Spatial distribution of lightning discharges and atmosphere-lithosphere coupling

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A lightning discharge is an important part of coupling between geospheres and in solar-terrestrial interactions. The occurrence of lightning discharges is modulated by Solar activity while its spatial distribution influences parameters of the earth-ionosphere waveguide and Ionospheric Alfven resonator (IAR). A lightning discharge is a source of electromagnetic emission on a wide frequency range and it also causes thermal and mechanical disturbances. This determines its contribution to processes in the lithosphere including formation of new minerals and seismo-electromagnetic effects.

However, an inter-relation between spatial distribution of lightning discharges at local and regional scales and processes in the lithosphere have not not studied in details. Variations of spatial distribution of lightning discharges can be an indicator or a precursor for such processes with high energy input as earthquakes. Simultaneously it a lighting can trigger processes with lower energy such as landslides.

In the present research, spatial distribution of lightning discharges and its variation with time is studied for the European Russia and Far east and their relation with geology and tectonic parameters are analyzed. For that, long-term time series of lightning discharges registered in years 2010-2016 and stored in the global lightning datasets WWLLN and ENGLN are utilized.

We have found that for non-seismic regions the maxima of lightning occurrence are associated predominantly with zones of fundament uplifts and boundaries of the first-order blocks. For seismic zones, cases of pre-seismic re-distribution of lightning discharges were found. A possible role of this re-distribution in reported seismo-electromagnetic variations at ULF-ELF frequencies is discussed.

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