World Academy of Science, Engineering and Technology
International Journal of Biological and Ecological Engineering
Vol:16, No:10, 2022

A Study for Area-level Mosquito Abundance Prediction by Using Supervised Machine Learning Point-level Predictor

Authors : Theoktisti Makridou, Konstantinos Tsaprailis, George Arvanitakis, Charalampos Kontoes

Abstract : In the literature, the data-driven approaches for mosquito abundance prediction relaying on supervised machine learning models that get trained with historical in-situ measurements. The counterpart of this approach is once the model gets trained on pointlevel (specific x,y coordinates) measurements, the predictions of the model refer again to point-level. These point-level predictions reduce the applicability of those solutions once a lot of early warning and mitigation actions applications need predictions for an area level, such as a municipality, village, etc... In this study, we apply a data-driven predictive model, which relies on public-open satellite Earth Observation and geospatial data and gets trained with historical point-level in-Situ measurements of mosquito abundance. Then we propose a methodology to extract information from a point-level predictive model to a broader area-level prediction. Our methodology relies on the randomly spatial sampling of the area of interest (similar to the Poisson hardcore process), obtaining the EO and geomorphological information for each sample, doing the point-wise prediction for each sample, and aggregating the predictions to represent the average mosquito abundance of the area. We quantify the performance of the transformation from the pointlevel to the area-level predictions, and we analyze it in order to understand which parameters have a positive or negative impact on it. The goal of this study is to propose a methodology that predicts the mosquito abundance of a given area by relying on point-level prediction and to provide qualitative insights regarding the expected performance of the area-level prediction. We applied our methodology to historical data (of Culex pipiens) of two areas of interest (Veneto region of Italy and Central Macedonia of Greece). In both cases, the results were consistent. The mean mosquito abundance of a given area can be estimated with similar accuracy to the point-level predictor, sometimes even better. The density of the samples that we use to represent one area has a positive effect on the performance in contrast to the actual number of sampling points which is not informative at all regarding the performance without the size of the area. Additionally, we saw that the distance between the sampling points and the real in-situ measurements that were used for training did not strongly affect the performance.

Keywords : mosquito abundance, supervised machine learning, culex pipiens, spatial sampling, west nile virus, earth observation data
Conference Title : ICMVEWNV 2022 : International Conference on Mosquito Vectors and Epidemiology of West Nile Virus
Conference Location : Bali, Indonesia
Conference Dates : October 20-21, 2022