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Improved Climate Characterisation and Persistence of West Nile Virus Risk in Europe based on regional climate model projections and Machine Learning

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West Nile virus is expanding across Europe under climate change, yet continental projection studies largely focus on outbreak probability while providing limited information on suitability persistence or geographic velocity. We use an XGBoost framework to predict WNV outbreak probability at NUTS3 resolution across Europe using E-OBS observations, ECDC outbreak records (2010-2024), and a bias-adjusted EURO-CORDEX CMIP6 ensemble under SSP1-2.6 and SSP3-7.0. Unlike previous studies relying primarily on regional climate means, our framework represents climate using transmission-relevant thermal indices together with percentile-based spatial descriptors that better characterize intra-regional climate distributions. Prospective validation on unseen outbreak seasons (2023-2024) demonstrates strong temporal generalization, yielding ROC-AUCs of 0.87 to 0.91. Future projections indicate substantial northward expansion under SSP3-7.0 but limited expansion under SSP1-2.6. Beyond conventional probability maps, we introduce a persistence classification distinguishing sporadic, emerging, persistent, and endemic hotspot regions. This reveals increasing suitability across central Europe, while some southern hotspots exhibit reduced persistence consistent with temperatures exceeding thermal optimums. Under SSP3-7.0, the northern suitability frontier advances by ~43 to 55 km per decade vs. near-stable conditions under SSP1-2.6, providing an interpretable framework for public health adaptation.

Keywords

WNV, ML, Risk Mapping & Projections, Climatic Drivers, Climate change & health

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Professional Status of the Speaker

PhD Student

Junior Scientist Status

Yes, I am a Junior Scientist.

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