

IONOSPHERIC SCINTILLATION OBSERVED BY LOFAR PL610 STATION

Mariusz Pozoga*, Barbara Matyjasiak, Hanna Rothkaehl, Helena Ciechowska, Marcin Grzesiak, Roman Wronowski, Katarzyna Budzińska, and Łukasz Tomasik¹

¹Space Research Centre, Polish Academy of Science

Observations

Ionospheric scintillation are rapid changes of observed signal caused by diffraction of radio wave or plasma irregularities. For measurements we use strong natural radio sources such as CasA, CygA, TauA, and VirA. The signal is observed in the bands in range between 14.8-47.8 MHz and 64.8-79.1 MHz for each source above the horizon. The signal intensity, Stokes parameter I, is used for ionospheric scintillation calculations.

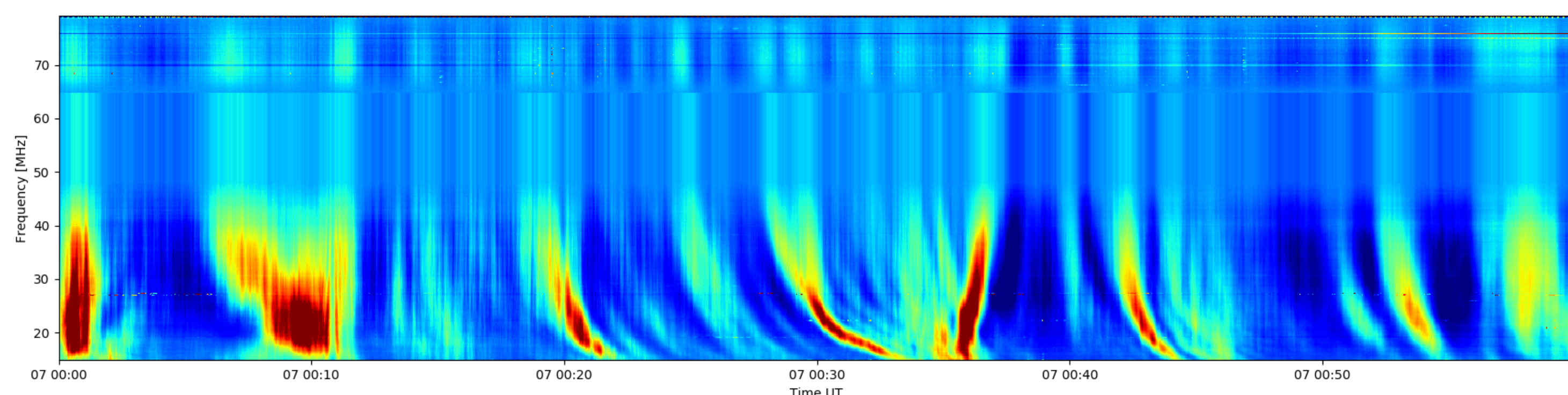


Fig. 1: 1 hour signal amplitude for CasA starting at 2019-11-07 00:00

From the observation we get time frequency dependence of radio source signal intensity. For statistical studies we need numeric value to describe scintillation intensity. For amplitude scintillation the S_4 index is given by $S_4 = \sqrt{\frac{\langle I^2 \rangle - \langle I \rangle^2}{\langle I \rangle^2}}$

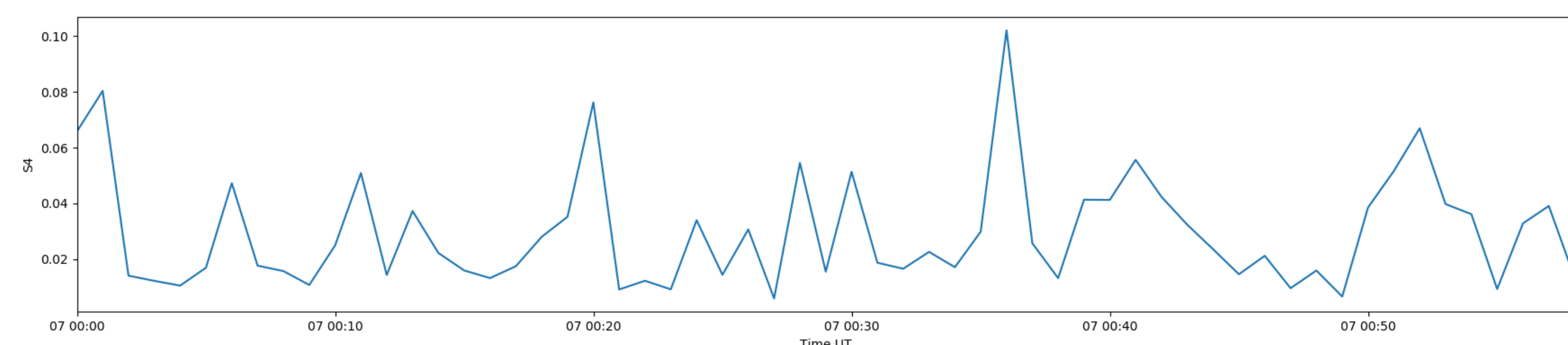


Fig. 2: The S_4 index computed for CasA at frequency of 30MHz

In order to obtain additional information, S_4 indices are counted for different integration time - 10, 15, 30, 60, 300 and stored in database. Between years of 2018-2020, with the use of PL610, we collected over 8500 hours of observations which allow to make statistical comparison of scintillations in observed region.

Result

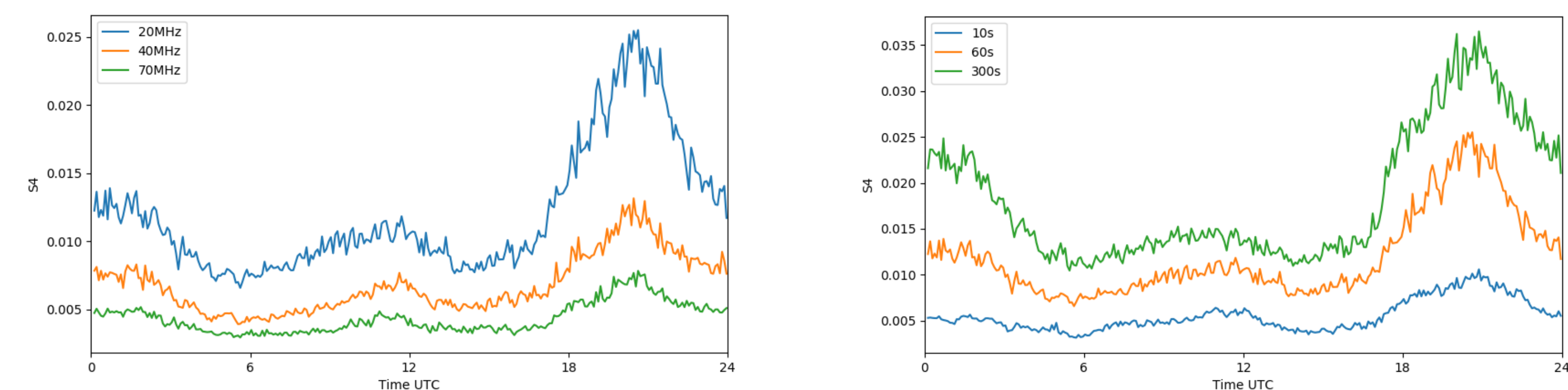


Fig. 3: Daily dependence of S_4 index computed as median, calculated for frequencies of 20, 40, 70 MHz and 60 seconds integration time, and for different integration time - 10, 60, 300 s at frequency of 20 MHz with CasA as a radio source.

We should note that scintillation is strongly dependent on geomagnetic latitude. Below we show observational coverage for CasA as well as value of S_4 computed for different geomagnetic latitudes, where this dependency is clearly visible.

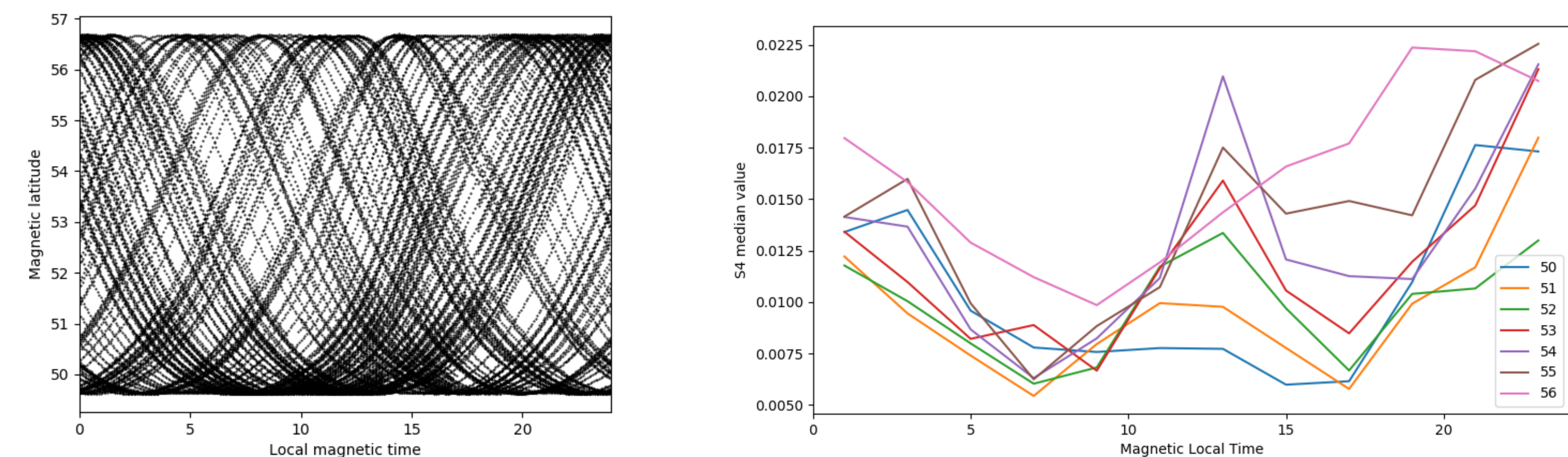


Fig. 4: Geomagnetic latitude coverage of and value of S_4 depends on geomagnetic latitude for CasA as a target.