R O S E T T A

RPC-MAG Studies on
S/C-Disturbances:

RO–IGEP–TR–0073

Issue: 2 Revision: 1

November 13, 2018

Impact of Wheel-Offloading (WOL)
on Magnetic Field Data

Mission Phase: PRECOMET (CVP - RVM1)
Time: March 2004 - December 2010

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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 one OB sensor. Both sensors recorded the magnetic field in three components between March 2004 and September 2016.

The observation time before the Comet phase (commencing 2014) is split up in several mission phases, starting with the Commissioning phase (CVP) in 2004 followed by several checkout and swing-by phases and ended with the Rendezvous Manoeuvre 1 (RVM1) in 2010. Table 1 contains the time course of all mission phases.

Table 1: Overview of mission phases.

Mission Phase	Duration		
CVP	March 2004	-	October 2004
EAR1	March 2005	-	March 2005
CR2	June 2006	-	July 2006
MARS	August 2006	-	May 2007
EAR2	September 2007	-	January 2008
CR4A	July 2008	-	July 2008
AST1	September 2008	-	September 2008
CR4B	January 2009	-	February 2009
EAR3	September 2009	-	November 2009
CR5	February 2010	-	May 2010
AST2	July 2010	-	July 2010
RVM1	November 2010	-	December 2012

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 how Wheel-Off-Loading (WOL) influences RPC-MAG measurements during the PRECOMET phase between March 2004 and December 2010. For this reason the effects of disturbances on magnetic field measurements are classified into different types. Afterwards, the defined classes of disturbance are used to flag the magnetic time series.

2 Impact of disturbance by Wheel-Off-Loading

A temporal comparison between the magnetic field time series and the command execution history-file data (command ZAC20188) has shown, that the WOL potentially disturbs magnetic field data in two different ways. In general, disturbance by WOL primarily affects the y-component (sc-coordinates) of the magnetic field, although spikes right after switch-on can be observed on all components. Possible WOL impacts are

- **Visible:** Approximately 5 sec after the execution of command ZAC20188 a steep decrease in the y-component of the magnetic field occurs. It jumps back after some minutes with a steep slope. The step height is in both cases 3 nT. Figure (1) shows a typical example for a fully visible WOL disturbance.
  Flag: disturbance completely visible
- **Visible & Spiky:** Figure (2) shows a typical example for a WOL where additional spikes spikes with roughly 1 nT amplitude and about 1.5 minutes period at a duty cycle of about 16% occur. **Flag: visible & spiky**.

So far, it has not been possible to examine the impact of WOL on the magnetic field with a automatic search routine, all data were therefore examined manually.

The duration of the WOL varies for every event. The end of the disturbance is not logged anywhere in the HK files, therefore the end of WOL has to be always determined by eye.

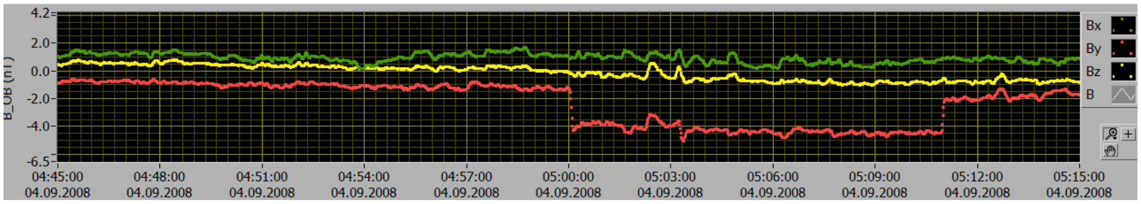

Figure 1: Example of a well resolved WOL disturbance recorded on 04.09.2008 during the AST1-phase with the OB sensor. The x-axis shows a 30-minute interval and the y-axis shows the magnetic field components in a total range of 11 nT. The WOL effects the magnetic field mainly in y-direction (red line).

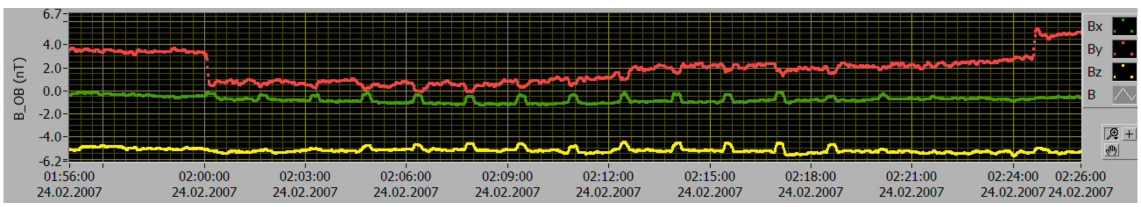

Figure 2: Example of a WOL, which goes along with 1 nT spiky-wave on each components, recorded on 24.10.2007 during the MARS-swingby phase.

3 Summary

During the PRECOMET phase 46 WOL commands were executed of which

- 24 events are completely visible (**Flag: disturbance completely visible**),
- 22 events are not recorded due to data gaps (**Flag: no data**),
- 0 are not visible (**Flag: not visible**),
- 0 events have no visible end (**Flag: end not visible**) and
- 0 events have no visible beginning (**Flag: start not visible**).
- 4 events show additional spikes on two or three components.(**Flag: visible & spiky**)
  Amplitude: ≈ 1nT.
  Period: ≈ 1.5min
  Duty cycle: ≈ 16%

All WOL events are listed below. The first columns contain start and end times of the disturbance, followed by the x-, y- and z-component of the magnetic field during the start and end, respectively. The last column contains annotations, which are one of the above defined flags. The table is also available as a txt-file called WOL_PRECOMET.txt.

Start (day/UTC)	End (day/UTC)	ΔB (nT)						Annotation
		x_S	x_E	y_S	y_E	z_S	z_E	
2004-03-19T18:26:21	2004-03-19T18:26:21							no data
2004-05-08T18:00:00	2004-05-08T18:00:00							no data
2004-09-23T17:00:00	2004-09-23T17:00:00							no data
2004-09-30T16:15:00	2004-09-30T16:15:00							no data
2004-10-10T03:00:00	2004-10-10T03:00:00							no data
2004-10-14T15:00:00	2004-10-14T15:00:00							no data
2005-03-03T23:00:00	2005-03-03T23:07:46	0	0	-3	+3	0	0	disturbance completely visible
2005-03-05T18:50:00	2005-03-05T18:53:20	0	0	-2	+2	0	0	disturbance completely visible
2005-03-07T15:00:00	2005-03-07T15:04:38	0	0	-3	+3	0	0	disturbance completely visible
2005-09-21T07:00:00	2005-09-21T07:00:00							no data
2005-12-08T05:00:00	2005-12-08T05:00:00							no data
2006-02-16T01:30:00	2006-02-16T01:30:00							no data
2006-10-18T23:30:00	2006-10-18T23:30:00							no data
2006-11-27T23:15:00	2006-11-27T23:18:24	0	0	-3	+3	0	0	disturbance completely visible
2006-12-02T23:15:00	2006-12-02T23:19:45	0	0	-3	+3	0	0	disturbance completely visible
2006-12-05T02:45:00	2006-12-05T02:48:03	0	0	-3	+3	0	0	disturbance completely visible
2006-12-07T22:15:00	2006-12-07T22:18:12	0	0	-3	+3	0	0	disturbance completely visible
2006-12-11T17:15:00	2006-12-11T17:19:50	0	0	-3	+3	0	0	disturbance completely visible
2006-12-16T06:15:00	2006-12-16T06:19:47	0	0	-3	+3	0	0	disturbance completely visible
2006-12-18T21:15:00	2006-12-18T21:18:17	0	0	-3	+3	0	0	disturbance completely visible
2007-02-22T04:59:59	2007-02-22T04:59:59							no data
2007-02-24T02:00:00	2007-02-24T02:25:02	0	0	-3	+3	0	0	disturbance visible & spiky
2007-02-25T14:00:00	2007-02-25T14:06:26	0	0	-3	+2	0	0	disturbance completely visible
2007-09-17T12:15:00	2007-09-17T12:15:00							no data
2007-11-08T13:14:59	2007-11-08T13:14:59							no data
2007-11-12T12:14:59	2007-11-12T12:14:59							no data
2007-11-14T17:15:00	2007-11-14T17:18:16	0	0	-3	+3	0	0	disturbance completely visible
2007-11-19T00:15:00	2007-11-19T00:22:54	0	0	-3	+3	0	0	disturbance completely visible
2008-07-14T02:10:00	2008-07-14T02:10:00							no data
2008-07-20T07:00:00	2008-07-20T07:00:00							no data
2008-07-25T02:40:00	2008-07-25T02:40:00							no data
2008-08-01T16:00:00	2008-08-01T16:00:00							no data
2008-09-04T05:00:00	2008-09-04T05:11:16	0	0	-3	+3	0	0	disturbance completely visible
2008-09-06T05:30:00	2008-09-06T05:40:56	0	0	-3	+3	0	0	disturbance completely visible

Start (day/UTC)	End (day/UTC)	ΔB (nT)						Annotation
		x_S	x_E	y_S	y_E	z_S	z_E	
2009-09-21T10:35:00	2009-09-21T10:35:00							no data
2009-09-21T10:35:00	2009-09-21T10:35:00							no data
2009-09-29T08:45:00	2009-09-29T08:45:00							no data
2009-10-01T09:35:00	2009-10-01T09:35:00							no data
2009-11-10T23:05:00	2009-11-10T23:09:55	0	0	-3	+3	0	0	disturbance completely visible
2009-11-12T22:35:00	2009-11-12T22:45:56	0	0	-3	+3	0	0	disturbance visible & spiky
2009-11-14T23:45:00	2009-11-14T23:55:53	0	0	-3	+3	0	0	disturbance visible & spiky
2009-11-16T13:05:00	2009-11-16T13:08:16	0	0	-3	+3	0	0	disturbance completely visible
2010-02-24T10:05:00	2010-02-24T10:08:13	0	0	-3	+3	0	0	disturbance completely visible
2010-03-14T14:05:00	2010-03-14T14:08:17	0	0	-3	+3	0	0	disturbance completely visible
2010-07-08T23:05:00	2010-07-08T23:12:41	0	0	-3	+3	0	0	disturbance visible & spiky
2010-07-11T02:05:00	2010-07-11T02:11:20	0	0	-3	+3	0	0	disturbance visible & spiky