SPACE WEATHER AND THE SAFETY OF GROUND INFRASTRUCTURES. A CONCEPT TO SIMULATE AND PREDICT EM EFFECTS FROM SUBSTORM ACTIVITY USING GROUND-BASED GEOMAGNETIC OBSERVATIONS AND OBSERVATIONS FROM ACE SATELLITE

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Strong eruptions at Sun's surface produce large release of matter (plasma), which, with a speed of 800-1000 km/s (the solar wind), flows into interplanetary space. If the Earth appears to be on the way of the solar wind the interaction of the wind with the Earth's magnetosphere and the ionosphere leads to abnormal disturbance of fluctuating geomagnetic field. In the middle latitudes, the disturbances (geomagnetic storms) last a few days and have amplitudes up to 400 nT. At high latitudes, these perturbations (magnetospheric substorms) last a few hours and have amplitudes up to 3000 nT. According to Faraday's law of induction, the fluctuating magnetic field in turn generates a electric field. The electric field for intense substorms can reach hundreds of volts/km in the polar region and generate very high, the so-called geomagnetic induced currents in the ground-based systems, such as power grids and pipelines. These currents are one of the most dangerous factors affecting the operation of the above systems. Thus extremely topical task in the field of "space weather" is the quantification and prediction of spatio-temporal distribution of the electric field during substorm activity. Despite the abundance of works carried out in this direction, the problem is still far from a satisfactory solution. In the field of modeling, researchers are still working with highly simplified models of both the source and the conducting Earth. As for prediction the situation is even worse. In this presentation we discuss a general formalism which allows for simulating the electric fields induced by the real geomagnetic substorms in the spherical model of the Earth with real three-dimensional distribution of conductivity. We also discuss a scheme to predict substorm spatio-temporal distribution of the electric field.