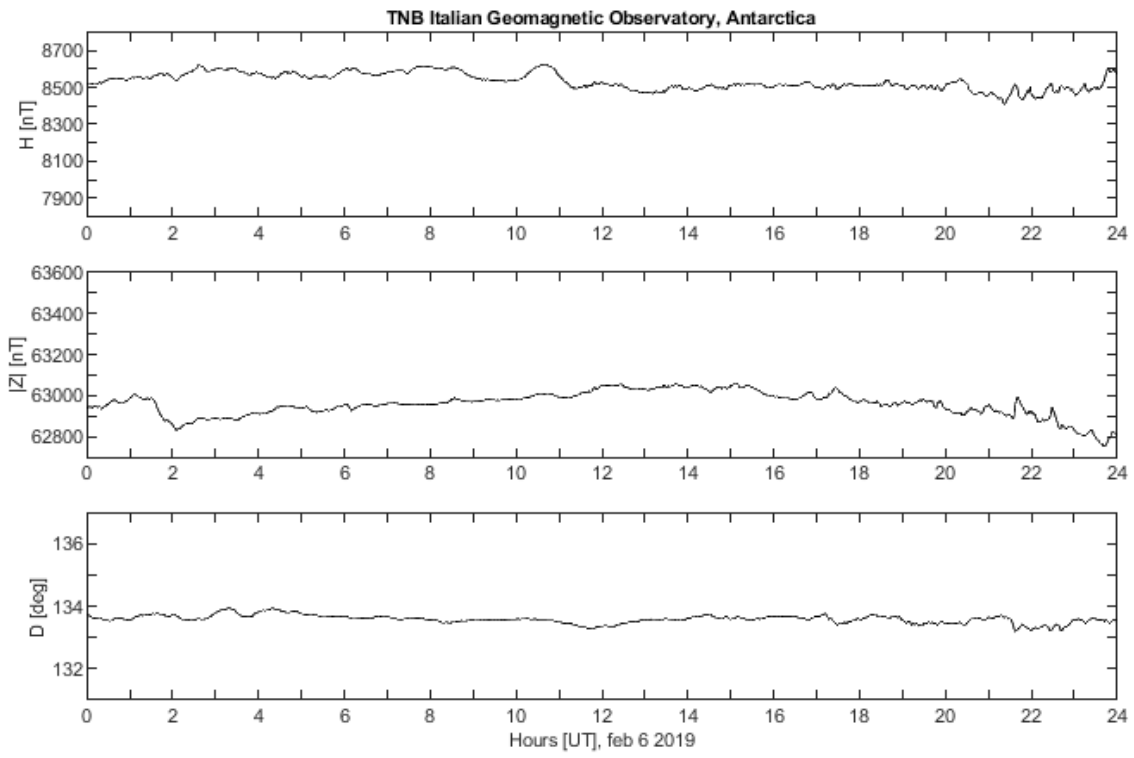


Fig. 88

