UNIVERSITÄT BAYREUTH | 50 JAHRE

Mathematisches Institut

Einladung zum Mathematischen Kolloquium

Am Donnerstag, dem **04. Dezember 2025**, spricht

Herr Dr. Kayode Oshinubi von der Northern Arizona University

Gast an der Professur für Mathematische Statistik bei Frau Prof. Dr. Melanie Birke

über das Thema

Forecasting West Nile Virus (WNV) using climate factors and Bayesian techniques

Abstract

Mosquito-borne diseases present a significant public health challenge, with effective prevention requiring accurate forecasting of mosquito populations and associated disease prevalence. According to data from the Centers for Disease Control and Prevention (CDC), Maricopa County, Arizona, is among the top U.S. counties with a high West Nile Virus (WNV) disease burden. Using a 10-year time series (2014–2024) of weekly mosquito abundance and WNV prevalence data collected in Maricopa County, we investigated how local climate variations influence mosquito population dynamics and disease transmission. We developed a mechanistic model of WNV dynamics driven by daily temperature and 30-day accumulated precipitation to predict mosquito populations and WNV prevalence. Our statistical forecasting framework leveraged climate factors to improve predictive accuracy by integrating adaptive modeling techniques and Bayesian methods to infer precise model parameters. To achieve this, we applied the Ensemble Kalman Filter (EnKF) method to estimate both time-varying parameters and static parameters. Using generalized additive models (GAMs), we forecasted these time-varying parameters on a two-week basis, incorporating precipitation and temperature as covariates. These forecasts were used as inputs for a mechanistic ordinary differential equation (ODE) model, which predicted mosquito abundance and WNV prevalence while capturing associated uncertainties. Our iterative framework was applied over a 52-week period, successfully capturing seasonal variations in mosquito populations and WNV prevalence throughout the decade-long dataset. Despite changes in environmental conditions, data quality, and underlying dynamics over the 10-year period, our method consistently captured key trends and variations, highlighting its robustness and adaptability. This enhanced methodology provides actionable insights for public health decision-makers, supporting resource allocation and improving mosquito-borne disease prevention outcomes. Our findings underscore the importance of integrating climate data with adaptive filtering techniques to address forecasting challenges and enable effective responses to emerging or re-emerging mosquito-borne pathogens, which, driven by human behavior and environmental changes, may potentially escalate to pandemic levels.

Beginn: 15.30 Uhr

Ort: Seminarraum S 80, Gebäude Naturwissenschaften II, Universitätsgelände

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