HNRAO Observing Log
40.673181 N – 80.437885 W
EN90sq

Date: May 22, 2019

Object: Jupiter – Io-C

Observer: Unattended

Start - Time UT:	**0448**	**Planetary K-index:**	
Jupiter Altitude (deg):	**20.9**	**Jupiter Azimuth (deg):**	**150.4**
Jupiter CML:	**263.95**	**Jupiter Io Phase:**	**235.16**
Jupiter RA (hr/min):	**17:24**	**Jupiter Dec (hr/min):**	**-22.:35**
Hour Angle (hr/min):	**-2:00**	**Polarization**	**LCP**
Sun Altitude (deg):	**-29.2**	**Sun Azimuth (deg):**	**353.0**
Sun RA (hr/min):	**03:47**	**Sun Dec (hr/min):**	**19:56**

End – Time UT:	**0717**	**De:**	**-2.8**
Jupiter Altitude (deg):	**26.4**	**Jupiter Azimuth (deg):**	**187.6**
Jupiter CML:	**354.04**	**Jupiter Io Phase**	**253.30**
Hour Angle (hr/min):	**00:29**	**Duration (min):**	**189**
Sun Altitude (deg):	**-22.6**	**Sun Azimuth (deg):**	**032.3**
Max Frequency MHz	**24**	**Min Frequency MHz**	**15**

Data from Radio-Jupiter Pro 3.8.2

Observatory Configuration

Spectrograph Receiver	Antenna	Polarization	System Loss	Multicoupler	Multicoupler port	Calibrated
FSX-8S	TFD	RCP LCP	-8.35 dB -7.59 dB	#2 RCP #1 LCP	Port 1 +10dB Port 1 +10dB	Twice daily Twice daily
FSX-2	LWA	RCP/LCP manual select		N/A	N/A	N/A
SDRPlay RSP2	TFD	RCP	-8.35 dB	#2 RCP	Port 2 +3dB	Twice daily
SDRPlay RSP2	TFD	LCP	-7.59 dB	#1 LCP	Port 2 +3dB	Twice daily
JOVE 1	TFD	RCP	-8.35 dB	#2 RCP	Port 3 +3 dB	04/20/2018
JOVE 1	TFD	LCP	-7.59 dB	#1 LCP	Port 3 +3 dB	04/20/2018
JOVE II	Jove dipoles	Linear	-3.66 dB	#3 Linear	Port 4 +3 dB	4/19/2019
SDRPlay RSP1	Experimental*					

JOVE dipoles phased @ 32 degrees for 2018-2019 season
TFD array phased @ 35 degrees for 2018-2019 season
LWA antenna phased @ 35 degrees and orientation for observation: 45 degrees
* Used for testing and evaluating antenna systems
Software Radio Sky Spectrograph 2.8.50
Red = Offline

All times are synced with a local GPS locked NTP server.

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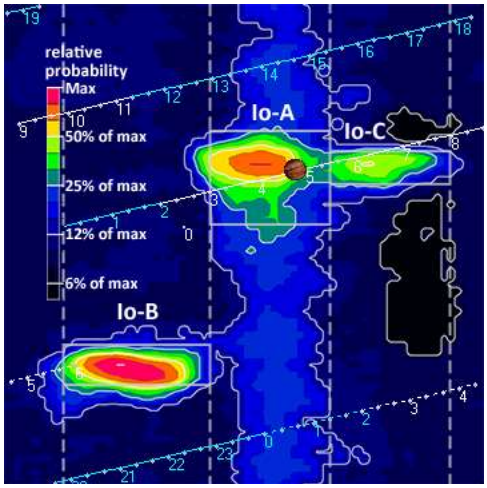
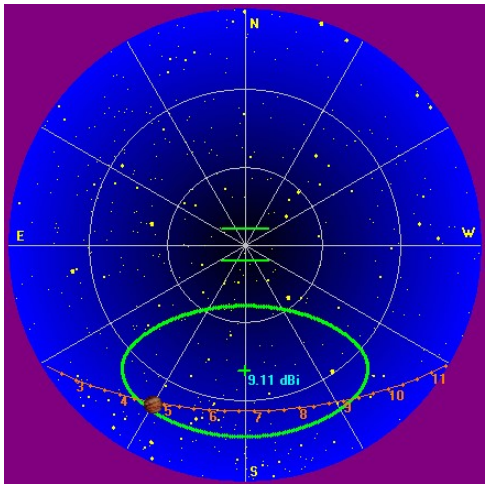
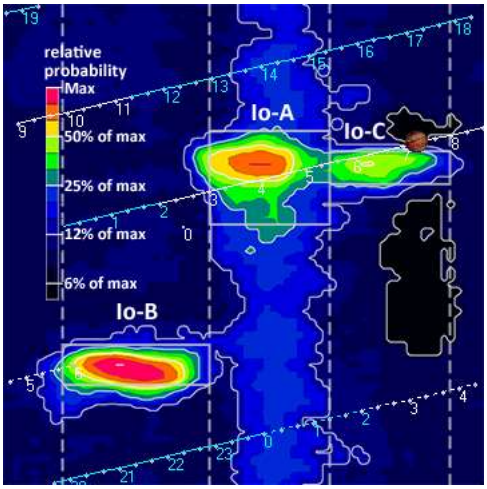
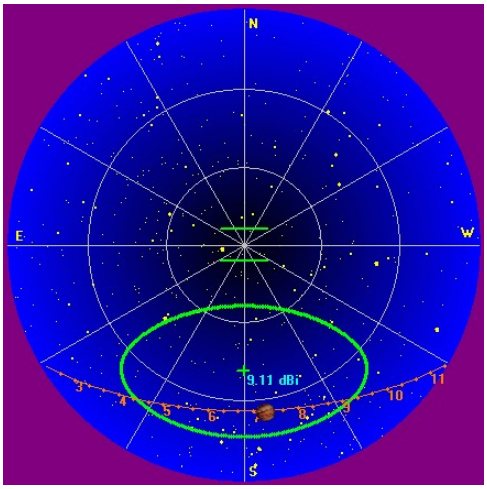




Beginning of Pass





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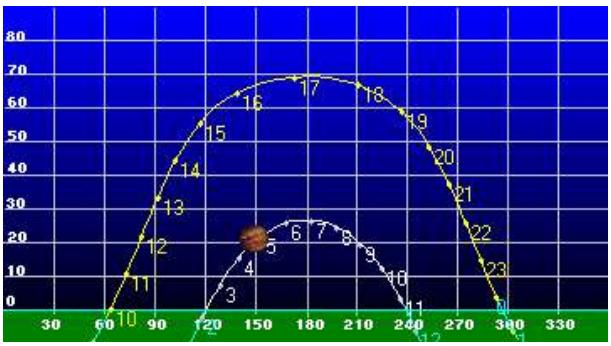

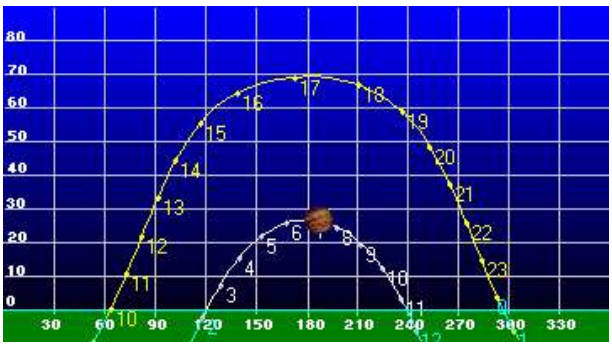

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MODE	CML RANGE	Io RANGE	MAX F	POLAR	ARC	NOTES
Io-D	0-200	95-130	18	LH	Early	Also called "fourth source"
Io-B	(105 - 185)	(80-110)	39.5	RH	Early	Also called "early source"
non Io-B	80-200	0-360	38	RH	Early	Voyager info
Io-A	(200-270)	(205-260)	38	RH	Late	Also called "main source"
non-Io-A	(230-280)	0-360	38	RH	Late	
Io-C	(300-20)	(225-260)	36	RH&LH	Late	Also called "third source"
non-Io-C	300-360	0-360	32	RH&LH	Late	Voyager info

https://www.radiosky.com/jupmodes.html

Modulation Lanes Designations*	
L – Burst	S-Burst
L1 – No lanes	S1 – No lanes
L2 – Positive slope	S2 – Positive slope
L3 – Cross hatched	S3 – Cross hatched
L4 – Negative slope	S4 – Negative slope
*Modulation Lanes in the Dynamic Spectra of Jovian L-bursts, J.J. Riihimaa, Astron. & Astrophys. 4, 1970	

An Io-C storm with a well-defined arc. All spectrographs and JOVE receiver were online and recording data. No known issues with antennas, spectrographs or receiver. There was substantial RFI on the SkyPipe chart. Source unknown.

Earliest emissions at 0447:50 UT between 16 MHz and 17 MHz with negative drift modulation lanes visible. Emissions spanned from 16 MHz through 24 MHz as observed with the SDRPlay RSP2/TFD array, and 15 MHz to 24 MHz with the FSX-8S/TFD array, with the peak frequency at about 0604 UT. The last observed emissions here were at 0717 UT. There are clearly S-bursts in this storm, with some S-burst emissions very strong. It also appears to have an L-burst component, possibly mixed with S-bursts. The resolution of the data makes that determination difficult. There were periods where some modulation lanes were heavily mixed with S-bursts, such as at 0552:40 UT. Looking back over my modulation lane data shows I've never recorded S-burst modulation lanes in this area, and never any S-burst modulation lanes with a negative drift at all. This does not preclude that these are not, in fact, S-burst modulation lanes and will make a note of this for the future.

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The emission group at 0500 UT between 17 MHz and 18 MHz appears to be L-burst with possible S-bursts mixed but resolution makes it uncertain, however, the next grouping between 0501 UT and 0501:10 show an L-burst, S-burst mix. The next significant emission group also show the L-burst, S-burst mix. There are some clearly defined S-bursts between 17 MHz and 18 MHz at 0547:40 UT. These S-burst groups continue at this point. Very strong S-bursts clusters between 18 MHz and 20 MHz at 0552:40 UT. Another group appears at 21 MHz at 055:50 UT. At 0611:45 UT, another strong group of S-bursts centered around 18 MHz. None of these stronger clusters of S-burst show any modulation lanes. Another series of strong S-bursts, again between 17 MHz and 18 MHz starts at 0613:05 UT. Still another period of very strong emissions between 0640:40 UT and 0642:30 UT. The chain of S-bursts at this time might be considered an N-event composed of S-bursts. At 0647 UT, the band of S-bursts that were centering around 17 MHz begin to clearly decrease in frequency, and show dropping below 16.5 MHz and 16 MHz. It's very clear that these emissions drop below 16 MHz. The FSX-8S spectrograph show them as low at 15 MHz.

An interesting note to this storm is where emissions were first detected. With Jupiter CML at 263.95 and Io Phase at 235.16, this places the start of emissions in the defined area of Io-A. Further, the emissions are clearly LCP with Io-A being RCP. Looking over the RCP and LCP data files from 0330 UT through 0430 UT clearly shows exclusively RCP L-bursts and S-bursts. This is clearly the earlier Io-A storm. The emission is weak and sporadic, but in a time comparison between 0330 UT through 0430 UT, of each event in both RCP and LCP, there was no LCP emission. So, it's safe to say that from 0330 UT through 0430 UT, was Io-A and Io-C being early starting at 0448 UT. Any RCP emission past this point appears to be bleed over caused by the hybrid ring.

RFI was very high with the JOVE II / JOVE Dipole array. Despite that, the strong emissions at 0627 UT did rise above the nose and showed a peak of about 760 kK and roughly the same at 0641 UT.

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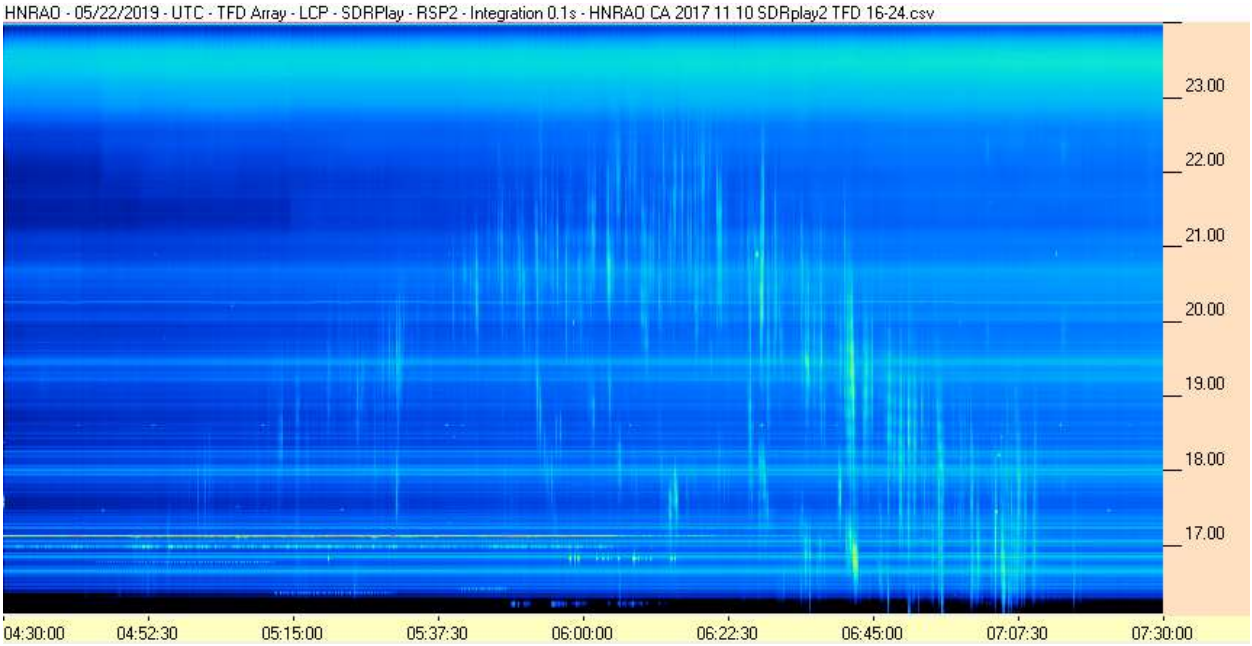
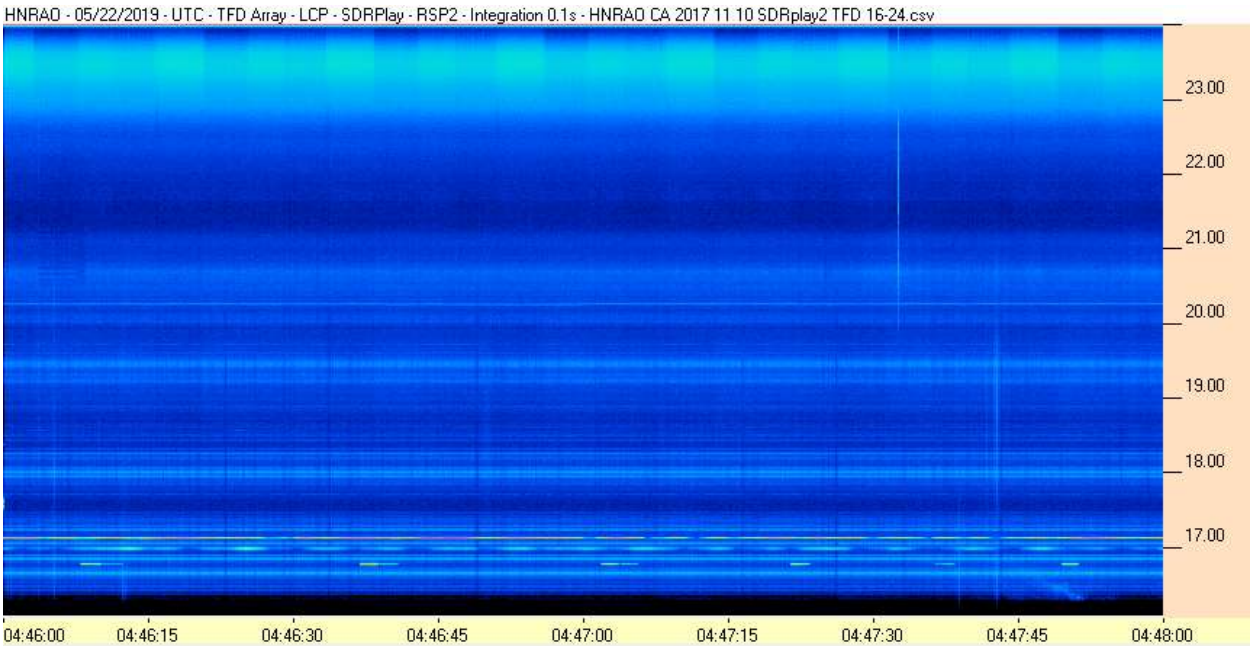
SDRPlay RSP2 / TFD Array





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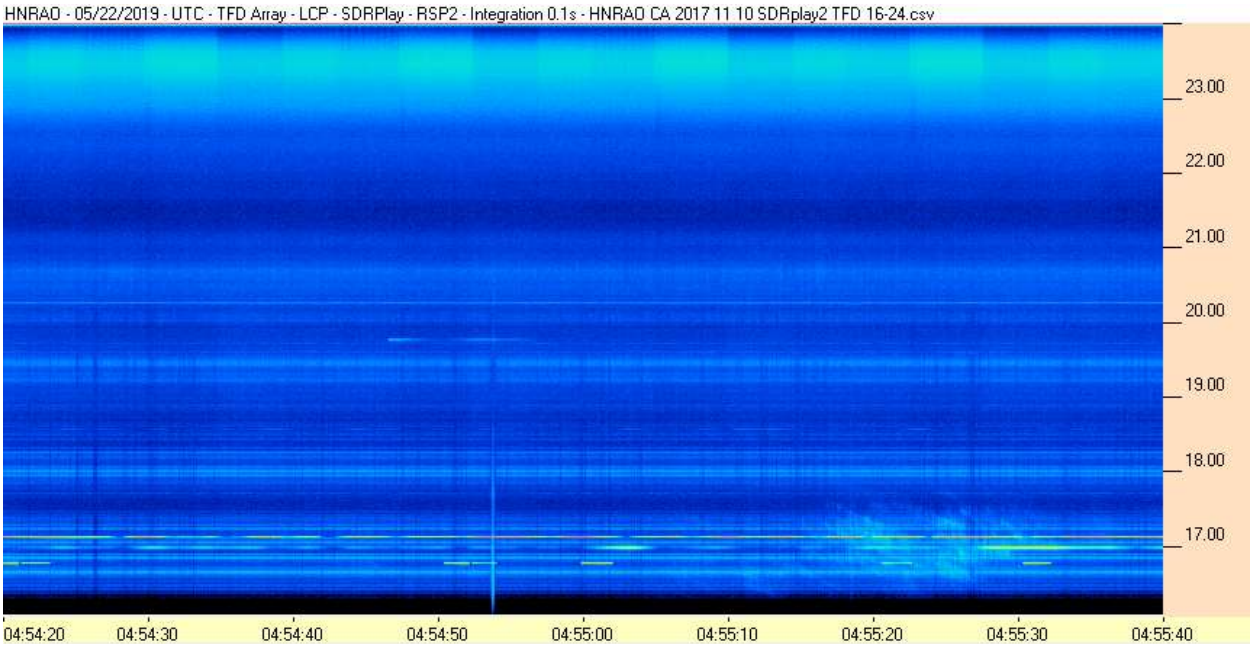
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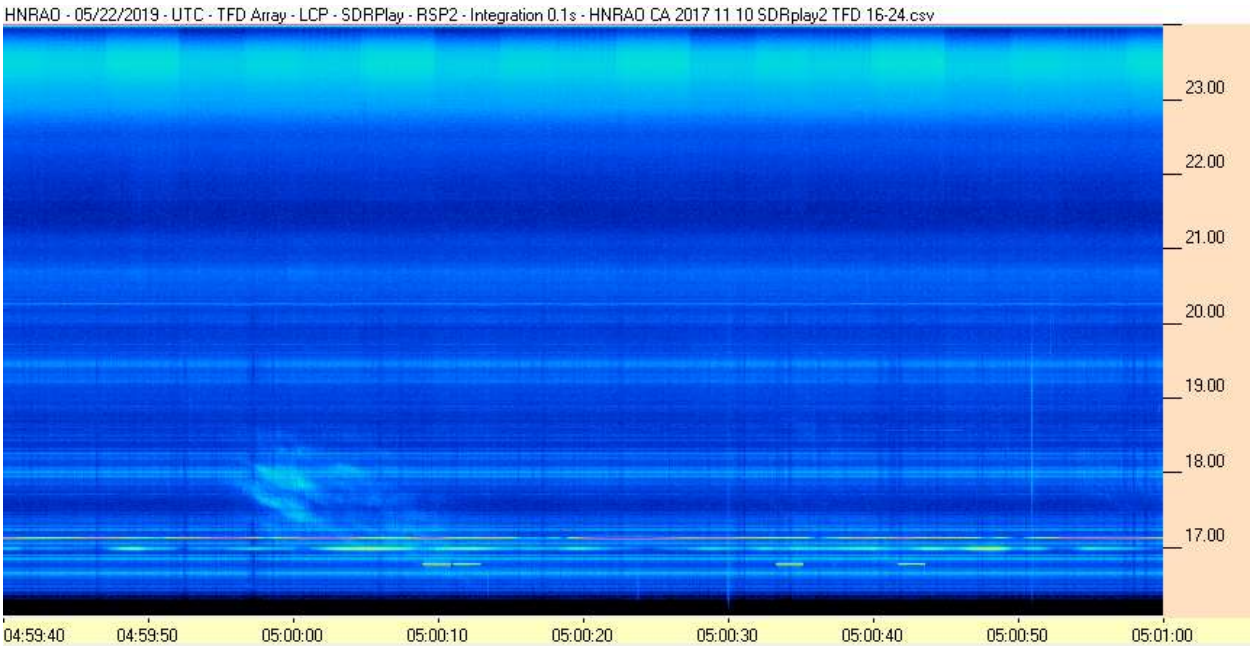
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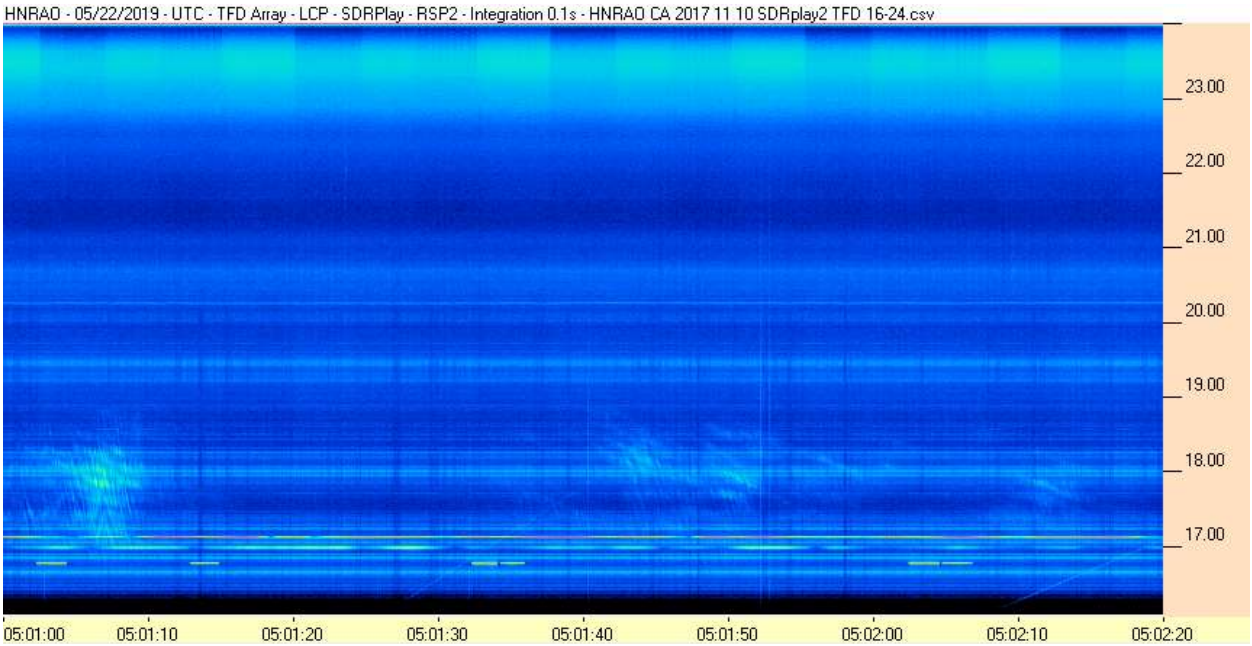
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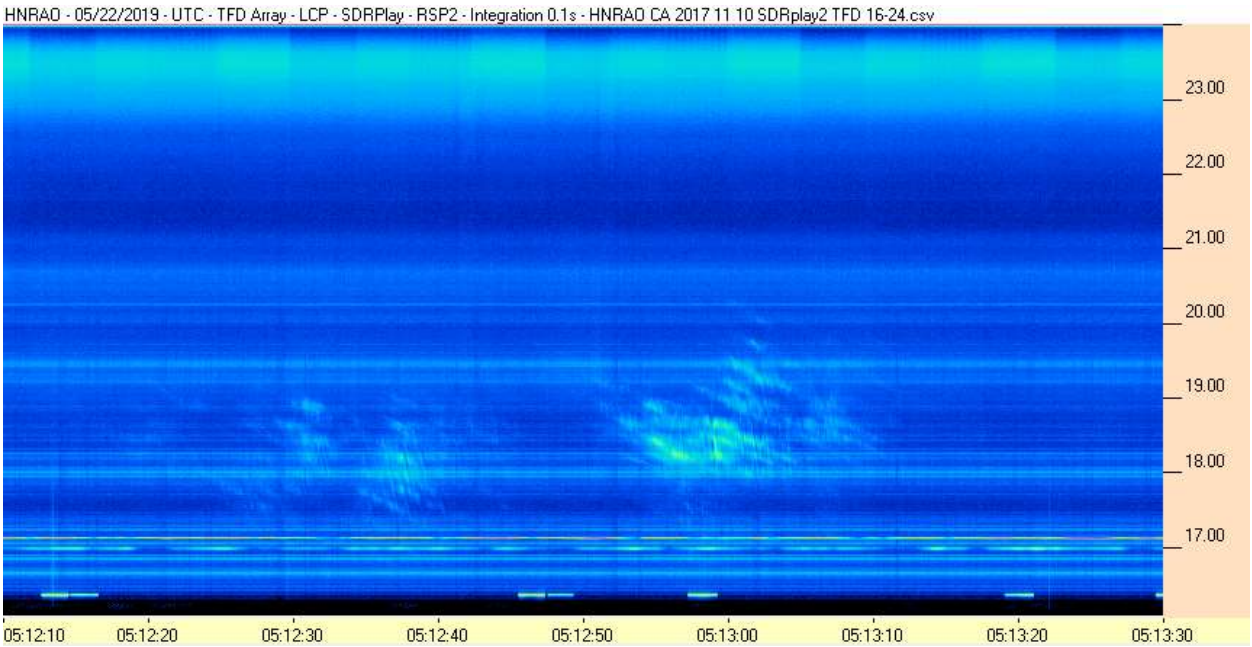
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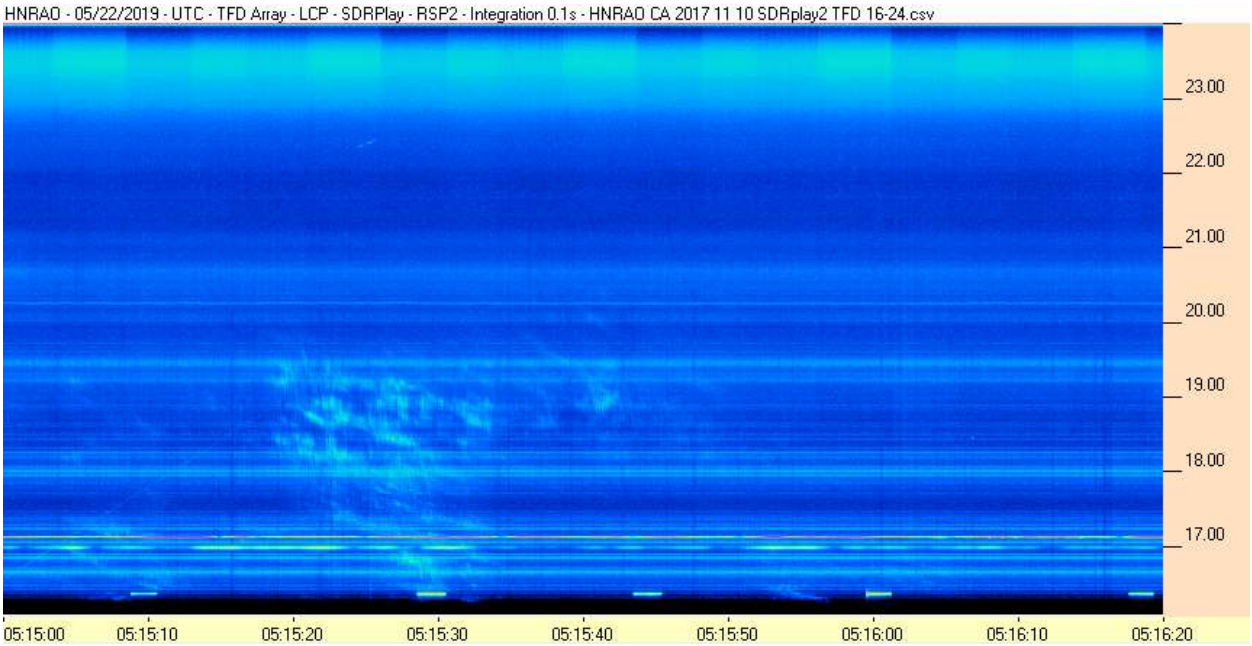
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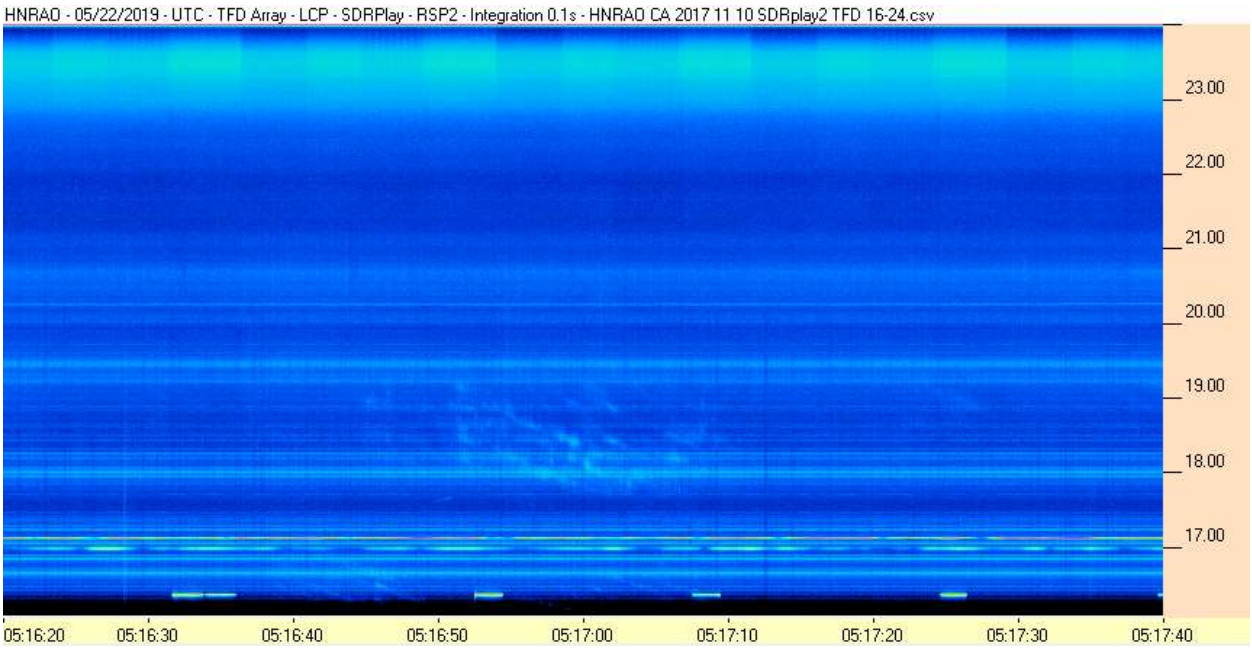
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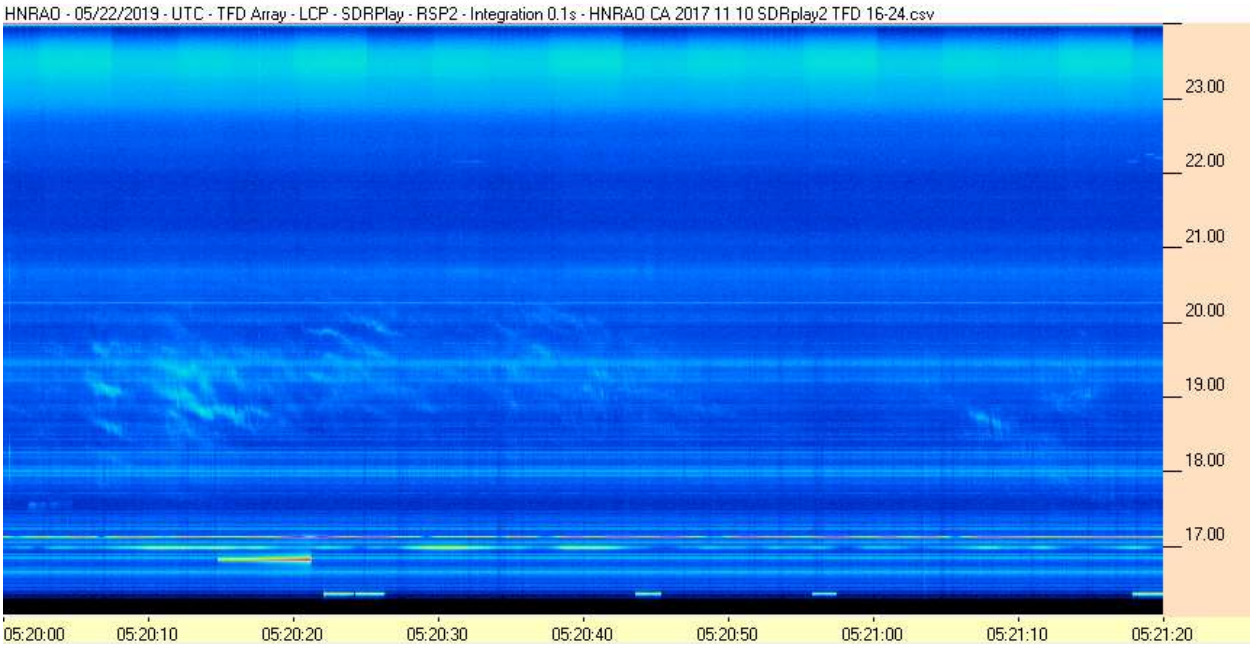
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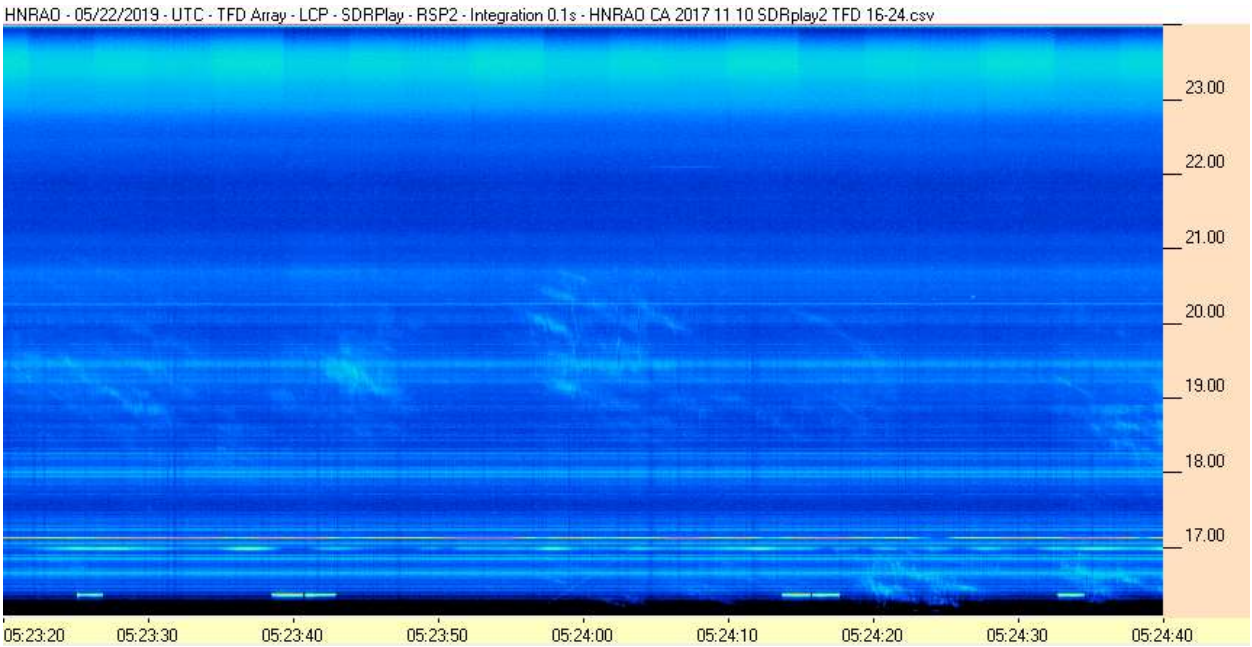
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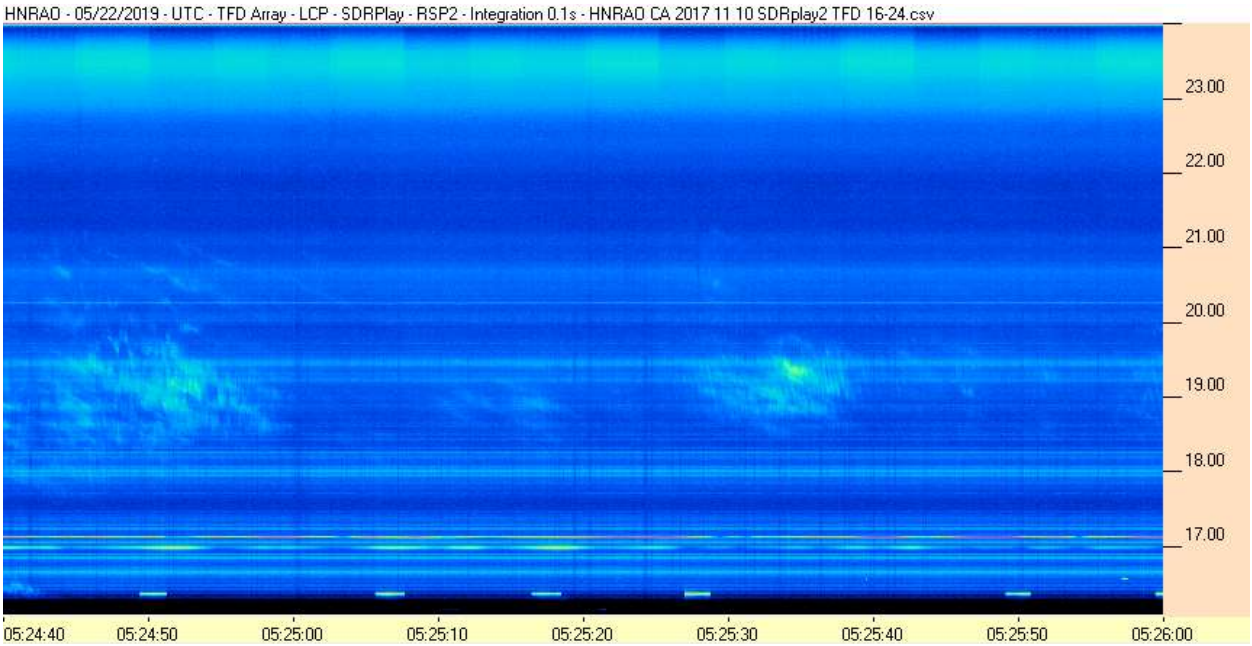
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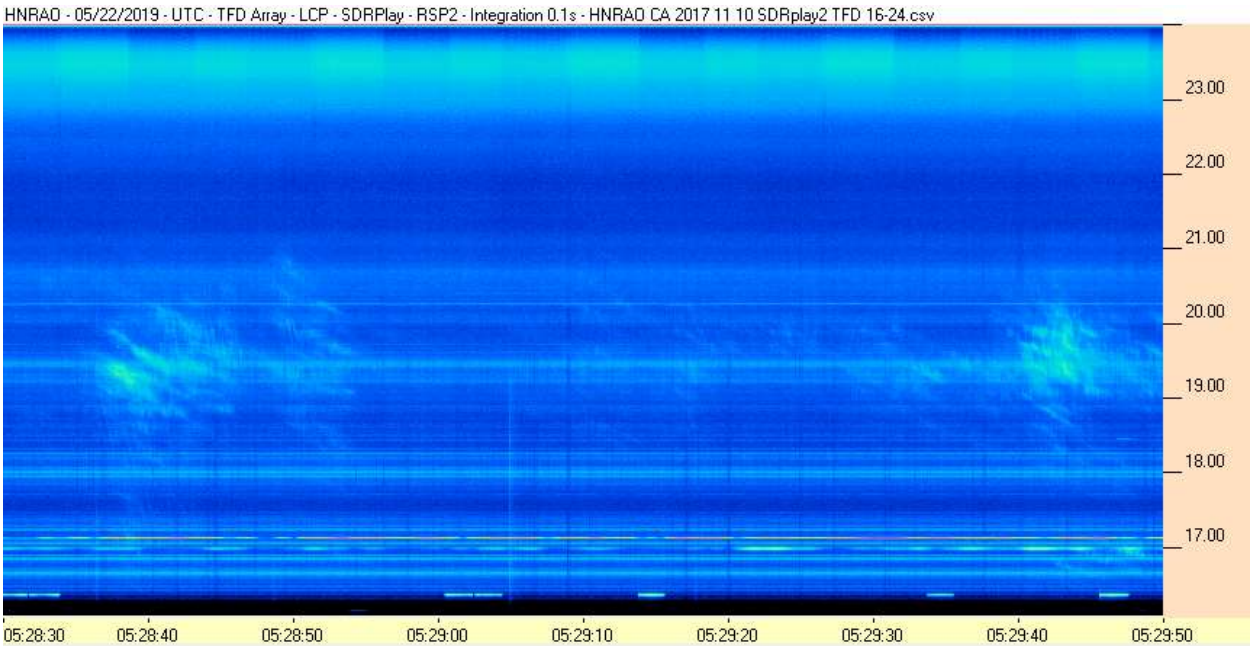
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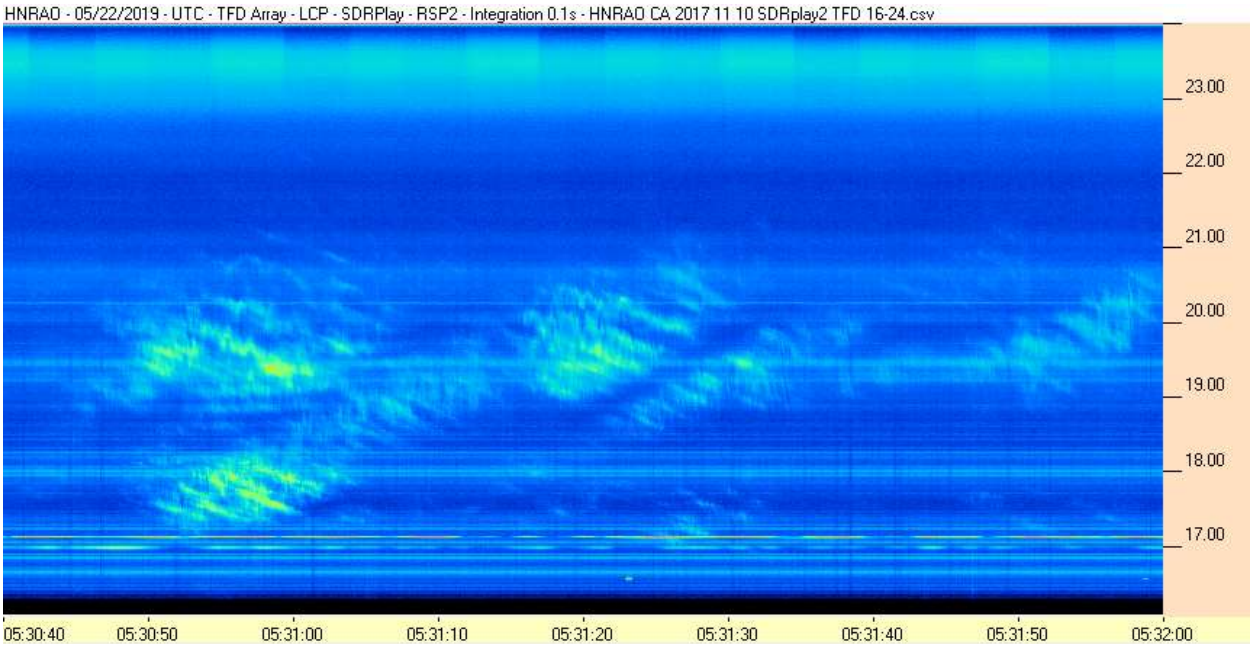
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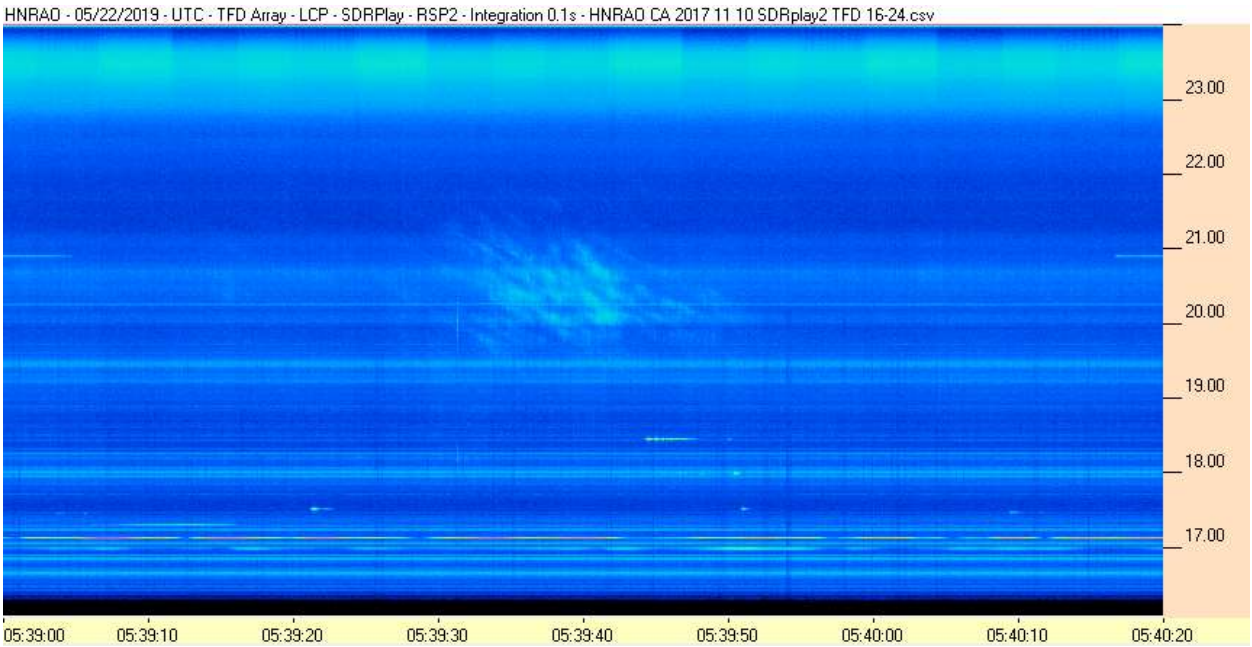
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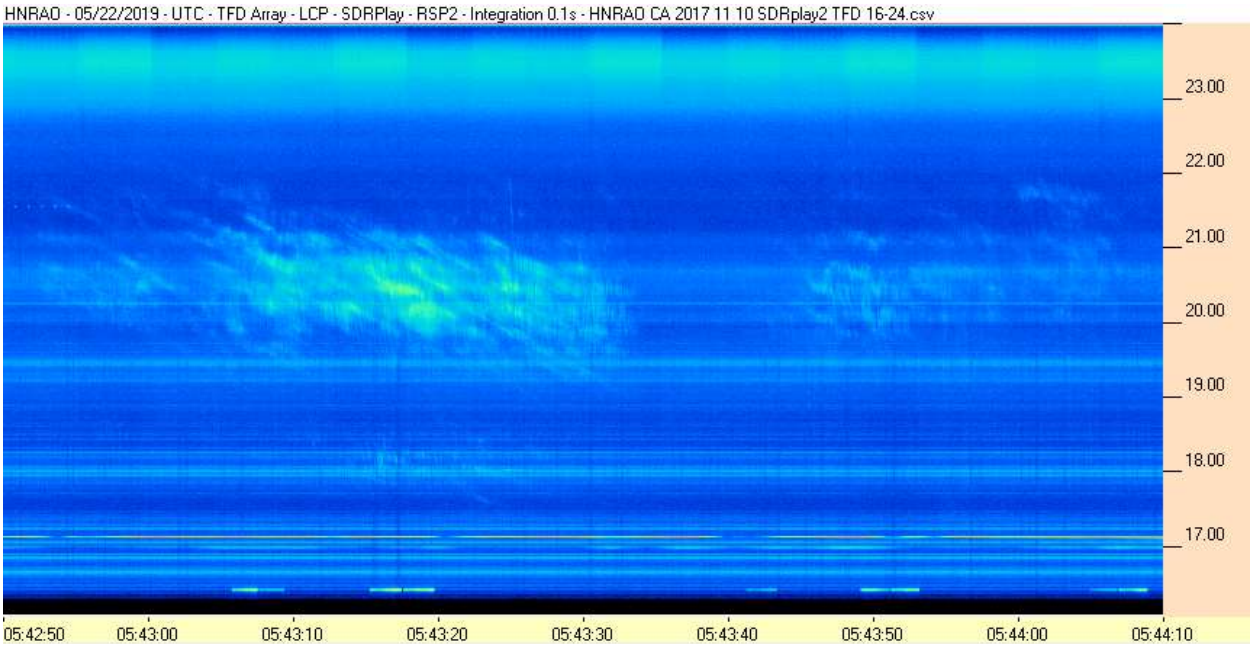
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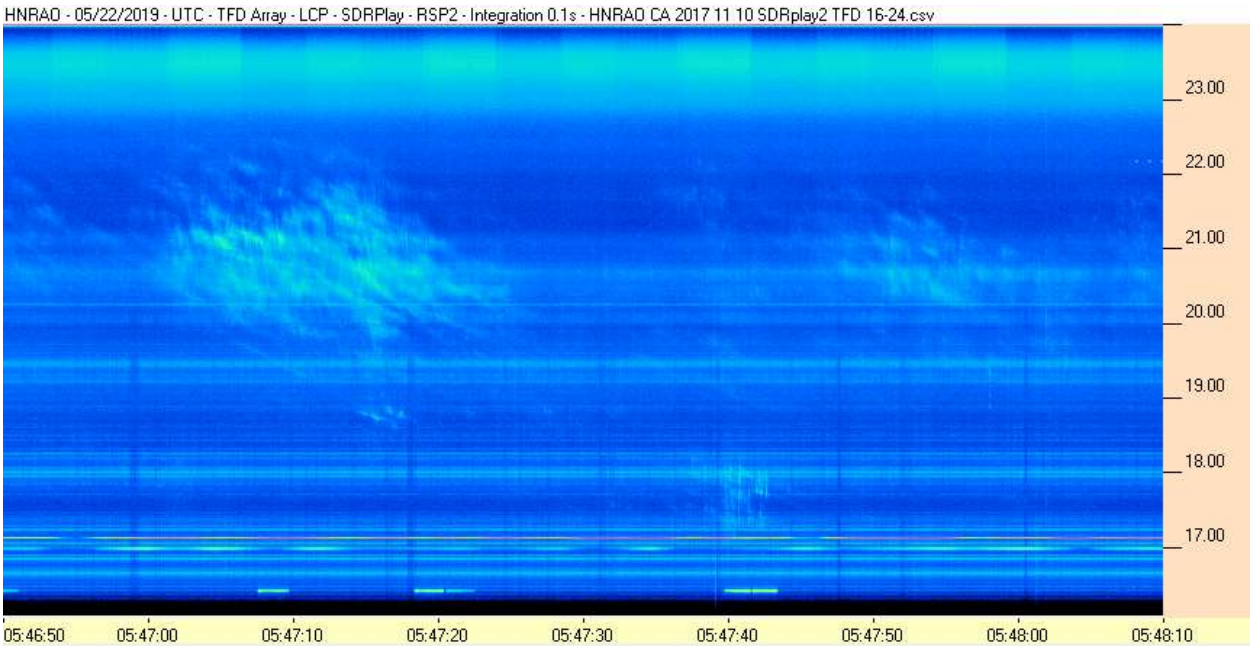
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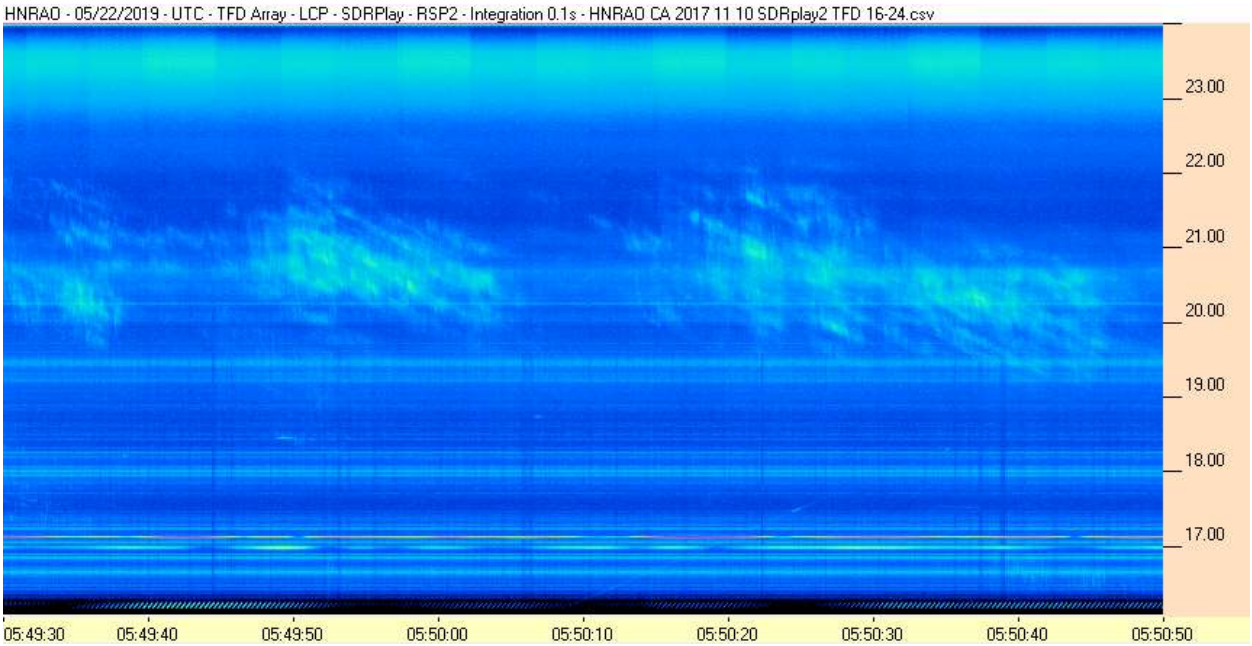
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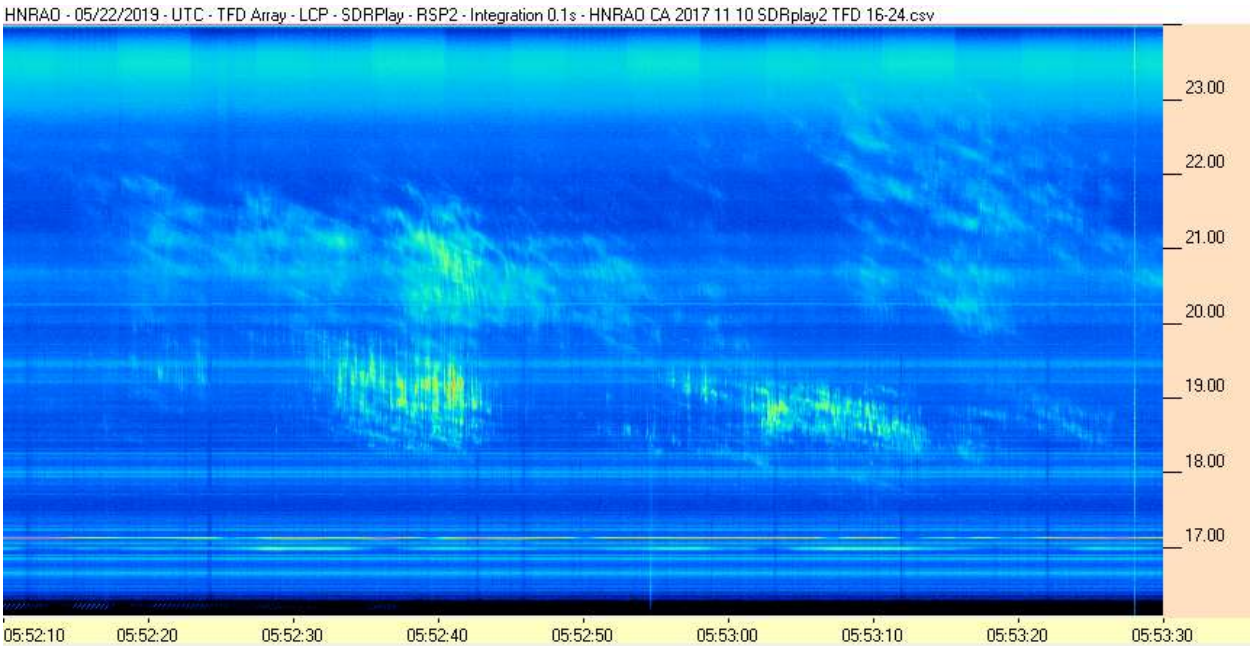
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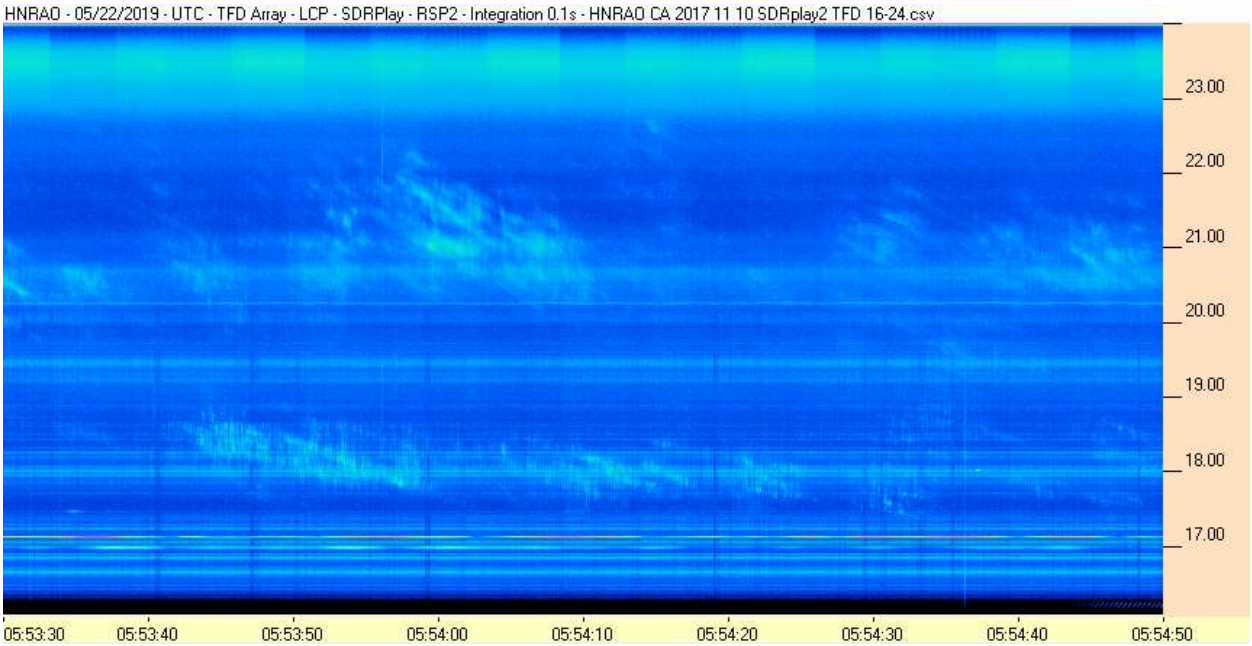
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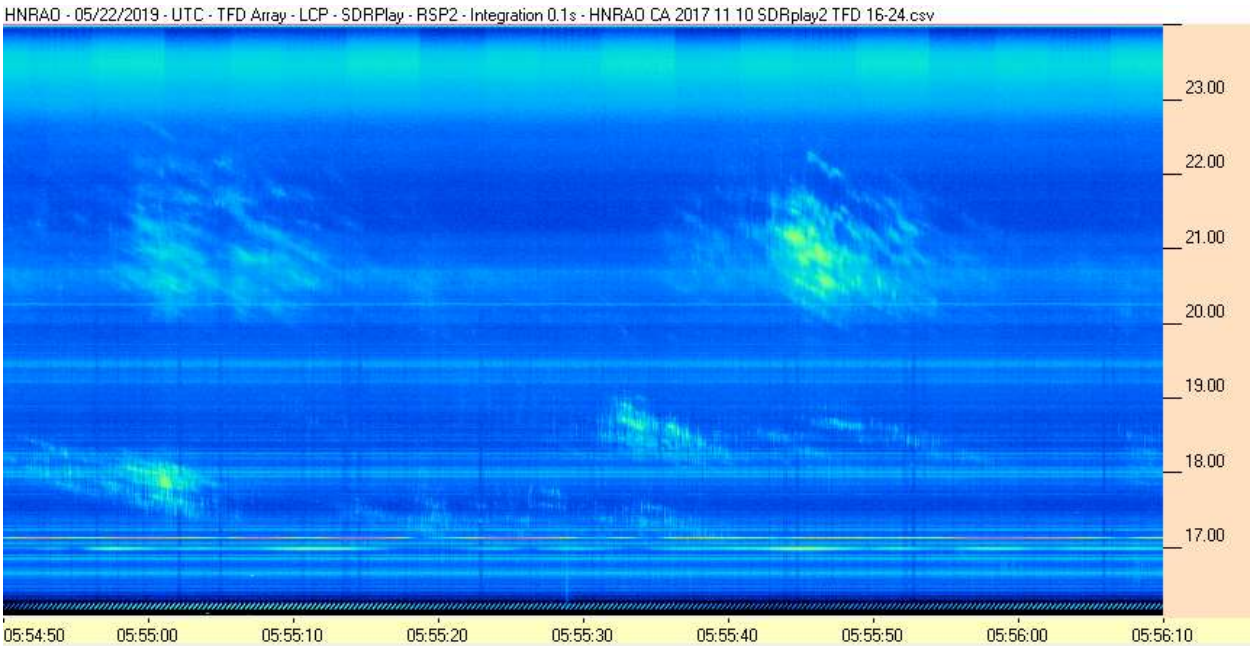
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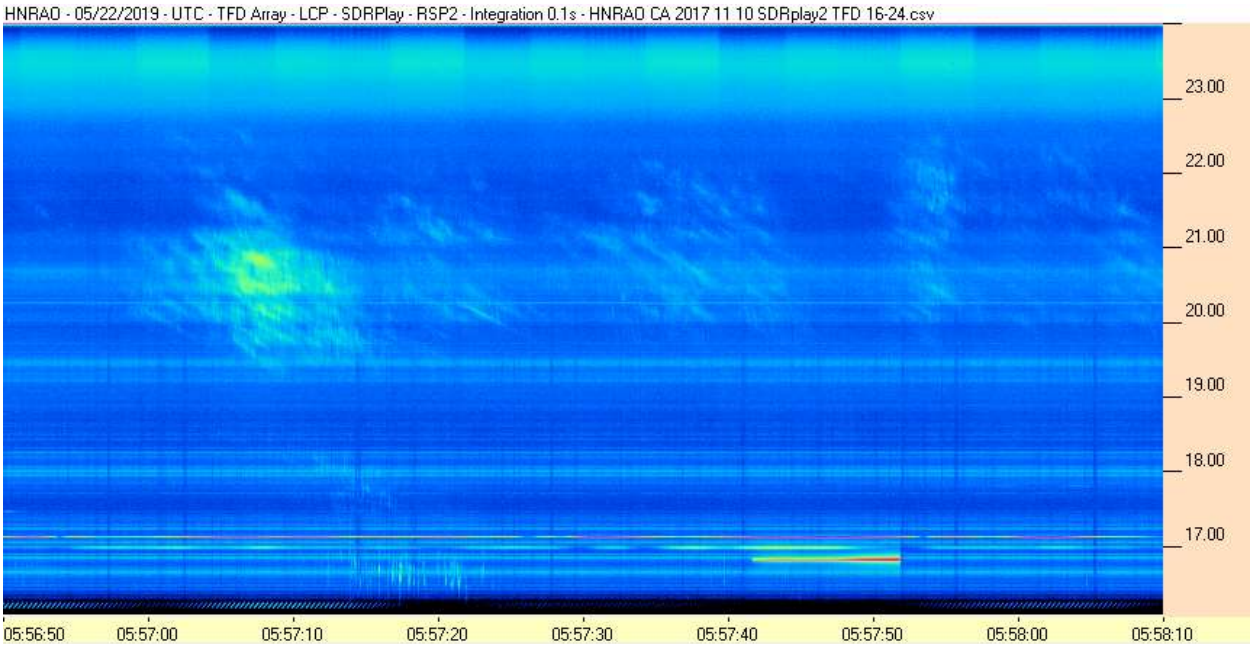
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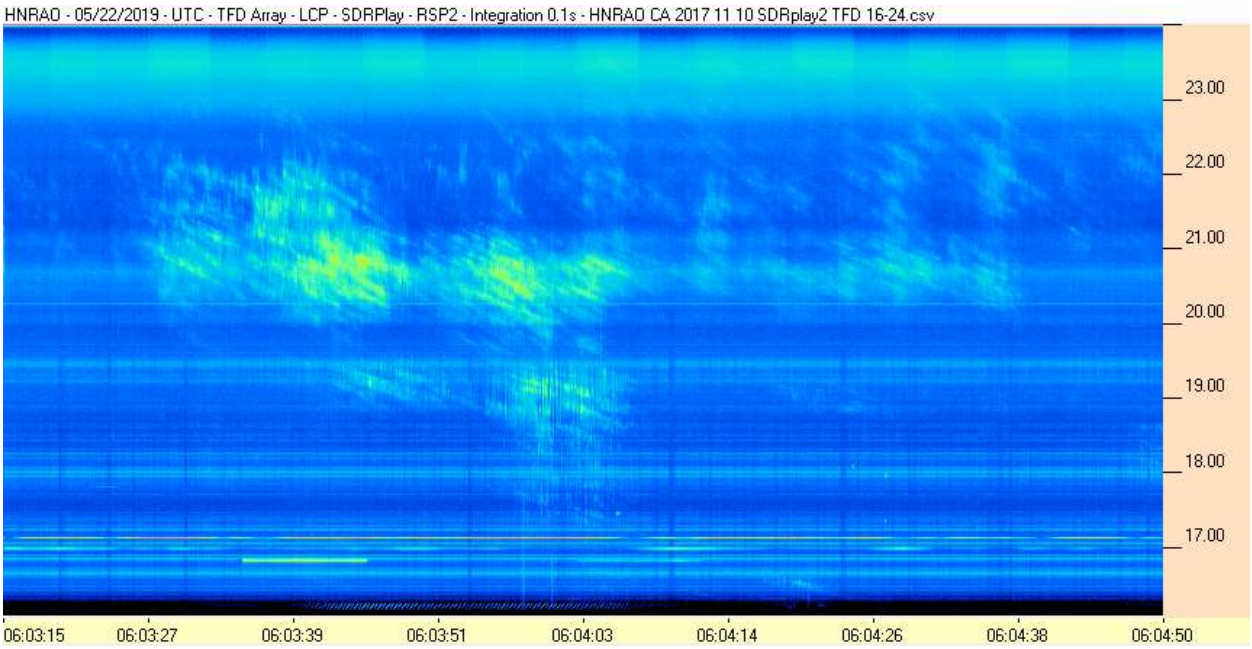
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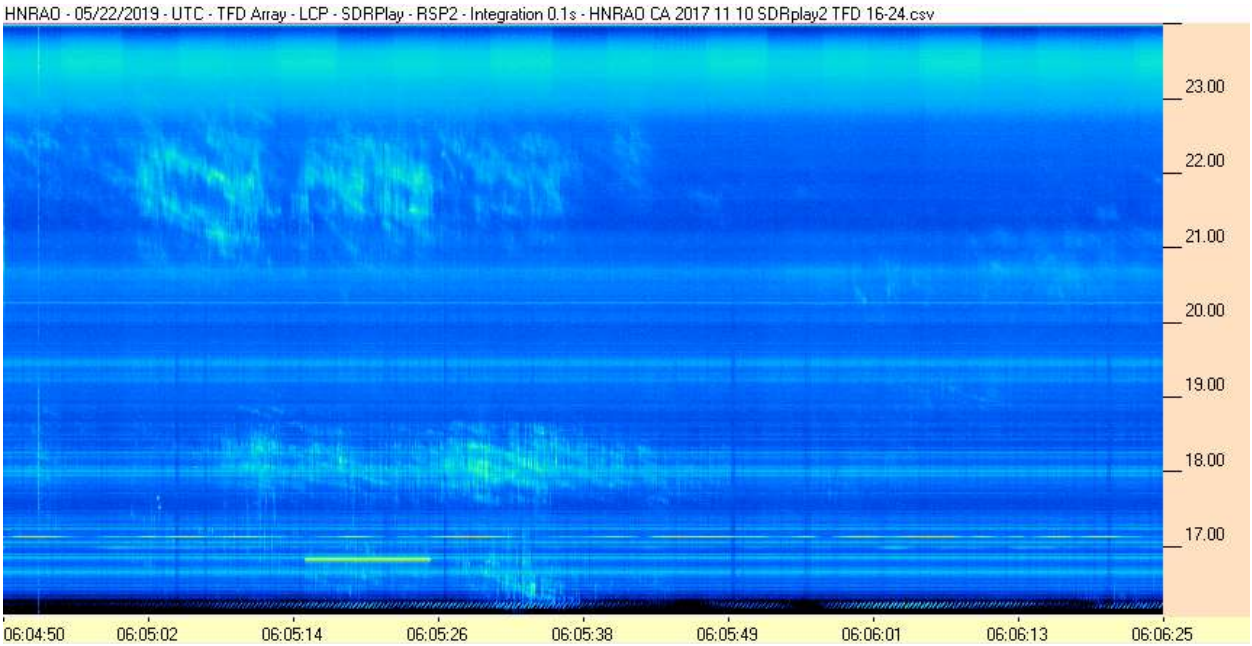
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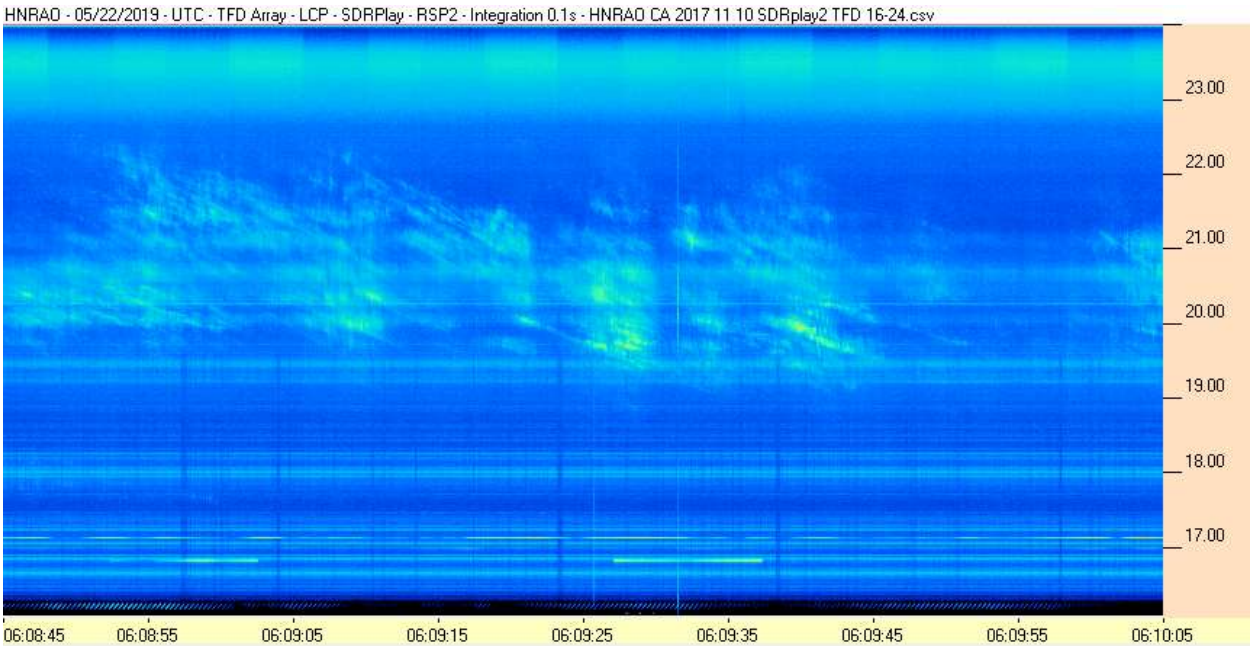
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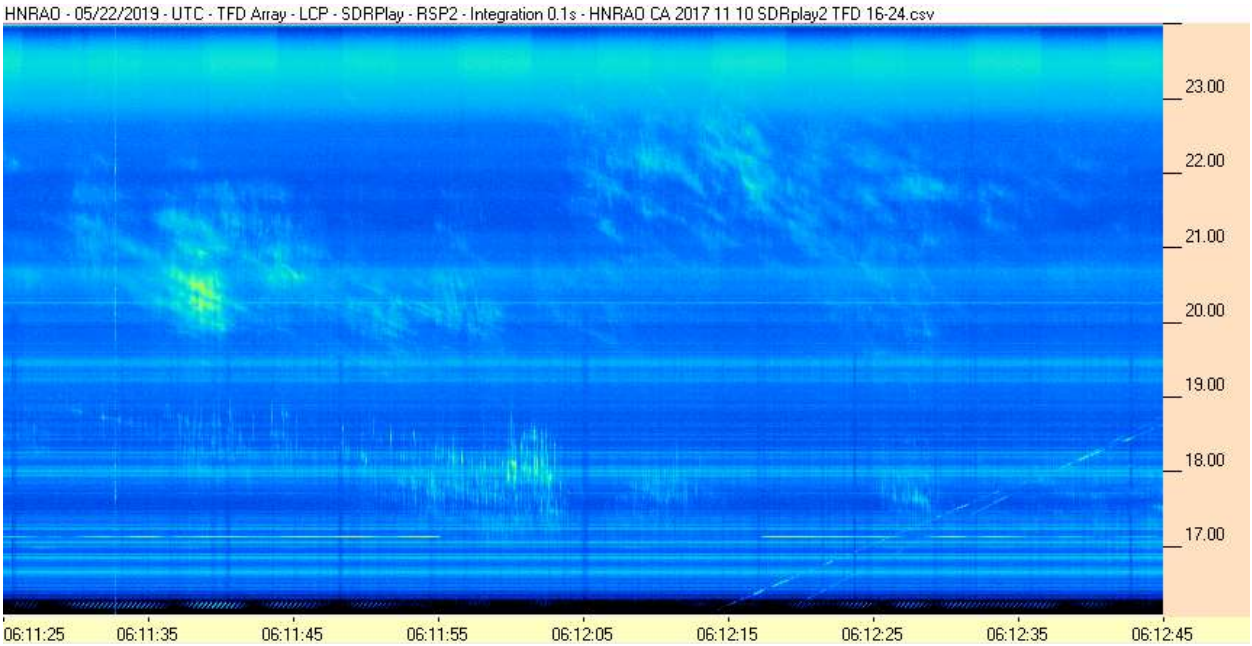
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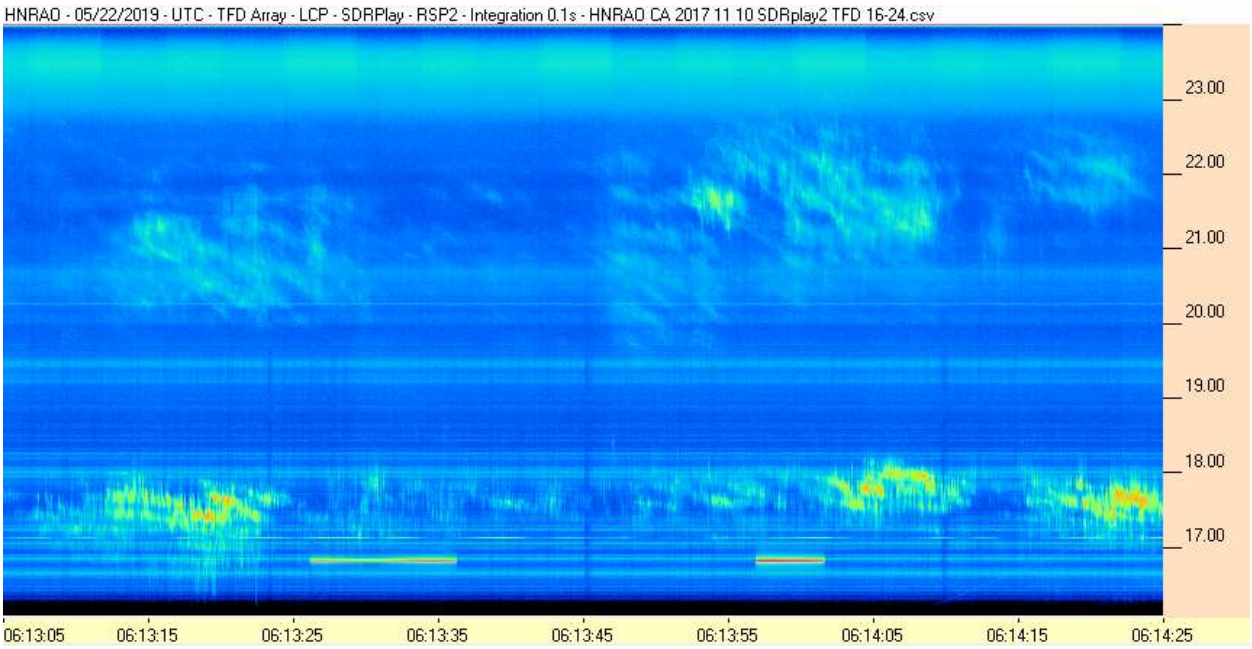
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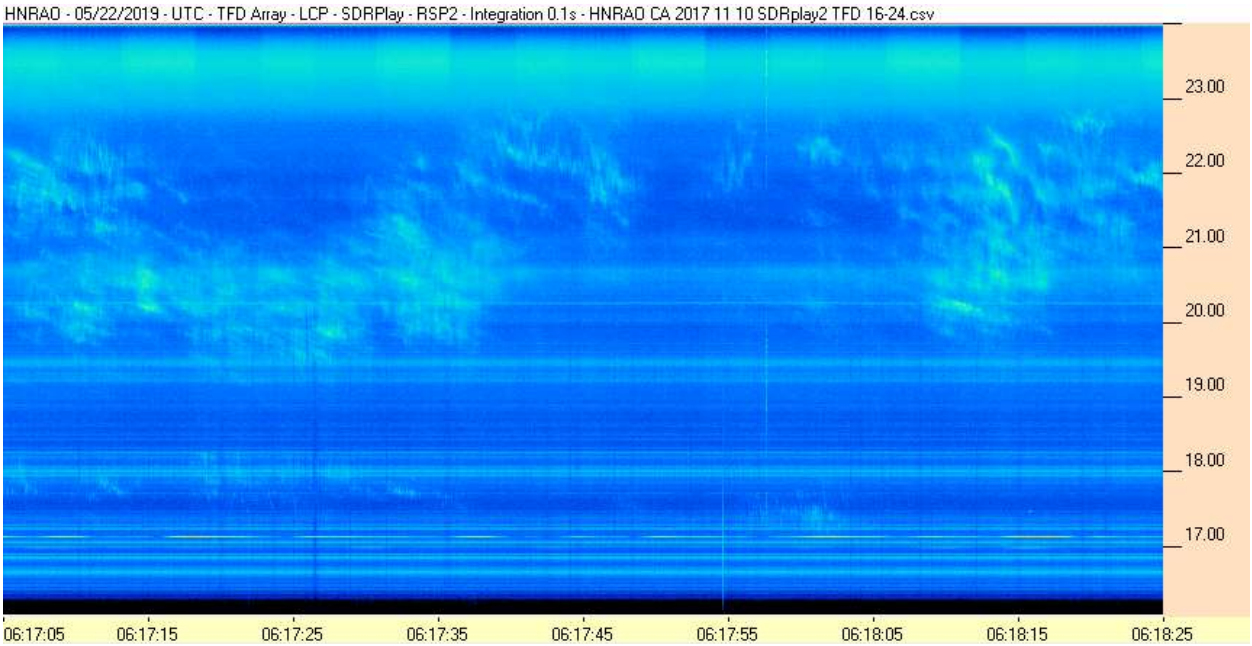
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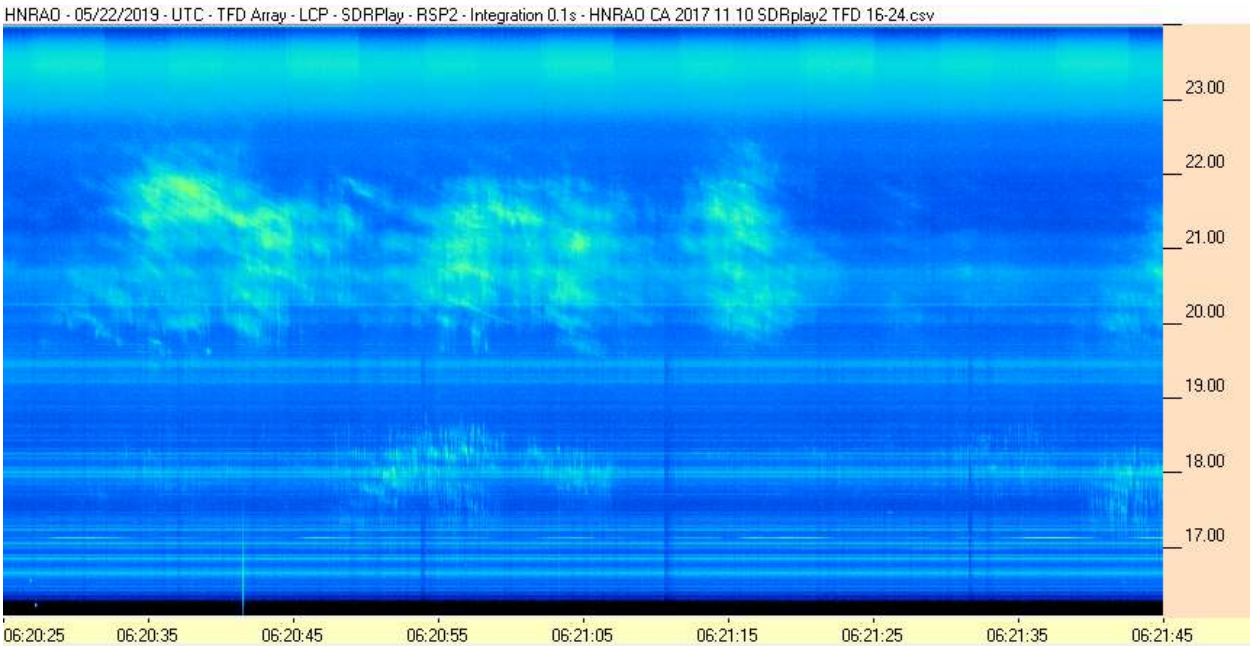
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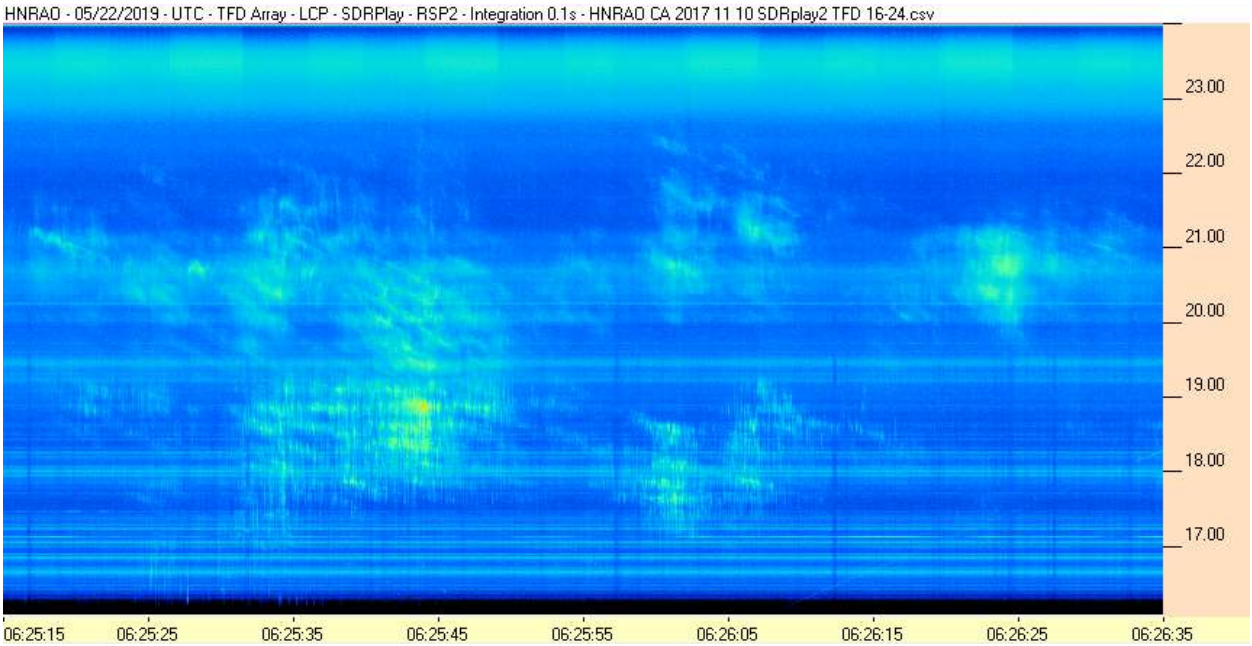
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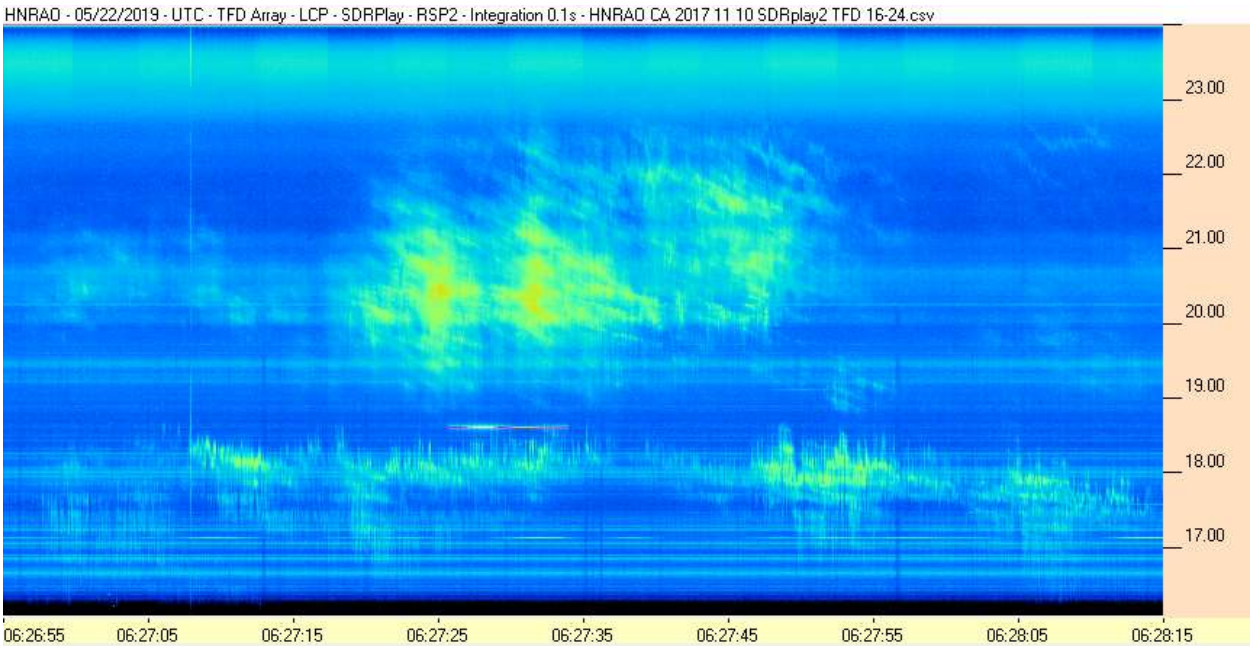
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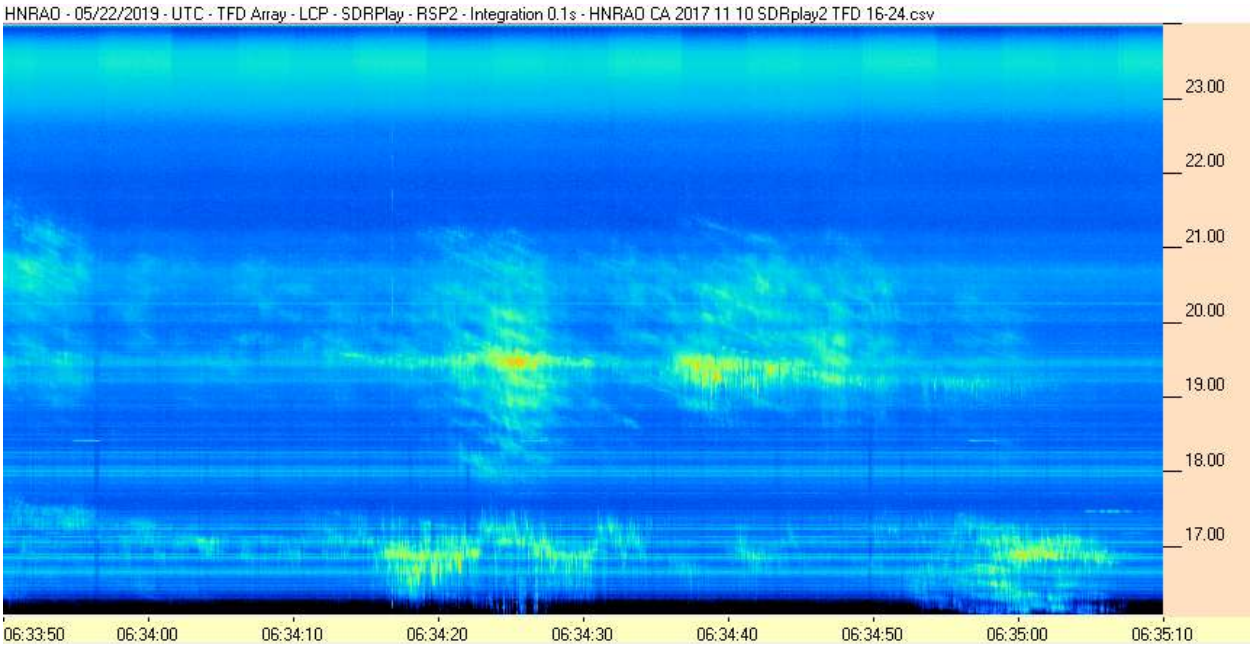
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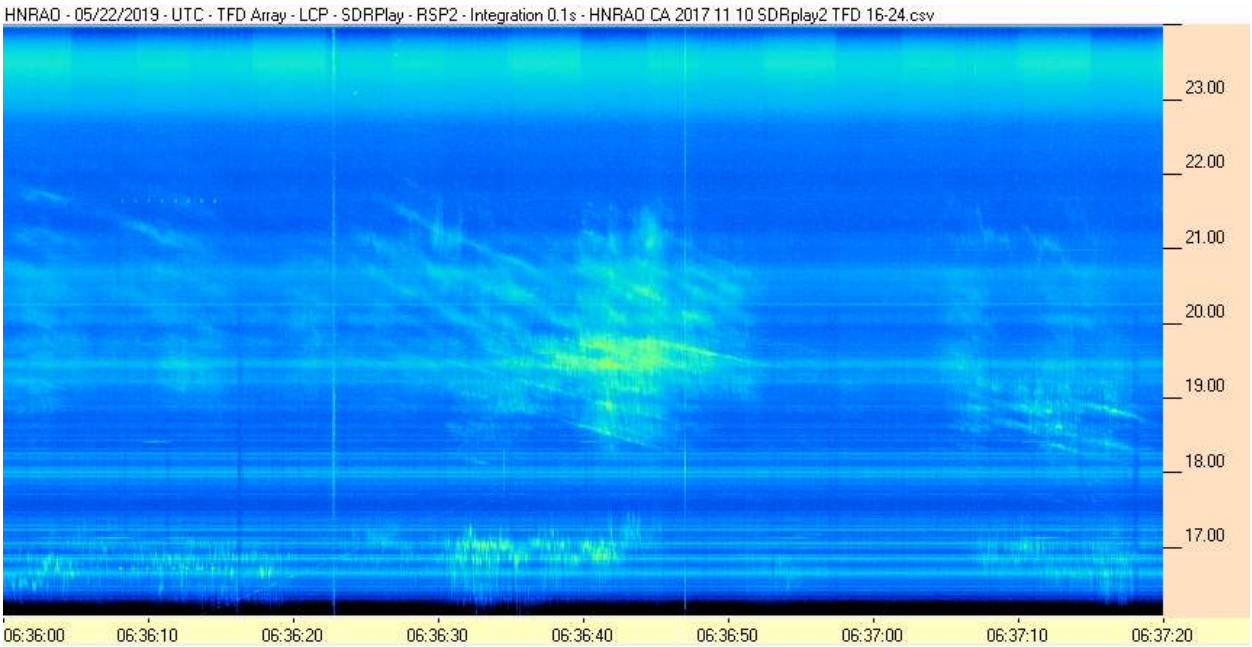
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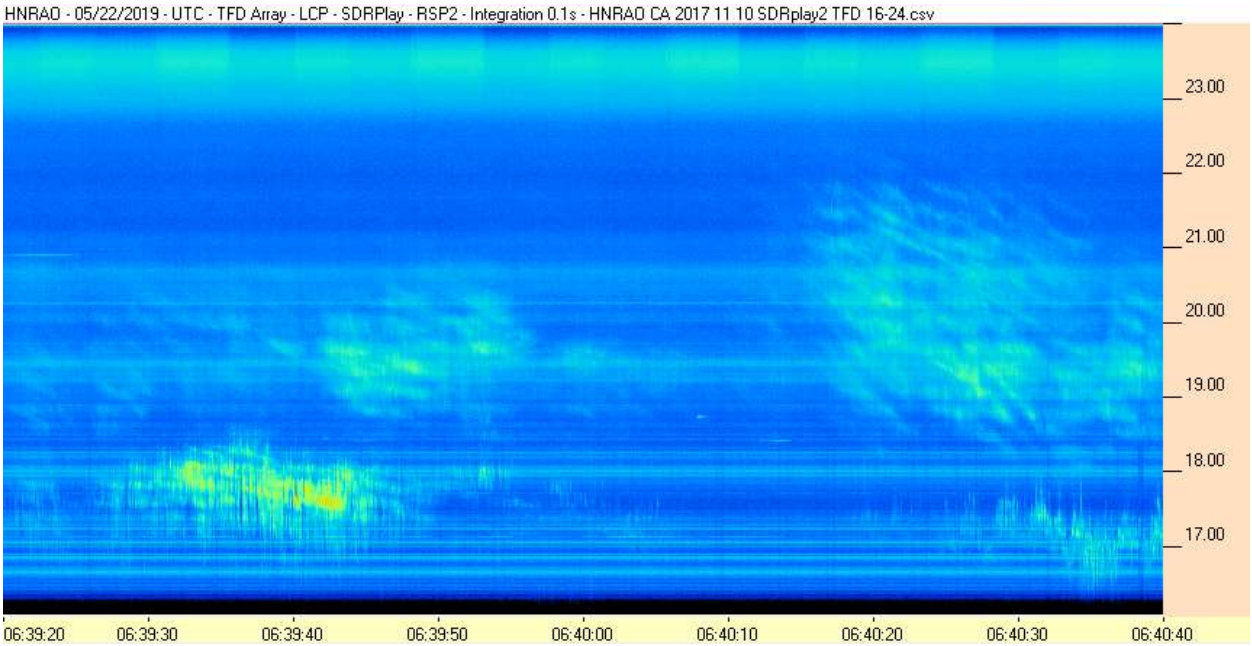
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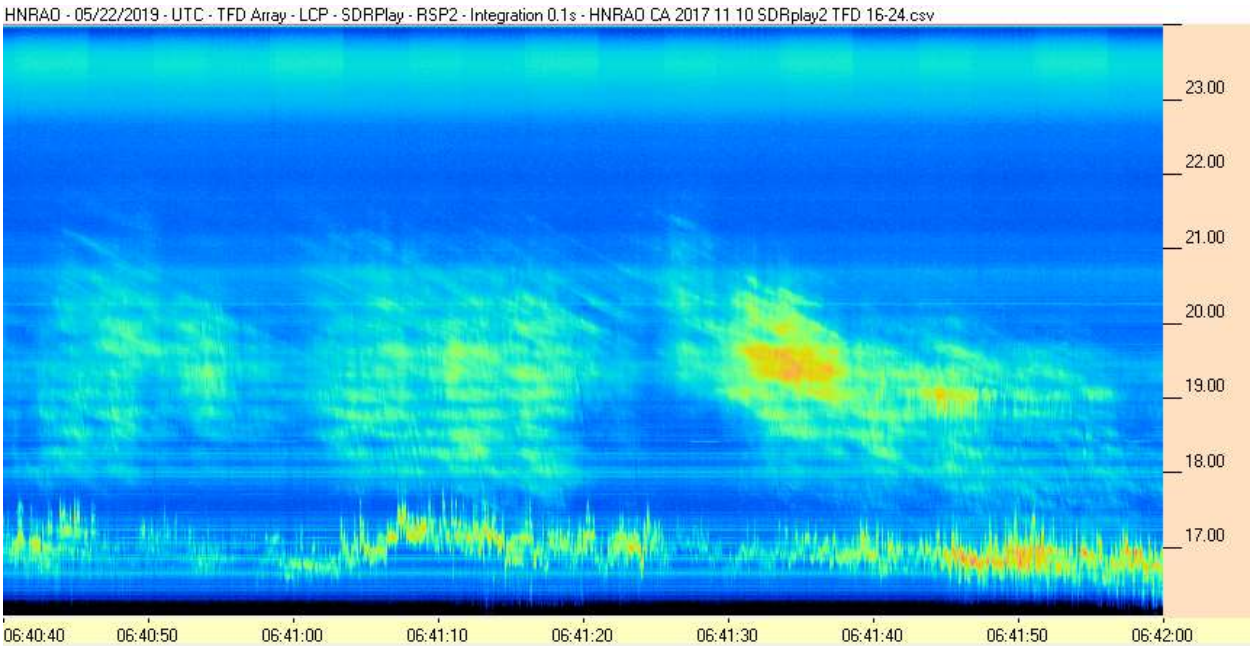
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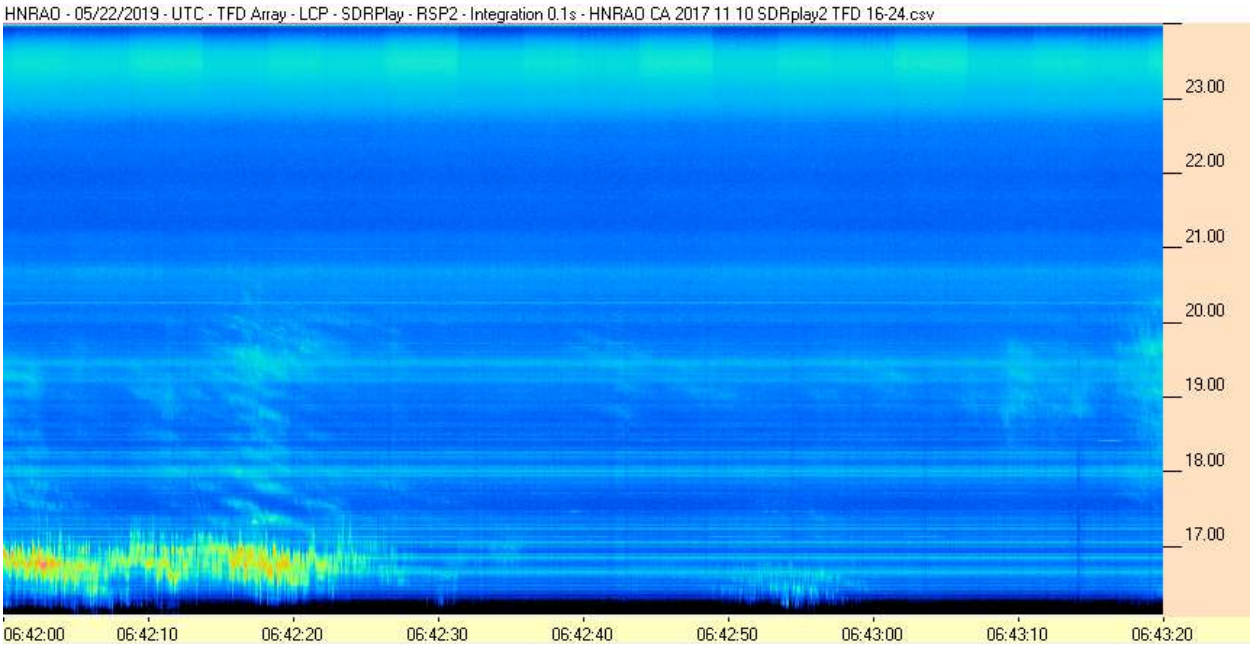
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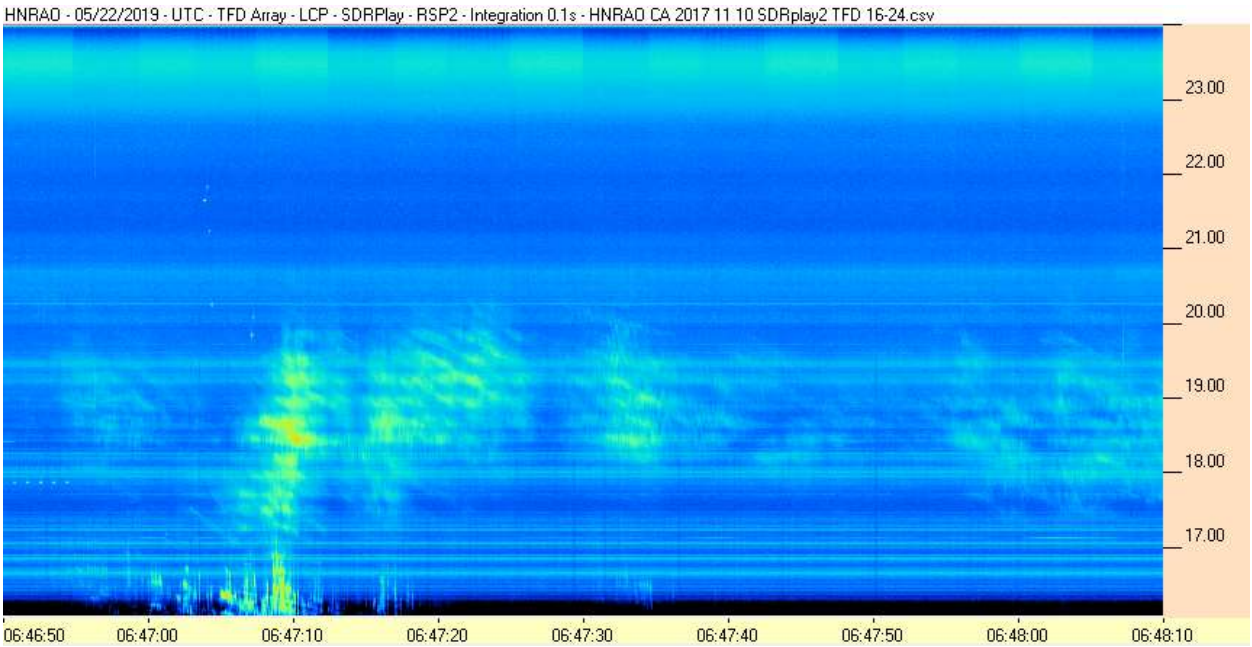
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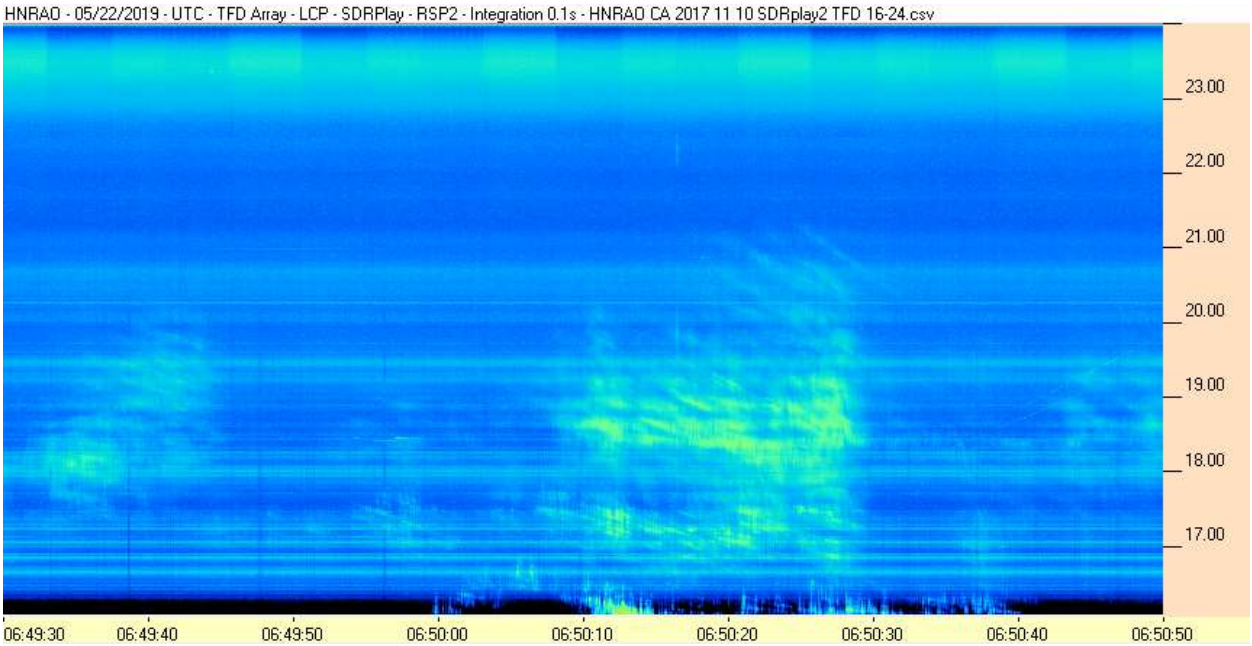
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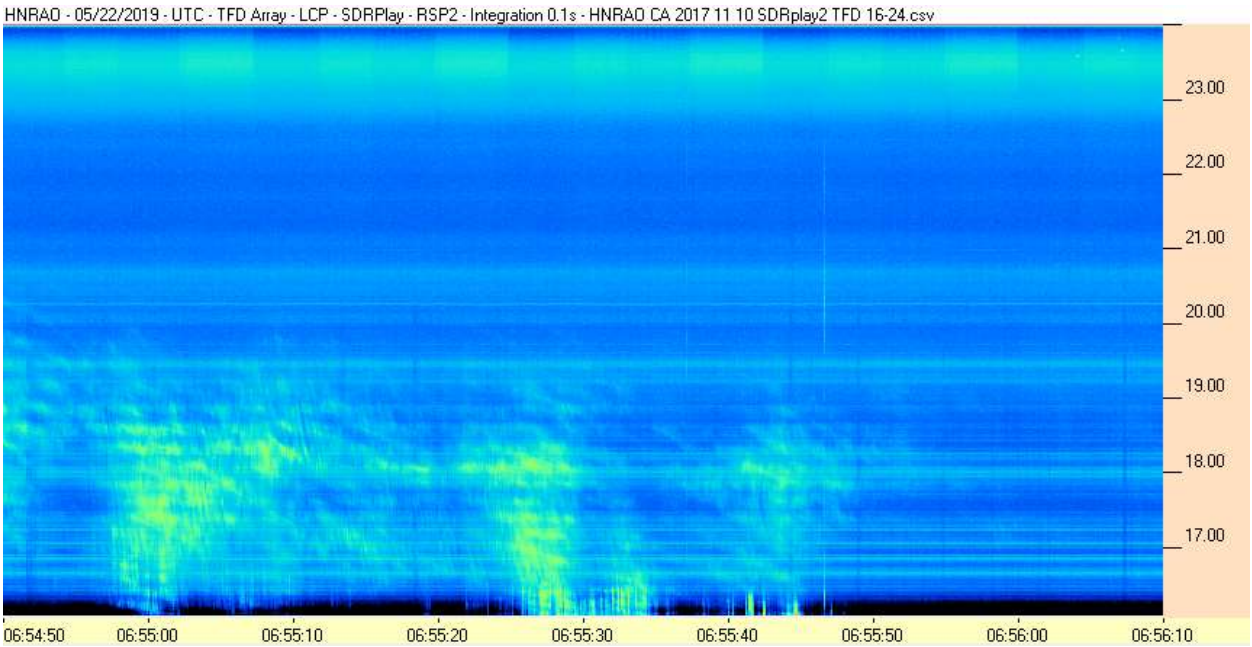
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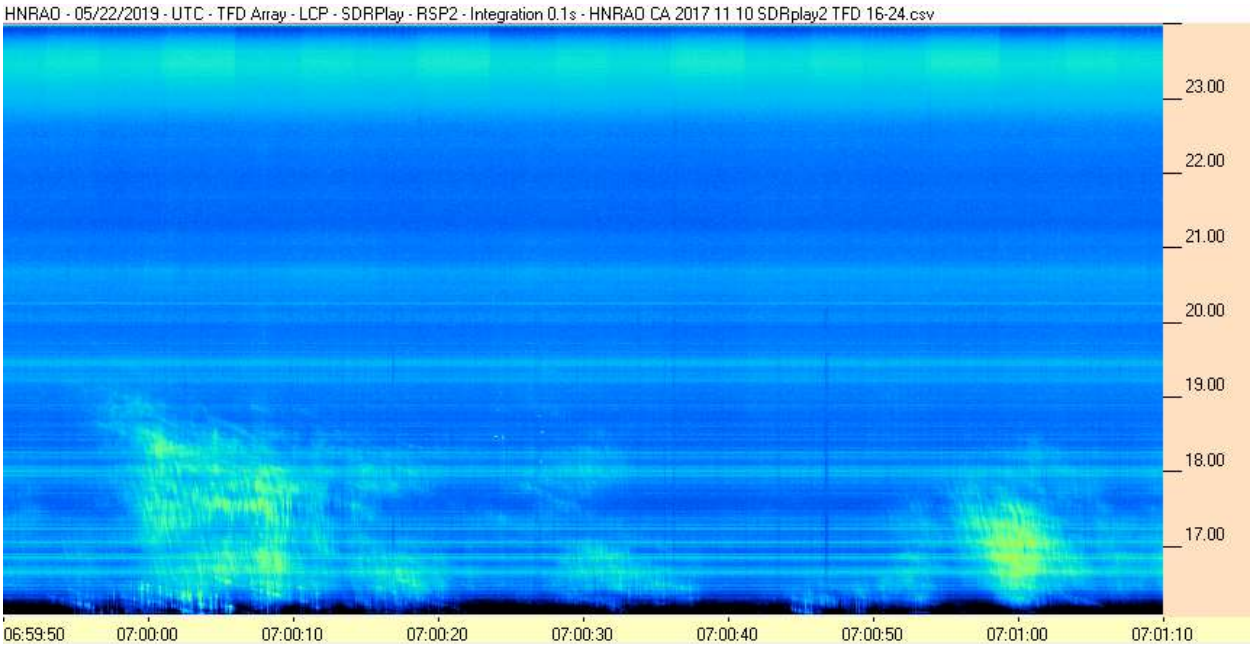
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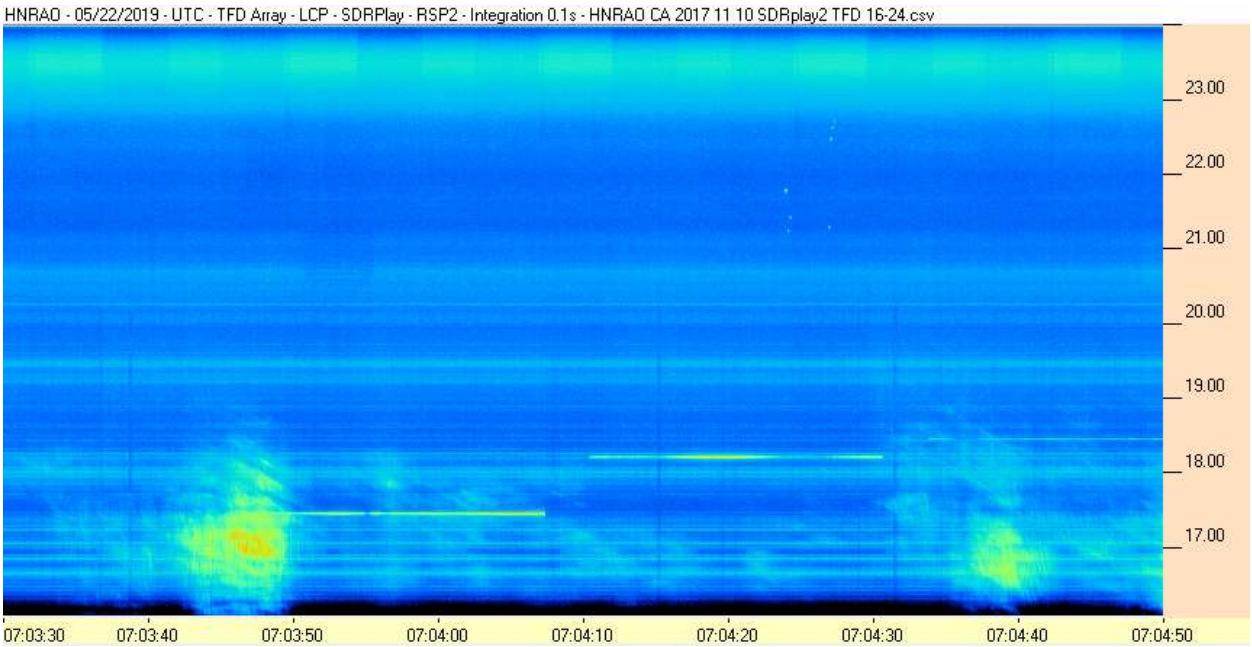
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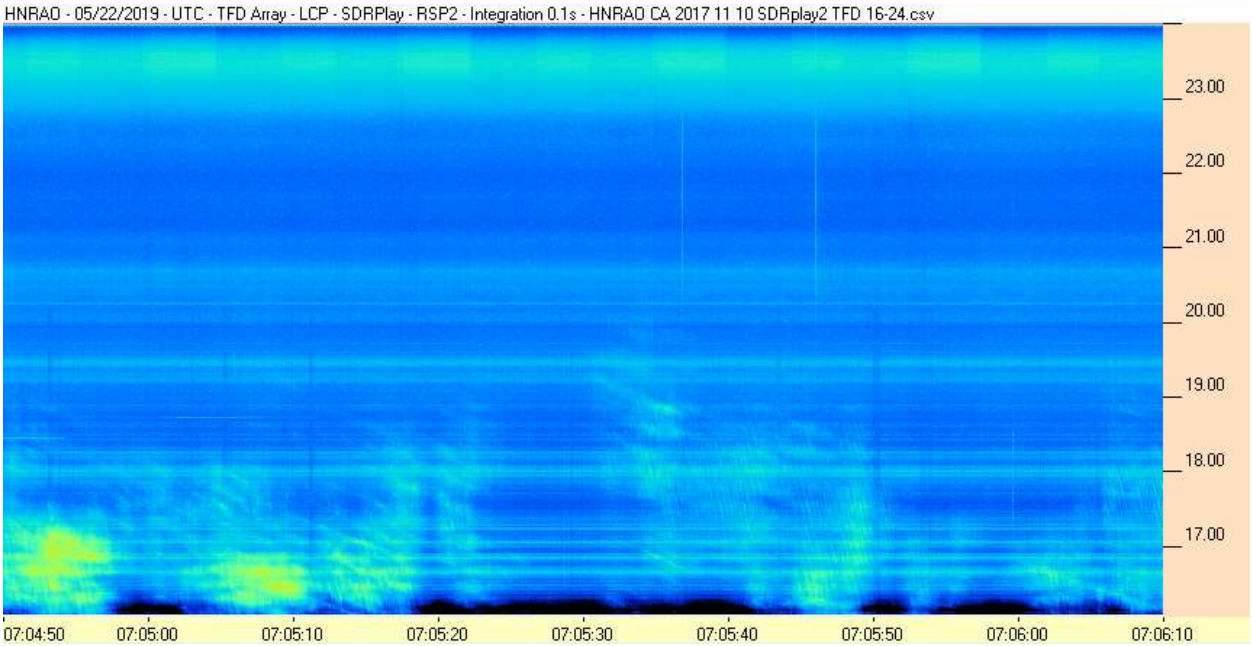
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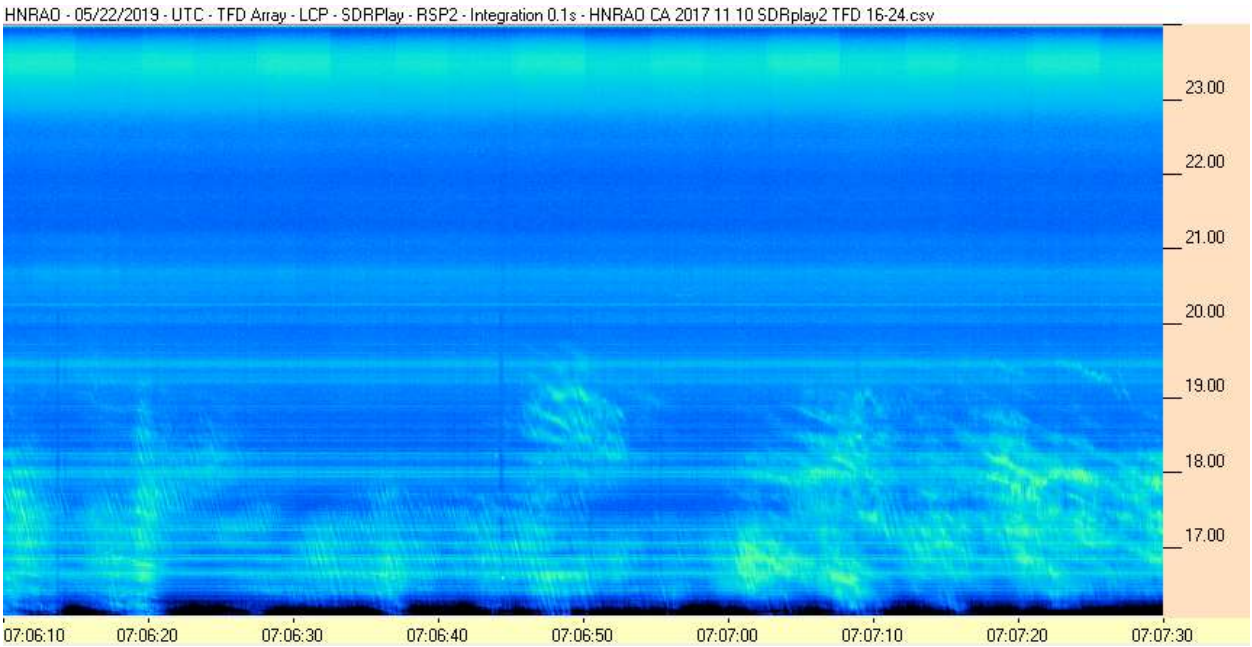
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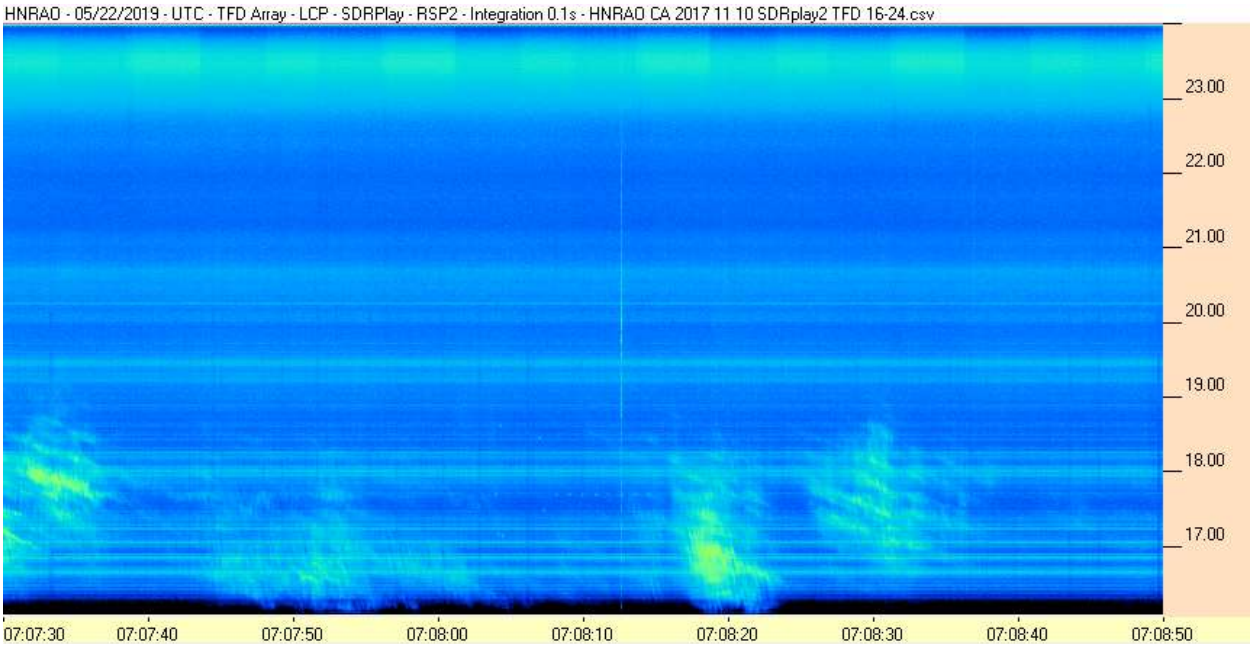
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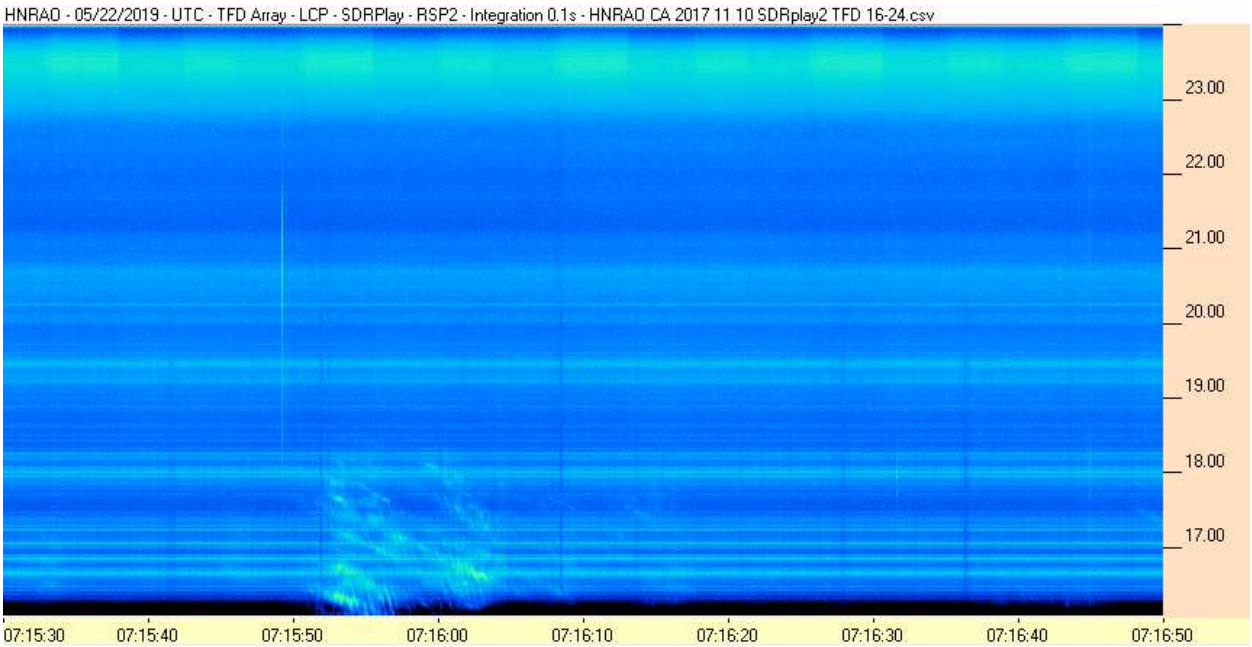
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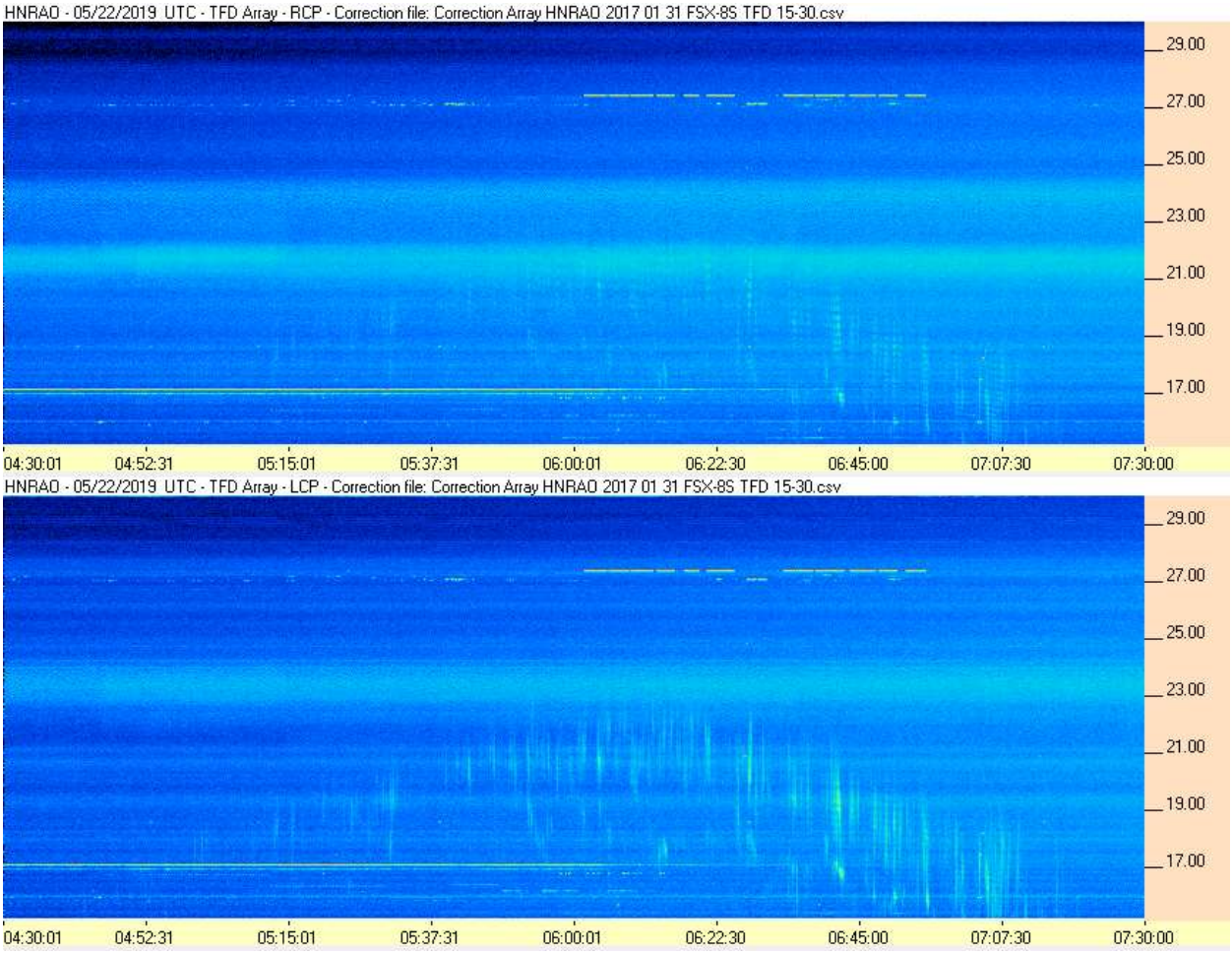
FSX-8S / TFD Array



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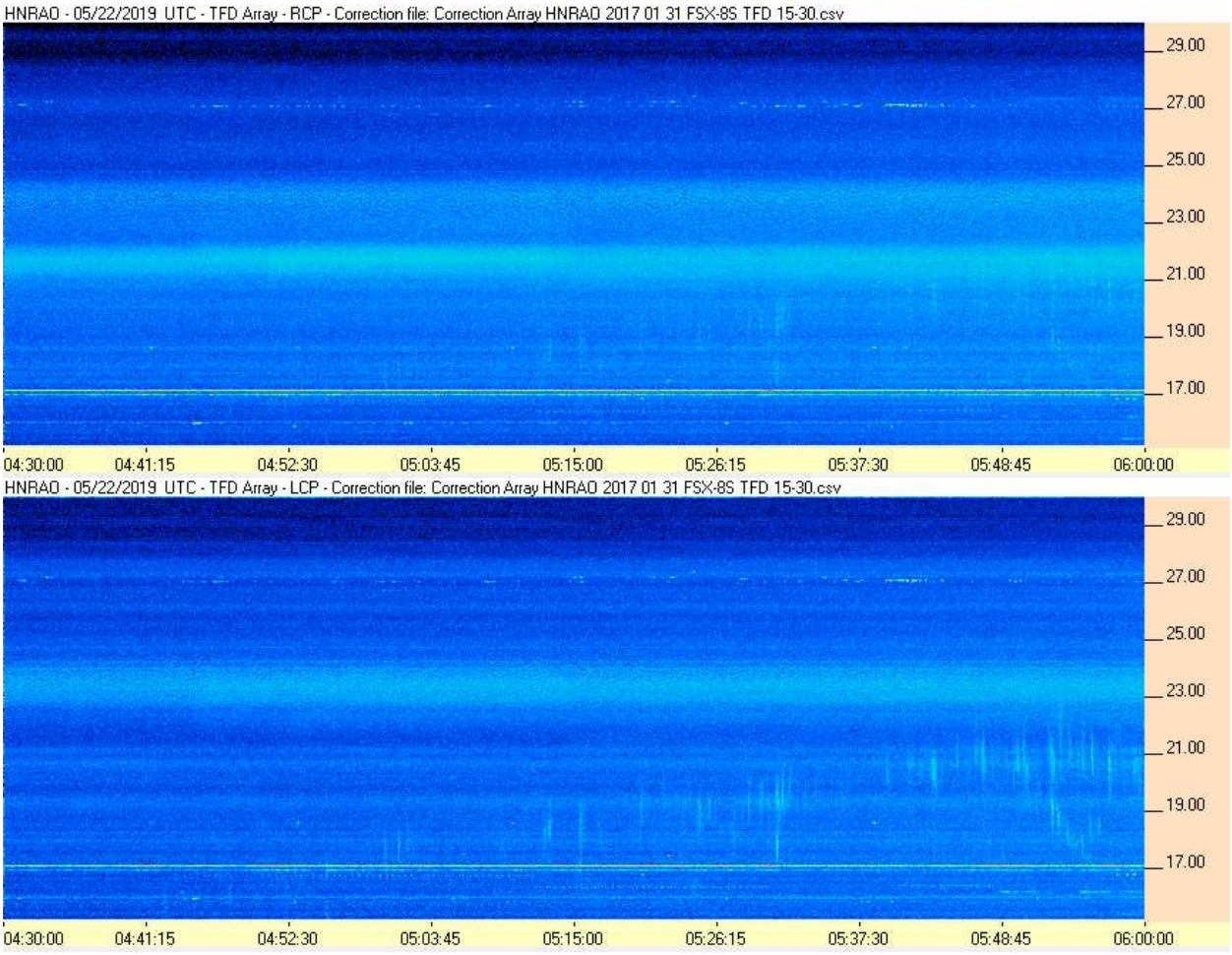
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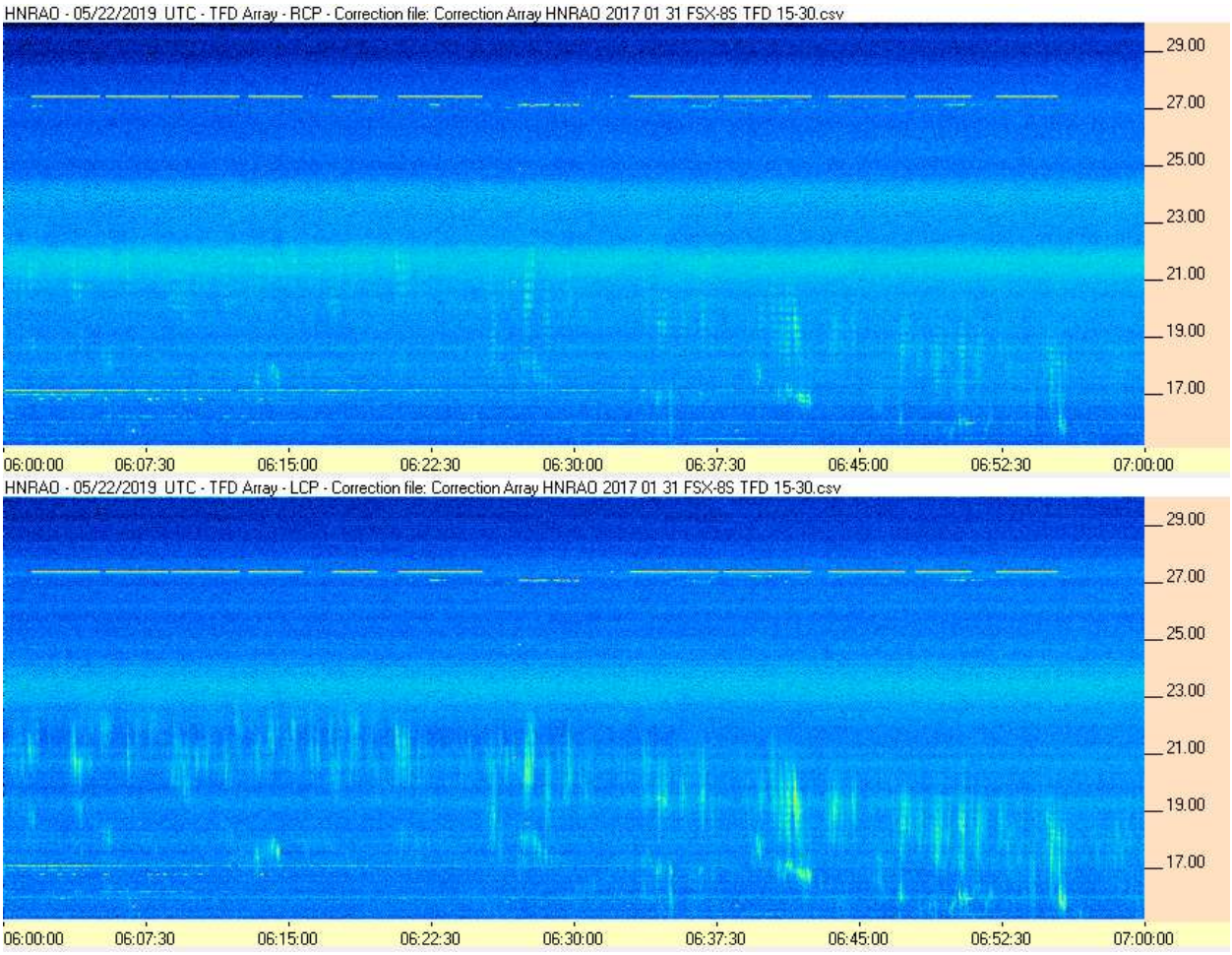
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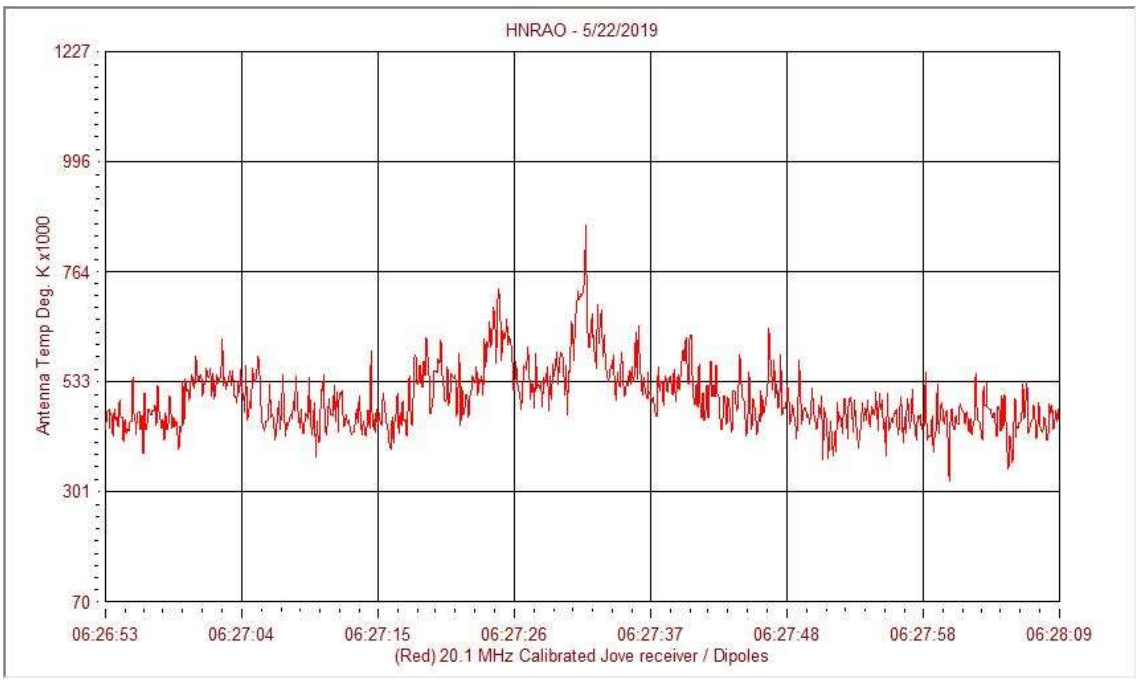
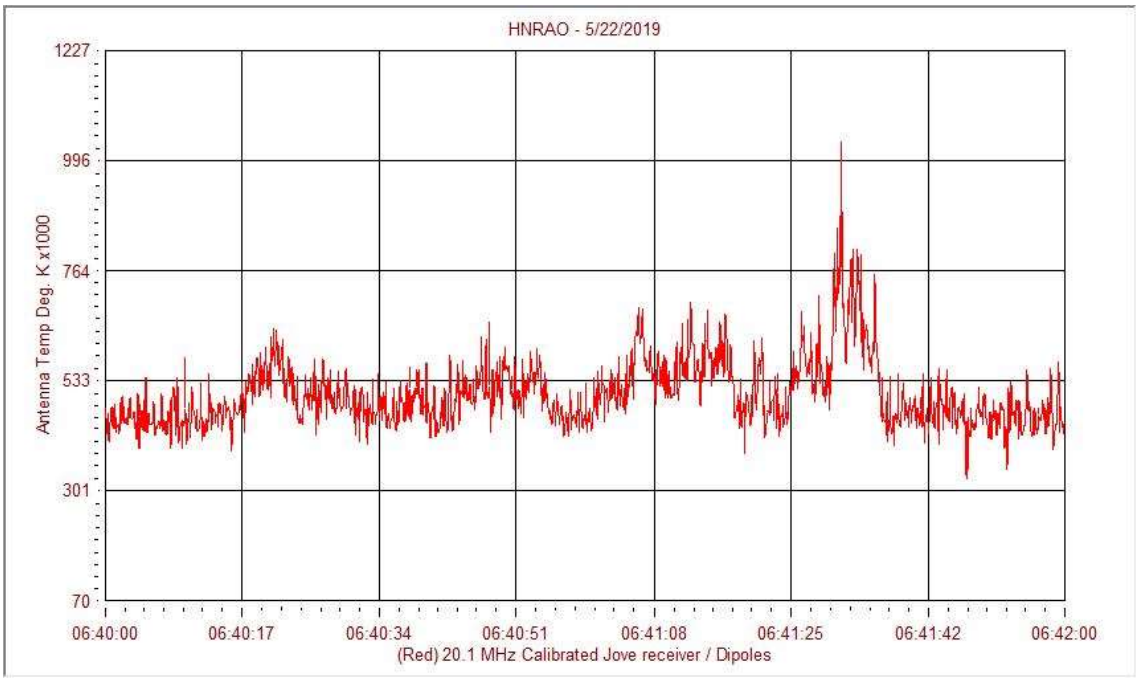
JOVE II / JOVE Dipoles





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