Note on data processing in the Lonjsko Polje Observatory

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The geomagnetic data from the Conrad Observatory (WIC) are routinely used for the purposes of quality control and preparation of definitive data in the Lonjsko Polje observatory (LON, Croatia). A simple example presented in this report, shows how important WIC data are, not only for science, but also for the operational needs of other European observatories.

The main task of a geomagnetic observatory is to record the Earth's magnetic field and its changes. Nowadays, these recordings should have resolution ≤ 0.1 nT (nanoTesla) and absolute accuracy better than 5 nT. The final 1-minute or 1-second definitive data should be free form spikes, jumps and other degradations in data. All corrupted data must be removed and if possible, data gaps should be complemented with recordings from backup magnetometers.

In the Croatian observatory Lonjsko Polje (LON) the process of the spike/noise detection (and its removal) is based on visual inspection of recordings. Often, very small magnetic contaminations are masked by natural magnetic variations and cannot be recognized even by the eye of experienced data checker. Therefore, at LON we use "difference plots" and dB/dt plots (Worthington et al. 2009) to detect degradations in our data. For this purpose, we routinely use WIC data along with the observatory data from neighbouring countries.

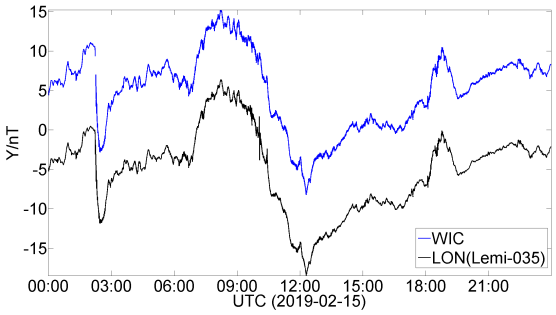

Figure 1: The Y (east) component of geomagnetic field variations recorded at WIC (blue) and LON (black). At LON variations are recorded with backup magnetometer LEMI-035.

As example, Fig. 1 shows LON and WIC recordings (1-second data) on 15th Feb. 2019. For better visibility, recordings are centred to zero and shifted with respect to each other. After careful look at diagrams in Fig. 1 suspicious values can be observed around 10 h UTC on LON diagram (black line). Indeed these are anomalous values of the main spike in the period 09-11 UTC. In this period, the observatory staff worked on maintenance and on several occasions, the location near the Lemi-035 sensor was magnetically contaminated. A much better picture of the extent of magnetic contamination is obtained if we plot differences between LON (Lemi-035) and data from surrounding observatories. Fig. 2 displays differences of the Y variations between LON (Lemi-035) and WIC (blue line), the red line is the difference between LON (Lemi-035) and BDV (Butkov, Czech Republic) observatory. In addition, a third black curve shows the difference between two LON magnetometers, Lemi-035 and DIDD. (For better visibility WIC and BDV difference diagrams are shifted with respect to LON). In contrast to the raw variation diagrams, all three difference-diagrams reveal several dominant spikes during the maintenance period (09-11 UTC). Except spikes, LON-WIC and LON-BDV diagram also show differences between the diurnal variations at three observatories. Due to practically identical magnetic field at locations of the DIDD and Lemi-035 sensor, the difference diagram is practically constant (except in the period of magnetic contaminations in vicinity of the Lemi-035 sensor).

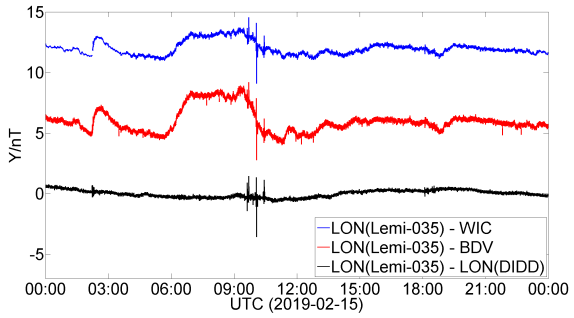

Figure 2: *Blue line*: The difference between LON (Lemi-035) and WIC variations, i.e. the difference between black and blue line on Fig1. *Red line*: The difference between LON (Lemi-035) and BDV variations. Black line: The difference between LON supplement (Lemi-035) and the main (DIDD) magnetometer.

The presented example demonstrates how high quality WIC data are valuable, not only for science, but also for the routine quality control and data processing in other European observatories.

References:

Worthington, E.W., Sauter, E.A. and Love J.J. (2009), Analysis of USGS one-second data, Proceedings of the XIIIth IAGA Workshop on Geomagnetic Observatory Instruments, Data Acquisition, and Processing, U.S. Geological Survey Open-File Report,262-266.

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