SHORT TERM SCIENTIFIC MISSION (STSM)
SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA15211- Atmospheric Electricity Network: coupling with the Earth System, climate and biological systems
STSM title: ElectroNet
STSM start and end date: 14/10/2019 to 19/10/2019
Grantee name: **Biagi Pier Francesco**, **Department of Physics, University of Bari, Italy**

PURPOSE OF THE STSM:

Since 1980, studies about the interaction between seismic activity and disturbances in radiobroadcasts have been carried out. Generally, receivers located on the ground have collected the radio data. Variations of some parameters in the ground (induced, for example, by increasing of electric conductivity due to radon emission increase before the earthquake), in the atmosphere and in the ionosphere (because, for example, variations in the atmospheric electric field) are responsible of the previous disturbances. Results on the earthquakes precursors obtained with the analysis of the radio signals employing such models are very encouraging thus attracting the interest of the research community. Part of this research community is INFREP (International Network for Frontier Research on Earthquake Precursors) network, which has been established in 2009 and it is consisted of a group of researchers from around the globe. The INFREP network currently consists of nine receivers located as follows: two in Romania and Greece; one in Italy, Austria, Portugal and Cyprus; actually one receiver is not installed. An Italian factory has manufactured the radio receivers for measuring the intensity of 10 radio signals in the bands VLF (20-80 kHz) and LF (150-300 kHz), with 1 min sampling rate. The signals radiated by VLF-LF broadcasting stations located in Europe are used. The objective of this short-term mission is to bring the not installed receiver in Serbia, to put it into operation, to describe the method of study and to insert the host Serbian colleagues in INFREP cooperation. The data collected by a receiver located in Serbia could be very useful because it is possible to select many radio-path crossing zones seismically very active as North-Central-South Italy, Slovenia, Croatia, Bosnia, Montenegro and Albania. Researchers of the Host Institute have expertise in the field of the radio signal propagation and disturbances produced in atmosphere-ionosphere for different causes including the preparatory phase of earthquakes.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

The activities of *Pier Francesco Biagi* in Belgrade, October 14-19, 2019, are described in the following text.

FIRST DAY

- First meeting at the Institute Physics Belgrade for planning the work
- Installation of INFREP antennae

Because of preliminary checking of recorded data antennas were installed the first day. First, the best place on the roof of the Institute was located. After that, the two rectilinear antennae with preamplifiers were fixed on the roof.

Later the receiver was located in a room near to the roof and was connected to the antennae means of two cables, 10 meters long each one. The receiver was scheduled and the data take-over started.

SECOND DAY

We made control of the receiver, its installation and first tests. Unfortunately, the first day of the collected data revealed a malfunction of the system. After many different attempts, the reason of the malfunction appeared to be related to some interruption in the cables;

so, new cables were purchased and substituted to the previous ones. After this operation, the system started to work properly.

THIRD DAY

We first check data again. After confirming good quality of recorded values we connected the receiver to Internet for data download and tested collected data after a few hours.
In the meantime we had meeting related to using of INFREP software. Also, Pier Francesco Biagi has delivered to the Serbian Team the data collected by the INFREP receivers from 2009. Furthermore, in a meeting he has described the main featured of the VLF/LF radio signals revealing by the data.
Afternoon, we has visited the Astronomical Observatory of Belgrade invited by Luka Popovic. In this meeting, the possibility to participate together (Italy and Serbia) to one of the next EU call in November was discussed. Other possible participants of other countries were proposed and an agreement was reached with the Serbia as leader of the proposal.

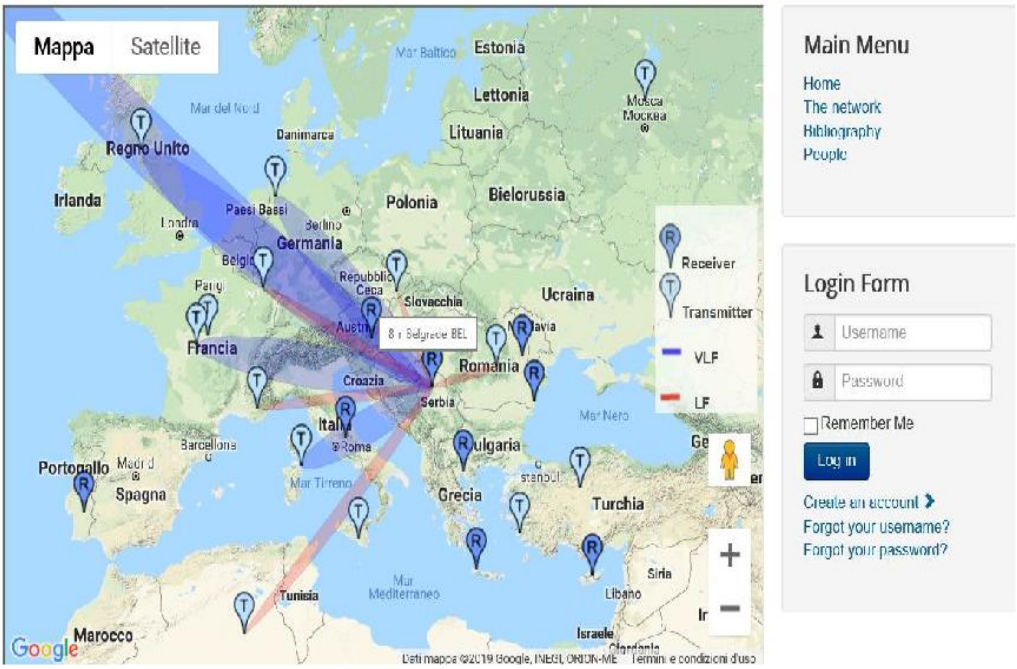
FORTH DAY

We made preliminary analysis of the data collected more than one day and adjusted of the reception and possible change.
During this day Pier Francesco Biagi had seminar detailing the investigations of the interaction between seismic activity and disturbances in atmospheric electric properties detected by VLF/LF receivers including in INFREP network.

FIFTH DAY

During the fifth day we finaly concluded that collected data are good quality. Therefore, the receiver and the Serbian Team were officially included in the INFREP network (http://193.204.188.101:8080/).

INFREP

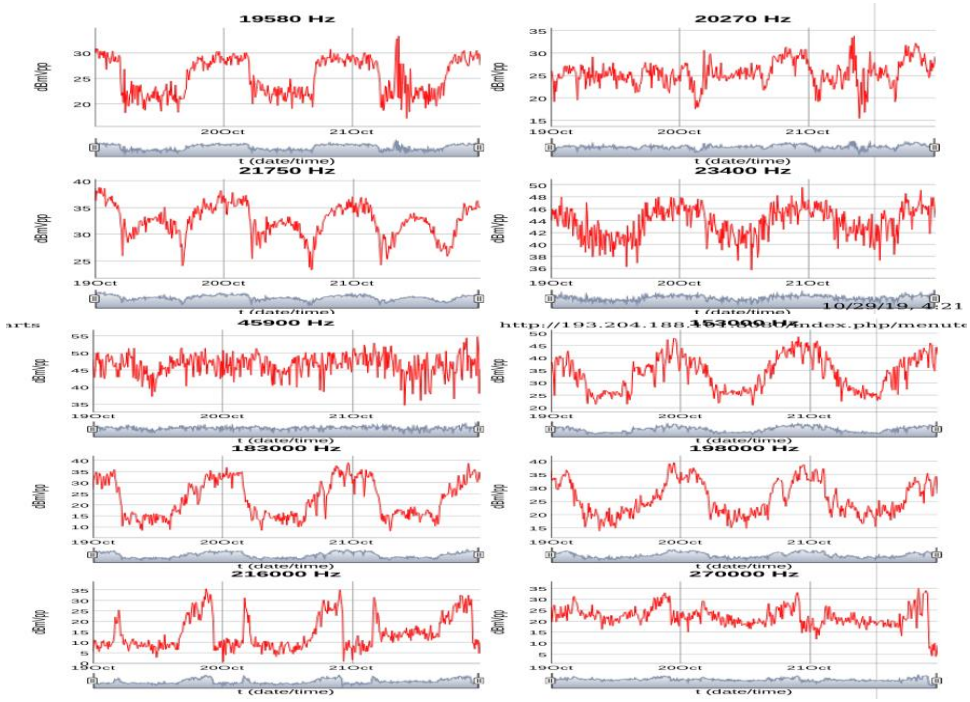


SIXTH DAY

We had a meeting for last control of the equipment and for examining the last data.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

Time evolution of ten recorded signals during three days are shown in next figures.



All the previous trends seem to indicate a good reception of the radio signals that is:

- **a good choice of the site for installation**
- **a correct running of the receiver**
- **a success of the STSM.**

Now, **the analysis of the data collected will start and we hope to obtain good results.**

FUTURE COLLABORATIONS (if applicable)

- Planned future work related to the STSM. Because of successful including Serbia in INFREP network we plane to write scientific paper based on data collected by the Belgrade VLF/LF receiver. In addition to research of the ionospheric precursors to earthquake we agree that recorded data should be applied for research of the ionospheric disturbances induced by different astro and geo phenomena.

- **The possibility to participate together (Italy and Serbia) in an HORIZON 2020 project.** We agree that INFREP network should be included in this proposal.

PIER FRANCESCO BIAGI