

Raven Expedition

Software tool for Long-term Spectral Averages





- Not publicly available yet, but it will be later this year
- We still have many bugs to fix and features to add
- Automatic updates will let you know when a new version is available
- If you find errors or bugs, please let us know!

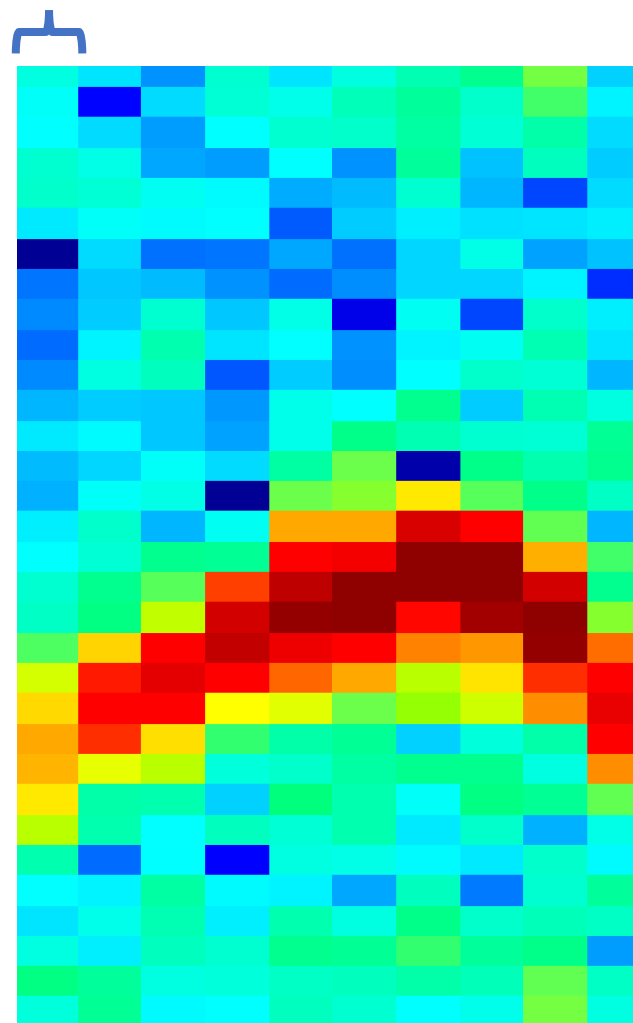
raven_support@cornell.edu



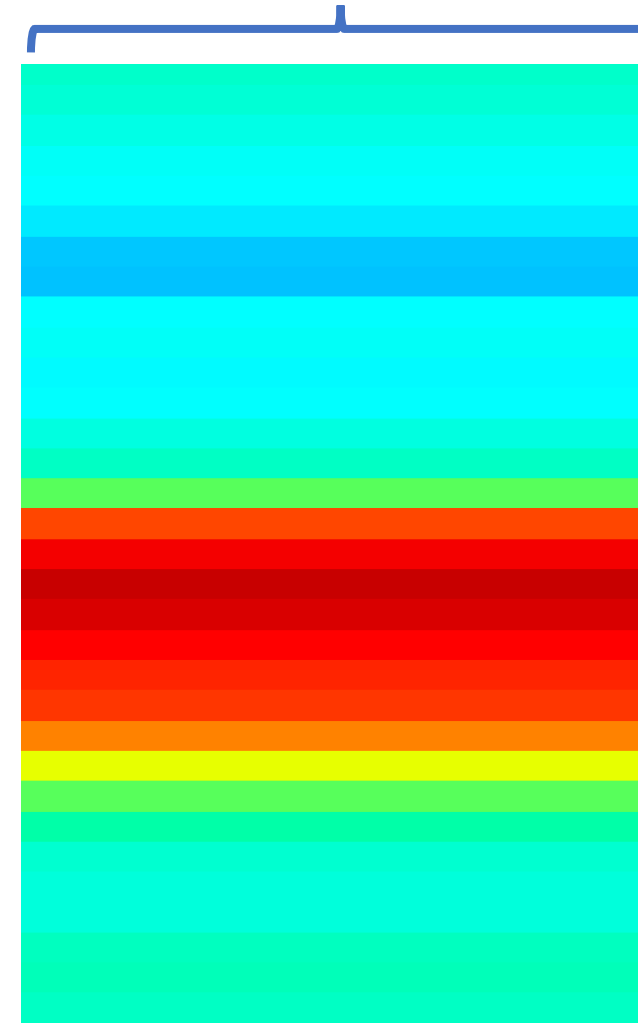
What is a Long Term Spectral Average?

Add the acoustic power spectrum values of each frame and divide by the length of time.

1 Spectrogram Frame



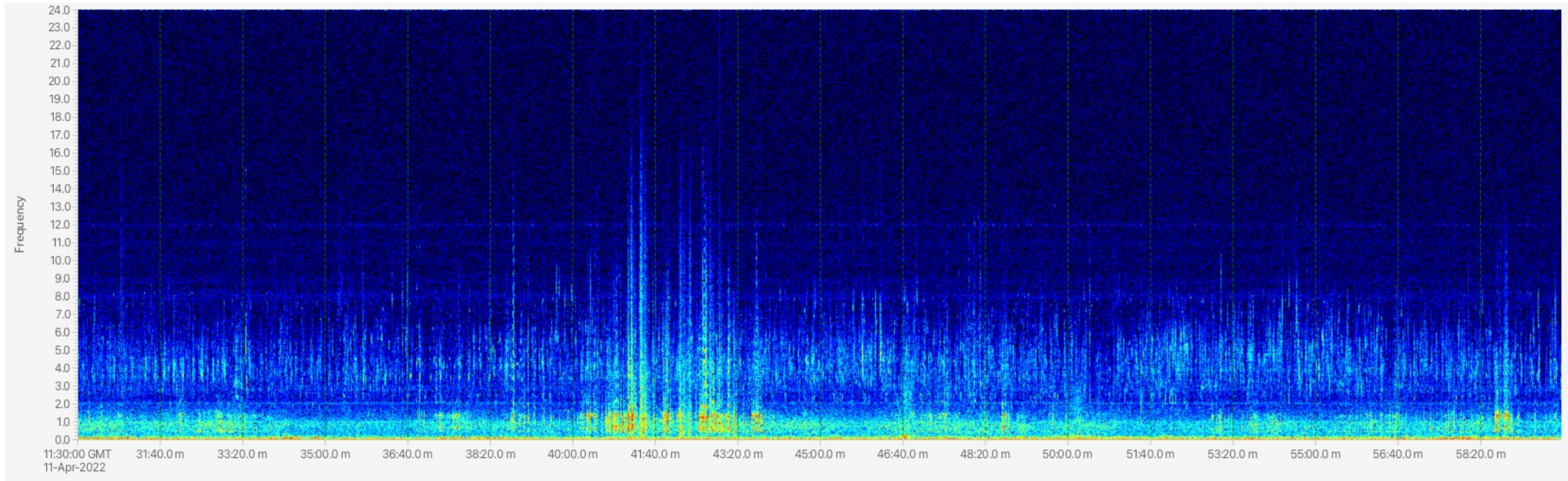
1 LTSA Frame





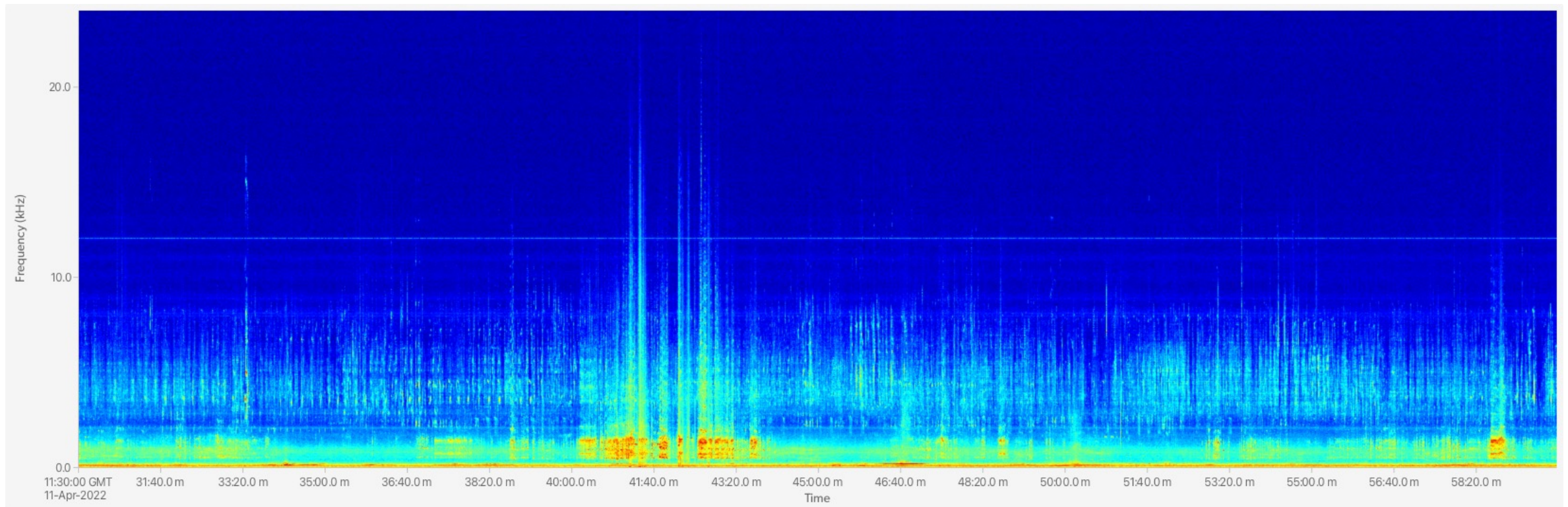
Normal Spectrogram

- 30 minutes of data
- 50ms window size
- 11.7 Hz frequency grid



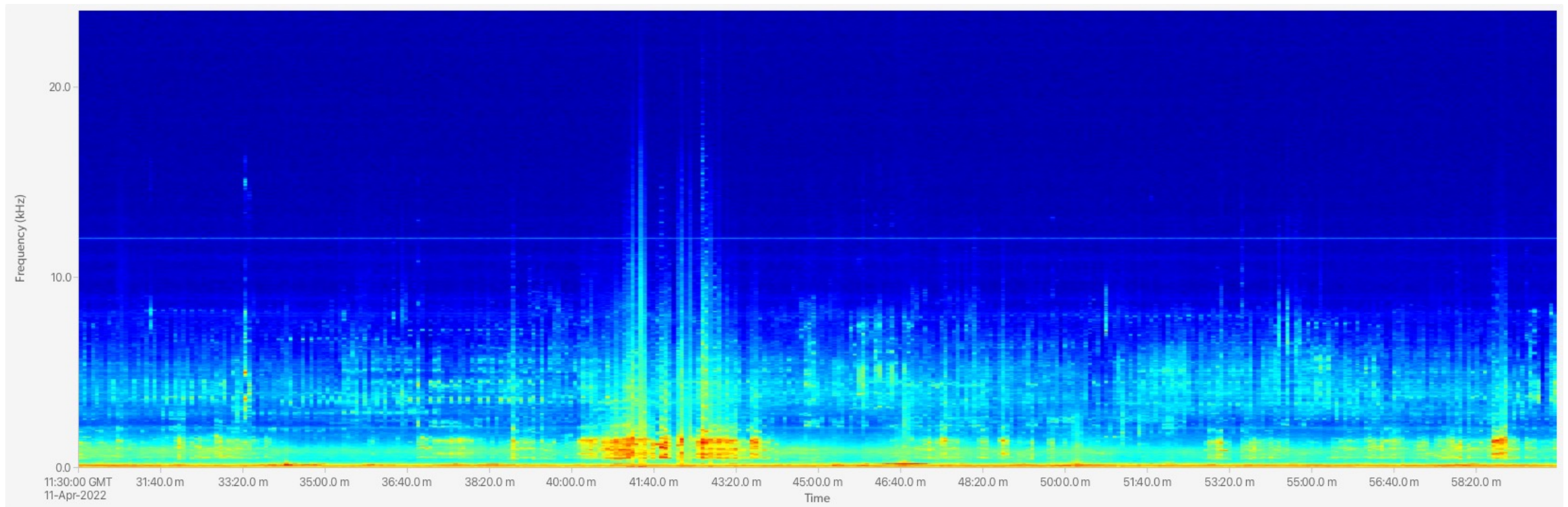


- 1 second average



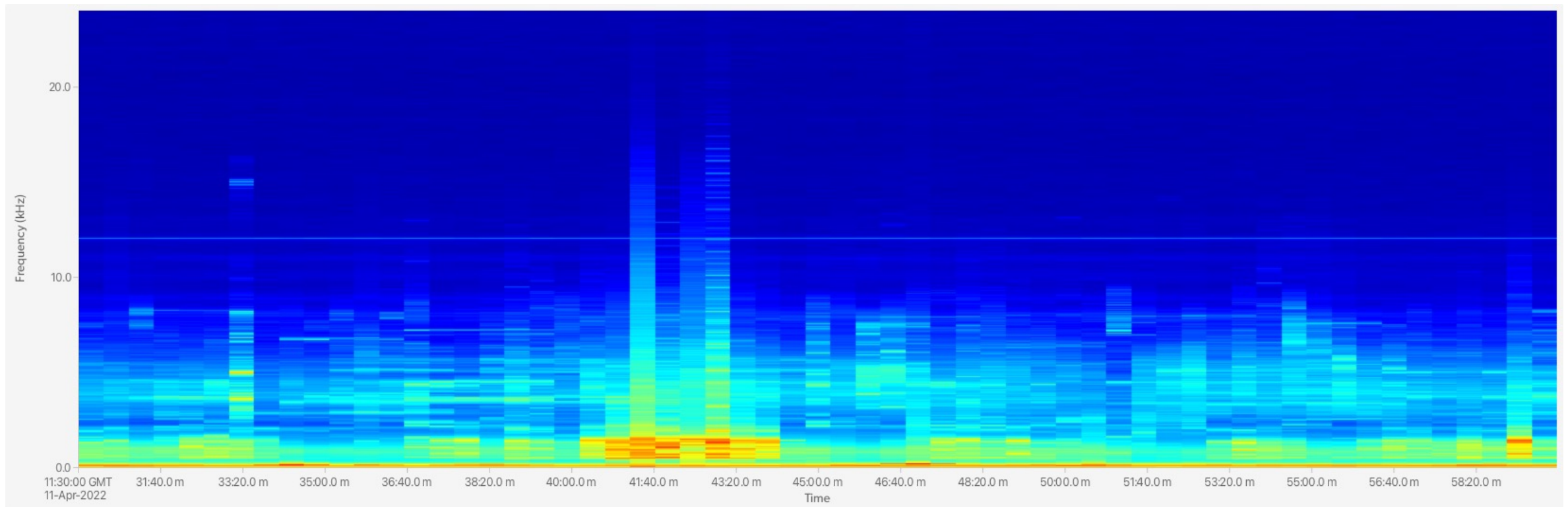


- 5 second average





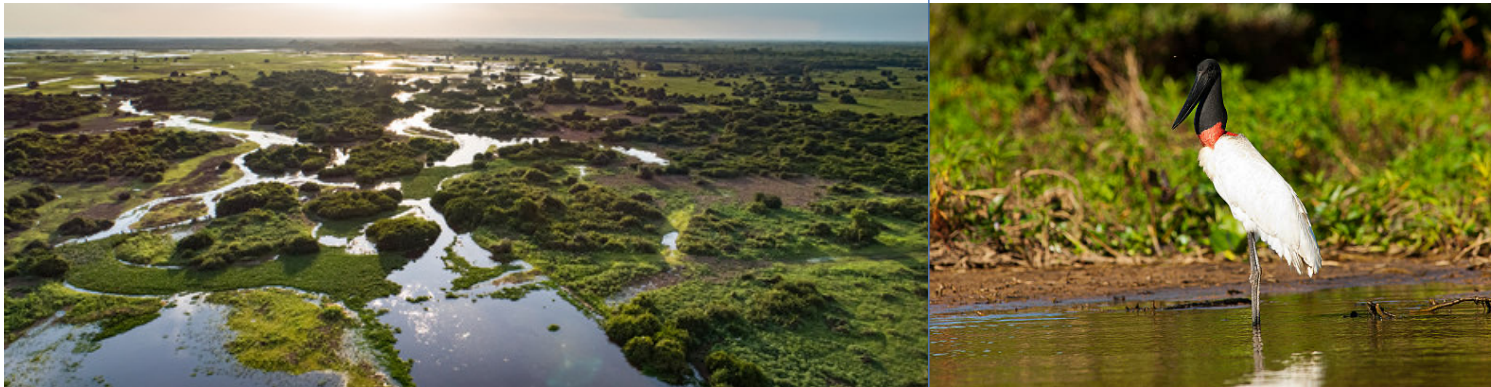
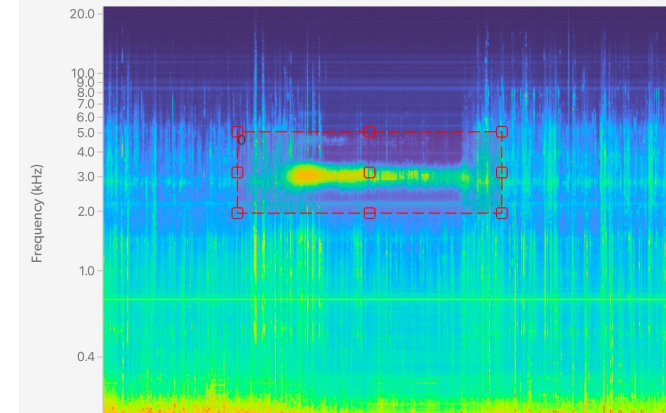
- 30 second average

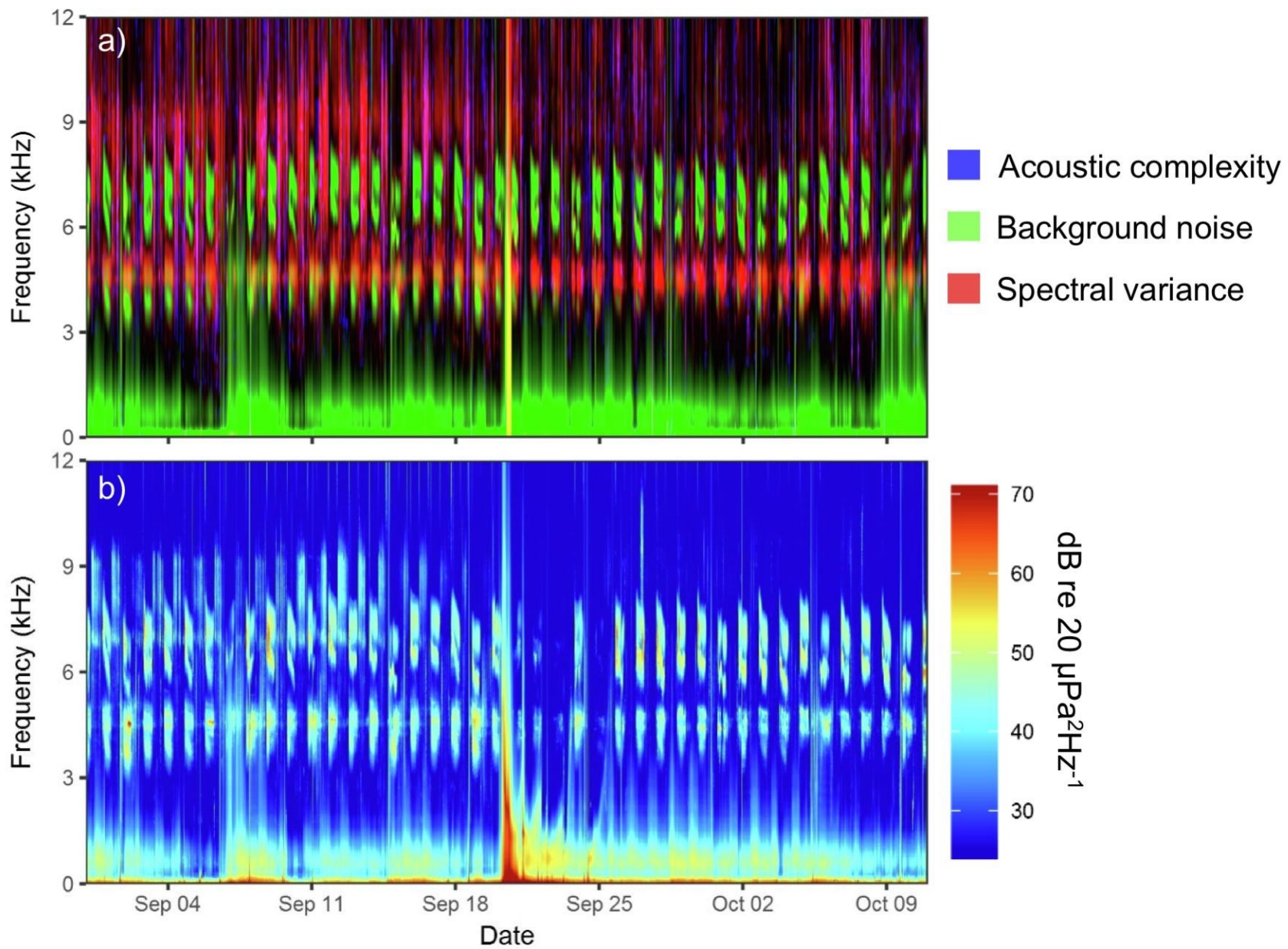


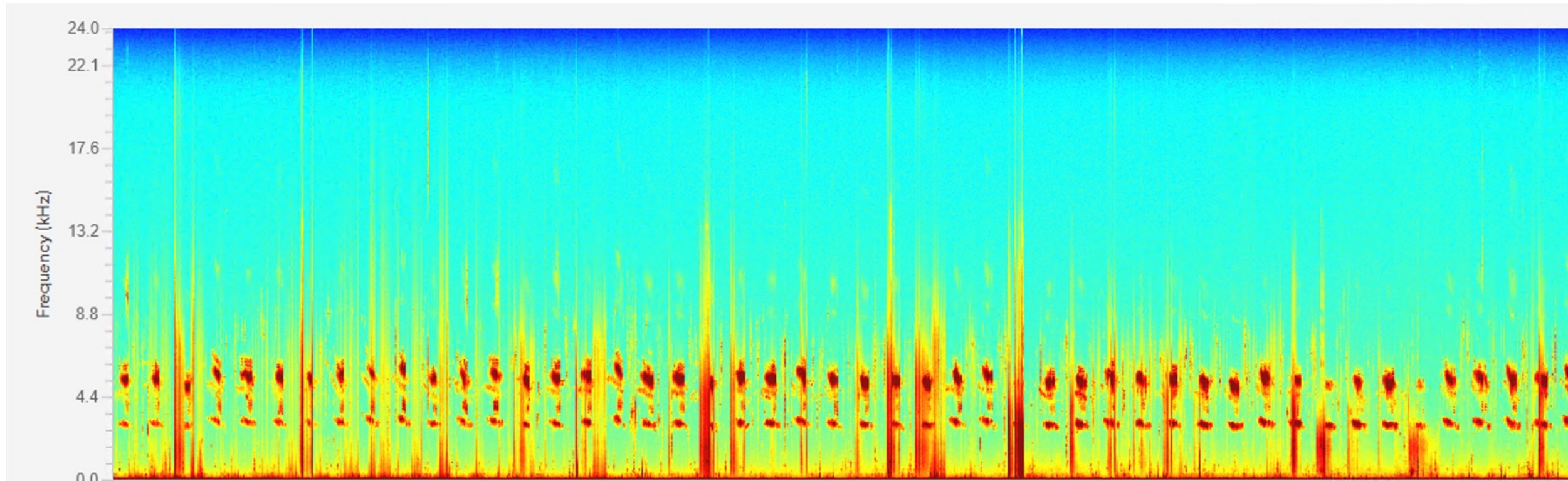


Why?

- High-level view of the entire dataset
- Quickly find areas of interest in large data sets
- Identify changes in soundscape over time
 - Weather, human activity, physical change

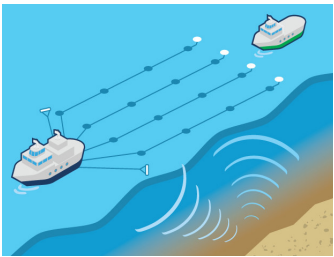




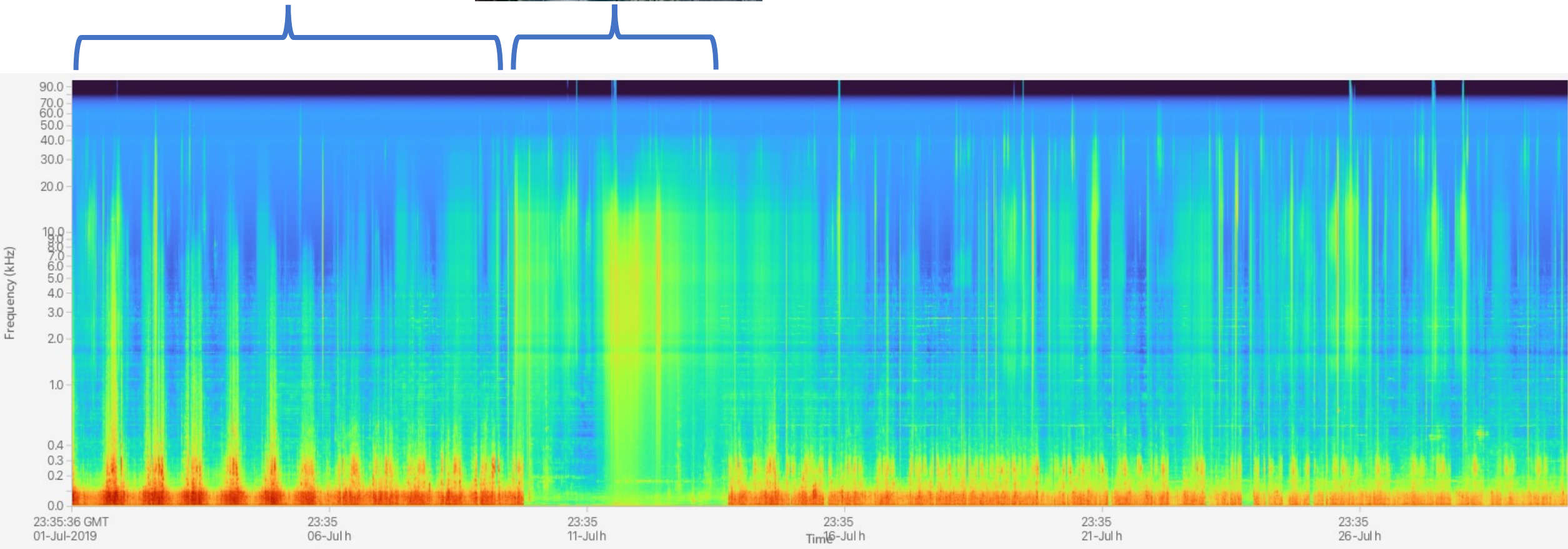


Underwater recording
July 2019, Gulf of Mexico

Seismic survey for oil and gas



Hurricane Barry



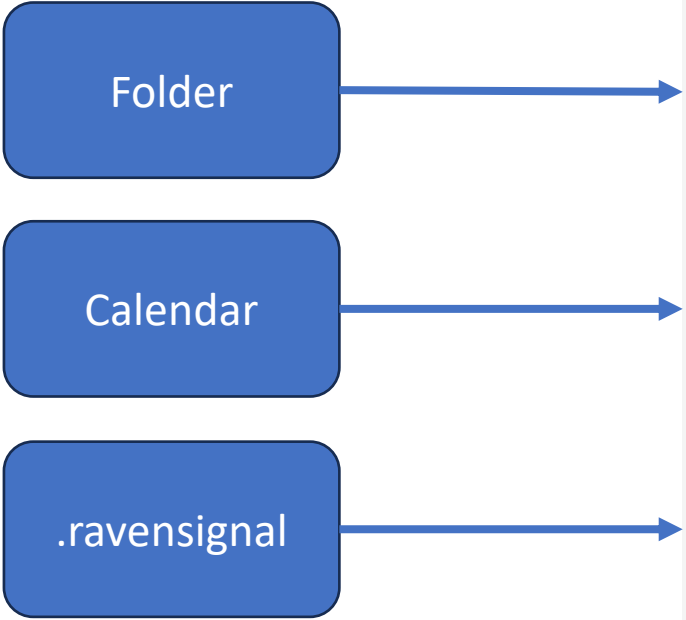


New LTSA

Select Data

Set Options

Calculate



Set up Raven Signal and Configure LTSA Input Parameters

Configure Raven Signal

Root Path: /Users/bwt28/Desktop/Workshop Drive/PantanalData 2023
Number of Files: 577
Type: wav
Encoding: 16-bit Signed Integer PCM
Channels: 1
Signal Start Time: 2023-11-02 00:00:00 Z
Duration of Raw Audio: 9 hours 36 minutes 53 seconds
Duration (with Padding): 9 hours 36 minutes 53 seconds
Sample Count: 1,526,455,808
Sample Rate: 44100.0
Pad Gap: false

☒ Use file timestamps for real time axis labels

Timestamp Format: <YYYY><MM><DD>_<HH><mm><SS>

File Name: INCT-P0_20231102_000000.wav

Example Start Time: 2023-11-02T00:00Z

Signal start time reference: 11/2/2023 0 Hours 0 Minutes 0 Seconds

☐ Pad Gaps

☐ Convert sample rate: Hz

Configure LTSA Input Parameters

Presets: [dropdown]

☒ Save LTSA when finished

Output File: /Users/bwt28/Raven Workbench/Raven Expedition/Ltsa/20240416_165244.ravensita

Time Resolution (s): 2

Frequency Resolution (hz): 20

Axis: ☐ Hybrid-millidecades ☒ Linear

Channel: 1

Memory Usage

Total LTSA Data Size: 76 MB

Cancel OK

LTSA calculation

Averaging data for LTSA frames

Calculating 22.0 %, 00:06:51 remaining

Cancel



LTSA

- The LTSA only needs to be calculated once, then it can be saved and opened quickly
- The LTSA file can be opened and shared without the original data set
- If you want to open the Wave/Spectrogram view, you will need the original data



Raven Signal

What is a .ravensignal file?

- List of sound files
- Absolute time references for the beginning and end of each file
- Information about the precise duration of each file



Raven Signal

Data.

Think of it as the signal *source*, or signal *stream*.

00000000	52	49	46	46	26	41	07	00	57	41	56	45	66	6d	74	20	RIFF&A..WAVEfmt
00000010	10	00	00	00	01	00	01	00	44	ac	00	00	88	58	01	00D...X..
00000020	02	00	10	00	64	61	74	61	02	41	07	00	d1	ff	dc	ffdata.A.....
00000030	eb	ff	00	00	18	00	33	00	4a	00	4b	00	36	00	28	003.J.K.6.(.
00000040	2f	00	42	00	39	00	23	00	19	00	0c	00	0e	00	fd	ff	/.B.9.#.....
00000050	e4	ff	e8	ff	f4	ff	02	00	07	00	14	00	19	00	18	00"
00000060	15	00	11	00	1a	00	20	00	22	00	1f	00	1c	00	18	00#.7.B.;.%.....
00000070	16	00	23	00	37	00	42	00	3b	00	25	00	07	00	f9	ff%.'.
00000080	ea	ff	d9	ff	de	ff	e4	ff	e7	ff	f6	ff	03	00	0a	00 +.1.,...4.,...
00000090	0f	00	15	00	0e	00	12	00	17	00	1a	00	25	00	27	00
000000a0	2b	00	31	00	2c	00	2e	00	2e	00	34	00	2c	00	1e	00
000000b0	12	00	09	00	10	00	11	00	0d	00	06	00	fe	ff	f7	ff
000000c0	03	00	1a	00	1f	00	1a	00	1a	00	16	00	09	00	03	00
000000d0	03	00	10	00	18	00	1a	00	1e	00	18	00	12	00	0c	00
000000e0	05	00	ff	ff	fe	ff	03	00	09	00	0b	00	15	00	17	00&.#.&.".....
000000f0	1d	00	26	00	23	00	26	00	22	00	1d	00	1b	00	16	00	





Calculation Speed

We usually use large datasets (months, years)

6 months of continuous data @ 48KHz is **440GB**

That much data will take ~ 10 hours to process

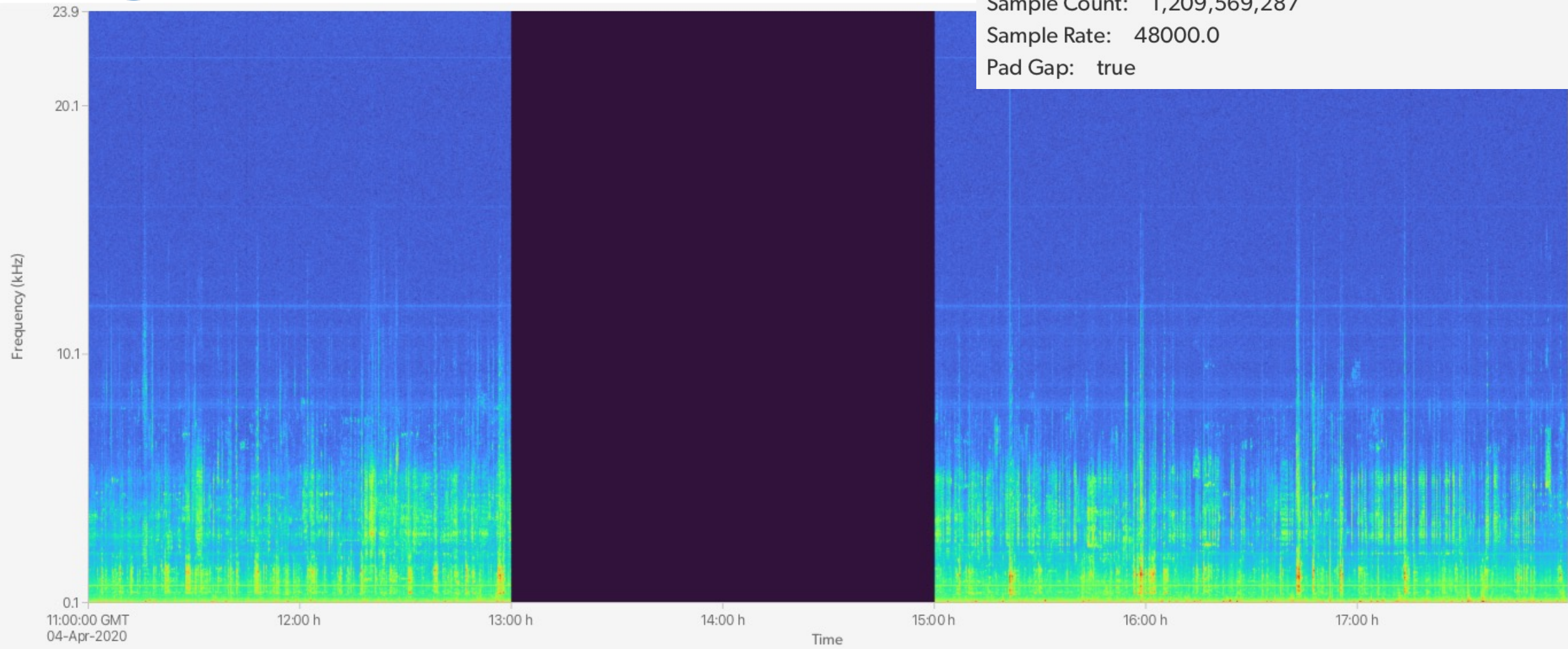


Gaps



Pad Gaps

Signal Start Time: 2020-04-04 11:00:00 Z
Duration of Raw Audio: 4 hours 59 minutes 45 seconds
Duration (with Padding): 6 hours 59 minutes 59 seconds
Sample Count: 1,209,569,287
Sample Rate: 48000.0
Pad Gap: true





Duty Cycle Recordings

Signal Start Time: 2022-11-05 07:15:00 Z
Duration of Raw Audio: 15 hours 31 minutes 49 seconds
Duration (with Padding): 9 days 16 hours 45 minutes 59 seconds
Sample Count: 36,954,035,504
Sample Rate: 44100.0
Pad Gap: true



Pad Gaps **High duty cycle. Padding is not recommended.**

▼ Memory Usage

Total LTSA Data Size: 915 MB



Duty Cycle Recordings

The axis can be configured to display absolute time for duty cycle recordings


Search

▼ Axis

File Boundaries Color Magenta

Max Number of File Boundaries

Show File Boundaries ☐

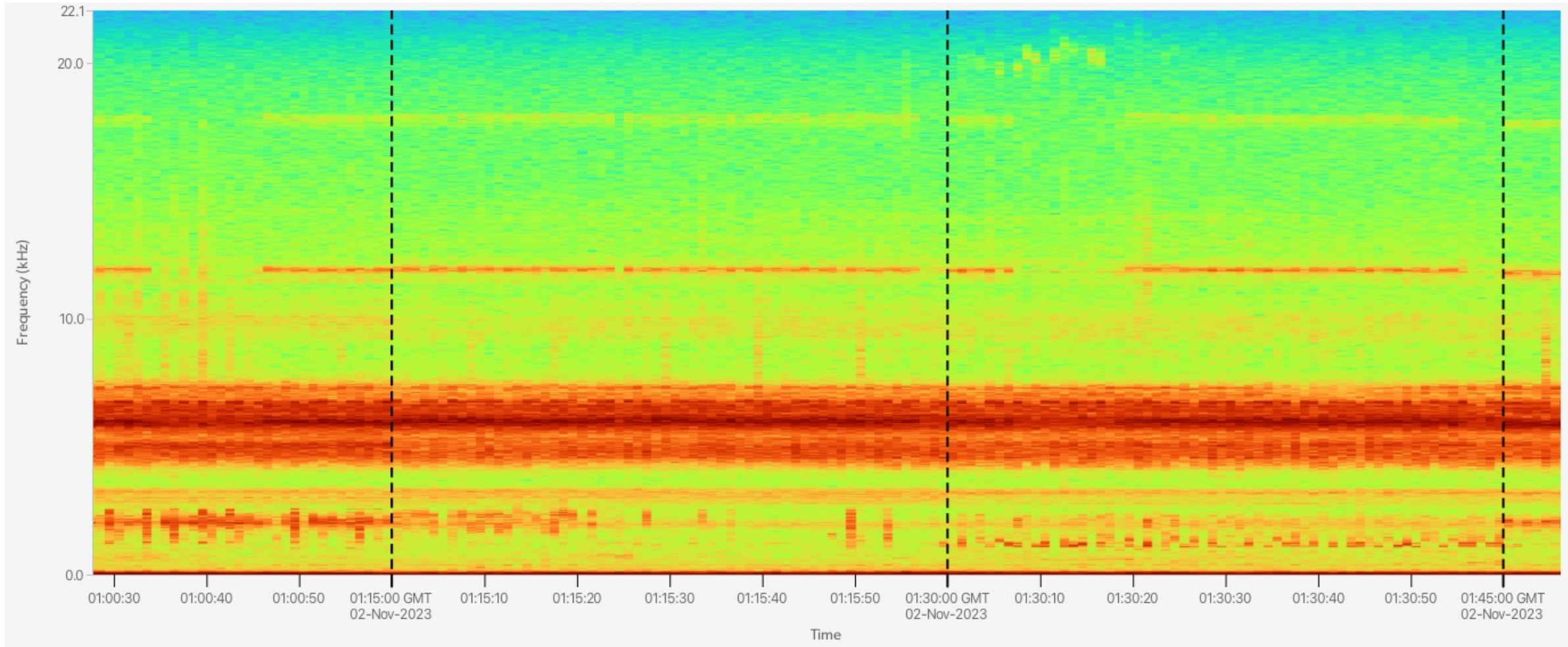
Use Duty Cycle Axis ☒ 

► General Options

► Views



X axis labels will indicate absolute time and date





Time and Frequency resolution

- Time Resolution determines the length of each LTSA frame
- Frequency Resolution determines the height of each frequency bin
- Both values impact the size of the LTSA file
(smaller numbers → bigger file)

Time Resolution (s):

Frequency Resolution (hz):

Axis:

☐ Hybrid-millidecades ☒ Linear

Channel



Axis types

Linear

- Set the size of the frequency bins directly

Hybrid Milli-decade

- Linear from 0-435 Hz, Logarithmic above 435 Hz
- Recommended for high frequency sample rates (≥ 96 kHz)
- Keep low frequency detail with *much* smaller LTSA size

Time Resolution (s) :

Frequency Resolution (hz):

Axis:

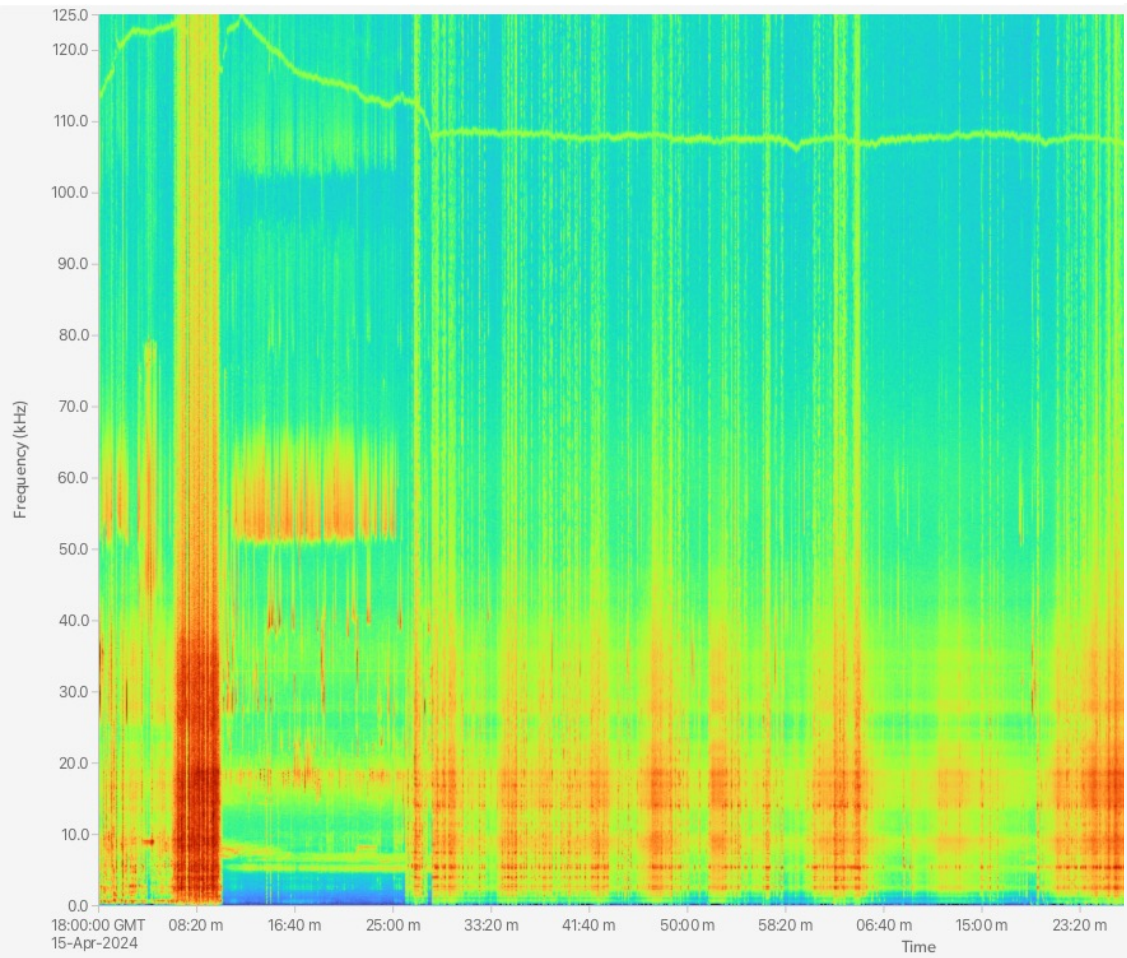
☐ Hybrid-millidecades ☒ Linear

Channel

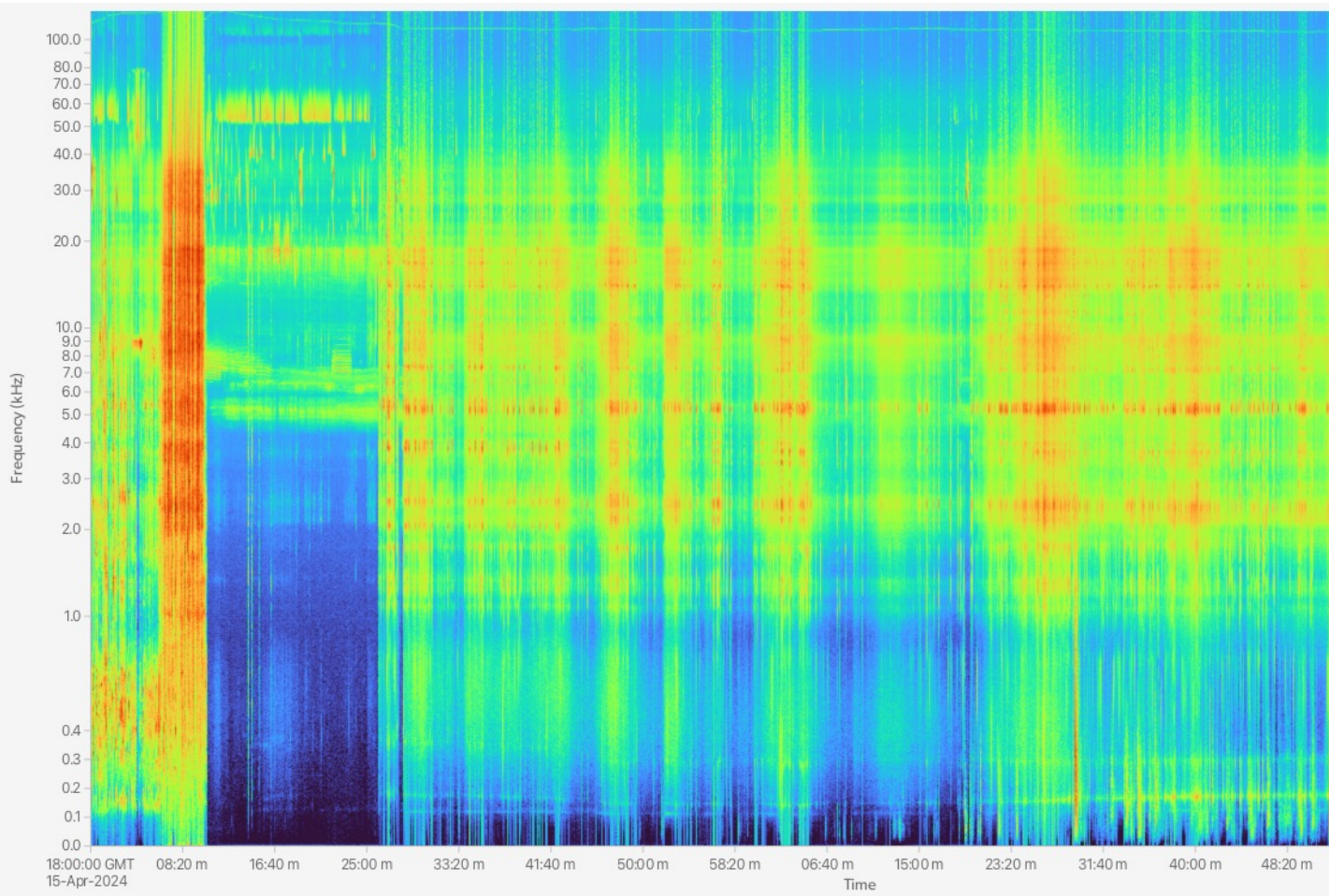


Axis types

Linear – 10Hz bins, 168MB



Hybrid milli-decade – 16MB





Demonstration

- Generate LTSA from signal
- Generate LTSA from calendar
- Wave/Gram view
- Event Table
- Preferences



Timestamp format

Characters not in <> will be matched exactly

<YYYY> or <YY> - year

<MM> - month of year (01 – 12)

<DD> - day of month (01 – 31)

☒ Use file timestamps for real time axis labels

Timestamp Format

File Name

Example Start Time

Signal start time reference

Hours Minutes Seconds



Timestamp format

<HH> - hours (0 – 23)

<mm> - minutes (0 – 59)

<SS> - seconds (0 – 59)

<s> - milliseconds or nanoseconds (.123, .392859230)

<Z> - time zone offset (Z, +0000, -0200, p0030)

☒ Use file timestamps for real time axis labels

Timestamp Format

File Name

Example Start Time

Signal start time reference

Hours Minutes Seconds