वार्षिकी
Year Book 2016

एचवाईबी (आईएमओ) एवं सीपीएल चुंबकीय वेधशालाएँ
HYB (IMO) and CPL Magnetic Observatories

कुसुमिता अरोरा, एल. मंजुला, के.सी.एस. राव, एन. फणिचंद्रशेखर
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चुंबकीय वेधशाला हैदराबाद / Magnetic Observatory Hyderabad

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Technical Report No. NGRI-2017-Magnetic Observatory-937

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CSIR-National Geophysical Research Institute
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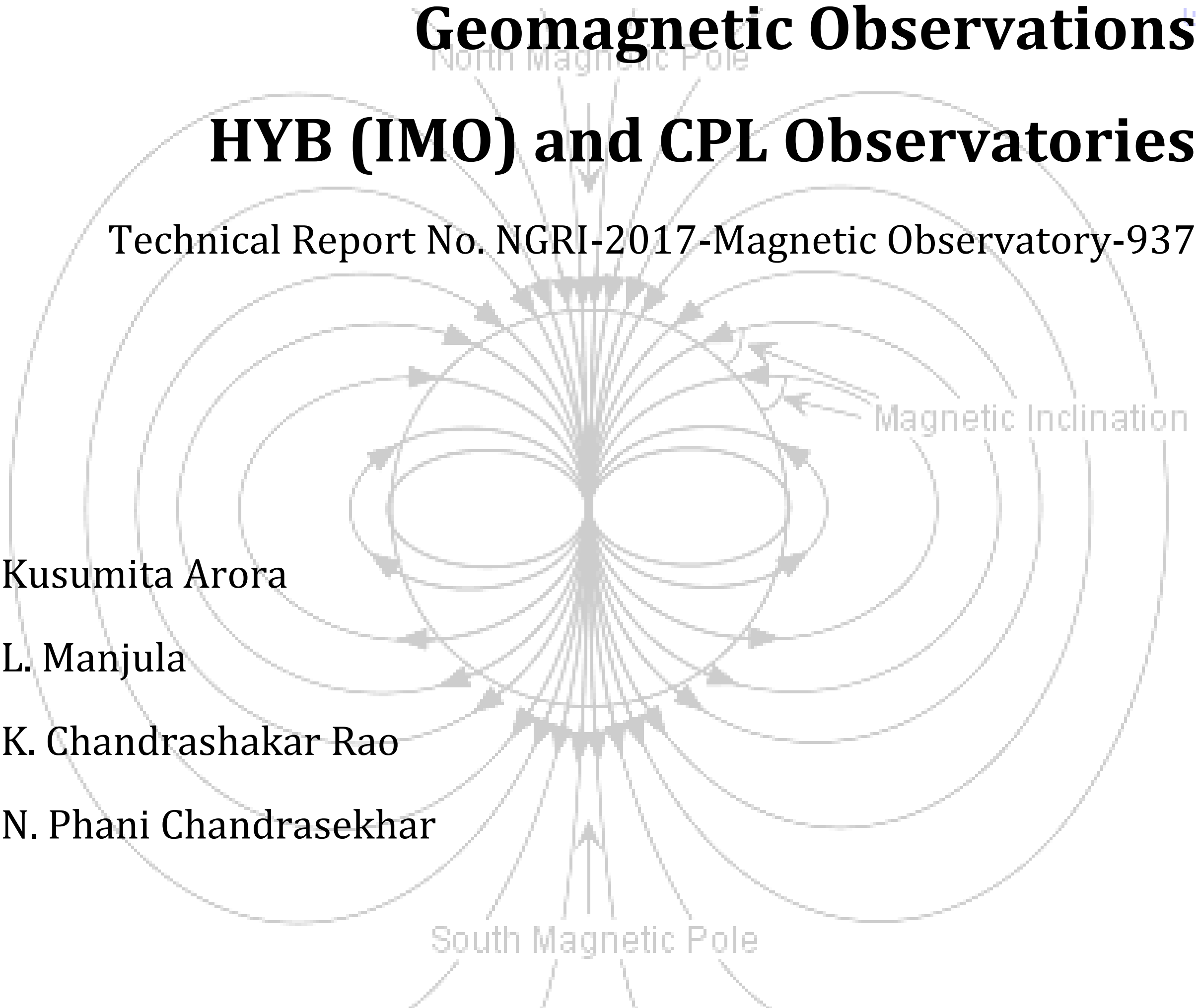
मई / May 2017

Year Book 2016

Geomagnetic Observations

HYB (IMO) and CPL Observatories

Technical Report No. NGRI-2017-Magnetic Observatory-937



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May 2017

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North Magnetic Pole
Magnetic Inclination
South Magnetic Pole

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1. Executive Summary

Hyderabad Magnetic Observatory (HYB) is a key low latitude observatory established in 1964, at NGRI campus in Hyderabad by CSIR-NGRI. Equipped with analog data recording system, it has recording data for generation of hourly, daily, monthly & yearly means of the H, D & Z components of the magnetic variations and analysis of K indices and activities and storms were published in CSIR-NGRI quarterly bulletins of the Geomagnetic, Geoelectric and Seismological Observatories Bulletin from 1965 to 1970. 1970 onwards till present, the data is being published in the IIG, INDIAN MAGNETIC DATA volumes every year.

In 2007 additionally digital Magnetometer DFM (Digital fluxgate magnetometer tri-axial fluxgate variometer(FGE)) was installed. The classical La cour (Analog) magnetometer and digital system were both recorded parallel for 4 years. Then onwards DFM considered as Primary variometer recording system and the La cour system served as secondary variometer system. Later from 2011 onwards La cour system was replaced with another fluxgate magnetometer named as GEOMAG-02M as secondary variometer system. In 2010 DMI100 absolute magnetomter and PPM absolute magnetometers were upgraded with DIM (WILD T+Mag-01H) and Overhauser scalar magnetometer.

From 2009, HYB achieved INTERMAGNET data standards, the raw data are transmitted in real time. This is updated every half an hour directly to INTERMAGNET website (http://www.intermagnet.org/data-donnee/dataplot-eng.php). Quasi-definitive data is reported monthly and Definitive data is reported annually to the Edinburgh GIN as per INTERMAGNET specifications. Annual compilation of data from all observatories is completed by INTERMAGNET for use by the global community. Global data from INTERMAGNET are used in near real time to study space weather and annually to study secular variations and changes of the main field. 2010 onwards with the complete establishment of the digital regime, Quick look plots of H, D & Z components of hourly means data have been added to the data reports for IIG, INDIAN MAGNETIC DATA volumes. Monthly Rapid Magnetic Variation data (RMV) are being reported since 2015 to Ebre Observatory, Spain.

Choutuppal Magnetic Observatory established in the Campus of CSIR-NGRI, Choutuppal in 2012. Continuing magnetic field observations thereafter using digital fluxgate magnetometers (DFM and GEOMAG-02M) and Overhausers total field magnetometers. From 2016 onwards additionally started one second magnetic field measurements using GEOMAG-02MO and Overhauser magnetometers which can make vital contributions to the understanding of ULF waves, storm time magnetospheric ring current systems, sudden impulses and space weather phenomena.

Semi-permanent stations data is use to study longitudinal and latitudinal behaviour of the geomagnetic field. Three component Fluxgate Magnetometers (GEOMAG-02M) are installed at all the remote sites and recording the data in one sampling interval. Once in six months absolute observations will be performed at the remote sites and the corresponding variation data for the last six months will be retrieved.

This Yearbook is based on the data acquired for one year at HYB, CPL and Semi-permanent stations. Besides the basic data description, it includes important details:

(i) Baseline plots with observed & adopted baseline values and table of deviation of H, D & Z, ΔF plots are included as primary QC indicators, hourly means plots with IQ & ID days, daily mean plot of H, D & Z, daily mean tables with maximum & minimum, plots of daily means deviated from monthly standard value, K-index (daily, monthly, yearly sums & daily, monthly, yearly frequencies), Principle magnetic storms including GC (General commencement) & SSCs (Storm sudden commencement).

(ii) Calibration of instruments.

(ii) Annual means values from 1964-2016, a plot of annual mean changes of magnetic components of H, D, Z, F & I (H-Horizontal component, Declination, Z-Vertical Component, Total magnetic field and Inclination).

(iii) Characteristics & data availability plots of remote stations, being operated from HYB.

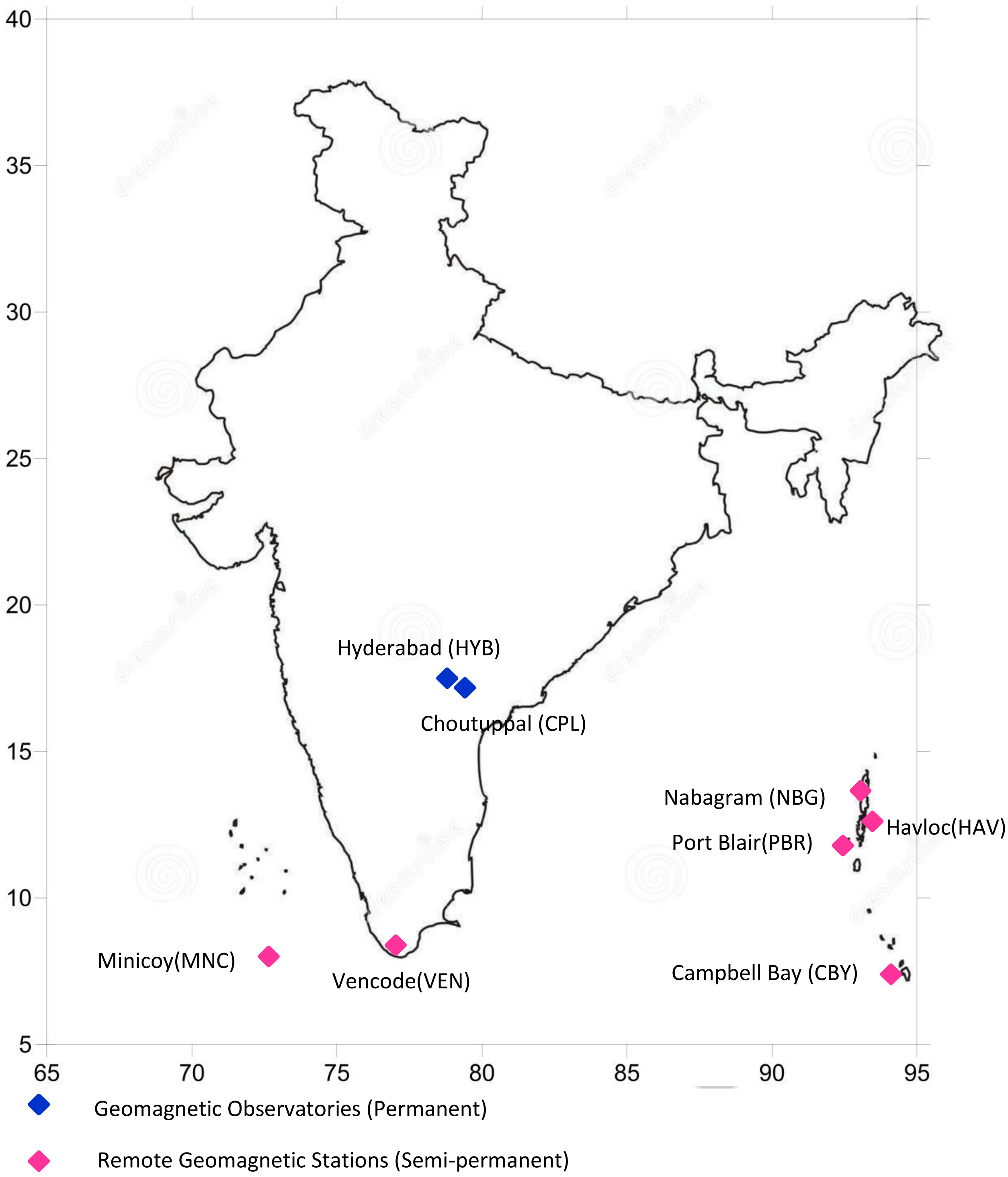


Figure 1.1: Map of Observatories (permanent & semi-permanent) operated by CSIR - NGRI

2. Observatories

2.1. Hyderabad Magnetic Observatory (HYB)

Hyderabad Magnetic Observatory was established in December 1964 by the CSIR-National Geophysical Research Institute, Hyderabad, within its campus. It is operated and data is processed, by the CSIR-National Geophysical Research Institute. The Magnetic Observatory was equipped with La Cour variometers (analog) for H, D & Z for normal photographic record of the field variations, Vector Proton Precession Magnetometer (VPPM) served as primary absolute magnetometer from 1965-1985 by measuring the vector components (H and Z) of the magnetic field by cancelling out one of the components by means of a Helmholtz coil. From 1965 to 2002 QHM (Quartz Horizonatal Magnetometer) and BMZ (Balance Magnetique Zero) served as secondary absolute instruments. Then from 1986 to 2002 VPPM and DIM100 severed as Primary absolute magnetometers. From 2003 to 2010 DMI100 Declination & Inclination magnetometer (DIM) and Proton Precession Magnetometer (PPM (IIG)) were used as primary absolute magnetometers and QHM served as secondary absolute magnetometer. From 2010 onwards primary absolute magnetometers were upgraded to DIM (Mag-01H sensor + Wild-T theodiolite) and Overhauser scalar magnetometer for better resolution and accuracy. The classical La Cour magnetometer was replaced by a Digital 3-component Fluxgate Magnetometer (DFM), of the Danish Meteorological Institute, and an Overhauser Magnetometer (GSM-90) for total field (F) variation in January 2008 apart from existing classical La Cour, under a collaborative project with the Adolf Schmidt Observatory of Geo Forschung Zentrum, Germany. The 1-second measurements are transferred by Optical Fibre Cable to a computer. These values are averaged to obtain 1-minute data. The real-time magnetogram is displayed on a screen, refreshed every 5 minutes, at the Control Room display screen. From 2008 to 2010 August we had parallel continuous measurements of variations in the geomagnetic field using La Cour Classical magnetometer and DFM Digital magnetometer. Later La Cour was phased out and DFM system is serving as primary system and GEOMAG-02M digital 3-component Fluxgate Variometer serving as a secondary system. The observatory has served as an international Key Observatory for IAGA since 1978. In September 2009, HYB achieved INTERMAGNET status.

The location of the observatory is, shown in Figure 1.1:

	Geographic	**Dipole**	**Dip**	**Dipole**	**Dip**
		2016	2016	2015	2015
Latitude	17° 25' N	8.81° N	07.304° N	8.77° N	07.29° N
Longitude	78° 33' E	152.34° E	78.55° E	152.24° E	78.55° E

2.1.1. Infrastructure:

Layout of HYB Magnetic Observatory

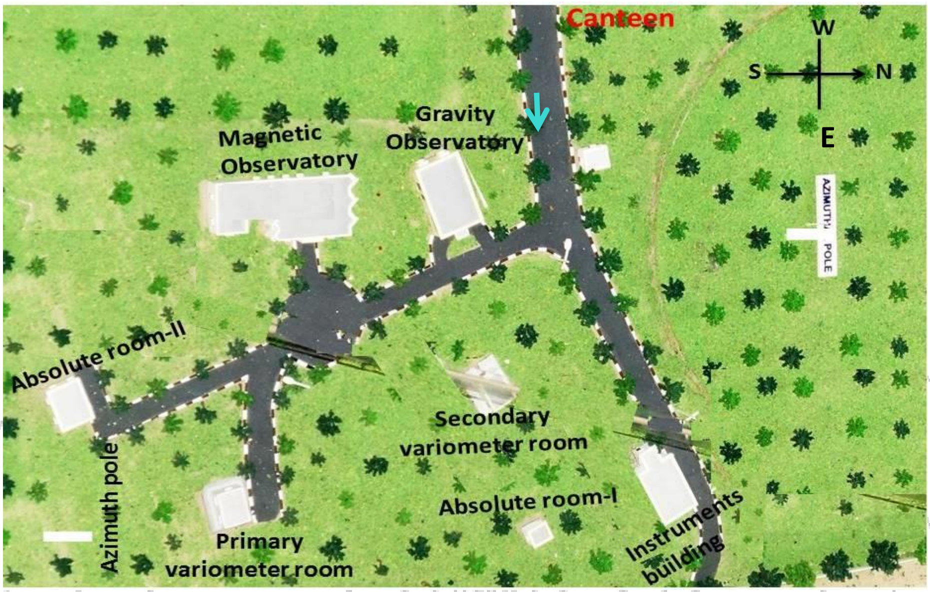


Figure 2.1a: Layout of the Magnetic Observatory complex in CSIR- NGRI; 1cm is approximately 20 m

Fig. 2.1b: Primary variometer building

Fig. 2.1c: Secondary variometer building

Fig. 2.1d: Absolute room I

Fig. 2.1e: Azimuth pillar

Fig. 2.1f: Absolute room II

2.2. Choutuppal Magnetic Observatory (CPL)

Continuous preliminary recording of magnetic variations commenced at Choutuppal Magnetic observatory in January 2012 in underground, thermally insulated non-magnetic housings and this recording continued till date as a secondary variometer with GEOMAG- 02M (Variometer) & GSM-19 Overhauser till September, 2014. In October, 2014 onwards permanent DFM system (DMI-FGM Variometer & GSM90F1 Overhauser) was installed in the primary variometer housing in the newly constructed double walled non-magnetic Primary Variometer Room. Digital measurements at 1-second sampling are transferred to the data storage computers by OFC cable and 1-min standard digital 3-component variations are continuously recorded within the Choutuppal NGRI campus.

Absolute measurements to determine total field (F), Inclination (I) and Declination (D) are made once a week using a DI-flux (Declination Inclination magnetometer (DIM) and Overhauser Magnetometer (PPM) and reduced to obtain observatory baselines for the components H, D and Z.

	Geographic	Dipole 2016	Dip 2016	Dipole 2015	Dip 2015
Latitude	17°17.6' N	8.66° N	07.316° N	8.62° N	07.303° N
Longitude	78°55.2' E	152.68° E	78.92° E	152.6° E	78.92° E

2.2.1. Infrastructure

One second magnetic measurements commenced in the year 2016 using the newly developed Observatory grade 1 second fluxgate magnetometer, GEOMAG-02MO, from GEOMAGNET Ukraine and the Overhauser Proton Precession Magnetometer along with the data acquisition system, MAGREC-4B. Two non-magnetic vaults of dimension 4′ x 4′ x 4′ were constructed at CPL Observatory campus for deploying the 3-component sensor and house the data logger systems. Extruded Polystyrene (EPS) foam sheets of 4 inch thickness of dimensions 4 ′ x 8 ′ are used as thermal insulator material inside the four corners of the vaults to achieve good temperature control both for the sensor and electronic units. Utmost care was taken for controlling temperature variations in the sensor and logger vault, as GEOMAG-02MO is having a typical temperature coefficient of ~0.2 nT/°C. Therefore to have a good quality of measurements free from temperature effects, two different sizes of enclosures were made and kept on the top of sensor, to make sure that the temperature variations should be almost constant over the day. The sensor-logger vaults and the GSM90-F1pillar are separated by about 20 m, almost equidistant from each other. The vector and scalar magnetometers are connected to their respective GPS receivers; enclosed in a polyvinyl chloride (PVC) pipe, provide the details of the accurate time stamping for field variations, geographic co-ordinates and elevation of the site. GEOMAG-02MO sensor is oriented nearest to the magnetic north leaving 'Y 'in uncompensated mode, GSM90-F1 sensor is oriented in East-West direction. GEOMAG-02MO comes with automatic compensation of the external field, which is sequentially adjusted. GEOMAG-02MO and GSM90-F1 sensors are connected to the respective data loggers via undergrounded connecting cables of length 25m. The two data acquisition systems are further connected to MAGREC-4B data acquisition system via RS-232 cables. Optical Fiber cable of length 110 m was laid underground between the MAGREC-4B data acquisition system located in logger vault to the main building of CPL Observatory, and connected to a computer to visualize and transmit the field variations in real-time to Hyderabad with a latency period of 1 minute.

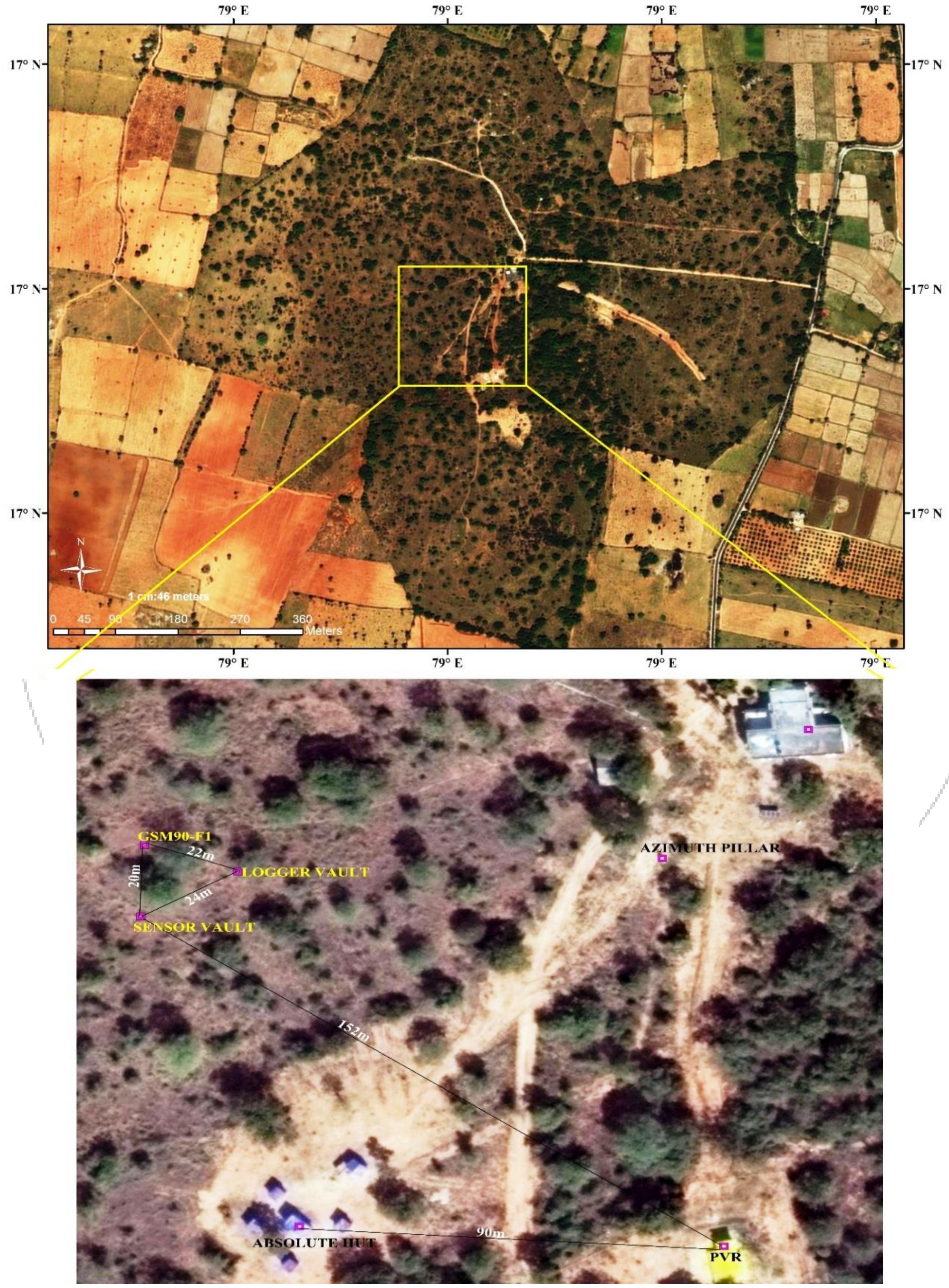


Fig.2.2.1a: Bird's eye view of Choutuppal campus of CSIR-National Geophysical Research Institute (top panel) and the highlighted text box show the location of variometer vaults, Azimuth pillar, Absolute hut and Primary variometer room (PVR) of Choutuppal Magnetic Observatory (bottom panel).

Fig. 2.2.1b: Primary variometer building (DFM)

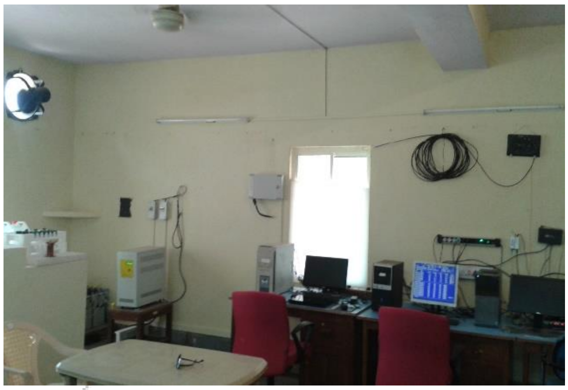


Fig. 2.2.1c: DFM control

Fig.2.2.1d: GEOMAG-02MO Vaults

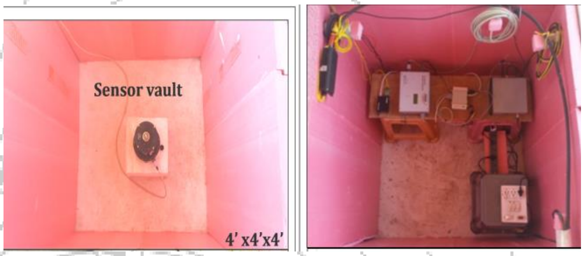


Fig. 2.2.1e: Underground vaults with shelters of natural material

Fig. 2.2.1f: Absolute hut

Fig. 2.2.1g: Azimuth pillar

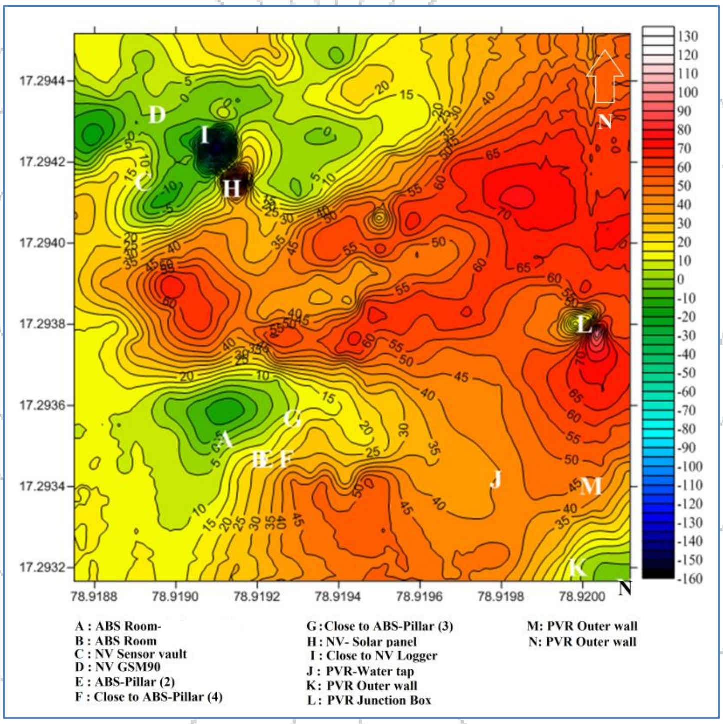
Fig. 2.2.1h: 7 Absolute huts

Fig.2.2.1i: Solar power panel set up

Contour map of magnetic anomalies at CPL Magnetic Observatory

A magnetic survey was carried out at CPL Magnetic Observatory during 23rd and 24th November 2016 to estimate the magnetic gradients in the recording premises. One GSM-19W and GSM90-F1 Overhauser magnetometers were used in 1 sec sampling mode and GARMIN hand GPS was used for the survey. A good coverage area of 135m x 135m was achieved by covering the new variometer vault, Primary variometer room and Absolute room with spare pillars of the observatory campus. A total of 545 survey stations were measured with a station spacing of 5m. The GSM-90F1 Overhauser magnetometer established at new variometer vault was used as a diurnal base magnetometer for the survey.

Resultant magnetic variations of the survey area are plotted using surfer software and the contour map with the survey points (Figure 2) and the locations of the new variometer vault, Primary variometer room, Azimuth pillar and Absolute room with spare pillars are shown in Figure (3) and labeled by using their geographic reference points.



The gradients are observed to be quite weak in the areas of new variometer vault and the Overhauser pillar. Moderate gradients were observed at Absolute room with spare pillars and Primary variometer room. Strong gradients are evident at solar panels located close to the new variometer logger vault and power supply junction box near to the main building.

2.3. Semi-permanent Stations

CSIR-NGRI commenced equatorial and low-latitude observations at Andaman & Nicobar Islands and southern tip of South India, Kanyakumari during the year 2011 and Minicoy, Lakshadweep islands during 2013 by installing 3-component fluxgate magnetometers. Non-magnetic, thermally insulated, weather-proofed wooden huts were constructed for protecting the fluxgate sensor and electronic console (data logger) and reducing effect of the temperature change. These sites are completely unmanned and are visited once in three-four months. During the time of every visit, the data is retrieved and Absolute experiments are carried out to obtain baseline values of H, D and Z components. Locations as given in Figure 1.1 are as below.

Table 2.3.1: Locations of remote stations

Location	**Station Code**	**Geographic Latitude**	**Geographic Longitude**	**Geomagnetic Latitude**	**Geomagnetic Longitude**	**Dip Latitude**
Campbell Bay	CBY	07° 00' N	93° 52' E	2.42°S	166.69°E	07.566°
Vencode	VEN	08° 15' N	77° 11' E	0.16°S	150.25°E	07.263°
Minicoy	MNC	08° 09' N	73° 18' E	0.08°N	146.42°E	07.148°
Port Blair	PBR	11°24' N	92° 27'E	2.01°N	165.47°E	07.575°
Nabagram	NBG	13° 15' N	92° 57'E	3.82°N	166.03°E	07.574°
Havelock	HAV	11°58' N	93° 01'E	2.55°N	166.05°E	07.574°

Variometer stations were setup in the equatorial region of India during 2010-2011 for focussed studies on the Equatorial electrojet. The locations are at Campbell Bay (CBY) in Great Nicobar in the A&N islands, Vencode (VEN) on the mainland at Kanyakumari and Minicoy (MNC) in the Lakshadweep islands (Fig. 1.1 for reference).

CBY (Fig 2.3a) is located on the island of Great Nicobar, the largest of the Nicobar Islands in the eastern Indian Ocean and ~540 km away from Port Blair by sea route. A semi-permanent Magnetic Observatory was established during the year 2011 in the premises of the Forest check post with the sensor buried in underground vault and electronics installed in the Forest check post room. The power supply to the magnetometer system is made using batteries charged by means of solar panels.

VEN (Fig. 2.3b) is 60 km away from Kanya Kumari at the southernmost point of peninsular India, Tamil Nadu. The semi-permanent Magnetic Observatory is situated at the premises of Bethany Navajeevan Matriculation School, Puthukkadai village, Kanya Kumari District facilitated by Manonmaniam Sundaranar University, Tirunelveli (Tamil Nadu). The site was established during the year 2010 and the variometer room was constructed at the extreme end of the school premises, which is located at the center of a coconut garden. The site is about 10 km away from the ocean. A non-magnetic thermally insulated building of size (2.4mx1.8m x 2.4m) was constructed. In this a small vault of size (0.9m x0.6m x0.6m) was made to house the sensor unit.

In the corner of the building a platform of size (0.6m x 0.6m x 0.3m) was made to place the data logger. The power supply to the magnetometer system is made using batteries charged by means of solar panels.

PBR (Fig. 2.3c) is situated at the premises of the Department of Science and Technology (DST) office, Dollygunj, Port Blair, Andaman Islands. The recording of magnetic field variations commenced during the year 2010. Two non-magnetic thermally insulated wooden hut of dimensions (1.2m x 1.2m) was made for the sensor and electronics. The power supply to the magnetometer system is made using batteries charged by means of solar panels.

NBG (Fig. 2.3e) is situated in the Forest nursery area in north Andaman. Two non-magnetic thermally insulated wooden hut of dimensions (1.2m x1.2m) was made for the sensor and electronics. The power supply to the magnetometer system is made using batteries charged by means of solar panels. The cables are frequently damaged by very large sized rats.

HAV (Fig.2.3f) No construction was made at HAV. MT measurements carried out in campaign mode.

MNC (Fig. 2.3d) is situated at Central Plantation Crops Research Institute (CPCRI) at Minicoy, the southernmost Lakshadweep Island. The recording of magnetic field variations commenced in 2013. Two non-magnetic thermally insulated wooden hut of dimensions (1.2m x1.2m) was made for the sensor and electronics. The power supply to the magnetometer system is made using batteries charged by means of solar panels.

Variometer sensor huts:

Fig. 2.3a: Campbell Bay (CBY)

Fig. 2.3b: Vencode (VEN)

Fig.2.3c Port blair (PBR)

Fig.2.3d Minicoy (MNC)

Fig. 2.3e: Nabagram (NBG)

Fig. 2.3f: Havelock(HAV)

2.4. Instrumentation

Photographs and specifications of the standard instruments used at various locations are provided in the following pages. A total of 10 variometers, 2 proton precession, 5 Overhauser magnetometers and 4 absolute magnetometers are available.

Base station Instruments:

Fig.2.4a: Left –suspended block of fluxgate sensor Right-MAGDALOG data logger.
Quantity 2

Fig.2.4b: GSM90 Overhauser are scalar magnetometers as primary systems at HYB & CPL. Quantity 3.

Fig.2.4c: Mag-01H DIflux magnetometers with non-magnetic theodolite WildT1 Quantity 2.

Fig. 2.4d: GEOMAG-02M, upper-sensor, lower-electronics. Quantity 1.

Fig. 2.4e: GEOMAG-02MO upper-sensor, lower-electronics. Quantity 1.

Fig. 2.4f: GSM19 Overhauser are scalar magnetometers. Quantity 2

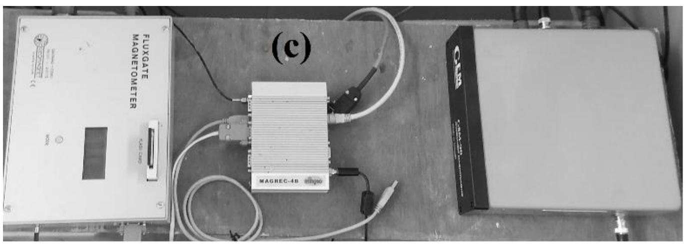


Fig. 2.4g: Magrec electronics (data logger). Quantity 1

Semi-permanent station instruments

Fig. 2.4h: Four GEOMAG-02M variometers are in field stations

Fig. 2.4i: Two MS-27 variometers are in field stations

Fig. 2.4j: Two GEOMETRICS PPM (total field magnetometer) for field

Fig. 2.4k: THEO-020A Absolute magnetometer for field stations

Fig 2.4l: THEO-020A & GEOMAG-03 absolute magnetometer for field stations

2.5. Data availability

2.5.1 Permanent stations:

During 2016, availability of Geomagnetic variations data from permanent stations of CSIR-NGRI, shown in the following figure. The coloured circle shapes indicates data availability in respective months, different colours indicate different instruments from both HYB and CPL.

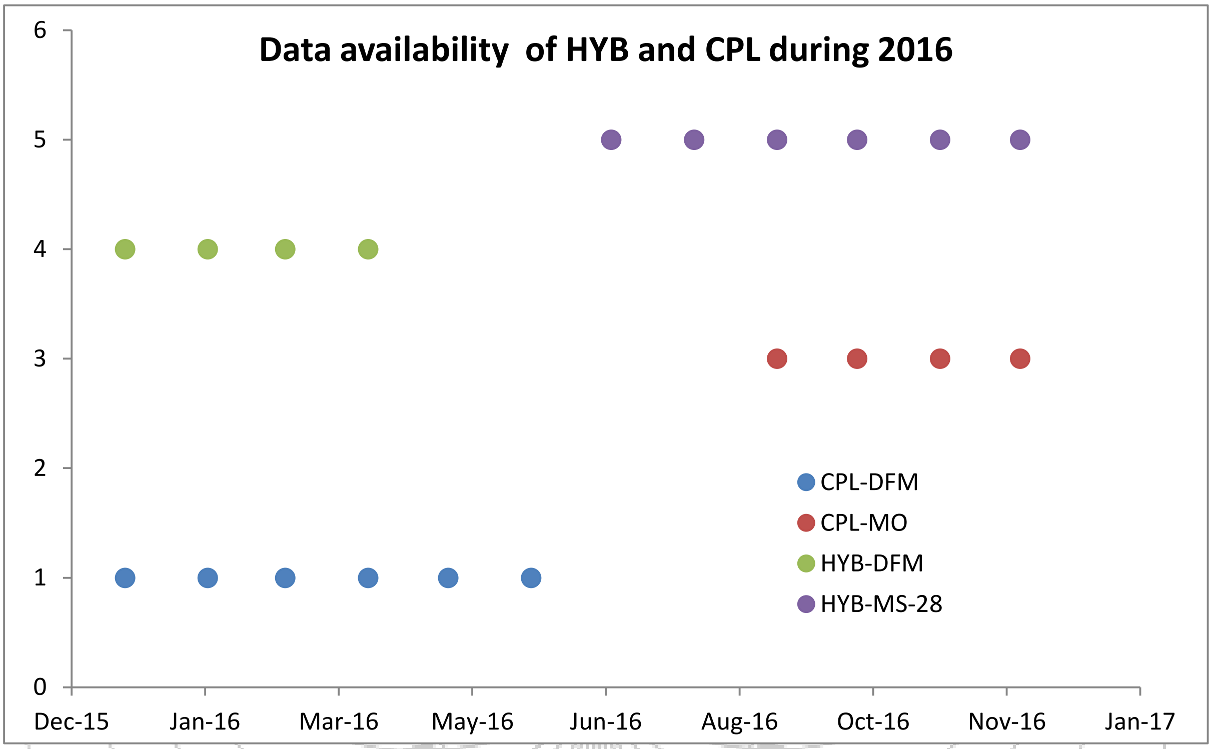


Figure2.5.1a: Data availability from HYB and CPL Observatories during 2016

2.5.2. Semi-permanent stations:

During 2016, the 3 component variometer data availability of the Semi-permanent magnetic stations of CSIR-NGRI, shown in the following figure. The coloured diamond shapes indicates data availability in respective months, different colours are different stations.

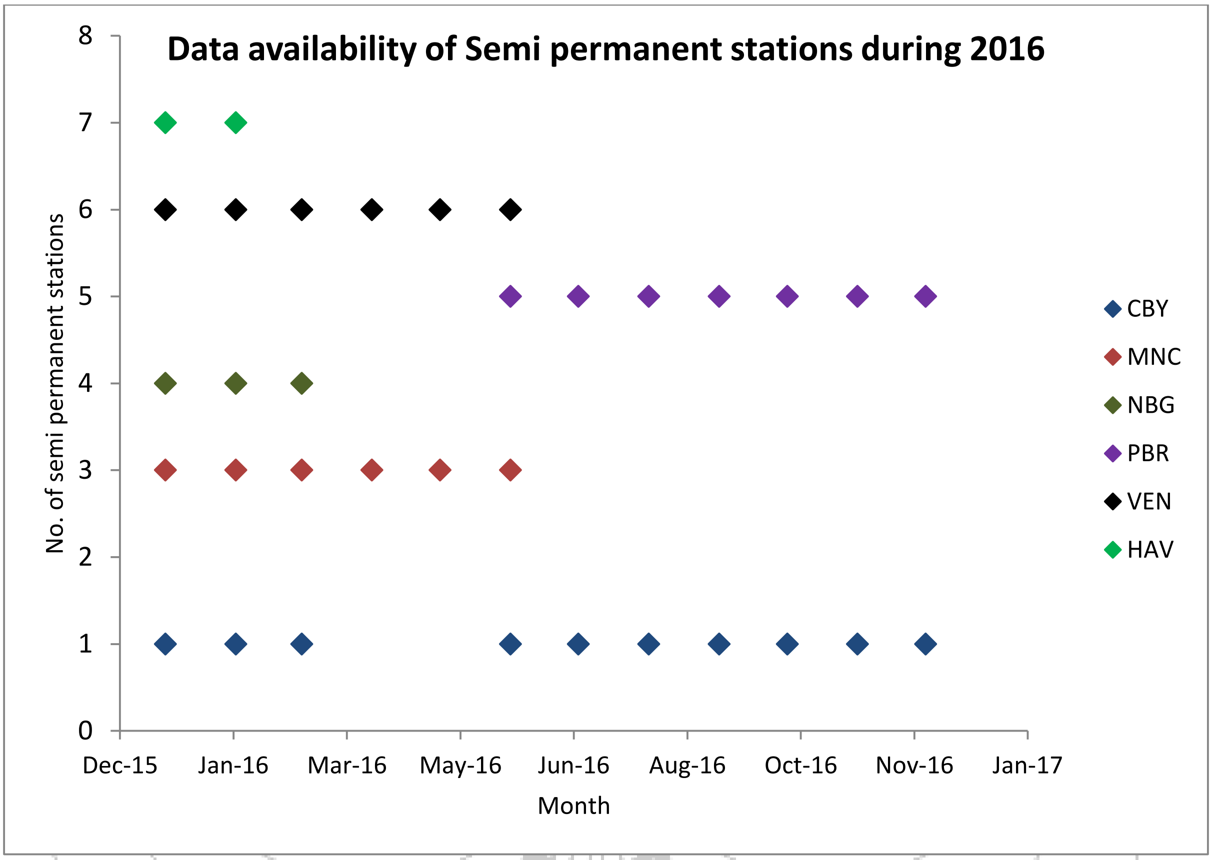


Figure 2.5.2a: plot of data availability of remote stations.

3. Calibration Reports

3.1. Proton precession Magnetometer during 03.03.2016

Name of the instruments	GEOMETRICS PPMS (AX865)
Serial No.	278572 & 278728
Calibrated with	GSM90 Overhauser magnetometer of CPL, Primary variometer room
Serial No.	24575
Location	CPL- absolute hut
Pillar	5 & 6
Date of calibration	03.03.2016
Duration of data used	05:00UT to 16:30UT
Data sampling	Minute
No. of sets	One
Name of the Observer	N. Phani Chandrasekar
Results	Satisfactory

Table 3.1: Details of calibrated instrument

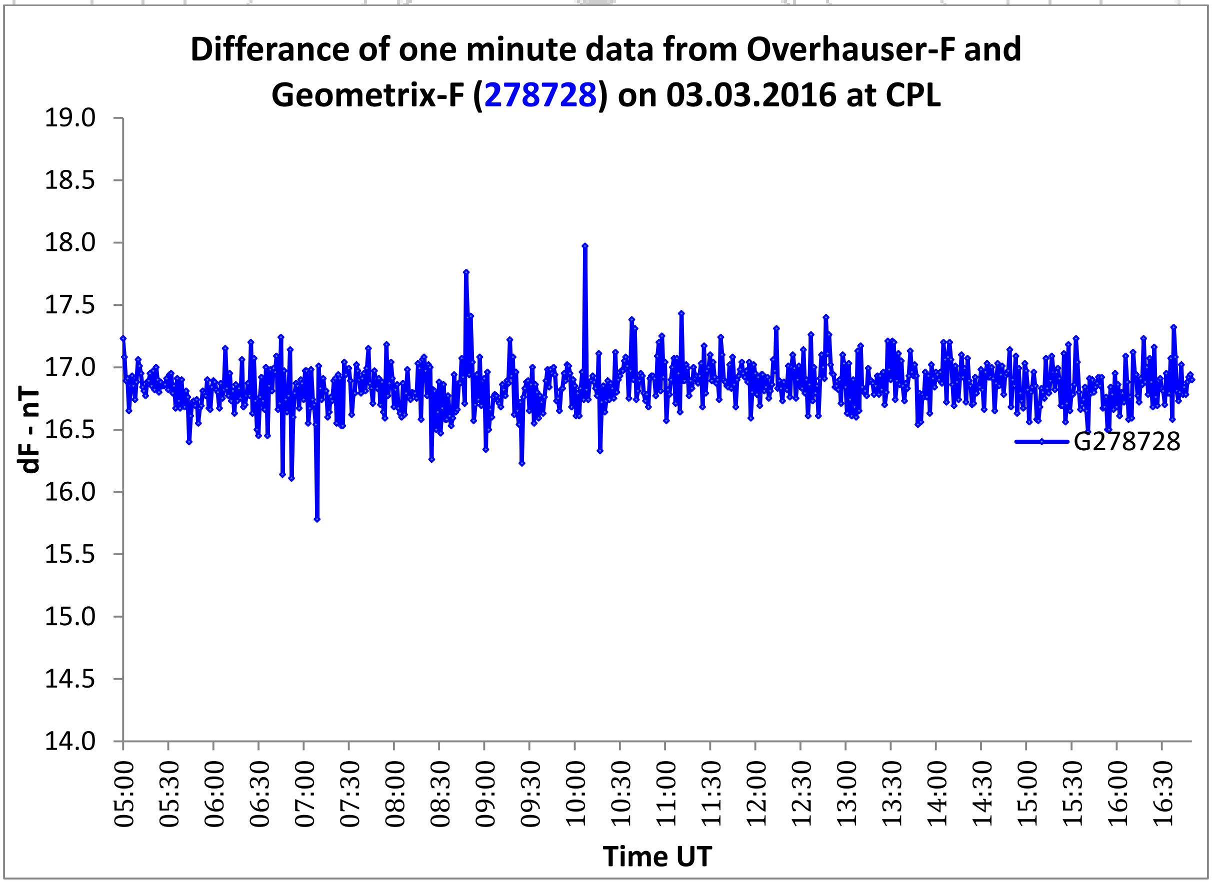


Figure 3.1a: Difference between Overhauser-F and Geometrics-F(278728)

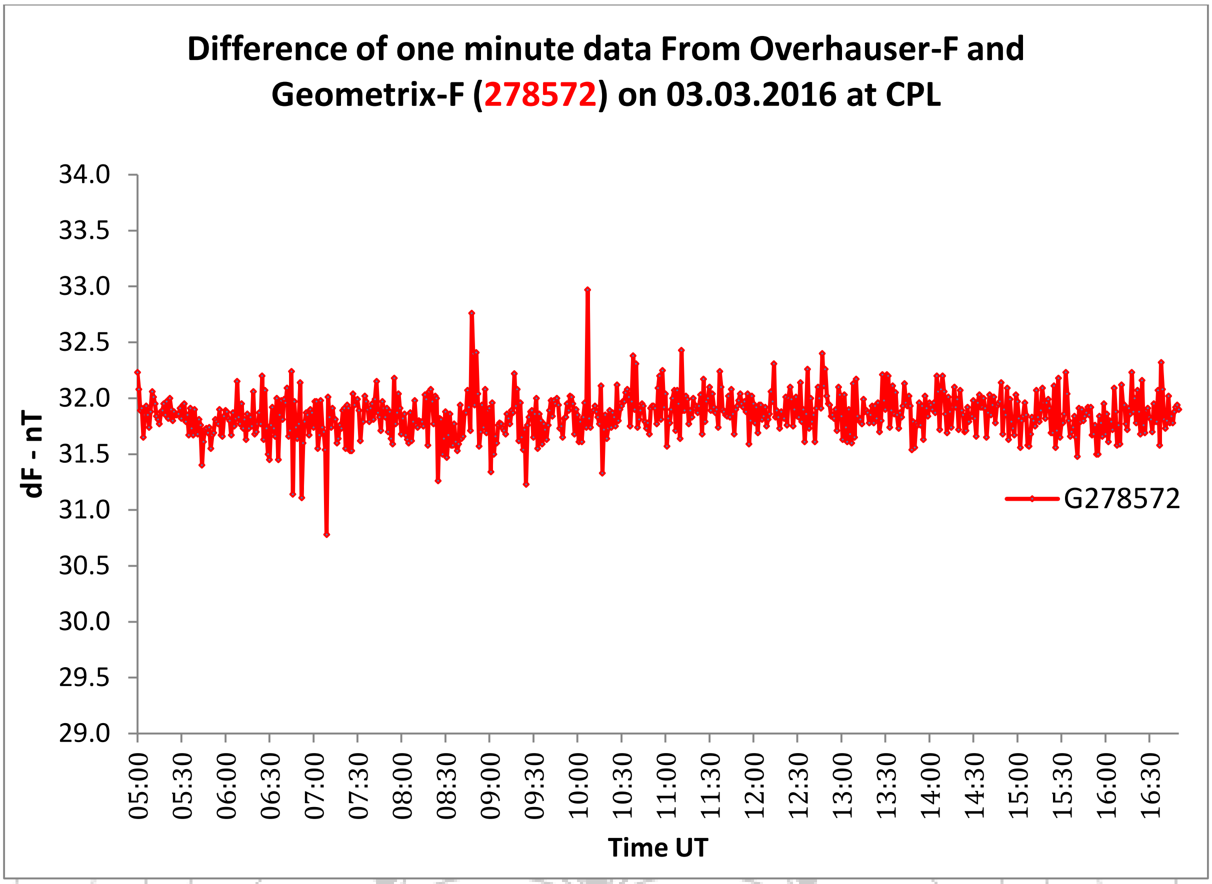


Figure 3.1b: Difference between Overhauser-F and Geometrics-F (278572)

3.2. Proton precession Magnetometer during 22.09.2016

Name of the instruments	GEOMETRICS PPMS (AX865)
Serial No.	278572 & 278728
Calibrated with	GSM90 Overhauser magnetometer of CPL, Primary variometer room
Serial No.	24575
Location	CPL- absolute hut
Pillar	
Date of calibration	22.09.2016
Duration of data used	05:00UT to 16:30UT
Data sampling	Minute
No. of sets	One
Name of the Observer	N. Phani Chandrasekar
Results	Satisfactory

Table 3.2: Details of calibrated instrument

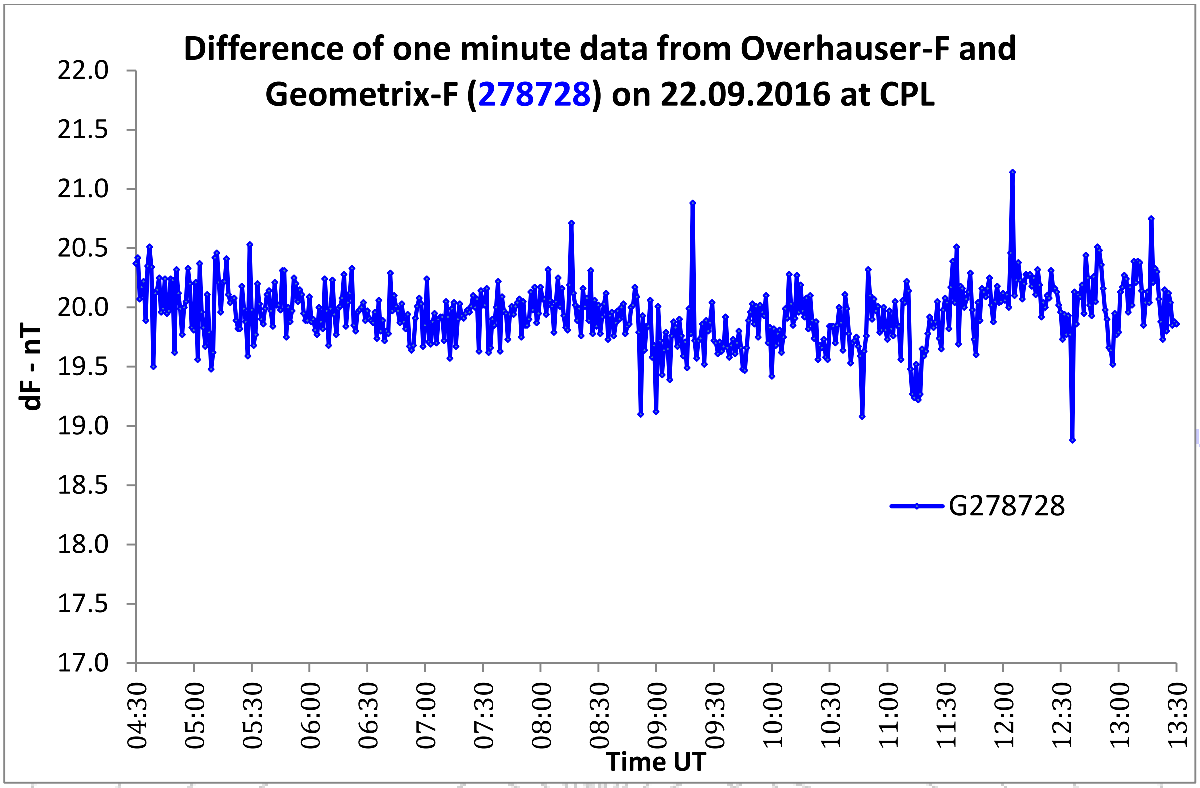


Figure 3.2a: Difference between Overhauser-F and Geometrics-F(278728)

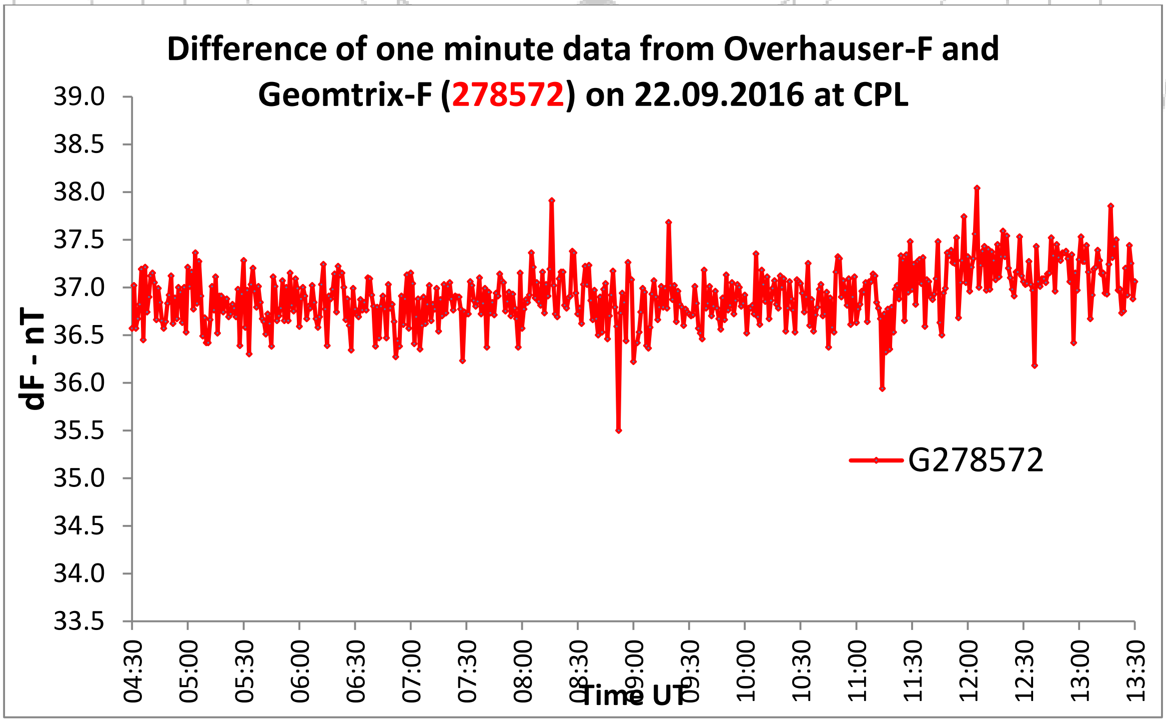


Figure 3.2b: Difference between Overhauser-F and Geometrics-F(278572)

3.3. DI-flux Magnetometer during 07-08.01.2016

Name of the instrument	DI-Flux magnetometer (Zeiss 20A +DMI sensor)
Serial No.	312723 and DI0098
Calibrated with	DI-Flux magnetometer (Zeiss 15B + Mag-01H sensor)
Serial No.	253282 and 492
Location	ABG – absolute building
Pier	Pillar no.1 in Absolute room (main pillar)
Date of calibration	07.01.2016 to 08.01.2016
Duration of data used	Two days
Data sampling	Seconds
No. of sets	Seven
Name of the Observer	K. Chandrashekhar Rao (from HYB) & A.P. Bhingare and Anoop K. S. (From ABG)
Results	DI-Flux magnetometer (Zeiss 20A +DMI sensor) working condition is satisfactory.

Table 3.3: Details of calibrated instruments.

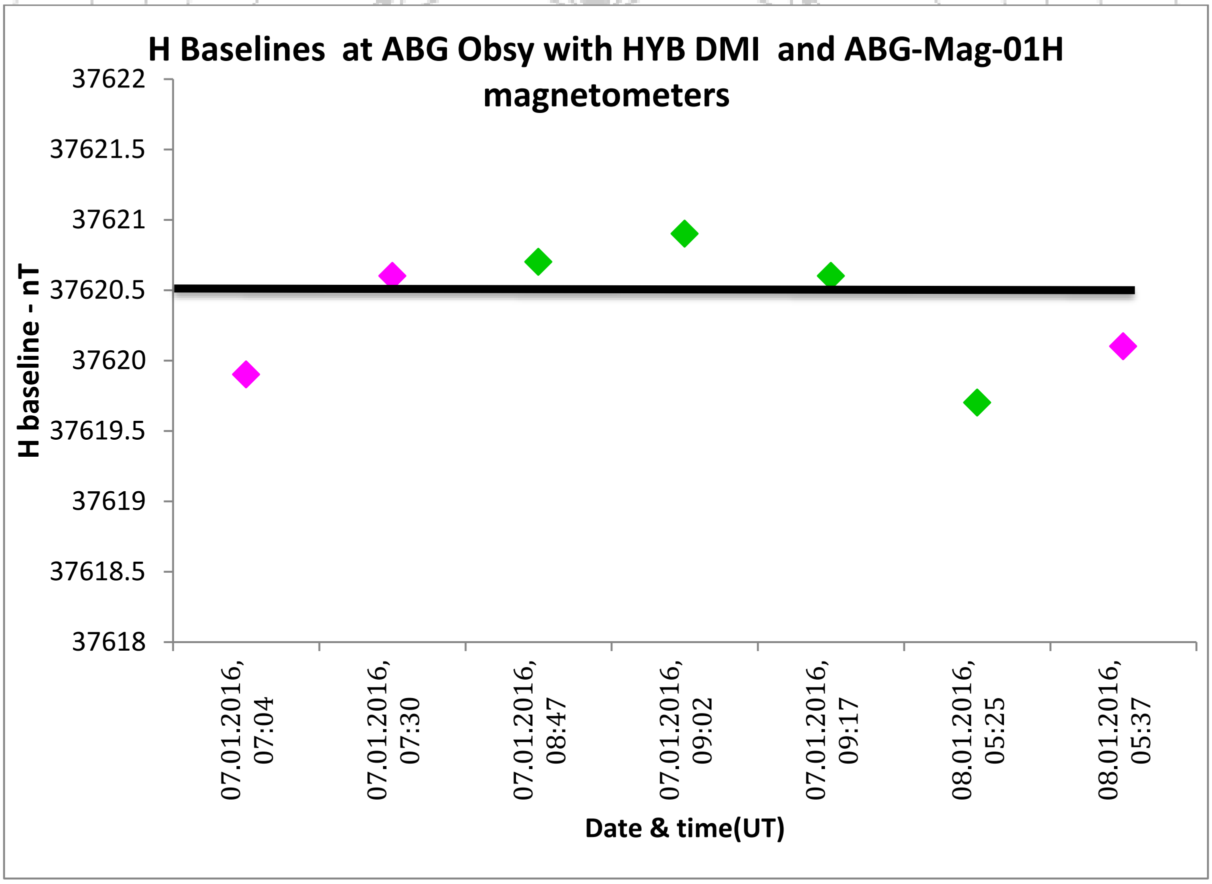


Figure 3.3a: Comparision plots of DMI DIM with Mag-01H DIM of H.

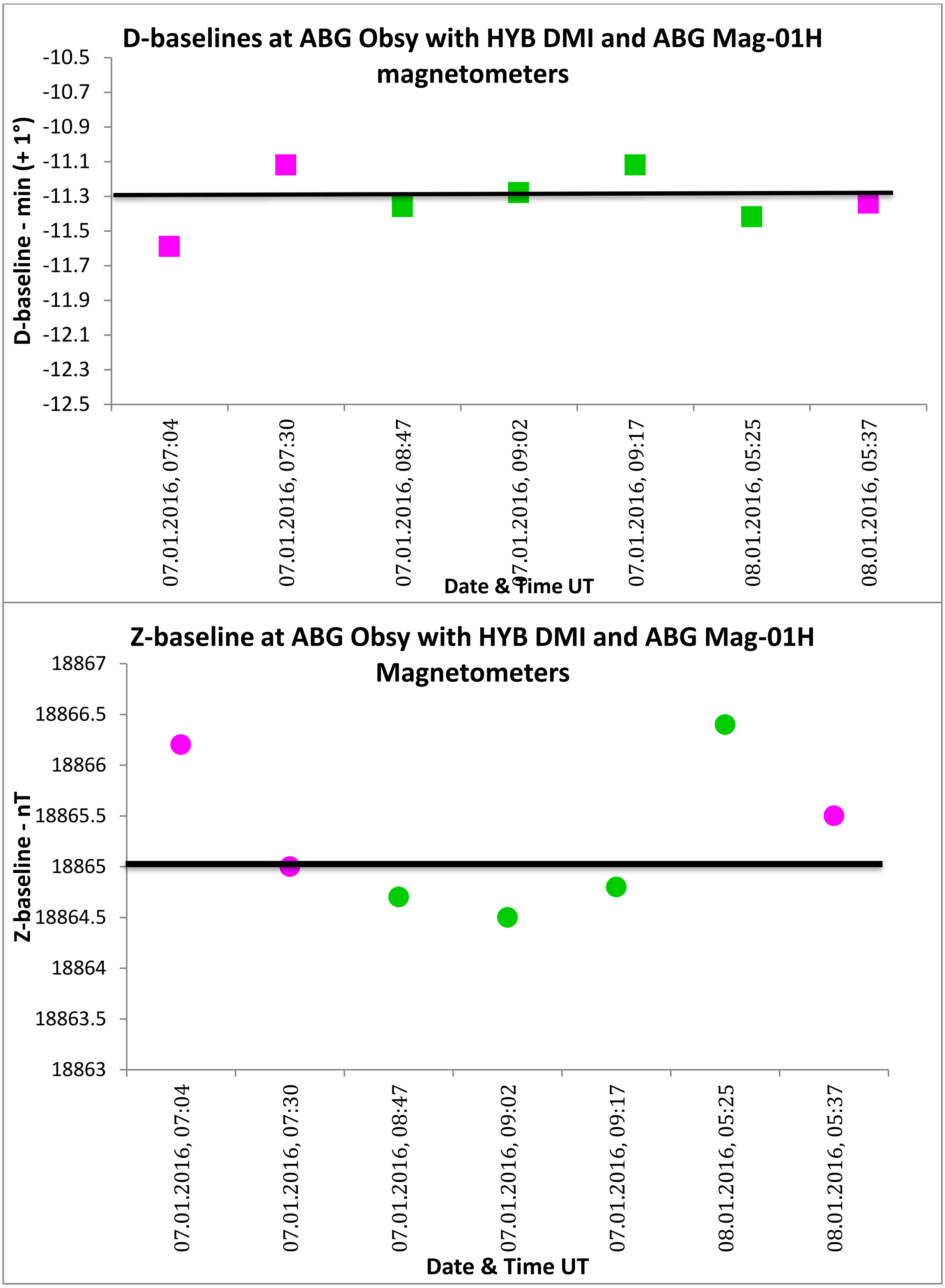


Figure 3.3b: Comparision plots of DMI DIM with Mag-01H DIM of D and Z

Note: in the above plots the pink colour sambols are ABG DIM (Alibagh Observatory) and Green colour are HYB DIM and fixed black lines are the fixed (adopted) baseline values for the respected day.

भारतीय भूचुम्बकत्व संस्थान
(विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार के अंतर्गत एक स्वायत्त निकाय)
चुंबकीय वेधशाला अलिबाग
जिला : रायगढ
अलिबाग - 402 201.
महाराष्ट्र.
टेलीफोन : 02141-22009
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संदर्भ सं./ Ref No. 237/calibration.

दिनांक / Date 09/01/2016

Calibration Certificate

To Whom So ever It may Concern

This is to certify that the Instrument DI Fluxgate Magnetometer of Institute NGRI, Magnetic Observatory Hyderabad, DIM Zeiss 20A S.No.312723 , Sensor with Magnetometer No. DI0098 is calibrated against DI Fluxgate Magnetometer of Alibag Magnetic Observatory, Zeiss 15B S.No253282 Sensor & Magnetometer No. 492 & 1032H on 7th & 8th Jan 2016 at Alibag Magnetic Observatory. Comparison & Calibration data results are enclosed herewith.

Following are the observers participated in comparison experiments.

1) Mr. K. Chandra Shekar Rao , Sr. T. O (NGRI).
2) Mr A. P Bhingare , T. O I (Alibag).
3) Mr Anoop K. S , S.T.A (Alibag).

(A. P Bhingare, T. O .I)

for The Officer-In-Charge / प्रभारी अधिकारी
Magnetic Observatory / चुम्बकीय वेधशाला
Alibag / अलिबाग - 402 201

MAGNETIC OBSERVETORY RAIGAD ALIBAG

Alibag Magnetic Observatory

Comparison Observation with Hydrabad DIM against Alibag DIM
ABG DIM Zeiss 15B Sr No. 253282, Sensor & Magnetometer 492 & 1032H
HYB DIM Zeiss 20A Sr. No 312723, Sensor with DMI magnetmeter - DI0098
Variations from DFM-2 & F from Overhauser
Observation Site: Tower First floor piller
Observers : K C S Rao (Sr. T O) NGRI & Anoop K S (Sr. T A) IIG,

Obsy	Date	Time in UT		I			F(nT)	H (abs)	H (ord)	H (bsl)
ABG	7/1/2016	704	15	27	32	40	42542.0	37720.0	97.4	**37619.9**
ABG	7/1/2016	730	35	27	32	19	42537.1	37717.6	94.4	**37620.6**
HYB	7/1/2016	847	51	27	32	48	42534.4	37712.5	89.1	**37620.7**
HYB	7/1/2016	902	6	27	32	48	42534.4	37712.5	88.9	**37620.9**
HYB	7/1/2016	917	21	27	32	51	42532.9	37710.8	87.6	**37620.6**
HYB	8/1/2016	525	27	27	34	5	42559.2	37727.1	104.8	**37619.7**
ABG	8/1/2016	537	41	27	33	53	42560.1	37729.0	106.3	**37620.1**

Obsy	Date	Time in UT		I			F(nT)	Z (abs)	Z (ord)	Z (bsl)
ABG	7/1/2016	704	15	27	32	40	42542.0	19673.0	807.7	**18866.2**
ABG	7/1/2016	730	35	27	32	19	42537.1	19666.9	802.8	**18865.0**
HYB	7/1/2016	847	51	27	32	48	42534.4	19670.9	807.2	**18864.7**
HYB	7/1/2016	902	6	27	32	48	42534.4	19670.9	807.4	**18864.5**
HYB	7/1/2016	917	21	27	32	51	42532.9	19670.8	806.9	**18864.8**
HYB	8/1/2016	525	27	27	34	5	42559.2	19696.5	831.0	**18866.4**
ABG	8/1/2016	537	41	27	33	53	42560.1	19694.7	830.2	**18865.5**

Obsy	Date	Time in UT		D			D (min)	D (ord)	(ord min)	D (bsl)
ABG	7/1/2016	648	59	0	15	44	15.73	301.3	26.90	**-11.59**
ABG	7/1/2016	724	27	0	15	54	15.90	297.9	26.60	**-11.12**
HYB	7/1/2016	840	45	0	15	30	15.50	296.1	26.44	**-11.36**
HYB	7/1/2016	856	0	0	15	18	15.30	293.0	26.16	**-11.28**
HYB	7/1/2016	913	16	0	15	15	15.25	290.6	25.95	**-11.12**
HYB	8/1/2016	520	23	0	16	26	16.43	307.3	27.44	**-11.42**
ABG	8/1/2016	531	35	0	16	42	16.70	309.3	27.62	**-11.34**

Baseline calculations by: Mr. Anoop K S (STA, IIG): Anoop 09/01/16

Results from the above data: Caliberation done and corrections - **NIL** -

Baseline Data checked by: Mr. Anand P Bhingare (TO I, IIG): 9/1/2016.

ABG No 237/Cal.

for The Officer-In-Charge / प्रभारी अधिकारी
Magnetic Observatory / चुम्बकीय वेधशाला
Alibag / अलिबाग - 402 201

3.4. DI-flux Magnetometer during 21.03.2016

Name of the instrument	DI-Flux magnetometer (Wild T1 +Mag-01H sensor)
Serial No.	235823 and 545
Calibrated with	DI-Flux magnetometer (Zeiss 15B + Mag-01H sensor)
Serial No.	253282 and 492
Location	ABG – absolute buidling
Pier	Pillar no.1 in Absolute buidling (1st floor pillar)
Date of calibration	21.03.2016
Duration of data used	One day
Data sampling	Seconds
No. of sets	Eight
Name of the Observer	K. Chandrashekhar Rao & L Manjula (from HYB) & A.P. Bhingare and Anoop K. S. (From ABG)
Results	DI-Flux magnetometer (Wild T1 +Mag-01H sensor) working condition is satisfactory.

Table 3.4: Details of calibrated instruments.

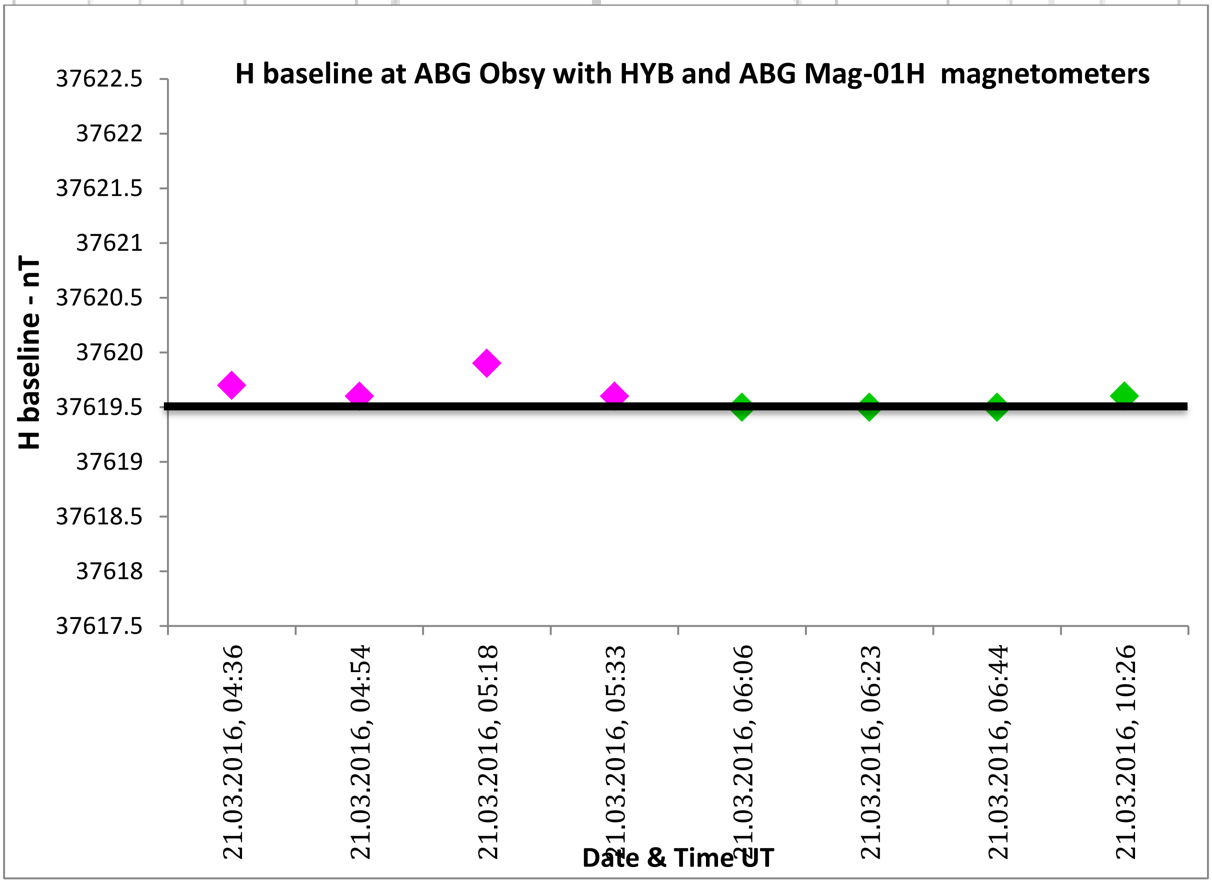

Figure 3.4a: Comparision plots of Mag-01H (HYB) with Mag-01H DIM of H baseline

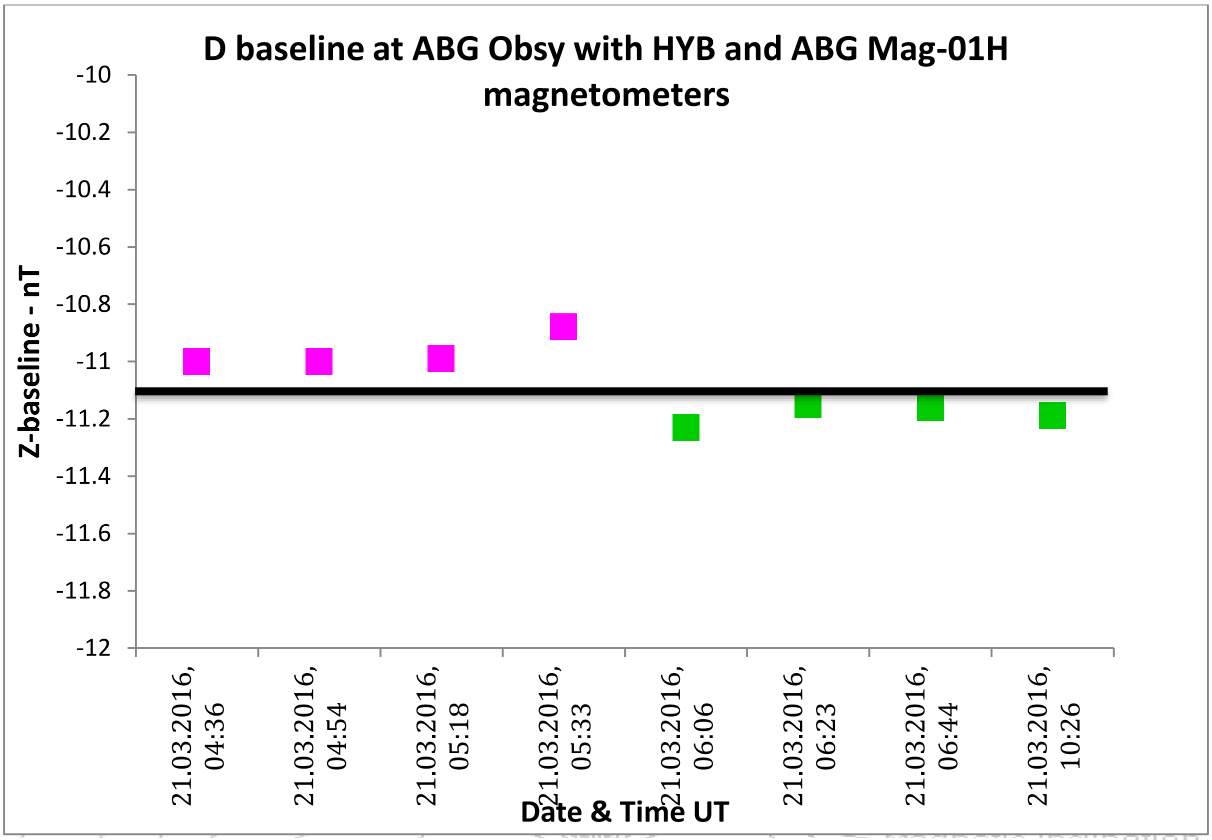

Figure 3.4b: Comparision plots of Mag-01H (HYB) with Mag-01H DIM of D baseline

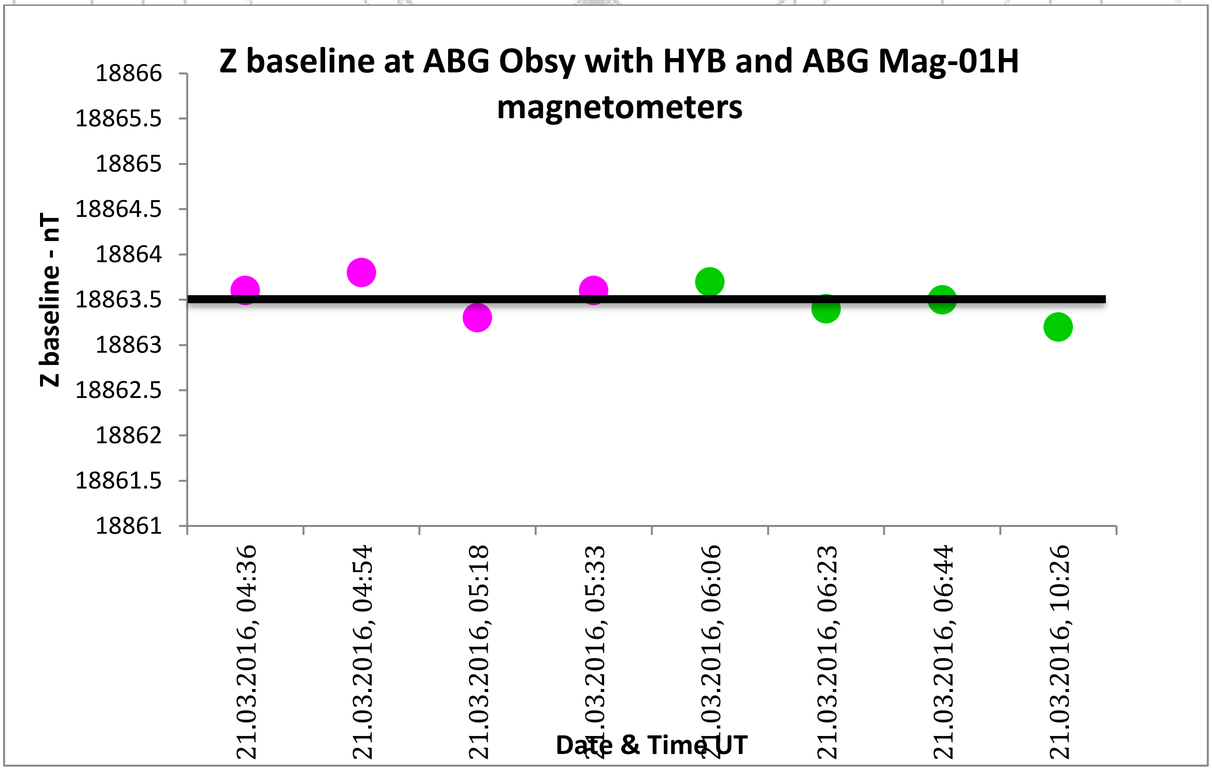

Figure 3.4c: Comparision plots of Mag-01H (HYB) with Mag-01H DIM of Z baseline

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चुंबकीय वेधशाला अलिबाग
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संदर्भ सं./ Ref No. 277/Calibration

दिनांक / Date 23/3/2016.

MAGNETIC OBSERVETORY RAIGAD ALIBAG

Calibration Certificate

To Whom So ever It may Concern

This is to certify that the Instrument DI Fluxgate Magnetometer of Institute NGRI, Magnetic Observatory Hyderabad, DIM WHILD T1 S.No.235823 , Sensor with Magnetometer No.545 & DI0094H is calibrated against DI Fluxgate Magnetometer of Alibag Magnetic Observatory, Zeiss 15B S.No253282 Sensor & Magnetometer No. 492 & 1032H on 21st Mar 2016 at Alibag Magnetic Observatory. Comparison & Calibration data results are enclosed herewith.

Following are the observers participated in comparison experiments.

1) Mr. K. Chandra Shekar Rao , Sr. T. O (NGRI).
2) Mr A. P Bhingare , T. O I (IIG).
3) Mr Anoop K. S , S.T.A (IIG).
4) Mrs L. Manjula , T.A (NGRI).

(A. P Bhingare, T. O .I)

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Alibag / अलिबाग - 402 201

Alibag Magnetic Observatory

Comparison Observation with Hyderabad DIM against Alibag DIM
ABG DIM Zeiss 15B Sr No. 253282, Sensor & Magnetometer 492 & 1032H
HYB DIM WILD T1 Sr. No 235823 , Sensor & Magnetometer 545 & 0994H
Observation Site: Tower 1st-Floor & variation from DFM-2 & OH90
Observers : Anand Bhingare (T O -I) IIG , Anoop K S (Sr. T A) IIG,
K C S Rao (Sr. T O) NGRI, L. Manjula (T A) NGRI

MAGNETIC OBSERVATORY
RAIGAD
ALIBAG

Obsy	Date	Time in UT		I			F(nT)	H (abs)	H.ord	H (bsl)
ABG	21/03/2016	436	41	27	34	32	42557.4	37722.9	100.6	**37619.7**
ABG	21/03/2017	454	58	27	34	20	42560.4	37726.7	104.5	**37619.6**
ABG	21/03/2018	518	24	27	33	42	42566.2	37735.5	113.0	**37619.9**
ABG	21/03/2019	533	38	27	33	16	42572.1	37743.2	121.0	**37619.6**
HYB	21/03/2020	606	12	27	33	6	42576.0	37747.6	125.5	**37619.5**
HYB	21/03/2021	623	29	27	32	53	42578.7	37751.3	129.1	**37619.5**
HYB	21/03/2022	644	55	27	33	2	42577.8	37749.6	127.5	**37619.5**
HYB	21/03/2023	1026	31	27	35	56	42544.7	37703.6	81.4	**37619.6**

Obsy	Date	Time in UT		I			F(nT)	Z (abs)	Z. ord	Z (bsl)
ABG	21/03/2016	436	41	27	34	32	42557.4	19700.6	837.9	**18863.6**
ABG	21/03/2017	454	58	27	34	20	42560.4	19699.8	836.9	**18863.8**
ABG	21/03/2018	518	24	27	33	42	42566.2	19695.5	833.2	**18863.3**
ABG	21/03/2019	533	38	27	33	16	42572.1	19693.5	830.8	**18863.6**
HYB	21/03/2020	606	12	27	33	6	42576.0	19693.5	830.7	**18863.7**
HYB	21/03/2021	623	29	27	32	53	42578.7	19692.3	829.9	**18863.4**
HYB	21/03/2022	644	55	27	33	2	42577.8	19693.6	831.0	**18863.5**
HYB	21/03/2023	1026	31	27	35	56	42544.7	19710.1	848.0	**18863.0**

Obsy	Date	Time in UT		D			D (min)	D (ord)	(min)	D (bsl)
ABG	21/03/2016	428	33	0	16	23	16.38	302.0	26.96	**-11.00**
ABG	21/03/2017	447	50	0	16	11	16.18	299.7	26.76	**-11.00**
ABG	21/03/2018	511	15	0	15	46	15.77	295.0	26.34	**-10.99**
ABG	21/03/2019	526	38	0	15	23	15.38	289.4	25.84	**-10.88**
HYB	21/03/2020	600	4	0	14	22	14.37	282.0	25.18	**-11.23**
HYB	21/03/2021	617	21	0	14	4	14.07	277.7	24.79	**-11.15**
HYB	21/03/2022	637	41	0	13	40	13.67	273.4	24.41	**-11.16**
HYB	21/03/2023	1020	23	0	15	1	15.02	288.8	25.79	**-11.19**

Baseline calculations by: Mr. Anoop K S (STA, IIG) Mrs. L. Manjula (TA, NGRI):

Baseline Data checked by: Mr. K C S Rao (Sr. T O) NGRI & Mr. Anand P Bhingare (TO I, IIG):

S No.	ABG H	NGRI H	Diff-nT	ABG-Z	NGRI-Z	Diff-nT	ABG-D	NGRI-D	Diff-'
1	37619.7	37619.5	0.2	18863.6	18863.7	-0.1	-11.00	-11.23	0.23
2	37619.6	37619.5	0.1	18863.8	18863.4	0.5	-11.00	-11.15	0.15
3	37619.9	37619.5	0.4	18863.3	18863.5	-0.2	-10.99	-11.16	0.17
4	37619.6	37619.6	0.0	18863.6	18863.0	0.6	-10.88	-11.19	0.31
		Mean	**0.16**		Mean	**0.19**		Mean	**0.22**

Results from the above data: Calibration done and corrections - NIL -

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4. Data of Hyderabad Magnetic Observatory (HYB)

Table 4a: Key Observatory information:

IAGA code	HYB
Commenced operation	1964
Geographic latitude	17° 25' N
Geographic longitude	78° 33' E
Geomagnetic latitude	7.6° N
Geomagnetic longitude	148.9° E
K 9 index lower limit	300nT
Principal pillar	Pillar1, Absolute room 1
Reference mark azimuth	175° 26' 8"
Distance	144 m
Observer	L. Manjula

Table 4b: Azimuth corrections for the Absolute pillars:

S.No.	Pillar	Azimuth Correction
1.	Pillar1, Absolute Room 1	175° 26' 08"
2.	Pillar 2, Absolute Room 2	123° 08' 54"
3.	Pillar 3, Secondary variometer room	-0° 35' 00"

4.1. Daily Means of H, D, Z & F

These daily mean values are calculated from the recorded H, D & Z variation data of FGE magnetometer. From this daily mean tables, the maximum & minimum variations of data monthly wise. In this region (Low latitude) the maximum magnetic field is reflected in the H component but in daily mean data maximum & minimum of the variometer data & total field data are not matching.

Tables 4.1a to d: are the daily means of H, D, Z & F components monthly wise with maximum and minimum values.

These daily mean values are calculated from the recorded H, D & Z variation data of FGE magnetometer. From this daily mean tables, the maximum & minimum variations marked monthly wise. We can notice the maximum and minimum of H and D and F components maximum value lies on magnetically quite days and minimum values lies on magnetically active days. Z-component minimum value is at starting days of the month and maximum is at ending days of the month due to gradually Z field is increasing day by day.

Daily Mean Values of the Horizontal Intensity

Hyderabad Daily Intervals Calculated in Terms of UTC, H= 39000 + Tabulated Value 2016

D	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	396.8	440.3	471.5	476.1	457.7	458.9	451.0	457.0	444.0	450.1	453.5	483.0
2	431.8	463.5	471.8	462.8	439.9	468.7	459.7	478.8	432.4	452.2	450.7	476.2
3	439.3	441.5	469.5	434.5	442.0	470.9	454.1	420.3min	425.8	457.9	439.4min	481.5
4	449.2	464.6	465.6	452.6	453.1	477.0	452.3	429.2	436.6	443.9	460.6	485.5
5	461.7	453.7	469.4	455.1	458.6	475.8	450.0	428.9	443.8	450.4	468.3	489.1max
6	447.2	459.3	454.0	458.8	455.8	435.7	459.8max	432.9	450.7	462.5	472.6	483.3
7	444.5	455.5	405.1min	468.5	460.1	461.0	450.0	439.3	448.7	462.0	478.9	467.0
8	448.4	443.8	436.5	450.6	400.4min	451.6	428.2	436.2	443.9	463.3	475.2	466.6
9	453.7	456.4	443.4	471.6	422.1	468.5	440.4	440.4	460.3	464.9	476.2	462.0
10	459.7	453.7	452.8	469.6	427.7	480.1max	445.7	435.8	459.8	462.2	439.3	457.8
11	448.8	443.5	461.6	475.2	447.1	466.3	444.6	448.2	463.1	475.4	457.1	468.2
12	447.6	453.6	458.6	459.3	451.8	475.5	429.9	439.4	476.8max	481.8	462.1	474.0
13	442.6	471.7	471.3	430.0	450.2	473.2	447.0	442.2	460.9	416.7min	462.1	473.8
14	448.8	456.3	469.0	426.6min	460.5	479.6	442.7	455.6	461.2	431.1	464.0	473.1
15	446.7	465.9	438.0	453.8	454.8	466.8	442.9	452.2	456.8	455.3	466.4	477.7
16	461.9	430.9	438.3	451.1	452.2	465.6	446.7	459.7	473.0	456.4	475.0	479.8
17	451.9	431.8	430.1	447.9	463.9	468.2	445.5	469.8	482.5	451.7	477.3	484.9
18	459.6	426.1min	441.5	464.6	462.1	470.5	444.5	458.4	475.8	455.9	478.8	471.6
19	457.8	434.0	436.4	469.8	465.0	469.8	458.6	467.1	462.6	463.0	483.0	467.2
20	389.9min	443.5	441.5	470.7	474.4	473.6	448.6	472.5	456.7	476.7	486.5max	473.7
21	415.5	454.1	455.2	478.1	461.4	479.2	451.2	481.6max	472.2	479.8	479.3	459.2
22	429.7	463.6	467.4	475.2	455.8	469.7	439.2	471.6	469.1	484.1max	475.1	447.9min
23	435.6	460.6	466.0	469.3	468.6	456.9	444.5	446.2	480.0	472.0	458.1	449.7
24	451.2	458.9	471.7	463.4	469.1	435.2min	454.8	437.0	483.7	445.6	448.2	458.7
25	452.5	470.0	466.1	469.1	473.8	444.8	422.6min	454.8	457.7	429.6	442.2	460.1
26	466.6	464.1	477.2max	472.0	482.6	451.6	446.9	463.9	446.2	426.5	458.4	454.4
27	468.1max	465.2	474.3	469.3	476.8max	445.1	459.5	467.5	440.7	431.6	457.8	462.0
28	457.0	472.9max	471.1	471.3	462.8	448.3	449.4	471.1	439.4	442.5	468.6	468.5
29	454.2	469.7	460.6	482.7max	464.7	450.1	441.6	476.7	422.0min	423.1	469.5	467.1
30	465.0		462.1	474.3	463.5	457.2	448.0	452.9	443.4	437.3	474.5	474.8
31	441.4		460.4		463.5		456.4	466.7		452.3		464.6
Mean	**469.8**	**445.9**	**454.1**	**456.7**	**462.5**	**456.2**	**463.2**	**456.3**	**455.7**	**453.5**	**465.3**	**469.8**

Table 4.1a: Daily Mean Values of the Horizontal Intensity

Daily Mean Values of the Declination (Westerly)

Hyderabad — Daily Intervals Calculated in Terms of UTC, D= 0° + ' Tabulated Value — 2016

D	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	41.53	41.48	41.35	40.78	40.82	40.95	39.20	38.83	40.29	40.15	40.05	40.03
2	41.62	41.48	41.25	40.95	40.77	40.55	39.37	39.05	40.28	39.96	40.32	40.23
3	41.78	41.69max	41.46	40.67min	40.92	40.89	39.16	38.75	40.11	40.16	40.10	40.28
4	41.77max	41.65	41.41	41.01	40.93	40.44	39.01	38.58	40.40	40.20	40.31	40.41
5	41.64	41.62	41.05	40.76	40.62	40.50	39.01	38.68	40.32	40.16	40.37	40.64max
6	41.75	41.58	41.35	40.99	40.73	41.17	39.34	38.84	40.38	40.06	40.33	40.48
7	41.63	41.33	40.62	41.05	40.93	41.76max	39.15	38.77	40.63	40.46	40.31	40.19
8	41.68	41.64	41.09	41.02	40.57	40.54	39.28	38.69	40.40	40.27	40.04	40.56
9	41.55	41.31	41.08	41.05	40.40min	40.76	38.85	38.69	40.33	40.27	40.27	40.19
10	41.73	41.31	41.17	41.12	40.41	40.95	39.02	38.67	40.55	40.01	39.88	40.12
11	41.64	41.30	41.09	41.18max	40.78	40.52	39.02	38.54min	40.44	40.17	40.27	40.13
12	41.39	41.26	41.05	41.15	40.70	40.57	39.11	38.58	40.64	40.27	40.11	40.19
13	41.53	41.51	40.97	41.03	40.59	40.84	38.76	38.75	40.79	39.95	40.27	40.04
14	41.43	41.23	41.13	40.90	40.83	40.79	39.23	38.97	40.58	39.97	40.27	40.29
15	41.08	41.45	40.60min	40.97	41.02	40.64	38.88	38.58	40.49	40.24	40.05	40.18
16	41.75	41.39	41.04	41.04	41.42	40.51	38.80	39.93	40.89max	40.33	39.98	40.32
17	41.42	41.05	40.96	40.70	41.54	40.90	38.81	40.08	40.57	40.08	40.16	40.36
18	41.76	41.04min	41.16	40.85	40.68	40.98	38.74	40.50	40.42	40.42max	40.20	40.38
19	41.65	41.09	40.84	41.01	40.40	40.44	39.23	40.68	40.67	40.32	40.19	40.25
20	40.97min	41.47	40.91	40.91	41.13	40.66	38.96	40.60	40.73	40.40	40.43max	40.06
21	41.78	41.24	41.31	40.93	40.50	40.86	38.80	40.89	40.56	40.33	40.05	39.77min
22	41.60	41.09	41.31	41.05	40.49	40.35	39.01	40.63	40.39	40.21	40.24	39.80
23	41.14	41.09	41.02	40.87	41.91max	39.29	38.73	40.15	40.53	40.25	40.02	39.91
24	42.05	41.35	41.08	40.74	40.88	39.20	38.85	40.69	40.35	40.00	39.83min	39.91
25	41.66	41.67	41.01	41.00	41.18	39.20	38.68	40.51	40.39	39.97	39.84	39.91
26	41.62	41.46	41.22	41.15	41.04	39.43	38.93	40.54	39.93min	39.95	39.91	40.13
27	41.70	41.49	40.91	41.01	40.39	39.15min	39.45max	40.53	40.12	39.99	40.06	40.01
28	41.65	41.45	41.53max	40.85	40.79	39.30	38.66	40.35	40.20	40.13	39.94	40.03
29	41.46	41.39	40.99	41.39	41.67	39.18	38.95	40.94	39.82	39.79min	40.12	40.13
30	41.60		41.11	40.79	40.42	39.26	38.46	40.29	40.15	40.15	40.21	39.95
31	41.36		41.13	40.96			39.21min	41.06max		39.88		39.89
Mean	**41.58**	**41.38**	**41.10**	**40.88**	**41.83**	**40.35**	**38.99**	**39.66**	**40.41**	**40.14**	**40.14**	**40.15**

Table 4.1b: Daily Mean Values of the Declination (Westerly)

Daily Mean Values of the Vertical Intensity

Hyderabad Daily Intervals Calculated in Terms of UTC, Z= 17000 + Tabulated Value 2016

D	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	749.5	758.7	767.5min	778.5	789.8min	800.4min	817.7min	826.1	820.2min	829.7	839.5	847.5min
2	749.6	757.6min	768.3	777.7min	791.5	800.4min	818.3	828.2	823.0	829.1min	839.4min	847.7
3	749.3	759.8	768.4	778.9	791.4	800.6	818.3	830.3	823.0	830.3	841.9	847.9
4	749.5	759.2	769.3	779.4	791.7	801.9	817.8	830.6	822.2	830.1	840.5	847.1
5	749.5	759.4	769.8	779.0	791.4	804.1	818.0	829.3	822.1	830.8	840.0	847.6
6	749.0min	759.2	769.5	779.7	794.5	804.6	819.8	829.7	823.2	830.6	839.2	848.4
7	750.5	760.7	770.7	779.3	794.3	802.7	819.6	830.0	823.2	832.1	840.0	847.5
8	751.3	761.7	771.1	781.4	797.1	802.7	821.4	830.5	824.8	831.0	840.4	848.9
9	751.5	761.4	769.7	781.3	794.6	802.7	820.9	830.6	824.5	831.7	840.4	848.8
10	750.2	761.5	772.0	781.0	795.0	804.0	821.0	830.3	823.5	831.7	842.6	850.5
11	750.7	761.8	771.1	782.2	795.1	803.3	821.1	831.5	823.4	831.5	842.4	850.8
12	750.9	762.4	772.0	780.6	795.0	805.0	822.1	830.8max	823.4	832.9	842.3	850.6
13	752.3	762.3	772.3	783.5	796.6	804.3	821.8	831.1	824.1	836.1	841.2	850.9
14	753.4	763.3	769.9	786.0	796.7	803.9	822.6	831.3	823.9	834.9	842.6	851.4
15	754.0	762.4	772.6	784.7	797.3	804.8	823.3	830.7	823.8	834.8	842.4	851.9
16	752.6	763.5	773.8	785.9	798.0	805.7	823.0	817.4	824.1	834.4	841.9	851.8
17	754.0	763.9	773.8	786.9	796.4	806.5	823.0	818.0	823.4	834.4	843.2	852.0
18	754.7	764.8	775.2	784.7	797.3	805.9	822.9	818.2	825.0	834.4	842.9	853.3
19	754.2	765.3	775.0	785.3	797.4	805.9	824.2	819.7	825.6	834.2	843.3	853.2
20	755.2	766.2	774.7	785.3	798.3	805.8	822.5	818.2	825.2	834.2	843.7	853.8
21	756.6	766.4	775.4	784.6	798.7	806.0	822.9	818.1min	825.4	834.5	844.0	853.4
22	755.8	765.9	775.6	784.6	798.2	807.4	825.4	818.4	825.5	834.4	844.3	853.5
23	756.8	764.7	775.2	785.3	797.7	815.3	824.4	820.8	825.2	835.8	845.7	853.9
24	755.3	766.1	774.9	787.0	798.4	815.0	824.6	821.4	824.5	837.2	845.2	854.8
25	756.6	766.9	775.4	787.3	798.6	815.1	826.9	820.9	827.4	837.4	846.9	855.0
26	755.3	766.7	777.0	786.7	799.3	814.8	825.1	819.2	828.9	838.0	847.2	855.8
27	756.6	767.4max	776.7	786.5	800.2	815.5	824.9	819.0	829.4	837.1	847.4max	855.0
28	757.1	766.5	776.6	787.6	800.7	815.7	826.0	819.7	828.5	837.8	846.2	856.2
29	757.9max	765.9	777.6	788.9max	799.4	816.1	826.3max	820.7	830.1max	839.2max	846.8	857.1max
30	757.1		778.3max	788.3	801.3max	817.2max	824.9	821.5	829.2	839.2max	848.0	856.5
31	758.5		777.8		800.3		825.5	820.7		839.2max		856.6
Mean	**753.4**	**763.2**	**773.1**	**783.6**	**796.5**	**807.1**	**822.5**	**824.6**	**824.9**	**834.2**	**843.0**	**851.9**

Table 4.1c: Daily Mean Values of the Vertical Intensity

Daily Mean Values of Total field

Hyderabad Daily Intervals Calculated in Terms of UTC, F= 43000 + Tabulated Value 2016

D	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	210.54 min	254.06	286.06	294.74	282.66	288.08	283.45	292.43	282.63	292.14	299.26	329.46
2	242.52	274.73	286.65	282.33	267.11	297.05	291.71	313.15	273.24	293.79	296.62	323.39
3	249.17	255.56	284.62	257.02	269.00	299.14	286.57	260.73min	267.22	299.48	287.37min	328.20
4	258.30	276.38	281.40	273.74	279.18	305.22	284.72	268.91	276.78	286.64	306.14	331.56
5	269.74	266.54	285.11	275.88	284.14	305.00	282.65	268.13	283.29	292.85	312.93	335.07max
6	256.27	271.56	270.91	279.51	282.88	268.66	292.38	271.97	290.02	303.80	316.48	330.06
7	254.46	268.69	226.84min	288.13	286.70	290.92	283.38	277.84	288.13	303.98	322.59	314.91
8	258.39	258.44	255.65	272.70	233.43	282.40	264.22	275.25	284.47	304.71	319.41	315.05
9	263.24	269.74	261.33	291.83	252.12min	297.81	275.09	279.15	299.30	306.42	320.34	310.86
10	268.21	267.36	270.89	289.91	257.42	308.85	279.97	274.77	298.43	303.97	287.63	307.69
11	258.43	258.21	278.57	295.45	275.16	296.06	279.07	286.57	301.33	315.95	303.73	317.26
12	257.45	267.65	276.13	280.31	279.38	305.09	266.08	278.33	313.87	322.36	308.26	322.55
13	253.43	284.07	287.84	254.81	278.59	302.74	281.55	280.95	299.63	264.37	307.84	322.47
14	259.56	270.53	284.75	252.76min	287.98	308.36	277.98	293.21	299.90	276.97	310.08	322.02
15	257.89	278.90	257.65	276.98	283.08	297.05	278.39	289.93	295.78	299.03	312.19	326.40
16	271.17	247.42	258.37	275.06	281.02	296.39	281.71	295.86	310.68	299.80	319.83	328.30
17	262.68	248.35	250.87	272.46	291.04	299.11	280.62	305.28	319.04max	295.55	322.45	333.00
18	269.99	243.52min	261.87	286.88	289.76	300.92	279.65	294.93	313.59	299.36	323.71	321.50
19	268.13	251.01	257.15	291.80	292.46	300.25	293.08	303.55	301.87	305.70	327.74	317.38
20	206.59	260.05	261.71	292.65	301.34	303.70	283.26	307.81	296.25	318.28	331.07max	323.55
21	230.57	269.71	274.46	299.13	289.65	308.88max	285.79	316.08max	310.49	321.17	324.66	310.17
22	243.17	278.23	285.70	296.41	284.33	300.79	275.91	307.06	307.70	325.07max	320.94	299.93min
23	248.93	274.99	284.21	291.38	295.85	287.88	280.35	284.89	317.50	314.62	306.03	301.75
24	262.58	274.03	289.23	286.72	296.55	267.97min	289.78	276.80	320.63	291.13	296.74	310.29
25	264.25	284.42	284.41	292.06	300.91	276.73	261.34min	292.78	298.13	276.68	292.03	311.66
26	276.62	279.03	295.15max	294.42	309.23max	282.85	282.85	300.40	288.22	274.08	306.85	306.82
27	278.45max	280.27	292.40	291.85	304.31	277.20	294.24max	303.53	283.41	278.37	306.42	313.41
28	268.59	286.91max	289.43	294.10	291.79	280.23	285.45	307.19	281.90	288.53	315.79	319.77
29	266.34	283.75	280.27	305.04max	292.96	282.01	278.41	312.62	266.70min	271.46min	316.84	318.86
30	275.84		281.90	297.20	292.70	288.89	283.68	291.34	285.77	284.44	321.89	325.66
31	254.92		280.14		292.24		291.63	303.56		298.09		316.41
Mean	**210.54**	**254.06**	**286.06**	**294.74**	**282.66**	**288.08**	**283.45**	**292.43**	**282.63**	**292.14**	**299.26**	**329.46**

Table 4.1d: Daily Mean Values of the Total Field

4.2. Absolute Measurements

Table 4.2.1: Offset values for the year 2016 (F value difference from DFM sensor room to absolute pillar1 at absolute room-1):

Date	Offset value
01.12.2015	-129.49
30.11.2016	-134.60

Throughout the year, the absolute measurements were carried out as follows:
Two absolute measurements are taken using the Wild DI-flux theodolite on pillar No.1 (Absolute room-I) twice per week, if required trice in a week. The corresponding total field measurement is taken from GSM Overhauser magnetometer located in DFM sensor room. Therefore, the F measurement values, obtained are corrected by means of the corresponding offset to the pillar No.1 (Absolute room-I). we get the baselines of H, D, Z from absolute values of H, D & Z by removing the respected variations of H, D & Z from FGE variometer.

The deviations ΔH, ΔD and ΔZ of the absolute measurements from the observed base values are shown in table shows the adopted base values as lines and small squares indicate the actual absolute measurements.

The following is the table of observed baselines H, D & Z (January to December) by means of the Wild-T & Mag-01H DI-Flux magnetometer and the GSM 19 Overhauser effect proton magnetometer, reduced with FGE variometer recordings.

In figure 4.2a black colour small squares indicates observed baseline values, the red line is the adopted baselines for all days. This adopted baselines are reduced using polynomial for the observed baseline values. This adopted values are added to daily variations of Magnetic field.
During 2016, 54 absolute observations carried out. Out of that 27 observations are considered for the baseline construction for 2016. H baseline change during 2016 is about 1nT, D baseline change is 0.2min and Z baseline change is 0.5 nT. Comparing to previous year this baselines are stable. From the baseline values table ΔH, ΔD and ΔZ gives the information about the consistency of the baselines.

Month	Day	Time in UT	Horizontal Intensity H/nT	ΔH/nT	Declination (Westerly) D	ΔD/'	Vertical intensity Z/nT	ΔZ/nT
Jan	01	05:41	39397.22	-0.77	1°05.82'	+0.03	17492.64	-0.21
Jan	05	04:40	39397.06	-0.16	1°05.79'	-0.03	17492.64	0.00
Jan	14	05:52	39396.86	-0.20	1°05.81'	+0.02	17492.41	-0.23
Jan	22	04:18	39397.12	+0.26	1°05.82'	+0.01	17491.96	-0.45
Feb	01	04:34	39397.12	0.00	1°05.72'	-0.10	17491.69	-0.27
Feb	11	04:55	39396.77	-0.35	1°05.85'	+0.12	17491.92	+0.23
Feb	23	04:20	39396.48	-0.29	1°05.86'	+0.01	17492.31	+0.41
Feb	29	04:38	39396.29	-0.19	1°05.83'	-0.03	17492.40	+0.09
Mar	07	04:22	39396.47	+0.18	1°05.88'	+0.05	17492.29	-0.11
Mar	17	06:36	39396.07	-0.40	1°05.83'	-0.05	17492.02	-0.27
Apr	01	04:54	39397.58	+1.51	1°05.90'	+0.07	17492.83	+0.81
July	19	04:43	39396.80	-0.78	1°05.65'	-0.25	17492.40	-0.43
Aug	01	07:16	39397.20	+0.40	1°05.44'	-0.21	17492.70	+0.30
Aug	09	10:56	39397.20	0.00	1°05.89'	+0.45	17492.90	+0.20
Aug	19	11:39	39397.20	0.00	1°05.95'	+0.14	17492.60	+0.30
Aug	26	12:30	39397.80	+0.60	1°06.00'	+0.05	17492.80	+0.20
Aug	30	11:01	39397.50	-0.30	1°06.04'	+0.04	17493.50	+0.70
Sept	06	11:45	39397.10	-0.40	1°05.98'	-0.06	17493.00	-0.50
Sept	14	11:22	39397.60	+0.50	1°06.03'	+0.05	17493.30	+0.30
Sept	20	11:02	39397.40	-0.20	1°05.95'	-0.08	17493.40	+0.10
Oct	05	11:31	39367.20	-0.20	1°06.16'	+0.21	17493.20	-0.20
Nov	30	07:30	39397.10	-0.10	1°06.08'	-0.08	17493.00	-0.20
Dec	02	06:23	39397.10	0.00	1°06.22'	+0.14	17493.00	0.00
Dec	09	04:49	39397.30	+0.20	1°06.05'	-0.17	17492.80	-0.20
Dec	20	05:52	39397.10	-0.20	1°06.05'	0.00	17492.80	0.00
Dec	27	04:06	39397.10	0.00	1°06.15'	+0.10	17492.80	0.00
Dec	31	04:10	39397.10	0.00	1°06.08'	-0.07	17492.90	+0.10

Table 4.2.2: Observed baselines H, D & Z (January to December) by means of the Wild- T & Mag-01H DI-Flux magnetometer and the GSM 19 Overhauser effect proton magnetometer, reduced with FGE variometer recordings.

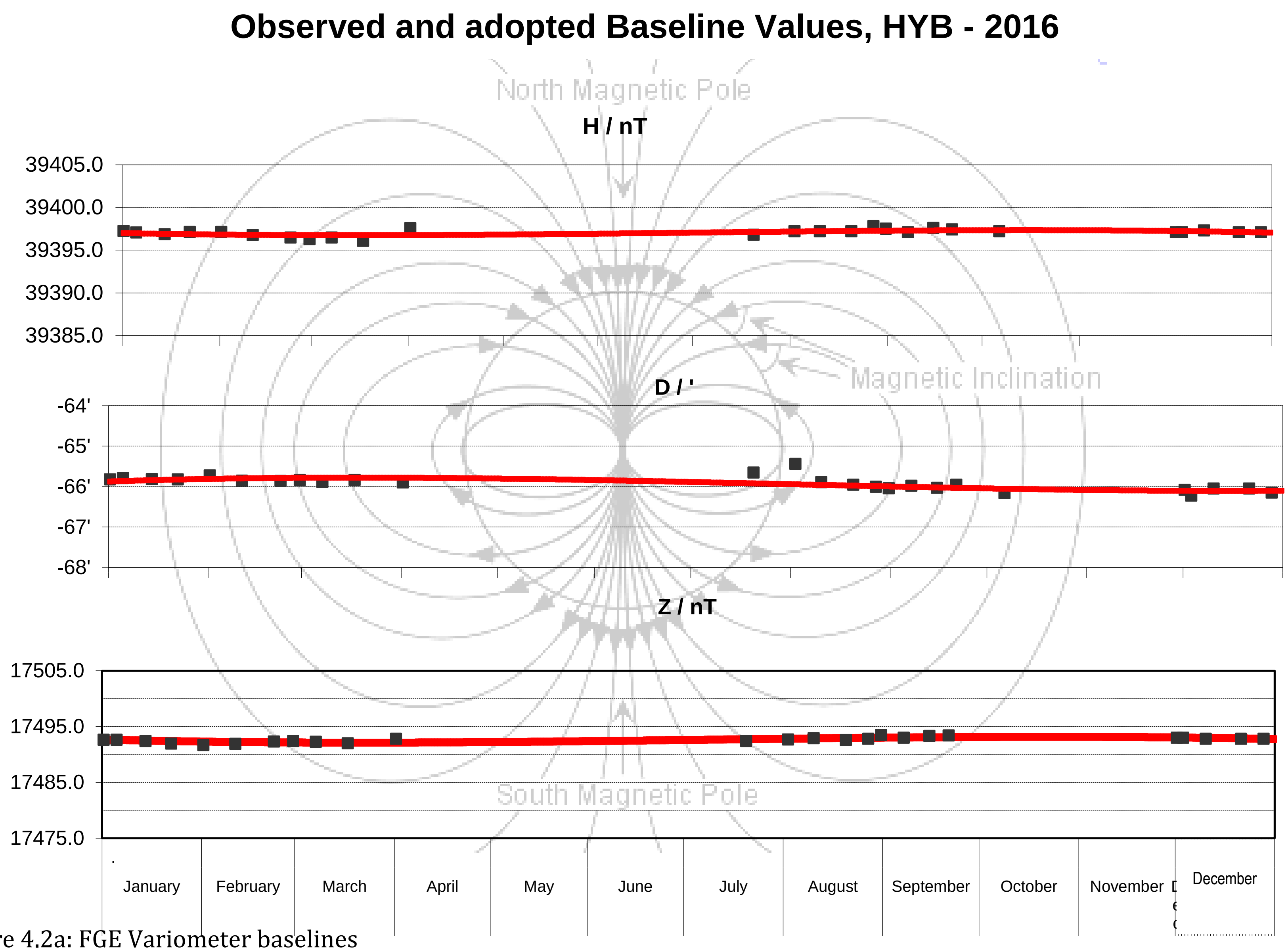
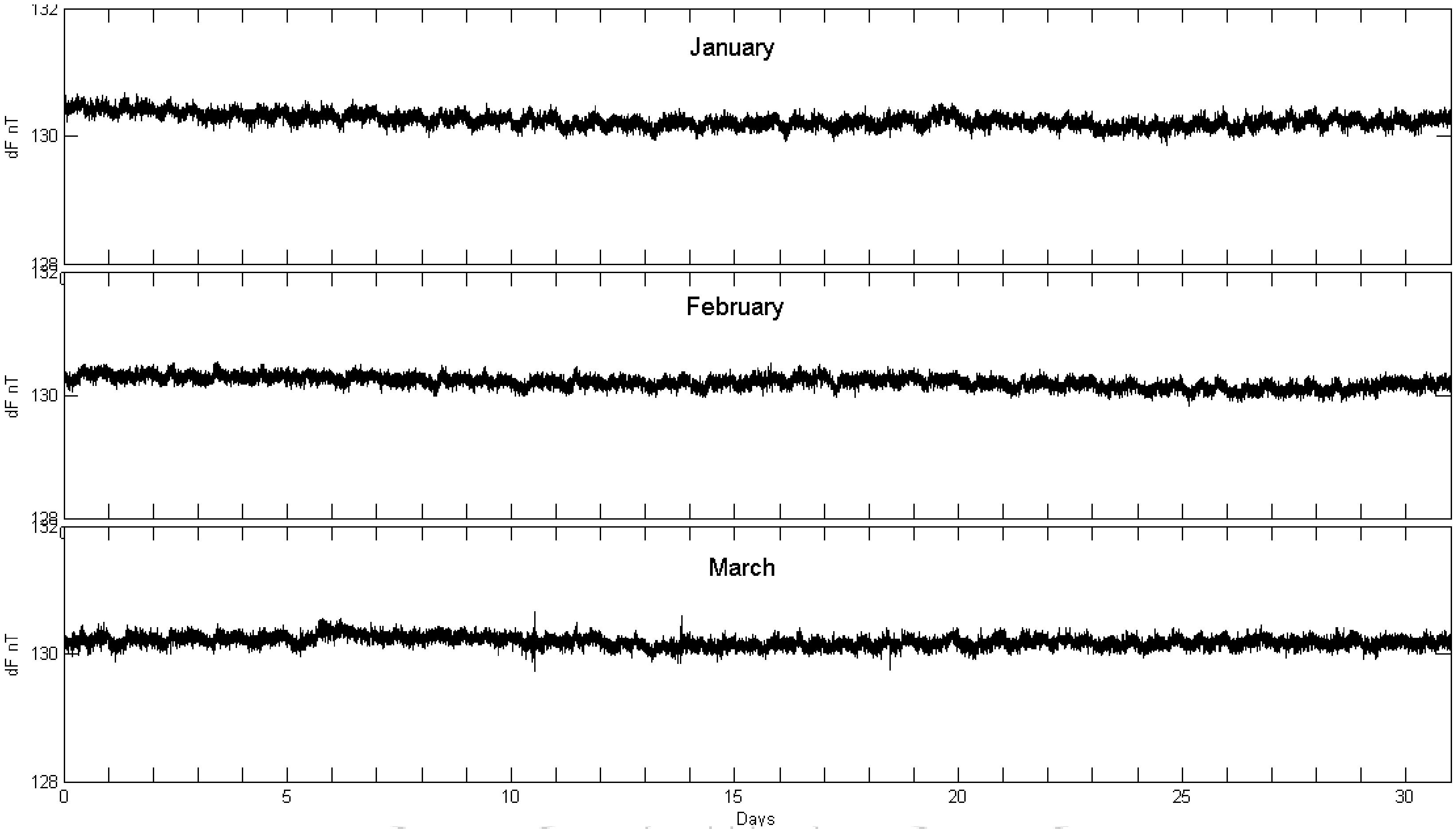


Figure 4.2a: FGE Variometer baselines

4.3. Monthly ΔF plots of HYB



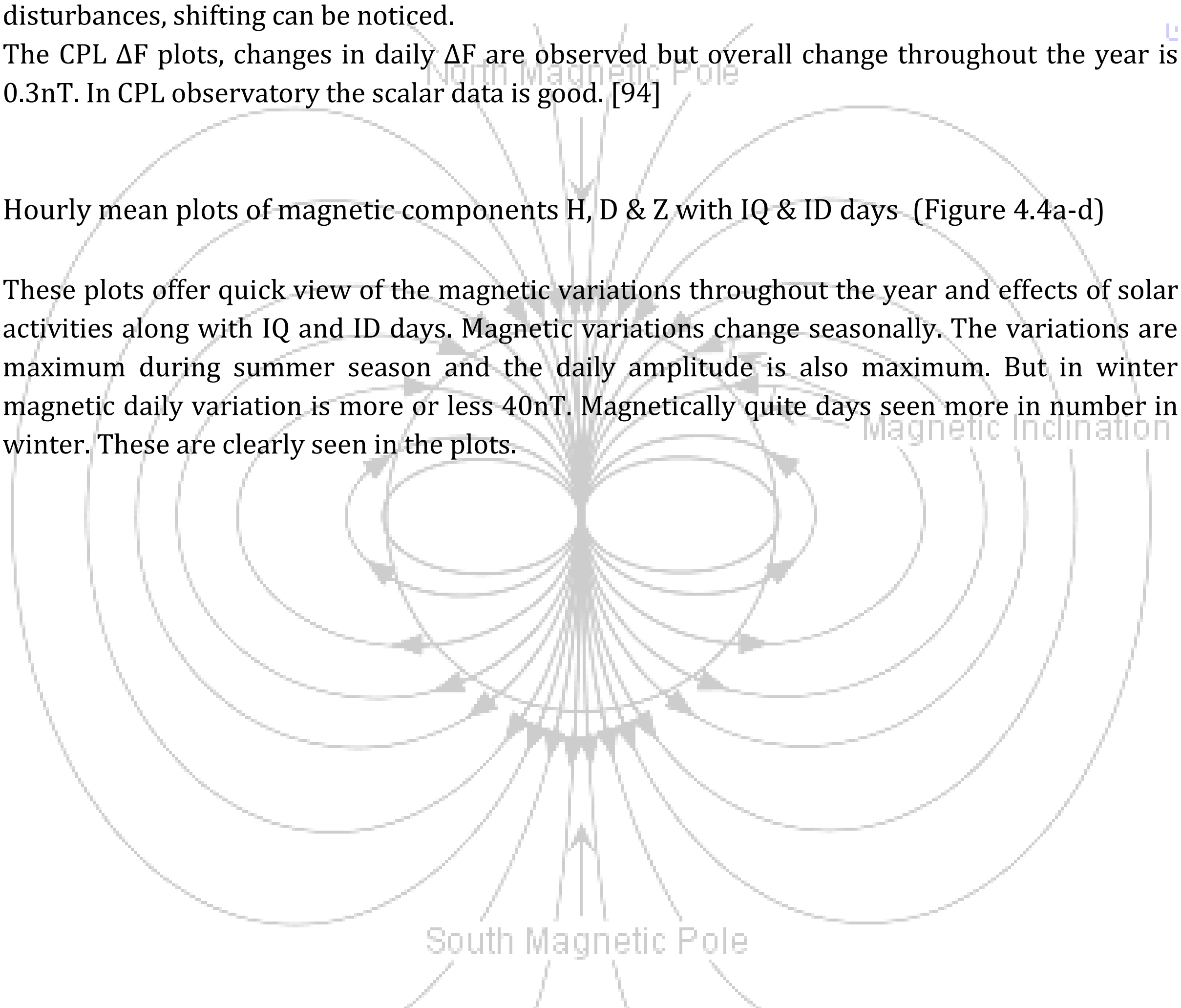
4.3. Monthly ΔF plots:

ΔF is the difference between the recorded total field and calculated total field from the variometer recording system means from H & Z. These plots are indicators of the quality of scalar data (Total field) as well as vector data (fluxgate data). These ΔF plots use to check the FGE & GSM data quality. From ΔF is the difference between calculated F (Total field) from H & Z component and scalar F (total field). The difference between these two should be constant. If it is varying, we have to check the data recording systems. At the HYB ΔF plots, the ΔF value looks stable, the ΔF change during three months is 0.2nT only. During highly active days the ΔF plots also having disturbances, shifting can be noticed.

The CPL ΔF plots, changes in daily ΔF are observed but overall change throughout the year is 0.3nT. In CPL observatory the scalar data is good. [94]

Hourly mean plots of magnetic components H, D & Z with IQ & ID days (Figure 4.4a-d)

These plots offer quick view of the magnetic variations throughout the year and effects of solar activities along with IQ and ID days. Magnetic variations change seasonally. The variations are maximum during summer season and the daily amplitude is also maximum. But in winter magnetic daily variation is more or less 40nT. Magnetically quite days seen more in number in winter. These are clearly seen in the plots.



4.4. Hourly means of H, D & Z with IQ & ID days

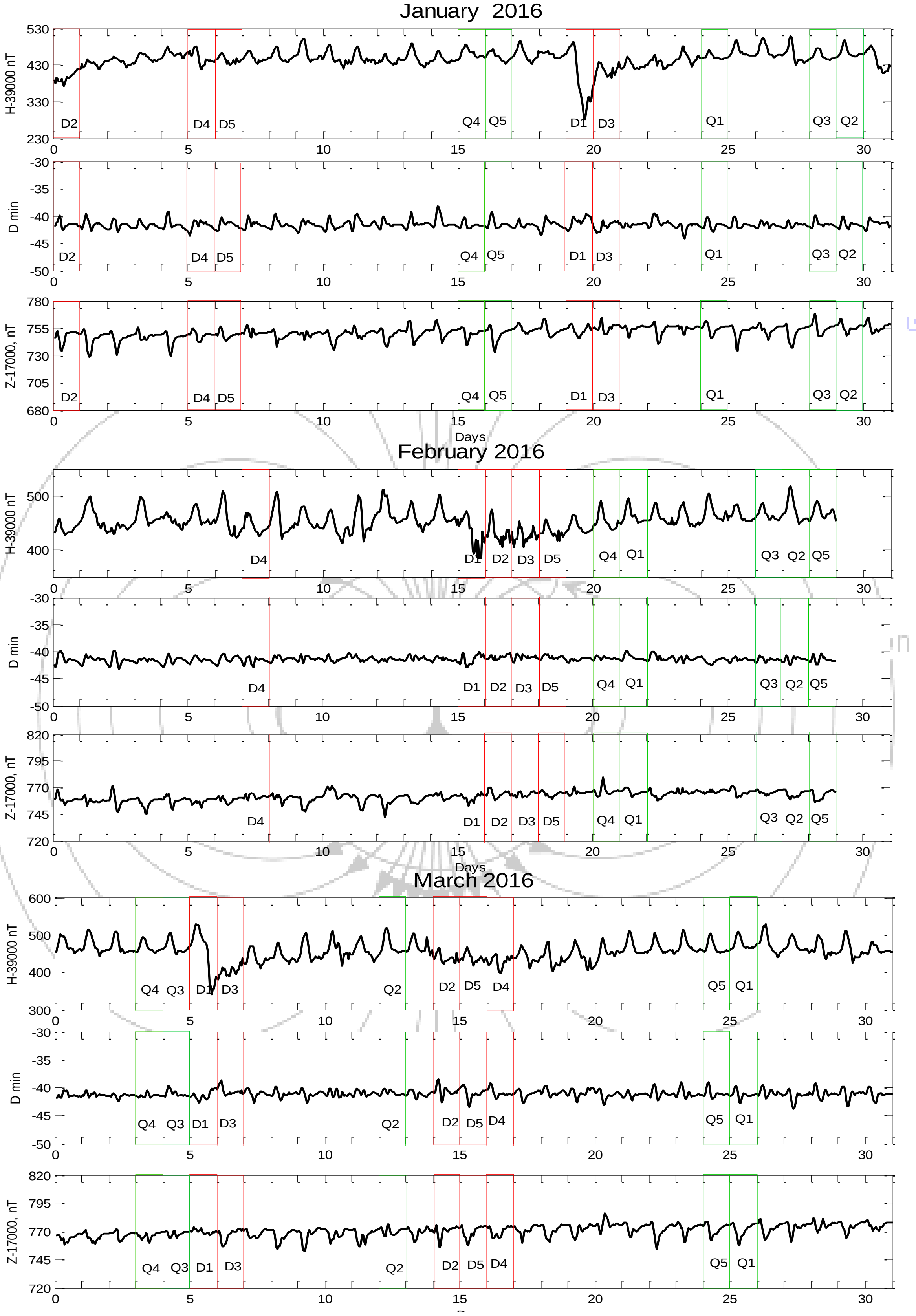


Figure 4.4a: Hourly mean plots of H, D and Z with IQ and ID days from January to March 2016

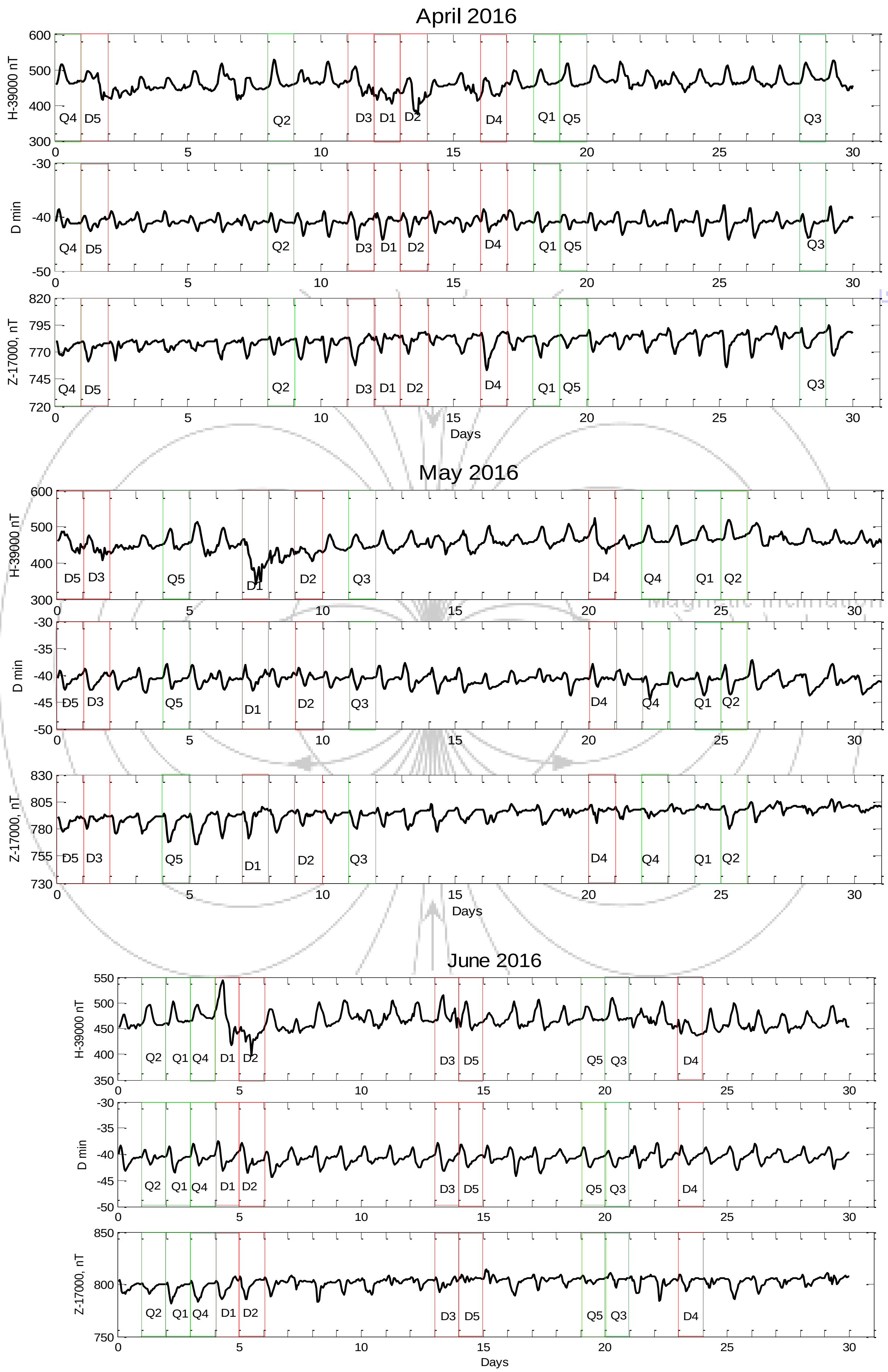


Figure 4.4b: Hourly mean plots of H, D and Z with IQ and ID days from April to June 2016

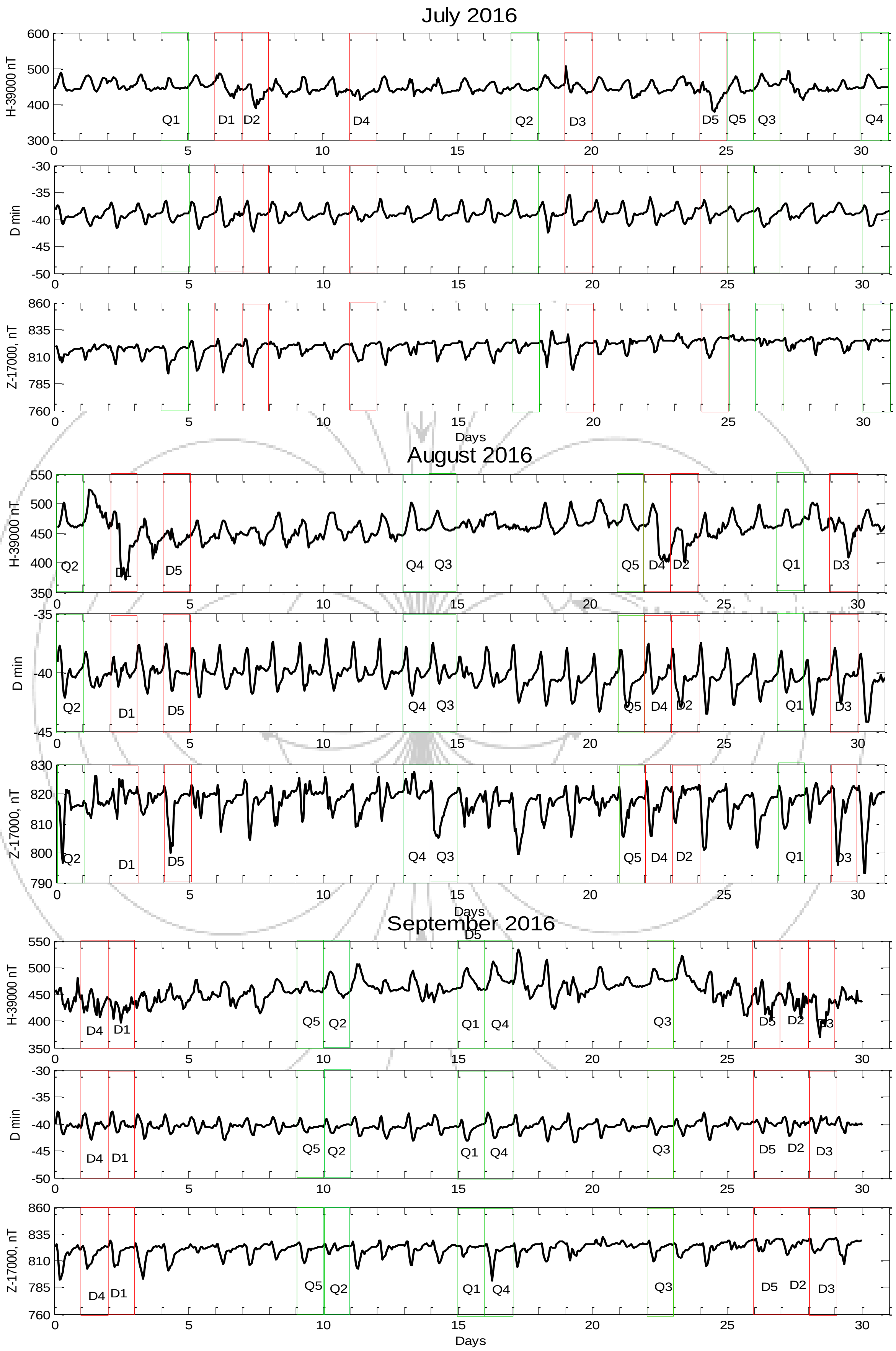


Figure 4.4c: Hourly mean plots of H, D and Z with IQ and ID days from July to September 2016

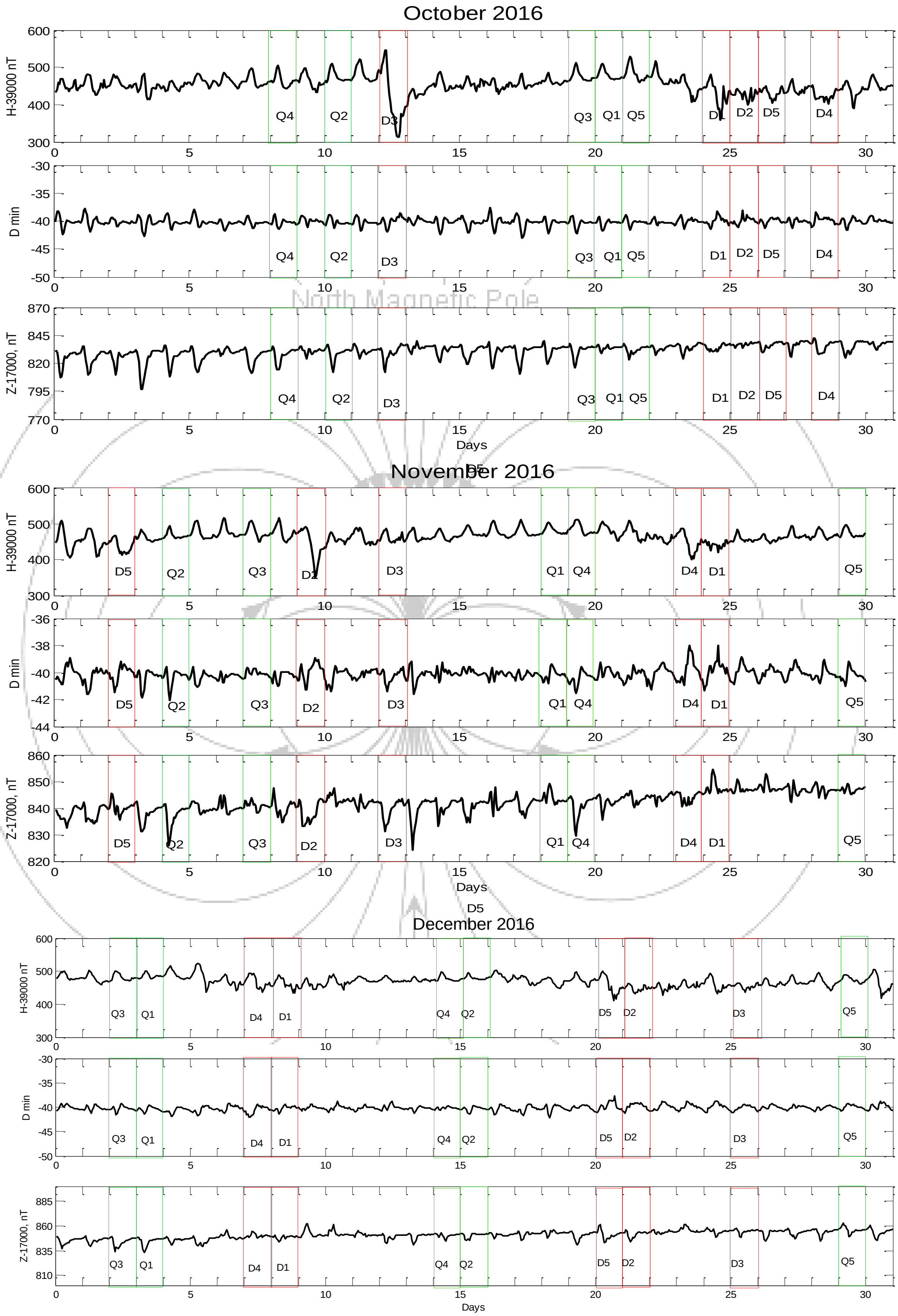


Figure 4.4d: Hourly mean plots of H, D and Z with IQ and ID days from October to December 2016

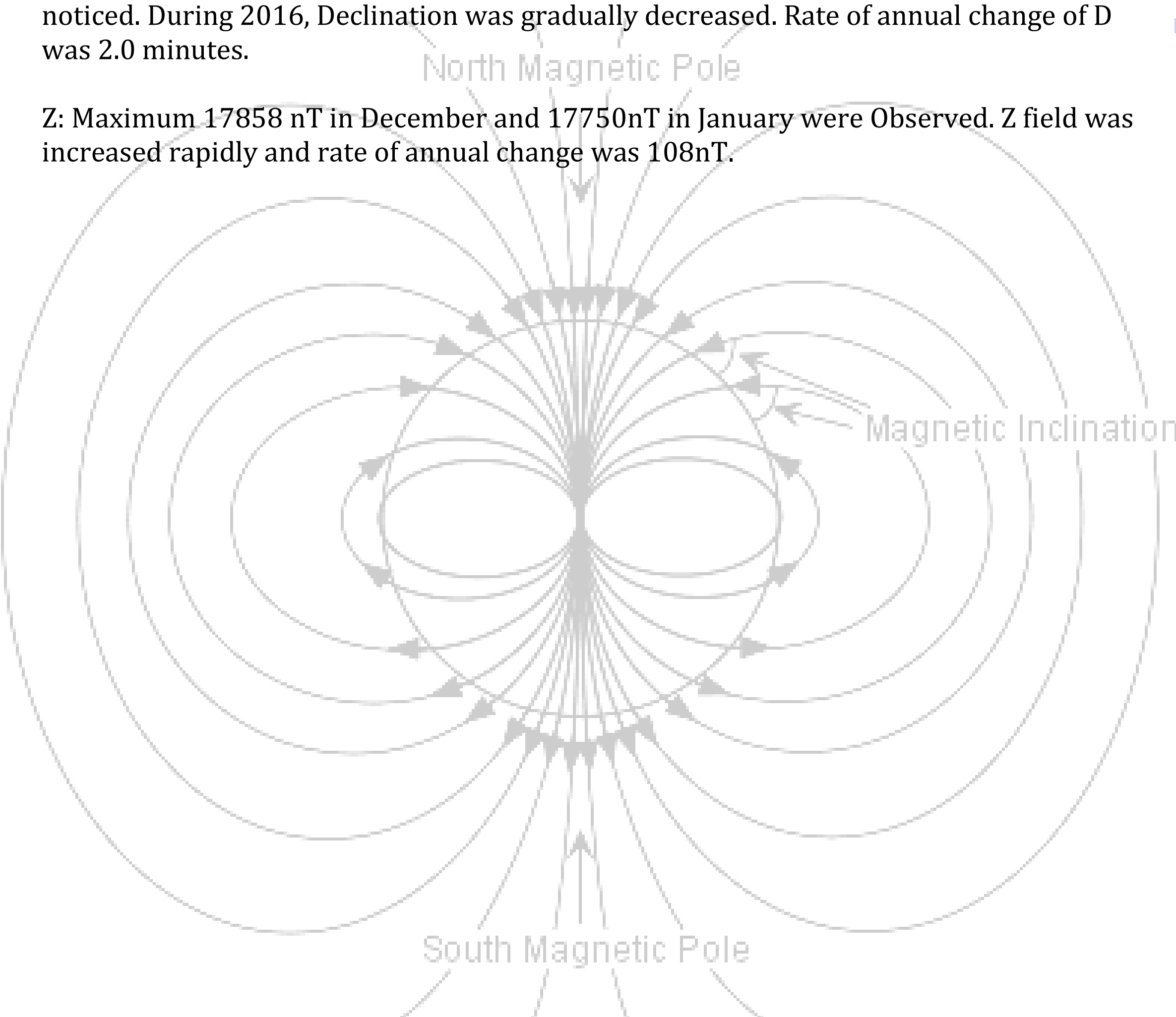
4.5. Annual Variations based on Daily Means

Based on daily means of diurnal variations of H, D and Z this annual variations were observed. It helps to have a quick look of variations of daily means and helps to know the magnetic field changes throughout the year 2016.

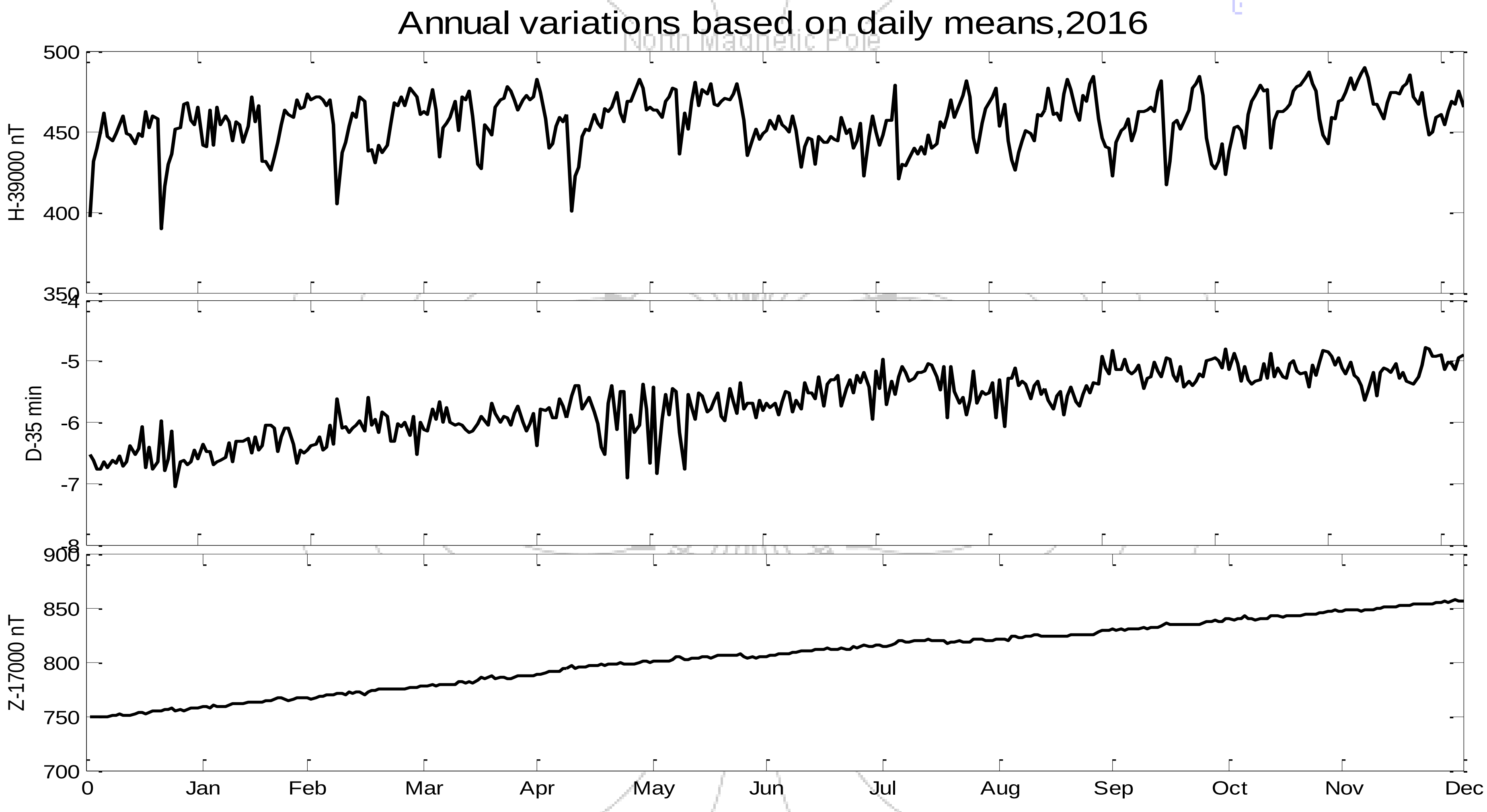
The minimum and maximum of HDZ of 2016:
H: Maximum 3949OnT in December and minimum 39474nT in January were observed. In the month of June maximum magnetic activity is observed. The rate of annual change of H field is 25nT. The of change was stable during 2016.

D: Maximum 42.2 minutes in January and minimum 40.40 minutes in December were noticed. During 2016, Declination was gradually decreased. Rate of annual change of D was 2.0 minutes.

Z: Maximum 17858 nT in December and 17750nT in January were Observed. Z field was increased rapidly and rate of annual change was 108nT.



Hyderabad


Annual variations based on daily means,2016
H-39000 nT
500
450
400
350
D-35 min
-4
-5
-6
-7
-8
Z-17000 nT
900
850
800
750
700
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

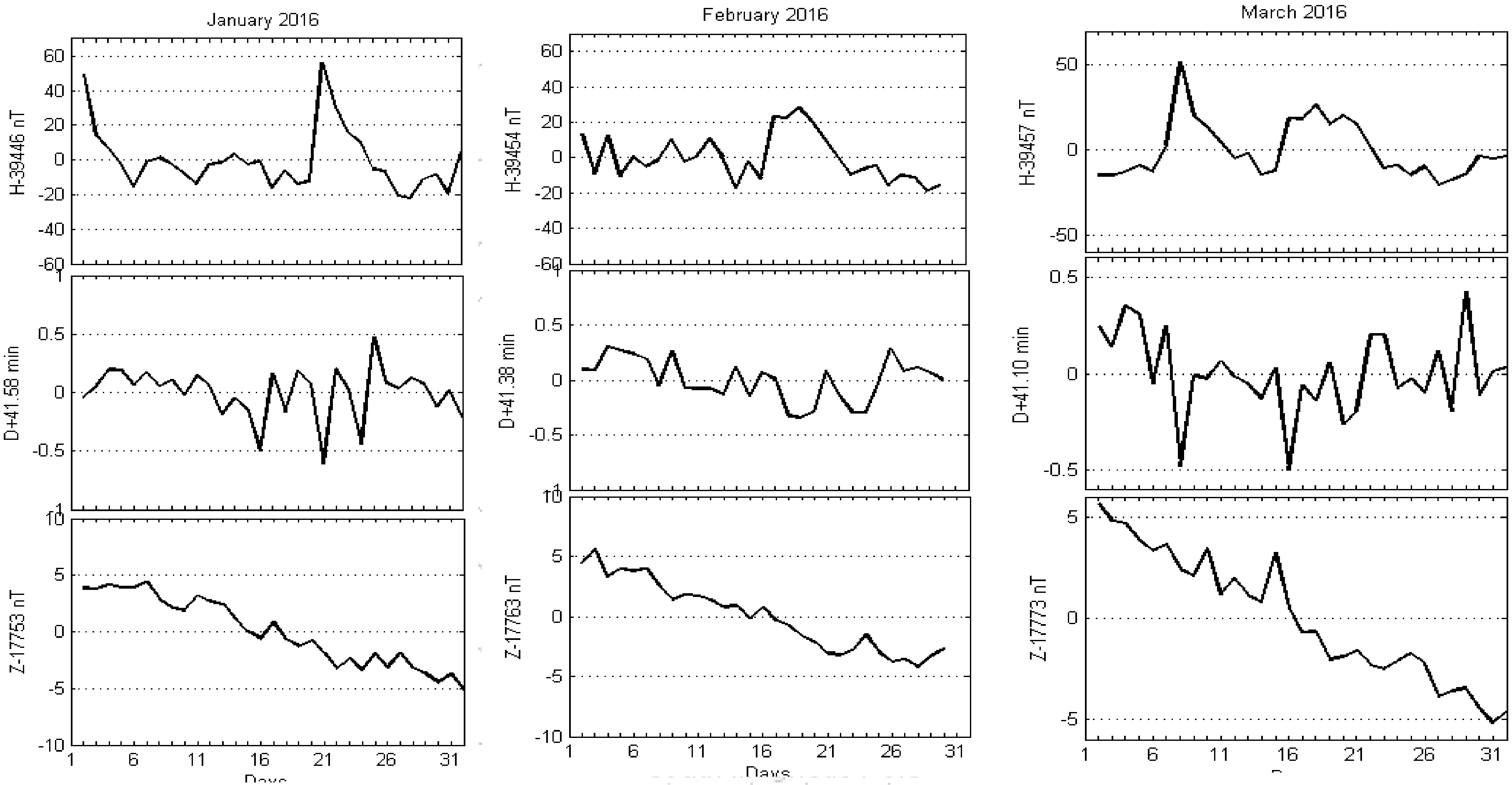
4.6. Monthly and Annual Means values of HYB, 2016

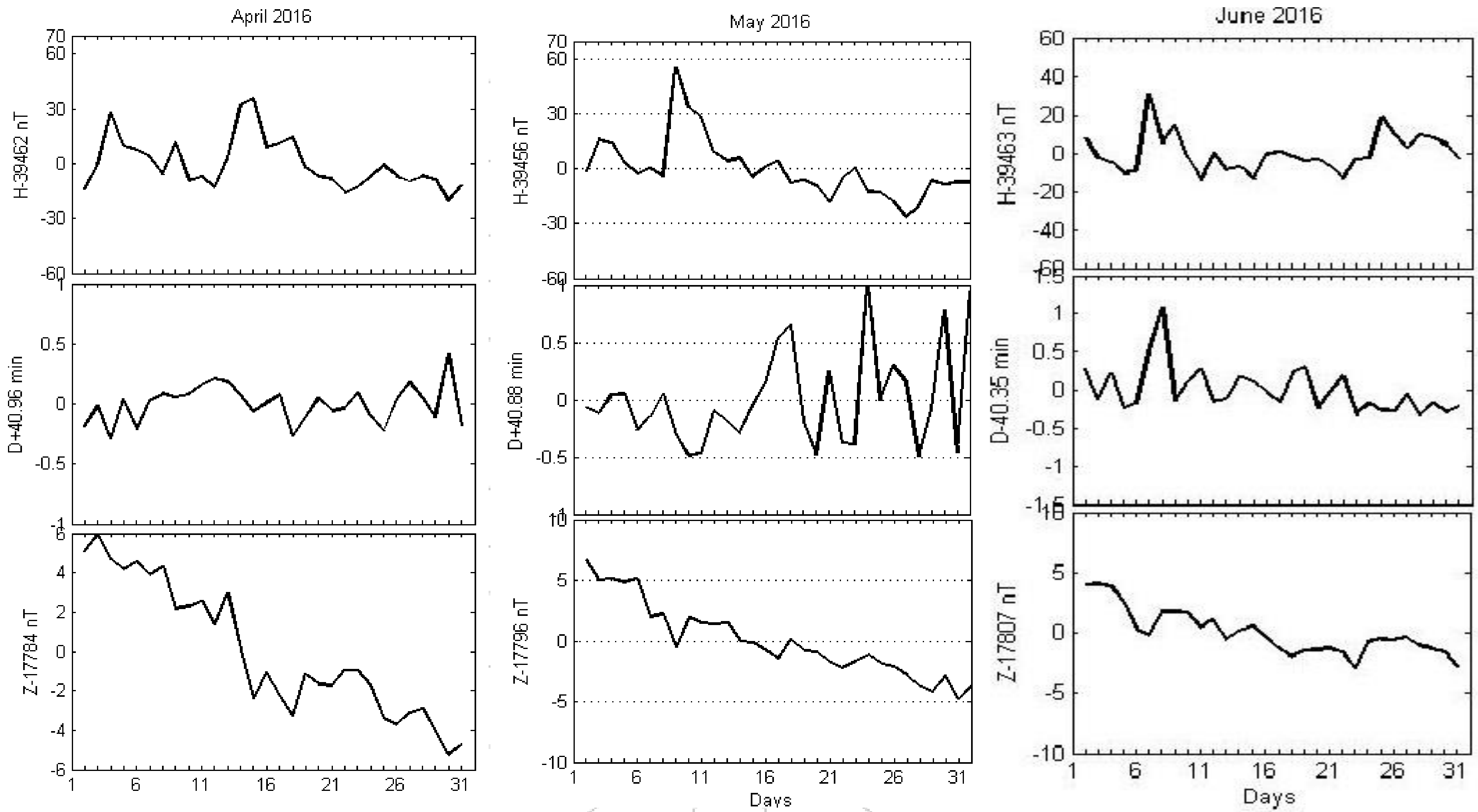
Month	D	I	H(nT)	Z(nT)	F(nT)
Jan	0° 40.15'	24° 20.21'	39469.8	17851.9	43319.2
Feb	0° 41.58'	24° 13.86'	39446.0	17753.4	43257.0
Mar	0° 41.38'	24° 14.30'	39454.1	17763.2	43268.4
Apr	0° 41.10'	24° 14.94'	39456.7	17773.1	43274.9
May	0° 40.96'	24° 15.51'	39462.5	17783.6	43284.4
Jun	0° 40.88'	24° 16.52'	39456.2	17796.5	43284.0
Jul	0° 40.35'	24° 17.19'	39463.2	17807.1	43294.7
Aug	0° 39.66'	24° 18.77'	39453.4	17824.6	43293.0
Sep	0° 40.41'	24° 18.71'	39455.7	17824.9	43295.2
Oct	0° 40.14'	24° 19.46'	39453.5	17834.2	43297.1
Nov	0° 40.14'	24° 19.72'	39465.3	17843.0	43311.5
Dec	0° 40.15'	24° 20.23'	39469.8	17851.9	43319.2
Year	**0° 40.58'**	**24° 17.45'**	**39458.8**	**17809.0**	**43291.6**

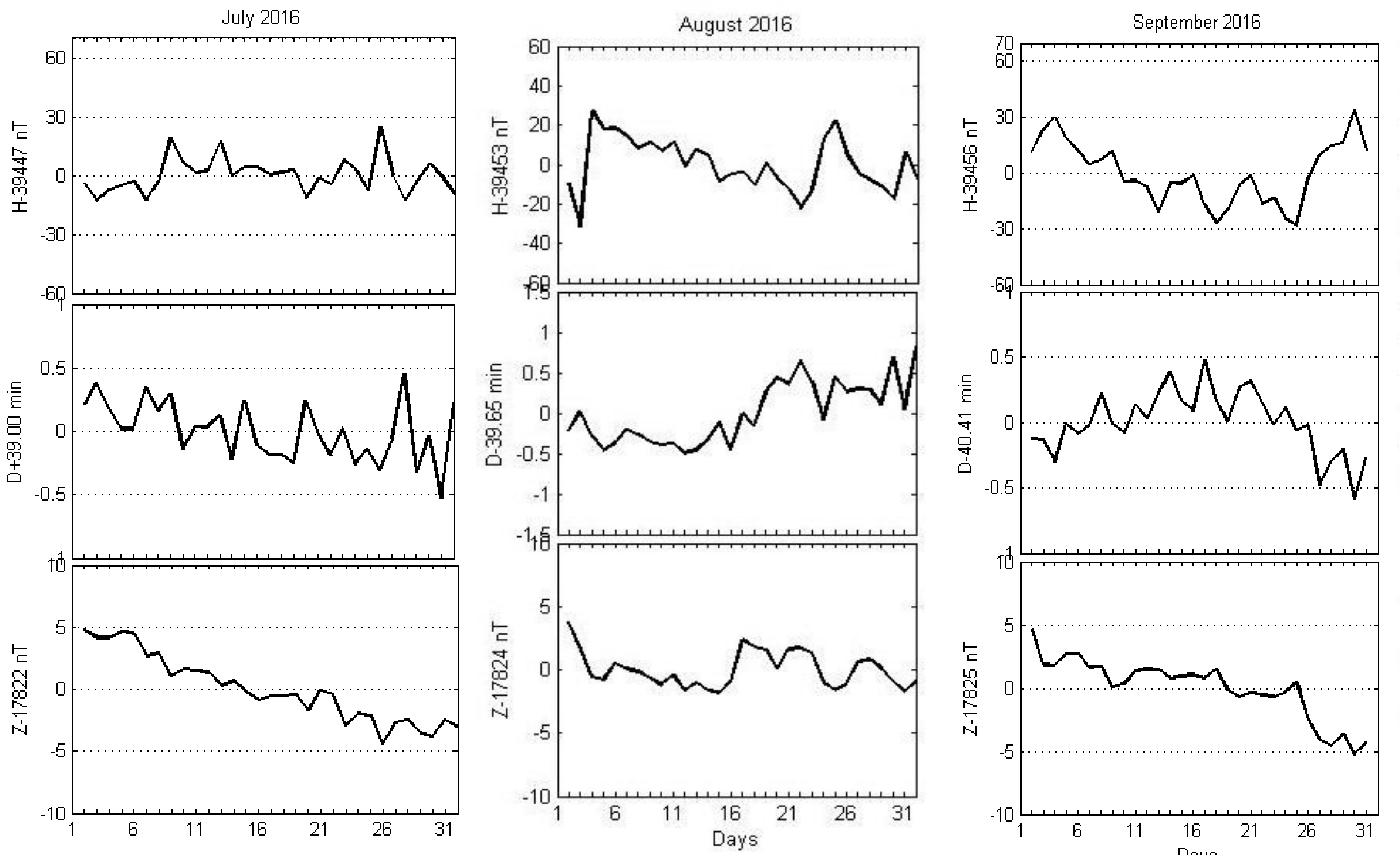
4.7. Deviation of the Monthly means from the Annual mean values of HYB, 2016

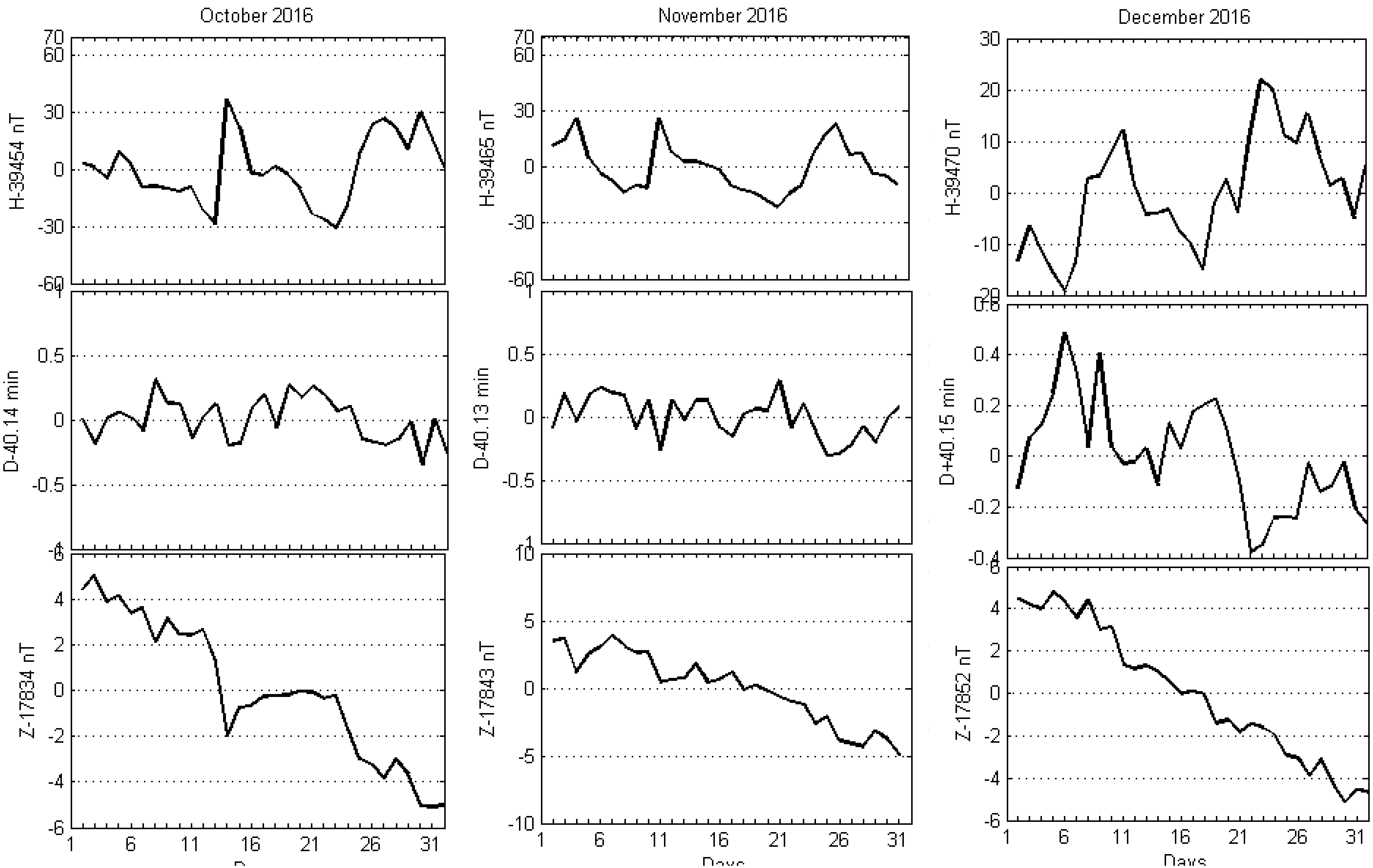
Month	D (')	I (')	H (nT)	Z (nT)	F (nT)
Jan	-0.42	-2.76	-10.94	-42.97	-27.66
Feb	1.00	3.59	12.88	55.55	34.57
Mar	0.81	3.15	4.73	45.80	23.13
Apr	0.53	2.51	2.12	35.81	16.66
May	0.39	1.94	-3.63	25.34	7.11
Jun	0.30	0.93	2.64	12.43	7.52
Jul	-0.22	0.26	-4.34	1.84	-3.20
Aug	-0.92	-1.32	5.48	-15.65	-1.45
Sep	-0.17	-1.26	3.18	-15.91	-3.65
Oct	-0.43	-2.01	5.34	-25.21	-5.51
Nov	-0.44	-2.26	-6.45	-34.10	-19.91
Dec	-0.42	-2.78	-10.94	-42.97	-27.66

4.8. Deviations of Daily means from the Monthly Mean of components H, D & Z, 2016




April 2016
May 2016
June 2016
H-39462 nT
D+40.96 min
Z-17784 nT
H-39456 nT
D+40.88 min
Z-17796 nT
H-39463 nT
D-40.35 min
Z-17807 nT
Days
Days


July 2016
August 2016
September 2016
H-39447 nT
D+39.00 min
Z-17822 nT
H-39453 nT
D-39.65 min
Z-17824 nT
H-39456 nT
D-40.41 min
Z-17825 nT
Days


October 2016
November 2016
December 2016
H-39454 nT
H-39465 nT
H-39470 nT
D-40.14 min
D-40.13 min
D+40.15 min
Z-17834 nT
Z-17843 nT
Z-17852 nT
Days

4.8. Deviations of Daily mean from monthly mean of Magnetic components

From this deviation plots it can easy to recognise most disturbed (it may be natural or artificial), quiet days. Maximum field (nT) positive deviations are observed in the magnetically active days in the Horizontal component and in Declination. It is understood that maximum daily mean is generally observed from high magnetically active/disturbed days. Maximum field negative deviations are observed in magnetically quiet days and days prior to magnetically active days in H component. Positive deviation of Vertical component (Z) is gradually increasing from January to December. When maximum field positive deviation is noticed in H component it is reflected as a Maximum number of high field negative deviations are observed in Z.

Table 4.9a: Upper K index limit:

K	H Range (nT)
0	< 3
1	< 6
2	< 12
3	< 24
4	< 42
5	< 72
6	< 120
7	< 198
8	< 300
9	>300

4.9. K-index frequencies daily & daily sum:

The maximum K daily sum is 36 in the month of May, 8th which is most magnetically disturbed day during 2016. The next maximum K daily sum is 34 observed in March, 24th. Minimum K daily sum is 2 in the month of October 21th. The best quietest day in 2016. From k-index values and its daily sum gives the understanding of variations in the magnetic field. Doing monthly and yearly sum explains the severity/strength of activity taken place monthly and yearly. During this year it is noticed K=2 is maximum in number i.e. 1023 it explains that maximum days are moderately disturbed. This year the maximum K value is 6 it is in months of February, March and October.

4.10. Principle magnetic storms 2016:

During 2016, 54 storms are observed. 09 sudden commencements are noticed. From this it is observed that 160 days are disturbed days over 2016. The maximum K is 6 on 7th hour period of 16th June, 6th hour period on 6th March, 5th hour period on 11th March and 6th hour period on 25th October. During 2016 nine Rapid Magnetic variations (RMV) were noticed in it. On 11th March is having highest amplitude of chief movement is +22nT for H component.

4.9. Daily K-indices & daily sum, 2016

January

D	1	2	3	4	5	6	7	8	Sum
1	4	3	3	3	2	2	2	2	21
2	3	2	3	2	2	3	2	1	18
3	2	2	2	2	2	3	1	2	16
4	1	2	2	1	1	3	2	1	13
5	2	2	2	2	2	3	3	3	19
6	3	2	3	3	3	2	2	2	20
7	2	2	2	3	3	3	3	2	20
8	1	2	3	3	3	2	2	1	17
9	2	1	2	1	2	2	1	1	12
10	2	2	2	3	2	2	2	3	18
11	2	3	3	2	2	3	4	3	22
12	3	2	3	2	3	3	3	2	21
13	2	2	1	1	3	3	3	1	16
14	1	2	2	2	2	2	2	2	15
15	1	1	2	1	1	2	1	1	10
16	1	2	2	2	3	1	1	1	13
17	2	2	3	2	1	2	1	1	14
18	1	2	2	1	2	2	1	3	14
19	3	2	3	4	2	2	1	2	19
20	2	3	3	3	4	5	5	4	29
21	3	3	3	3	2	5	4	4	27
22	2	2	2	2	2	3	3	2	18
23	2	3	4	2	3	3	1	1	19
24	1	2	3	1	1	3	3	1	15
25	1	1	1	1	0	0	0	0	4
26	1	2	2	2	1	2	3	1	14
27	2	4	2	3	1	0	0	0	12
28	1	2	2	2	2	1	0	1	11
29	1	1	1	1	1	1	1	0	7
30	2	1	1	2	1	1	0	0	8
31	2	2	2	1	3	3	2	3	18

February

D	1	2	3	4	5	6	7	8	Sum
1	2	2	2	2	0	1	0	0	9
2	1	2	2	1	2	3	3	3	17
3	2	3	2	1	1	2	2	1	14
4	2	2	1	2	3	1	1	2	14
5	3	3	2	2	2	3	3	2	20
6	1	2	1	1	2	2	1	3	13
7	2	1	2	3	2	4	2	1	17
8	3	3	3	3	2	1	1	2	18
9	2	2	2	3	3	2	2	3	19
10	2	2	2	1	0	1	2	1	11
11	2	2	2	1	1	3	3	4	18
12	2	2	3	4	4	3	3	3	24
13	3	4	3	2	1	1	1	1	16
14	1	2	2	2	2	3	2	1	15
15	2	2	3	3	2	1	2	3	18
16	3	3	2	4	5	5	6	3	31
17	3	3	4	2	4	3	4	5	28
18	3	4	3	4	2	3	4	2	25
19	2	2	2	3	3	4	3	1	20
20	1	2	2	1	2	1	0	2	11
21	1	1	1	0	1	1	3	2	10
22	1	1	1	1	1	1	1	1	8
23	1	2	2	2	1	1	2	3	14
24	2	2	2	2	2	2	2	1	15
25	2	1	2	2	2	2	3	3	17
26	3	2	2	1	2	1	2	0	13
27	1	2	2	2	1	1	1	1	11
28	1	1	2	1	2	1	1	1	10
29	1	1	1	2	1	1	2	2	11

March

D	1	2	3	4	5	6	7	8	Sum
1	2	3	2	2	2	2	1	2	16
2	1	2	2	2	3	3	1	0	14
3	1	3	3	3	3	1	1	1	16
4	1	1	2	-	0	1	0	0	
5	1	1	2	2	2	1	0	0	9
6	2	3	4	3	3	6	5	5	31
7	3	4	3	3	3	3	3	4	26
8	2	2	2	2	3	2	2	0	15
9	1	2	1	2	2	2	2	1	13
10	2	2	3	1	2	2	3	3	18
11	2	5	5	5	6	5	4	2	34
12	2	2	2	2	2	2	3	1	16
13	1	3	2	1	0	0	0	0	7
14	1	2	1	2	1	4	5	4	20
15	3	3	3	2	2	2	5	4	24
16	3	3	2	3	3	2	4	4	24
17	3	3	3	4	2	3	3	3	24
18	1	2	3	1	3	2	2	3	17
19	2	3	3	4	3	4	2	1	22
20	1	2	2	2	2	4	4	2	19
21	1	3	2	2	2	3	3	2	18
22	3	2	2	2	2	0	1	2	14
23	2	3	2	2	1	1	3	2	16
24	2	1	2	2	2	2	2	1	14
25	2	1	1	1	2	2	1	1	11
26	1	1	1	0	1	1	2	2	9
27	2	3	4	3	2	4	3	2	23
28	2	2	2	2	2	1	3	2	16
29	3	3	3	3	2	3	1	1	19
30	2	1	2	2	4	2	3	1	17
31	2	2	2	1	1	2	1	1	12

April

D	1	2	3	4	5	6	7	8	Sum
1	3	2	1	1	1	1	2	1	12
2	2	1	1	0	4	5	5	3	21
3	2	3	2	3	2	2	2	4	20
4	2	3	2	2	2	1	2	2	16
5	2	2	1	1	2	2	3	1	14
6	2	1	2	2	2	3	1	1	14
7	2	2	3	2	2	3	5	4	23
8	3	4	1	1	0	0	1	0	10
9	3	3	3	1	0	2	1	0	13
10	2	2	2	1	2	1	2	3	15
11	3	2	1	2	2	3	1	2	16
12	2	3	2	2	3	3	5	4	24
13	4	3	3	3	3	4	3	3	26
14	2	2	3	5	3	5	4	4	28
15	3	1	1	1	2	2	2	1	13
16	2	2	2	2	3	4	4	3	22
17	4	3	2	2	2	3	4	3	23
18	3	3	3	2	1	0	1	1	14
19	2	0	0	1	0	1	0	1	5
20	2	1	2	2	1	0	1	1	10
21	2	1	2	2	1	1	1	1	11
22	2	3	2	2	4	3	1	2	19
23	2	2	2	1	2	2	3	3	17
24	3	2	2	1	2	3	4	1	18
25	2	1	1	2	2	1	1	0	10
26	4	3	2	2	2	2	2	3	20
27	3	3	3	2	3	3	2	2	21
28	2	1	1	1	1	1	1	1	9
29	2	2	2	1	1	0	2	1	11
30	3	3	3	2	2	2	3	3	21

May

D	1	2	3	4	5	6	7	8	Sum
1	3	2	2	2	3	4	4	3	23
2	3	4	2	2	2	4	4	3	24
3	2	2	2	2	2	3	3	2	18
4	3	2	1	2	2	2	0	0	12
5	2	2	2	3	3	2	1	4	19
6	2	2	2	2	4	3	4	3	22
7	2	2	2	2	3	2	1	3	17
8	4	4	4	5	5	5	4	5	36
9	5	3	2	3	4	3	4	3	27
10	3	3	2	1	3	3	2	2	19
11	2	1	1	1	1	1	0	2	9
12	2	1	1	1	1	0	1	1	8
13	2	2	2	2	2	2	2	1	15
14	3	2	3	3	2	2	3	4	22
15	3	2	2	2	4	4	3	2	22
16	2	3	3	4	3	3	2	1	21
17	2	2	3	3	2	3	3	2	20
18	2	2	2	2	2	1	1	1	13
19	2	2	2	2	3	2	2	2	17
20	3	3	1	1	1	0	2	1	12
21	3	4	5	3	3	3	2	1	24
22	2	2	2	2	3	1	0	0	12
23	2	2	2	2	1	0	2	1	12
24	2	2	1	3	2	0	1	0	11
25	2	1	1	1	1	1	0	0	7
26	3	3	2	1	0	0	1	1	11
27	3	2	1	2	1	3	3	3	18
28	3	3	4	2	1	2	2	2	19
29	2	1	2	2	2	2	2	2	15
30	3	3	3	2	1	2	2	1	17
31	1	2	3	2	2	2	3	3	18

June

D	1	2	3	4	5	6	7	8	Sum
1	1	1	1	1	1	1	0	1	7
2	0	2	1	1	0	0	0	0	4
3	1	1	1	1	0	0	0	1	5
4	4	4	1	1	0	1	2	3	16
5	4	4	3	4	4	4	3	3	29
6	3	4	3	5	4	2	3	2	26
7	3	4	1	2	1	2	2	1	16
8	3	3	1	2	2	2	0	1	14
9	1	2	1	1	0	0	1	0	6
10	1	1	1	1	2	2	3	2	13
11	2	1	2	1	2	2	2	3	15
12	1	3	3	2	2	2	3	2	18
13	2	3	2	2	1	1	1	0	12
14	1	2	3	2	2	2	5	4	21
15	3	2	2	3	2	2	2	1	17
16	2	1	1	1	1	1	1	1	9
17	1	2	2	2	1	2	2	0	12
18	2	2	1	2	2	2	1	1	13
19	1	2	2	1	1	1	0	0	8
20	1	2	1	1	1	0	0	1	7
21	1	1	1	1	1	0	1	0	6
22	3	2	2	4	1	3	4	3	22
23	3	2	2	1	1	2	2	3	16
24	2	3	3	1	1	2	1	2	15
25	2	1	1	1	1	1	2	2	11
26	1	2	1	2	2	2	2	1	13
27	3	2	2	1	1	1	1	1	12
28	2	2	1	2	2	1	2	1	13
29	1	1	1	1	0	1	2	0	7
30	1	1	1	1	0	2	3	2	11
1	1	1	1	1	1	1	0	1	7

July

D	1	2	3	4	5	6	7	8	Sum
1	2	2	2	2	1	1	0	0	10
2	1	1	1	1	1	1	3	4	13
3	2	2	2	1	1	1	2	2	13
4	1	2	3	2	1	0	3	1	13
5	1	1	0	0	0	0	0	0	2
6	1	1	1	1	1	1	1	2	9
7	3	3	3	2	3	3	4	3	24
8	2	2	2	3	4	3	3	1	20
9	2	2	3	2	2	2	1	1	15
10	2	3	2	3	2	2	1	1	16
11	2	2	2	2	2	2	2	1	15
12	2	3	3	2	2	2	2	2	18
13	2	2	2	2	2	1	1	2	14
14	2	3	3	4	1	2	2	1	18
15	2	3	3	3	2	2	1	1	17
16	2	2	2	1	3	1	2	1	14
17	1	2	1	1	1	1	1	2	10
18	1	1	1	0	0	0	0	0	3
19	0	1	2	0	1	0	0	4	8
20	5	3	3	2	2	3	2	0	20
21	1	1	2	2	2	3	0	2	13
22	1	2	2	2	2	2	2	1	14
23	2	3	2	1	1	0	1	2	12
24	1	1	2	2	2	4	4	4	20
25	4	4	2	3	3	3	3	2	24
26	0	1	1	1	1	1	1	1	7
27	0	1	0	2	1	1	1	2	8
28	3	3	4	3	2	3	3	2	23
29	2	3	3	3	2	3	2	1	19
30	1	2	1	1	1	1	1	0	8
31	2	1	1	1	1	1	1	0	8

August

D	1	2	3	4	5	6	7	8	Sum
1	2	1	0	0	1	1	0	0	5
2	1	3	2	2	3	4	4	5	24
3	3	4	3	5	4	5	2	2	28
4	1	3	2	3	4	4	3	1	21
5	1	3	4	3	3	2	1	2	19
6	1	2	2	3	2	2	2	2	16
7	2	2	1	1	2	2	1	1	12
8	2	2	1	1	2	3	3	0	14
9	2	3	2	3	3	3	1	3	20
10	2	2	2	3	2	3	2	2	18
11	1	1	1	2	1	2	2	2	12
12	2	3	2	2	2	2	1	1	15
13	2	2	1	1	2	1	2	1	12
14	1	1	1	1	1	0	1	0	6
15	1	1	1	0	1	0	0	1	5
16	0	1	3	3	2	2	2	3	16
17	2	2	2	1	1	0	2	2	12
18	2	2	1	2	2	1	1	1	12
19	1	0	1	1	2	1	0	0	6
20	2	2	2	1	0	0	0	0	7
21	1	2	2	1	3	3	1	2	15
22	1	1	1	1	0	0	1	1	6
23	2	2	1	3	4	2	3	4	21
24	3	3	2	4	4	2	2	4	24
25	1	2	3	3	2	3	2	3	19
26	2	2	1	1	0	1	2	1	10
27	1	1	1	2	1	0	1	0	7
28	1	1	0	1	1	0	1	1	6
29	2	1	1	2	2	2	3	2	15
30	2	2	2	2	2	4	4	3	21
31	1	2	1	0	1	1	1	1	8

September

D	1	2	3	4	5	6	7	8	Sum
1	2	2	3	2	3	3	4	3	22
2	4	4	2	2	5	4	1	3	25
3	2	4	3	3	4	4	3	3	26
4	3	3	3	3	3	4	4	3	26
5	2	3	3	2	2	3	3	2	20
6	2	2	3	2	2	2	2	1	16
7	2	2	1	2	3	3	1	0	14
8	3	2	2	2	2	2	2	1	16
9	0	1	0	0	1	1	0	1	4
10	1	2	1	0	0	0	0	2	6
11	0	1	0	0	1	1	1	1	5
12	2	3	2	2	3	1	1	1	15
13	1	1	2	1	1	1	1	2	10
14	1	2	2	2	2	2	4	2	17
15	3	2	1	1	0	1	1	2	11
16	1	1	0	2	1	2	2	0	9
17	2	2	1	2	1	0	0	1	9
18	2	2	1	2	2	1	1	1	12
19	1	2	2	2	3	3	2	3	18
20	3	3	3	3	1	3	2	1	19
21	2	2	2	2	2	0	1	1	12
22	2	1	1	1	1	0	0	0	6
23	1	2	2	1	1	1	0	1	9
24	1	1	2	1	1	1	2	3	12
25	2	3	1	4	3	3	5	3	24
26	2	2	3	2	3	2	3	4	21
27	4	2	3	4	4	4	3	2	26
28	4	3	2	4	4	4	5	4	30
29	2	3	4	5	4	4	3	2	27
30	3	2	3	3	2	3	4	1	21

October

D	1	2	3	4	5	6	7	8	Sum
1	1	3	2	2	3	3	4	2	20
2	2	2	2	2	3	3	4	3	21
3	2	3	3	1	2	2	4	2	19
4	3	3	2	3	4	2	4	2	23
5	2	2	3	2	2	3	2	2	18
6	1	2	1	0	1	2	2	1	10
7	1	1	1	1	1	2	2	1	10
8	1	2	1	2	1	2	2	1	12
9	1	1	1	1	1	1	3	1	10
10	2	3	2	0	2	3	3	1	16
11	1	1	2	1	1	0	1	1	8
12	1	2	1	1	0	1	2	3	11
13	3	3	4	3	3	3	5	3	27
14	3	2	2	2	2	2	1	1	15
15	3	2	2	3	2	3	2	2	19
16	2	1	3	3	3	3	5	3	23
17	2	2	3	4	2	4	3	2	22
18	2	2	2	2	1	1	1	2	13
19	2	1	2	1	1	1	1	0	9
20	1	1	1	0	1	0	1	0	5
21	1	1	0	0	0	0	0	0	2
22	1	2	2	2	2	1	3	2	15
23	1	3	3	1	1	3	2	2	16
24	3	2	3	2	4	2	2	1	19
25	2	2	3	4	5	6	5	5	32
26	3	3	3	4	3	5	3	3	27
27	3	2	3	3	3	4	4	3	25
28	1	2	2	2	4	4	2	2	19
29	3	3	2	3	3	2	3	2	21
30	2	2	2	3	4	3	3	1	20
31	1	2	2	2	3	2	2	0	14

November

D	1	2	3	4	5	6	7	8	Sum
1	1	0	1	3	3	2	2	2	14
2	2	2	1	2	3	3	1	3	17
3	2	2	3	3	3	2	3	3	21
4	1	2	1	0	1	0	1	0	6
5	1	1	1	0	0	0	1	0	4
6	0	1	1	1	1	1	2	1	8
7	1	1	2	2	2	1	0	0	9
8	0	0	1	1	1	0	1	1	5
9	1	1	3	1	2	1	3	3	15
10	3	3	2	2	3	4	3	3	23
11	2	1	1	3	2	3	2	2	16
12	2	3	3	3	2	4	3	3	23
13	2	2	2	3	3	3	4	2	21
14	1	2	2	2	2	4	3	2	18
15	1	1	2	2	2	2	1	0	11
16	0	1	1	1	0	1	2	1	7
17	1	1	1	0	0	1	1	1	6
18	1	1	1	0	0	1	0	0	4
19	0	1	0	1	1	1	1	1	6
20	1	1	2	2	1	1	1	1	10
21	0	1	1	1	2	2	2	2	11
22	1	2	2	2	3	4	3	3	20
23	2	1	2	1	2	2	4	1	15
24	2	2	3	3	4	3	4	3	24
25	3	4	3	3	4	3	5	1	26
26	1	2	1	2	2	2	2	1	13
27	2	1	2	2	2	1	2	1	13
28	1	1	2	1	2	3	3	2	15
29	1	0	0	2	2	1	2	2	10
30	1	1	1	1	0	1	1	1	7

December

D	1	2	3	4	5	6	7	8	Sum
1	1	2	2	1	1	0	0	0	7
2	1	1	1	1	1	1	2	1	9
3	0	2	0	0	0	1	2	0	5
4	0	1	0	0	0	0	1	1	3
5	1	2	1	0	2	1	1	2	10
6	0	1	2	3	3	2	1	2	14
7	0	1	1	1	3	3	4	2	15
8	2	3	3	3	4	3	4	2	24
9	2	3	2	4	3	3	4	3	24
10	2	2	2	3	3	3	2	1	18
11	2	3	1	3	3	4	2	1	19
12	1	1	2	1	1	2	1	1	10
13	1	1	1	1	1	1	1	1	8
14	0	1	1	1	1	1	1	0	6
15	1	1	1	1	0	1	1	0	6
16	1	1	1	0	0	0	0	1	4
17	0	1	2	2	2	2	3	3	15
18	2	2	1	2	1	1	1	2	12
19	1	2	1	1	1	1	2	0	9
20	1	2	2	1	1	2	1	3	13
21	1	2	1	4	4	5	4	2	23
22	2	3	3	3	3	3	4	2	23
23	1	2	2	3	3	4	3	3	21
24	2	2	2	1	3	4	2	2	18
25	1	2	2	3	3	4	3	1	19
26	2	2	2	2	4	3	2	2	19
27	2	1	1	2	3	1	2	2	14
28	1	1	1	1	1	2	0	0	7
29	1	0	0	1	2	2	0	0	6
30	0	1	1	1	1	0	1	0	5
31	0	1	2	3	4	3	3	3	19

4.10. Daily K- indices monthly wise 2016

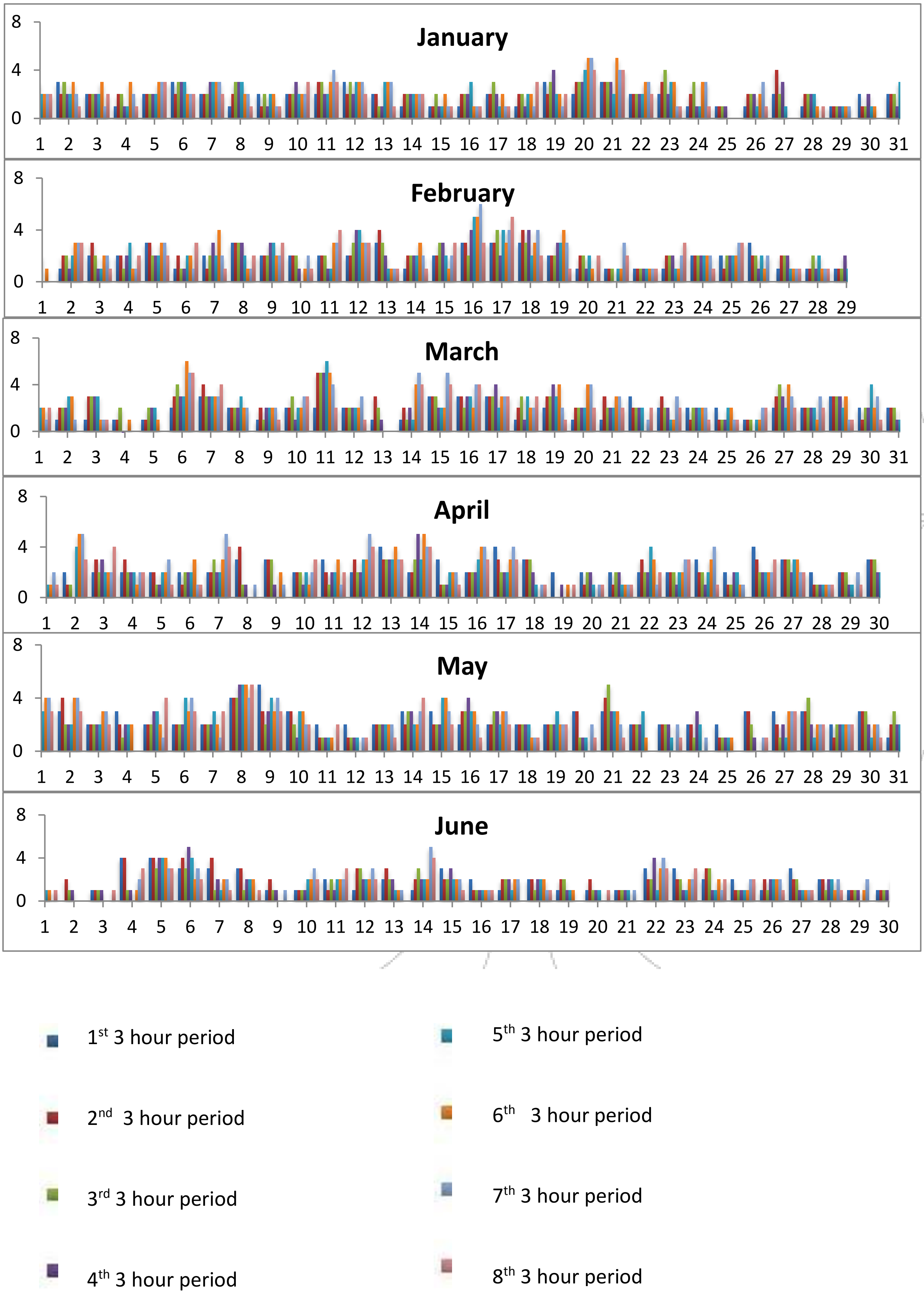


Figure 4.10a: K-index values monthly from January to June

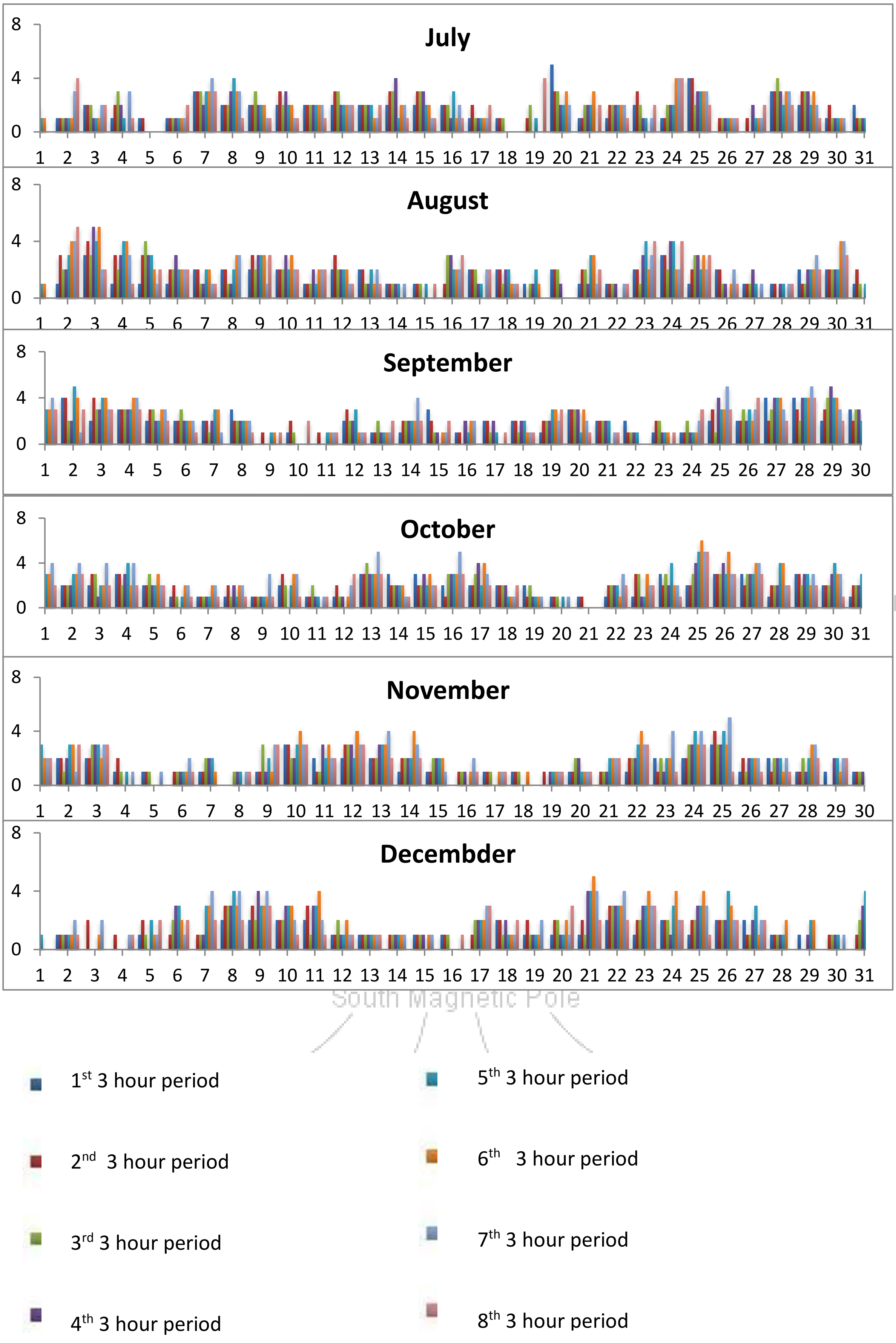


Figure 4.10b: K-index values monthly from July to December

4.11. PRINCIPAL MAGNETIC STORMS 2016

YEAR 2016 MO	DA	STORM TIME UT START HR	MIN	UT END MO	DA	HR	OBS TYPE	SUDDEN COMMENCEMENT AMPLITUDES D(')	H(nT)	Z(nT)	DEGREE OF ACTIVITY	MAXIMAL ACTIVITY ON K-SCALE 0 TO 9 MO	DA	3 HOUR PERIOD	K INDEX	D (')	RANGES H (nT)	Z (nT)
01	01	00	00		03	24	..				M	01	1		4	4	92	27
	05	01	00		07	24	..				M	05	6,7,8		3	5	67	29
													06	1,3,4,5				
													07	4,5,6,7				
	11	05	30		13	21	SC	-0.2	10	01	M	11	7		4	4	81	24
	18	21	56		23	18	SC	-0.2	12	01	M	20	6,7		4	3	91	27
												21	6		5	4	220	08
02	02	13	00		03	21	..				M	02	6,7,8		3	4	77	25
													03	2				
	05	00	00		05	24	..				M	05	1,2,6,7		3	3	43	17
	07	06	02		08	15	SC	0.0	05	03	M	07	6		4	3	93	12

YEAR 2016 MO	DA	STORM TIME UT START HR	MIN	UT END MO	DA	HR	OBS	TYPE	SUDDEN COMMENCEMENT AMPLITUDES D(')	H(nT)	Z(nT)	DEGREE OF ACTIVITY	MAXIMAL ACTIVITY ON K-SCALE 0 TO 9 MO	DA	3 HOUR PERIOD	K INDEX	RANGES D (')	H (nT)	Z (nT)
	11	04	00		13	18		..				M		11	8	4	2	109	32
																12	4,5		
																13	2		
	15	03	00		19	21		..				M		16	5,6	5	3	133	19
																17	8		
03	06	06	00		08	21		..				M		06	6	6	4	213	19
	11	05	19		12	21		SC	-0.2	22	01	M		11	5	6	2	116	17
	14	17	08		19	23		SC	0.0	12	01	-		14	7	5	6	113	24
																15	7		
	20	06	00		22	15		..				M		20	6,7	4	3	119	23
	27	00	00		29	18		..				M		27	3,6	4	5	110	22
	27	07	30		--	--		SC	-0.1	08	01								

YEAR 2016 MO	DA	STORM TIME UT START HR	MIN	UT END MO	DA	HR	OBS	TYPE	SUDDEN COMMENCEMENT AMPLITUDES D(')	H(nT)	Z(nT)	DEGREE OF ACTIVITY	MAXIMAL ACTIVITY ON K-SCALE 0 TO 9 MO	DA	3 HOUR PERIOD	K INDEX	RANGES D (')	H (nT)	Z (nT)
04	02	01	00		03	24		..				M		02	6,7	5	4	92	21
	07	06	00		08	06		..				M		07	7	5	4	113	23
	12	12	00		15	03		..				M		12	7	5	6	142	32
	14	07	35		--	--		SC	-0.2	09	00								
	16	06	00		18	09		..				M		16	6,7	4	4	98	38
														17	1,7				
	22	12	00		24	21		..				M		22	5	4	5	95	27
														24	7				
05	01	03	00		03	23		..				M		01	6,7	4	4	84	20
														02	2,6,7				
	06	12	00		10	22		..				M		08	4,5,6,8	5	6	180	39

YEAR 2016 MO	DA	STORM TIME UT START HR	MIN	UT END MO	DA	HR	OBS	TYPE	SUDDEN COMMENCEMENT AMPLITUDES D(')	H(nT)	Z(nT)	DEGREE OF ACTIVITY	MAXIMAL ACTIVITY MO	DA	3 HOUR PERIOD	ON K-SCALE 0 TO 9 K INDEX	RANGES D (')	H (nT)	Z (nT)
	14	06	00		17	23	..					M		14	8	4	6	87	29
																15	5,6		
																16	4		
	27	00	00		28	23	..					M		28	3	4	6	70	23
06	05	06	00		06	24	..					M		06	4	5	7	165	24
	14	06	00		15	21	..					M		14	7	5	6	74	20
	23	02	00		24	24	..					M		23	6,8	3	5	70	16
	26	12	00		28	20	..					M		27	1	3	5	61	25
	30	21	28	01/07		16	..					M		30	7	3	4	54	17
07	02	19	27		04	22	..					M		02	8	4	5	52	22
	06	16	00		15	20	..					M		07	7	4	7	84	34
																08	5		
																14	4		

YEAR 2016		STORM TIME UT START		UT END			OBS TYPE	SUDDEN COMMENCEMENT AMPLITUDES			DEGREE OF ACTIVITY	MAXIMAL ACTIVITY ON K-SCALE 0 TO 9				RANGES	
MO	DA	HR	MIN	MO	DA	HR		D(')	H(nT)	Z(nT)		MO DA	3 HOUR PERIOD	K INDEX	D (')	H (nT)	Z (nT)
	20	01	00		21	24	SC	0	09	1	M	20	1	5	6	97	37
	24	15	00		25	18	..				M	24	6,7,8	4	5	107	25
														25	1,2		
	28	00	00		30	20	..				M	28	3	4	4	89	19
08	02	04	00		05	24	..				M	02	8	5	5	164	28
														03	4,6		
	23	15	00		25	24	..				M	23	5,8	4	7	111	25
														24	4,5,8		
	29	01	00		30	24	..				M	30	6,7	4	6	101	29
09	01	00	00		08	21	..				M	02	5	5	6	92	39
	19	11	00		20	24	..				MS	19	5,6,8	3	6	98	21
														20	1,2,3,4,6		

YEAR 2016		STORM TIME					OBS TYPE	SUDDEN COMMENCEMENT AMPLITUDES			DEGREE OF ACTIVITY	MAXIMAL ACTIVITY ON K-SCALE 0 TO 9				RANGES		
		UT START		UT END														
MO	DA	HR	MIN	MO	DA	HR		D(')	H(nT)	Z(nT)		MO	DA	3 HOUR PERIOD	K INDEX	D (')	H (nT)	Z (nT)
	25	00	00		01/10	21	..				M		25	7	5	5	132	28
													28	7	5			
													29	4	5			
10	03	01	00		05	24	..				MS		03	7	4	5	83	42
													04	5,7				
	12	20	00		15	24							13	7	5	4	250	29
	16	01	00		17	22	..				M		16	7	5	5	73	25
	23	05	00		30	22	..				M		25	6	6	4	174	18
11	09	06	43		14	24	SC	0	16	1	M		10	6	4	3	187	25
													12	6				
													13	7				
													14	6				

YEAR 2016 MO	DA	STORM TIME UT START HR	MIN	UT END MO	DA	HR	OBS	TYPE	SUDDEN COMMENCEMENT AMPLITUDES D(')	H(nT)	Z(nT)	DEGREE OF ACTIVITY	MAXIMAL ACTIVITY ON K-SCALE 0 TO 9 MO	DA	3 HOUR PERIOD	K INDEX	RANGES D (')	H (nT)	Z (nT)
	22	05	00		27	21	..					M		25	7	5	4	120	15
12	07	12	00		11	24						M		07	7	4	4	75	19
																08	5,7		
																09	4,7		
																11	6		
	21	10	00		27	24						S		21	6	5	4	108	20
	31	09	00		31	24						MS		31	5	4	2	97	16

4.12. Monthly K- index frequencies, 2016

January

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	-	-	-	-	01	02	04	04	11
1	11	05	04	09	08	04	09	12	62
2	14	20	15	13	12	11	08	08	101
3	05	05	11	08	08	12	07	05	62
4	01	01	01	01	01	00	02	02	09
5						02	01		03
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

February

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	-	-	-	01	02	-	02	02	07
1	10	06	05	09	08	13	07	10	68
2	12	16	17	11	13	05	10	07	91
3	07	05	05	05	03	07	07	08	47
4	-	02	01	03	02	02	02	01	13
5	-	-	-	-	01	01	-	01	03
6	-	-	-	-	-	-	01	-	01
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

March

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	-	-	-	01	02	02	03	05	13
1	11	06	04	05	04	05	07	09	51
2	14	11	16	15	15	11	06	09	97
3	06	12	08	06	08	09	09	02	60
4	-	01	02	02	01	04	03	04	17
5	-	01	01	01	-	01	02	01	07
6	-	-	-	-	01	01	-	-	02
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

April

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	-	01	01	01	03	04	01	03	14
1	-	07	08	11	06	07	10	11	60
2	18	10	14	15	14	07	08	04	90
3	09	11	06	02	05	08	04	08	53
4	3	1	-	-	02	02	04	04	16
5	-	-	01	01	-	02	02	-	06
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

May

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	-	-	-	-	01	05	04	04	14
1	01	04	07	06	08	04	05	09	44
2	16	17	16	17	10	10	10	08	104
3	12	07	05	06	08	08	06	07	59
4	01	03	02	01	03	03	05	02	20
5	01	-	01	01	01	01	-	01	06
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

June

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	01	-	-	-	06	05	06	07	25
1	13	09	17	17	13	09	07	11	96
2	07	13	08	08	09	14	10	06	75
3	07	04	05	01	-	01	05	05	28
4	02	04	-	02	02	01	01	01	13
5	-	-	-	01	-	-	01	-	02
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

July

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	03	-	02	03	02	05	05	06	26
1	10	10	07	09	13	11	11	11	82
2	13	11	13	12	12	07	08	10	86
3	02	09	08	06	03	07	05	01	41
4	01	01	01	01	01	01	02	03	11
5	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

August

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	01	01	02	03	03	07	04	06	27
1	14	09	14	11	08	08	11	10	85
2	14	14	11	07	12	09	10	08	85
3	02	06	03	08	05	05	04	04	37
4	-	01	01	01	01	04	02	02	12
5	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

September

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	02	-	03	03	02	04	05	03	22
1	07	06	07	05	09	08	08	10	60
2	13	15	10	14	05	06	05	07	75
3	05	07	09	04	07	06	05	07	50
4	03	02	01	03	04	06	04	02	25
5	-	-	-	01	01	-	02	-	04
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

October

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	-	-	01	04	02	03	01	04	15
1	13	07	06	07	09	05	05	09	61
2	10	16	14	10	07	09	10	11	87
3	08	08	09	07	08	09	06	06	61
4	-	-	01	03	04	03	05	-	16
5	-	-	-	-	01	01	03	01	06
6	-	-	-	-	-	01	-	-	01
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

November

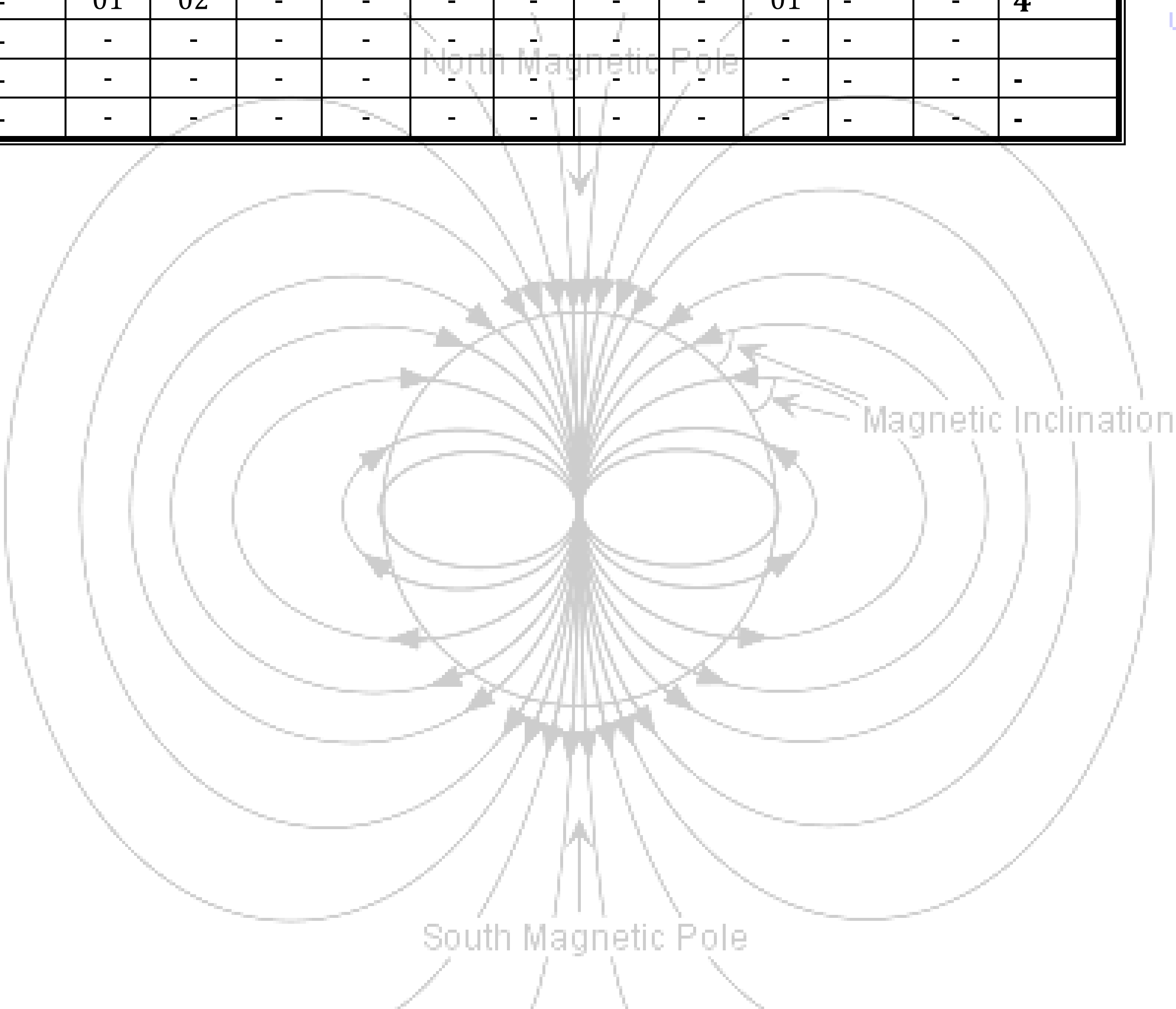
UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	05	03	02	04	05	03	02	05	29
1	15	16	13	09	05	11	09	11	89
2	07	08	10	10	12	06	08	07	68
3	02	02	05	07	06	06	07	07	42
4	-	01	-	-	02	04	03	-	-
5	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

December

UT K=	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	S
0	08	01	03	04	04	04	04	08	36
1	14	13	14	13	10	09	10	07	90
2	09	12	12	04	03	06	08	10	64
3	-	04	02	08	10	07	04	05	40
4	-	-	-	02	04	04	05	-	15
5	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-

4.13. K Index frequencies monthly & Yearly sum

K	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
0	11	07	13	14	14	25	26	27	22	15	29	36	**239**
1	62	68	51	60	44	96	82	85	60	61	89	90	**848**
2	101	91	97	90	104	75	86	85	75	87	68	64	**1023**
3	62	47	60	53	59	28	41	37	50	61	42	40	**580**
4	09	13	17	16	20	13	11	12	25	16	-	15	**167**
5	03	03	07	06	06	02	-	-	04	06	-	-	**37**
6	-	01	02	-	-	-	-	-	-	01	-	-	**4**
7	-	-	-	-	-	-	-	-	-	-	-	-	
8	-	-	-	-	-	-	-	-	-	-	-	-	**-**
9	-	-	-	-	-	-	-	-	-	-	-	-	**-**



4.14. Annual mean values

Hyderabad Magnetic Observatory from 1965-2016, HYB

Year	D	I	H (nT)	Z (nT)	F (nT)
1965	01°42.7'	20°29.1'	40142	14997	42852
1966	01°40.7'	20°29.8'	40114	14995	42825
1967	01°39.0'	20°30.0'	40081	14986	42791
1968	01°36.6'	20°30.0'	40056	14976	42764
1969	01°34.6'	20°29.7'	40026	14961	42731
1970	01°38.6'	20°29.1'	39989	14939	42688
1971	01°39.4'	20°27.7'	39963	14912	42655
1972	01°36.5'	20°26.8'	39929	14887	42614
1973	01°33.6'	20°27.4'	39900	14883	42585
1974	01°36.7'	20°28.7'	39872	14890	42562
1975	01°38.9'	20°30.9'	39868	14918	42568
1976	01°37.7'	20°34.4'	39846	14956	42560
1977	01°38.6'	20°38.2'	39824	14998	42555
1978	01°38.6'	20°44.0'	39777	15057	42531
1979	01°39.2'	20°49.4'	39746	15117	42524
1980	01°38.6'	20°56.2'	39714	15194	42521
1981	01°38.9'	21°02.4'	39665	15258	42498
1982	01°38.1'	21°10.2'	39613	15341	42480
1983	01°37.2'	21°19.3'	39588	15452	42497
1984	01°30.7'	21°26.2'	39557	15532	42497
1985	01°29.2'	21°32.6'	39529	15606	42498
1986	01°26.9'	21°38.4'	39496	15668	42490
1987	01°25.3'	21°42.3'	39482	15716	42495
1988	01°23.1'	21°44.6'	39454	15735	42476
1989	01°20.4'	21°47.0'	39425	15755	42456
1990	01°18.4'	21°48.8'	39413	15775	42453
1991	01°16.9'	21°49.6'	39403	15781	42446
1992	01°15.1'	21°49.2'	39422	15787	42466
1993	01°13.9'	21°50.9'	39417	15804	42467
1994	01°13.4'	21°52.5'	39412	15824	42470
1995	01°12.1'	21°57.0'	39414	15884	42494
1996	01°10.6'	22°02.9'	39417	15964	42527
1997	01°09.3'	22°08.0'	39421	16034	42557
1998	01°08.0'	22°12.8'	39414	16094	42573
1999	01°07.2'	22°17.2'	39422	16158	42605
2000	01°06.3'	22°21.4'	39428	16216	42632
2001	01°06.4'	22°27.1'	39424	16291	42657
2002	01°05.9'	22°32.4'	39431	16378	42697
2003	01°06.4'	22°37.9'	39478	16460	42772
2004	01°05.7'	22°44.1'	39501	16552	42829
2005	01°04.7'	22°51.3'	39510	16653	42876

Year	D	I	H (nT)	Z (nT)	F (nT)
2006	01°03.5'	22°57.4'	39525	16741	42924
2007	01°02.0'	23°05.3'	39526	16848	42967
2008	01°00.8'	23°12.5'	39531	16949	43011
2009	01°00.2'	23°23.9'	39423	17058	43047
2010	00°58.5'	23°32.3'	39417	17170	43086
2011	00°56.8'	23°35.8'	39413	17216	43009
2012	00°53.2'	23°48.5'	39407	17388	43073
2013	00°50.3'	23°54.5'	39420	17475	43120
2014	00°45.7'	24°02.3'	39432	17588	43177
2015	00°44.4'	24°09.7'	39432	17634	43195
2016	00°40.6'	24°17.5'	39459	17809	43292

5. Data of Choutuppal Magnetic Observatory

5.1. Data & Observations

During 2016, we have data from the DFM system (FGE variometer along with GSM-90 Overhauser) at Primary variometer room up to June. From August onwards we have data from secondary variometer i.e. GEOMAG-02M) and GSM-19 Overhauser.

Table 5.1.1: Key Observatory information:

IAGA code	(CPL)
Commenced operation	2012
Geographic latitude	17° 17.6' N
Geographic longitude	78° 55.2' E
Geomagnetic latitude	8.62° N
Geomagnetic longitude	152.6° E
K 9 index lower limit	300 nT
Principal pier	Pillar -1
Reference mark azimuth	42° 22.31'
distance	100 m
Observers	Mr. KCS Rao/ L. Manjula

5.2. Baseline values

The base values of the FGE variometer (the observatory main variometer) were determined by means of useful adoptions from the absolute measurement results (table 5.2.1). For every day an adopted base value exists of every recorded element (H, D, Z). The deviations ΔH, ΔD and ΔZ of the absolute measurements from the absorved base values are shown in table 5.2.1. Fig. 5.2a shows the adopted base values as lines and small squares are the results of the absolute measurements.

Table 5.2.1: Absolute measurement results (January to December) by means of the Mag-01H DI-Flux & Wild-T1 theodolite and the GSM 19 Overhauser effect proton magnetometer, reduced with FGE variometer recordings.

Month	Day	Time in UT	Horizontal Intensity H/nT	ΔH/nT	Declination (Westerly) D '	ΔD/'	Vertical intensity Z/nT	ΔZ/nT
Jan	01	09:39	39366.01	-0.26	54.27'	+0.01	16832.72	+0.42
Jan	13	05:04	39365.90	-0.09	54.29'	+0.02	16832.09	-0.63
Jan	22	06:42	39365.89	-0.01	54.27'	-0.02	16832.39	+0.30
Jan	28	07:26	39365.92	+0.03	54.27'	0.00	16832.18	-0.21
Feb	09	06:28	39366.56	+0.64	54.28'	+0.01	16831.73	-0.45
Feb	19	06:40	39366.44	-0.12	54.22'	-0.06	16832.19	+0.46
Feb	22	04:37	39366.32	-0.12	54.21'	-0.01	16832.06	-0.13
Feb	29	01:48	39366.15	-0.17	54.21'	0.00	16832.32	+0.24
Mar	07	01:25	39366.92	+0.77	54.10'	-0.10	16832.55	+0.23
Mar	11	10:22	39366.53	-0.39	54.18'	+0.08	16832.38	-0.17
Mar	17	05:26	39366.70	+0.17	54.10'	-0.10	16832.45	+0.13
Mar	27	06:07	39366.53	-0.17	54.14 '	+0.04	16832.36	-0.09
Apr	05	06:23	39366.49	-0.04	54.15	+0.01	16832.46	+0.10
Apr	15	05:47	39366.70	+0.21	54.12	-0.03	16832.49	+0.03
Apr	21	01:03	39366.79	+0.09	54.11	-0.01	16832.58	+0.09
Apr	30	02:22	39366.96	+0.17	53.97'	-0.13	16833.25	-0.33
May	13	10:45	39366.37	-0.49	54.05	+0.08	16833.42	+0.17
May	19	10:17	39366.07	-0.30	53.79	-0.26	16833.86	+0.44
May	26	10:33	39366.31	+0.24	54.07	+0.28	16832.82	-0.04
Jun	03	09:59	39366.50	+0.19	53.98	-0.09	16832.43	-0.39
Jun	10	10:26	39366.06	-0.46	54.04	+0.06	16833.00	+0.57
Jun	17	01:25	39366.40	+0.34	54.36	+0.22	16833.20	+0.20
Jun	22	01:25	39366.70	+0.30	54.40	+0.04	16832.60	+0.40
Sept	02	10:22	39366.00	-0.30	54.38	-0.02	16833.30	-0.30
Sept	08	05:42	39365.90	-0.10	54.41'	-0.03	16833.50	+0.20
Sept	14	05:26	39366.20	+0.30	54.45'	-0.04	16833.20	-0.30
Sept	20	05:26	39366.10	-0.10	54.39'	-0.06	16833.30	+0.10
Oct	16	06:07	39366.30	+0.20	54.42'	-0.03	16833.10	-0.20
Oct	22	07:16	39366.50	+0.20	54.40'	-0.02	16832.90	-0.20
Oct	30	07:16	39366.20	-0.30	54.39'	-0.01	16833.40	+0.50
Nov	08	02:34	39366.60	+0.40	54.45'	+0.06	16833.50	+0.10
Nov	15	12:35	39366.40	-0.20	54.40'	-0.05	16833.30	-0.20
Nov	22	05:00	39366.00	-0.40	54.49'	+0.09	16833.30	0.00
Nov	30	05:47	39366.10	+0.10	54.51'	+0.03	16833.40	+0.20
Dec	05	05:28	39366.40	+0.30	54.47'	-0.04	16833.00	-0.40
Dec	14	01:03	39366.30	-0.10	54.53'	+0.06	16833.10	+0.10
Dec	20	05:06	39366.10	-0.20	54.50'	-0.03	16833.30	+0.20
Dec	27	01:01	39366.20	+0.10	54.49'	-0.01	16833.20	-0.10

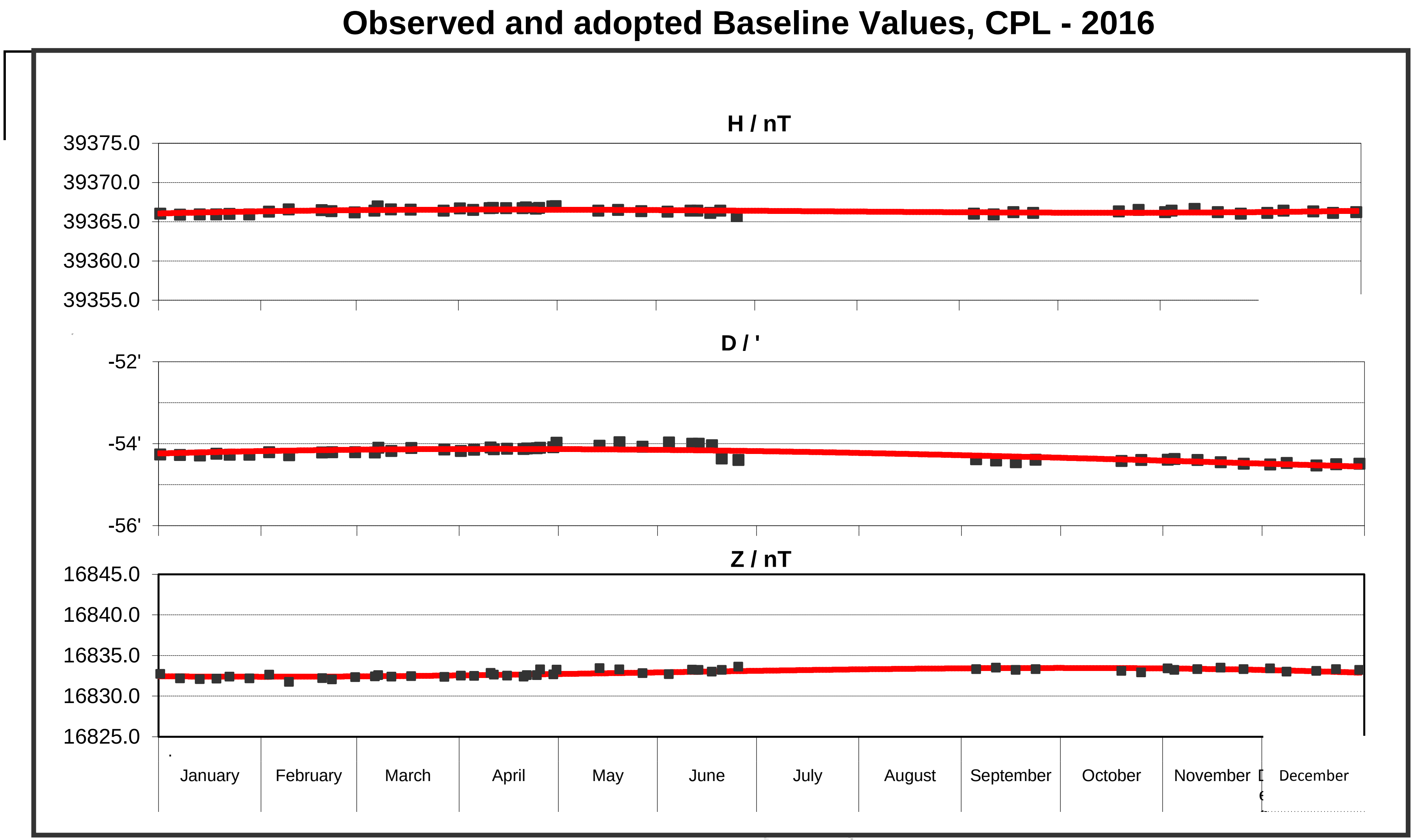
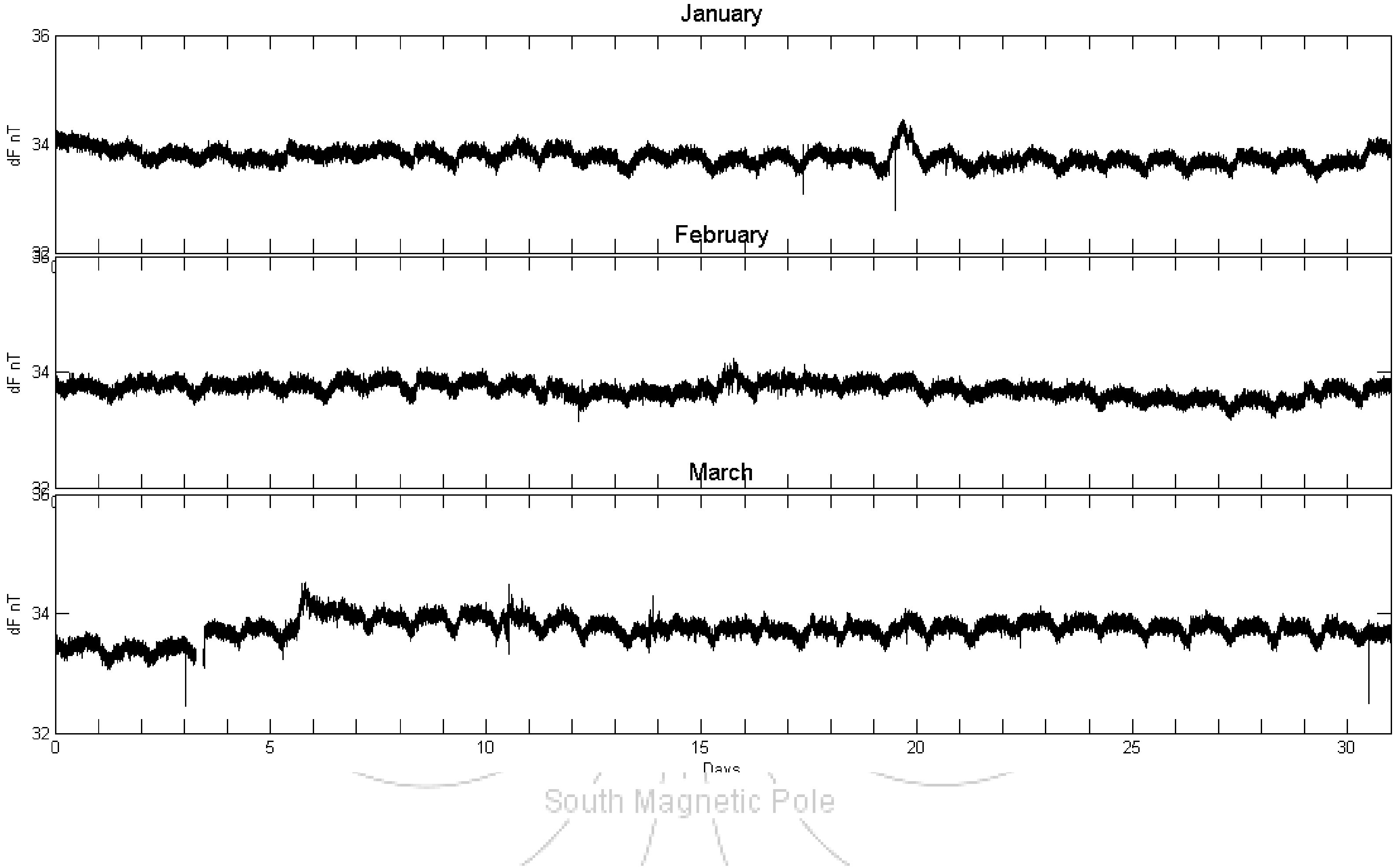
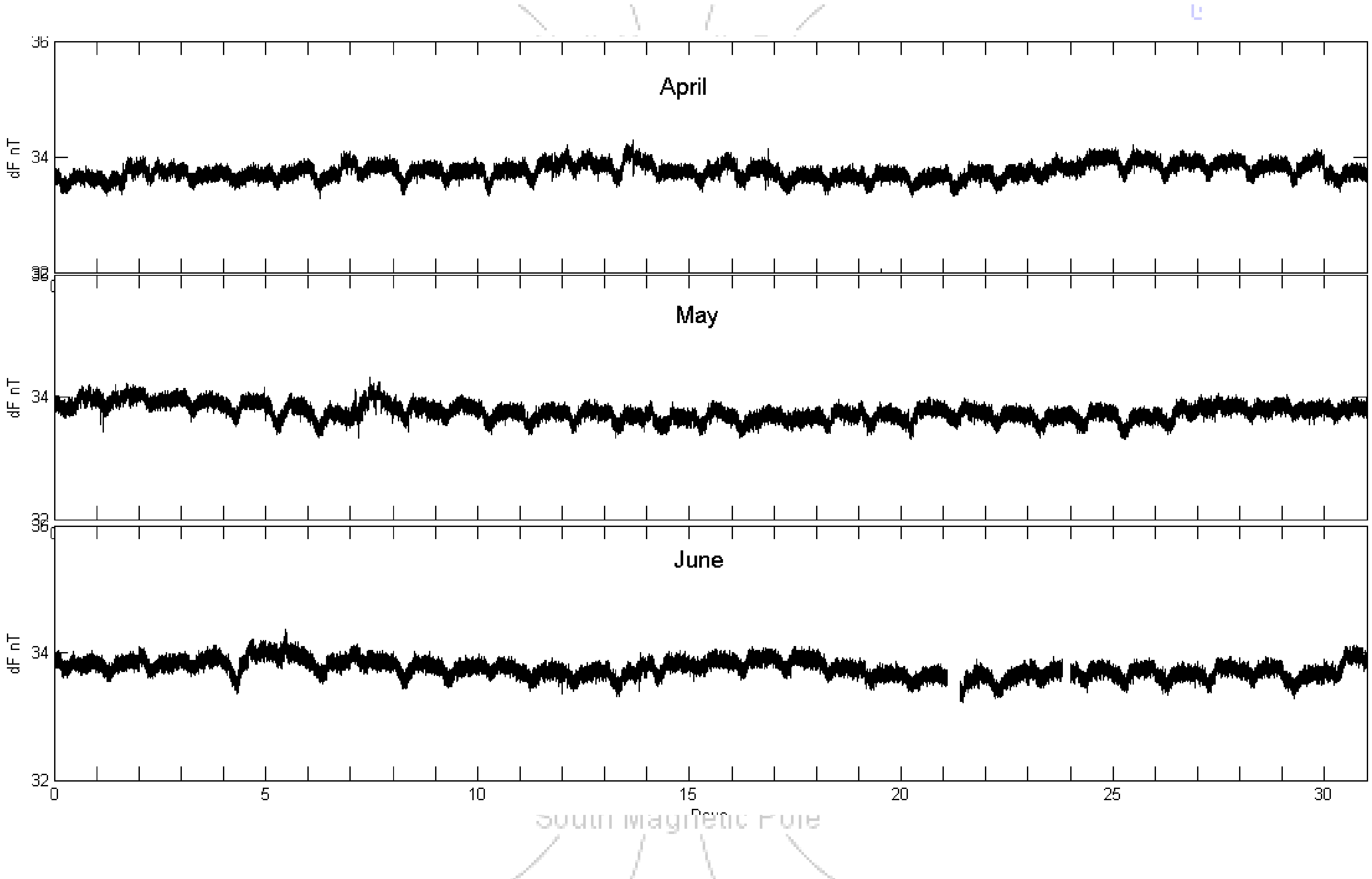


Figure 5.2a: Observed & Adopted baselines of CPL

5.3. Monthly ΔF plots, 2016 CPL

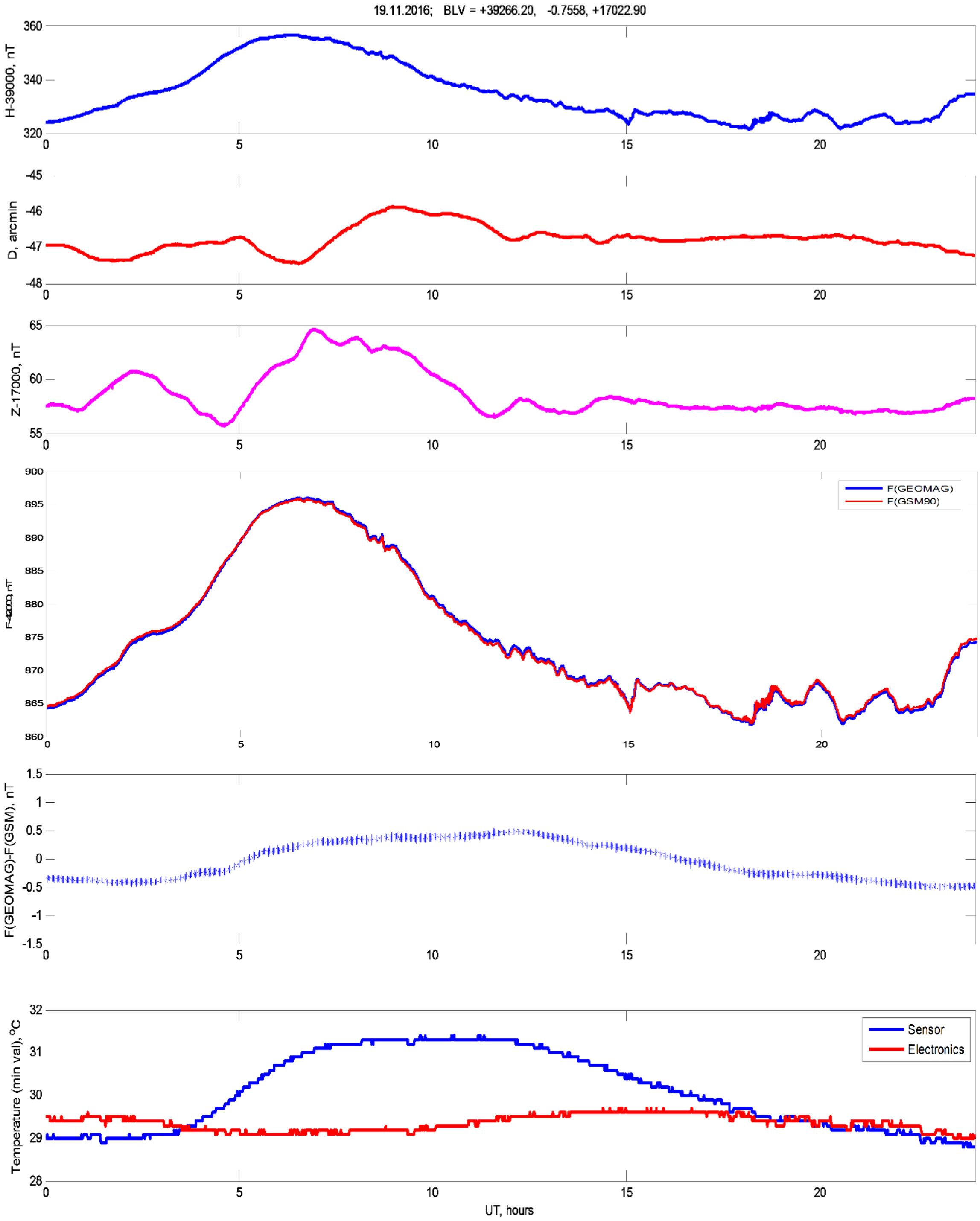


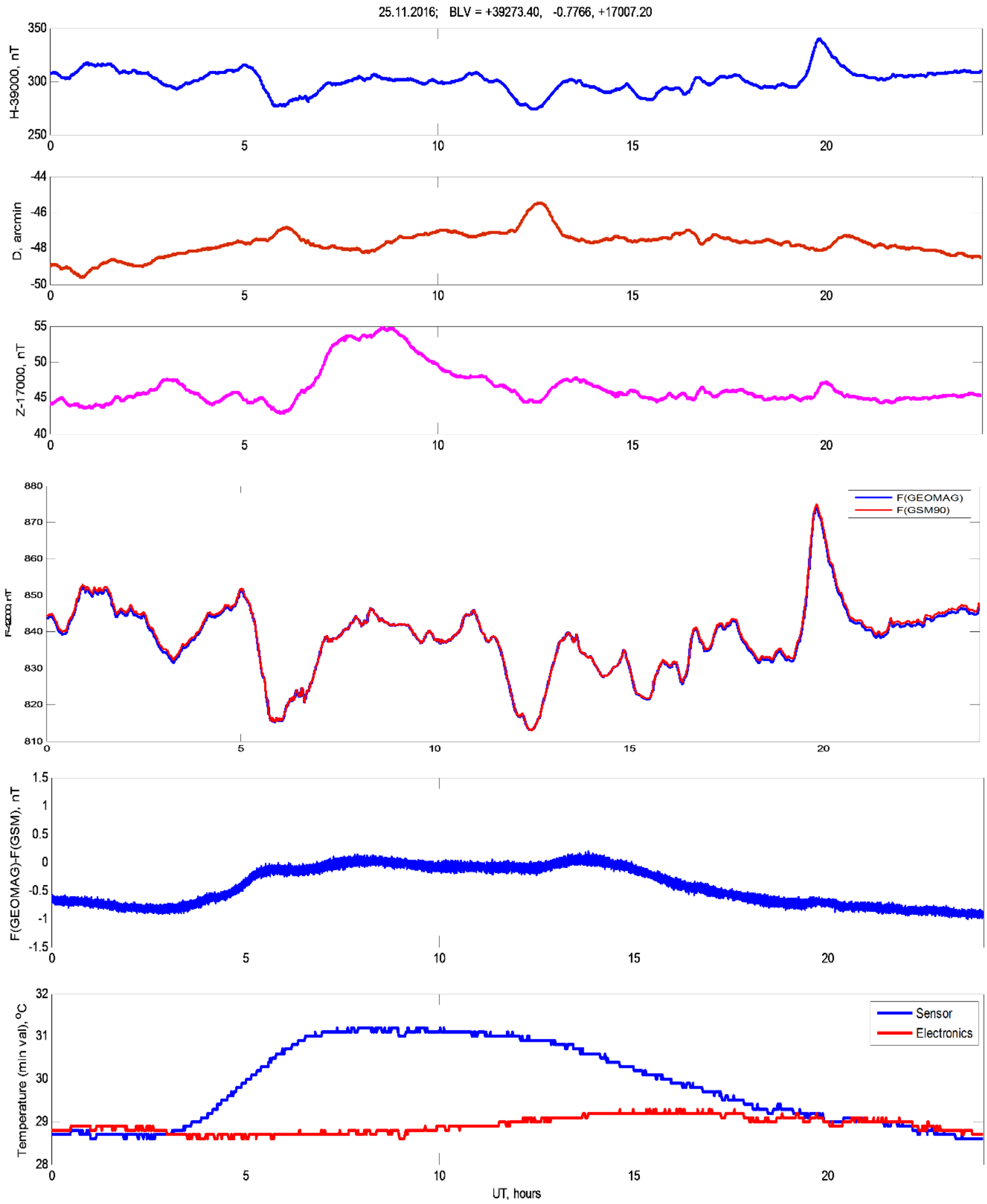


5.3.1: Monthly ΔF plots of CPL Observatory

5.4 GEOMAG-02MO one second data plots at CPL Observatory:

H, D, Z diurnal variations, temperature of the sensor & electronics and comparison scalar and vector F plots on 19.11.2016(Quite) and 25.11.2016 (Disturbed) days.

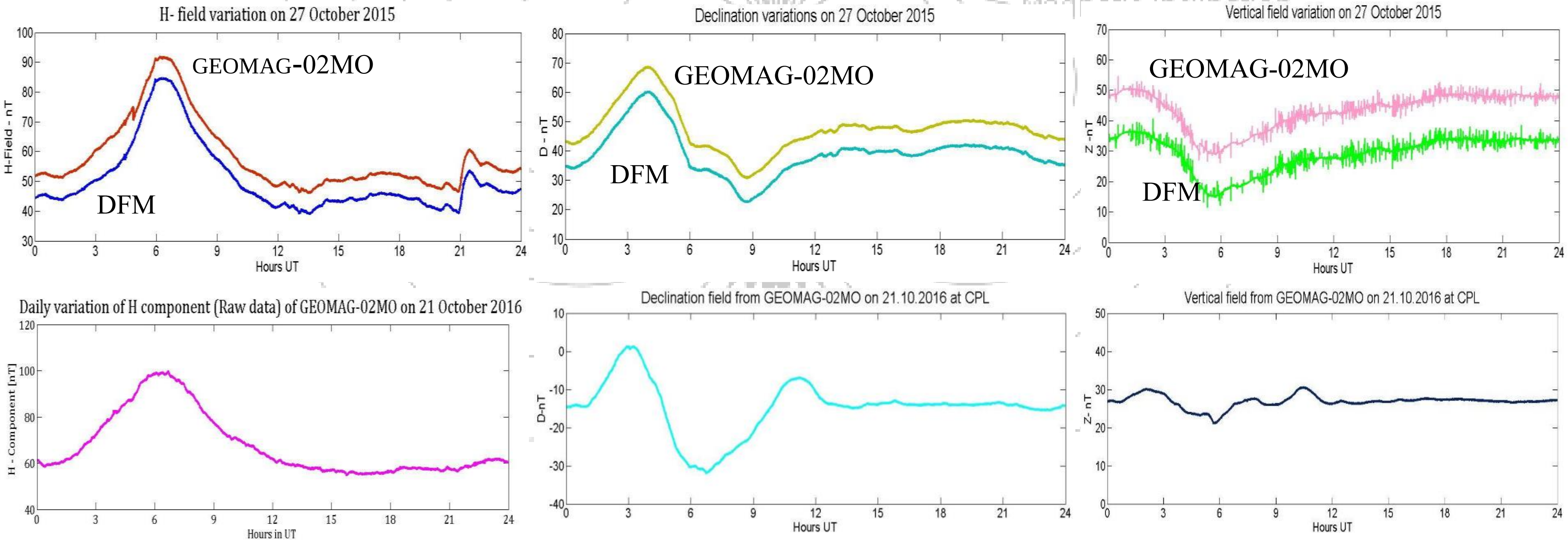



25.11.2016; BLV = +39273.40, -0.7766, +17007.20
H-39000, nT
D, arcmin
Z-17000, nT
F(GEOMAG)
F(GSM90)
F(GEOMAG)-F(GSM), nT
Temperature (min val), °C
Sensor
Electronics
UT, hours

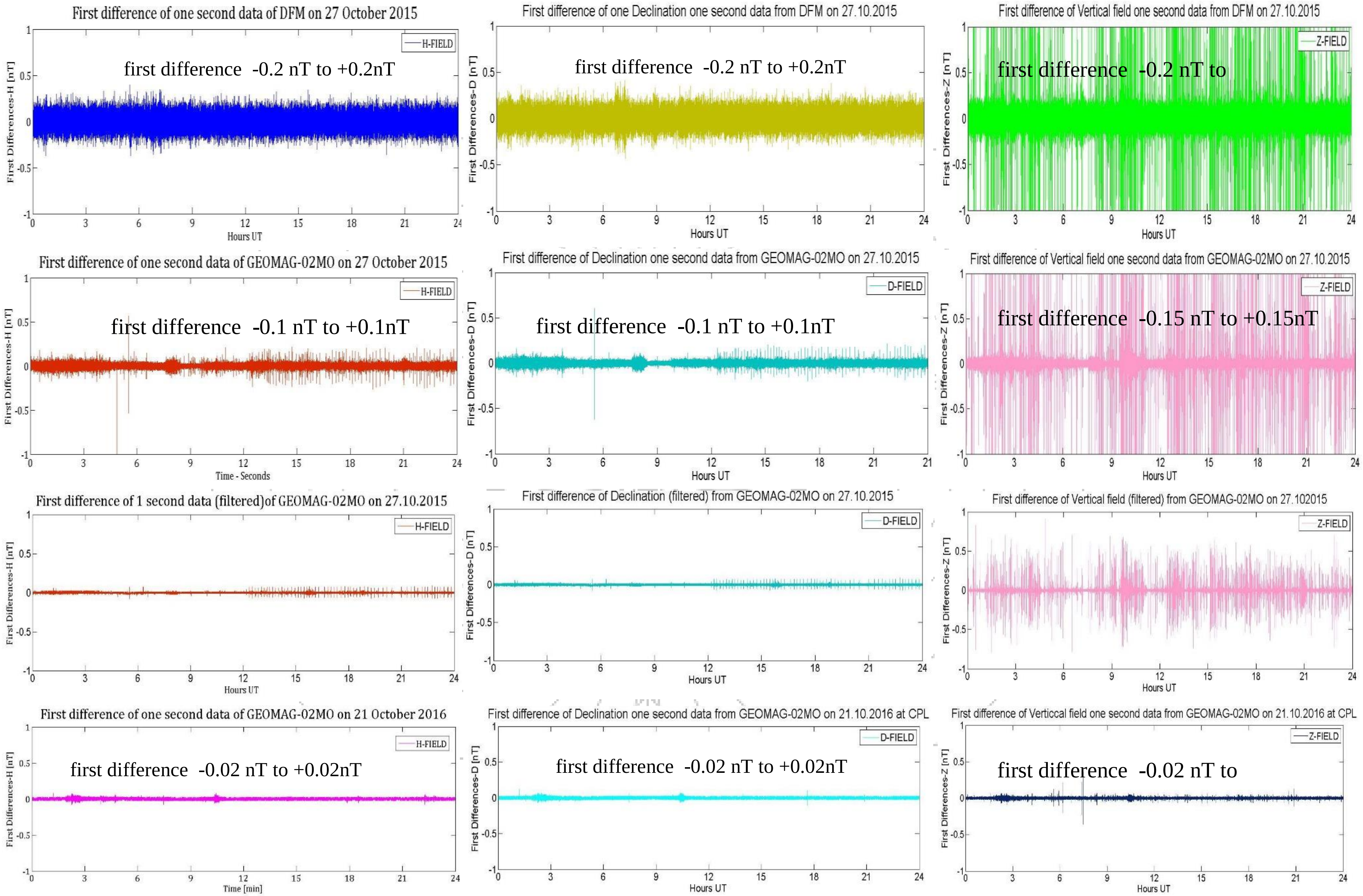
5.4.1. Preliminary GEOMAG-02MO one second data Checking at HYB and CPL and comparing with HYB DFM system:

Before installation of GEOMAG-02MO in CPL, MO was installed at HYB from October to November, 2015 and data was compared with DFM-FGE data for two months. As part of a process of validation, it is necessary to determine the resolution and noise content of new data. Two different analysis methods are used; the first method consists of side-by-side comparisons of the data from DFM and MO. The second method consists of analysis of second-to-second differences (first differences) of the data. And also GEOMAG-02MO data checked in noise free environment in CPL Observatory.

Daily variations on 27.10.2015 and 21.10.2016

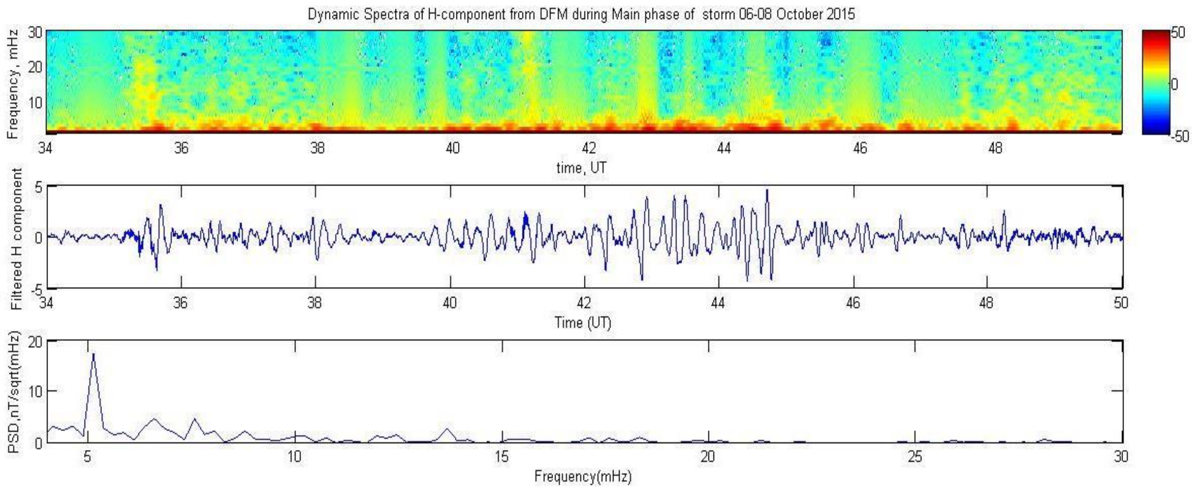


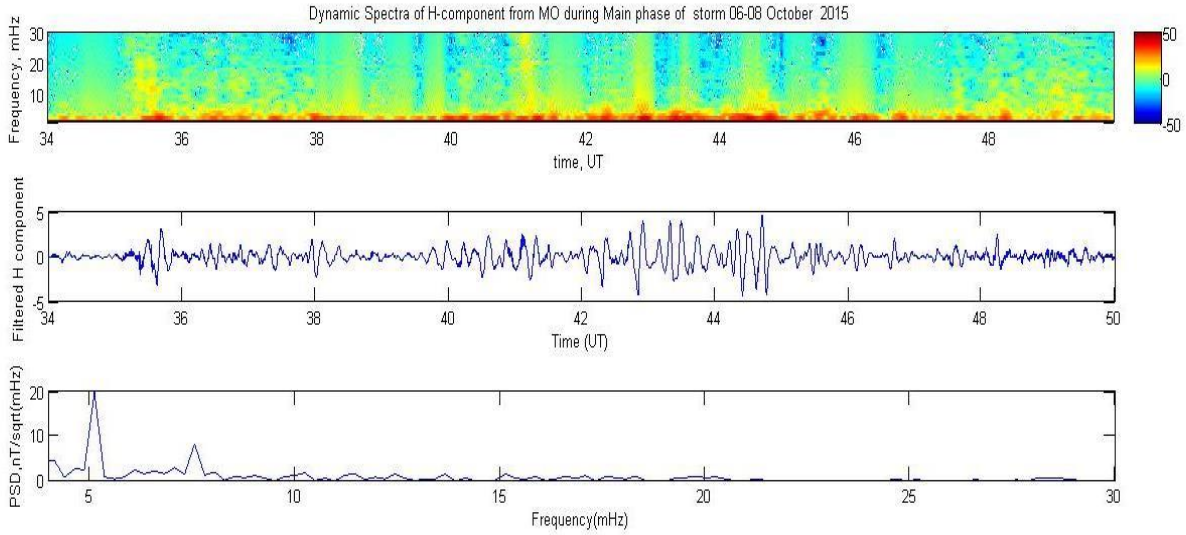
First differences



These analysis technique has an advantage that the regular variations of the magnetic field are removed and will not affect the results. What remains is the combination of the system noise of the data acquisition systems. The two analysis techniques were successful in the estimation of noise levels of one second data. Raw data of GEOMAG-02MO shows consistent trends and less noise in the data. Raw data first difference of one second data shows data quality of GEOMAG-02MO is high when compare to DFM data at HYB. The first difference of root mean square (RMS) errors shows GEOMAG-02MO is more stable to the environmental noise comparing to DFM in HYB.

Spectral contents of one second data of GEOMAG-02MO and DFM:





Pc5 pulsations are associated energy budget geomagnetic storm. More the storm strength, more the particle penetration in the earth's ionosphere. This leads to increased amplitude of Pc5 during the main phase of the storm.

6. Data of Semi-permanent stations

6.1. Diurnal variation of H during February 2016 at semi-permanent stations

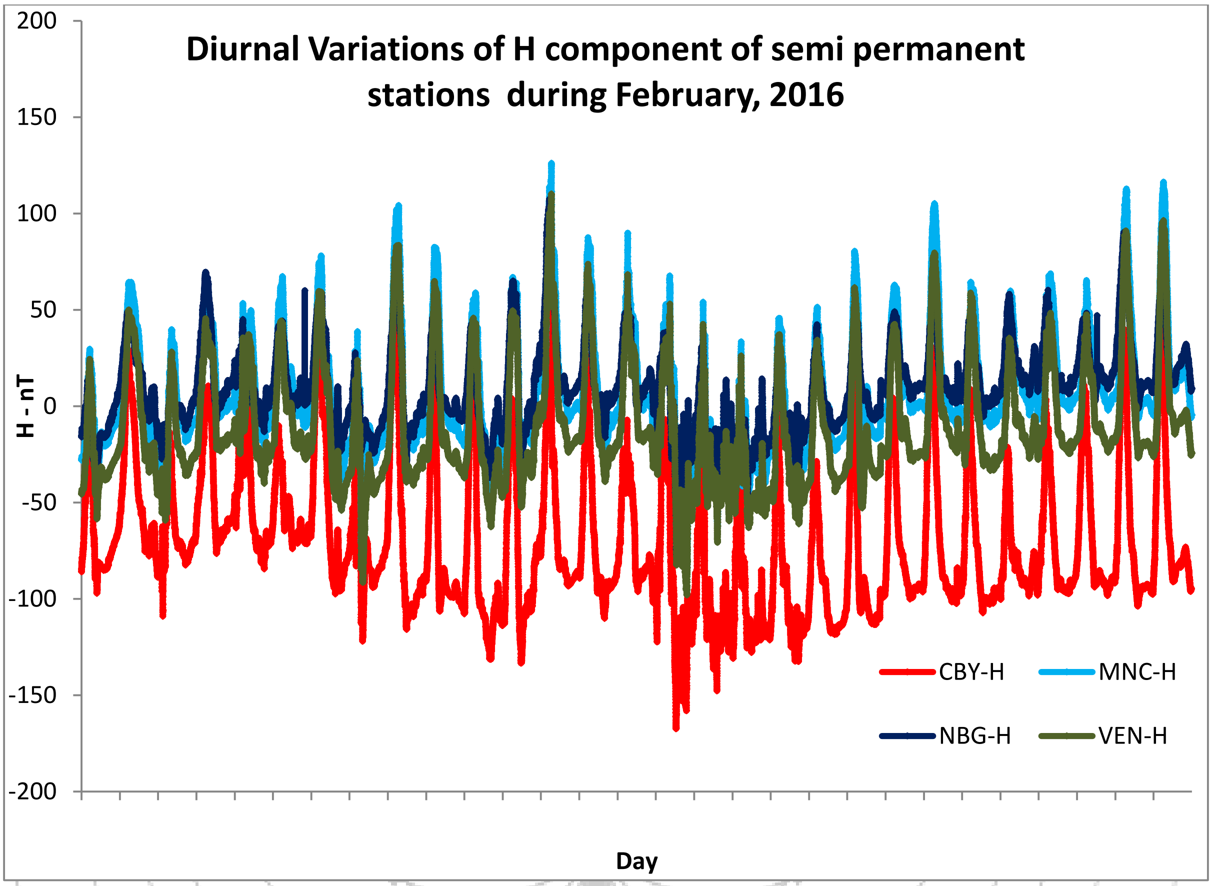


Figure6.1a: diurnal variations of H, D & Z of Semi-permanent stations during February, 2016

6.2. Induction arrows at different seasons from semi-permanent stations data

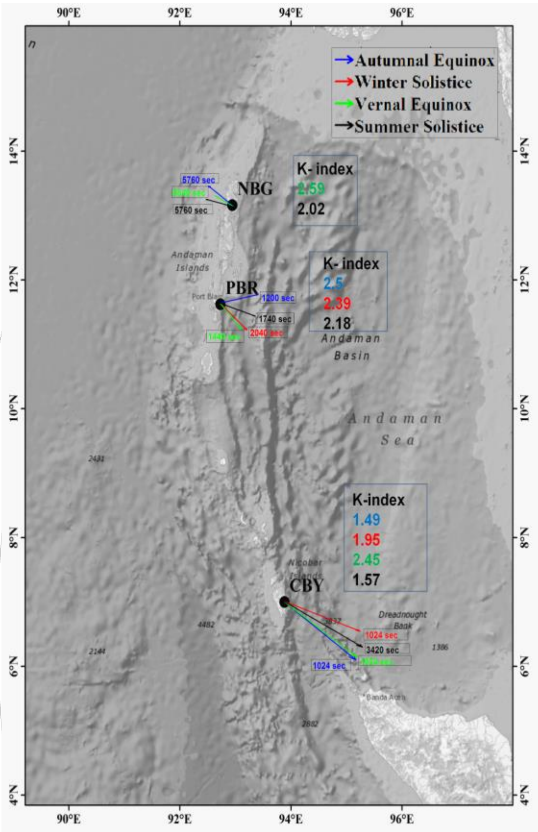


Figure 6.2a: Comparison of induction arrows at different seasons.

Seasonal variability

- This figure represents induction arrows of real vectors at four seasons(Autumnal Equinox, Vernal Equinox, Winter Solstice, Summer Solstice) at 3 sites NBG (Nabagram), PBR (Portblair), CBY(Campbell bay) at Andaman-Nicobar Islands.
- Real vectors are taken from the characteristic period (where the imaginary vectors showing minimum amplitude (zero) and flip in the direction) to show the high conductivity contrast and anomalous conducting body .
- Compared K-index of each season with the pattern of induction arrows at each site .
- At 3 sites the amplitude of the real vectors is maximum at maximum K-index values. The amplitude decreasing with decreasing K-index.
- The depth of penetration depends on conductivity of the subsurface and frequency of the signal. For Same K-index at NBG the real vectors showing less amplitude, at CBY the real vectors showing more amplitude because of CBY is more conducting than NBG.
- The length of induction arrows are more in summer solstice compared to winter solstice. This may be due to the influence of source field effects.

6.3. Morphology of Equatorial Electrojet at three closely spaced sites in the Indian sector

Electrojet(EEJ) is the eastward current flowing through E layer of the ionosphere along +/- 3° dip latitude region, which enhances the diurnal variation of H component(ΔH) at equatorial sites. Sometimes during day hours EEJ shows depression due to westward current this phenomena named as Equatorial counter Electrojet(CEJ).
ΔH variation at low latitude region is of solar quiet current (Sq) and at equatorial site ΔH is the combination of Sq and EEJ, EEJ strength at a site can be calculated using the below equation.

EEJ strength =ΔH at Electrojet station (EEJ+Sq) - ΔH at non Electrojet station (Sq)

EEJ and CEJ phenomena is highly variable in spatially and temporaly, there were several studies on EEJ and CEJ variability. Phani Chandrasekhar et.al, *[2014,2016]* reported the longitudinal variability of EEJ and CEJ phenomena at 15° longitudinal separation in Indian sector(between VEN and CBY) based on day to day variability , It has observed that EEJ strength is more at CBY with less number of CEJs and VEN was showing less EEJ strength compared to CBY with large number of CEJs . The reason for the variability mainly attributed to the localized wind effects.

Recently we have studied EEJ and CEJ characteristics at three closely spaced sites in Indian sector, which are separated at 5°,15°&20° longitudes. Five months of concurrent data obtained from three equatorial remote sites Minicoy (MNC, 72°E), Vencode (VEN, 77°E) Campbell Bay (CBY, 93°E) and low latitude sites Alibag (ABG), Hyderabad (HYB) and Nabagram (NBG, Andaman Islands) are used to calculated EEJ strength at equatorial sites. Location of the sites are given in figure(01) . Monthly average of ΔH for the month of April 2015 shown at all sites figure(02), ΔH at equatorial sites enhanced by EEJ, ΔH equatorial and low latitude sites follow the same pattern with peak at local noon time.

The present study provide the longitudinal trend of EEJ and CEJ in Indian sector which shows a linear trend of (a) increase in EEJ amplitude and decrease in CEJ amplitude from west (MNC,72°E) to east (CBY,93°E) (b) decline in correlation coefficient of EEJ with increase in spatial separations, correlation is very strong at 5° apart but significantly low 15° and 20° apart. The observed longitudinal patter can be related to global EEJ four wave structure (DE3 wave) with one of the wave crust at 100°E. CBY (93°E) is close to the crest of the wave pattern compared to MNC(72°E)&VEN(77°E), which is the one of the reason of high EEJ strength at the site. Large number of CEJs events at MNC&VEN is because of weakening of the EEJ four wave structure along long 60-70°E, which makes the generation of westward current (CEJ) in the upper atmosphere more effective at 70°, than at 90°.

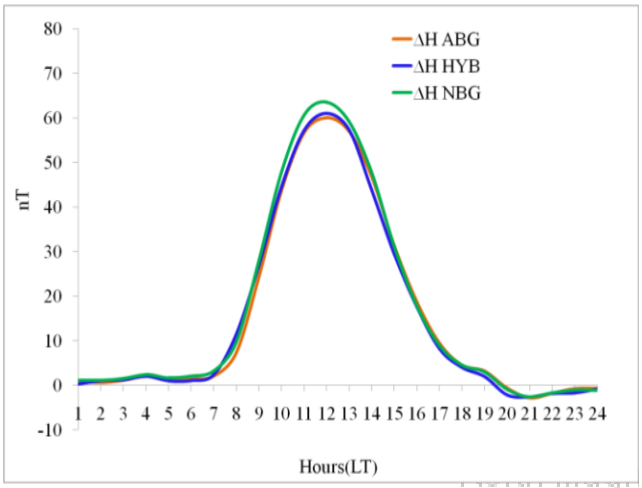


Figure 6.3a: 02Monthly average of ΔH for April 2015 at low latitude

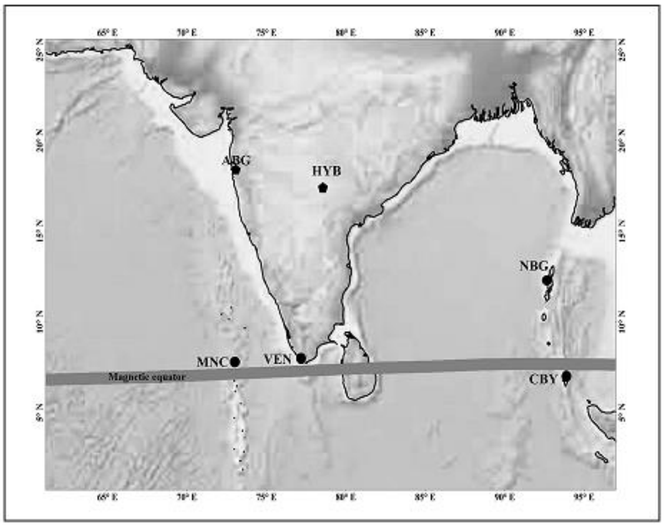


Figure 6.3b: Location of the sites

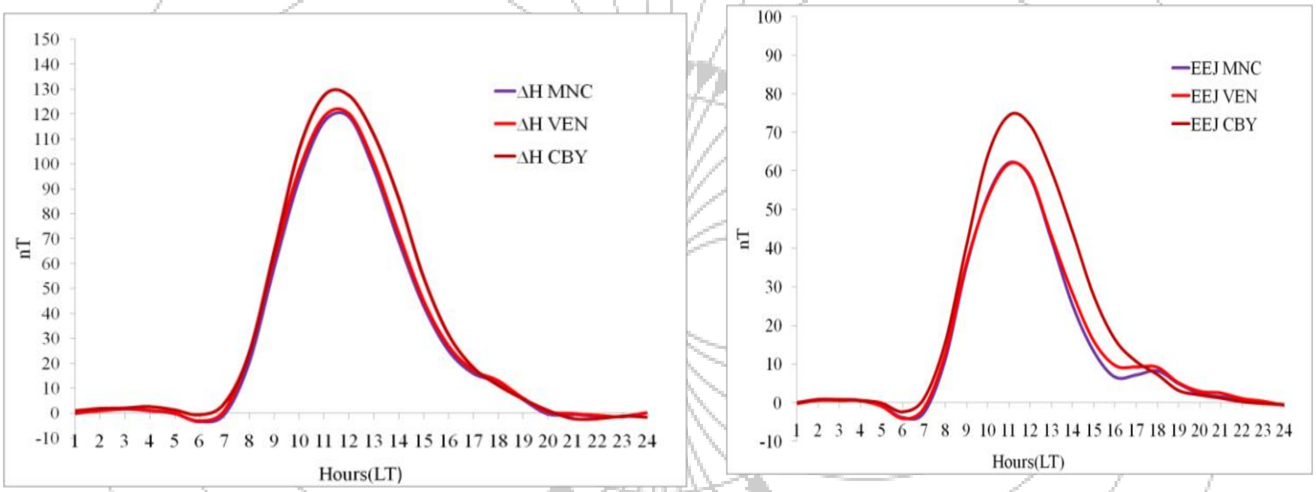


Figure 6.3c: Monthly average of ΔH and EEJ at equatorial sites for April 2015

Longitudinal pattern of CEJ amplitudes

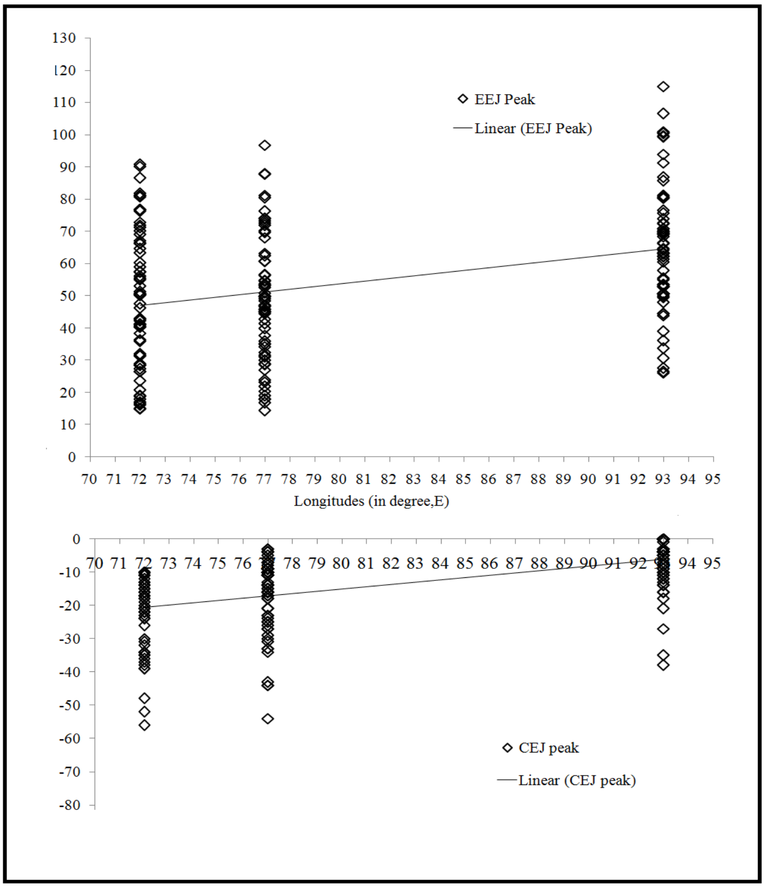


Figure 6.3d: Longitudinal pattern of CEJ amplitudes

7. Summary

Data gaps:

HYB

Data missing: 04.04.2016 to 31.12.2016

Reason: Due to shot-circuit of the DFM electronics (Data logger)

Trouble shooting: DFM electronics send for it's repair to Niemegk Observatory, Germany and got it repaired.

Missing data replacement: Replaced data from 04.04.2016 to 21.06.2016, from CPL DFM System (HDZ).

Replaced H, D and Z data from 23.06.2016 to 31.12.2016, from HYB Secondary System (GEOMAG-02M (MS-28))

CPL

DFM system:

Data missing: 22.06.2016 to 31.12.2016

Reason: Due to Failure of GPS Optical Fiber cable (OFC) of DFM system.

Trouble Shooting: Purchased Optical Fiber cable from Germany and replaced successfully got the problem solved by communicating with Germany colleagues.

Missing data replacement: Replaced data from 04.10.2016 to 31.12.2016 from GEOMAG-02MO of CPL Secondary system.

GEOMAG-02MO:

Installed in CPL Observatory at New Vaults on 16.06.2016.

Data missing: 29.07.2016 to 17.08.2016

Reason: MO data logger failure.

Trouble Shooting: Trip made by Mr. KCS Rao to Ukarine to rectify the problem.

Data missing: 27.08.2016 to 03.10.2016

Reason: Due to heavy rains severe water leakage found in GEOMAG-02MO sensor and logger vaults.

Trouble shooting: What is pumped and the vault is dried for few days. Necessary arrengements made for both the vaults and re-installed GEOMAG-02MO on 04.10.2016

Baselines:

HYB

No recording of Absolute Observations: 04.04.2016 to 18.07.2016 and 05.10.2016 to 24.11.2016

Reason: From 04.04.2016 to 22.06.2016 complete absence of variations and scalar data at HYB.

From 23.06.2016 to 18.07.2016 Scalar data not available at HYB.

From 05.10.2016 to 24.11.2016 Scalar data not available at HYB

CPL

No recording of Absolute Observations: 23.06.2016 to 31.08.2016 and 21.09.2016 to 15.10.2016

Reason: From 23.06.2016 to 31.08.2016 and 21.09.2016 to 15.10.2016 complete absence of variations and scalar data at CPL.

Major Jumps and Shifting of Baselines:

HYB

During 3rd and 5th October 2016 we have absolute Observations at HYB but these values are discorded due to huge jumps observed in the baseline values. The reason is unknown.

CPL

Baselines during October 2016 had Major shifts noticed between regular periods of Observations. These shifting were corrected and considered the Observations to construct daily baselines.

From both the Observatories (HYB and CPL) interpolated daily baselines (Adopted baselines) for 365 days by considering the available baselines data and generated absolute magnetic data from HYB and CPL.

HYB observatory has reported stable baselines and one minute absolute data even though it has external electromagnetic effects generated by the introduction of Metro rail about 500m from the Observatory. HYB data stability and it's temperature effect on data even more controlled than CPL data and It temperature effects. This clearly noticed in the ΔF plots.

Calibrations:

GEOMETRIX PPMS:

On regular basis GEOMATRIX PPMs were calibrated with Overgauser Magnetometer at CPL Observatory. It is noticed that working condition of the both the PPMs is good.

DIM (DMI100):

On regular basis DIM (DMI100) was got serviced in Mumbai then it was calibrated at Alibagh Observatory, Mumbai with DIM (Mao-01H). Results were satisfactory.

DIM (Mag-01H):

On regular basis DIM (Mag-01H) of HYB was got serviced in Mumbai then it was calibrated at Alibagh Observatory, Mumbai with DIM (Mao-01H). Working condition of DIM is good.

Primary Observations:

During 2016, due to the 24 Solar cycle descending Phase overall magnetic activities were noticed lesser than 2015 from ground data at HYB.

During 2016 magnetic activity is comparing to less than 2015, the maximum K daily sum is 36 observed in the month of May, 8th which is most magnetically disturbed day during 2016.

The next maximum K daily sum is 34 observed in 24th March.

Minimum daily K sum is 2 on 21th October which is known best quiet day in 2016.

During this year it is noticed that K=2 repeated 1023 times, it explains that the maximum days are quite days.

The maximum K=6 are noticed in the months of February, March and October.

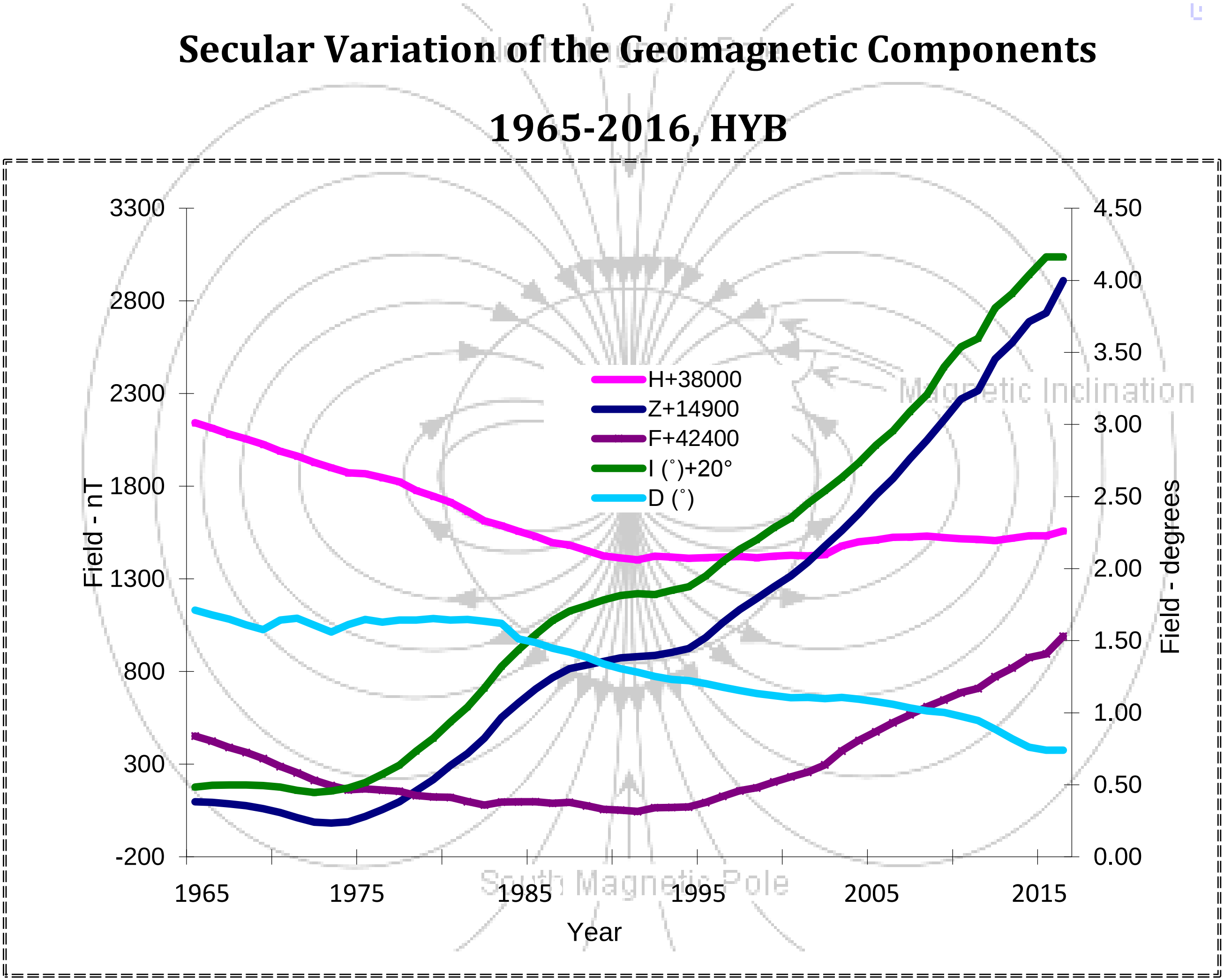
54 magnetic storms (General commencements (GC) and storm sudden commencements (SSCs)) 54 are observed.

09 storm sudden commencements are noticed. On 11th March is having highest amplitude of chief movement is +22nT for H component.

Secular Variation at HYB:

Regional estimates of secular variations of geomagnetic field components from 1965 -2016 at HYB Magnetic Observatory. Secular change of H-component is very low during this year it is about 25nT, secular change of Declination over 2016 is 2.0 minutes, Z is 110 nT and F is about 100nT and I is 6.0 minutes.

Secular Variation of the Geomagnetic Components 1965-2016, HYB



8. Data requests

--------- Forwarded message ----------
From: <webmaster@intermagnet.org>
Date: Fri, Apr 1, 2016 at 6:23 PM
Subject: INTERMAGNET data requests report for HYB
To: kusumita.arora@gmail.com
Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET FTP Server
Processed logs from 2016-03-01 UT to 2016-03-31 UT
Generated at : 2016-04-01 12:52:59
#---

IMO : HYB
Requests for IAGA2002 (provisional) files : 785
Requests for IAGA2002 (quasi-definitive) files : 619
Requests for IAGA2002 (definitive) files : 731
Requests for IAGA2002 (variation) files : 538
Total : 2673

Requests for minute files : 2673
Total : 2673
Sampling rate : minute
|-- Requested by : imaginpe
| |-- IAGA2002 (provisional) files : 70
|-- Requested by : imagbgs
| |-- IAGA2002 (quasi-definitive) files : 529
| |-- IAGA2002 (provisional) files : 580
|-- Requested by : imagpots
| |-- IAGA2002 (quasi-definitive) files : 90
| |-- IAGA2002 (provisional) files : 135
| |-- IAGA2002 (definitive) files : 731
|-- Requested by : imagrong
| |-- IAGA2002 (variation) files : 522
|-- Requested by : imagusgs
| |-- IAGA2002 (variation) files : 16
Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET Web Server
Processed logs from 2016-03-01 UT to 2016-03-31 UT
Generated at : 2016-04-01 12:53:03
#---

IMO : HYB

Requests for IAGA2002 (quasi-definitive) files : 1321
Requests for IAGA2002 (provisional) files : 68
Requests for IAGA2002 (definitive) files : 1846
Requests for IAGA2002 (variation) files : 4
Total : 3239

Requests for minute files : 3239
Total : 3239

Sampling rate : minute
|-- Requested by : zsheng93@foxmail.com
| |-- IAGA2002 (quasi-definitive) files : 33
|-- Requested by : lakshmiramprasath@gmail.com
| |-- IAGA2002 (provisional) files : 4
|-- Requested by : lrp34006@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 4
| |-- IAGA2002 (provisional) files : 2
|-- Requested by : talk2ocleen@yahoo.com
| |-- IAGA2002 (definitive) files : 13
|-- Requested by : sanaz.nourbakhsh.1@outlook.com
| |-- IAGA2002 (provisional) files : 2
|-- Requested by : sanaz.nourbakhsh@outlook.com
| |-- IAGA2002 (provisional) files : 1
|-- Requested by : andrei11vorobev@gmail.com
| |-- IAGA2002 (variation) files : 4
| |-- IAGA2002 (quasi-definitive) files : 10
| |-- IAGA2002 (definitive) files : 3
|-- Requested by : kcsrao18ngri@gmail.com
| |-- IAGA2002 (provisional) files : 1
|-- Requested by : champion_chb@126.com
| |-- IAGA2002 (definitive) files : 365
| |-- IAGA2002 (quasi-definitive) files : 182
|-- Requested by : jovenho@163.com
| |-- IAGA2002 (definitive) files : 1095
|-- Requested by : 879144166@qq.com
| |-- IAGA2002 (quasi-definitive) files : 1026
|-- Requested by : danielshamambo@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 16
| |-- IAGA2002 (provisional) files : 2
|-- Requested by : tharani012@gmail.com
| |-- IAGA2002 (provisional) files : 1
|-- Requested by : mehrdad.moradi7070@gmail.com
| |-- IAGA2002 (provisional) files : 1
|-- Requested by : jjcurto@obsebre.es
| |-- IAGA2002 (definitive) files : 1
|-- Requested by : sumeshgopinath@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 6
|-- Requested by : 307013584@qq.com
| |-- IAGA2002 (definitive) files : 3
|-- Requested by : songchk@126.com
| |-- IAGA2002 (definitive) files : 366
| |-- IAGA2002 (quasi-definitive) files : 31
| |-- IAGA2002 (provisional) files : 54
|-- Requested by : zolot@iszf.irk.ru
| |-- IAGA2002 (quasi-definitive) files : 13

---------- Forwarded message ----------
From: <webmaster@intermagnet.org>
Date: Mon, May 2, 2016 at 8:01 PM
Subject: INTERMAGNET data requests report for HYB
To: kusumita.arora@gmail.com

```
# Summary Report for HYB
# Files downloaded from Ottawa INTERMAGNET FTP Server
# Processed logs from 2016-04-01 UT to 2016-04-30 UT
# Generated at : 2016-05-02 14:31:18
#-------------------------------------------------------

IMO : HYB

Requests for IAGA2002 (provisional) files        : 56
Requests for IAGA2002 (quasi-definitive) files    : 417
Requests for IAGA2002 (variation) files          : 733
Total                                  : 1206

Requests for minute files                   : 1206
Total                                  : 1206

Sampling rate : minute
|-- Requested by : imagbgs
|  |-- IAGA2002 (provisional) files : 2
|  |-- IAGA2002 (quasi-definitive) files : 1
|-- Requested by : imagrong
|  |-- IAGA2002 (variation) files : 733
|-- Requested by : imaginpe
|  |-- IAGA2002 (provisional) files : 54
|-- Requested by : imagpots
|  |-- IAGA2002 (quasi-definitive) files : 416

# Summary Report for HYB
# Files downloaded from Ottawa INTERMAGNET Web Server
# Processed logs from 2016-04-01 UT to 2016-04-30 UT
# Generated at : 2016-05-02 14:31:19
#-------------------------------------------------------

IMO : HYB

Requests for IAGA2002 (provisional) files        : 77
Requests for IAGA2002 (quasi-definitive) files    : 44
Requests for IAGA2002 (definitive) files         : 733
Total                                  : 854

Requests for minute files                   : 854
Total                                  : 854

Sampling rate : minute
|-- Requested by : eslam.hamza.1000@facebook.com
|  |-- IAGA2002 (provisional) files : 1
|-- Requested by : yyx8425061@163.com
|  |-- IAGA2002 (provisional) files : 9
|-- Requested by : zsheng93@foxmail.com
|  |-- IAGA2002 (quasi-definitive) files : 6
|-- Requested by : isahiom@hotmail.com
|  |-- IAGA2002 (quasi-definitive) files : 1
|-- Requested by : india.ajesh@gmail.com
|  |-- IAGA2002 (quasi-definitive) files : 31
|  |-- IAGA2002 (provisional) files : 66
|-- Requested by : brett.carter@rmit.edu.au
```

| |-- IAGA2002 (quasi-definitive) files : 1
|-- Requested by : coisson@ipgp.fr
| |-- IAGA2002 (quasi-definitive) files : 3
|-- Requested by : kcsrao18ngri@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 2
| |-- IAGA2002 (provisional) files : 1
|-- Requested by : lilianola@yahoo.com
| |-- IAGA2002 (definitive) files : 731
|-- Requested by : drfreez@ya.ru
| |-- IAGA2002 (definitive) files : 2

Fwd: INTERMAGNET data requests report for HYB

----- Forwarded Message -----
From: webmaster@intermagnet.org
To: karora@ngri.res.in
Sent: Wednesday, June 1, 2016 5:48:32 PM
Subject: INTERMAGNET data requests report for HYB

Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET FTP Server
Processed logs from 2016-05-01 UT to 2016-05-31 UT
Generated at : 2016-06-01 12:18:08
#--

IMO : HYB

Requests for IAGA2002 (quasi-definitive) files   : 93
Requests for IAGA2002 (variation) files   : 516
Total   : 609

Requests for minute files   : 609
Total   : 609

Sampling rate : minute
|-- Requested by : imagalca
| |-- IAGA2002 (quasi-definitive) files : 93
|-- Requested by : imagusgs
| |-- IAGA2002 (variation) files : 28
|-- Requested by : imagrong
| |-- IAGA2002 (variation) files : 320
|-- Requested by : imagrsi
| |-- IAGA2002 (variation) files : 168
Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET Web Server
Processed logs from 2016-05-01 UT to 2016-05-31 UT
Generated at : 2016-06-01 12:18:09
#--

IMO : HYB

Requests for IAGA2002 (provisional) files   : 1
Requests for IAGA2002 (definitive) files   : 382

Requests for IAGA2002 (quasi-definitive) files : 96
Requests for IAGA2002 (variation) files : 365
Total : 844

Requests for minute files : 844
Total : 844

Sampling rate : minute
|-- Requested by : lfalberca@iqs.es
| |-- IAGA2002 (provisional) files : 1
|-- Requested by : martina.guzavina@erdw.ethz.ch
| |-- IAGA2002 (definitive) files : 2
|-- Requested by : sunlingfeng@mail.iggcas.ac.cn
| |-- IAGA2002 (quasi-definitive) files : 10
| |-- IAGA2002 (definitive) files : 14
|-- Requested by : z4rf@yahoo.com
| |-- IAGA2002 (definitive) files : 365
|-- Requested by : 745043732@qq.com
| |-- IAGA2002 (quasi-definitive) files : 1
|-- Requested by : hendra.31294@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 20
|-- Requested by : 1819019267@qq.com
| |-- IAGA2002 (quasi-definitive) files : 2
|-- Requested by : orel4985@mail.ru
| |-- IAGA2002 (variation) files : 365
|-- Requested by : archana2208772@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 58
|-- Requested by : ecla@bgs.ac.uk
| |-- IAGA2002 (quasi-definitive) files : 3
|-- Requested by : coisson@ipgp.fr
| |-- IAGA2002 (quasi-definitive) files : 2
|-- Requested by : drfreez@ya.ru
| |-- IAGA2002 (definitive) files : 1

----- Forwarded Message -----
From: webmaster@intermagnet.org
To: karora@ngri.res.in
Sent: Wednesday, June 1, 2016 5:48:32 PM
Subject: INTERMAGNET data requests report for HYB

Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET FTP Server
Processed logs from 2016-05-01 UT to 2016-05-31 UT
Generated at : 2016-06-01 12:18:08
#--

IMO : HYB

Requests for IAGA2002 (quasi-definitive) files : 93
Requests for IAGA2002 (variation) files : 516
Total : 609

Requests for minute files : 609
Total : 609

Sampling rate : minute

|-- Requested by : imagalca
| |-- IAGA2002 (quasi-definitive) files : 93
|-- Requested by : imagusgs
| |-- IAGA2002 (variation) files : 28
|-- Requested by : imagrong
| |-- IAGA2002 (variation) files : 320
|-- Requested by : imagrsi
| |-- IAGA2002 (variation) files : 168
Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET Web Server
Processed logs from 2016-05-01 UT to 2016-05-31 UT
Generated at : 2016-06-01 12:18:09
#--

IMO : HYB

Requests for IAGA2002 (provisional) files : 1
Requests for IAGA2002 (definitive) files : 382
Requests for IAGA2002 (quasi-definitive) files : 96
Requests for IAGA2002 (variation) files : 365
Total : 844

Requests for minute files : 844
Total : 844

Sampling rate : minute
|-- Requested by : lfalberca@iqs.es
| |-- IAGA2002 (provisional) files : 1
|-- Requested by : martina.guzavina@erdw.ethz.ch
| |-- IAGA2002 (definitive) files : 2
|-- Requested by : sunlingfeng@mail.iggcas.ac.cn
| |-- IAGA2002 (quasi-definitive) files : 10
| |-- IAGA2002 (definitive) files : 14
|-- Requested by : z4rf@yahoo.com
| |-- IAGA2002 (definitive) files : 365
|-- Requested by : 745043732@qq.com
| |-- IAGA2002 (quasi-definitive) files : 1
|-- Requested by : hendra.31294@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 20
|-- Requested by : 1819019267@qq.com
| |-- IAGA2002 (quasi-definitive) files : 2
|-- Requested by : orel4985@mail.ru
| |-- IAGA2002 (variation) files : 365
|-- Requested by : archana2208772@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 58
|-- Requested by : ecla@bgs.ac.uk
| |-- IAGA2002 (quasi-definitive) files : 3
|-- Requested by : coisson@ipgp.fr
| |-- IAGA2002 (quasi-definitive) files : 2
|-- Requested by : drfreez@ya.ru
| |-- IAGA2002 (definitive) files : 1

Fwd: INTERMAGNET data requests report for HYB July 2
Sent from my iPhone

Begin forwarded message:
From: webmaster@intermagnet.org
Date: 2 August 2016 at 5:07:24 PM IST
To: kusumita.arora@gmail.com
Subject: INTERMAGNET data requests report for HYB
Reply-To: webmaster@intermagnet.org
Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET FTP Server
Processed logs from 2016-07-01 UT to 2016-07-31 UT
Generated at : 2016-08-02 11:35:35
#---

IMO : HYB

Requests for IAGA2002 (variation) files : 20
Total : 20

Requests for minute files : 20
Total : 20

Sampling rate : minute
|-- Requested by : imagusgs
| |-- IAGA2002 (variation) files : 20

Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET Web Server
Processed logs from 2016-07-01 UT to 2016-07-21 UT
Generated at : 2016-08-02 11:35:37
#---

IMO : HYB

Requests for IAGA2002 (quasi-definitive) files : 360
Requests for IAGA2002 (provisional) files : 12
Requests for IAGA2002 (definitive) files : 3
Total : 375

Requests for minute files : 375
Total : 375

Sampling rate : minute
|-- Requested by : india.ajesh@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 12
|-- Requested by : enh@teknova.no
| |-- IAGA2002 (quasi-definitive) files : 284
|-- Requested by : archana2208772@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 24
|-- Requested by : zolot@iszf.irk.ru
| |-- IAGA2002 (quasi-definitive) files : 36
| |-- IAGA2002 (provisional) files : 12

|-- Requested by : martina.guzavina@erdw.ethz.ch
| |-- IAGA2002 (definitive) files : 3
|-- Requested by : bulusujayashree@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 4

For print and archival

Begin forwarded message:
From: webmaster@intermagnet.org
Date: 12 September 2016 at 3:31:23 PM IST
To: kusumita.arora@gmail.com
Subject: INTERMAGNET data requests report for HYB
Reply-To: webmaster@intermagnet.org
Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET FTP Server
Processed logs from 2016-08-01 UT to 2016-08-31 UT
Generated at : 2016-09-12 10:01:02
#---

IMO : HYB

Requests for IAGA2002 (quasi-definitive) files : 363
Requests for IAGA2002 (provisional) files : 30
Total : 393

Requests for minute files : 393
Total : 393

Sampling rate : minute
|-- Requested by : imagpots
| |-- IAGA2002 (quasi-definitive) files : 238
| |-- IAGA2002 (provisional) files : 30
|-- Requested by : imagbgs
| |-- IAGA2002 (quasi-definitive) files : 125

Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET Web Server
Processed logs from 2016-08-01 UT to 2016-08-31 UT
Generated at : 2016-09-12 10:01:03
#---

IMO : HYB

Requests for IAGA2002 (quasi-definitive) files : 73
Requests for IAGA2002 (definitive) files : 1
Total : 74

Requests for minute files : 74
Total : 74

Sampling rate : minute
|-- Requested by : phaninelapatla@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 32

|-- Requested by : piersantimirko28@hotmail.com
| |-- IAGA2002 (quasi-definitive) files : 2
|-- Requested by : olgsokolova@yandex.ru
| |-- IAGA2002 (quasi-definitive) files : 30
|-- Requested by : vazhakka2000@yahoo.com
| |-- IAGA2002 (definitive) files : 1
|-- Requested by : bulusujayashree@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 9

Fwd: INTERMAGNET data requests report for HYB

----- Forwarded Message -----
From: webmaster@intermagnet.org
To: karora@ngri.res.in
Sent: Monday, October 3, 2016 4:59:40 PM
Subject: INTERMAGNET data requests report for HYB

Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET Web Server
Processed logs from 2016-09-01 UT to 2016-09-30 UT
Generated at : 2016-10-03 11:29:18
#---

IMO : HYB

Requests for IAGA2002 (quasi-definitive) files : 1622
Requests for IAGA2002 (definitive) files : 1476
Requests for IAGA2002 (provisional) files : 12
Total : 3110

Requests for minute files : 3110
Total : 3110

Sampling rate : minute
|-- Requested by : heba.salah@aucegypt.edu
| |-- IAGA2002 (quasi-definitive) files : 1
|-- Requested by : mohamad.elmasry2050@yahoo.com
| |-- IAGA2002 (definitive) files : 1
|-- Requested by : Khomutov@ikir.ru
| |-- IAGA2002 (quasi-definitive) files : 6
| |-- IAGA2002 (provisional) files : 12
| |-- IAGA2002 (definitive) files : 10
|-- Requested by : zhaoxud@mail.iggcas.ac.cn
| |-- IAGA2002 (quasi-definitive) files : 35
|-- Requested by : 7450437322@qq.com
| |-- IAGA2002 (quasi-definitive) files : 1
|-- Requested by : 745043732@qq.com
| |-- IAGA2002 (quasi-definitive) files : 19
|-- Requested by : martina.guzavina@erdw.ethz.ch
| |-- IAGA2002 (quasi-definitive) files : 9
|-- Requested by : khairulafifi@yahoo.com
| |-- IAGA2002 (quasi-definitive) files : 1208
| |-- IAGA2002 (definitive) files : 1461
|-- Requested by : manjulalingala@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 43
|-- Requested by : shyamoli@iigs.iigm.res.in

| |-- IAGA2002 (definitive) files : 2
| |-- IAGA2002 (quasi-definitive) files : 1
|-- Requested by : aniliype@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 294
|-- Requested by : yara_ahmed1792@yahoo.com
| |-- IAGA2002 (definitive) files : 2
|-- Requested by : xinzhng@163.com
| |-- IAGA2002 (quasi-definitive) files : 4
|-- Requested by : ljadhav@iigs.iigm.res.in
| |-- IAGA2002 (quasi-definitive) files : 1

---------- Forwarded message ----------
From: <webmaster@intermagnet.org>
Date: Tue, Nov 1, 2016 at 4:49 PM
Subject: INTERMAGNET data requests report for HYB
To: kusumita.arora@gmail.com

Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET FTP Server
Processed logs from 2016-10-01 UT to 2016-10-31 UT
Generated at : 2016-11-01 11:09:24
#--

IMO : HYB

Requests for IAGA2002 (quasi-definitive) files : 29
Requests for IAGA2002 (provisional) files : 31
Total : 60

Requests for minute files : 60
Total : 60

Sampling rate : minute
|-- Requested by : imagsolov
| |-- IAGA2002 (quasi-definitive) files : 29
|-- Requested by : imagalca
| |-- IAGA2002 (provisional) files : 31

Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET Web Server
Processed logs from 2016-10-01 UT to 2016-10-31 UT
Generated at : 2016-11-01 11:09:26
#--

IMO : HYB

Requests for IAGA2002 (definitive) files : 44
Requests for IAGA2002 (quasi-definitive) files : 182
Requests for IAGA2002 (provisional) files : 1
Total : 227

Requests for minute files : 227
Total : 227

Sampling rate : minute
|-- Requested by : manjulalingala@gmail.com
| |-- IAGA2002 (definitive) files : 6
|-- Requested by : lfalberca@iqs.es
| |-- IAGA2002 (quasi-definitive) files : 1
|-- Requested by : tikuwabuu.odensan@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 7
|-- Requested by : 616334105@qq.com
| |-- IAGA2002 (definitive) files : 26
|-- Requested by : 745043732@qq.com
| |-- IAGA2002 (definitive) files : 12
| |-- IAGA2002 (quasi-definitive) files : 8
|-- Requested by : pkm@tifr.res.in
| |-- IAGA2002 (quasi-definitive) files : 6
|-- Requested by : anusha.geotech@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 153
|-- Requested by : andrei11vorobev@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 1
| |-- IAGA2002 (provisional) files : 1
|-- Requested by : 1819019267@qq.com
| |-- IAGA2002 (quasi-definitive) files : 5
|-- Requested by : apatenkov@mail.ru
| |-- IAGA2002 (quasi-definitive) files : 1

Fwd: INTERMAGNET data requests report for HYB

From: <webmaster@intermagnet.org>
Date: Mon, Dec 5, 2016 at 6:41 PM
Subject: INTERMAGNET data requests report for HYB
To: kusumita.arora@gmail.com

Summary Report for HYB
Files downloaded from Ottawa INTERMAGNET Web Server
Processed logs from 2016-11-01 UT to 2016-11-30 UT
Generated at : 2016-12-05 13:09:55
#---

IMO : HYB

Requests for IAGA2002 (quasi-definitive) files : 1357
Requests for IAGA2002 (definitive) files : 1884
Total : 3241

Requests for minute files : 3241
Total : 3241

Sampling rate : minute
|-- Requested by : 111111111111@qwer.om
| |-- IAGA2002 (quasi-definitive) files : 31
|-- Requested by : 745043732@qq.com
| |-- IAGA2002 (quasi-definitive) files : 16
|-- Requested by : martina.guzavina@erdw.ethz.ch
| |-- IAGA2002 (definitive) files : 6
|-- Requested by : do.farooq@gmail.com

| |-- IAGA2002 (quasi-definitive) files : 457
|-- Requested by : yanxiangxiang@upc.edu.cn
| |-- IAGA2002 (definitive) files : 1
|-- Requested by : ivankutiev@yahoo.com
| |-- IAGA2002 (definitive) files : 5
|-- Requested by : rosbell_love.22@hotmail.com
| |-- IAGA2002 (quasi-definitive) files : 31
|-- Requested by : anusha.geotech@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 546
| |-- IAGA2002 (definitive) files : 1
|-- Requested by : johnpappachen@gmail.com
| |-- IAGA2002 (quasi-definitive) files : 164
|-- Requested by : 5252yq@163.com
| |-- IAGA2002 (definitive) files : 24
|-- Requested by : shahryarnadr@yahoo.com
| |-- IAGA2002 (quasi-definitive) files : 90
|-- Requested by : wangxiang.whu@whu.edu.cn
| |-- IAGA2002 (definitive) files : 19
| |-- IAGA2002 (quasi-definitive) files : 16
|-- Requested by : zolot@iszf.irk.ru
| |-- IAGA2002 (quasi-definitive) files : 6
|-- Requested by : phaninelapatla@gmail.com
| |-- IAGA2002 (definitive) files : 1828

9. Publications from Hyderabad & Remote Magnetic Observatories

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