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One second vector and scalar magnetic measurements at the low-latitude Choutuppal (CPL) magnetic observatory

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2.2 Digital Filtering

Figure S1 shown as examples of application of the LPF (Low Pass Filter) tool and the obtained noise free data at CPL Magnetic Observatory. The top panel of Figures S1 (a) and (b) illustrates the loading of 1 second data from Magrec-4B into LPF-GEOMAG tool. This header file contains the consummate information about the format of the data, instruments deployed, name and co-ordinates of the Observatory, reporting magnetic field components, sensor orientation, sampling interval, data type and the field variations of the day. The information about the filter parameters is shown in the middle panel of Figure S1 (a) and (b). After running the LPF-GEOMAG filter, the software engenders three output data files: (i) the raw file; (ii) filtered file and (iii) the noise data, shown in last panel. The despiked data is illustrated in Figures 09a and 09b for each component.

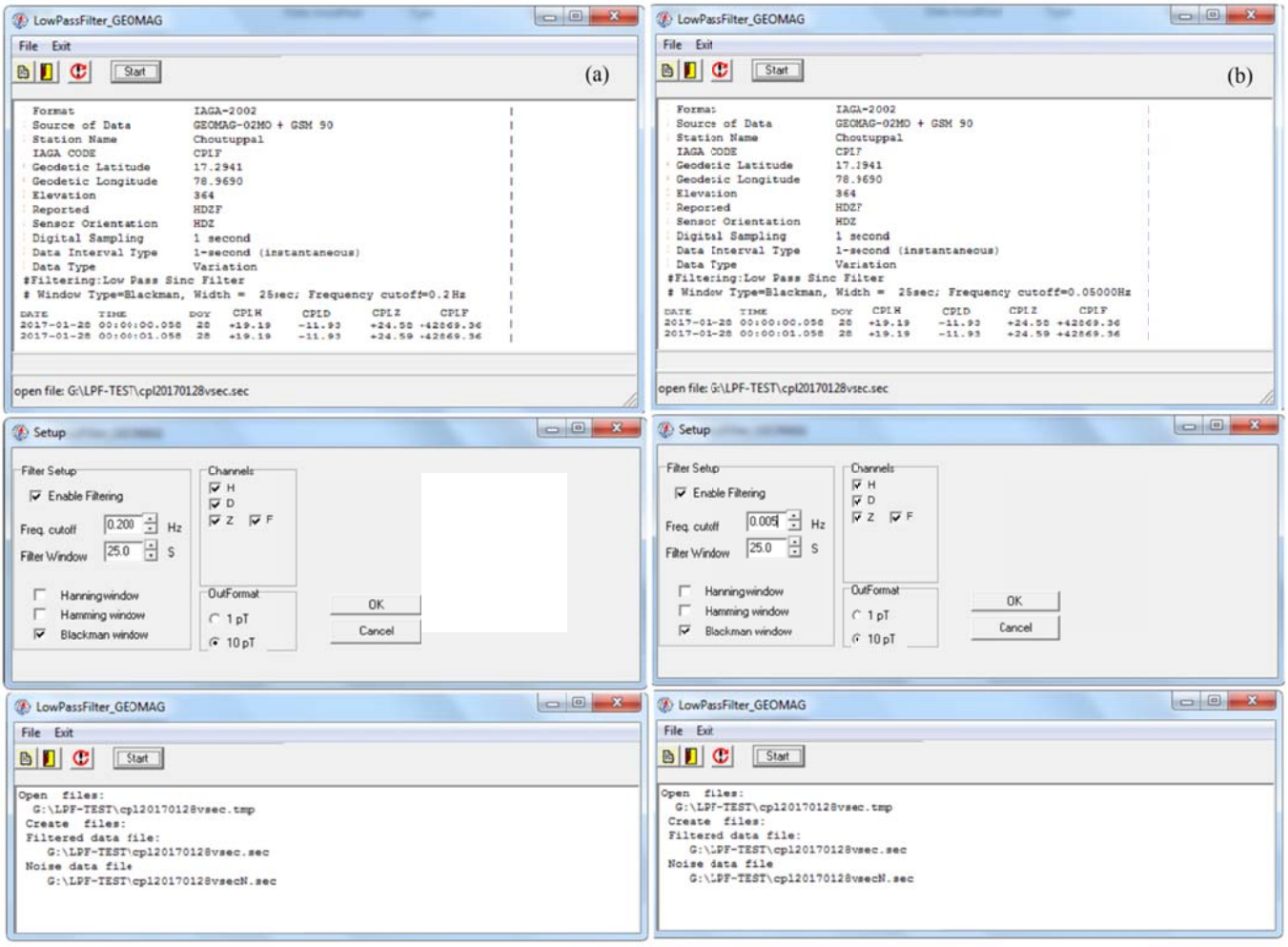

Figure S1: Low Pass Filter GEOMAG-02MO software with cut-off frequency (a) 0.200 Hz and (b) 0.005 Hz

3 Data acquisition system: Magrec-4B

Apart from the display of the real-time 1 second magnetometer data and temperature profiles of GEOMAG-02MO discussed in Figure 6, Magrec-4B additionally offers the niceties of the functioning of various parameters associated with magnetometers, which are discussed in Figures S2 and S3.

Figure S2 illustrates the (i) 1 second raw vector from GEOMAG-02MO (Figure S2a); (ii) 1 minute averaged INTERMAGNET Gaussian filter applied on 1 second data for GEOMAG-02MO and GSM-90F1 (Figure S2b); (iii) minute means supplementary data of sensor and logger temperatures of GEOMAG-02MO (Figure S2c); (vi) raw data from GSM-90F1 (Figure S2d); (v) 1 sec temperature data of the Magrec-4B data acquisition system (Figure S2e), (vi) 10 minute mean temperature data of the Magrec-4B data acquisition system (Figure S2f).

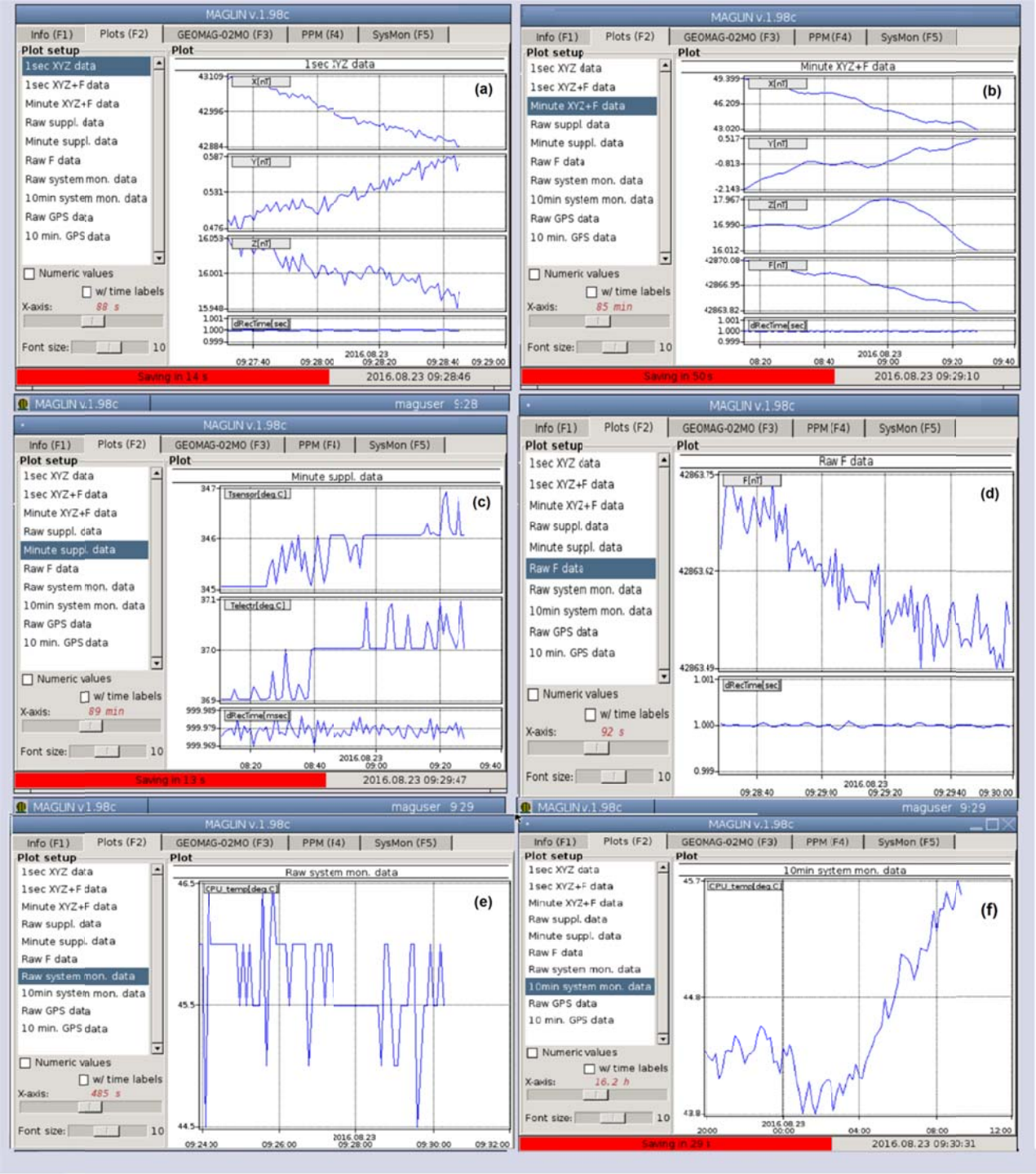

Figure S2. Illustration of various plotting parameters in Magrec-4B (a) 1 second 3 component data from GEOMAG-02MO; (b) 1 minute Gaussian filtered vector and scalar data; (c) 1 minute means of Sensor and Logger temperatures of GEOMAG-02MO; (d) 1 second Scalar data from GSM-90F1; (e) 5 second means of temperature data of Magrec-4B; and (f) 10 minute means of temperature data of Magrec-4B.

Figure S3 illustrates the (i) details about the 1 sec and 10 minute mean GPS data (Figure S3a); (ii) 10 minute means of GPS data (Figure S3b) and (iii) details of the sampling interval of the CPU temperature of the Magrec-4B data logger (Figure S3c).

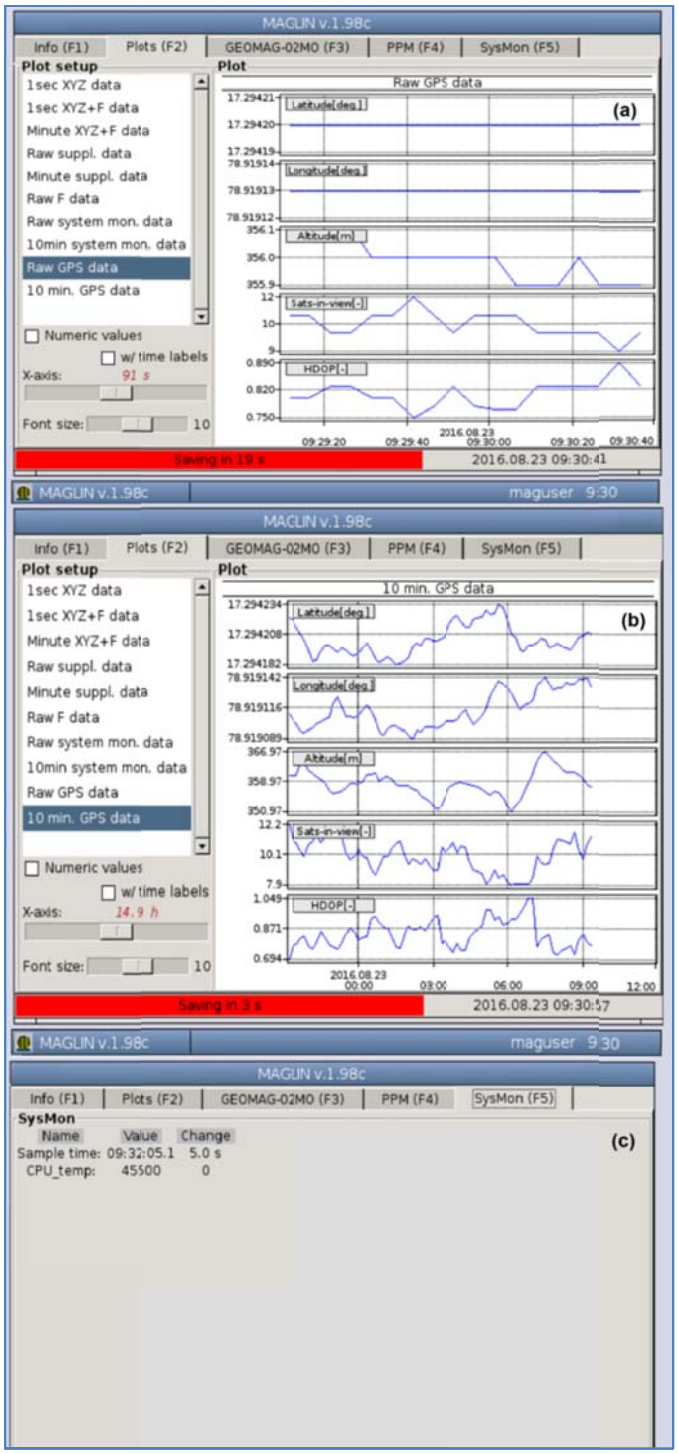

Figure S3. Illustration of various plotting parameters in Magrec-4B (a) 1 second GPS data; (b) 10 minute means of GPS data; and (c) 5 second means of CPU temperature data of the Magrec-4B data logger.

4 Near Real-time data transmission from CPL to HYB Magnetic Observatory

We have installed a Batch file with “Abort” option and confirm with “Off” option so as to ascertain the health of the connection at client end, reiterated for a default time limit of 120 seconds. The session commences by checking the Host ID username and the authenticated pre-entered password with RSA (Rivest, Shamir, and Adelman) Key through SFTP (Secured File Transfer Protocol). The terms ‘Comparing’ and ‘Synchronizing’ in the figure shows the details of the data transmission from host to client machine at conventional intervals with a time interval of 120 seconds.

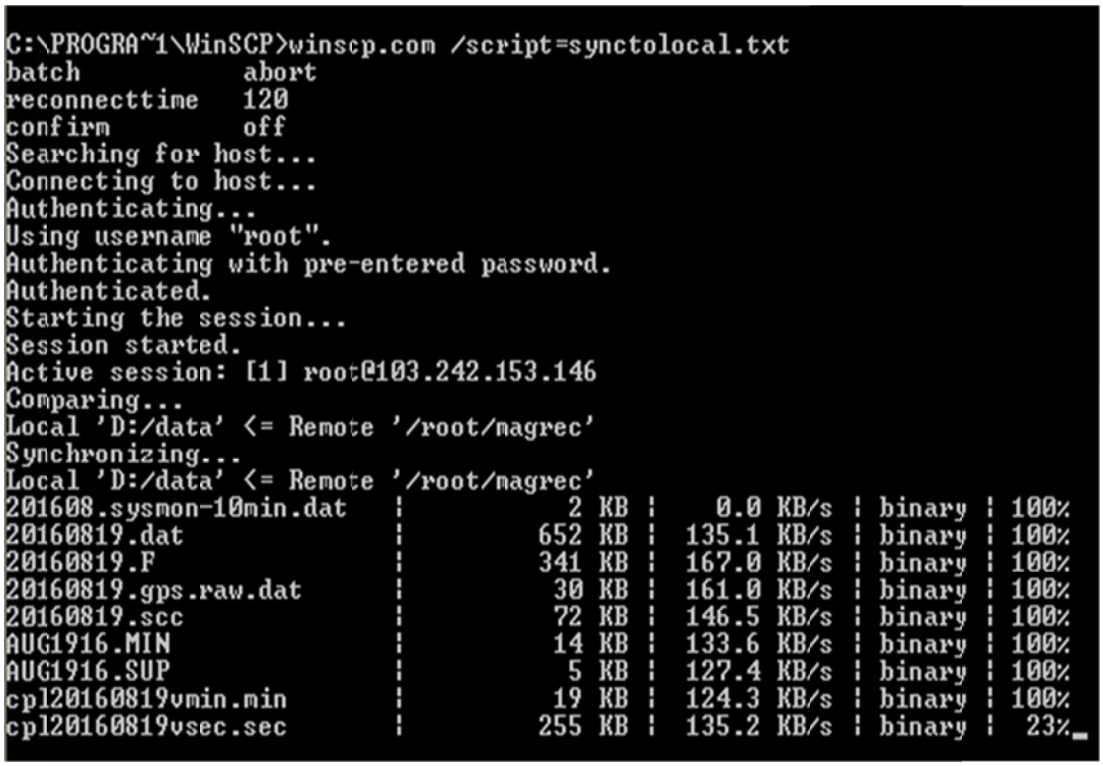

Figure S4: Screenshot of real-time data transmission from CPL to HYB Magnetic Observatory using secured algorithms and scripts

From the Magrec-4B data acquisition system, we have culled 9 data parameters from binary files as shown in the Figure 06 for transmission of real time data to the Client machine. The details of the file size, of each data parameter as well as the haste at which the data is being transmitted from the host to the client machine are withal shown in the same figure. The percentages shown in column 5 of Figure 09 show the data transmission and updating process at client machine. 100% data transfer is achieved only when 1 second data is copied with the latest records of 120 seconds and additionally the client machine rechecks the data by synchronizing the earlier records of the current day. The example of perpetual process of data transmission with the latest records and the updating process is also shown in the same figure at Row 9. Once the data is synchronized with the latest records the 23% of file transmission (each) will become 100% on completion of this task, with further synchronizing with the earlier saved data. The file size of the above said 9

parameters keeps incrementing for every 120 seconds of the data being updated at the host machine. The whole process is reiterated for each cycle of 120 seconds till the day is completed.

5.3 Correction of Time stamping error

Few milliseconds of delay between the two recording units, GEOMAG-02MO and GSM-90F1 are detected by the Magrec-4B data acquisition system. After a few days of analysis on time stamping between the systems, it is observed that the GSM-90F1 GPS is not exactly synchronizing with the GPS of the GEOMAG-02MO. The time stamping issue is resolved by upgrading the software of the GSM90-F1 system and performing corresponding changes made in the Magrec-4B data acquisition system.