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When does forecasting become actionable? Real-time vs. seasonal prediction of Aedes aegypti abundance

Inhalt

Aedes aegypti, the primary vector of dengue, Zika, and chikungunya, has expanded its range globally, increasing demand for spatially granular forecasting tools to support vector control. Short-term forecasts can inform near-term surveillance and intervention planning; however, few studies evaluate real-time, site-level approaches operationally. Using weekly trap data from 2017–2023 across sites in Southern California, with Earth observation and meteorological predictors, we evaluated two forecasting problems: (1) out-of-sample prediction of the 2023 seasonal abundance trajectory using models trained on 2017–2022 data, and (2) two-week-ahead, site-level forecasts in a rolling framework. We compared a generalized additive model (GAM), Random Forest (RF), and spatial Random Forest (RFsp) against appropriate baselines. Seasonal models captured broad abundance patterns but failed to reproduce an unusually sharp late-summer peak; performance was sensitive to year-to-year variation poorly explained by environmental predictors. Rolling forecasts updated with recent observations substantially outperformed seasonal predictions; RFsp performed best, with spatial features improving accuracy and spatial coherence. Short-term forecasts using recent site-level data offer more reliable operational guidance than seasonal outlooks, particularly where *Ae. aegypti* is newly established. Findings inform the design of surveillance systems and forecast updating protocols for vector control.

Keywords

Aedes aegypti; Vector-borne disease forecasting; One Health; Machine learning

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