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Global Electric Circuit as engine of seismo-ionospheric coupling. Concept validation within the framework of INSPIRE project.

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The very early versions of seismo-ionospheric coupling models were based on direct calculations of seismogenic electric field effect from the ground surface to the ionosphere. All of them are based on the methodology of electric field penetration into the ionosphere from thundercloud (Park and Dejnakarintra, 1973). Nevertheless, this approach is insufficient from several points of view: a) it does not consider the nature of anomalous seismogenic electric field; b) it does not work at equatorial latitudes; c) it takes as an initial condition the minimal value of the vertical electric field at the ground surface no less than 1000 V/m what is observed not so often, while the ionospheric anomalies are registered regularly, including the anomalies over the sea surface.

The Global Electric Circuit (GEC) concept as its intrinsic property considers the coupling between ground and ionosphere which is expressed in the form of the Ionospheric Potential (IP) which is actually the potential difference between ground and lower border of the ionosphere. It was established that during period of nuclear weapon tests in atmosphere the ionospheric potential undergo essential variations which most probably were caused by variations of air conductivity due to air ionization by active products of radioactive decay. The same role in seismically active regions plays radon which emission essentially increases before earthquakes. This idea was a starting point for creation of the Lithosphere-Atmosphere-Ionosphere Coupling model (LAIC).

The ISPIRE Project (IoNospheric Sounding for Pre-seismic anomalies Identification REsearch) initiated by ESA and carried out by international consortium as one of the tasks had validation of the LAIC model where the GEC conception was the most important part. The processes of precursor's development were analyzed starting from the crustal movements, radon emission and air ionization, thermal and atmospheric anomalies, electric field and electromagnetic emissions generation, variations of the ionospheric plasma parameters, in particular vertical TEC and vertical profiles of the electron concentration. Assessment of the LAIC model performance with definition of performance criteria for earthquake forecasting probability has been done in statistical and numerical simulation domains of the Global Electric Circuit. These simulations demonstrated that the GEC concept adequately describes the process of ionospheric precursor generation and its dynamics accordingly to changes of lower atmosphere conductivity.

The validation included also the analysis of experimental data of phenomena where changes of air conductivity were not connected with radon emanation but were caused by other factors such as dust storms, volcano eruption, radioactive pollution and others.