

COST Action – CA15211 "ElectroNet"

Application form for Short-Term Scientific Missions (STSM)

1. APPLICANT

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2. HOST

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3. STSM PERIOD: 5 February, 2017 – 12 February, 2017

4. DETAILED WORKING PLAN (1 to 3 pages):

4.1 Overall context and objectives of this proposal

The electric potential gradient (PG) measured near the surface of the Earth is a fundamental parameter of the global electric circuit (GEC). GEC comprises the electrically conductive surfaces of the Earth and the lower ionosphere, as well as the air between them. Natural charge separation in active thunderstorms and in electrified shower clouds supports a c.a. 250 kV potential difference between the two conductive surfaces in which large scale electric current systems transport charges to fair weather areas. In fair weather areas, the circuit is closed as the potential difference is getting relaxed by weak vertical currents flowing through the dielectric air (Rycroft et al., 2008).

The involvement of thunderstorms and the lower ionosphere enables studying climate variations, cloud properties, and space weather effects on the atmosphere through the analysis of easily measurable parameters of the GEC (Rycroft and Harrison, 2012).

While fair weather PG values are supposed to mirror the global state of the GEC, the measurements are not independent of local effects (Yaniv et al., 2016) and may show different trends in long term variations (Márcz and Harrison, 2005). PG is measured at several locations on the globe and also within Europe but with very different instrumentation. Even with careful calibration, the local environment of the measuring site can affect and bias the measured values. In order to be able to obtain valid findings, PG measurements, too, need to be carried out in a coordinated manner so that global and local effects in PG measurements can be reliably separated and analyzed.

PG measurements are going on practically continuously in the Széchenyi István Geophysical Observatory (NCK) of the Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences near Nagycenk, Hungary since 1961. The original measurements were done with locally developed systems which contain radioactive material

(Bencze and Märçz, 1981). Although the measuring systems have been running continuously, the records have not been processed recently. To make benefit of the valuable long term continuous PG measurements at NCK, a new generation of researchers, including the applicant, has started working on them. Recently, two Boltek EFM-100 field mills were purchased. One of these has been installed to record PG at a fixed location at NCK, while the other is kept portable and will be used to measure PG at different locations and in different environments.

The objectives of the proposed mission are

- preparing for coordinated PG measurement campaigns by making parallel measurements with the portable field mill from Hungary and the permanent field mill in the WISE observatory in Israel. The performance of the two equipments of different brands will be compared and the transfer function between the two field mills will be evaluated for later use in joint analysis of the absolute PG measurements at WISE observatory and at NCK.
- making PG measurements with the portable field mill at different locations in Israel to collect experience on operating a PG sensor in different environments. Data will be collected in the WISE observatory in the Negev Desert, in the Mt. Hermon monitoring site in North Israel, and in Tel Aviv in urban area.
- participation of the applicant on the Batsheva de Rothchild Seminar on The Atmospheric Global Electric Circuit to be held in Israel during within the time frame of the mission. The topics of the seminar cover the organization and coordination of the international scientific work which is based on joint measurements of various parameters of the GEC.

References:

- Bencze, P, and F. Märçz, 1981, The Geophysical Observatory near Nagycenk. II. Atmospheric electric and ionospheric measurements, *Acta Geodaet., Geophys. et Montanist. Acad. Sci. Hung. Tomus 16 (2—4)*, pp. 353—357
- Märçz, F. and R.G. Harrison, 2005, Further signatures of long-term changes in atmospheric electrical parameters observed in Europe, *Annales Geophysicae*, 23, pp. 1987–1995, doi:10.5194/angeo-23-1987-2005
- Rycroft, M. J., R.G. Harrison, K.A. Nicoll, E.A. Mareev, 2008, An Overview of Earth's Global Electric Circuit and Atmospheric Conductivity, *Space Sci. Rev.*, 137: 83–105, doi:10.1007/s11214-008-9368-6
- Rycroft, M.J. and R.G. Harrison, 2012, Electromagnetic Atmosphere-Plasma Coupling: The Global Atmospheric Electric Circuit, *Space Sci. Rev.*, 168:363–384, doi:10.1007/s11214-011-9830-8
- Yaniv, R., Y. Yair, C. Price, S. Katz, 2016, Local and global impacts on the fair-weather electric field in Israel, *Atmospheric Research*, Vols. 172–173, pp. 119–125, doi: 10.1016/j.atmosres.2015.12.025

4.2 Reason for choosing the host institute

PG measurements are continuously going on in the WISE observatory for several years now under the supervision of the atmospheric electricity (AE) group in Tel Aviv University. The location of the site in the desert is ideal for making AE measurements in contrast to NCK where the possible influence of vegetation and that of the relatively near buildings is present. Comparing the PG measurements at NCK to those made in the WISE observatory can serve well in determining the necessary correction factors to be applied on the NCK records for the correct global evaluation of the GEC.

The AE group of Tel Aviv University has achieved important new results in interpreting the locally observed variation of the measured PG parameters (e.g., Yaniv et al., 2016). This group is now organizing the Batsheva de Rothchild international seminar on the atmospheric GEC. With expert GEC researchers from all over the world participating in the seminar, this meeting is an important event for all researchers interested in studying the GEC.

Note that also a Schumann resonance (SR) monitoring facility is working both in the WISE observatory and in NCK observatory. As SR observations, too, are considered in this COST action, visiting the AE research group makes it possible to discuss the coordination and possible joint analysis of SR measurements in addition to those of PG.

4.3 Detailed work plan

05 February, 2017: Arrival to Tel Aviv

06-10 February, 2017: Attending the AE seminar and making PG measurements during the meeting: at WISE observatory 6-9 February, at Mt. Hermon site 10 February, and in Tel Aviv 10-11 February

12 February, 2017: Leaving Israel

4.4 Potential outcomes and relevance to COST

Upon successful completion of the mission objectives, absolute matching of the PG measurements at two recording sites separated by global distances will be possible for the first time in Europe. This would be an important step in the implementation of the objectives of the COST Action which include developing networked operation and coordinated processing of AE measurements. As the applicant is involved both in WG1 (AE network) and in WG3 (Climatic relevance) of the Action, experiences gained during the field measurements and on the AE seminar will facilitate the scientific work related to the topics of the mission both at the applicant's home institute and in the host institute. The exchange of know-how and ideas during the seminar is of invaluable importance from the point of view of planning the related scientific work in the next years since the Action will still be near its start at the time of the proposed mission.

5. PUBLICATIONS : list up to 3 of your publications that are relevant to this STSM (if there are any)
- Sátori, G., Rycroft, M, Bencze, P., Márcz, F., Bór, J., Barta, V., Nagy, T., Kovács, K., 2013, An Overview of Thunderstorm-Related Research on the Atmospheric Electric Field, Schumann Resonances, Sprites, and the Ionosphere at Sopron, Hungary, *Surveys in Geophysics*, Volume 34, Issue 3, 2013, Pages 255-292, doi: 10.1007/s10712-013-9222-6
- Nickolaenko, A.P., Schekotov, A.Yu. , Hayakawa, M., Hobara, Y., Sátori, G., Bor, J., Neska, M., 2014, Multi-point detection of the elf transient caused by the gamma flare of december 27, 2004, *Radiophysics and Quantum Electronics*, Volume 57, Issue 2, Pages 125-140, doi:10.1007/s11141-014-9498-5
- Yaniv, R., Yair, Y. , Price, C., Bór, J., Sato, M., Hobara, Y., Cummer, S., Li, J., Devir, A., 2014, Ground-based observations of the relations between lightning charge-moment-change and the physical and optical properties of column sprites, *Journal of Atmospheric and Solar-Terrestrial Physics*, Volume 107, Pages 60-67, doi:10.1016/j.jastp.2013.10.018
6. DETAILED BREAKDOWN OF THE GRANT REQUEST: indicating amounts in EUR and national currency, as requested from COST office (travel costs, subsistence allowance, and indication of contribution from other sources).
- Travelling by Airplane: 500 EUR
- Conference Fee (includes participation fee, local transportation, accommodation, and full board): 1500 EUR
- One additional night in Tel Aviv: 100 EUR (410 ILS)
- Airport transfer: 50 EUR (200 ILS)
- Total cost: 2150 EUR
7. SHORT CV OF THE APPLICANT (including present address) : sent with e-mail
8. ACCEPTANCE LETTER BY THE HOST INSTITUTION : sent with e-mail