

Avia-GIS, Risschotlei 33
2980 Zoersel
Belgium



STSM SCIENTIFIC REPORT

Title of the STSM: Modeling the climatic suitability of *Aedes albopictus* in Montenegro.

Reference: Short Term Scientific Mission, COST Action TD1303

Reference code: COST-STSM-ECOST-STSM-TD1303-090315-057867

Working group: WG3

Beneficiary: Mina Petrić, Department of Physics, University of Novi Sad, Serbia
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Host: Dr. Els Ducheyne, Avia-GIS, Belgium, educheyne@avia-gis.be

Period: 09/03/2015 to 20/03/2015

Place: Avia-GIS, Risschotlei 33, 2980 Zoersel, Belgium

STSM Coordinator: Prof. Dr. Dušan Petrić, University of Novi Sad, Faculty of Agriculture, Serbia

MC Chair: Prof. Dr. Andrei Mihalca, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania

1. Purpose of the visit

The STSM was carried out at Avia- GIS, within the scope of EurNegVec TD1303 Action. The purpose of the STSM was to receive a theoretical and practical training on (i) spatial database setup, (ii) spatial modeling in VECMAP and R using statistical and machine learning techniques and (iii) accuracy and uncertainty assessment.

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2. Description of the work carried out

The STSM was carried out in keeping with the proposed work-plan. During the period 2015-03-08 to 2015-03-20 in Belgium, I did work in Quantum GIS, R-project and VECMAP for the purpose of analyzing the spatial distribution of *Aedes albopictus* in Montenegro. During the first week I completed a course in QGIS that covered: Acquiring spatial data, importing and displaying raster and vector data layers, using queries and working with attribute tables. I learned to work with projections and coordinates and 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). Furthermore, I was introduced to software tools and plugins for geoprocessing of vector and raster data in QGIS. I gained knowledge on working with table data, visualizing the joined information, performing spatial queries and finally applying point file interpolation techniques which we used on the station meteorological data for Montenegro.

The second course during the first week focused on working with spatial layers in the R-project software through the use of the R Spatial Project “sp” package. This package provides a more elegant solution that allows for more possibilities for visualization and analysis of spatial data in R. Some of the topics covered were analyzing point locations in geographic space, creating a first- and second-order trend surface from a point set, generate variogram clouds, experimental and directional variograms and variogram surfaces. I acquired training on creating raster objects, applying raster algebra, cell based computation, data type conversion and manipulating raster resolution.

During the second week, we carried out a comparison between observed station meteorological data and satellite (remote sensing) MODIS data for Montenegro for 2000. The remotely sensed data that we used were night and daytime land surface temperature values, LST, at a daily resolution from LP DAAC, high level MODIS Land products. The MODIS raster stack was interpolated using linear interpolation and spline and both output files were compared to the observed temperature values.

Finally, we used the Random Forest and NLDA (Nonlinear Discriminant Analysis) models from VECMAP (The VECMAP system is an integrated set of software components and supporting services with the purpose of assisting national public health agencies and regional mosquito surveillance programs in predicting vector-related health risks and disease control) to create a spatial distribution map for *Aedes albopictus* in Montenegro for 2013. We used the surveillance (presence/absence) data for *Aedes albopictus* for Montenegro (2013) together with VBORNET data for Serbia and Bosnia & Herzegovina to account for absence data. The environmental data used to run the model was the MODIS remote sensing data for LST.



3. Description of the main results obtained

I gained knowledge on the subjects of (i) spatial database manipulation and setup, (ii) spatial modeling using sophisticated machine learning techniques such as Random Forest and NLDA in VECMAP, (iii) Using R packages for analyzing spatial data such as “sp” and “gstat”, (iv) interpolation techniques like IDW, Spline and Kriging as well as (v) accuracy and uncertainty assessment regarding statistical distribution models.

Specific results obtained:

For the comparison of the MODIS remote sensing data and the observed climate dataset, first we interpolated the MODIS raster files using temporal interpolation functions from the “zoo” R package. Interpolation was carried out to account for absent values due to cloud coverage and missing data. We used spline and linear interpolation from the “zoo” package. Finally we calculated the correlation with observed temperature values from 8 stations in Montenegro. The result was a strong positive correlation for both linear ($r=0.83$) and spline ($r=0.8$) interpolated MODIS.

Regarding the Random Forest model output for the distribution of *Aedes albopictus* in Montenegro, a suitability map was obtained for 2013 based on surveillance presence/absence data and MODIS land surface temperature values (Cohen's Kappa: 0.87, AUC: 0.95, Sensitivity: 0.94, Specificity: 0.95). The whole coast together with the southern inland regions of the Nikšić and Podgorica counties appear to be highly suitable for the establishment of *A. albopictus*. A simulated decrease in suitability can be observed in the northwest part of the country and even less suitable conditions over the northeast municipalities of Kolašin and Berane.

4. Future collaboration

It is planned to expand the research on *A. albopictus* suitability and distribution for Montenegro taking into account the impact of the changing climate and modeling future distribution and general trends by comparing results obtained from climatic projections from a regional dynamical model.

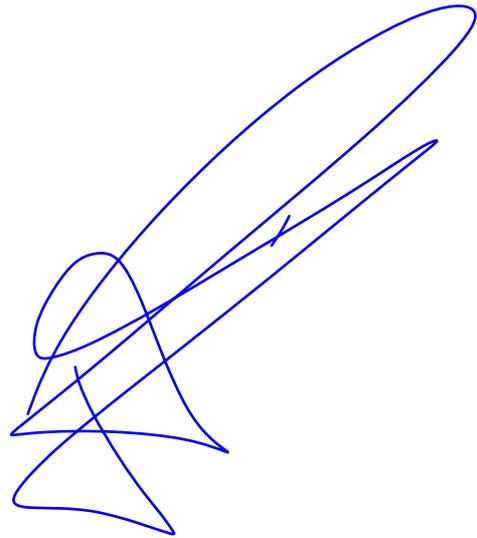


5. Projected publications/articles resulting or to result from the STSM

The results of the STSM together with further work on assessing the future suitability of *A. albopictus* in Montenegro will be published in a peer-reviewed journal.

6. Confirmation by the host of the successful execution of the mission

I herein confirm the present report regarding the COST-STSM-ECOST-STSM-TD1303-090315-057867 at Avia-Gis (Belgium).

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Mina Petrić
University of Novi Sad
Serbia

Dr. Guy Hendrickx
Managing director
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