RPW operations & data overall status

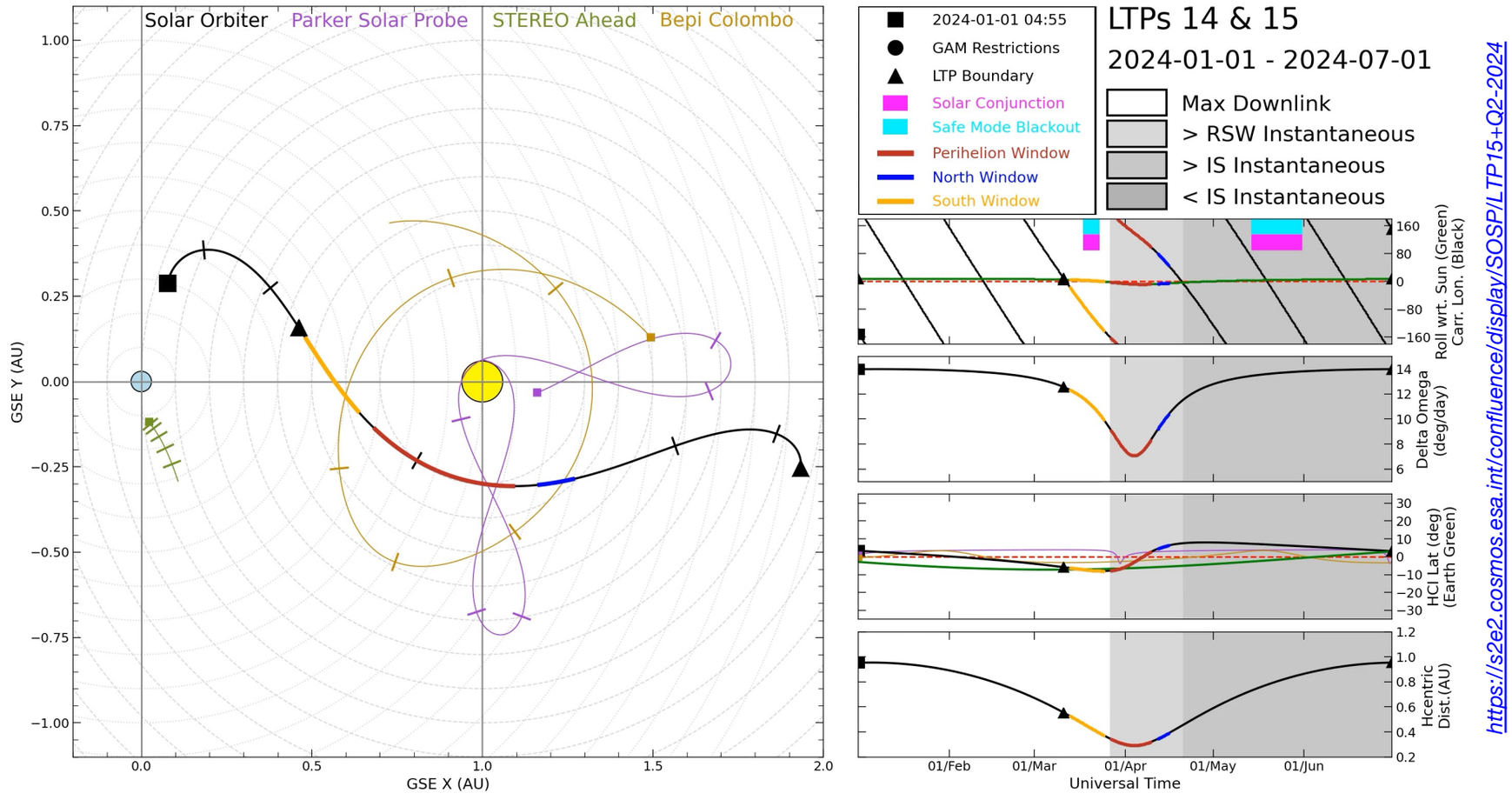
Xavier Bonnin & RPW Teams

RPW-FIELDS joint meeting – Orléans – Feb. 26, 2024

Operation status and notable events

Science operation activities:

- Nominal in overall
- RPW in high cadence config til Feb. 18 (12h BURST mode windows / day)
- Switched to lower cadence config from Feb 19 to March 11 (due to TM rate constraints)



Anomalies:

- Issue with antenna V3 since Nov. 13, 2023 at ~23:30z (see Milan's presentation)
- First tests were performed on-board (Dec. 16, 2023 and Jan, 22, 2024)
- When possible, configurations without V3 measurement applied on-board

RPW data overall status

Data processing:

- Nominal
- Work in progress to update CDF files (CDF 3.9, metadata compliance, data quality flags, etc.)
- New L3 data in preparation for THR and LFR (see next slides)

Data dissemination & archiving:

- Delivery to Solar Orbiter Archive (SOAR) at ESAC has been temporary suspended
- No public data after Nov. 13, 2023
- RPW preliminary data remain available from the private server at LESIA*
- Summary plots production is not suspended**

Data user support:

- On-going works to improve the access and readability of the RPW data (see dedicated presentation at 14:45 today)

** https://rpw.lesia.obspm.fr/roc/data/private/solo/rpw/data/*

*** https://rpw.lesia.obspm.fr/rpw-data/daily-summary-plots/*

In situ shock SBM1 detection status

Some statistics:

- RPW SBM1 mode has triggered 690 times since Jan. 01, 2022
- Since Jan. 01, 2022, science data from 154 events have been downloaded on ground
- On these events, TBD are real in situ shocks

Works in progress:

- Upload a new set of SBM1 algo parameters to optimize the detection
- Parameters' values are deduced from SBM1 algo simulator on-ground, trained with a reference list of in situ shocks
- Reference list has been built by Diane Bérard and Olga Alexandrova from shocks reported by Andrew Dimmock and by RPW

Fixed issues:

- Problem with partial SBM1 science data retrieved on-ground* has been fixed

To be done:

- Implement a procedure to classify SBM1 data between real and not-real shocks
- Publish SBM1 science data and list of real shocks detected by RPW

** See SBM presentation at RPW team meeting on Oct. 2023 in Prague*

- **TNR and HFR are both operating well**
- **ANT 3 ISSUE is affecting TNR-HFR science**

THR configuration until 21/01/2024

V1-V2	V1-V2	V1-V2	V1-V2	
A	B	C	D	
32	32	32	32	
2 s				

- **NO magnetic measurements**
- **Mesurements at one dipole (V1-V2) only**

V1-V2	V1-V2	
HF1	HF2	
5x10+50	5x10+50	5 frequences at : 3.2, 5.1, 6.9, 10, 12.2 MHz + list 50 frequences standard
2s		deltat 5 freq = 0.02

January 22nd 2024: investigate ANT 3 failure

TNR-HFR normal mode nominal

Ch1																
	ANT	V1	V1	V1	V1	V2	V2	V2	V2	V3	V3	V3	V3	V1-V2	V1-V2	V1-V2	V1-V2
	Band	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Ch2																	
	ANT	V2-V3	V2-V3	V2-V3	V2-V3	V3-V1	V3-V1	V3-V1	V3-V1	V1-V2	V1-V2	V1-V2	V1-V2	V1-V2			
	Band	A	B	C	D	A	B	C	D	A	B	C	D	HF			

TNR-HFR burst mode nominal

Ch1																
	ANT	B_MF	B_MF	B_MF	B_MF	V1-V2	V1-V2	V1-V2	V1-V2	B_MF	B_MF	B_MF	B_MF	V1-V2	V1-V2	V1-V2	V1-V2
	Band	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Ch2																	
	ANT	V1	V1	V1	V1	B_MF	B_MF	B_MF	B_MF	V3	V3	V3	V3	V1-V2			
	Band	A	B	C	D	A	B	C	D	A	B	C	D	HF			

From January 23rd 2024: NO V3 measurements

TNR-HFR normal mode nominal

Ch1																
	ANT	V1	V1	V1	V1	V2	V2	V2	V2	V1	V1	V1	V3V1	V1-V2	V1-V2	V1-V2	V1-V2
	Band	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Ch2																	
	ANT	V1-V2	V1-V2	V1-V2	V1-V2	V3-V1	V3-V1	V3-V1	V3-V1	V1-V2	V1-V2	V1-V2	V1-V2	V1-V2			
	Band	A	B	C	D	A	B	C	D	A	B	C	D	HF			

TNR-HFR burst mode nominal

Ch1																
	ANT	B_MF	B_MF	B_MF	B_MF	V1-V2	V1-V2	V1-V2	V1-V2	B_MF	B_MF	B_MF	B_MF	V1-V2	V1-V2	V1-V2	V1-V2
	Band	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Ch2																	
	ANT	V1	V1	V1	V1	B_MF	B_MF	B_MF	B_MF	V2	V2	V2	V3V2	V1-V2			
	Band	A	B	C	D	A	B	C	D	A	B	C	D	HF			

Antenna gains

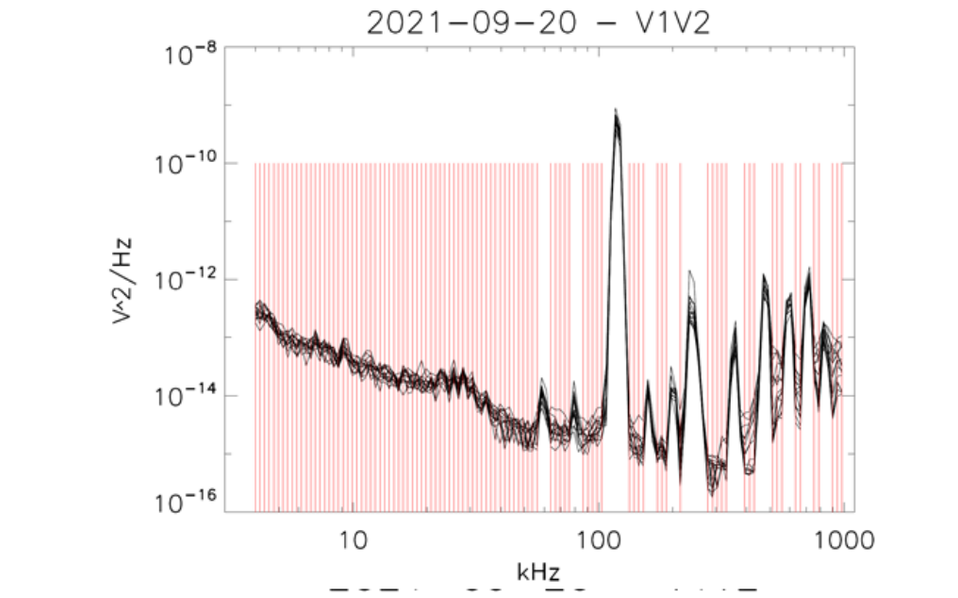
	ΓL_{eff} (m) for $f \leq 2000\ kHz$	ΓL_{eff} (m) $f > 2000\ kHz$
V1V2 (CONF 9)	2.903 ± 0.184	$2.903 \times \exp[1.514 \cdot 10^{-4}(f - 2000)]$
V2V3 (CONF 10)	2.410 ± 0.186	$2.410 \times \exp[1.369 \cdot 10^{-4}(f - 2000)]$
V3V1 (CONF 11)	2.925 ± 0.175	$2.925 \times \exp[1.472 \cdot 10^{-4}(f - 2000)]$

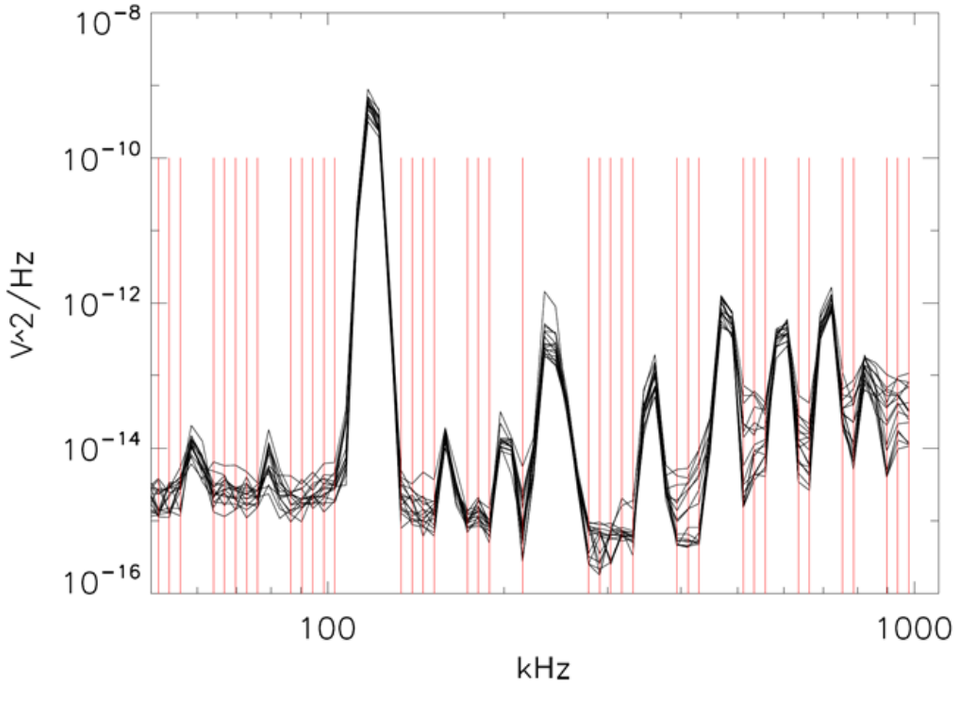
The THR effectives lengths have been obtained after a detailed comparison between the Stereo/Wind and the RPW simultaneous observations of a dataset of 12 radio Type III bursts.

Documentation will be released soon

Frequency coverage

98 clean frequencies for TNR and 50 for HFR have been identified





HFR can be configured to only measure the selected 50 frequencies.

This is not possible for TNR

Production of L3 data

- Plasma frequency from THR peak tracking

- L3 data, providing 2D arrays of the dynamic spectra, will be delivered very soon

- Direction finding data: affected by the ant 3 issue

Issue with the full HFR quicklook plot

- NO HFR quicklook plot available from December 13 2022

- ISSUE CLOSED: all the HFR quicklook plots are now available

Quasi-Thermal Noise measurements from TNR

Collaboration with Mihailo Martinovic (University of Arizona)

- **Quasi-Thermal Noise (QTN) spectroscopy**

→ electron density and T and comparison with SWA measurements

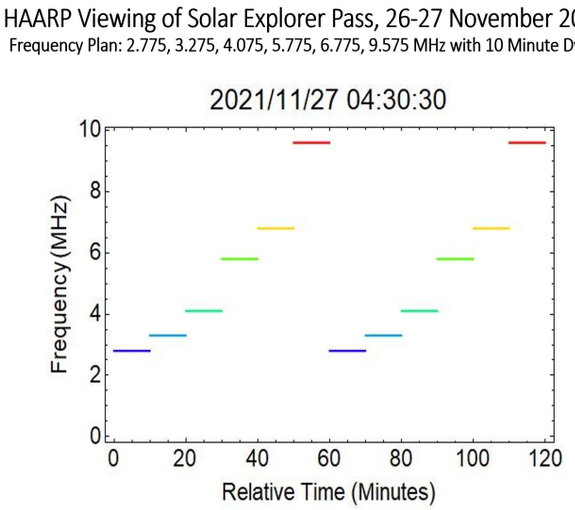
- **Removing interference and technical issues**

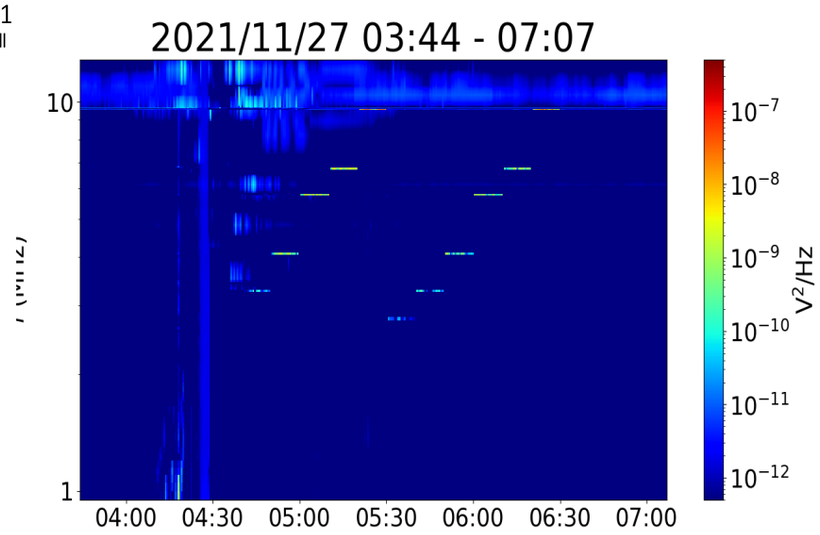
Analysis and interpretation of the signals sent by HAARP observatory

- Refine antenna calibration

3. Send a radio signal from the ground during the last EGAM via HAARP (November 2021)







TDS status and recent operations

February 26, 2024

RPW consortium meeting in Prague

TDS operations

- TDS operates nominally with the wave and dust detection algorithm tuned for optimal efficiency.
- Two standard operation configs defined and used since 2022
  - 524 kHz sampling used < 0.5 AU, 262 kHz sampling used otherwise
  - Combined dipole-monopole antenna config (V1-V3, V2-V1, V2)
  - Low gain mode used
- **Changes due to the antenna V3 anomaly:**
  - Since November 13, 2023, the dipole V1-V3 is effectively a monopole. Will be corrected in calibration, more noise in the data
  - After January 22, 2024, TDS switched to monopole configuration (V1,V2,V3).
  - Soon, we will probably switch to V1, V2-V1, V2 and use V2-V1 dipole for triggering. This configuration will still give us 2D E-field, but with more noise
- Cadence of TDS periodic snapshots and other products is varied according to the available telemetry

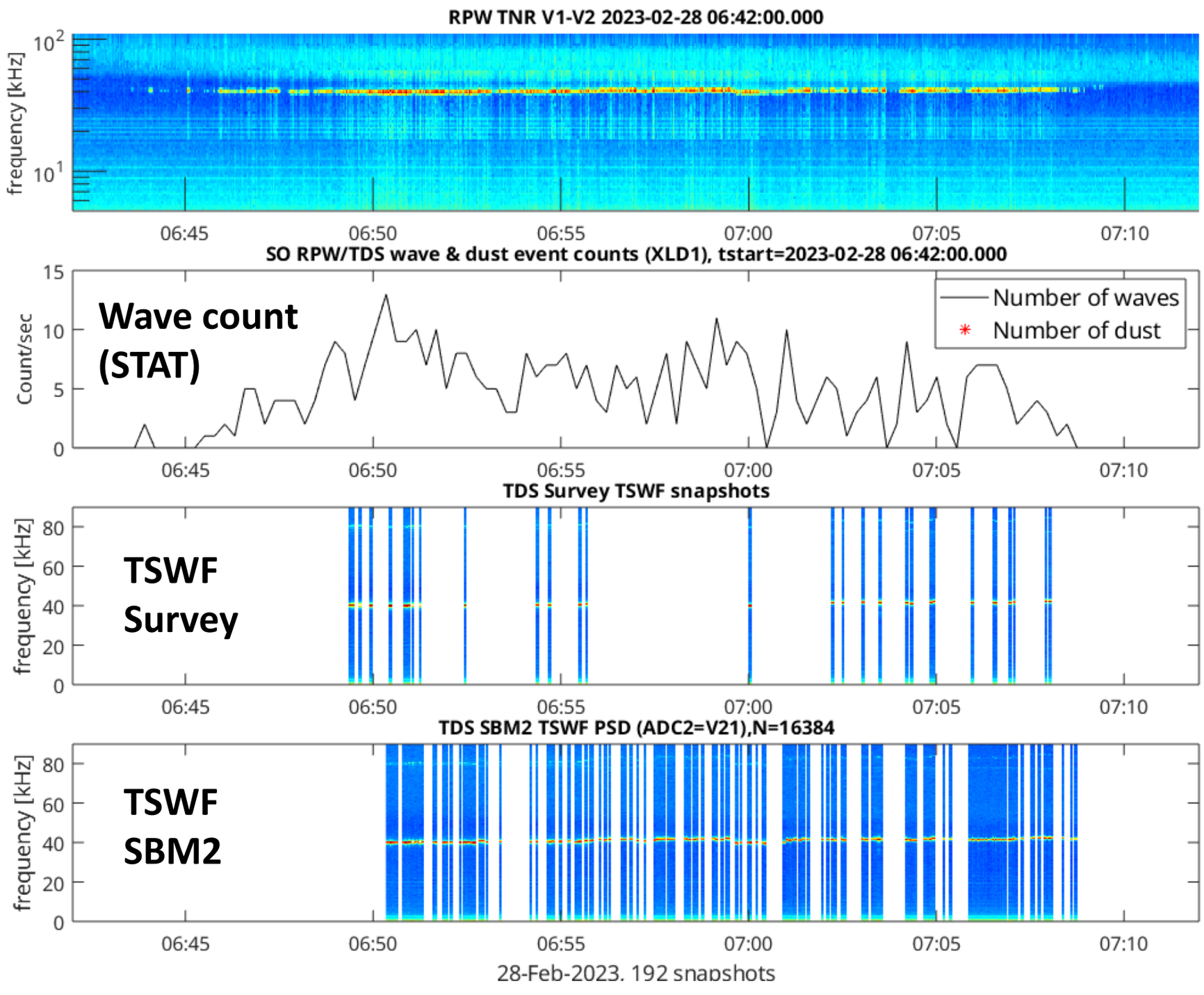
Possible L3 products and improvements to TDS data usability.

- TDS snapshot data is provided in the form of calibrated time series
  - Data is in sensor coordinates, but the CDF files contain effective antenna directions
  - Conversion to orthogonal frame (e.g SRF) is straightforward, but we plan to add the transformed waveform in the CDF too.
  - We believe the snapshots are easy to use and no L3 product is needed
- What can be improved ***(no progress since the RPW meeting in October, sorry)***:
  - Documentation.
  - Quality flags and corrected classification
  - Statistics data could be improved with information from ground processed snapshots and MAMP. This would be a basis for a new L3 product. This is labor-intensive, so it will take a while.

SBM2 events

- RPW implements a dedicated triggered burst mode to capture in-situ Type III bursts.
  - The triggering is configured to activate when an extended interval of plasma wave activity is observed by TDS – depends on the TDS on-board wave detection.
  - No selection is done, all SBM2 data is requested to be downloaded
- The SBM2 triggers in the past 12 months (previously, some of the events were unfortunately incomplete due to missing packets, but this improved in 2023):
  - 2023-08-24T10:02:41 (157 TDS snapshots)
  - 2023-04-30T13:30:12 (35 TDS snapshots)
  - 2023-04-16T11:24:33 (240 TDS snapshots)
  - 2023-02-28T06:50:11 (192 TDS snapshots)
  - 2023-09-11T22:48:03 (115 TDS snapshots)
  - 2023-09-21T06:33:57 (68 TDS snapshots)
  - 2023-10-05T08:24:23 (215 TDS snapshots)
- Since the trigger accuracy is very good, but conservative, we may consider lowering the threshold a little to get more events.

SBM2 – February 28, 2023



- A Type III burst with ~20 minutes of continuous Langmuir waves
- SBM2 triggers only a few minutes after onset, provides detailed coverage of most of the event.
- Survey data is collected in parallel, so the Survey triggered snapshots provide some coverage of the early phase.

LFR ground segment software

Status

Current status

- L1 to L1R pipeline produces : - CWF in SBM1, SBM2 and SURV mode.
  - SWF in SURV mode.
- L1 to L2 pipeline produces : - BP1 in SBM1, SBM2 and SURV mode.
  - BP2 in SBM1, SBM2 and SURV mode.
  - ASM in SURV mode.
- Summary plots for BP1, BP2 and ASM (L1 and L2) and CWF and SWF (L1).

Recent updates

- Production of new L3 products for ASM, BP1 and BP2.

Upcoming upgrades

- Mass production of L3.
- Produce L3 quicklooks.
- Document BIAS failures that affects our electric data.
- Implement a new CDF library implemented at LPP.