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Impact of S/C-Currents on Magnetic Field Data

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1 Introduction

The Rosetta Orbiter-Magnetometer is part of the Rosetta Plasma Consortium (RPC). The instrument consists of two identical fluxgate sensors mounted on a 1.5 m long boom outside the spacecraft and an electronics box placed inside the orbiter. The inner sensor is called IB sensor, the outer sensor OB sensor. The observation time during the Comet phase in 2014 - 2016 is split up in mission phases, starting with the pre-landing phase (PRL) followed by so called comet escort phases (ESC1 to ESC4) and the extended mission phases (EXT1 to EXT3). A first look at the RPC-MAG data revealed that operational spacecraft activities have a significant impact on measured magnetic field data. It turned out that some spacecraft operations are often related to special magnetic field signatures, which occur during the entire mission duration.

This document gives an overview on how the artificial magnetic fields caused by currents linked to spacecraft operations influence RPC-MAG measurements during the mission. Access to the Rosetta Housekeeping (HK) data is provided by ESA through the MUST web interface. As this study is based on the actual currents measured on-board, the temporal resolution is limited by the HK sampling rate. The highest acquisition rate is 250 mHz (4 s), while some channels are as slow as 29 mHz (34 s), which means that the impact of high-speed switching or transient events on the magnetic field could not be investigated.

2 Method

In a first step all currents were extracted from the database. A threshold of 50 mA for the standard deviation was used to exclude all currents that were either constant or exhibited variations too small to cause interference. Then the currents were searched for characteristic edges. In a final step these signatures were compared to known disturbances in the magnetic field.

3 Results

Over all no influence of the available currents can be seen in the magnetic field. Figure 1 and Figure 2 show as a typical example that currents cause no direct disturbance in the magnetic field. One exception is the interference caused by the Philae ESS ground loop (see commissioning reports) shown in Figure 3. After separation of the electronic connection to Philae the disturbance vanished as shown in Figure 5.

4 Conclusion

A correction of the disturbed data is not possible, because the magnetic field induced by the ESS cannot be modeled sufficiently. As a consequence all time intervals, during which the lander was switched on, will be flagged.

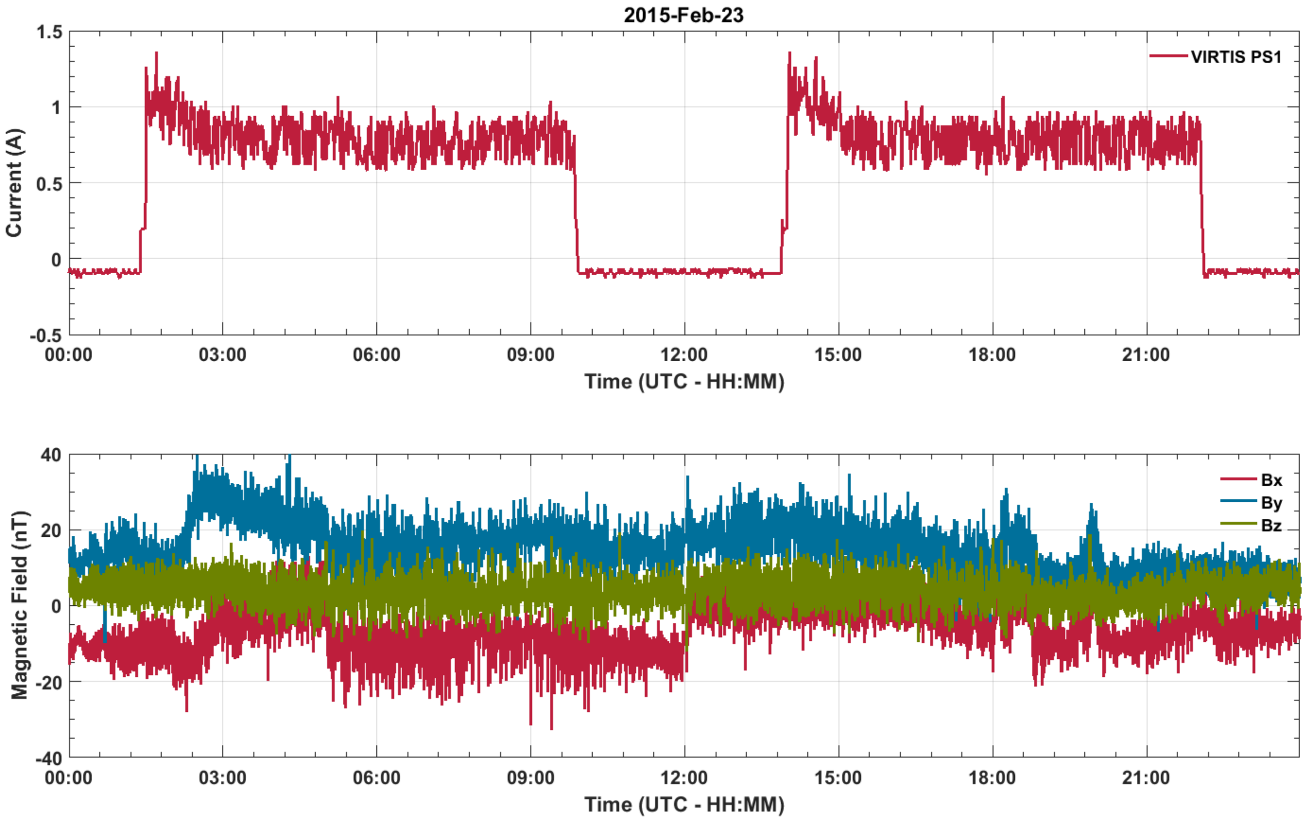

Figure 1: Top panel: power supply current of VIRTIS. Bottom panel: x-, y- and z-component of the magnetic field. The characteristic signature in the current causes no disturbance in the magnetic field.

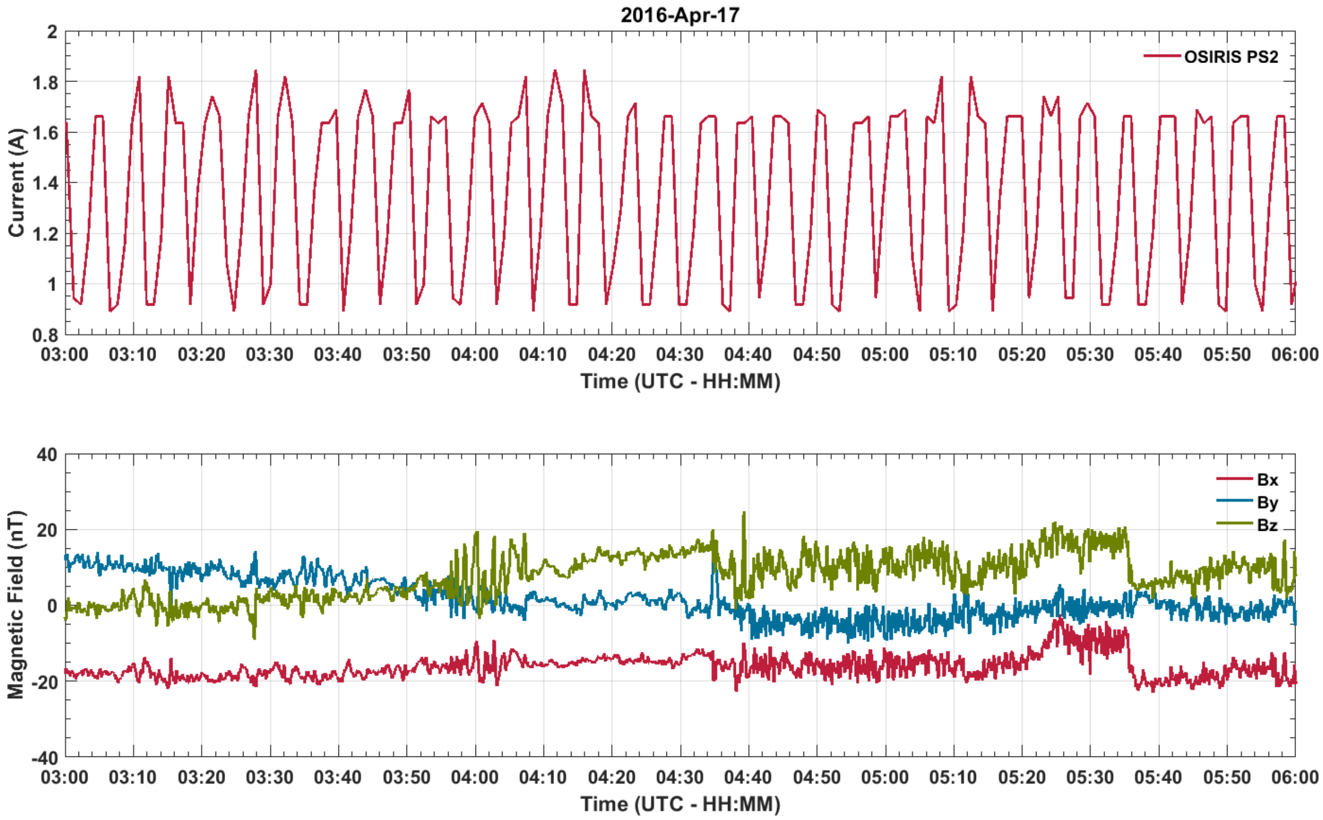

Figure 2: Top panel: power supply current of OSIRIS. Bottom panel: x-, y- and z-component of the magnetic field. Similar to Figure 1 higher frequency currents cause no interference in the magnetic field.

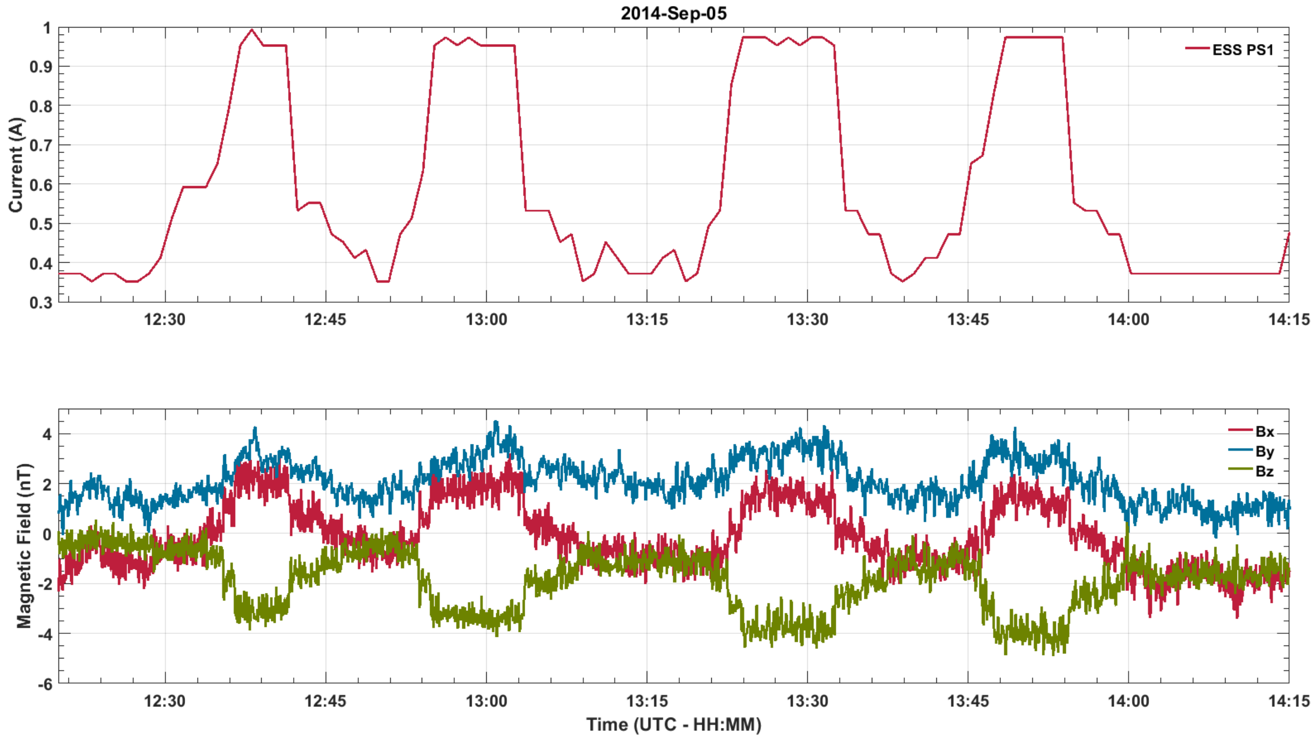

Figure 3: Top panel: power supply current of the ESS before separation. Bottom panel: x-, y- and z-component of the magnetic field. The structure of the ESS current is visible mirrored in all magnetic field components.

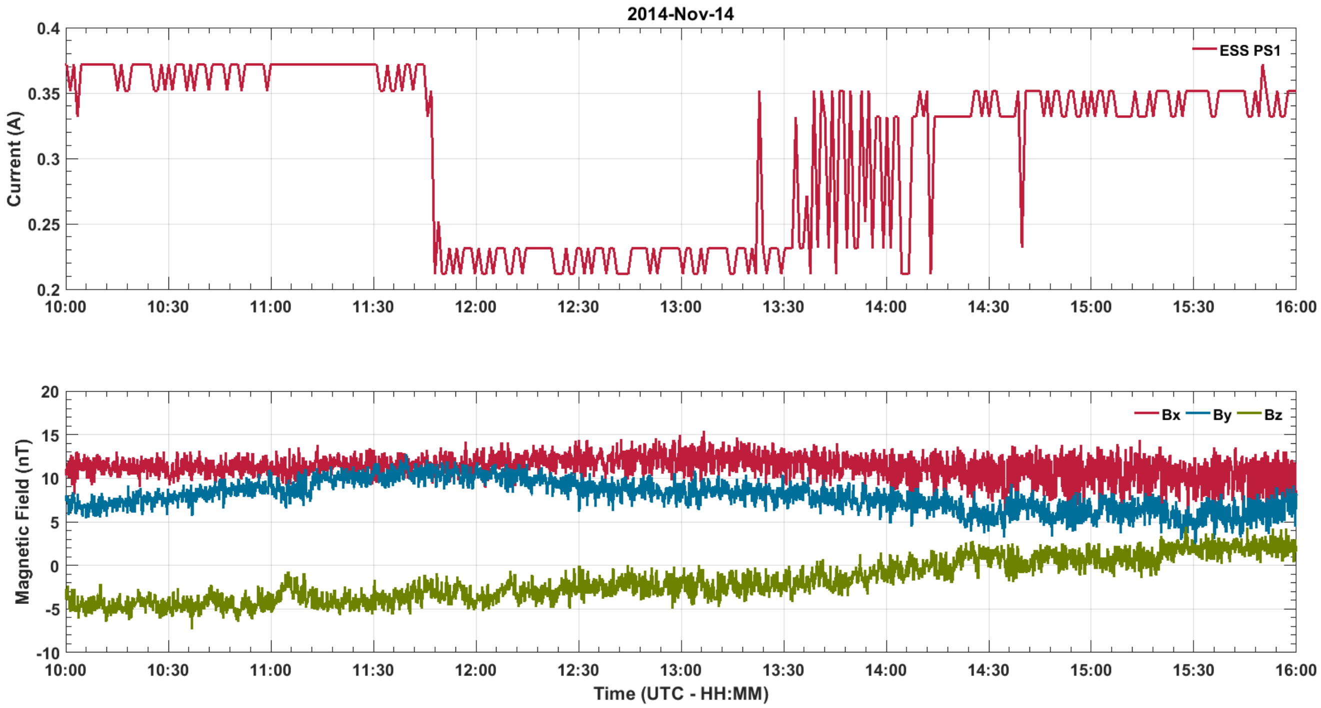

Figure 4: Top panel: power supply current of the ESS after separation. Bottom panel: x-, y- and z-component of the magnetic field. Interferences caused by the ESS current vanish after separation.

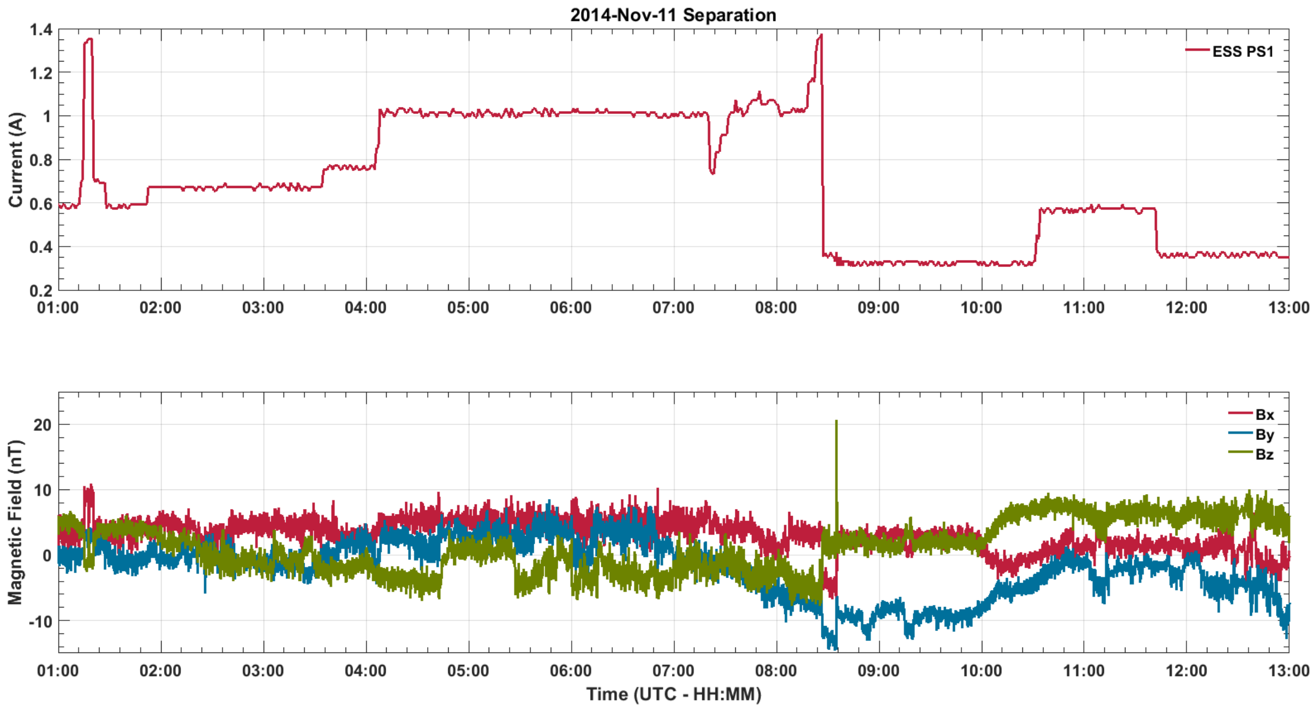

Figure 5: Top panel: power supply current of the ESS during separation. Bottom panel: x-, y- and z-component of the magnetic field. Separation of the lander is clearly visible in the form of a peak in the current and magnetic field.