Communicating arboviral forecast models: A decision tool for West Nile & St. Louis Encephalitis virus transmission.

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Abstract: 7145

CONCLUSION:

Environmentally-informed modelling systems have been shown to be effective in estimating mosquito arboviral transmission dynamics and human spillover events. This work represents an initial step in developing decision tools to better communicate arbovirus transmission forecast results, as well as trends in mosquito testing and environmental data.

Background

West Nile virus (WNV) and Saint Louis Encephalitis virus (SLEV) are flaviviruses endemic to California and transmitted by the same *Culex* mosquito vectors. WNV and SLEV are maintained in an enzootic cycle between mosquitoes and birds, but humans and other mammals (dead-end hosts) can be incidentally infected when viral transmission in the enzootic system peaks causing spillover events.[1]

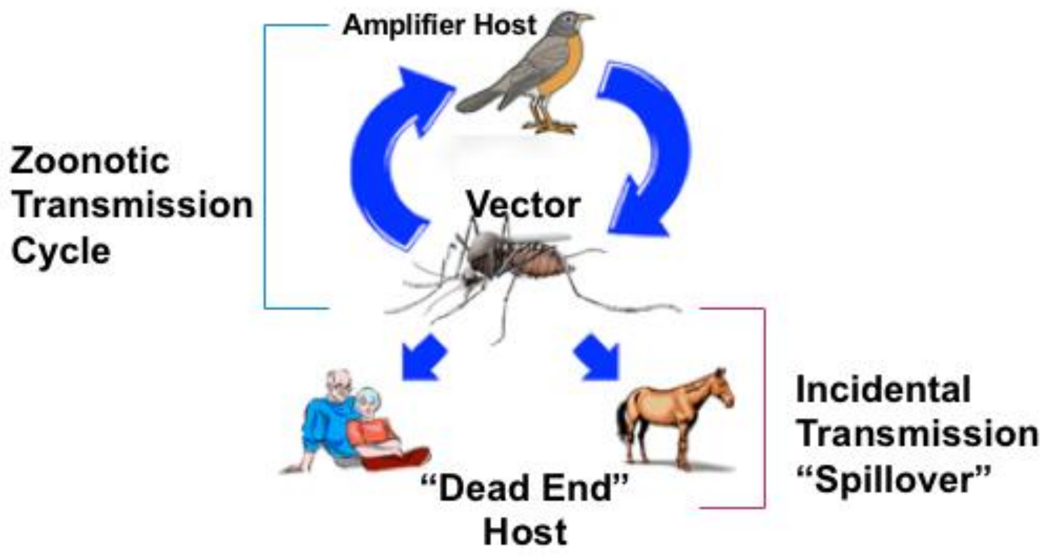

Figure 1. WNV & SLEV transmission cycle

SLEV is endemic to California but was displaced by WNV when it was introduced in 2003. Since SLEV's reintroduction in 2015 both WNV and SLEV have been routinely detected in *Cx. tarsalis* and *Cx. quinquefasciatus* in Coachella Valley, CA (CV) (Figure 2).[2]

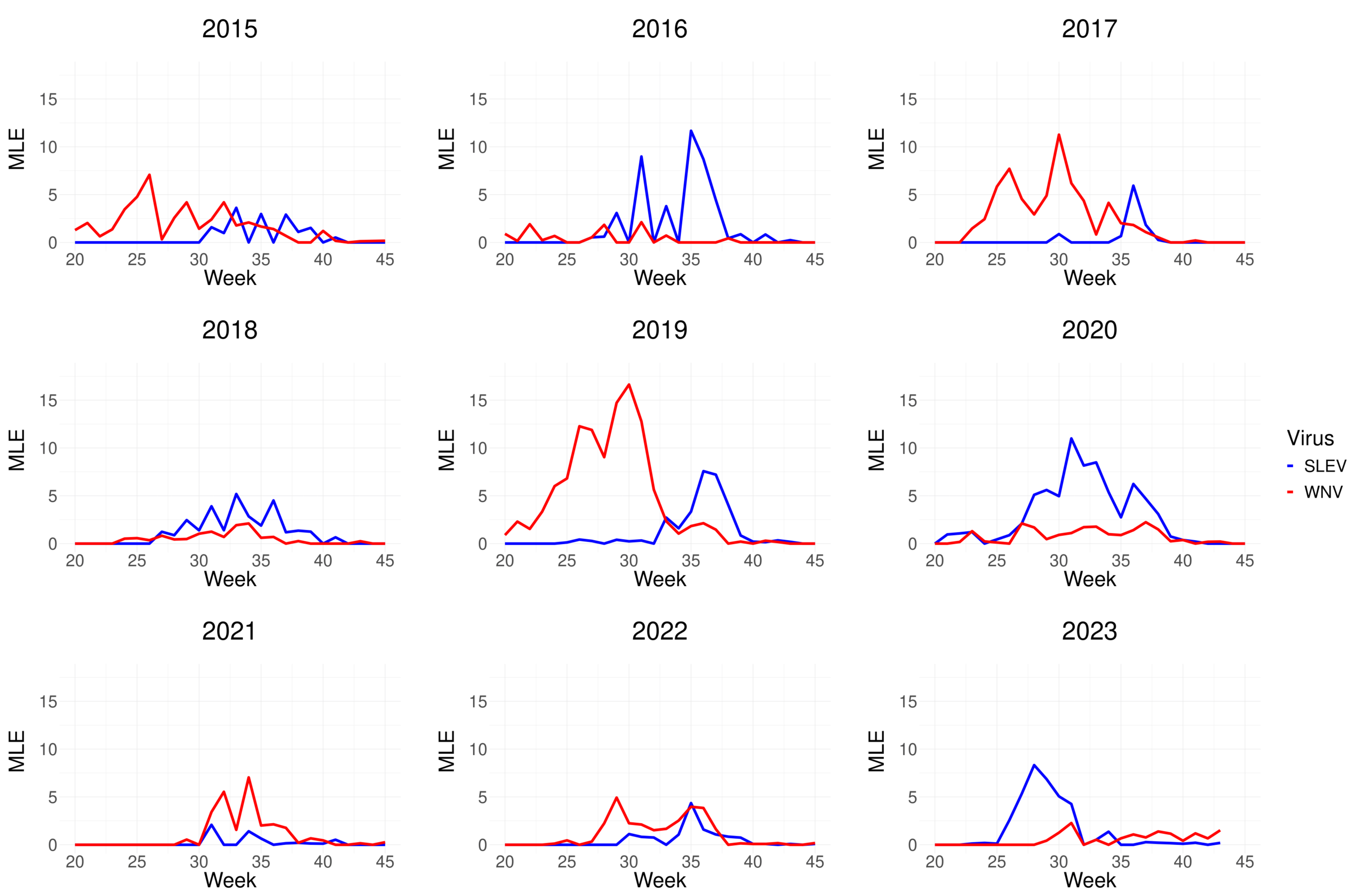

Figure 2. Weekly mosquito infection rates per 1000 mosquitoes tested for WNV (red) and SLEV (blue) in Coachella Valley, 2015 to 2023.

We have previously developed two environmentally informed forecast models for WNV and SLEV. Our compartmental model integrates mosquito infection rates and human WNV cases with an ensemble adjusted Kalman filter (EAKF) to forecast peak timing and magnitude of infectious mosquitoes and human WNV cases. This forecast can accurately predict the total number of human WNV cases >74% of the time prior to when 50% of human cases were reported and 9 weeks prior to the end of transmission (Figure 4).[3] Our ensemble forecast model using NLDAS data shows a cooler drier winter followed by a wetter warmer spring and a cooler than usual summer are associated with an increase in mosquito infection rates in CV and predicts annual infection rates 80% of the time (Figure 5).[4]

Funding & Collaborators

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References

See attached QR code in top left corner for references and more information.

Decision Tool

Conveyance of these models to stakeholders in real-time remains a challenge. We have started development of a web-based communication tool to aid in real-time decision-making (Figures 3 - 5).

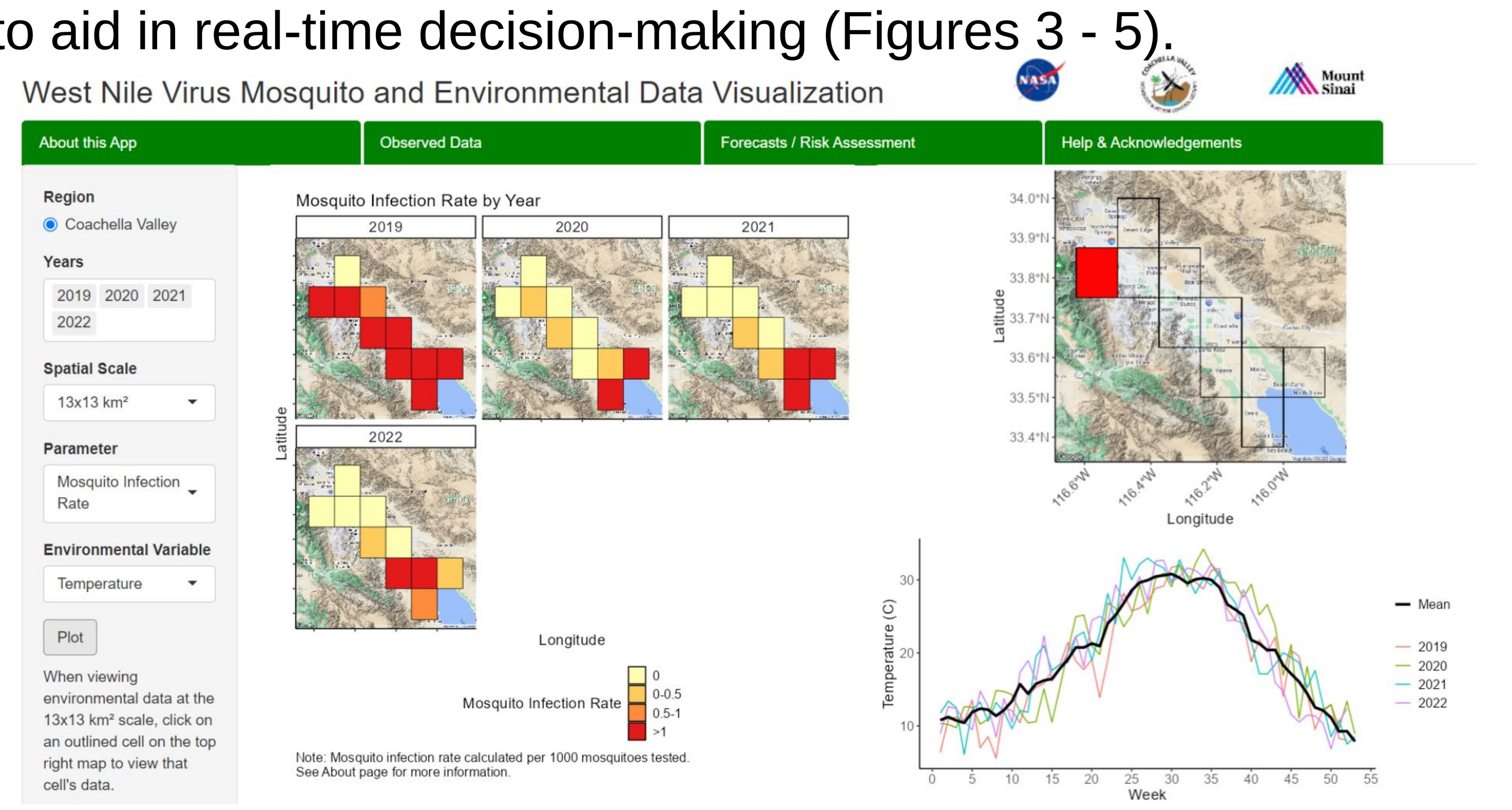

Figure 3. Mosquito testing and environmental data visualization page. Left: Annual mosquito infection rates. Right: Weekly temperature, 2019-2022.

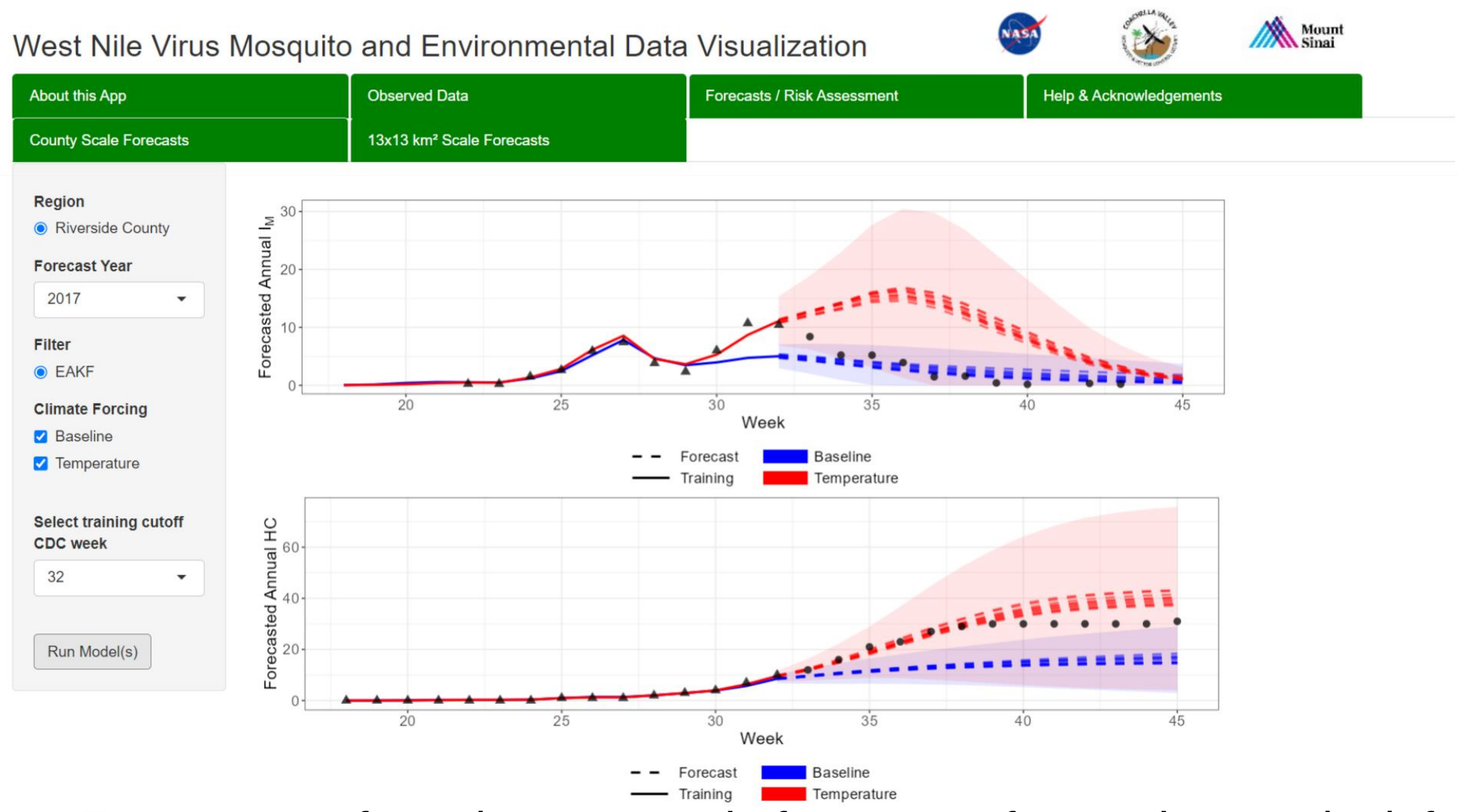

Figure 4. Temperature forced county-scale forecasts of annual mosquito infection rates (top) and annual human case counts (bottom) of WNV for 2017.

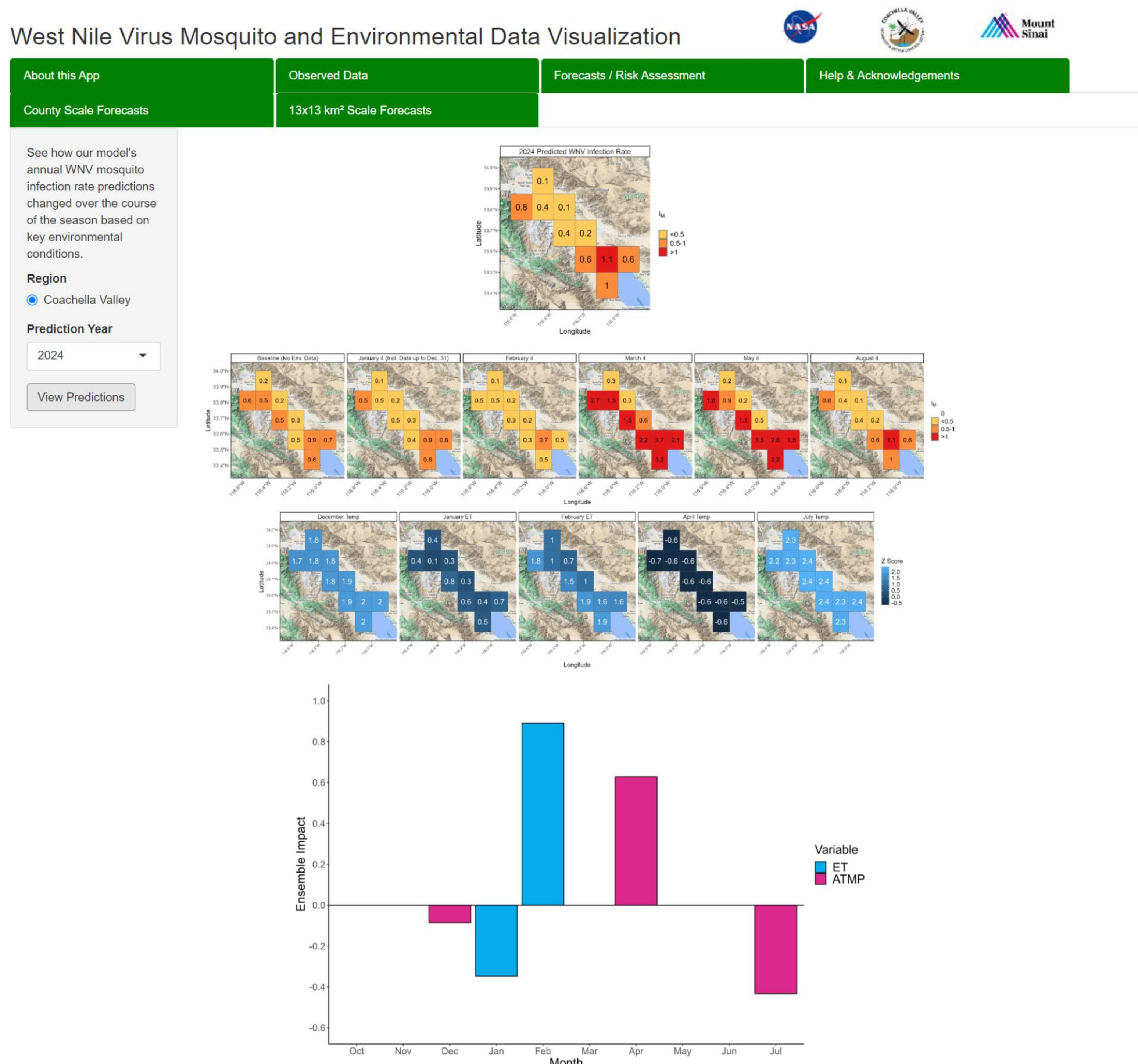

Figure 5. Environmentally informed ensemble model forecasts of mosquito infection rates for 2024 by 13x13 km^2 NLDAS grid. Row 1: Annual infection rates, generated August 4. Row 2: baseline and monthly forecasts of annual infection rates. Row 3: Monthly environmental inputs. Row 4: impact of monthly environmental variables on complete ensemble.