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Early Warning System for West Nile Virus outbreaks based on Satellite Earth Observation Data

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The aim of this study is the development of an operational Early Warning System (EWS) that will utilize new and enhanced satellite Earth Observation (EO) sensors with the purpose of forecasting and risk mapping the West Nile Virus (WNV) outbreaks. Satellite EO data were leveraged to estimate environmental variables that influence the transmission cycle of the pathogen that leads to WNV, a mosquito-borne disease (MBD). The system was trained with epidemiological and entomological data from the region of Central Macedonia, the most epidemic-prone region in Greece regarding the WNV. The satellite derived environmental parameters of the Normalized Difference Vegetation Index (NDVI), the Normalized Difference Water Index (NDWI), the Land Surface Temperature (LST), precipitation data as well as proximity to water bodies were coupled with meteorological data and were used as explanatory variables for the models. The management and analysis of the big satellite data was conducted with the Open Data Cube (ODC), providing an open and freely accessible exploitation architecture. Statistical and machine learning algorithms were used for short-term forecast, while dynamical models were utilized for the seasonal forecast. The system explores the analysis of big satellite data and proves its scalability by replicating the same models in different geographic regions; e.g the northeastern Italian region of Veneto. This EWS will be used as a tool for helping local decision-makers to improve health system responses, take preventive measures in order to curtail the spread of WNV in Europe and address the relevant priorities of the Sustainable Development Goals (SDGs) such as good health and well-being (SDG 3) and climate action (SDG 13).