

Mapping Oropouche Virus Risk Through Land Cover Change and Vector Ecology

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Background

- Oropouche virus (OROV)** is an emerging arbovirus transmitted primarily by *Culicoides* midges (and secondary mosquito vectors, **Figure 1**) across tropical Latin America (**Figure 2**), with an estimated 500,000 human infections to date (**Figure 3**).
- Leticia, Colombia** (pop. ~48,000) sits at the tri-border of Colombia, Brazil & Peru on the Amazon River. Its mosaic of dense rainforest, seasonally flooded forests (**Figure 4**), and peri-urban neighborhoods (**Figure 5**)—with frequent human-wildlife contact—makes it a sentinel site for OROV emergence. Currently, the area is experiencing an ongoing epidemic, with 41 known positive cases in the early half of 2024.
- Rapid **deforestation, urban expansion, and climate variability** in the Amazon Basin create high-risk interfaces for zoonotic spillover.
- Remote sensing, AI-driven modeling, and targeted field surveillance** offer a scalable framework to forecast outbreaks and guide public health action.



Figure 1. Size difference between an adult biting midge (left) and mosquito (right) (CDC, courtesy of Dunpharlain)

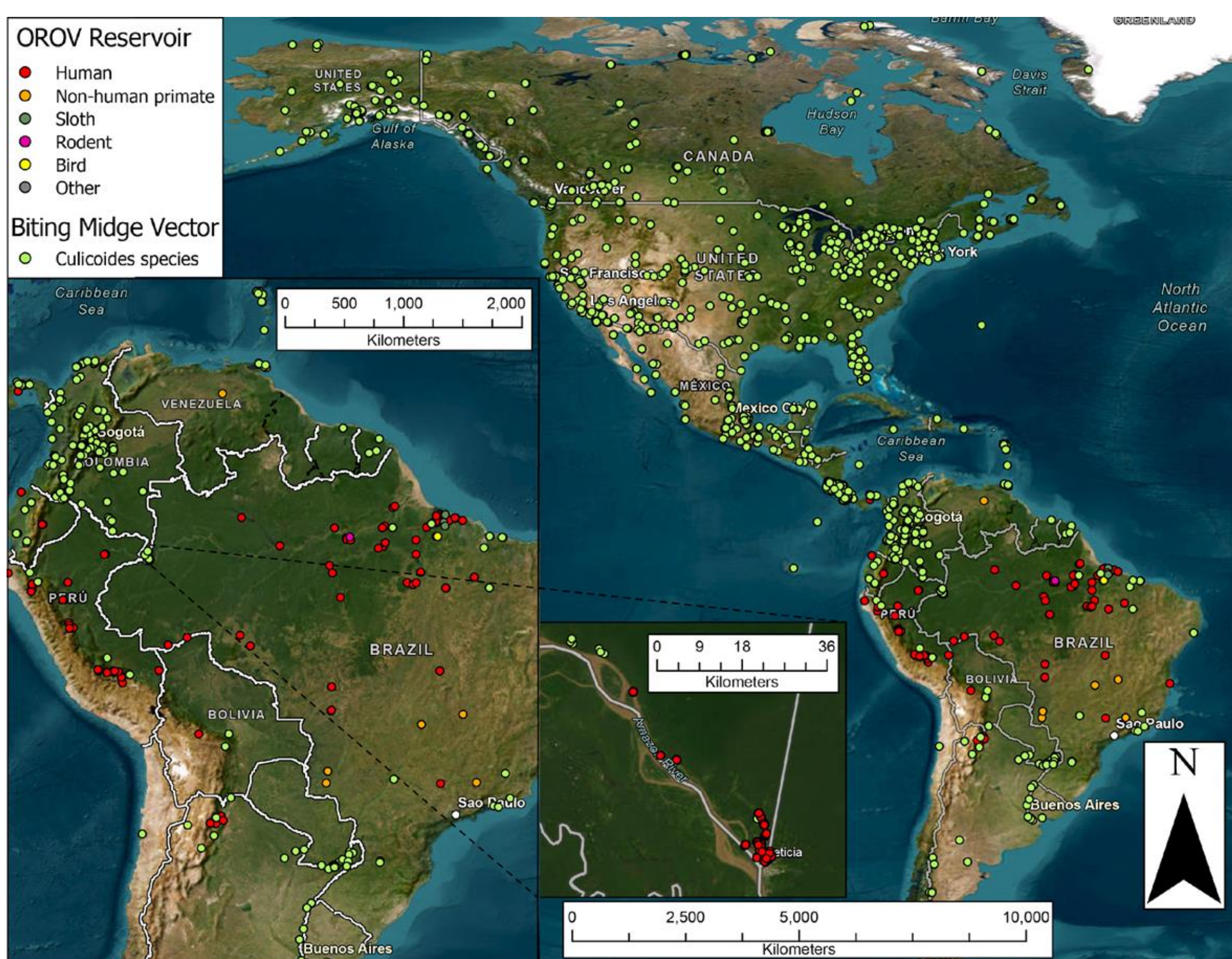


Figure 2. Map of Oropouche cases in human (red) and wildlife (other colors), as well as range of *Culicoides* vectors (green) capable of transmitting the virus.

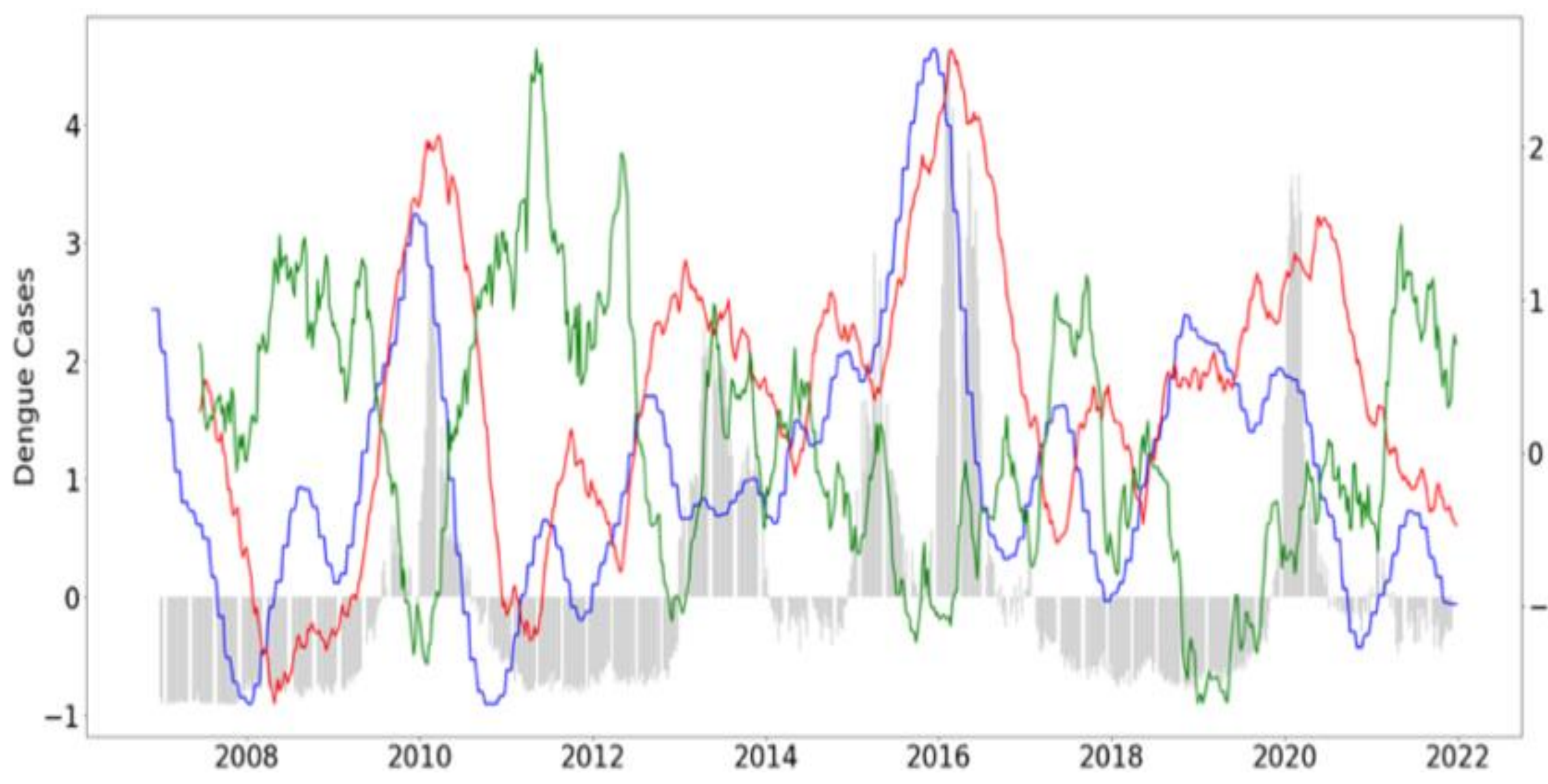


Figure 4. Climate and dengue epidemiological data in Cali, Colombia. Note the relationship between transmission (grey, dengue cases in thousands) and hydroclimate variables at both local and global scales (colored, right axis).

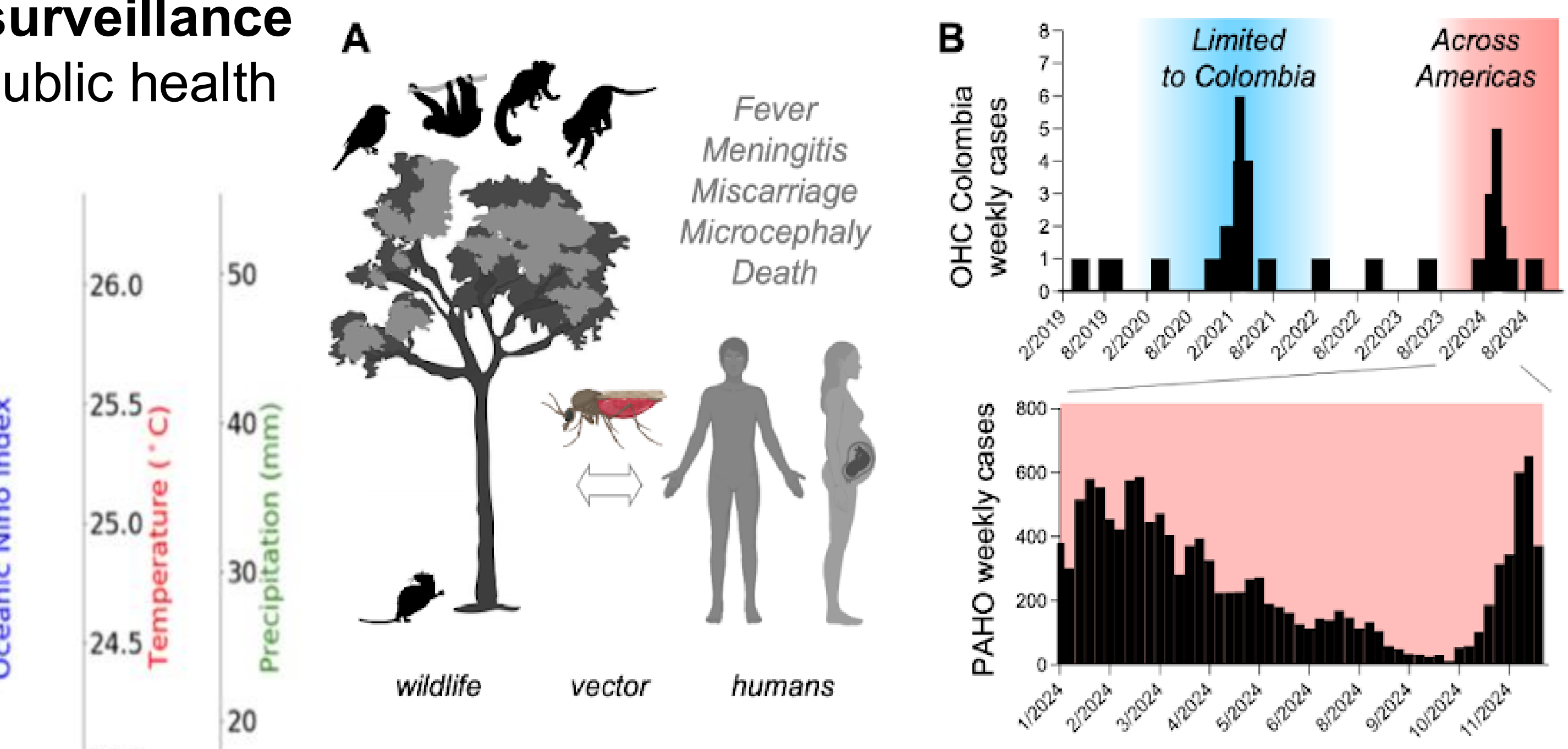


Figure 3. Oropouche cases and potential for spread in the Americas. (A) Transmission cycle of Oropouche virus in wildlife and humans. (B) Incidence of Oropouche found by the UW-Madison Global Health Institute Colombia One Health Center (Colombia OHC, top) and Pan American Health Organization (PAHO, bottom).

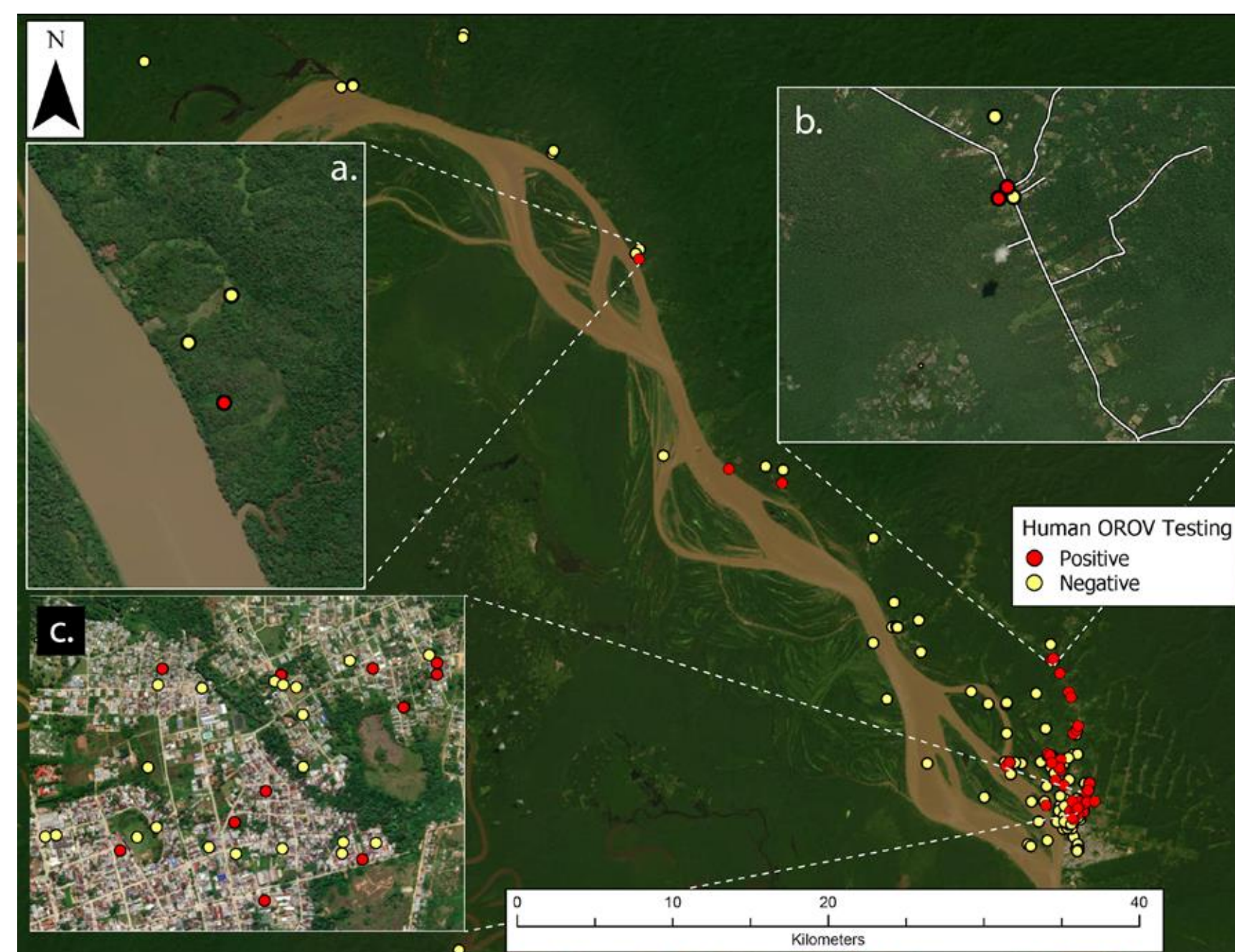


Figure 5. Distribution of OROV cases in Leticia, Colombia. Location of human OROV positive and negative samples. Confirmed human infections are distributed along a rural (a) to periurban (b) to urban (c) gradient, with variation in environmental features.

Methods & Preliminary Analysis

- Remote Sensing & Environmental Monitoring** (*Present state of research*): 1. Processing NASA EO data (Landsat 8, Sentinel-2, MODIS/VIIRS) in Google Earth Engine to derive NDVI, NDWI, LST, land-cover change and hydrology layers; 2. Integrate and overlay with human case data. 3. Hotspot analyses (Getis-Ord G_i^*) to map vector habitat suitability and temporal trends.
- Vector & Pathogen Surveillance** (*Anticipated start early 2026*): 1. Quarterly **CO₂-baited light traps** and **BG-Sentinel traps** deployed across urban, peri-urban, and sylvatic ecotones in Leticia, Colombia; 2. Morphological ID, genetic barcoding, and qRT-PCR to confirm vector species and OROV infection rates; 3. **Blood-meal analysis** via vertebrate mtDNA sequencing to reveal host feeding patterns.
- Wildlife Reservoir Assessment**: 1. **Drone-mounted thermal imaging** (DJI Matrice 4T) to non-invasively detect mammals and birds beneath dense canopy (**Figure 9**); 2. Supplemental **camera traps** and **acoustic sensors** for continuous ground-level biodiversity monitoring.
- AI-Driven Predictive Modeling & Dashboard**: 1. Ensemble ML models (Random Forest, XGBoost, Bayesian hierarchies) integrating EO indices, entomological, ecological, and climate data; 2. **OROVView** web dashboard (built on ArcGIS Online) for real-time risk maps, scenario forecasts, and local citizen-science data submission (modeled after mosquitodashboards.org)

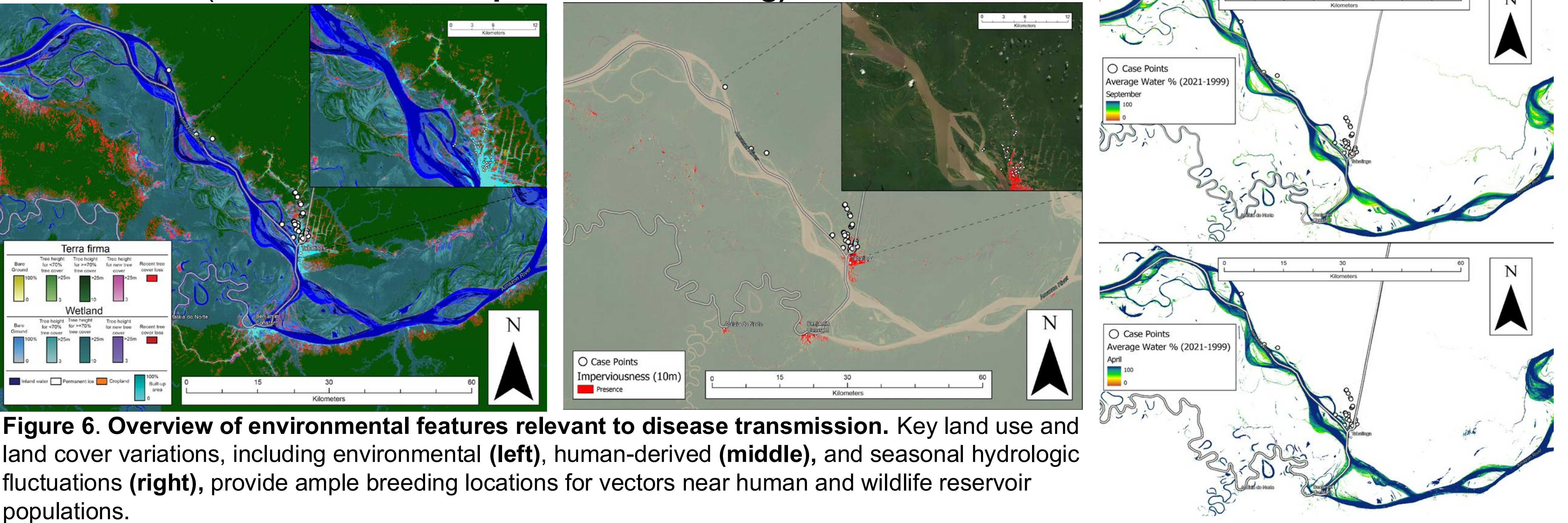


Figure 6. Overview of environmental features relevant to disease transmission. Key land use and land cover variations, including environmental (left), human-derived (middle), and seasonal hydrologic fluctuations (right), provide ample breeding locations for vectors near human and wildlife reservoir populations.

Next Steps

- Expanded Thermal Imaging & Ground "Trot" Surveys:** Deploy thermal drone across multiple high-risk ecotones at dawn/dusk to refine wildlife detection algorithms.
- Intensive Field Collections & Analysis:** 1. Conduct synchronized **ground trotting transects** to validate drone-based sightings and collect wildlife waste samples (discarded food items, feces, urine) for viral screening; 2. Perform high-throughput qRT-PCR on pooled vectors and blood-meal hosts; sequence viral isolates to map strain diversity.

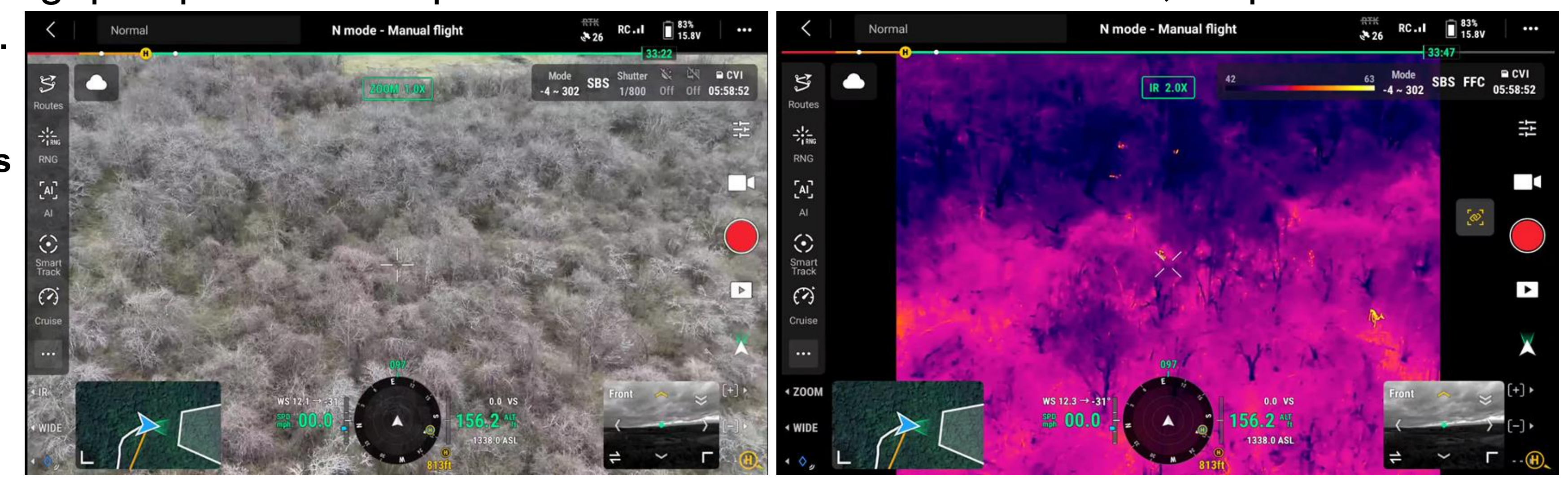


Figure 7. Matrice 4T thermal capabilities for noninvasive wildlife detection. Numerous white-tailed deer are easily observed when utilizing the high-definition thermal lens (right) (Youtube, courtesy of fdnyfish).

Let's Connect!

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