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STSM SCIENTIFIC REPORT

COST Action: CA17108

STSM Request reference number: ECOST-STSM-Request-CA17108-47924

STSM title: Modelling the spatio-temporal distribution of *Aedes albopictus* in Serbia

Home institution: Faculty of Agriculture, Novi Sad, RS

Host institution: Avia-GIS NV, 2980 Zoersel, Belgium

STSM start and end date: 2021-08-09 - 2021-08-20

Working group: WG 1, Task 1.2

Purpose of the STSM

The purpose of the STSM was to receive hands-on training on (i) data acquisition and processing, (ii) setting up a spatial database, (iii) modelling the spatial distribution of *Aedes albopictus* using machine learning algorithms available in VECMAP; (iv) sensitivity analysis; (v) basic model verification and uncertainty assessment.

Description of the work carried out during the STSM

During the period of my stay, I followed the proposed working plan which has been achieved by the end of my stay. The first week I went through a hands-on tutorial of VECMAP, an integrated platform for data collection and team planning (web and mobile), including geodata preparation and risk modeling, desktop version. I did interactive exercises for project design, data levels, and forms, GIS basics, data preparation for modeling and clustering. The result of this work was learning about the intuitive VECMAP workflow.

Besides, I was also focused on working with spatial layers in the R-project software through the use of the R Spatial Project "sp" package. I learned basic commands, data exploration, quality control, gap filling, and learned how to analyze point locations in geographic space and how to

create a first- and second-order trend surface from a point set. I acquired training on creating raster objects, applying raster algebra, cell based computation, data type conversion and manipulating raster resolution.

I also did work in Quantum GIS which covered acquiring spatial data, importing and displaying raster and vector data layers, using queries and working with attribute tables. I learned to understand the scope of regional and global coordinate systems, projected and geographic coordinate systems as well as performing transformations between different projections (later applied to R and VECMAP).

During the second week of my stay I was trained to use Random Forest and NLDA (Nonlinear Discriminant Analysis) models from VECMAP, making exercise with data provided for *Aedes aegypti*: balancing and clustering of data. I run the first RF model with GBIF data for named species during the training. Further I worked on model validation and validation packages R for *Aedes albopictus* for Serbia in QGIS what was the planned project of my STSM. I run multiple RF models for *Ae. albopictus* for Serbia and had very useful final discussion about the obtained results.

Training was completely interactive and with lot of discussions and explanations which were very much useful.

Description of the main results achieved

During my STSM visit to Avia-GIS I gained knowledge in the following topics (i) data acquisition and processing, (ii) spatial database setup, (iii) spatial modelling in VECMAP using different machine learning techniques, (iv) model verification and sensitivity analysis using parameter-space exploration techniques and (v) model scalability in terms of simulations on different spatial extents, which was run for *Aedes albopictus* in Serbia.

After this training course, as an entomologist, I see field sampling in a different way now. I realized the importance of a well-designed project, sampling, and fieldwork monitoring approach in order to provide good and useful model outputs.

Random Forest model output for the distribution of *Ae. albopictus* in Serbia was based on presence/absence data in the VectorNet area using data from the ECDC database. When we included introduced cases and used WorldClim2.1 precipitation and temperature values unexpected high probability for certain regions appeared on the map. In the second model, we excluded introduced cases and got a more suitable model (Cohen's Kappa: 0.81, AUC: 0.97, Sensitivity: 0.92, Specificity: 0.89), with a high probability of *Ae. albopictus* presence in the central

part of the country, which includes the two already known introduction points. For further analysis, traps should be set randomly in the country, but special attention should be paid to certain points along the main highways, having in mind the spreading behavior of invasive insect species which is usually in connection to human activities.

Future collaboration with the Host institution

Future work might include climate projection data on also invasive (currently one of the most important pest species) insect, Brown Marmorated Stink Bug (*Halyomorpha halys*). Based on a simple climatic threshold for the spring diapauses of BMSB 9-GCM model ensemble and four SSP scenarios for 2021-2040, 2041-2060, 2061-2080 are in progress.

Foreseen publications/articles resulting from the STSM

Results of the STSM together with further work on assessing the suitability of *Ae. albopictus* in Serbia will be published in a peer-reviewed journal. Also, results of the future work on another invasive insect, *H. halys*, will be published as soon as they are ready for publishing.

Confirmation by the Host institution of the successful execution of the STSM

I herein confirm the present report regarding the ECOST-STSM-Request-CA17108-47924 at Avia-GIS(Belgium).

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Serbia   Avia-GIS
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