The geoelectric structure of the Romanian underground and its contribution to the geoelectric hazard during the solar cycle 23

V. Dobrica, D. Stanica, C. Demetrescu, C. Stefan

Institute of Geodynamics, Romanian Academy, Bucharest, Romania

venera@geodin.ro

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Space weather hazard (GICs)

Induction in the Earth

Variable external magnetic field

↓

Telluric currents

↓

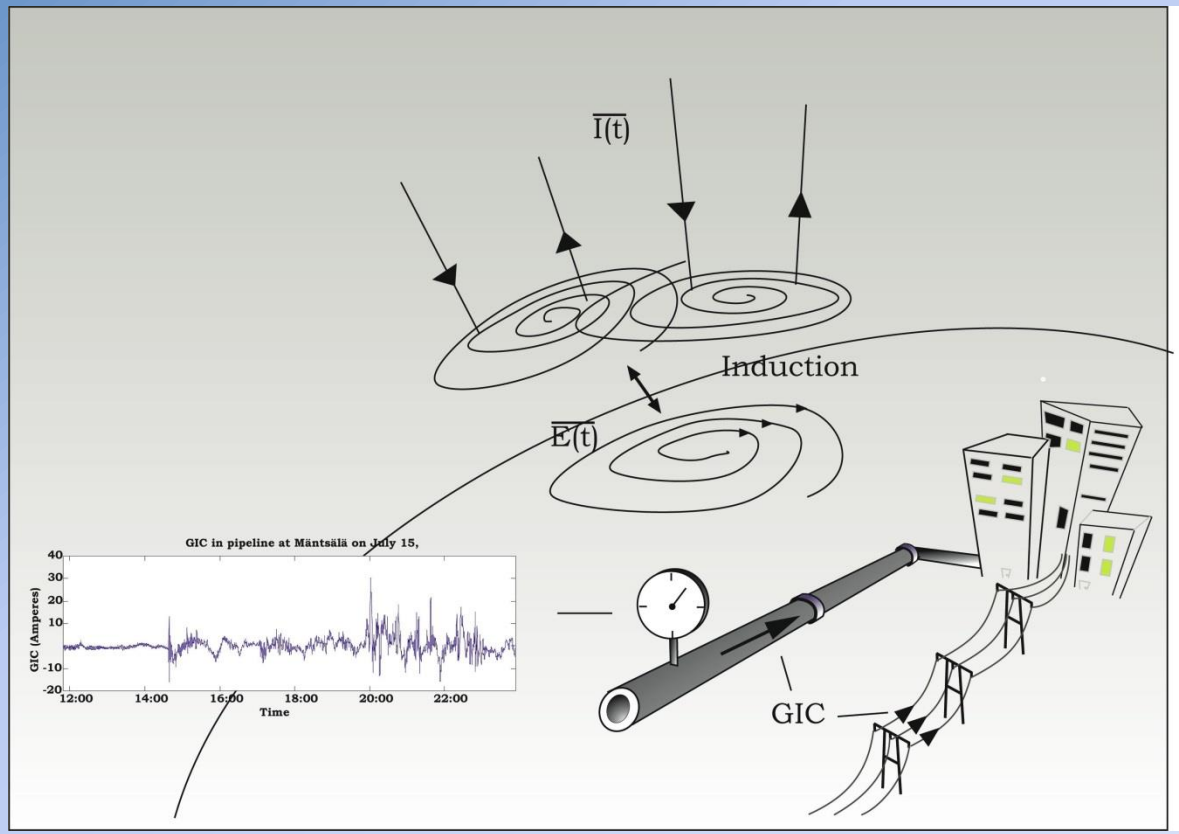
Secondary magnetic field

↓

Surface electric Field (E)

↓

Electric currents (GICs)



The surface geoelectric field

Plane wave model (Viljanen&Pirjola, 1989)

- the underground electric conductivity
- the time derivative of the recorded geomagnetic field

Background on Earth conductivity - regional and local scale

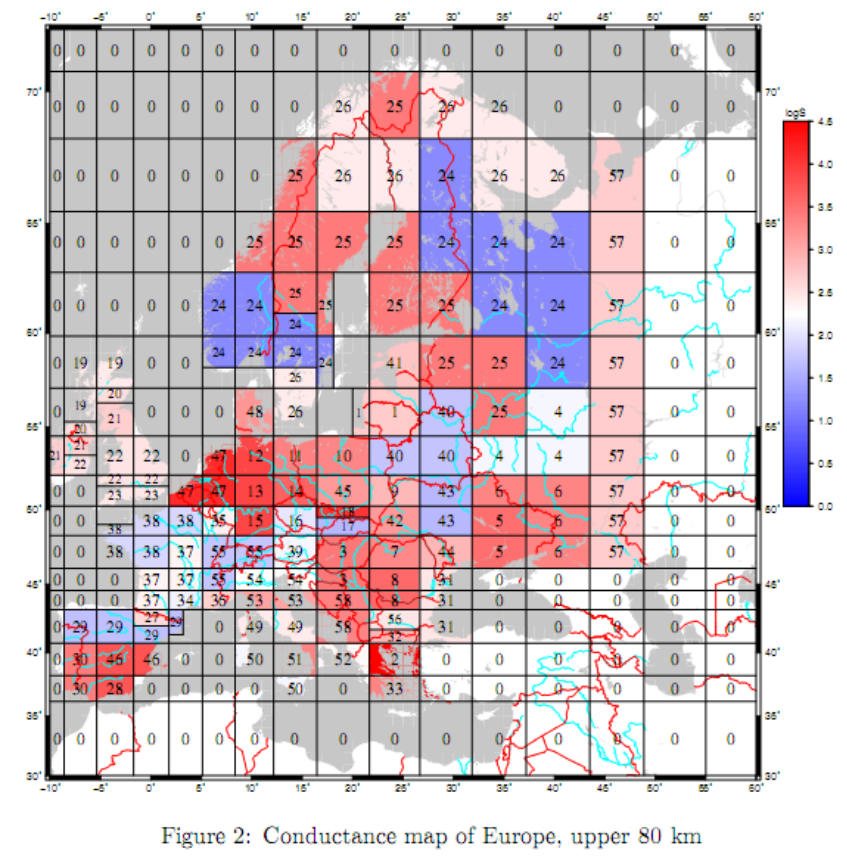
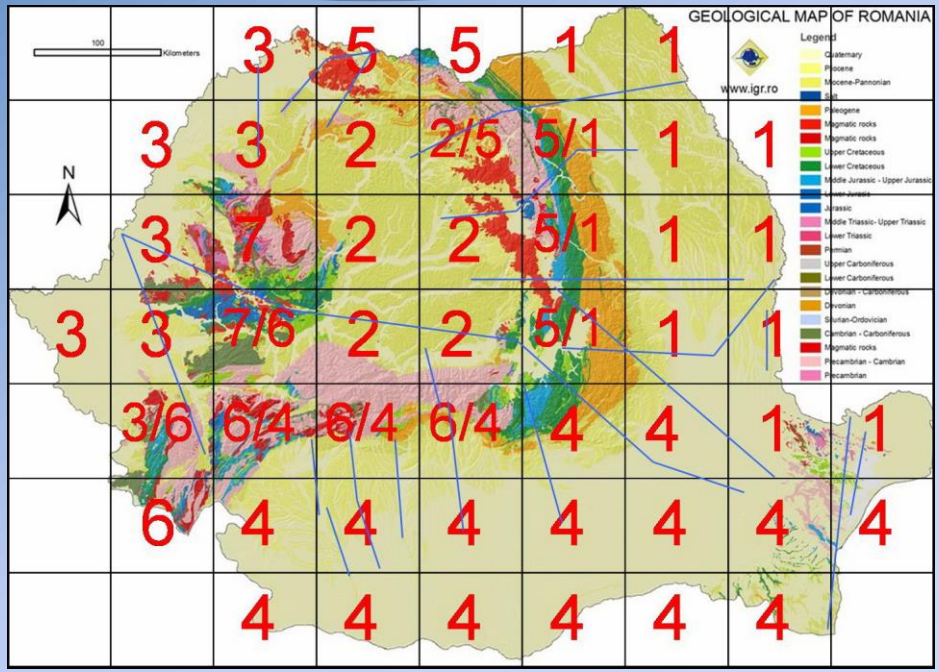


Figure 2: Conductance map of Europe, upper 80 km

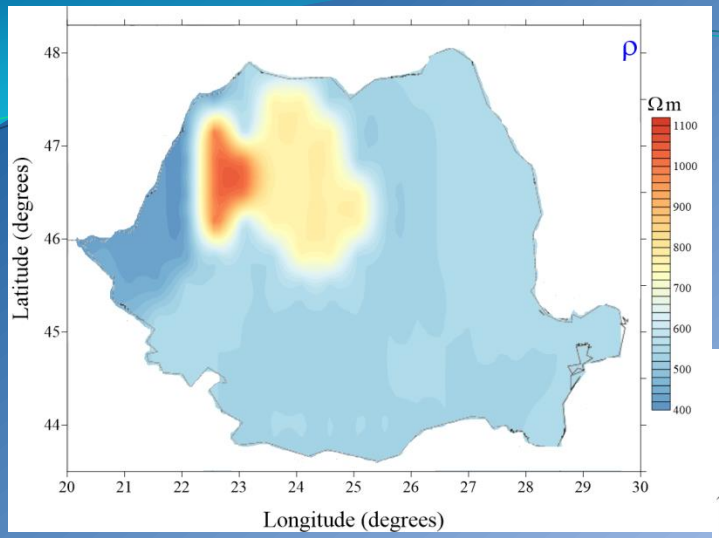
MT model of Adam et al. (2002)

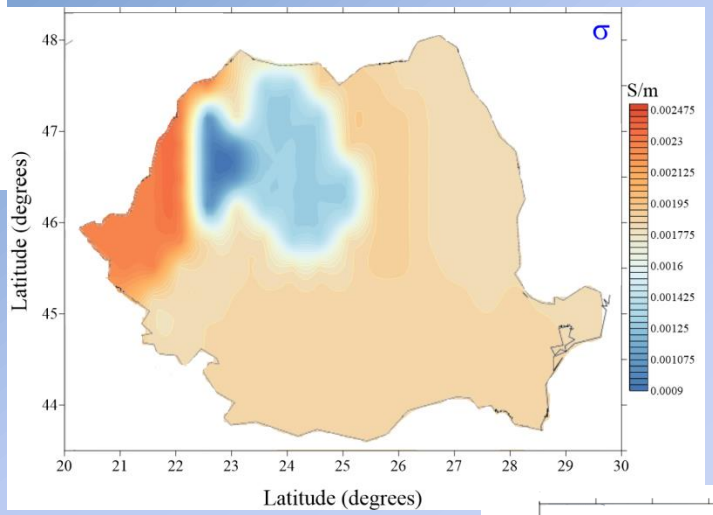


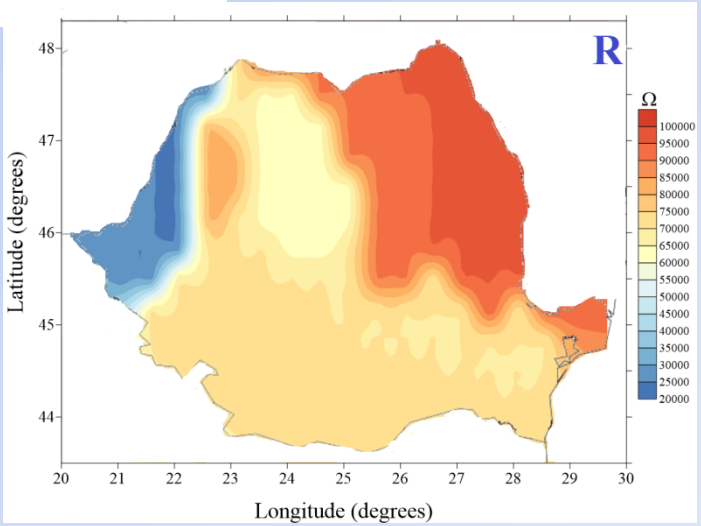
Geological map of Romania with the MT geotransects (blue lines) and square cells, numbered from 1 to 7, corresponding to the 1-D MT lithospheric models

Tectonic unit
East European Platform + Scythian Platform + Carpathian Foredeep + North-Dobrogean Orogen – 1
Transylvanian Depression - 2
Pannonian Depression - 3
Moesian Platform - 4
East Carpathians - 5
South Carpathians - 6
Apuseni Mountains - 7

Geoelectric structure of the Romanian underground



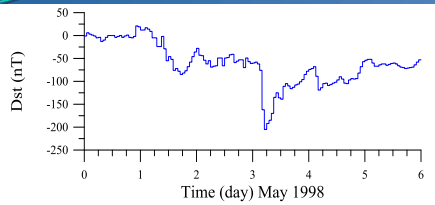


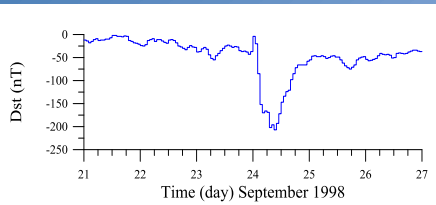


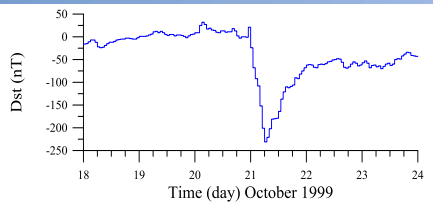
Stanica et al. (RRG, 2016)

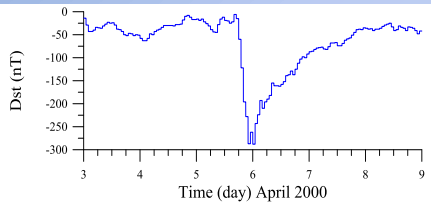
Geomagnetic storms

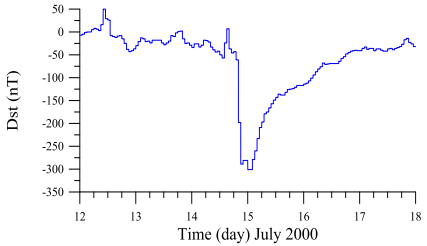
Intense (Dst < -150 nT) storms – solar cycle 23

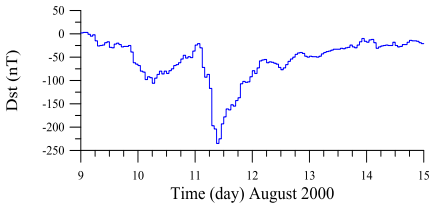


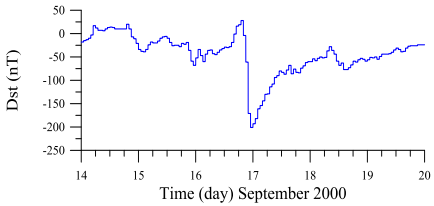


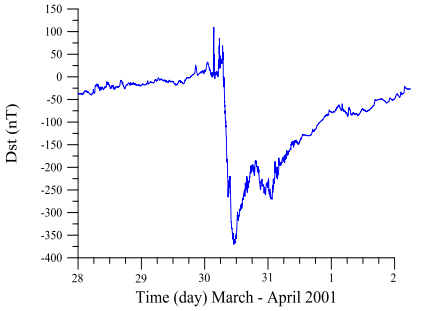


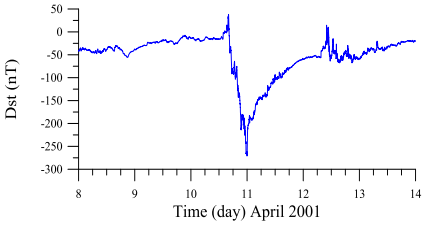


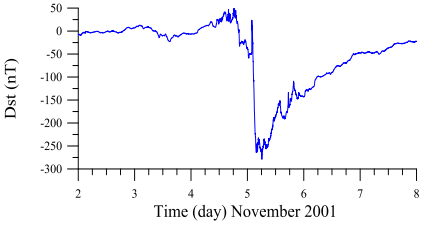


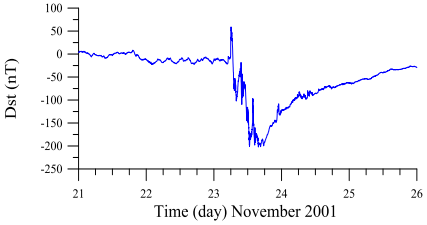




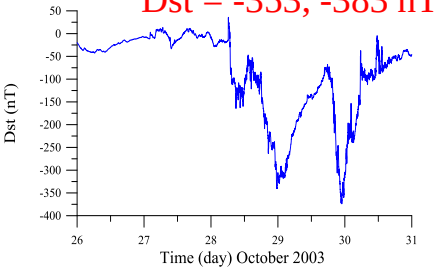




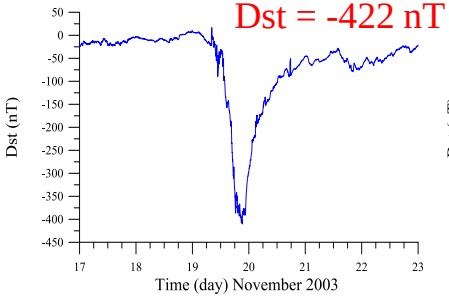


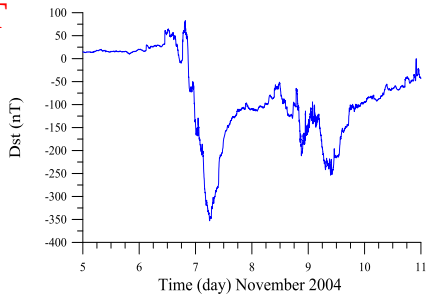


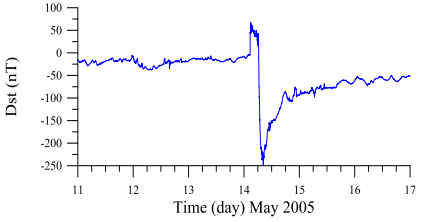
Dst = -353, -383 nT

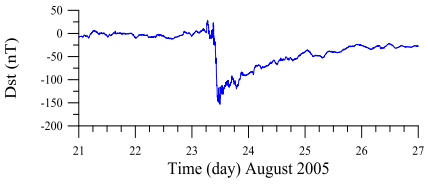


Dst = -422 nT

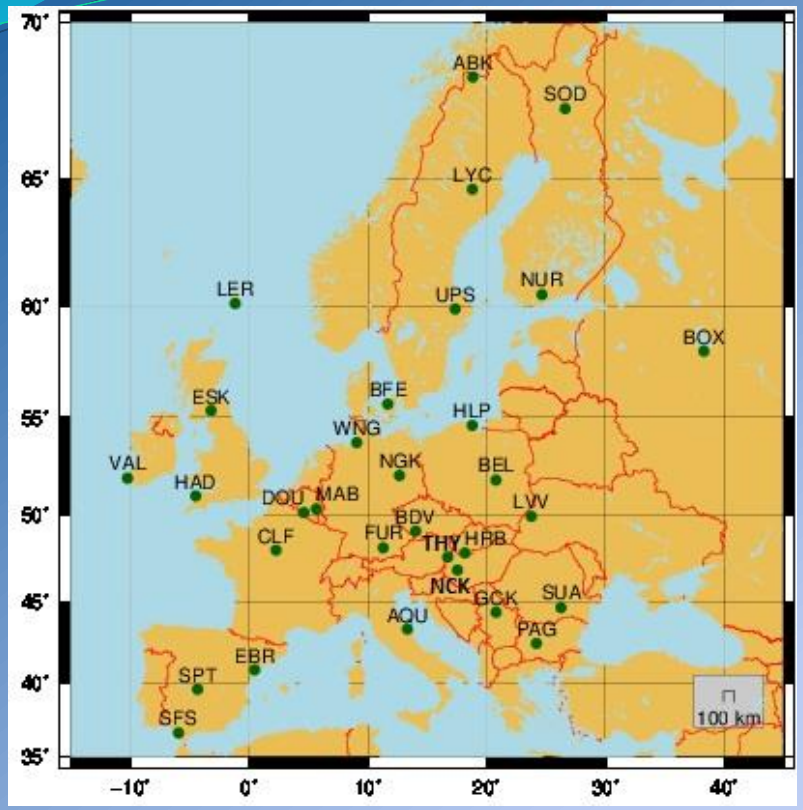






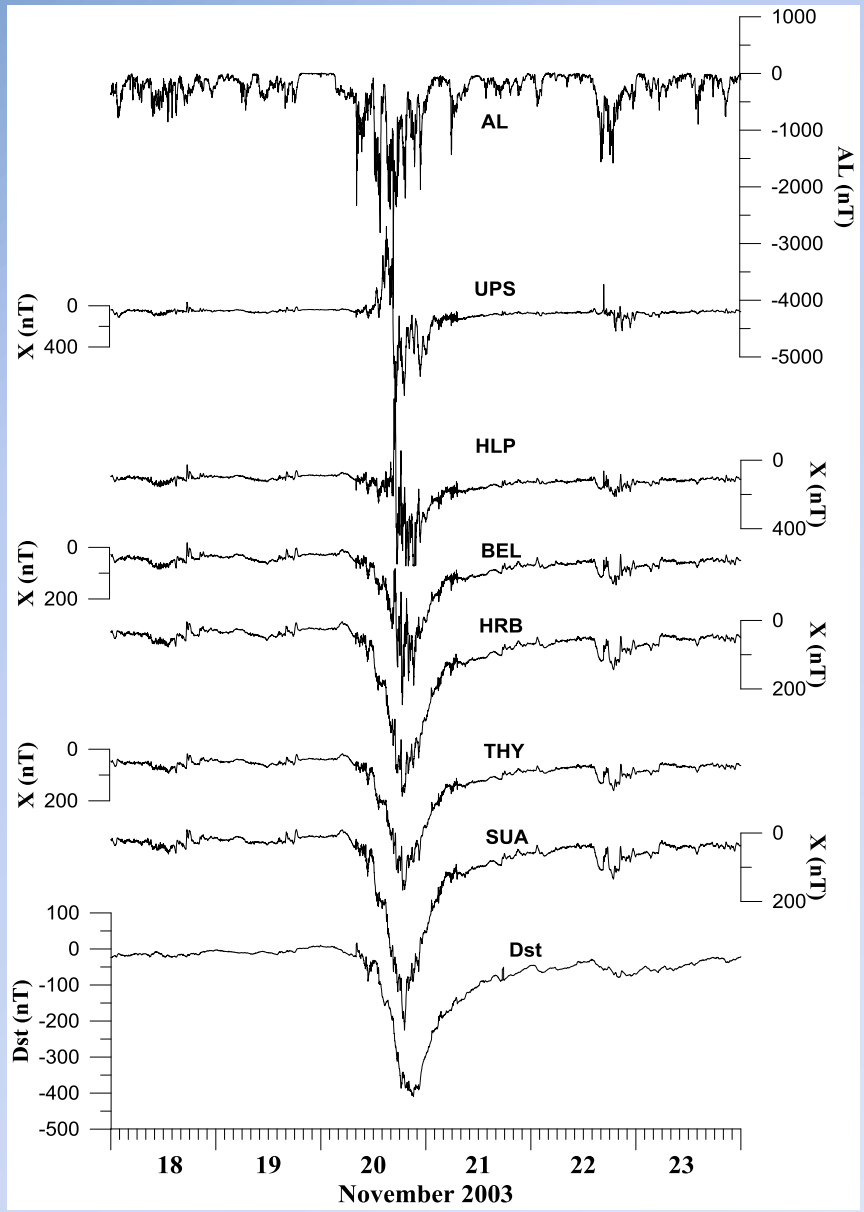


Geomagetic data – European geomagnetic observatories network



- 1-minute data for geomagnetic field components (www.intermagnet.org)

November 2003 storm
~105°E

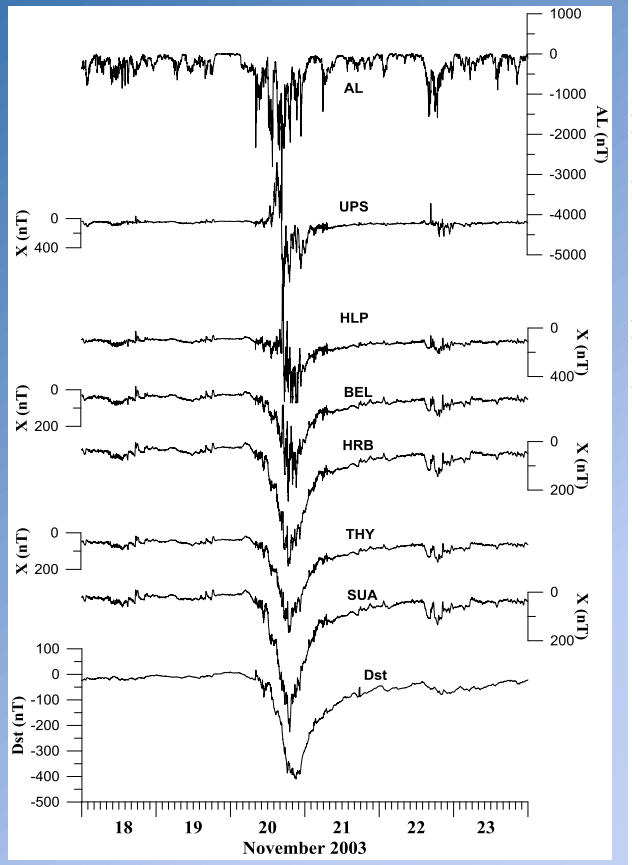


- the disturbance in X is 2-3 times larger at northern latitudes than at mid&southern latitudes;

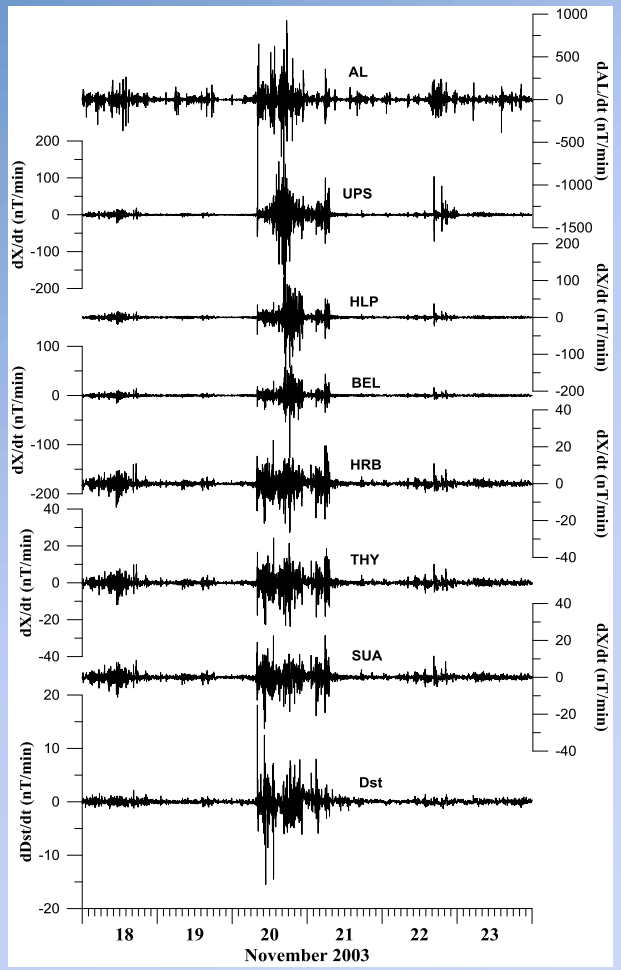
Surface geoelectric field (E)

November 2003 storm
~105°E

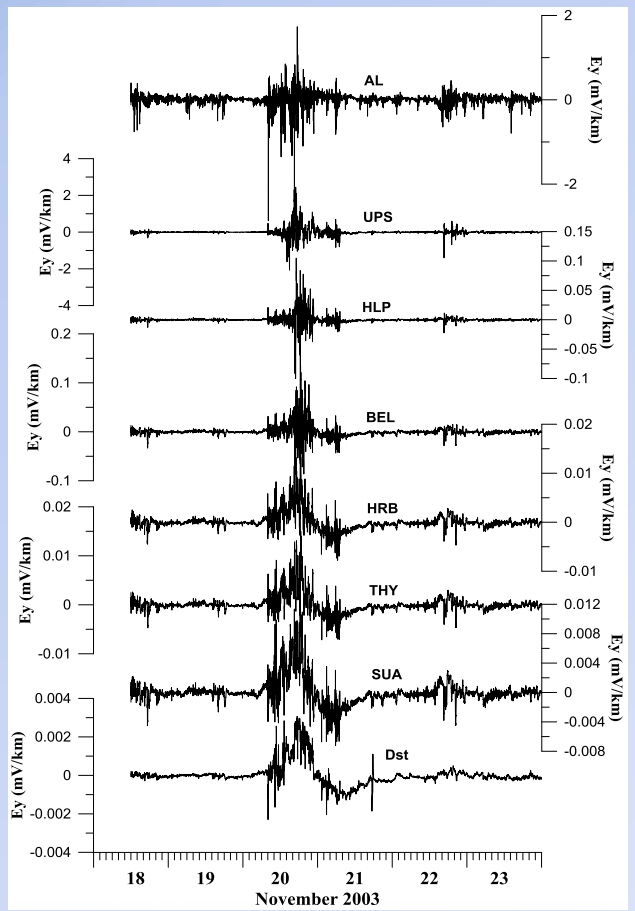
X (nT)



dX/dt (nT/min)



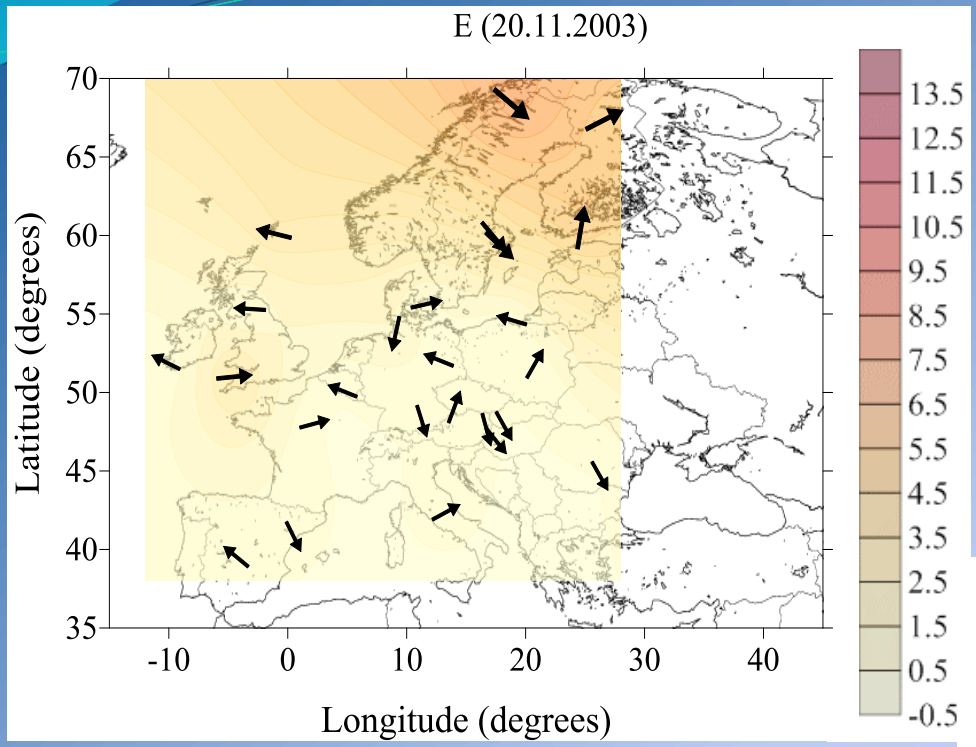
Ey (mV/km)



- hundreths of mV/km in case of SUA (45°N)
- 1-2 mV/km in case of UPS (60°N);

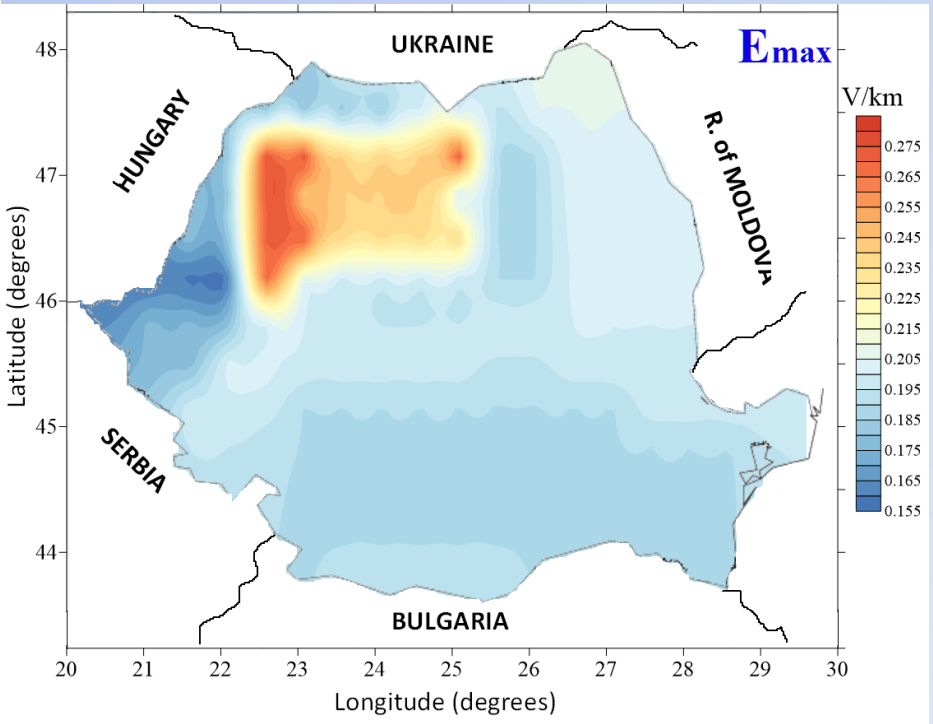
Surface geoelectric field – Emax (Geoelectric hazard maps)

November 2003, Dst = -422 nT



E max value is not reached at the same moment at all observatories and its orientation depends on that moment of the storm development. Field direction and magnitude – arrows centered on the geomagnetic observatory location

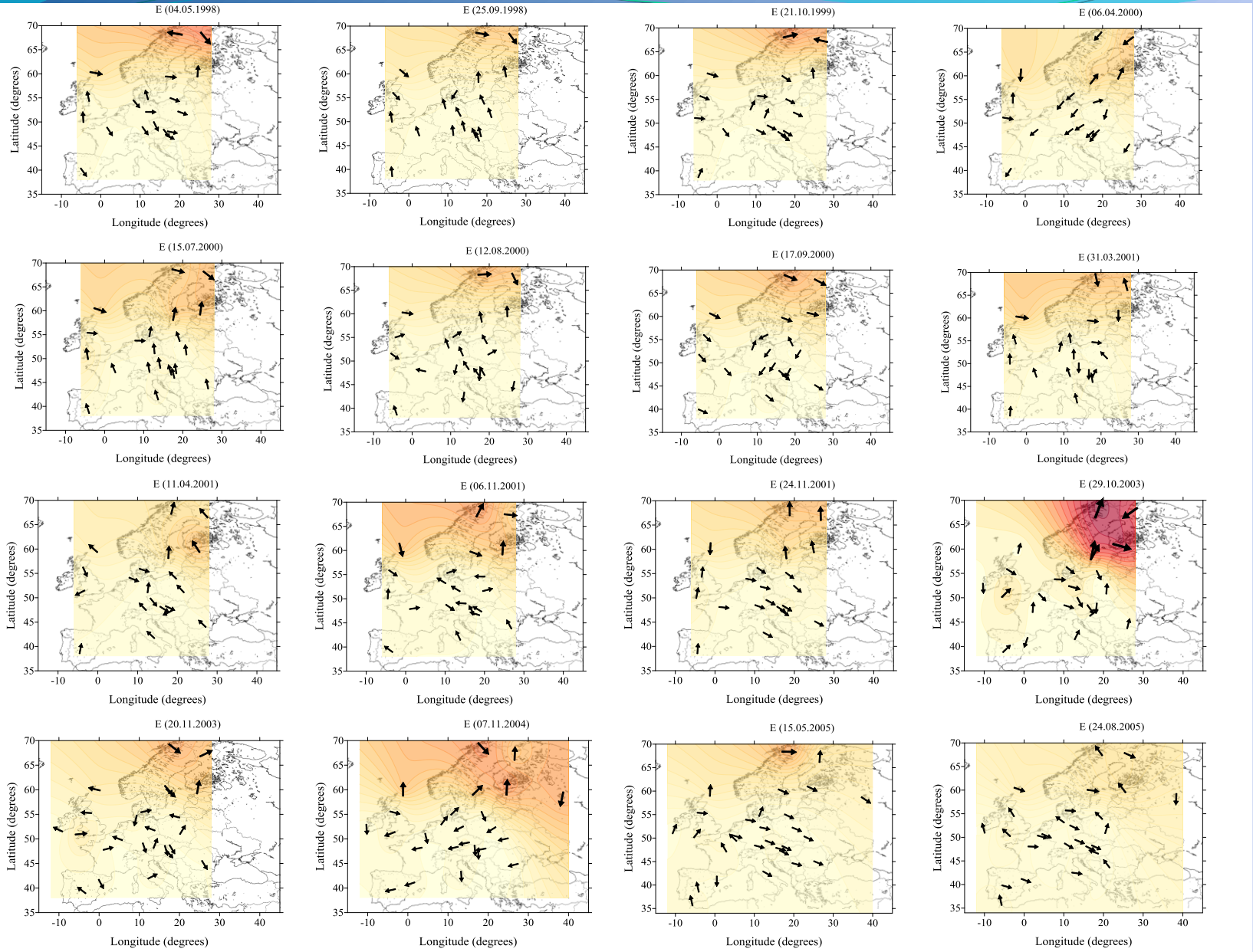
Field direction and magnitude – arrows centered on the geomagnetic observatory location



Dobrica et al. (RRG, 2016)

Geoelectric hazard (Emax maps)

- solar cycle 23 -



Dobrica et al. (Sun and Geosphere, 2016)

Concluding remarks

- the disturbance in X is 2-3 times larger at northern latitudes than at mid&southern latitudes;
- the more pronounced geoelectric component is directed East-West;
- the amplitude of the geoelectric field produced by magnetic variations is of the order of hundreths of mV/km in case of SUA (45°N), and of 1-2 mV/km in case of UPS (60°N);
- the maximum E value is not reached at the same moment at all observatories and its orientation depends on that moment of the storm development;
- the geoelectric hazard (GICs) is significant above the 50ºN (S) geomagnetic latitude;
- the future work: assesing Emax Romania for all intense storms of solar cycle 23; estimating effects of historical storms.