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Study of lightning activity in three main thunderstorm centers based on Schumann resonance measurements in the years 2005-2006

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This paper aims at describing a temporal variation of the lightning activity in three main tropical thunderstorm centers located at Asia, Africa and America. The lightning activity is estimated from ELF (extremely low frequency) observations carried out in years 2005-2006 in the observatory station of the Jagiellonian University in the Eastern Carpathians [Kulak 2003a,b]. The method uses the magnetic component of the first 7 Schumann resonances (SR) for calculation so called storm activity rate IRS [Nieckarz 2007].

The main source of Schumann Resonance (SR) field observed in the Earth – ionosphere cavity is the electric storm activity. It is commonly assumed that nearly all the energy of background SR component comes from CC and CG flashes connected with a storm center. Calculating SR background component has been used for a long time as a measure of the planet's global storm activity [Heckman 1998, Christian 2003]. The correlation between the first SR amplitude and mean global temperature [Williams1992] and upper tropospheric water vapor [Price 2001] were also indicated.

A large problem in lightning activity estimation from Schumann resonance is an interaction of the standing waves field in the resonator with the field of running waves which transmit energy from lightning discharges to Earth-ionosphere cavity. Our method explore the concept that the observed ELF spectrum (4-60 Hz) can be described by an asymmetric function [Kulak 2006] which decomposes the measured ELF field into the Schumann resonances and the running waves fields. Then the com-

puted amplitudes of the first seven observed Schumann modes allow calculating storm activity rate IRS that is further used for estimation of the lightning activity. This is a relatively simple and cheap method for study changes in global lightning activity distribution on different time scales using one station measurements of SR magnetic fields in the north-south (NS) and east-west (EW) directions. The method is comparatively simple in calculating and has a high time resolution.

IRS values used in the paper were computed for each hour a day, separately for signals recoded in (NS) and (EW) antenna. From these values the daily indexes of IRS and the maximum daily indexes IRSmax for each of the three tropical thunderstorm regions (Asia, Africa and America) were constructed independently. Basing on the least squares method (LSM) and using modified periodograms and an iterative technique of fitting and subtracting sinusoids in the time domain, detailed frequency, amplitude and phase characteristics of any of IRS rate time series were obtained. Results indicate differences in oscillations observed in the investigated centers. We analyze various correlations and try also to estimate how large part of the observed variations can be explained by a chaotic run of the data.

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