

Research Networking Programmes

Short Visit Grant ⊠ or Exchange Visit Grant □

(please tick the relevant box)

Scientific Report

Scientific report (one single document in WORD or PDF file) should be submitted online within one month of the event. It should not exceed eight A4 pages.

Proposal Title: Studying thunderstorm-ionosphere relationships by ionograms

Application Reference N°: 5751

1) Purpose of the visit

Meteorological processes (cold fronts, mesoscale convective complexes, thunderstorms) in the lower atmosphere can affect the ionosphere through the electrical and electromagnetic phenomena (red sprites, blue jets etc.) and upward propagating waves in the neutral atmosphere, like Atmospheric Gravity Waves (AGWs) and Infrasound waves. The purpose of the short term visit was to study the thunderstorm-sprites-ionosphere mechanical and electromagnetic coupling mechanisms. Ionograms recorded by the Digisonde DPS4.5 at Pruhonice belonging to the Institute of Atmospheric Physics in Prague have been studied in those time intervals when TLEs were observed from Sopron, Hungary in the vicinity of the ionosonde station during thunderstorms. This would mean possibility to disclose further thunderstormionosphere coupling mechanisms. Furthermore in Pruhonice there is ionospheric Doppler measurement which we can study the effect on the ionosphere of different type of waves generated by thunderstorms.

2) Description of the work carried out during the visit

(i) In the ionospheric Doppler data I searched signes of waves which could be generated by thunderstorms or other meteorological processes during period of the last solar minimum (2008-2009). To identify the meteorological systems LINET lightning data and METEOSAT-9 infrared maps were used in this work. Between 2007 and 2009 184 TLEs especially sprites were observed from Sopron, Hungary above Czech Republic

and his vicinity. In the Doppler data I tried to find signes of AGWs and Infrasound waves which can be related the thunderstorms that produced the TLEs.

- (ii) Between 2007 and 2009 three huge (when we observed more than 20 TLEs above them) thunderstrom was chosen for event studies. We will study the ionograms recorded by the Digisonde DPS4.5 at Pruhonice during the period of the thunderstorms.
- (iii) Measurements related to thunderstorm were performed in Pruhonice in two campaigns of the summer, 2013 on 29th of May (09:50 15:25) and on 20th of June (18:00 24:00). During those two periods of the campaign the ionograms were recorded in every minutes. Those two cases were good occasion for the study of the thunderstorm related variations in the ionosphere. Furthermore during the night of 20th of June 38 sprite were observed from Sopron, Hungary above the thunderstorm which passed through the Czech Republic. During the period of the short term visit I have started to manually validate the ionograms of these two campaigns.

3) Description of the main results obtained

A couple of wave like structure have been found in the Doppler data that could be related to thunderstorms or other meteorological systems. Three cases of them have been analyzed in details till now.

- On 8th of Agust, 2008 between 4am and 5am a couple of AGWs have been found with dominant period about 10 minutes. As for propagation characteristics, the observed waves propagated roughly to northeast (Azimuth from ~15 to ~40), horizontal velocity of propagation from ~100 to ~250 m/s, but there are large uncertainties here, because of low quality of signal. According to the results of the analysis the source of the waves could be the thunderstorm which was in the South East territory of Germany and in Austria a couple of hours before. Above that thunderstorm we observed 26 TLEs between 21:08 and 23:35 on 7th of August from Sopron, Hungary.
- On 16th of July, 2009 between 20am and 21am a couple of huge AGWs have been found with dominant period about 15 minutes. Regarding to the propagation characteristics the waves propagated roughly to north-east-east (Azimuth from ~50 to ~70), the horizontal velocity is from ~150 to ~ 250 m/s and the source of the observed AGWs could be the huge front in France but there are huge uncertainties again.
- On 23th of July, 2009 between 16am and 18am short period fluctuations have been observed in the Doppler data which seem to be infrasound waves with the period from ~2 to ~ 4.5 minutes. In those period a huge squall line thunderstorm passed through the Czech Republic. There is almost no geomagnetic activity with the exception of minor pulsations from ~17:00 to ~17:10. The slowness analyzes indicate that most of the energy propagates vertically, which is consistent with the infrasound from below.

To summarize, the analysis supports the hypothesis that the observed wave activity by Doppler measurement could be from the thunderstorms in all the cases above.

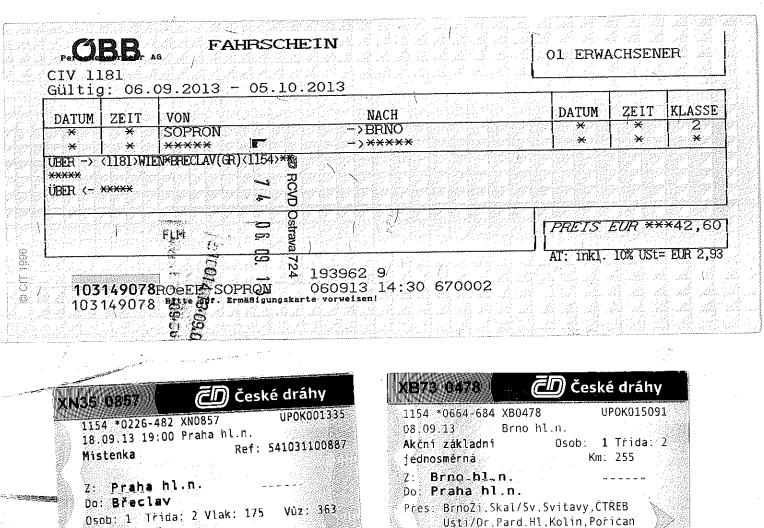
4) Future collaboration with host institution (if applicable)

We keep in touch and we will discuss about the results through e-mail. Depending on the results we plan some campaign measurements with the Digisonde DPS4.5 at Pruhonice on the summer of 2014.

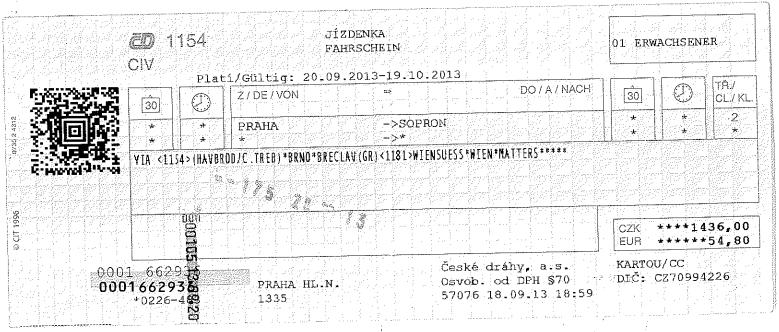
5) Projected publications / articles resulting or to result from the grant (ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant)

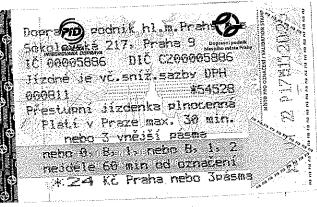
We will present the results in international conferences (EGU 2014, TEA-IS Summer School) and we plan a common publication in a journal in the future depending on the results after analysing the data.

- 6) Other comments (if any)
- (i) The spirit of collaboration between members of the group and me was really friendly.
- (ii) I travelled from Sopron to Prague through Brno by train and I have arrived to the central station of Prague on 8th afternoon where Dalia Buresova waited for me and took me to my accommodation.
- (iii) Dalia Buresova and Jaroslav Chum met me in Prague; throughout my visit, they looked after me perfectly, and thoughtfully.
- (iv) I stayed in the Hotel of the Geophysical Institute, my room was very comfortable and there was a well-equipped kitchen in front of my room.
- (v) Unfortunatelly I had to return to Hungary one day earlier than I have planned, I took a train from Prague to Sopron on 20th afternoon.









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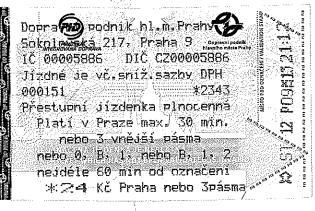
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