# RPW-TDS update
# (data status, new observations)

September 4, 2020

*Virtual RPW consortium meeting II*

# Time Domain Sampler – TDS: cruise operations so far

❑ Sampling rate set to 262 kHz. Sufficient for R > 0.5 AU and much less affected by spacecraft noise.

❑ One of the following antenna configurations is used:

   o Monopole antenna configuration (V1, V2, V3 and Bx): This is good for dust, but data is more impacted by interference

   o Dipole antenna configuration (V1-V3, V2-V1, V3-V2 and Bx). This is the cleanest data (and on-board wave detection works best)

   o A combined configuration (V1-V3, V2-V1, V2 and Bx). This has one monopole (for dust) and two dipoles (waves). The dipole is used for on-board analysis. This is now the baseline.

❑ One periodic waveform snapshots of 4096 samples every 5 or 10 minutes

❑ Triggered (autodetected "best") snapshots – between 96 and ~200 per day

# TDS wave/dust detection and statistics

- ❑ TDS implements an algorithm detecting waves and dust based on:
  - ○ Peak to median amplitude ratio (PMED)
  - ○ Spectral bandwidth (BW)
  - ○ Large PMED and Large BW => dust
  - ○ Low PMED and low BW => wave

- ❑ Best waves stored as triggered snapshots

- ❑ Dust events are counted and some predefined number (2-4) per dump are stored too.

- ❑ Statistical summary data are sent

- ❑ After parameters tuning, this now works, but not 100% and sometimes is affected by interference (in particular in monopole mode).

# TDS observations so far

❑ Extra telemetry available during cruise is mostly used for triggered snapshots.

❑ TDS observed

    ❑ Langmuir-like waves are the electron plasma frequency

    ❑ Dust impacts

    ❑ Low frequency ion acoustic waves

    ❑ Type III observed both in radio and in-situ

❑ Some mysterious emissions, most likely not natural

❑ Data delivery:

    ❑ For public release in September, most TDS data will be released (barring perhaps one histogram product)

    ❑ Quality set to 2 (use with caution) for snapshots and 1 (known issues) for everything else

# RPW TDS data (typical day)



Langmuir waves at fpe

Dust impacts

This is spectrum from triggered snapshot data. Spectra are non-uniform in time, X-axis is index.
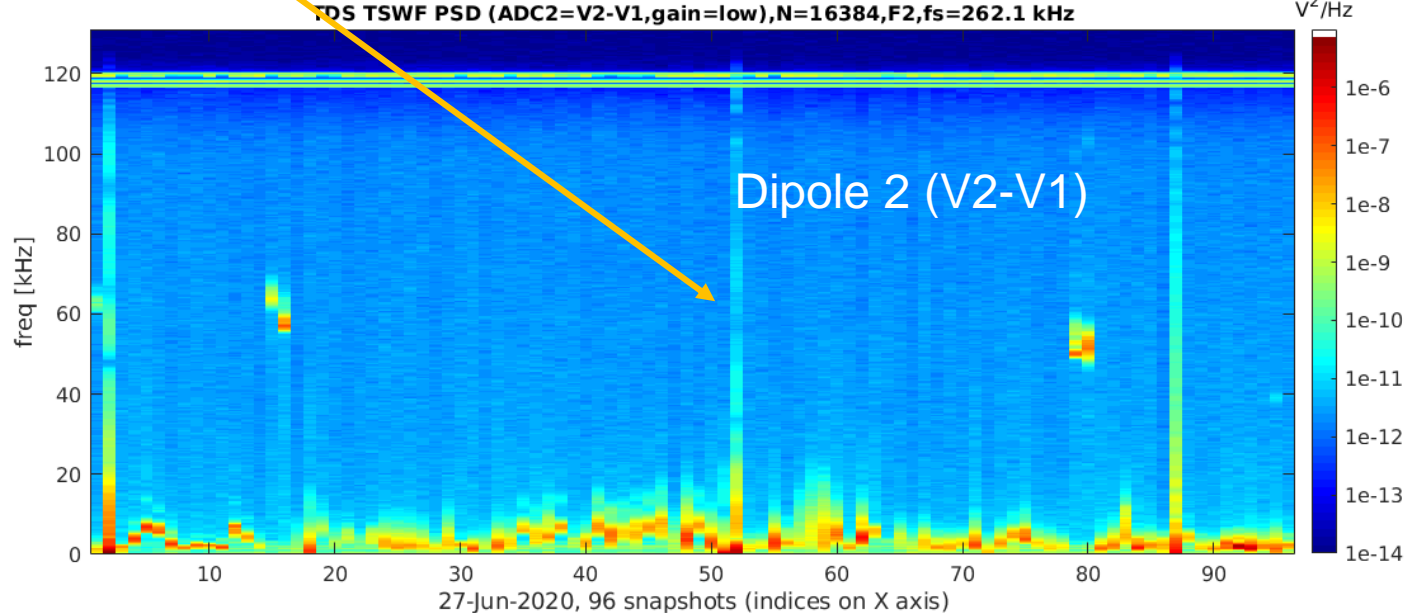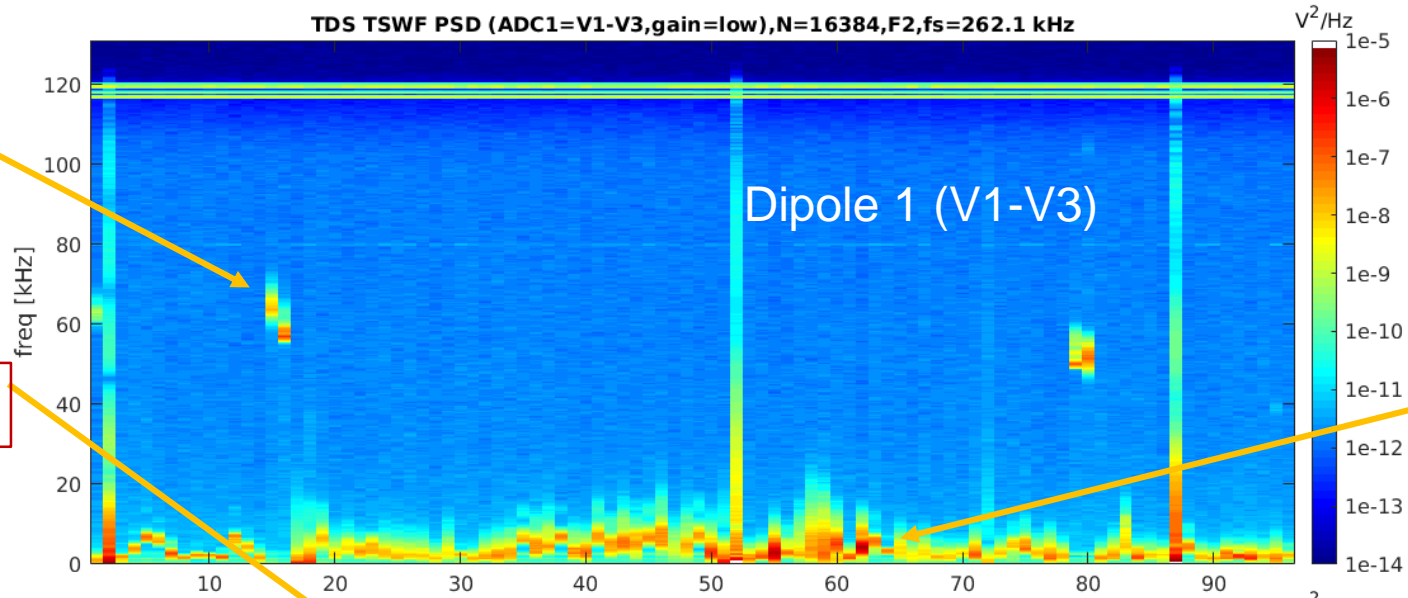
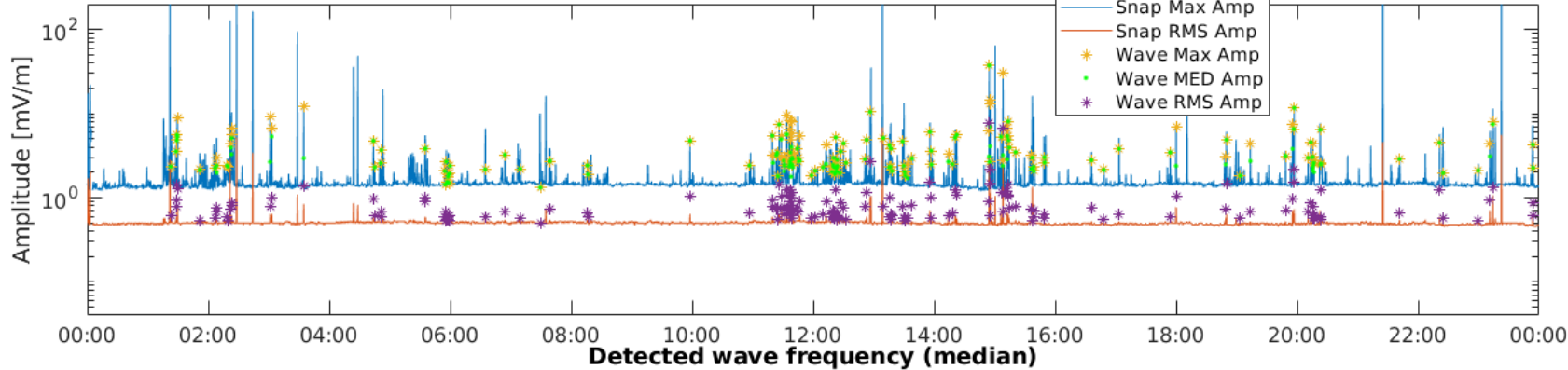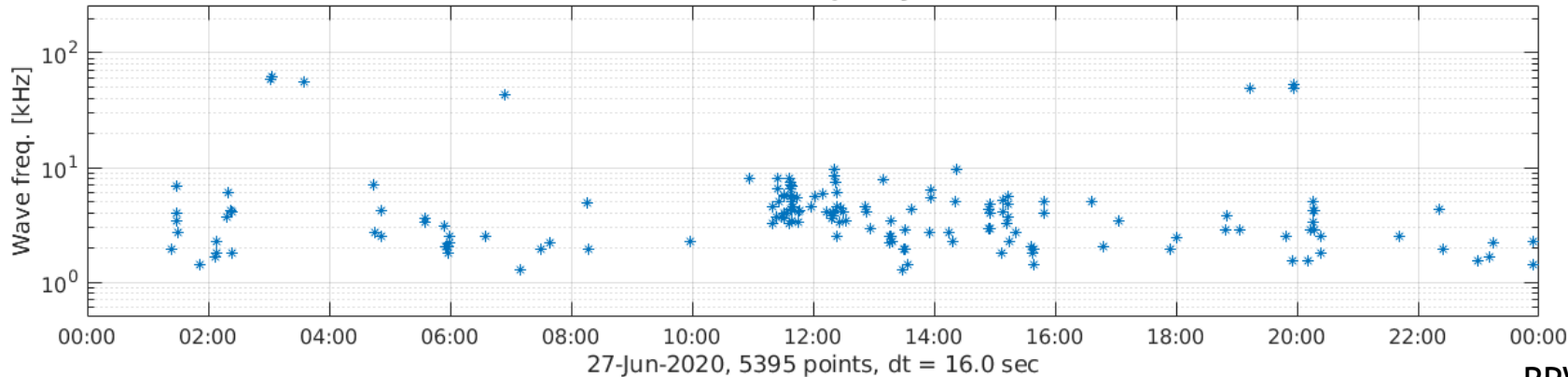Low frequency waves (< fpe): Doppler shifted ion-acoustic waves.

TDS TSWF PSD (ADC1=V1-V3,gain=low),N=16384,F2,fs=262.1 kHz

Dipole 1 (V1-V3)

TDS TSWF PSD (ADC2=V2-V1,gain=low),N=16384,F2,fs=262.1 kHz

Dipole 2 (V2-V1)

27-Jun-2020, 96 snapshots (indices on X axis)

5

# RPW TDS statistics



TDS STAT 27-Jun-2020: fs=262138 kHz,cfg=(V1-V3,V2-V1,V3-V2,BM,low)
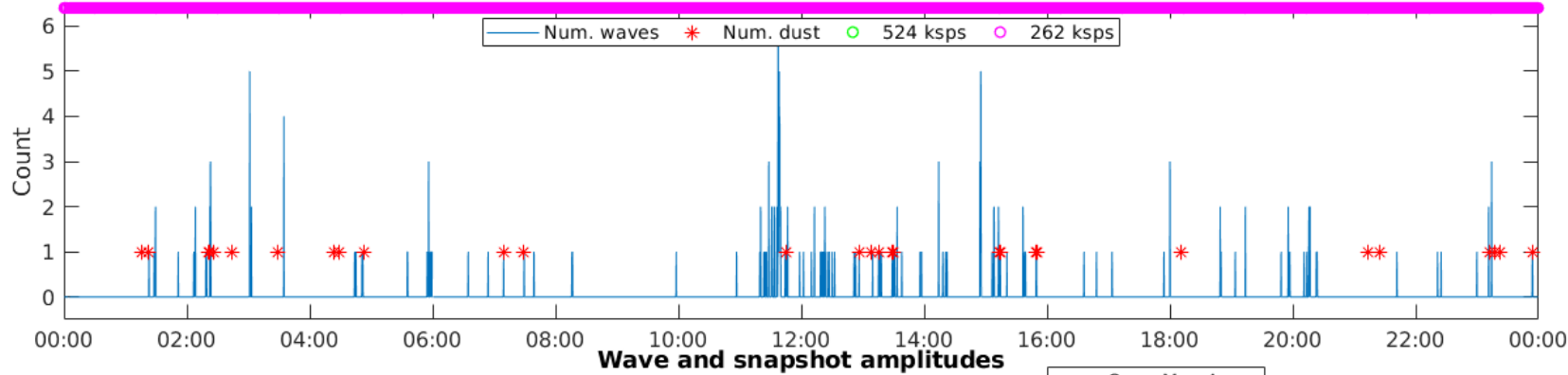
Counts of wave/dust per 16 seconds

Average amplitudes of waves and snapshots

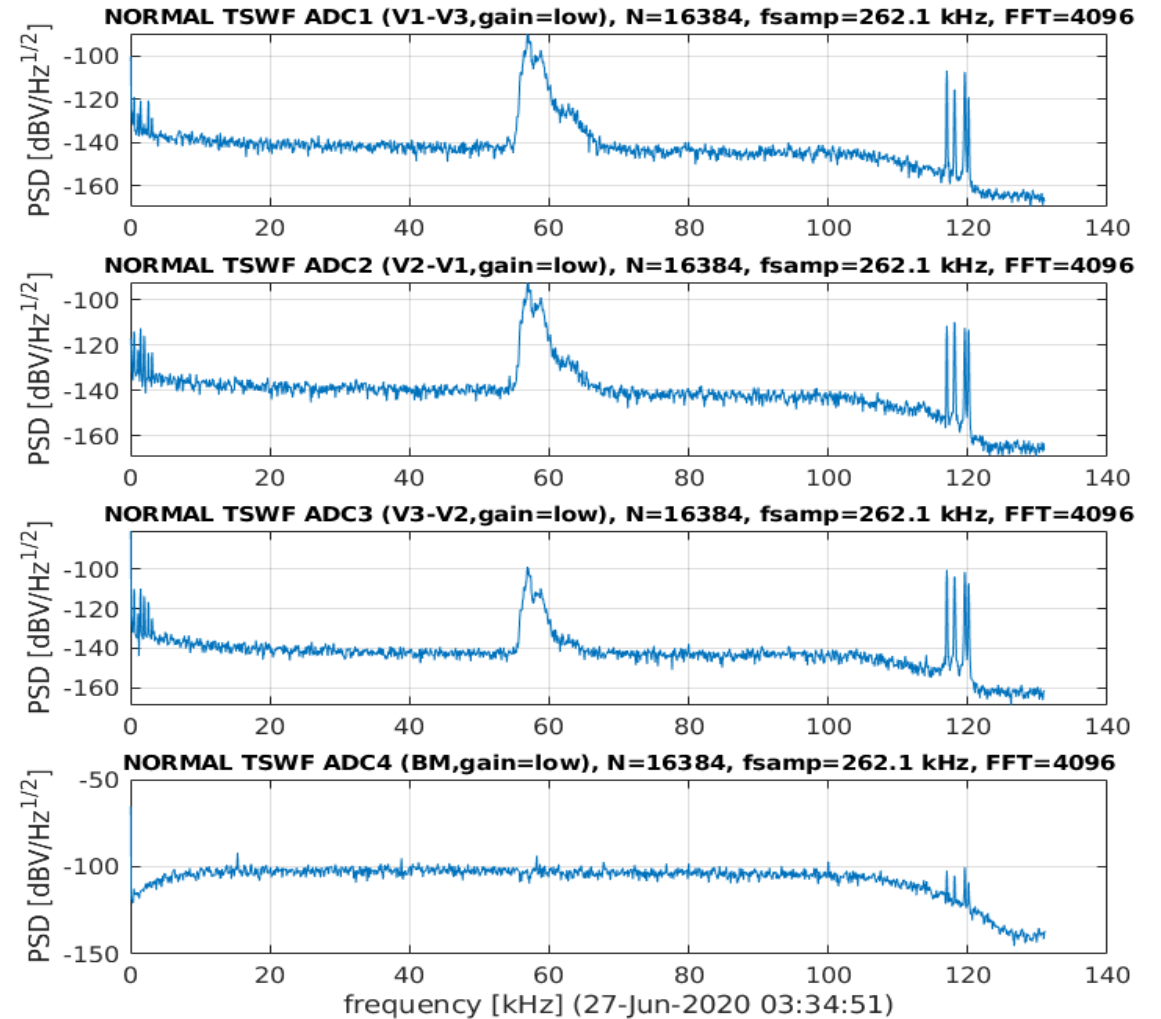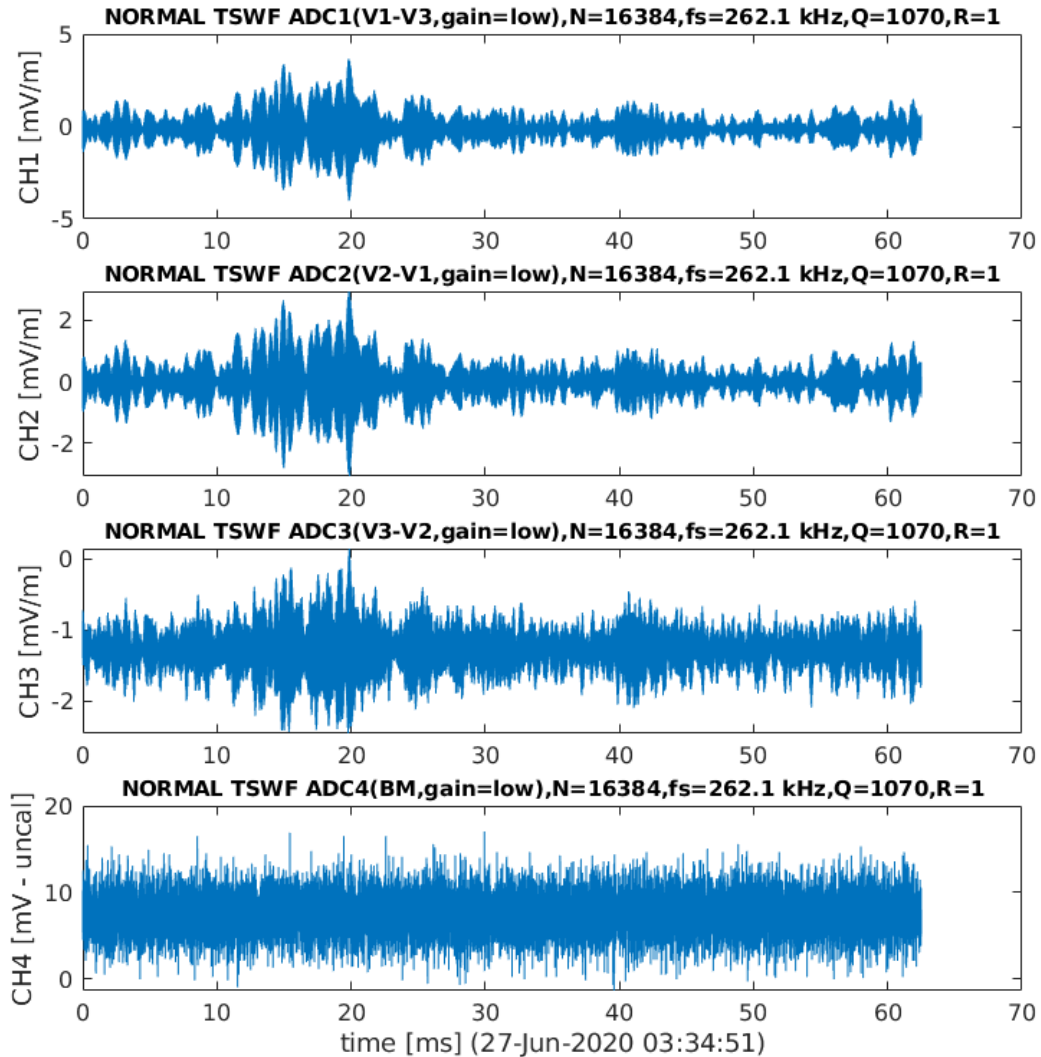Median frequency of the detected waves

# Low freqency waves

❑ Low frequency waves at kHz frequencies (Doppler shifted ion-acoustic waves).

❑ These are the most common observation by TDS.
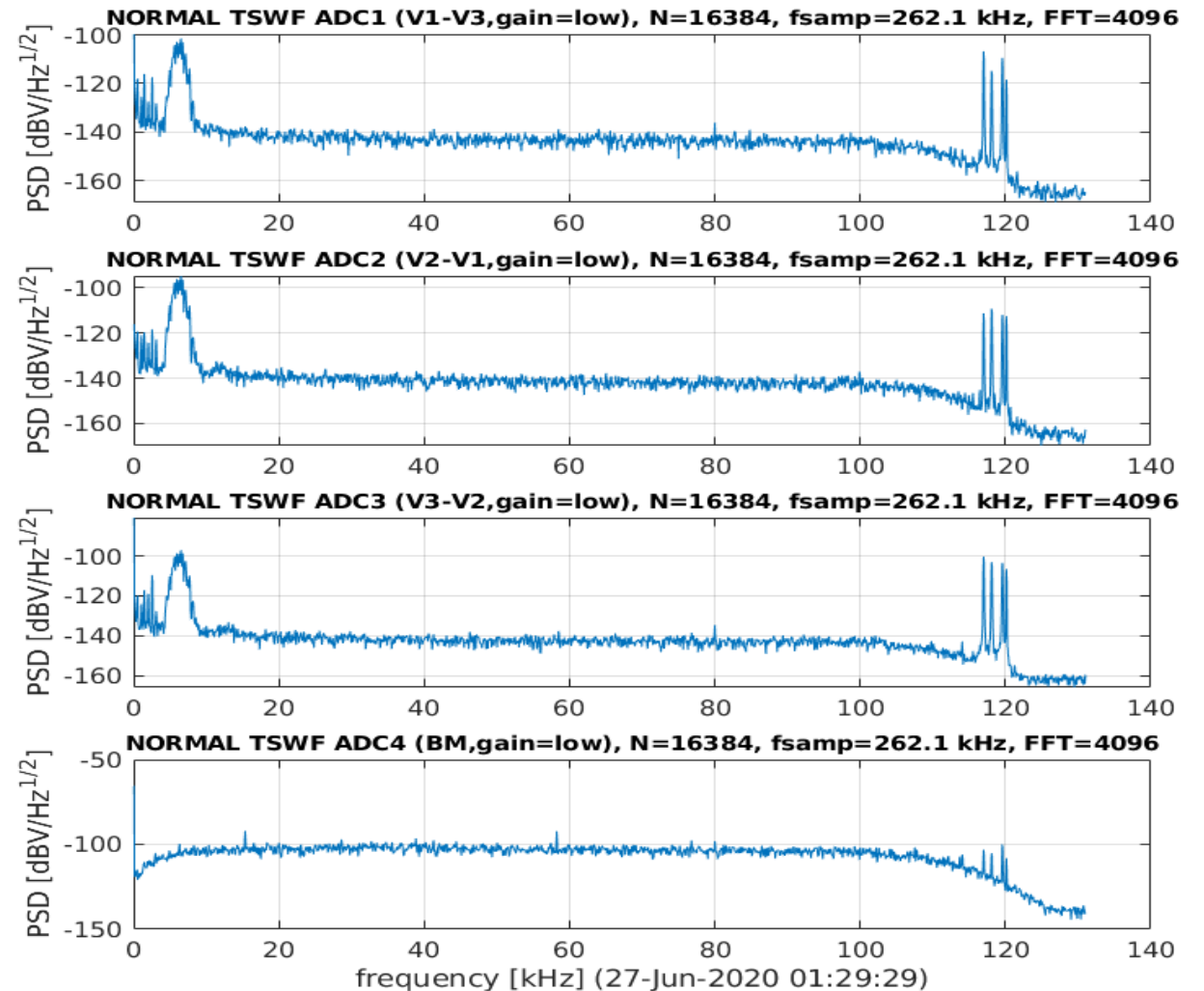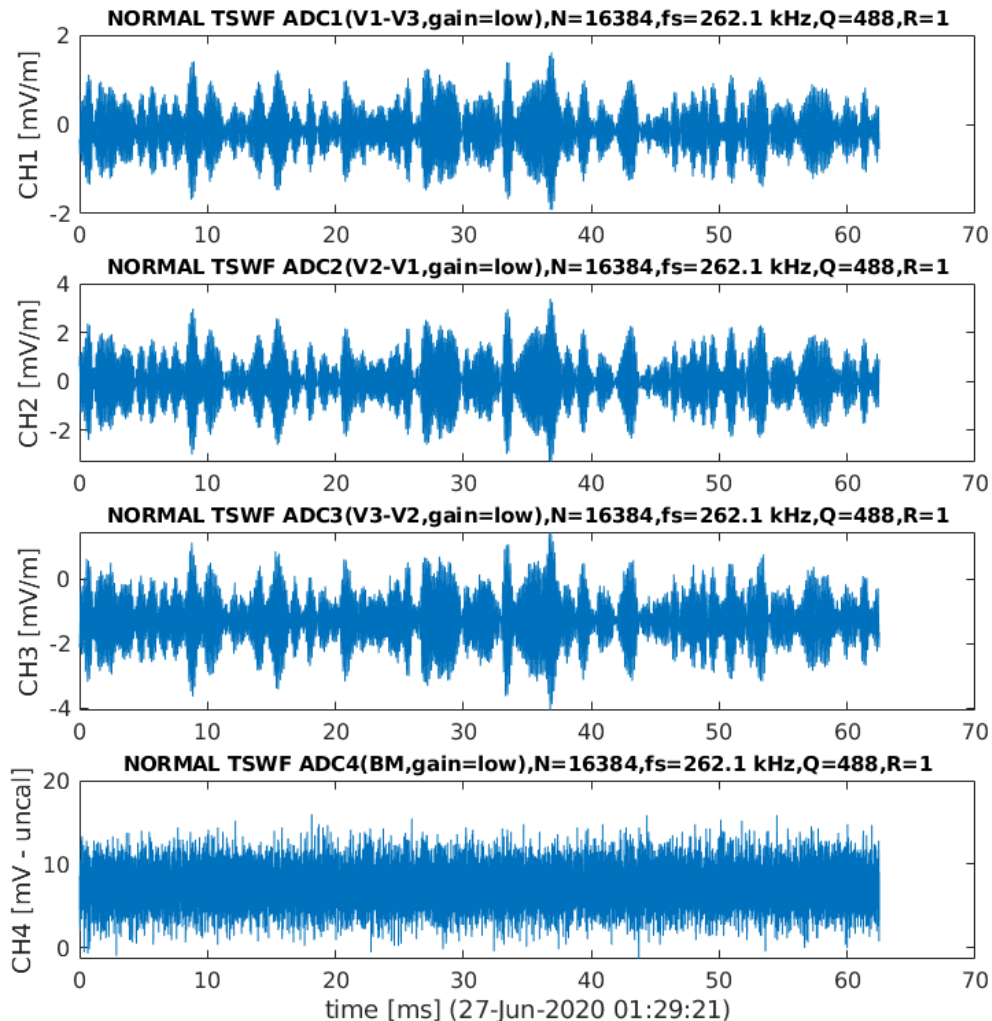
# Langmuir waves

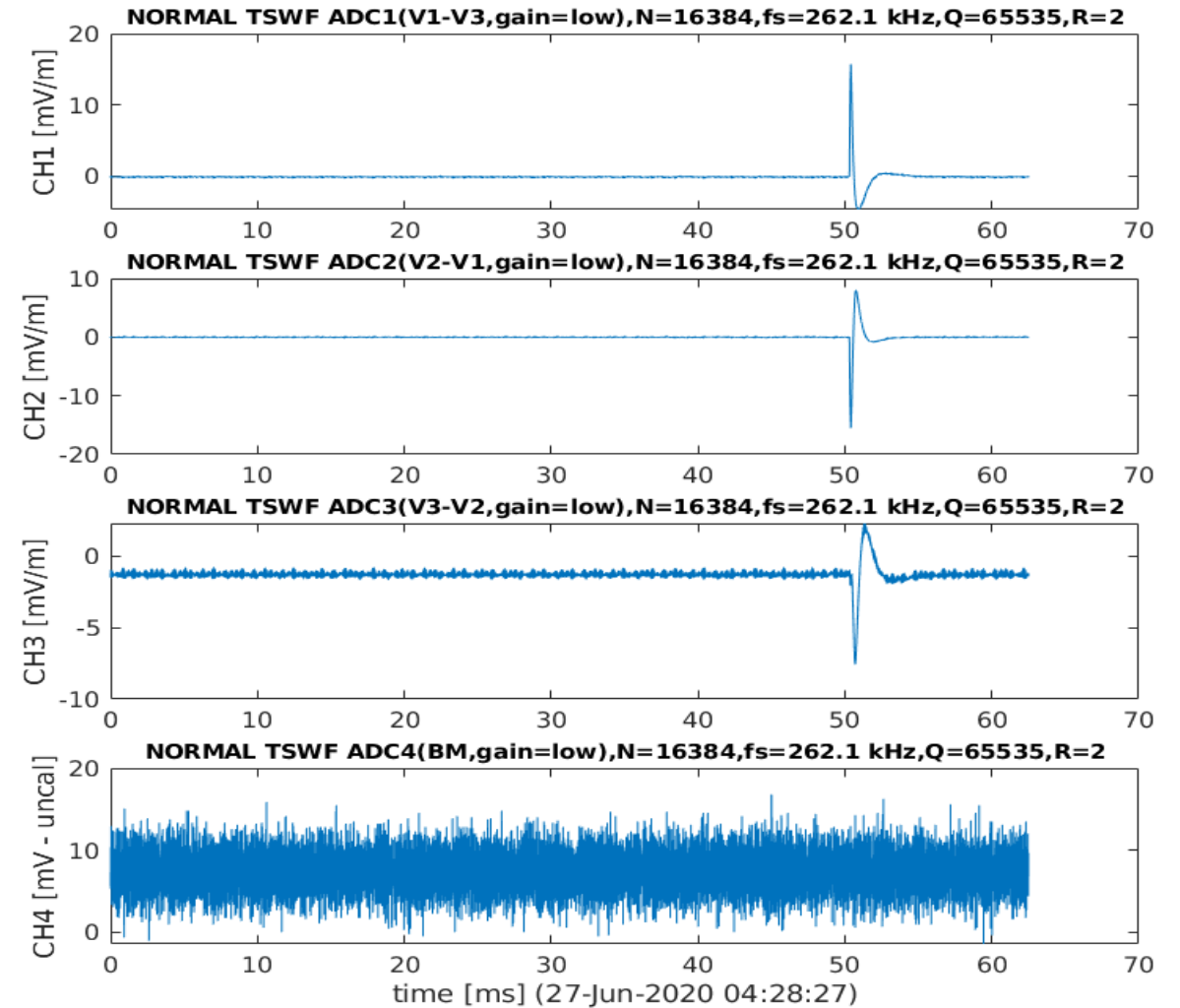TDS observes a lot of Langmuir waves (usually relatively weak)
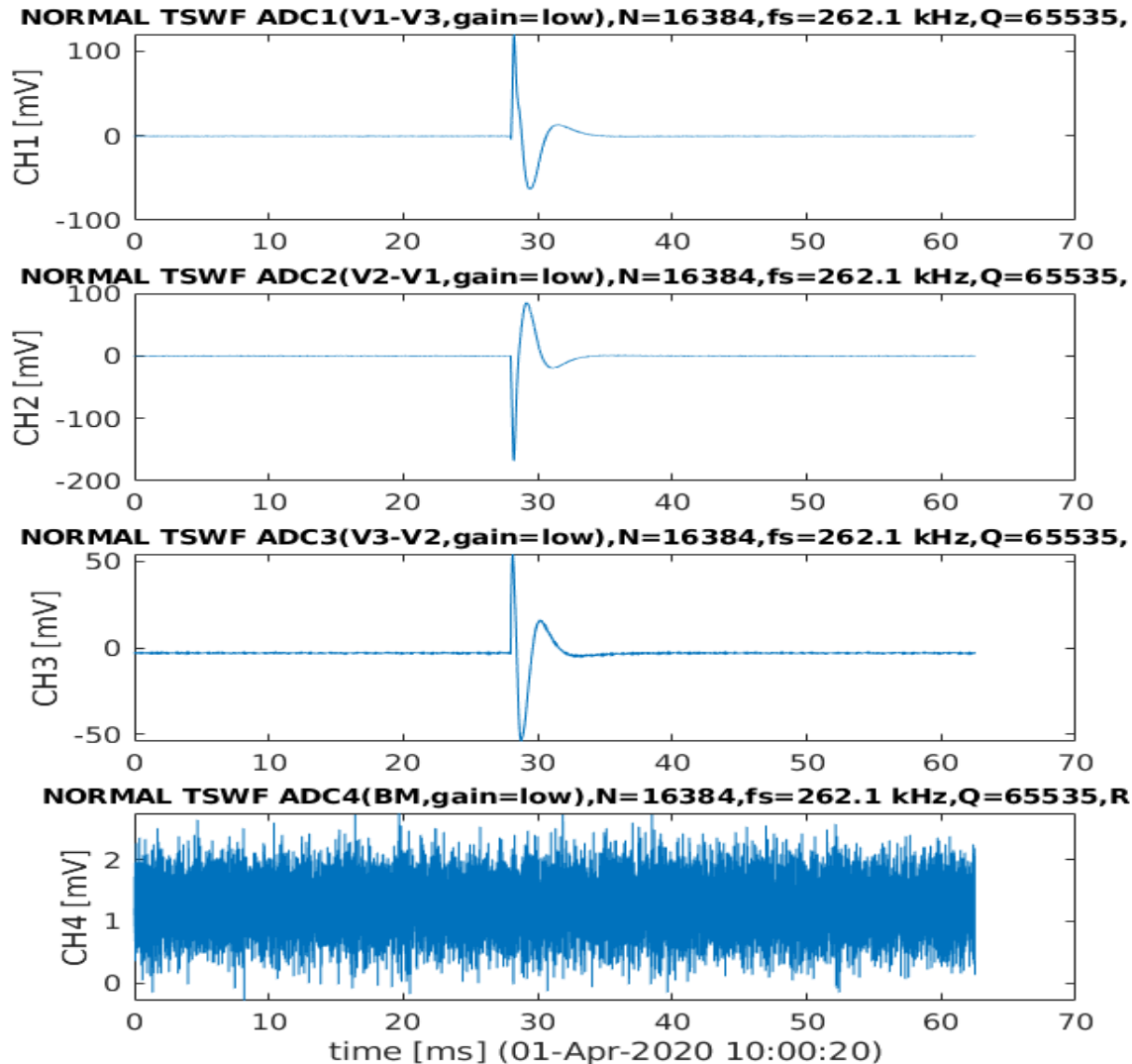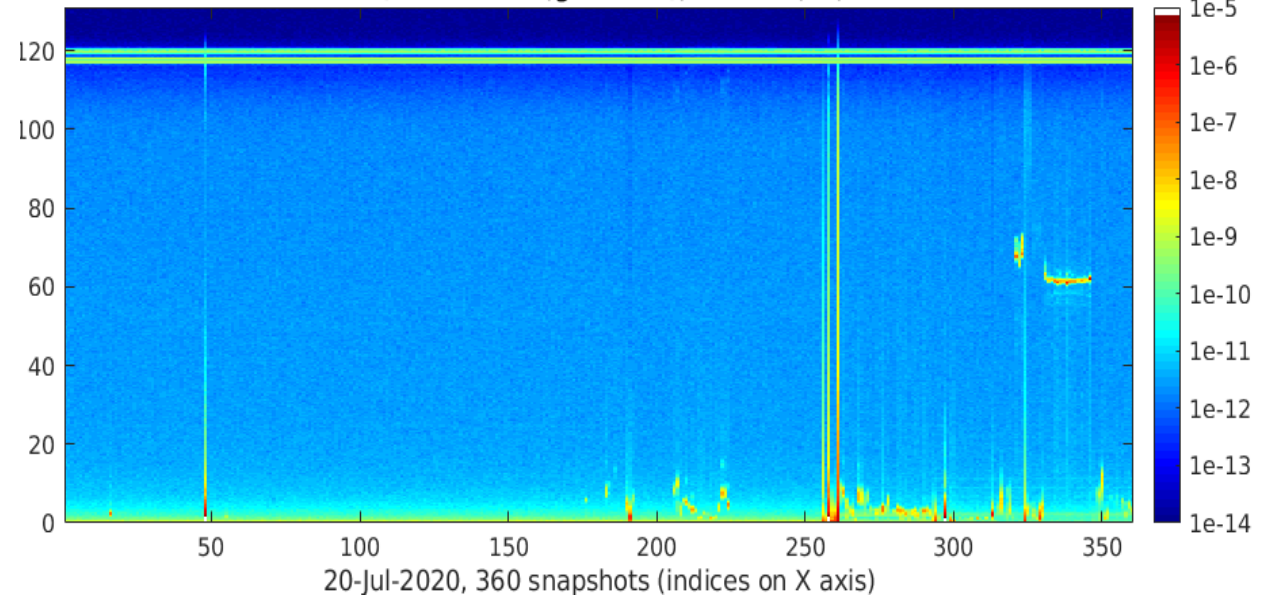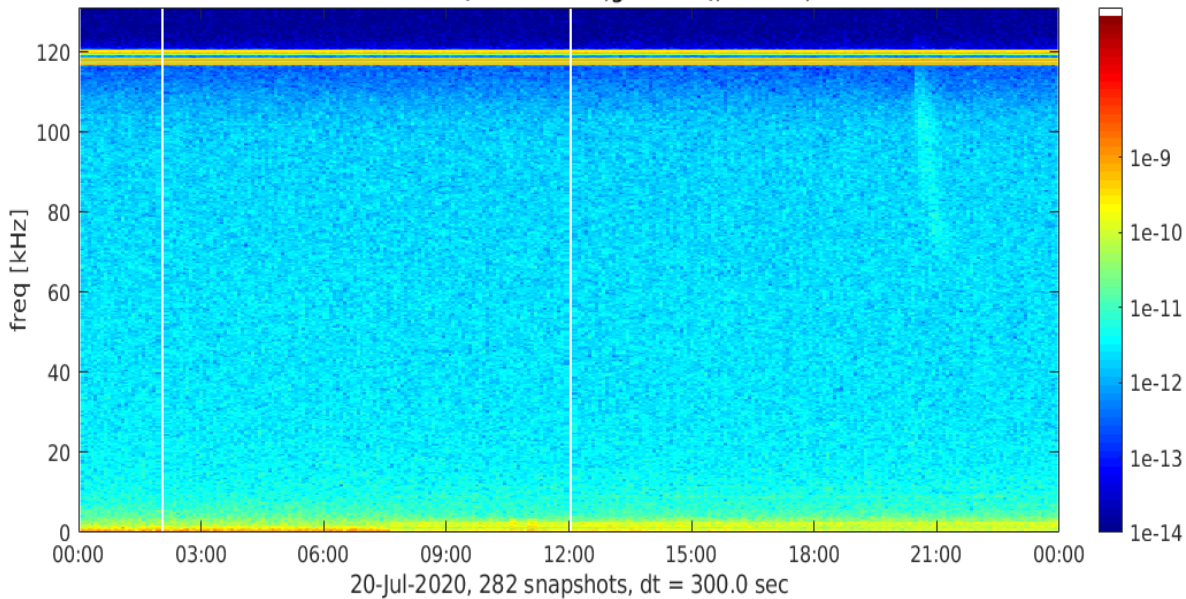
# Dust impacts

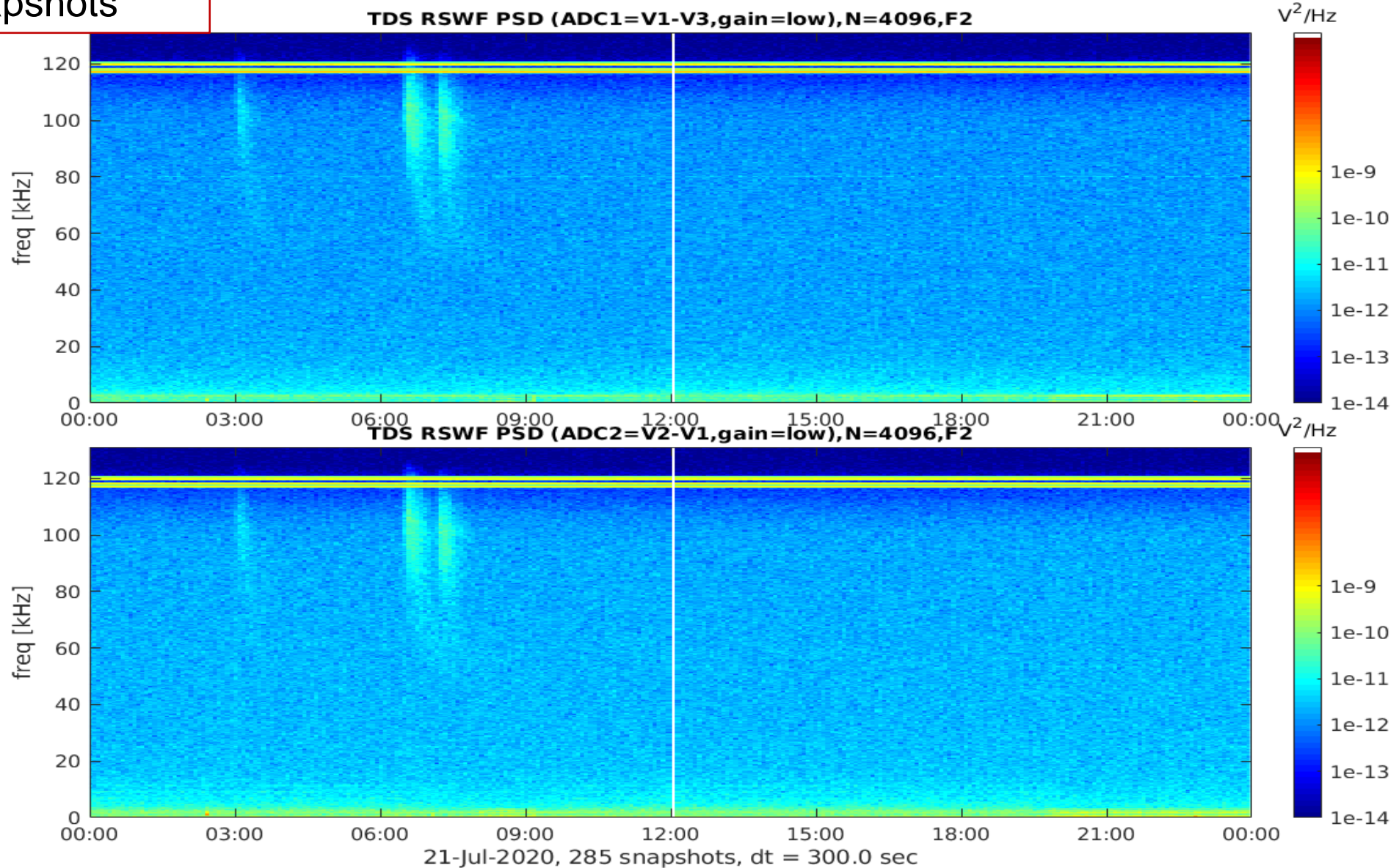❑ Several dust impacts per day observed and detected.

# Radio bursts- in situ

TDS RSWF PSD (ADC1=V1-V3,gain=low),N=4096,F2

TDS TSWF PSD (ADC1=V1-V3,gain=low),N=16384,F2,fs=262.1 kHz

TDS RSWF PSD (ADC2=V2-V1,gain=low),N=4096,F2

TDS TSWF PSD (ADC2=V2-V1,gain=low),N=16384,F2,fs=262.1 kHz

20-Jul-2020, 282 snapshots, dt = 300.0 sec

20-Jul-2020, 360 snapshots (indices on X axis)
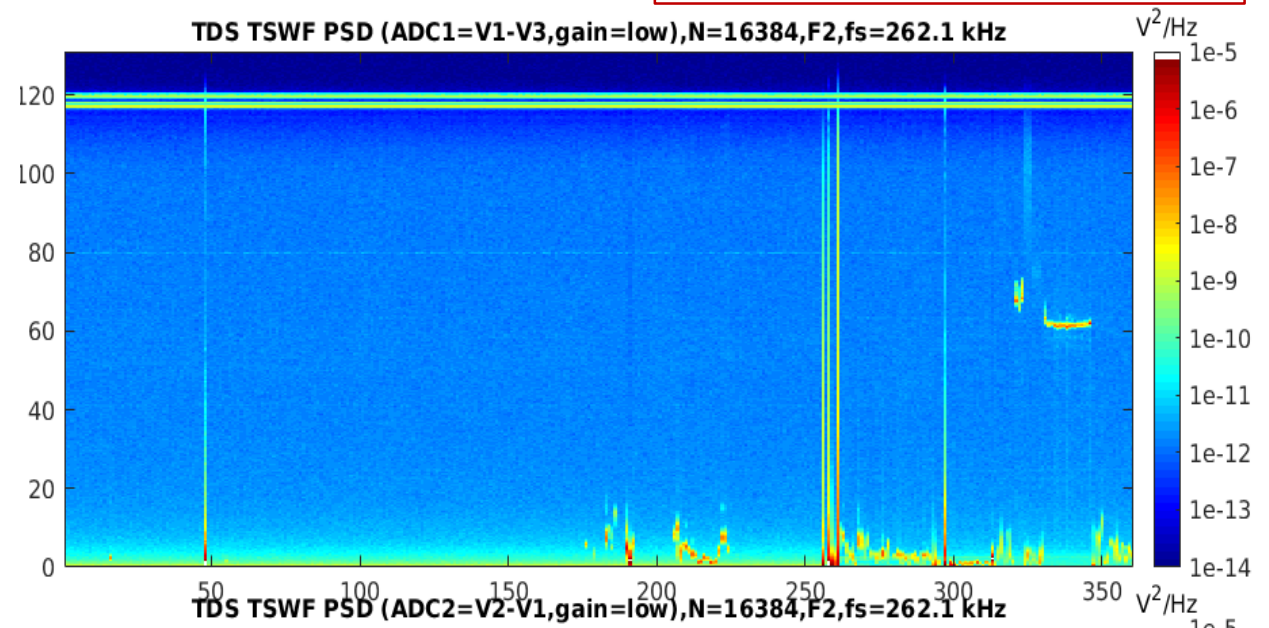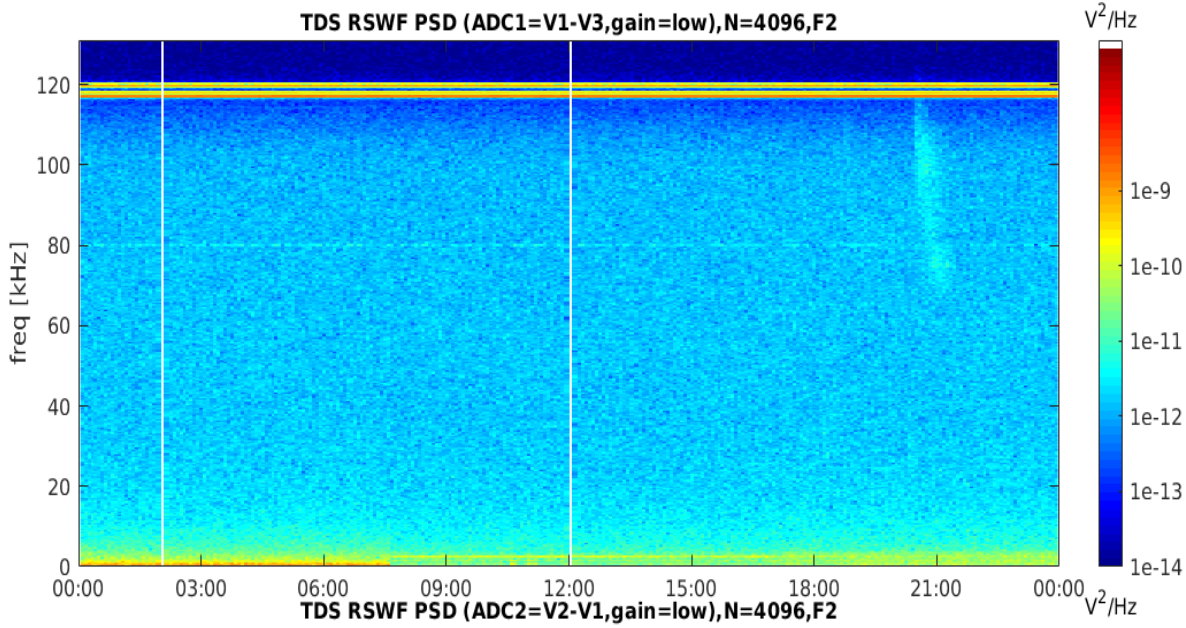
# Radio bursts at low frequency

Regular snapshots



TDS RSWF PSD (ADC1=V1-V3,gain=low),N=4096,F2

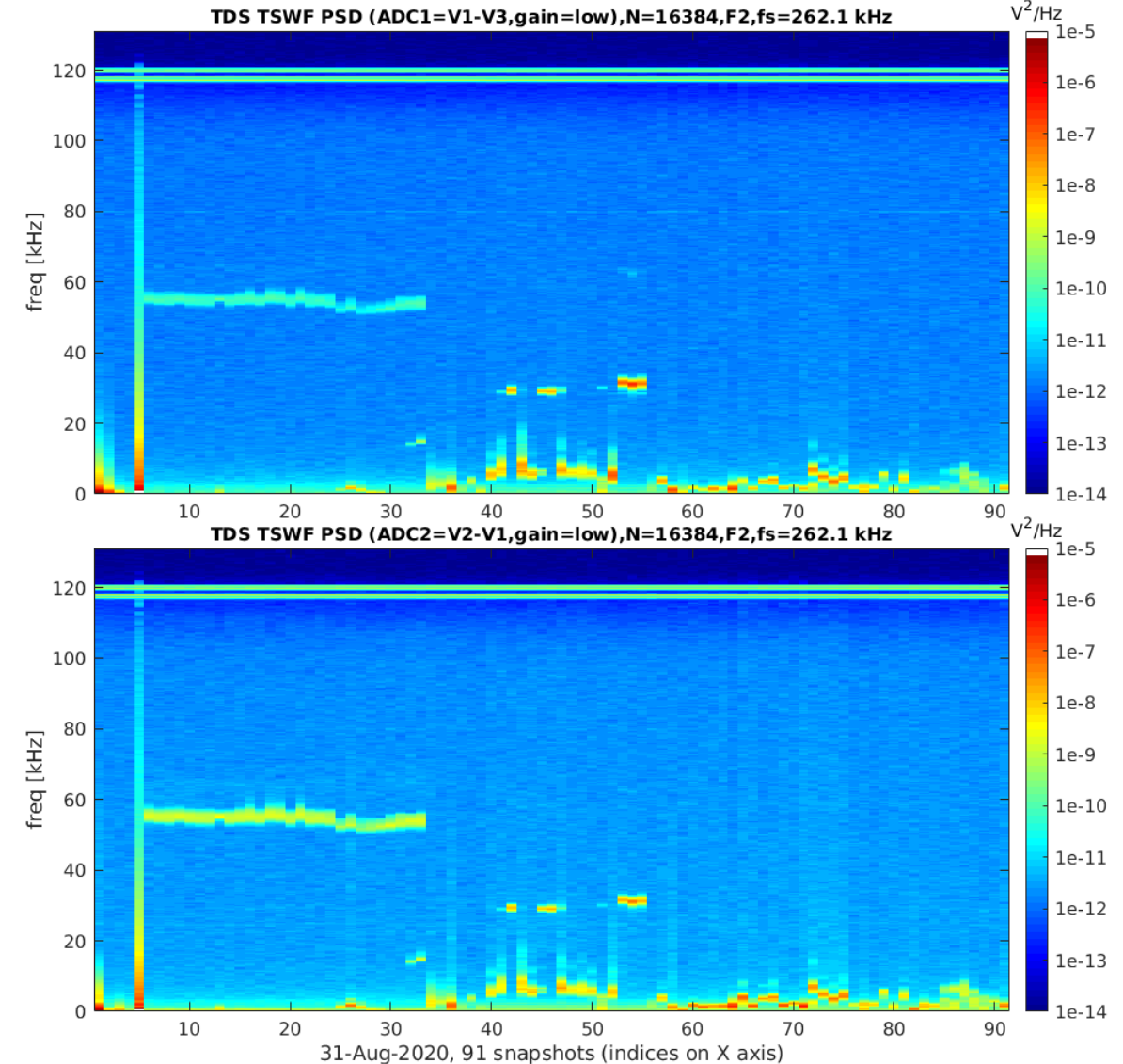TDS RSWF PSD (ADC2=V2-V1,gain=low),N=4096,F2

21-Jul-2020, 285 snapshots, dt = 300.0 sec

# Radio and Langmuir wave observation

Statistics
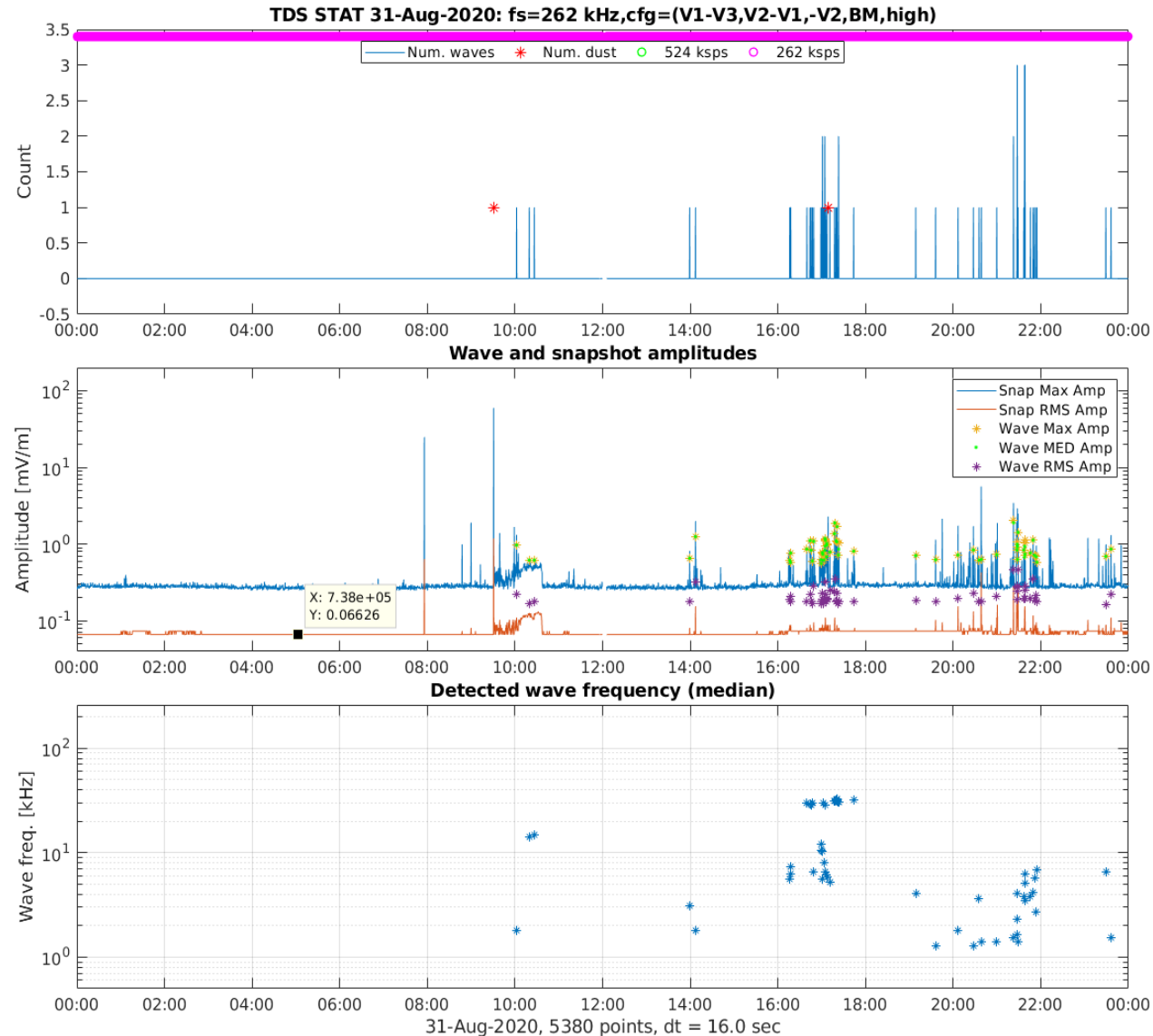
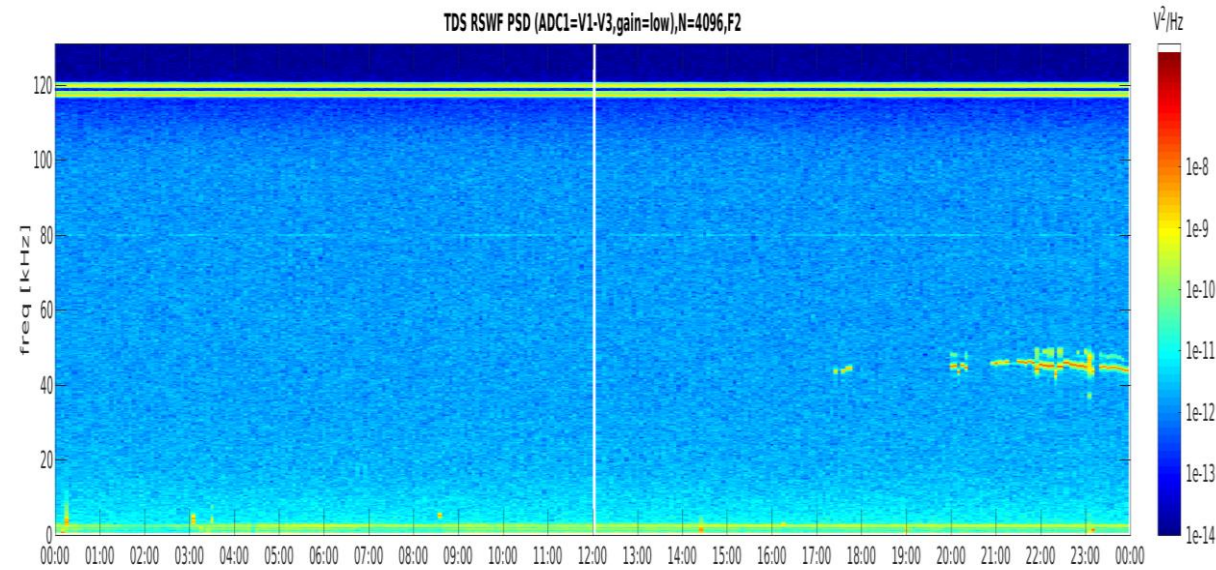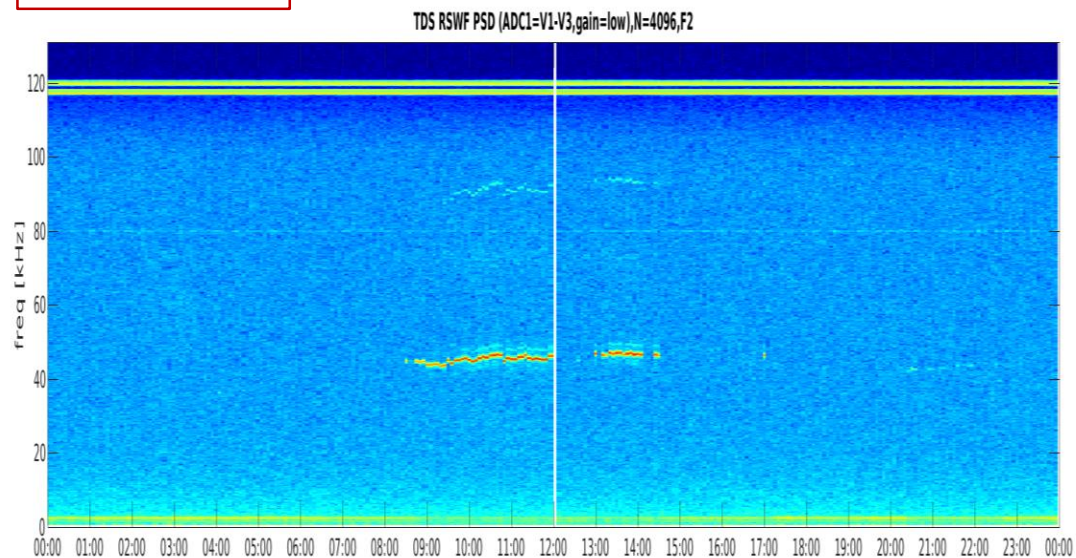Triggered snapshots

# Mysterious signals

TDS RSWF PSD (ADC1=V1-V3,gain=low),N=4096,F2

TDS RSWF PSD (ADC1=V1-V3,gain=low),N=4096,F2

TDS RSWF PSD (ADC2=V2-V1,gain=low),N=4096,F2

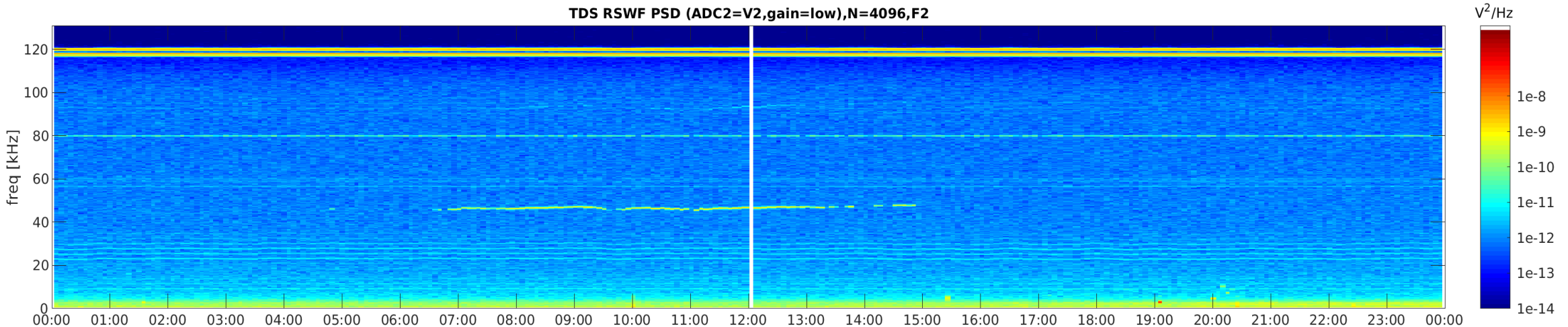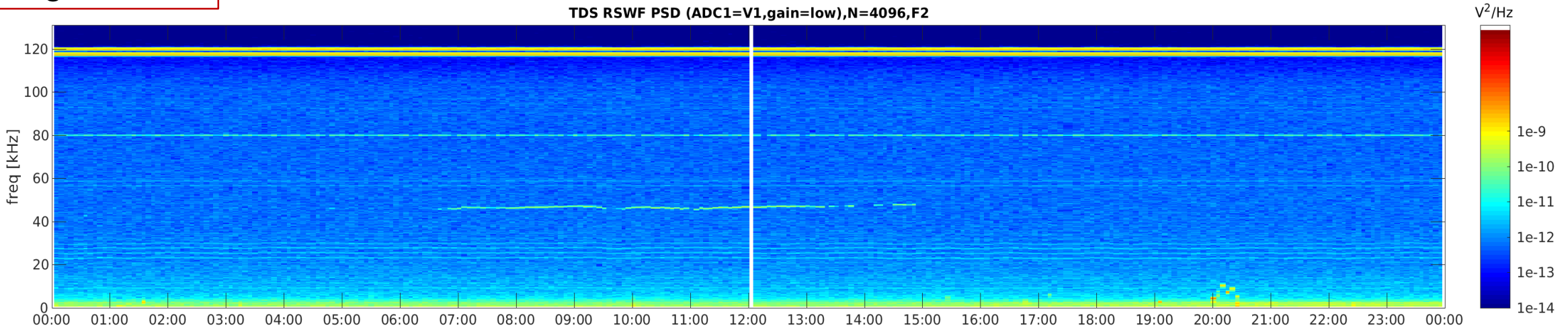TDS RSWF PSD (ADC2=V2-V1,gain=low),N=4096,F2
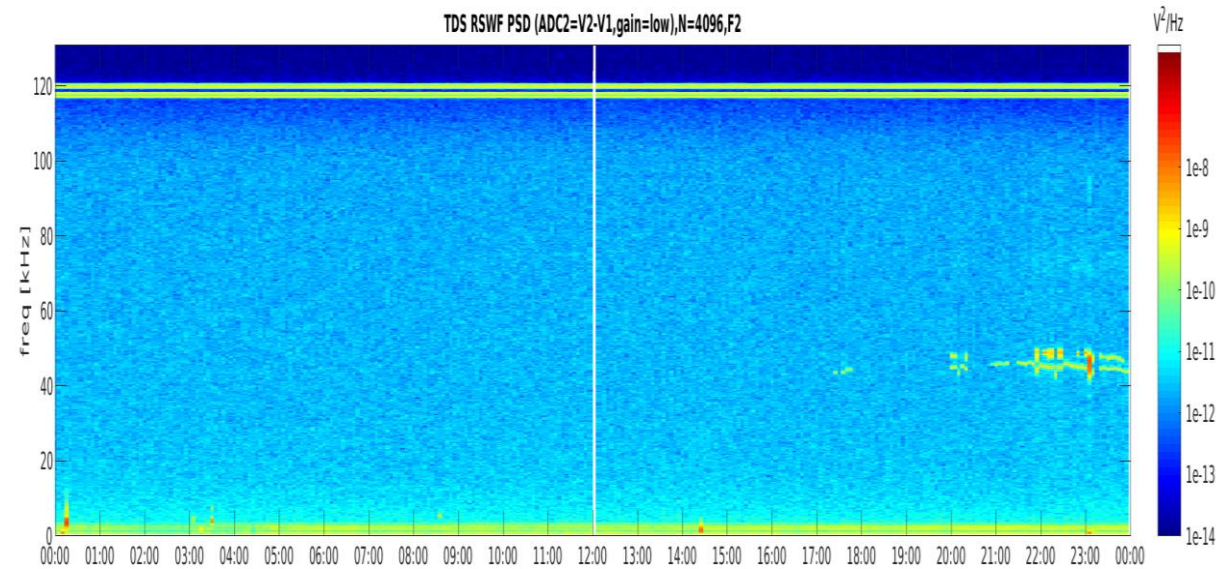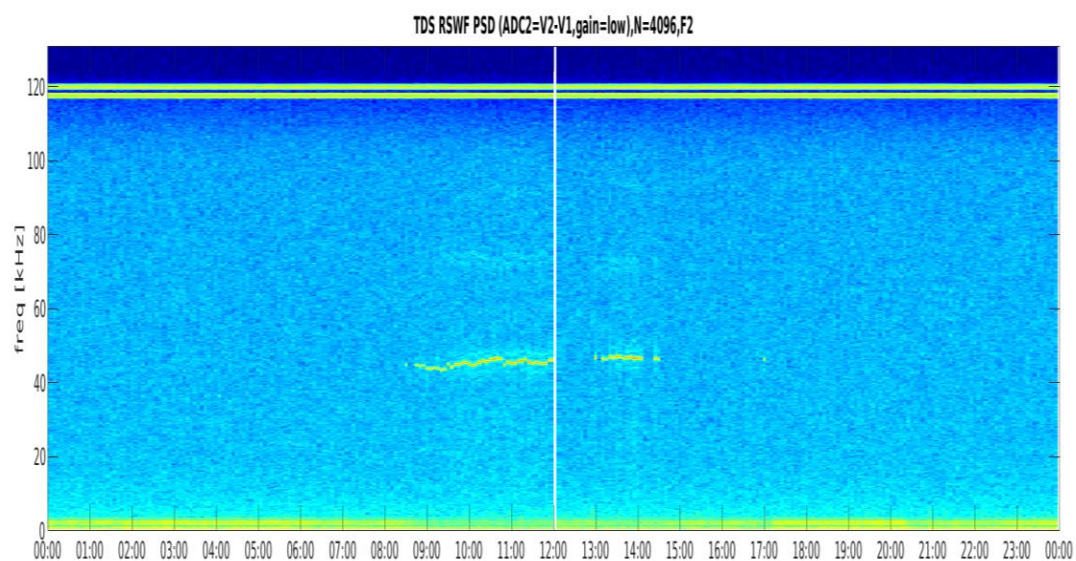
# Mysterious signals

Observed once in a while (5 days so far over 2 months), emission around 45-46 kHz. Frequency seems similar within 2 kHz on all days -> unlikely to be natural

Possibly spacecraft emission coupling to the antenna through plasma

August 4th

# Overall summary

- TDS in good health, performance nominal.

- Wave and dust detection works reasonably well in 262 kHz mode, but not in 524 kHz mode. This needs to be addressed by a software patch.

- Running continuously, good TM in cruise phase, some interesting data

**Data release:**

- TDS will release first science data in September.

- L2 data calibration now reasonably OK, includes effective antenna lengths. Waveform data is stable, statistics / histograms now mostly fine too (except 2D histograms)

- No data cleaning/filtering was done. There are many artifacts, including strong artificial signals. Use with caution and check with us.