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To: EDGES group

From: Alan E.E. Rogers

Subject: Analysis of the solar flare on 31 December 2023 observed by EDGES-3 at the WA

The solar flare occurred at about 21:47 UT with the parameters listed below:

Site latitude	-26.7 degrees
Site longitude	116.5 degrees
Sun elevation	3.93 degrees
Sun azimuth	113.89 degrees
Antenna azimuth	269 degrees
Antenna gain at 40 MHz	-21 dBm
Antenna gain at 120 MHz	-16 dBm

Table 1. List of key parameters

A waterfall plot of the solar flare is shown in Figure 1. This is only partially calibrated. Fully calibrated plots of the data in 30 second blocks are shown in Figure 2. Text files are available in which the calibrated antenna temperature is converted to flux density in Janskys using the antenna gain. Text files of the calibrated antenna temperatures and solar flux in Janskys for the time span of the data in Figure 2 have been written and available upon request. In this analysis the contribution from the sky without a solar flare, which is close to the results from 2023:365:21:46:06 UT have not been subtracted from the solar flux in Janskys. The flux is calculated using

$$F = \frac{2 \times 10^{-26} \times 4 \pi k T}{\lambda^2 G}$$

where F = flux in Janskys

k = Boltzman's constant = 1.38e-23

T = antenna temperature K

λ = wavelength m

G = antenna gain isotropic

The factor of 2 in 2e-26 is needed on the assumption that the flare is unpolarized so an equal power is present in the orthogonal linear polarization which is not measured.

time in UT	Frequency MHz	Antenna temp K	Solar flux Janskys	Plot of ant. temp
2023:365:21:46:06	40.002	9598	7.45e+08	top middle
2023:365:21:46:06	80.237	2347	4.11e+08	top middle
2023:365:21:46:06	119.690	1385	3.06+08	top middle
2023:365:21:47:40	40.002	524031	4.07e+10	middle
2023:365:21:47:40	80.237	5416	9.48e+08	middle
2023:365:21:47:40	119.690	3018	6.66e+08	middle

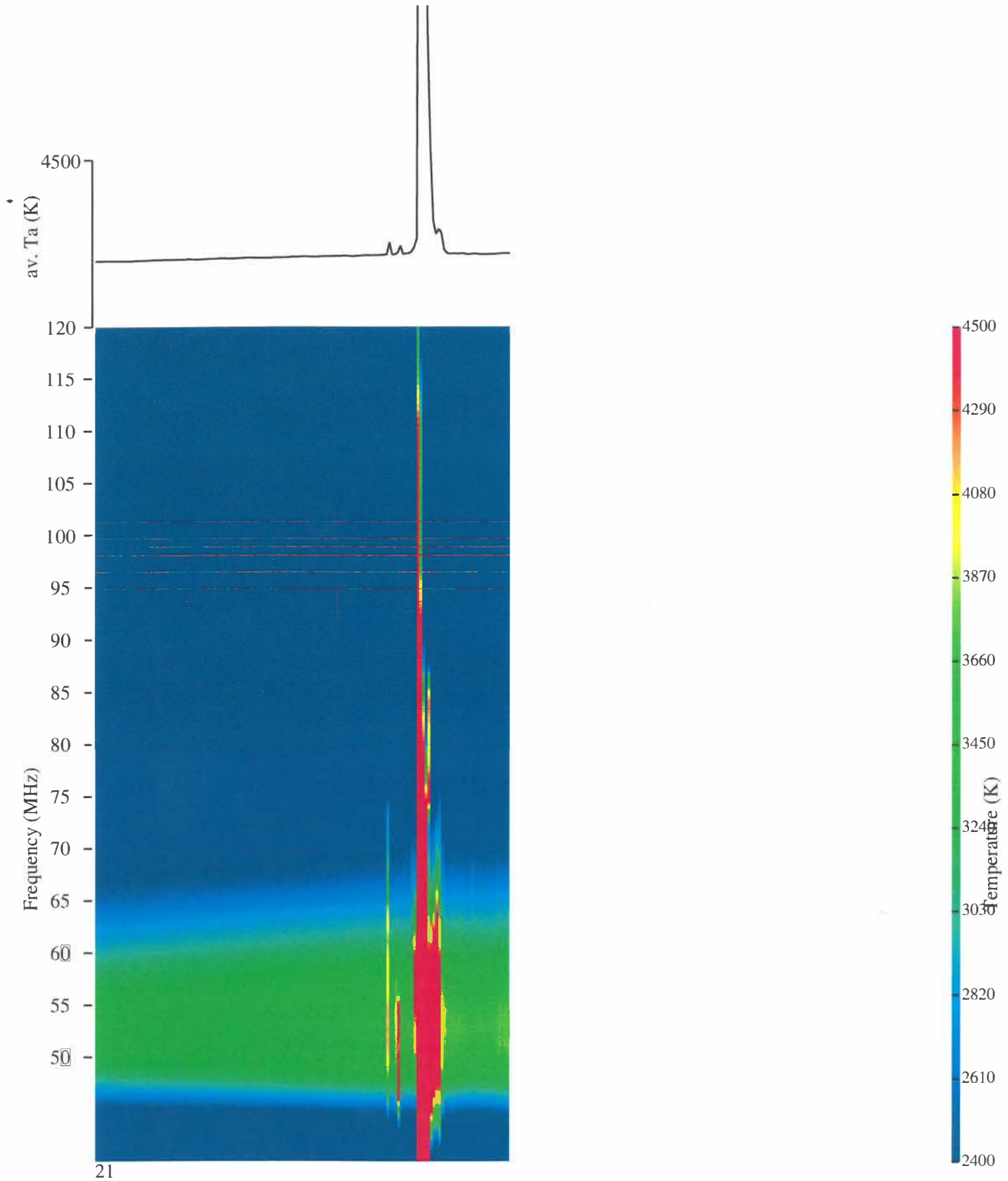
Table 2. Samples of data available in text files

Since a Solar Flux Unit (SFU) is $1e4$ Janskys the peak solar flux at 40 MHz at 21:47:40 is $4e6$ SFU so far I have not been able to confirm if this signal is typical of a solar flare. The EDGES-3 has a very high dynamic range but as a check of potential ADC saturation the measured values around the peak are listed in Table 3.

Time UT	total power fraction in percent	ADC peak volts
2023:365:21:46:07	7	0.2
2023:365:21:46:31	15	0.3
2023:365:21:46:54	7	0.3
2023:365:21:47:41	8	0.3

Table 3. Total power at EDGES-3 ADC

The EDGES-3 has added out of band noise to increase the dynamic range as discussed in memo 364 and Table 3 shows that while the input voltage increase is seen during the peak of the solar flare there is no indication of any saturation which could effect the SFU measurements.



file: 2023_365.acq
 Solar flare 31 Dec 2023
 fstart 40 fstop 120 pfit 0 smooth 0 resol 6 kHz rfi 0.0 nline 153 secint 978

Figure 1. Waterfall plot of partially calibrated solar flare.

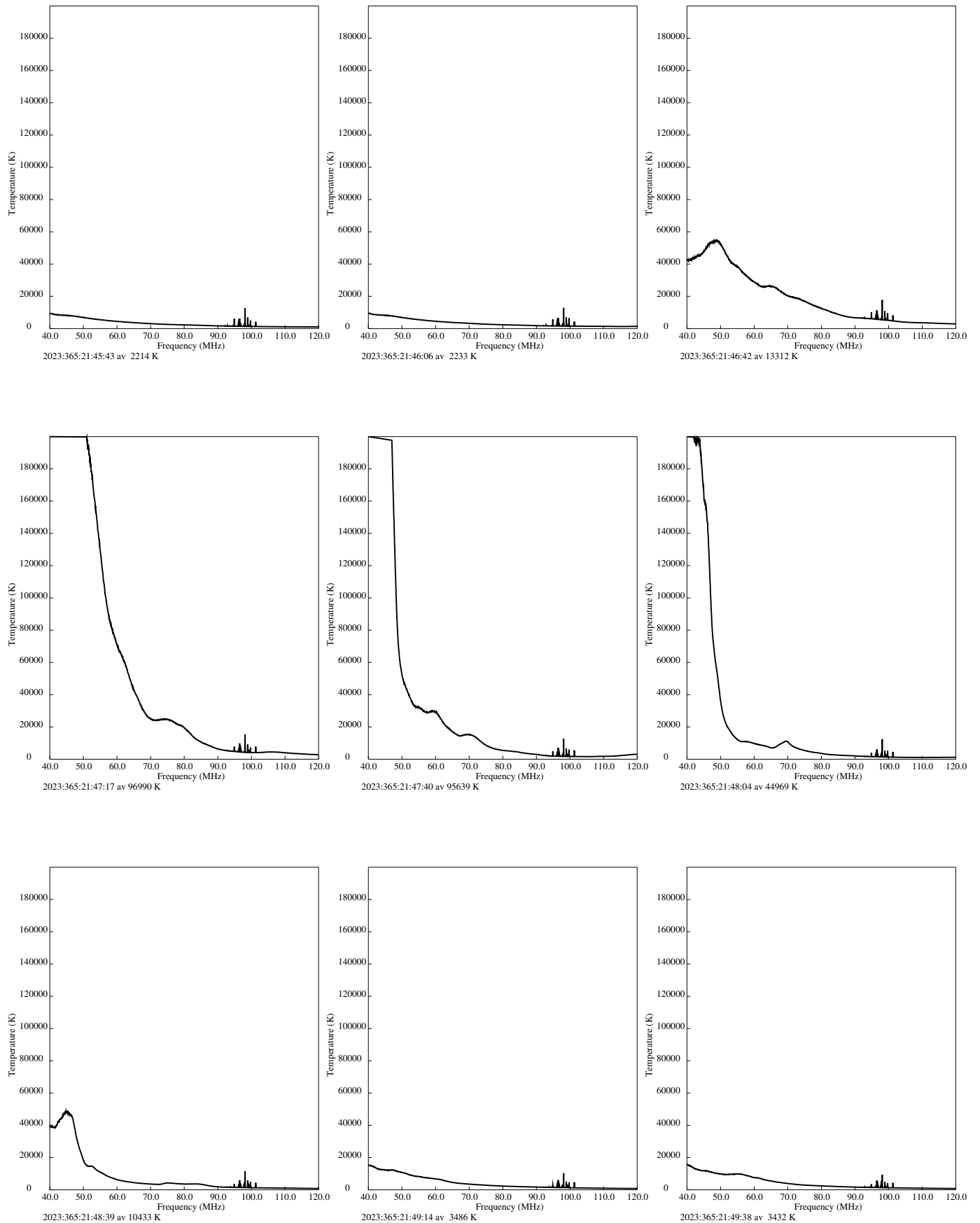


Figure 2. Plots calibrated data from 21:45:43 UT to 21:49:38 UT in units of temperature