Developing Spatial Real-Time Forecasts of Mosquito-Borne Diseases

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8/18/2021

ECOSTRESS

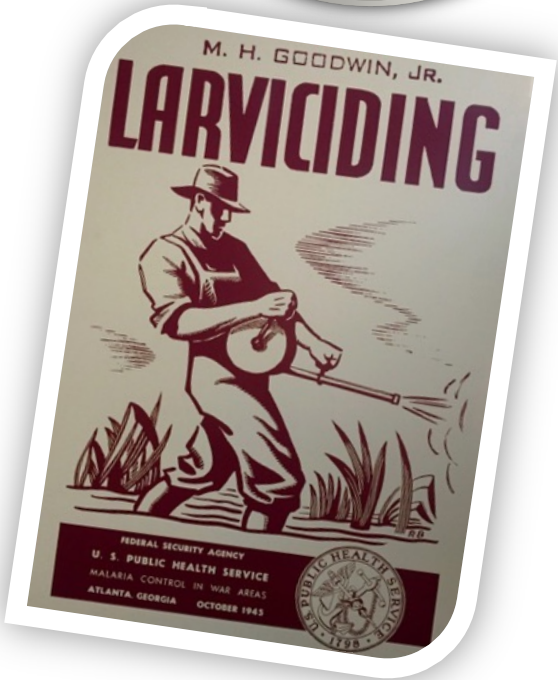
Mount Sinai

USRA

NASA

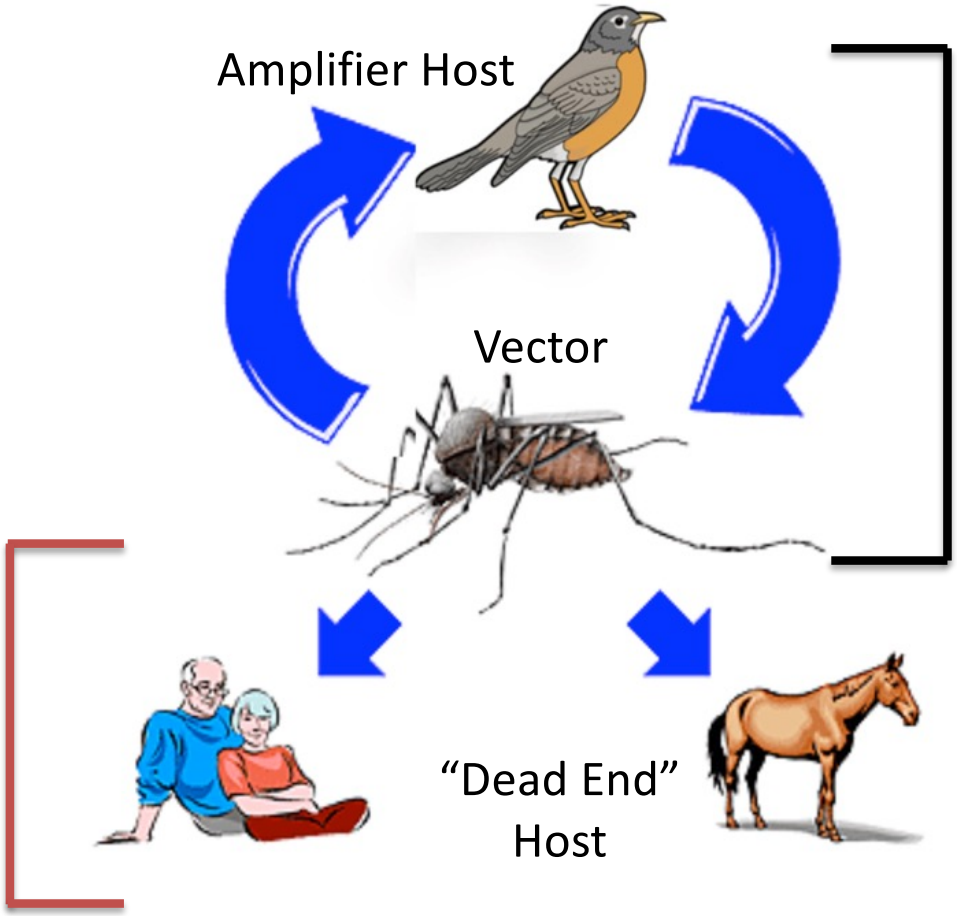
West Nile virus Disease Dynamics

- The leading cause of domestically acquired arthropod-borne viral (arboviral) disease in the United States
- Produces periodic seasonal epidemics
- Enzootic cycle of WNV between mosquito vectors and bird hosts
- Goal: identifying the key environmental conditions that facilitate and accelerate transmission
- Use this environmental indicator to inform effective vector control



Background

West Nile Virus Transmission Cycle

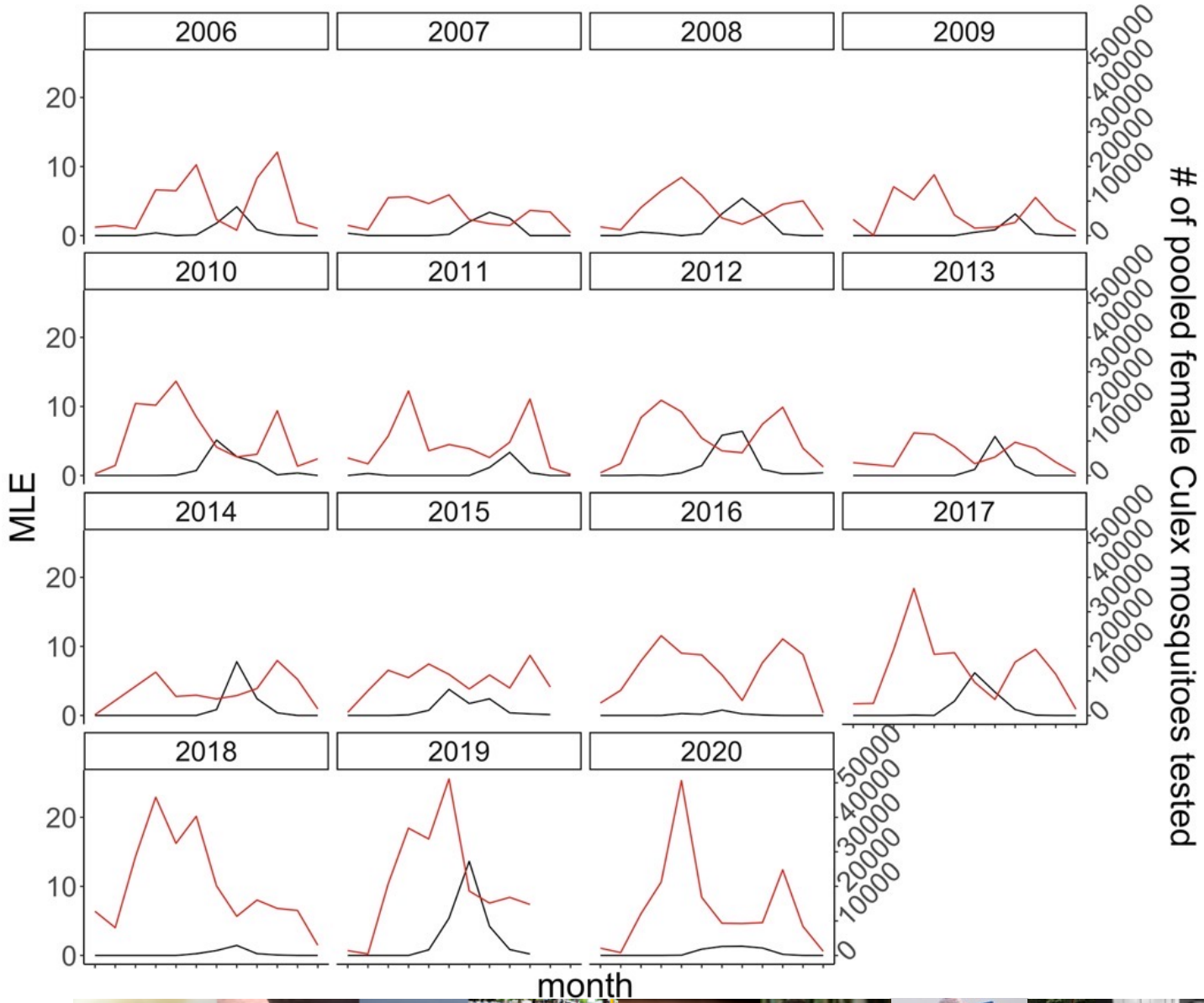


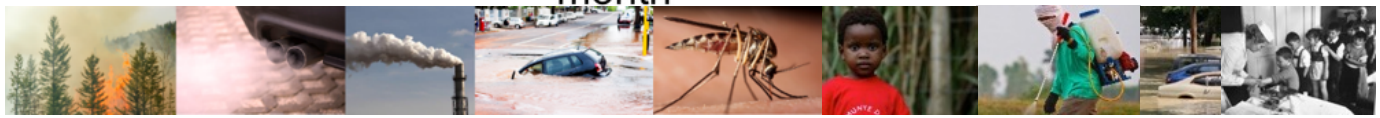
Zoonotic
Transmission Cycle

Incidental
Transmission
"Spillover"

Background

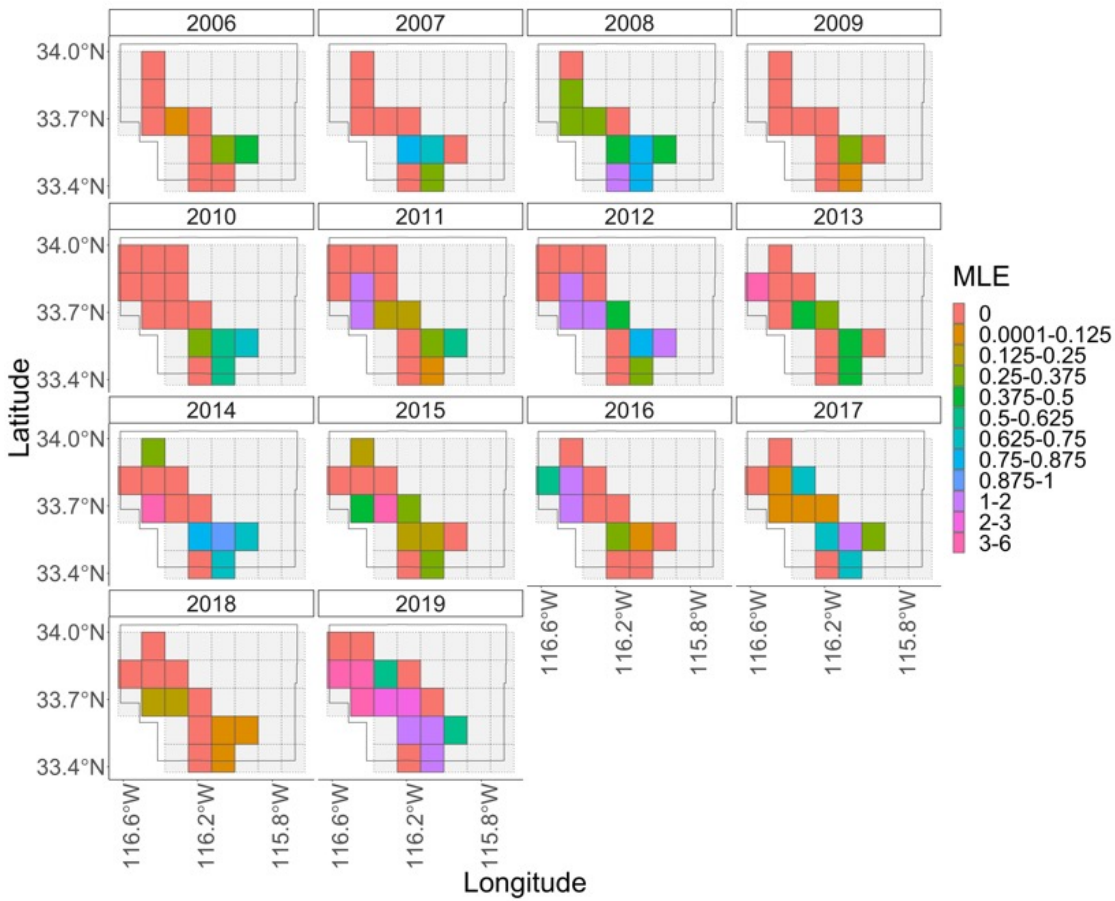
Temporal variability of Mosquito infection rates





Background

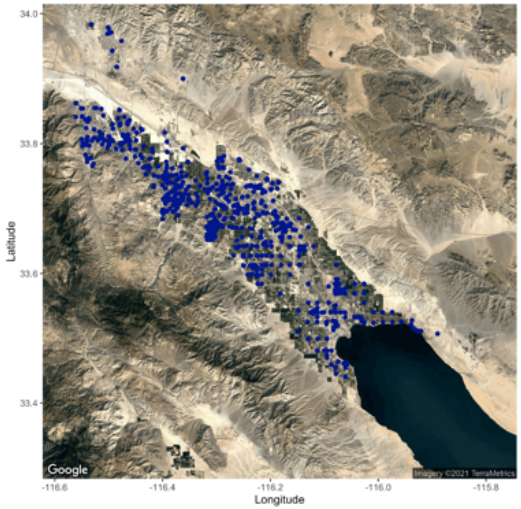
Spatial variability of mosquito infection rates



Background

Prevention

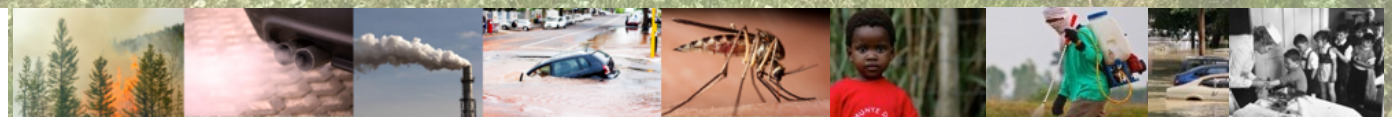
- No human vaccine or specific treatment
- Personal protection
  - Mosquito repellent
  - Long sleeve shirts and pants
- Community based mosquito control programs



Background

Environmental Components Influence the Transmission Cycle

Humidity **Temperature** **Hydrology/Precipitation**



Challenges

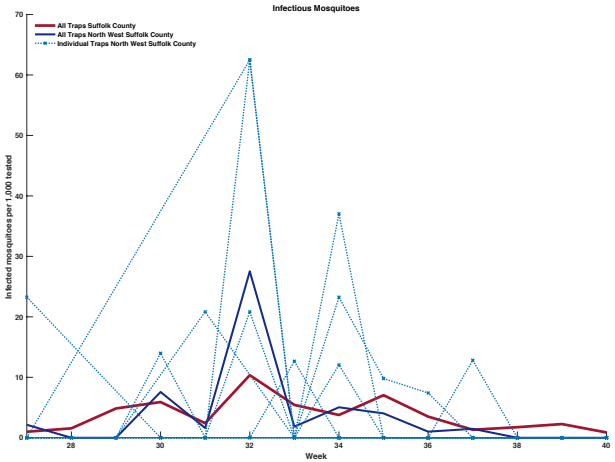
Objectives

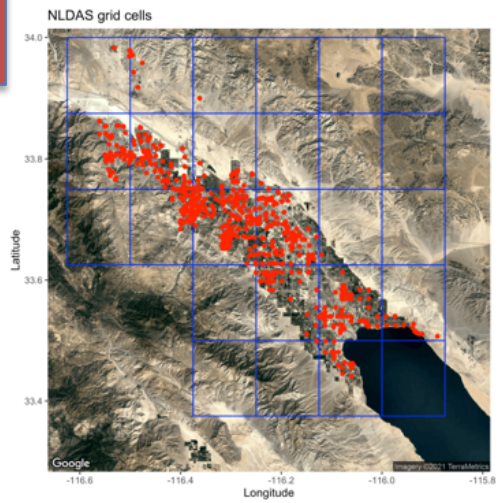
Task #1
Create Database
Dec 2020

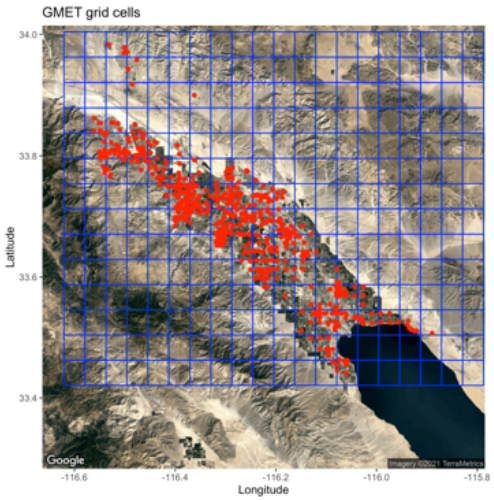
Task #2
Environmental Drivers of WNV Transmission May 2021

Task #3
ECOSTRESS Derived WVN Forecasts May 2022

Task #4
Decision App for WNV Risk May 2022

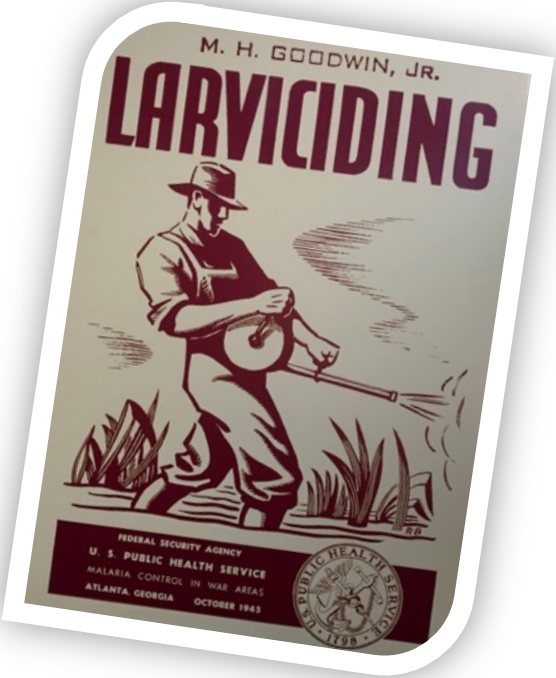






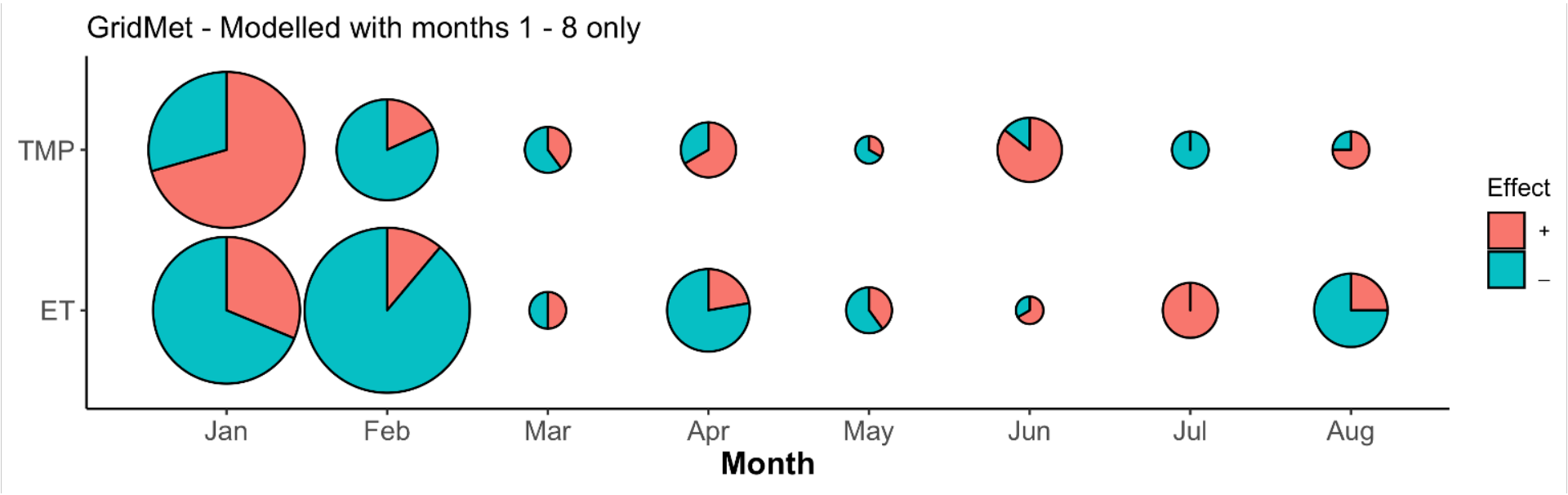
Environmental parameters that drive infections rates

- ECOSTRESS
  - Land surface temperature
  - Evapotranspiration
- Model selection
  - Exhaustive search, forward and backward stepwise, and sequential replacement



Task 1

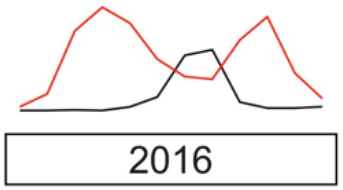
Environmental predictions at 4 km^2

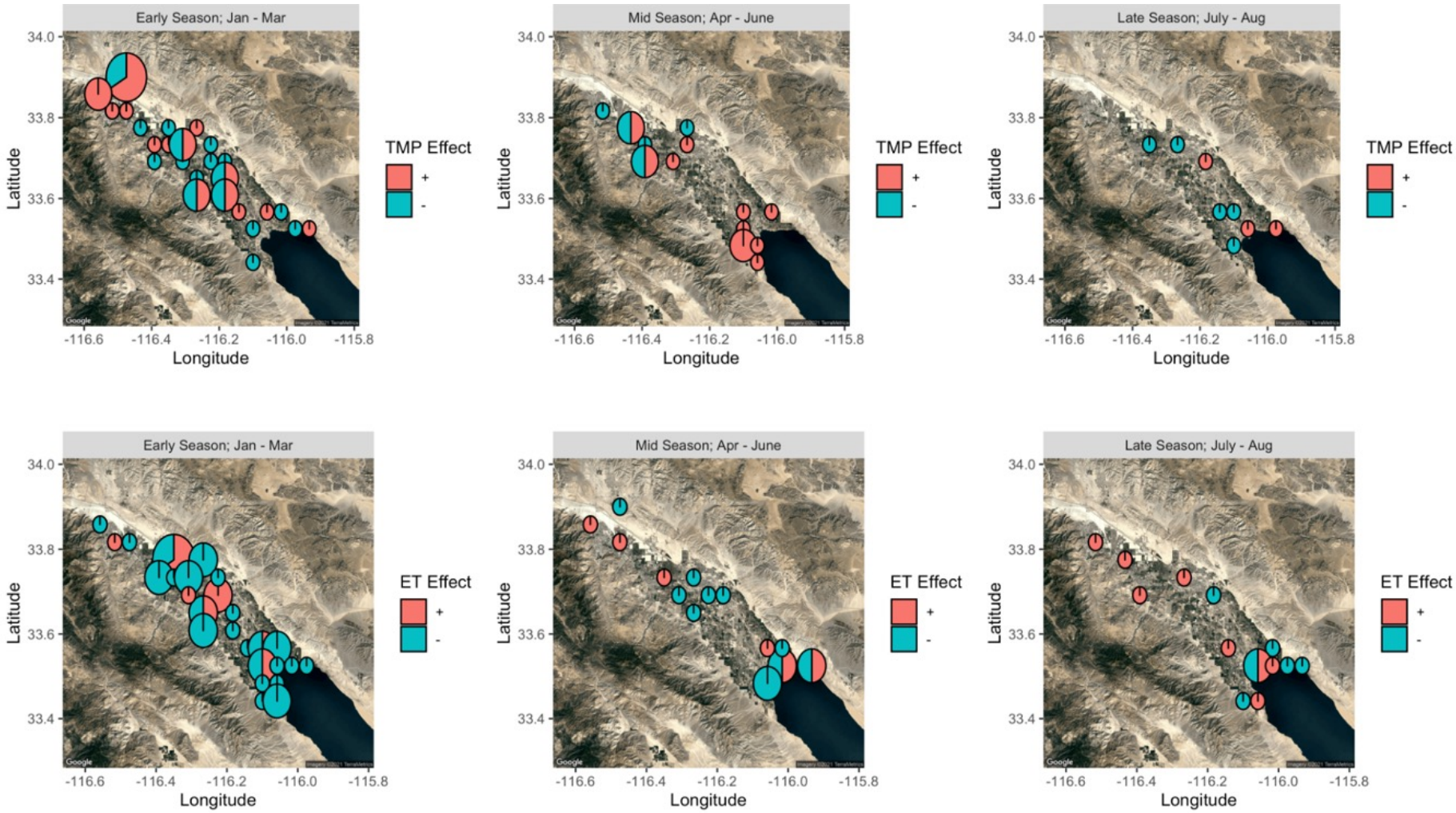


- Climatic conditions associated with the enzootic cycle between mosquito vectors and bird hosts.
  - Warm dry winter
  - Followed by a warm spring

Results

Seasonal impact on WNV transmission





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Task 1

ECOSTRESS

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Create Database
Dec 2020

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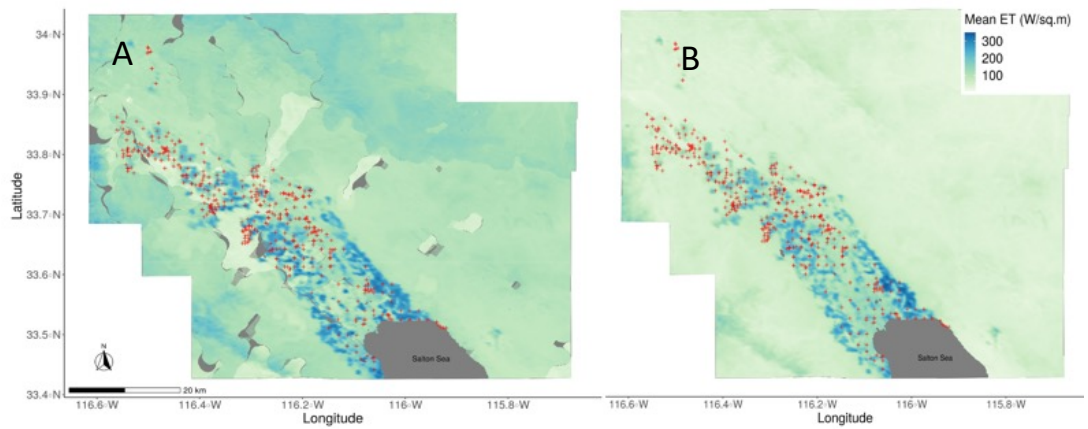
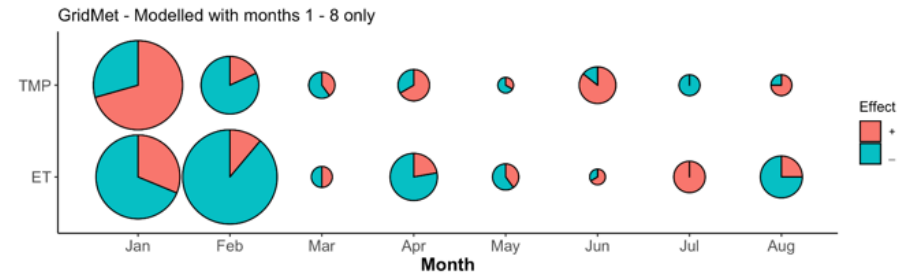


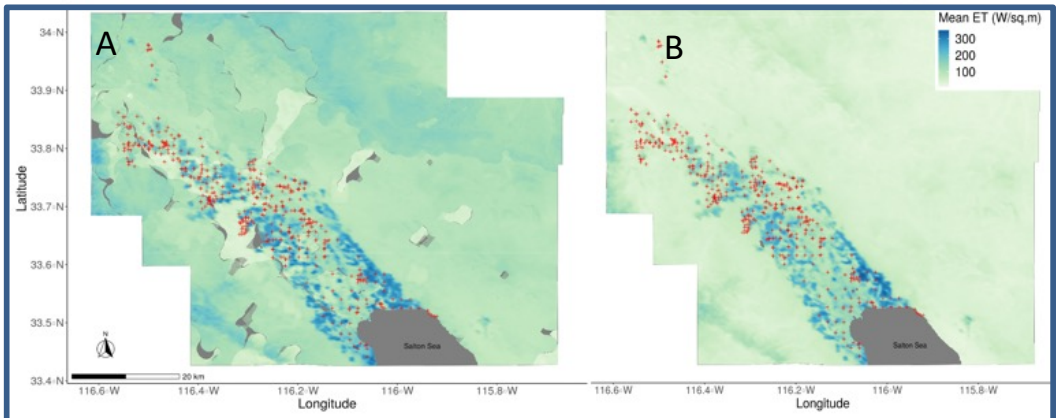
Mean ET (W/m^2) as measured by ECOSTRESS in the Coachella Valley, CA during the early season (Figure A: March - May) and late season (Figure B: June - Aug) with trap locations (red x) for 2019.

Potential to help guide public health interventions

- West Nile virus transmission is driven by an enzootic cycle between mosquito vectors and bird hosts
- Identifying the key environmental conditions that facilitate and accelerate this cycle can be used to inform effective vector control
- Statistical models using GRIDMET data, 4km resolution, <u>show dry winter followed by warm spring</u> are associated with an increase in mosquito infection rates
- ECOSTRESS has potential to identify hydrologically rich areas where mosquitoes and birds interact during a warm spring following a dry winter



Climatic conditions associated with the enzootic cycle between mosquito vectors and bird hosts.



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Acknowledgements:

- Mosquito abatement and health departments:
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Questions?

Mailman School's
Transmission
newsletter 2017

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