RPW Consortium

IP Shocks (SBM1) and in-situ type III (SBM2) detections

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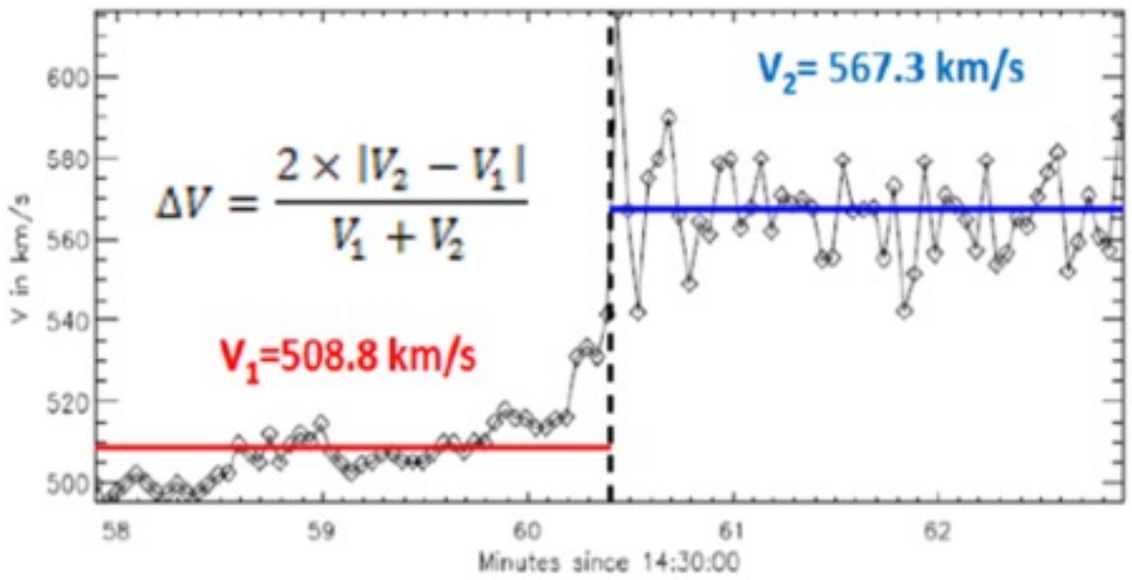
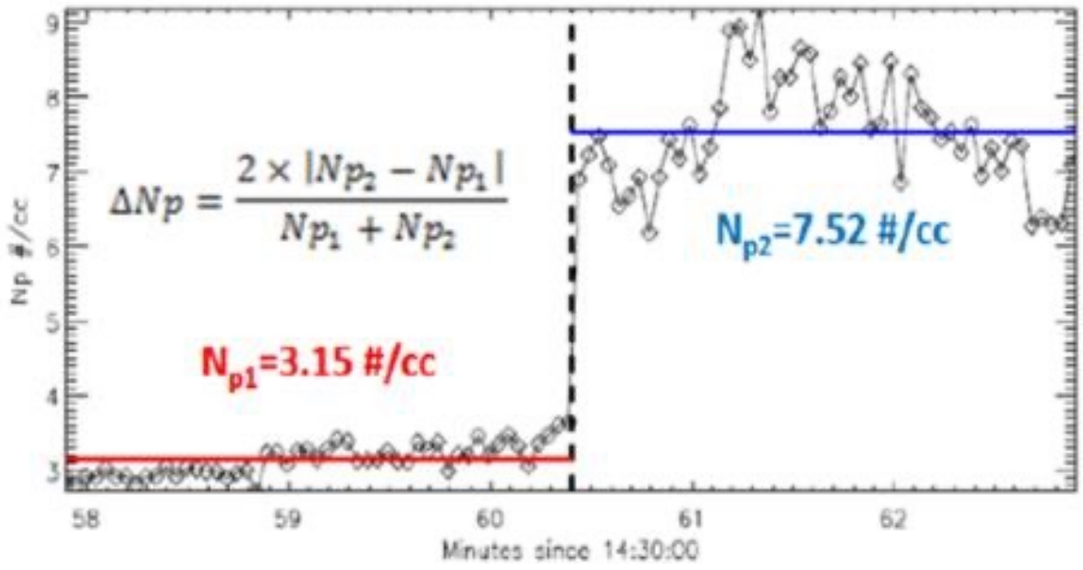
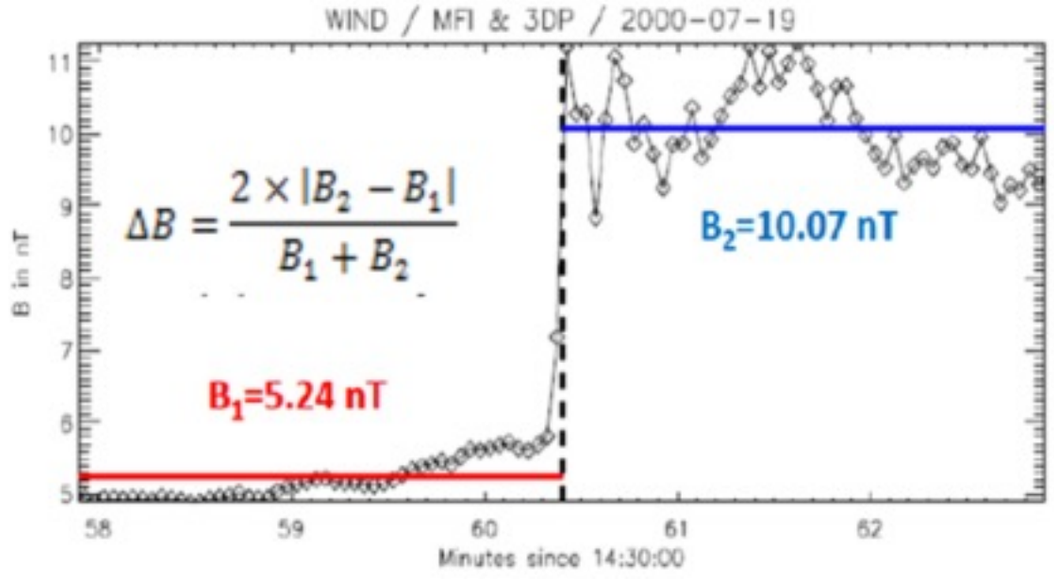
Automatic detection of shocks (SBM1) in flight

In flight, automatic algorithm detects interplanetary shocks → 13-min high cadence data centered around the shock time.







Automatic detection of shocks (SBM1) in flight

Detection criteria :

Let Tm be the shock time. A shock is detected if :

1. Q = alpha x ΔB + beta x ΔNp + gamma x ΔV at Tm is the maximum of all Q values of the rolling buffer. With alpha + beta+ gamma = 1 (here alpha = beta = gamma = 0,33)
2. Q at Tm > Qm = 0,12
3. ΔB at Tm > ΔBm = 0,5
4. ΔNp at Tm > ΔNpm = 0
5. ΔV at Tm > ΔVm = 0
6. |ΔB – ΔNpl at Tm < CR = 2

Values used since 2022

GOAL : find the optimal set of parameters to detect as many shocks as possible.

Month	Number of detections in flight	Number of « real »shocks among detections	Number of events retrieved on ground
January 2022	20	4	20
February 2022	7	4	7
March 2022	17	5	5
April 2022	12	3	1
May 2022	48	6	0
June 2022	64	2	0
July 2022	26	5	0
August 2022	54	4	0
Sept. 2022	15	3	0
Oct. 2022	21	3	0
Nov. 2022	4	0	0
Dec. 2022	12	2	12
January 2023	18	6	18
February 2023	13	2	13
March 2023	39	3	7
April 2023	124	1	0
May 2023	42	2	0
June 2023	12	0	1
July 2023	24	1	0
August 2023	24	4	2

Results

~1-5 events per month

Since this summer : work with SOC to establish a process to retrieve interesting data

Results

Month	Number of detections in flight	Number of « real »shocks among detections	Number of events retrieved on ground	Number of shocks identified by A. Dimmock
January 2022	20	4	20	1
February 2022	7	4	7	2
March 2022	17	5	5	3
April 2022	12	3	1	3
May 2022	48	6	0	2
June 2022	64	2	0	4
July 2022	26	5	0	3
August 2022	54	4	0	6
Sept. 2022	15	3	0	5
Oct. 2022	21	3	0	0
Nov. 2022	4	0	0	0
Dec. 2022	12	2	12	2
January 2023	18	6	18	2
February 2023	13	2	13	5
March 2023	39	3	7	/
April 2023	124	1	0	/
May 2023	42	2	0	/
June 2023	12	0	1	/
July 2023	24	1	0	/
August 2023	24	4	2	/

Results

Month	Number of detections in flight	Number of « real »shocks among detections	Number of events retrieved on ground	Number of shocks identified by A. Dimmock	Number of missing detections in flight
January 2022	20	4	20	1	0
February 2022	7	4	7	2	0
March 2022	17	5	5	3	0
April 2022	12	3	1	3	1
May 2022	48	6	0	2	0
June 2022	64	2	0	4	2
July 2022	26	5	0	3	1
August 2022	54	4	0	6	2
Sept. 2022	15	3	0	5	4
Oct. 2022	21	3	0	0	0
Nov. 2022	4	0	0	0	0
Dec. 2022	12	2	12	2	0
January 2023	18	6	18	2	1
February 2023	13	2	13	5	1
March 2023	39	3	7	/	/
April 2023	124	1	0	/	/
May 2023	42	2	0	/	/
June 2023	12	0	1	/	/
July 2023	24	1	0	/	/
August 2023	24	4	2	/	/

In flight, some events are missed (compared to Andrew's list)…

Month	Number of detections in flight	Number of « real »shocks among detections	Number of events retrieved on ground	Number of shocks identified by A. Dimmock	Number of missing detections in flight
January 2022	20	4	20	1	0
February 2022	7	4	7	2	0
March 2022	17	5	5	3	0
April 2022	12	3	1	3	1
May 2022	48	6	0	2	0
June 2022	64	2	0	4	2
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August 2022	54	4	0	6	2
Sept. 2022	15	3	0	5	4
Oct. 2022	21	3	0	0	0
Nov. 2022	4	0	0	0	0
Dec. 2022	12	2	12	2	0
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February 2023	13	2	13	5	1
March 2023	39	3	7	/	/
April 2023	124	1	0	/	/
May 2023	42	2	0	/	/
June 2023	12	0	1	/	/
July 2023	24	1	0	/	/
August 2023	24	4	2	/	/

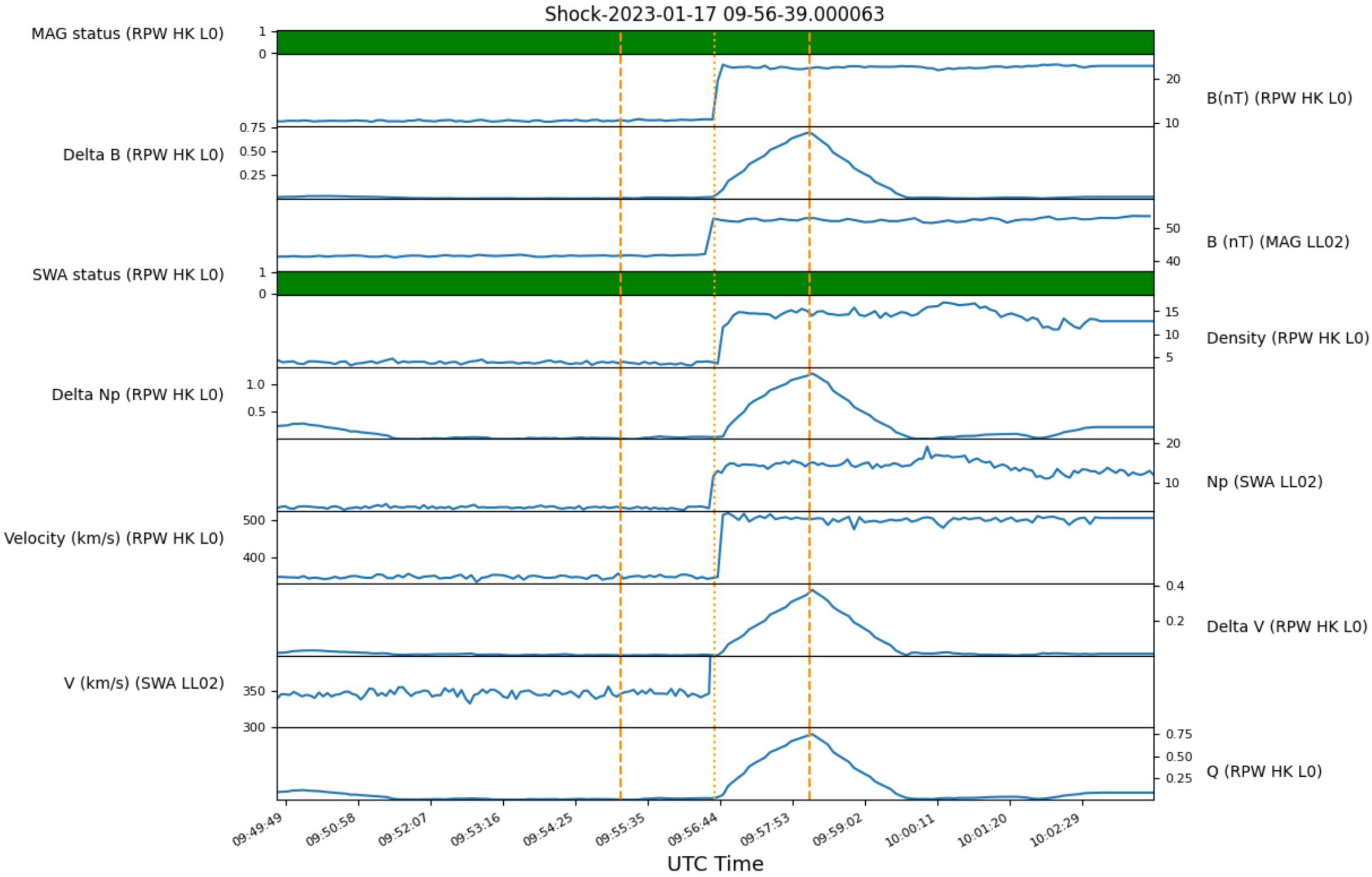
Results

In flight, some events are missed (compared to Andrew's list)…

… but events are also missing in Andrew's list…

Which criteria have been used to select shocks ?

Shocks « missed » by Andrew



Further steps on IP shock detection

Goal : Find the optimal set of parameters to catch as many shocks as possible, with limited false detections in order to not saturate the on-board memory

Problem : No shocks list to compare to.

WE NEED YOU (at least one or two people) to get a list of real shocks that our algorithm should have detected.

- New list of shocks ?
- Look at RPW previous detections to select real shocks
- Other ideas ?

Automatic detection of type III bursts in flight (SBM2 mode)

In-flight algorithm to detect in-situ Type III events. When triggered, RPW collects very frequent TDS triggered snapshots for 2 hours, plus more detailed LFR data.

Detection criteria :

Mode 1: EPD energetic flux increase, followed by detection of Langmuir waves by the TDS on-board detection algorithm. This mode is currently not used due to uncertainty in the EPD on-board data.

Mode 2: (RPW-only backup mode) Triggered if TDS detects Langmuir waves for an extended period of time. Threshold on amplitude, frequency and persistence of wave detection. This mode is being used since 2020.

A small study performed by T. Formanek in 2021 to find optimum thresholds based on existing type III data (at the time). A set of threshold has been found to detect ~73% of events known at the time.

This parameter set is being used since August 2021.

In situ type III detections (SBM2 events)

Recent detections of SBM2:

- 2023-09-11T22:48:01.382 : high cadency data requested to SOC

Past detections in 2022-2023: high cadency data retrieved on ground but sometimes incomplete due to missing data packets (see X. Bonnin's presentation tomorrow – ROC Status):

- 2023-08-24T10:02:41.442 (157 TDS snapshots, no bad snapshots)
- 2023-04-30T13:30:12.472 (35 TDS snapshots, 1 bad)
- 2023-04-16T11:24:33.868 (240 TDS snapshots, no bad snapshots)
- 2023-02-28T06:50:11.07 (192 TDS snapshots, no bad snapshots)
- 2022-09-22T13:44:35.734 (703 TDS snapshots, 71% bad)
- 2022-04-09T12:15:38.961 (894 TDS snapshots, 5% bad)

All of the above events are real Type III events ! The algorithm is conservative, but nearly all detected events are real. Some data examples will be shown in TDS presentation on Tuesday.

Few events per year, data download on ground always requested to SOC.