Scientific report of the Short Term Scientific Mission (STSM)

STSM title: Parallel measurement with two Field Mill instruments at the Swider Geophysical Observatory

COST Action: CA15211

Reference: ECOST-STSM-CA15211-280317-082913

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3. STSM PERIOD: 28 March 2017 to 2 April 2017

Overall context and objectives of the STSM

A long-term (1962–2001) decrease has been identified in the potential gradient (PG) measured in the Széchenyi István Geophysical Observatory (SZIGO) at Nagycenk [Märcz and Harrison, 2003] suggesting that this variation is partly attributed to a global change in the atmospheric electricity related to a decline in cosmic rays and also to a local shielding effect due to the growing trees

However Williams et al. [2005] claimed that the long-term field decline can exclusively be explained by the shielding effect of the growing trees at Nagycenk.

Recently a measurement series have been performed by two (a stationary and a portable) Field Mill instruments in order to disclose the impact of the local observatory circumstances (buildings, trees etc.) on the atmospheric electricity measurements.

The objectives of the present proposal are:
- Inter-calibrate the Field Mill (BOLTEK 100, it was used as the portable device during the measurement series) instrument of Geodetic and Geophysical Institute (Hungary) measuring the electric field in parallel with the Field Mill instrument installed at Swider Observatory
- Measuring the same global atmospheric electric circuit parameter with different instruments at the same place
- To perform a similar measurement series by the same (portable) Field Mill instrument at Swider Observatory which have been done at SZIGO in order to survey and identify local factors that influence PG measurements on a given site

The work carried out during the STSM

I. Tuesday 28.3.2017 (afternoon): Arrival to Warsaw, meet the host scientist, Anna Odzimek and occupy the room at the accommodation.

II. Wednesday 29.3.2017: Welcome meeting at the Institute of Geophysics, Polish Academy of Sciences (IGF PAS), introduction to the work and research at IGF PAS and the Geophysical Observatory in Swider. Presentation of the results of the measurement series which have been performed at SZIGO. Discussion of the practical issues of the implementation of the same measurement series at Swider.

III. Thursday 30.3.2017: Go to Swider Geophysical observatory. Familiarization with the operation of the different atmospheric electricity measurements at the Swider observatory, especially the measurement sites and the operation method.

IV. In order to intercalibrate the portable BOLTEK EFM 100 Field Mill and the Field Mill installed at the Swider observatory. At Swider observatory the atmospheric electric field is measured by a rotating dipole type field mill [Berlinski et al. ICAE2017]. I will call it in my report as "the Static Field Mill" instrument. Parallel measurements have been performed with the BOLTEK and the Static Field Mill devices.
    - 1st parallel measurement: 15:00 (UTC), 30.3.2017 – 08:30 (UTC), 31.3.2017 The head of the BOLTEK EFM 100 was located at the ground as you can see at the Fig. 1.

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Fig. 1. 1st parallel Field Mill measurement at Swider, the head of the BOLTEK is at the ground.

Preliminary result:

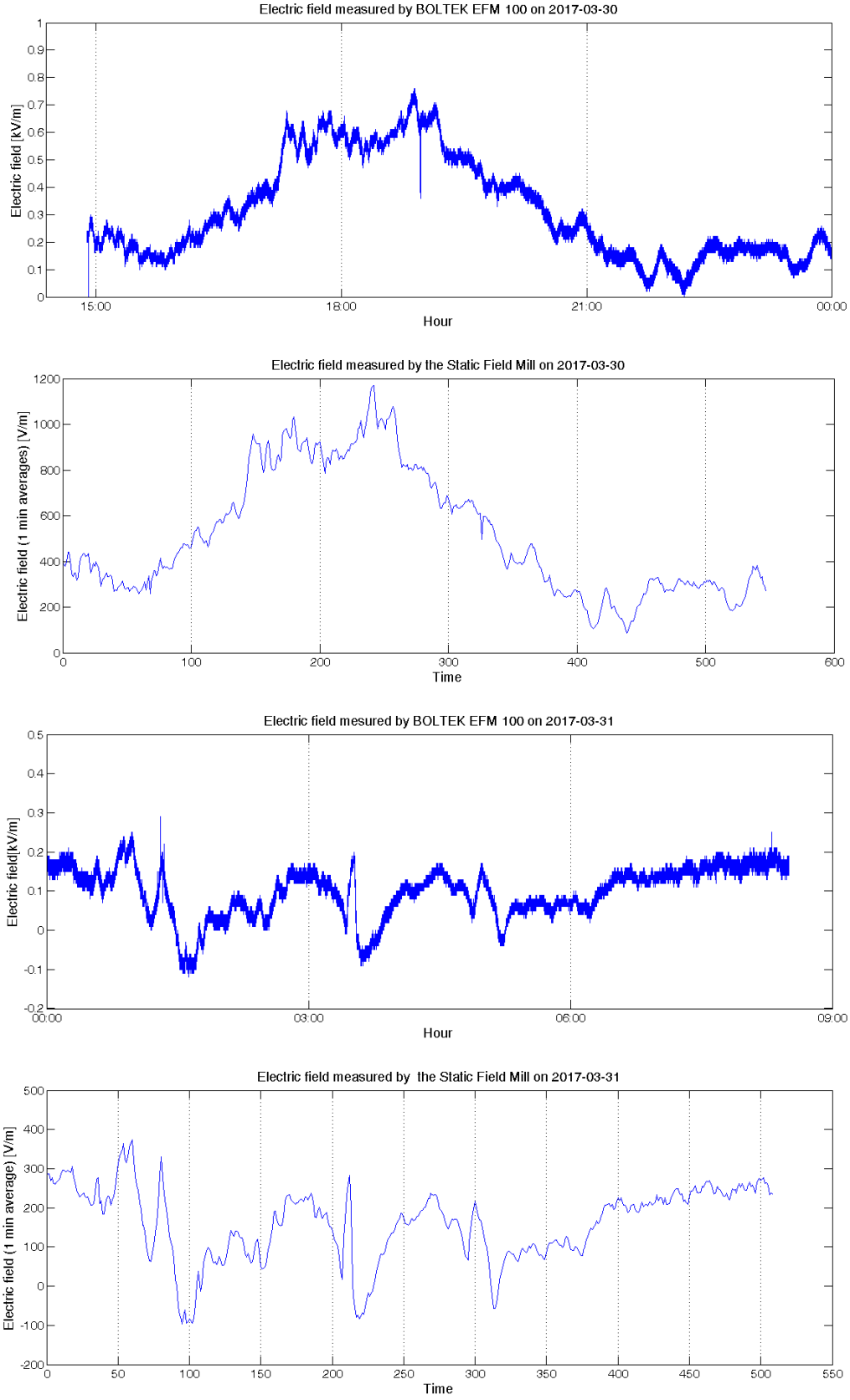


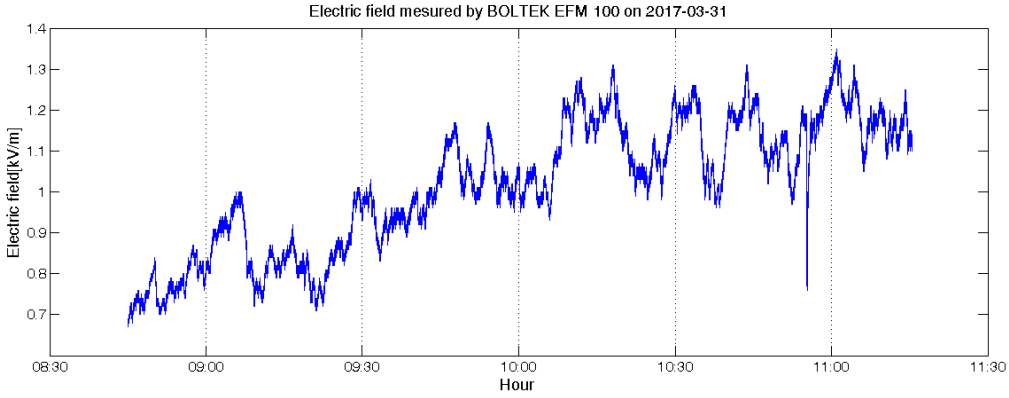
Fig. 2. Preliminary results of 1st parallel Field Mill measurement at Swider by BOLTEK EFM 100 and the Static Field Mill devices, the head of the BOLTEK was at the ground.

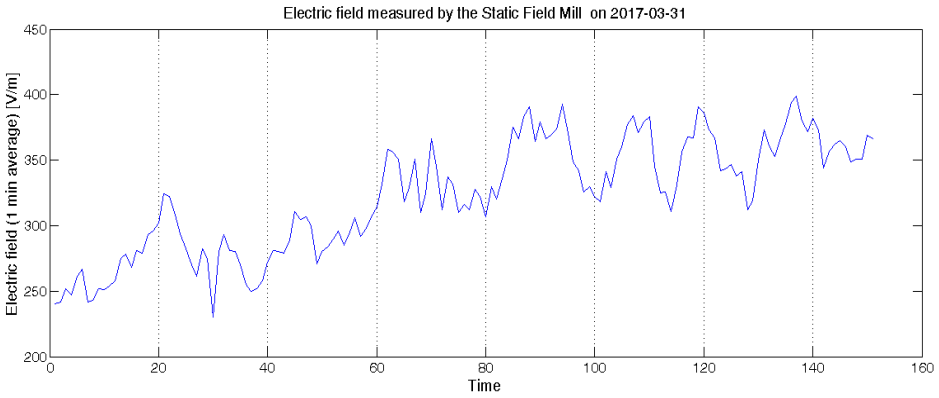
According to the preliminary results the variation of the electric field (E field) measured by the BOLTEK EFM 100 and the Static Field Mill devices were very similar (Fig. 2.). In this case the magnitude of the E field measured by the two instruments were similar as well. The signal measured by the BOLTEK is quite noisy. The reason of that can be that in the case of the 1st parallel measurement the head of the BOLTEK device was at the ground.

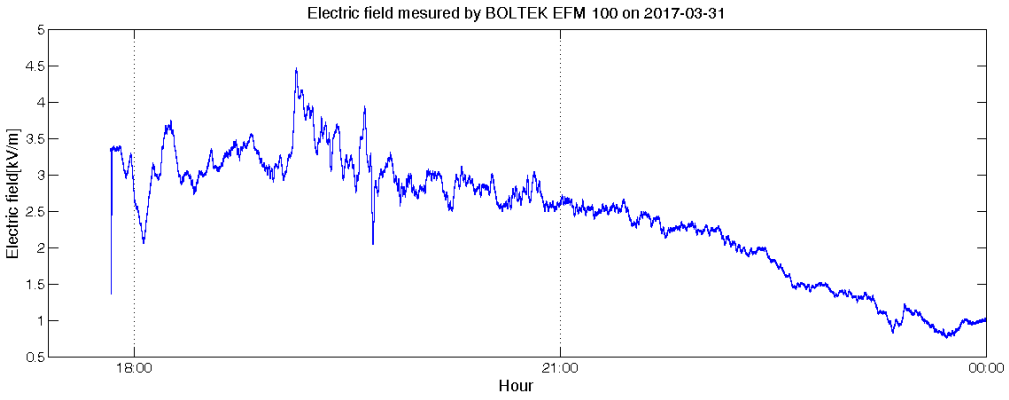
- 2nd parallel measurement: 08:45 – 11:15 (UTC) 31.3.2017, and 17:50 (UTC) 31.3.2017 – 10:05 (UTC), 1.4.2017
  The head of the BOLTEK EFM 100 was located at 1 m (Fig. 3.)

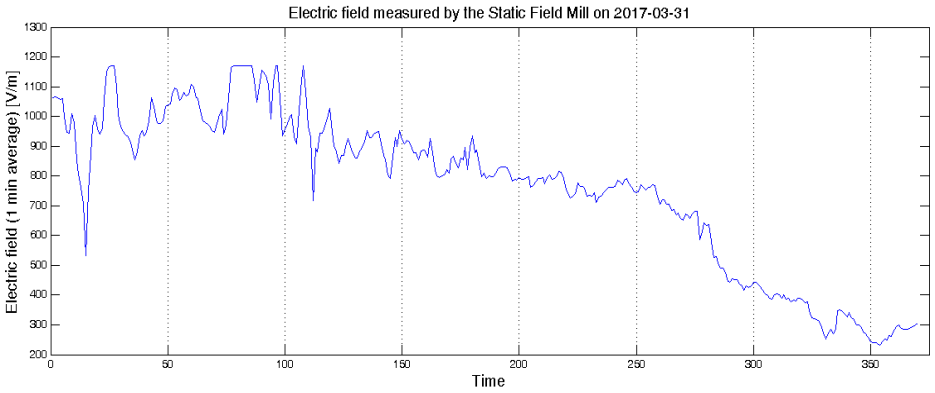
Fig. 3. 2nd parallel Field Mill measurement at Swider, the head of the BOLTEK is at .1 m.

Preliminary results:









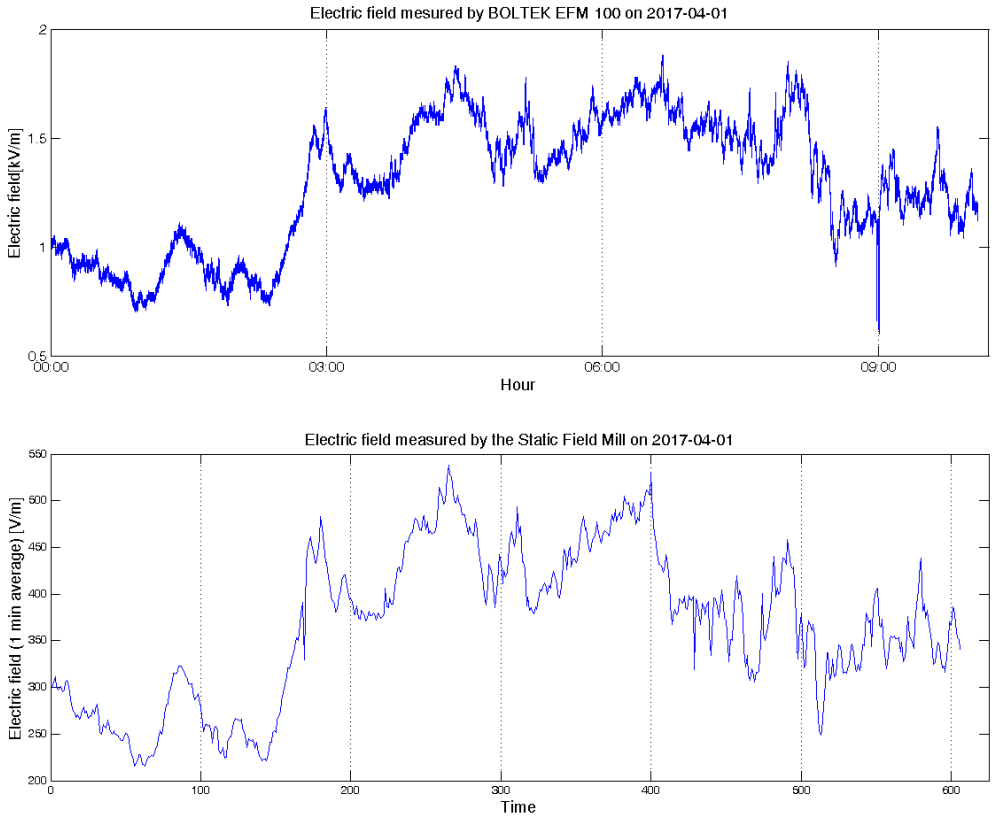


Fig. 4. Preliminary results of 2nd parallel Field Mill measurement at Swider by BOLTEK EFM 100 and the Static Field Mill devices, the head of the BOLTEK was at 1m.

The variation of the electric field measured by the BOLTEK EFM 100 and the Static Field Mill devices were very similar (Fig. 4.) in this case as well. However, the magnitude of the E field measured by the BOLTEK EFM 100 was ~ 3 times higher than what was detected by the Static Field Mill. Furthermore the signal observed by BOLTEK was less noisy than in the previous case. The reason of both phenomena can be that the head of the BOLTEK Field Mill was at 1 m in this case.

- 3rd parallel measurement: 12:20 – 13:50 (UTC) 1.4.2017
  The head of the BOLTEK EFM 100 was located at the same height as the head of the Static Field Mill device, at 2 m (Fig. 5.)

Fig. 5. 3rd parallel Field Mill measurement at Swider, the head of the BOLTEK is at .2 m.

Preliminary results:

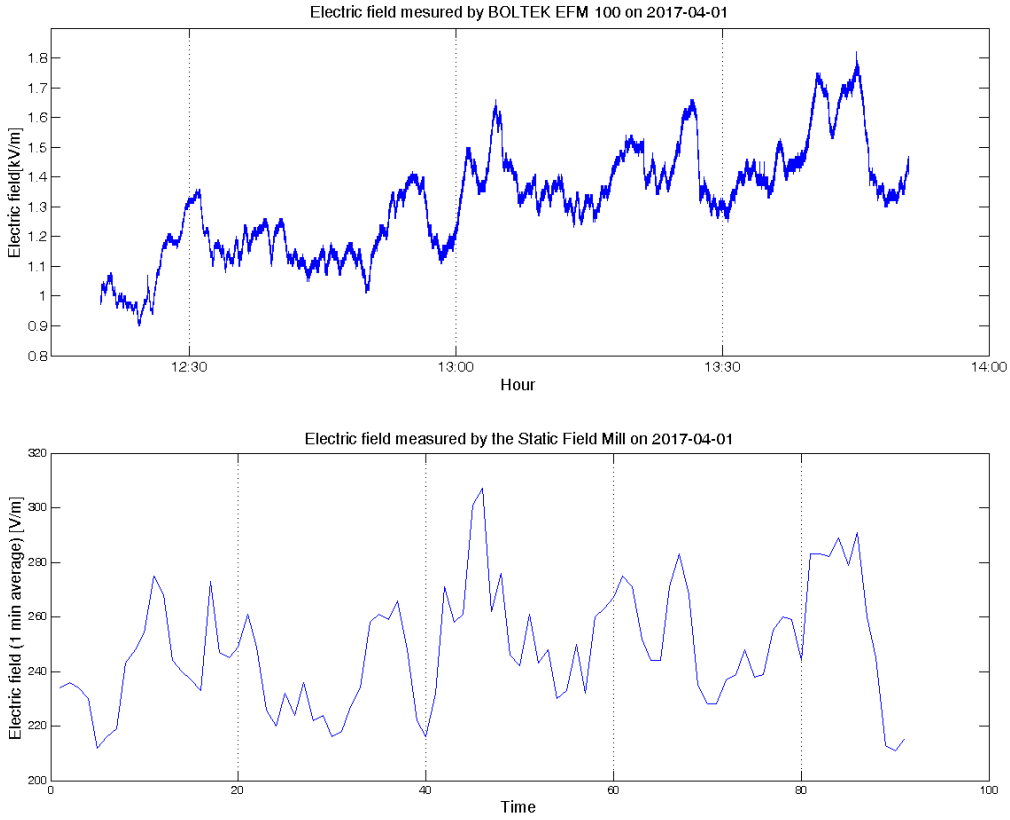


Fig. 6. Preliminary results of 3rd parallel Field Mill measurement at Swider by BOLTEK EFM 100 and Static Field Mill devices, the head of the BOLTEK was at 2m.

The variation of the electric field measured by the BOLTEK EFM 100 and the Static Field Mill devices showed some similarities in this case as well (Fig. 6.). Although there is an increasing trend in the BOLTEK data which is not clearly seen in the registration of the other Field Mill. Furthermore, the magnitude of the E field measured by the BOLTEK EFM 100 was ~ 5 times higher than what was detected by the Static Field Mill despite the fact that the head of the two devices were located at the same height (at 2 m) in this case.

- 4th parallel measurement: 15:50 – 16:02 (UTC), 1.4.2017.
  The head of the BOLTEK EFM 100 was entrenched into the ground, the rotating part was located in the level of the ground as it is seen on the Fig. 7.

Fig. 7. 4th Parallel Field Mill measurement at Swider, the rotating part of the head is at the ground level

Preliminary results:

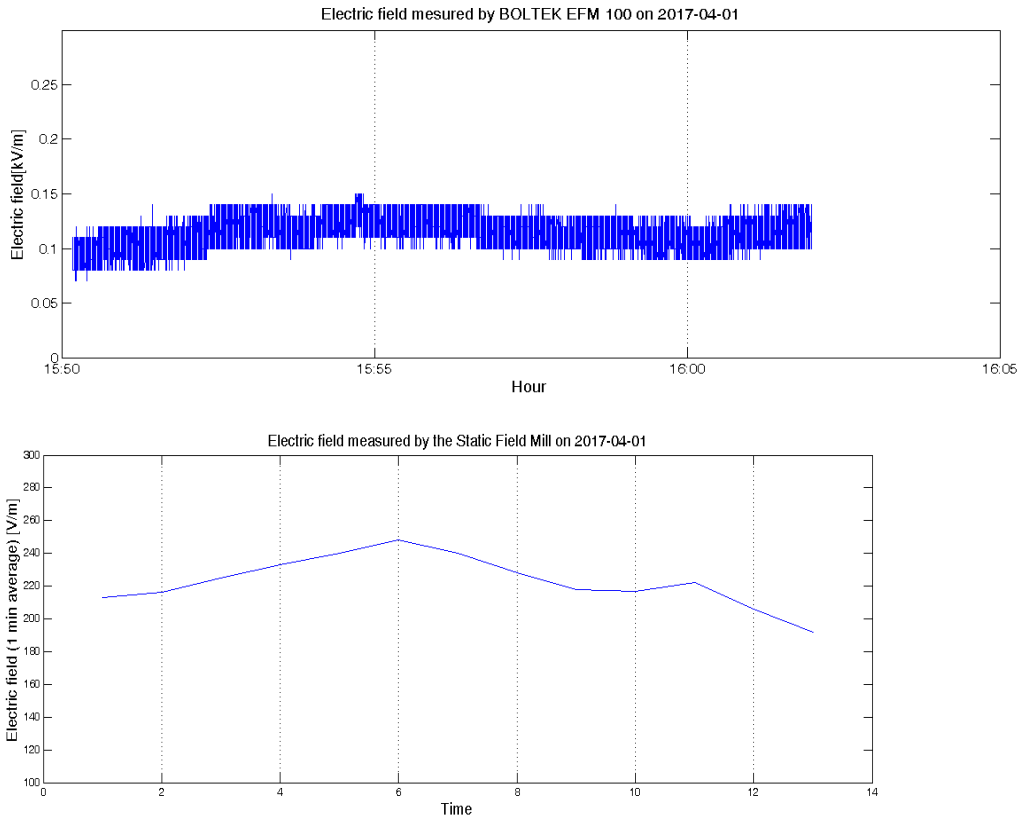


Fig. 8. Preliminary results of 4th parallel Field Mill measurement at Swider by BOLTEK EFM 100 and the Static Field Mill devices, the head of the BOLTEK EFM 100 was entrenched into the ground, the rotating part was located at the ground level.

The variation and the magnitude of the electric field measured by the BOLTEK EFM 100 and the Static Field Mill devices were similar (Fig. 8.). Although the Static Field Mill detected a little bit higher electric field in this case. Furthermore the signal measured by the BOLTEK is quite noisy. The reason of that can be in this case as well, that the head of the BOLTEK device was at the ground level again.

V. A similar measurement series has been repeated at Swider Observatory on 2017-03-31 and 2017-04-01 which has been done at SZIGO in order to survey and identify local factors that influence PG measurements on a given site. The measurement series has been performed by the same (portable) Field Mill instrument which was used at the SZIGO observatory.
The atmospheric electricity measurement can be influenced by the shielding effect of trees and buildings (Fig. 10.) in the observatory during this measurement series. To study these impacts the E field has been observed in 50 different measurement point along three lines. The BOLTEK Field Mill has been left for three minutes to observe the E field in every point. The sketch of the observation site is seen on Figure 9. Some photos, which have been taken during the measurement series, are reported as well (Fig. 10.).

Fig. 9. The sketch of the measurement series (50 point along three lines) which has been performed at the Swider observatory. The measurement profiles are seen with red, furthermore the buildings, trees and the other instruments are seen as well.

Fig. 10. The BOLTEK EFM 100 measures the E field at different points which can be affected by local circumstances (trees (a.), other Field Mill (b.) or buildings (c.))

Preliminary results:

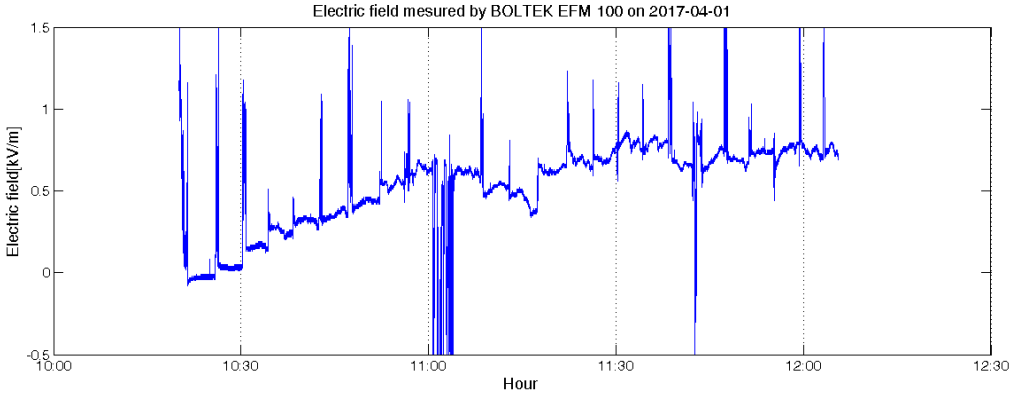


Fig. 11. The electric field measured along the 1st line, started from the trees on 2017-04-01.

The variation of the electric field measured by the BOLTEK EFM 100 along the 1st profile (Fig. 9) on 2017-04-01 is shown on Figure 11. Although the observed values haven't been compared with the E field measured by the Static Field Mill yet the shielding effect of the trees can be clearly seen in the preliminary results as well. The measured atmospheric electric field is reduced close to the trees (Fig. 10a.) and it increases step-by-step moving away from the trees. There is a reduction again at ~ 11:15 which can be caused by the shielding effect of the two building (Fig. 10c.).

Planned future work related to the STSM

Thanks to the parallel measurements which have been performed the transfer functions between the Static Field Mill instrument and the portable PG (BOLTEK) sensor can be determined. Furthermore, since the head of the BOLTEK EFM 100 instrument was located at different heights above the ground level during the different parallel measurements the scale factor can be defined as well.

After the determination of the transfer function the impact of the local circumstances (trees, buildings etc.) can be studied thanks to the measurement series which has been performed on 2017-03-31 and on 2017-04-01. The results will be compared with the previous observations which have been done at SZIGO observatory. The shielding effect caused by the trees and buildings at given site will be determinable.

Experiences gained during the STSM and the results of the planned comparative analyses are planned to be disseminated in appropriate scientific journals.

Acknowledgements

The grantee thanks Anna Odzimek and Marek Kubicki their great help in the realization of the STSM. The grantee is grateful to the MC and STSM committee of the Action for supporting his application.

Sopron, Hungary, 26th April, 2017.

Barta Veronika

Veronika Barta

Institute of Geophysics
Polish Academy of Sciences

27 April 2017

Statement of agreement on CA15211 STSM Report – Veronika Barta

I hereby confirm the acceptance by the host institution of the final report on the Short-Term Scientific Mission (STSM) of Dr Veronika Barta from Geodetic and Geophysical Institute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences, in the framework of COST Action CA15211 "Atmospheric Electricity Network: coupling with the Earth system, climate and biological systems".

The work plan of Dr Barta's STSM was carried out as described in the STSM proposal and report and the main objectives of the STSM were achieved.

This STMS will definitely foster further collaboration and scientific exchange between the two institutions in the field of observations of atmospheric electricity and atmospheric electric field measurements.

Anna Odzimek

Institute of Geophysics PAS

STSM host

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