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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Geoelectric monitoring at the Boulder magnetic observatory" *by* Cletus C. Blum et al.

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General comments

The USGS team members are the prominent experts in geophysical network creation, data registration, collection and analysis. They are well-known for their hardware developments for various geophysical data acquisition, in particular, for the magnetic observatories supported by the USGS Geomagnetism Program. The research presented in this manuscript displays another serious achievement – the installation of a long-term basis geoelectric monitoring system and its first operational results. A concise title and a short abstract fully reflect the main contents of the manuscript. Nowadays there is a constantly growing need for efficient monitoring of natural hazards (such

as space weather disturbances, magnetic storms etc) that can have a serious negative impact on the functioning of modern technological systems. On the other hand, solar-terrestrial physics phenomena occurring due to the interaction of interplanetary magnetic field and the Earth's magnetosphere and ionosphere, and the geoelectromagnetic phenomena caused by geomagnetic activity, remain an important object of study. This makes the presented research fundamentally valuable, as well as the further results that will be obtained during this activity. Taking into account all that aspects, the scientific questions addressed in the paper are of certain relevance. The paper is written in a good scientific style, compendious and not overloaded with excessive terminology. The manuscript is quite brief and structured in even more brief sections depicting the essential results of the research. However, a detailed, clear and thorough description of the instruments and their installation is given, so that one can use this manuscript as a short introduction guide for the geoelectric monitoring network installation, highlighting the basic technical aspects. The authors properly indicate their own contribution and the technical solutions provided by different companies, such as Borin Manufacturing Inc. There are some concepts presented in the paper that could be profitable both for scientific tasks and for exploration geophysics. One of such concepts is the automatic power supply switch and charge system using the relays and a solar power source, which is a really smart solution. The images display the main items highlighted in the manuscript: the geoelectric monitoring array scheme, the close-up photos of electrodes and the data acquisition system, the schematic of electrodes and their positioning in the ground. A plot of the geoelectric (Ex, Ey) and geomagnetic (Bx, By) component time series registered during the storm that happened on October 12, 2016, clearly reveals the correlation between the electric and magnetic field. The described results will be absolutely useful for testing and validating algorithms for mapping geoelectric fields, as the authors mention in the abstract. Moreover, as it was said, the described methodology provides a perspective support for such tasks as geoelectric zoning, assessment of the hazards of geomagnetically induced currents, and various studies of geoelectromagnetic fields and their interaction.

Specific comments

- line 142. As mentioned in a conclusion at the end of “Using the data” section, the described geoelectric monitoring technology could provide remote reference data for regional magnetotelluric surveys (especially in the tasks of mapping of some high-resistivity ledges or basement rocks), although the best known reference for a magnetotelluric exploration survey is still the geological data including cross-section and drilling data. A geoelectric model obtained from the data inversion the way it is done in magnetotelluric data analysis could be possibly added to illustrate this conclusion. - The last section, “Operational aspects of long-term electric field monitoring”, gives a most proper description of the measurement array, the electrode positioning and the cable connection. However some technical issues were not mentioned. As it was mentioned in the paper, 60Hz notch filtering is used with a factor of about 20 dB to attenuate the power distribution network noise, and also a high pass filter is used to attenuate possible long-period signals caused by electrode drift and temperature effects. It would be interesting to reveal some more detailed aspects of that filter – its gain-frequency characteristic and slope, for example. It would be also interesting to see how the long-period geoelectric signal is distinguished from that caused by temperature instabilities and drifts. - Probably if some results of the silver-silver chloride electrode noise rate estimation and stability could be demonstrated and the corresponding plots depicting the test results could be given, that would add some more completeness to this research. Maybe these details are not quite significant, but they could arouse some curiosity among various professionals dealing with geoelectric measurements and, therefore, expand the audience. - Nevertheless, these comments do not impact the overall value of the presented research.

Technical corrections

Line 124: “Note, furthermore, that the consistency between the geoelectric time series for the 100 and 200-m dipoles”. – I think, “that” is a mistake here?

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