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

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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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Professional Status of the Speaker

Postdoc

Junior Scientist Status

Yes, I am a Junior Scientist.

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