

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: COST Action ES13006

STSM title: Establishment of a water sampling campaign to compare a Serbian case study with the Icelandic case study

STSM start and end date: 15/12/2017 to 23/12/2017

Grantee name: David C. Finger (STSM reference number: 39589)

PURPOSE OF THE STSM/

Reykjavik University (RU) and University of Belgrade (UB) have been collaborating in the frame of a previous STSM where Dragana Đorđević (MC Member of ES1306) visited Reykjavik University in order to assess hydrologic connectivity of the rivers Eystri-Rangá and Ytri-Rangá located within the Rangárvellir watershed in southern Iceland. During the STSM Dragana Đorđević collected numerous water and sediment samples and identified patterns of soil and river sediments using sequential extraction of heavy metals and trace elements [1]. These results will potentially allow to determine the hydrologic connectivity within the Rangárvellir watershed. Preliminary results have been presented at EGU2017 in Vienna.

Within the present STSM proposal Reykjavik University and University of Belgrade aim at establishing a water sampling procedure for Iceland and for a selected watershed in Serbia in order to apply the same sampling and data processing technique between the two countries. The overall goal of this sampling procedure will be a holistic understanding of hydrologic connectivity within the Icelandic and the Serbian watersheds. The present STSM should help initiate a long-term partnership, enabling young scientist to travel between the two countries and complement and finalize the preliminary results generated by Đorđević et al. [1].

Scientific approach

The scientific approach is similar to the STSM carried out by Dragana Đorđević in July 2016 in Iceland. During the STSM David Finger and Dragana Đorđević intend to collaborate with experts from various professional fields, especially in the fields of hydrology and geology. The core method of the STSM is, however, similar to the methods used in the STSM of Dragana Đorđević.

Expected outcome:

The results of this STSM is expected to build the bases for a long-term exchange of young scientists between Serbia and Iceland in order to continue connectivity research in both countries. The STSM will aim at developing the following outcomes:

- Sampling strategy for rivers in Serbia and Iceland
- Establishment of an exchange program between Serbia and Iceland

- Identification of a suitable case study in Serbia

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

The following tasks were carried out:

15/12/2017: Travel from Reykjavik, Iceland, to Belgrade, Serbia.

16-18/12/2017: Weekend and exploration of the surroundings

19/12/2017: Visits and discussion in Belgrade

9:00 – 11:00: Meeting at the Heinrich-Böll-Stiftung (HBS) in Belgrade

Outcomes:

- HBS will support student projects from RU carried out in the frame of internships, BSC or MSC theses related to the topic of connectivity and sustainable development
- HBS, UB and RU agreed to collaborate and develop future joint projects. In particular on the following topics:
 - Hydrologic connectivity of geothermal sources with the purpose of investigating the development of utilization of renewable energy sources in Serbia
 - Reducing air pollution in Serbia by promoting renewable sources: this can be done by investigating atmospheric connectivity of advective transport of pollutants.
 - Any other joint project aiming at the development of sustainable solutions in Serbia

20/12/2017: visit of the Scientific Institution Institute of Chemistry, Technology and Metallurgy (ICTM) of BU:

9:00-12:00: The following instruments were presented and discussed: GC-FID/ECD-TD, HPLC-MS/TQ, MW digester and extractor, ICP-IO, ICP-MS, Ion Chromatography.

14:00 – 16:00: Business lunch and scientific discussions with Dragana Đorđević, Ivana Pektović, Aleksandra Mihajlić Zelić and Sđan Petrović.

21/12/2017: Field trip to geothermal sources in southern Serbia with Dragana Đorđević, Ivana Pektović and Aleksandra Mihajlić-Zelić

9:00 – 14:00: travel from Belgrade to Niš (260.237 inhabitants) and Niska Banja (4.437 inhabitants)

Below Niska Banja and Nis, under the ground is a natural source of hot water, unique potential of clean and renewable geothermal energy at the surface of up to 65 square kilometres. The natural reservoir is at a depth of 500 to 800 meters, and the estimated capacity is about 400 million cubic meters of thermal mineral water.

14:00-16:00 Visit of the Institute Niška Banja with Prof. Aleksandra Stanković (Rheumatologist, Medical faculty, University of Nis) and water sampling of the geothermal stream next to the Institut Niška Banja.

16:00 -18:00: Travel to Vranje

22/12/2017:

9:00-12:00 Travel from Vranje to Vranjska Banja

Meeting with financial director Novica Vrbanja (Specijalna Bolnica za rehabilitaciju);

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- Visit and water sampling of all geothermal hot spots and water sources.

15:00-18:00 Travel from Vranska Banja to Sijarinska Banja

Meeting with the director of Sijarinska Banja well ness spa, Pera Jogarčević

Inspection and water sampling of all geothermal wells next to the Sijarinska Banja wellness spa.

23/12/2017: Travel back home

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The main results of this STSM can be summarized as follows:

- An overview of the environmental air pollution was generated by discussing with relevant stake holders, in particular with Damian Bogunović from the Heinrich Böll Stiftung. In Serbia energy production is dominated by up to 80% of coal power, emitting huge amounts of GHG and pollutants especially particulate matter into the air. Most private houses are heating their homes with wood or pellets, frequent not dried or stored without protection against precipitation and humidity. This generates huge air emissions into the atmosphere. Combined with frequent inversions of the atmospheric boundary layer, the high amounts of pollution creates health threatening conditions in most habitat areas of Serbia. Research of atmospheric connectivity can allow us to identify pollution sources and works towards adequate solution in mitigating relevant pollution sources.
- The geothermal potential of Serbia is not well known but for sure has an unexploited huge potential. In a first step hydrologic connectivity is needed in order to identify and quantify geothermal energy sources (in form of high and low temperature water fields).
- A holistic measurement plan was discussed and elaborated for potential future joint MSc, PhD and other research projects. Three main study sites were identifies for further research: i) the geothermal ground water layer below the city of Niš, ii) the geothermal water sources in the uphill of Niška Banja and the geothermal fields in the vicinity of Sijarinska Banja. All three locations could become demonstration sites on how to use geothermal sources as clean, renewable and cost efficient energy sources. Such a shift could reduce heating with wood and pellets, reduce emissions, increase air quality and finally improve the health for the local residents. The low costs associated with geothermal energy and its renewability will furthermore reduce heating costs for local residents.

FUTURE COLLABORATIONS (if applicable)

This STSM has led to extensive plans for future collaboration as summarized below:

- February 2018: Dragana Đorđević will visit Iceland in February 2018 in order to visit the demonstration site of geothermal water sources operated by D. Finger and his students. This visit will be funded by the Serbian-Icelandic Erasmus+ programm. The visit will include teaching and

research collaboration between Belgrade University and Reykjavik University.

- June 2018: A team of four experts from Reykjavik University (namely Prof Hlynur, Prof Einar, Gudy and Prof Finger) will visit University of Belgrade and relevant institutes in order to elaborate a more detailed research and teaching collaboration. This visit will be funded by the Serbian-Icelandic Erasmus+ programm.
- *June 2018*: Ivana Pektović will visit Reykjavik University in order to investigate Icelandic geothermal water sources. This work will be carried out in the frame of Ivana's PhD project. This visit will be funded by the Serbian-Icelandic Erasmus+ programm.