Emulating Disturbance Effects on Evapotranspiration:

Supporting Land Management & Water Resources Planning

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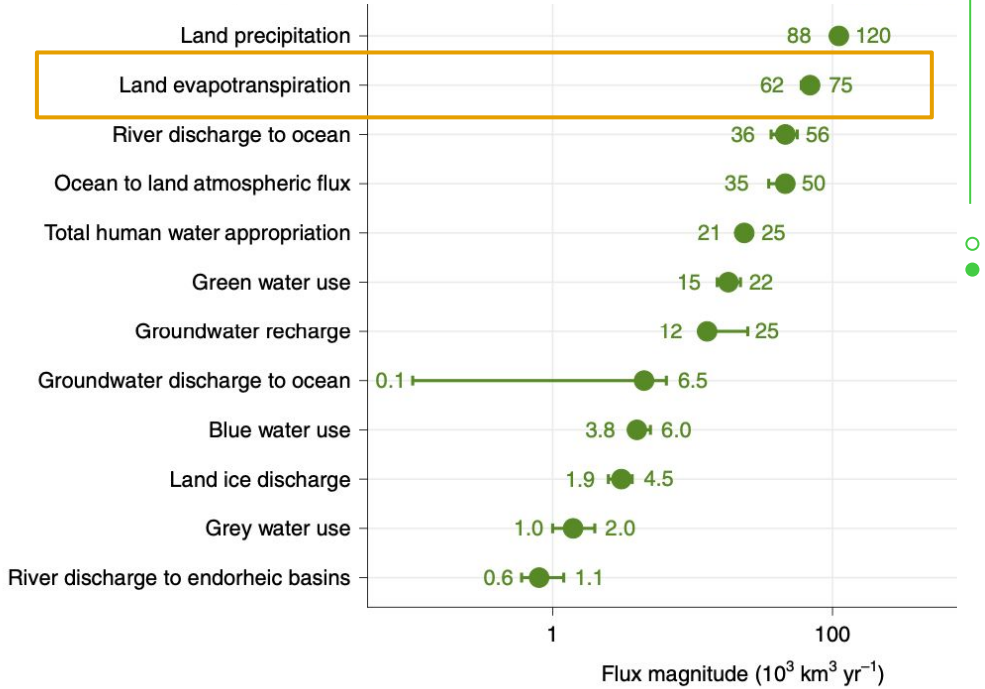
Why ET

- Lots of approaches to measuring ET
  - Physical equations
  - Direct & indirect empirical estimates
  - Remote-sensing versions of the above



From Abbott, et al. 2019 Figure 1

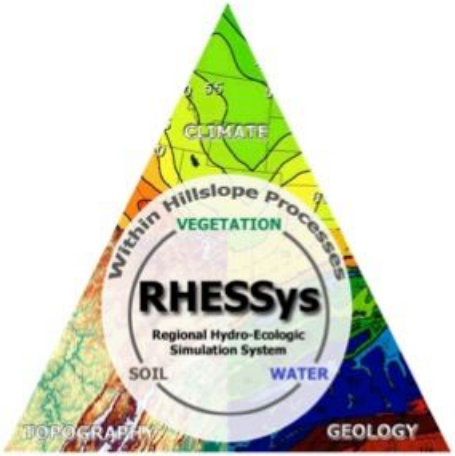
No “Disturbance” in ET formulas

Approaches:

- Develop multiple parameterizations
- Couple hydrologic and vegetation models
- Apply an empirical correction
- Treat time series as observations

$$ET_o = 0.0023(T_{mean} - 17.8)(T_{max} - T_{min})^{0.5} R_a$$

$$\lambda ET = \frac{\Delta(R_n - G) + \rho_a c_p \frac{(e_s - e_a)}{r_a}}{\Delta + \gamma\left(1 + \frac{r_s}{r_a}\right)}$$



$$ET = 101.49 * e^{(2.6853*NDVI)}$$

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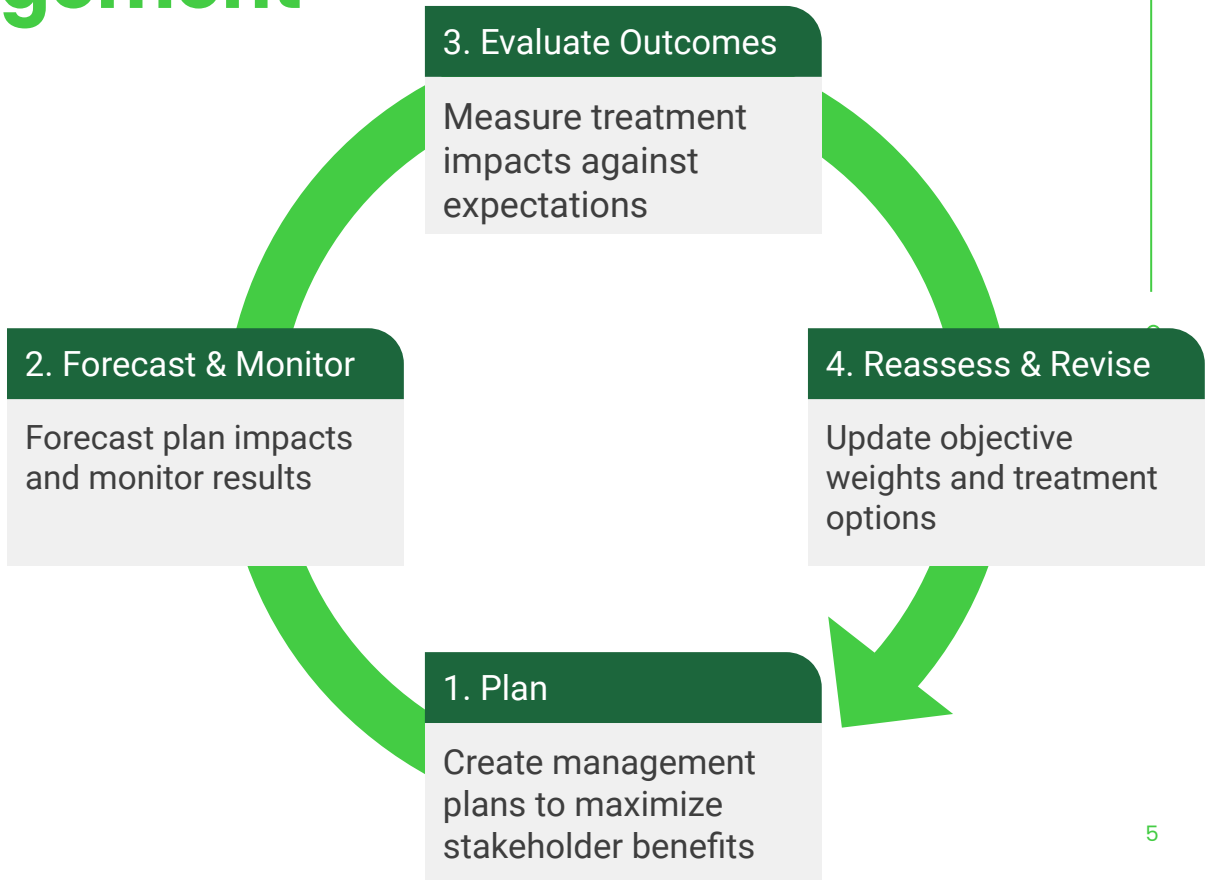
Disturbance matters!

- Wildfire Crisis Strategy landscapes
  - Unplanned (wildfire)
  - Planned (fuels treatments)
- Are treatments working?

Credit: Steve Rondeau, Natural Resources Director of the Klamath Tribes

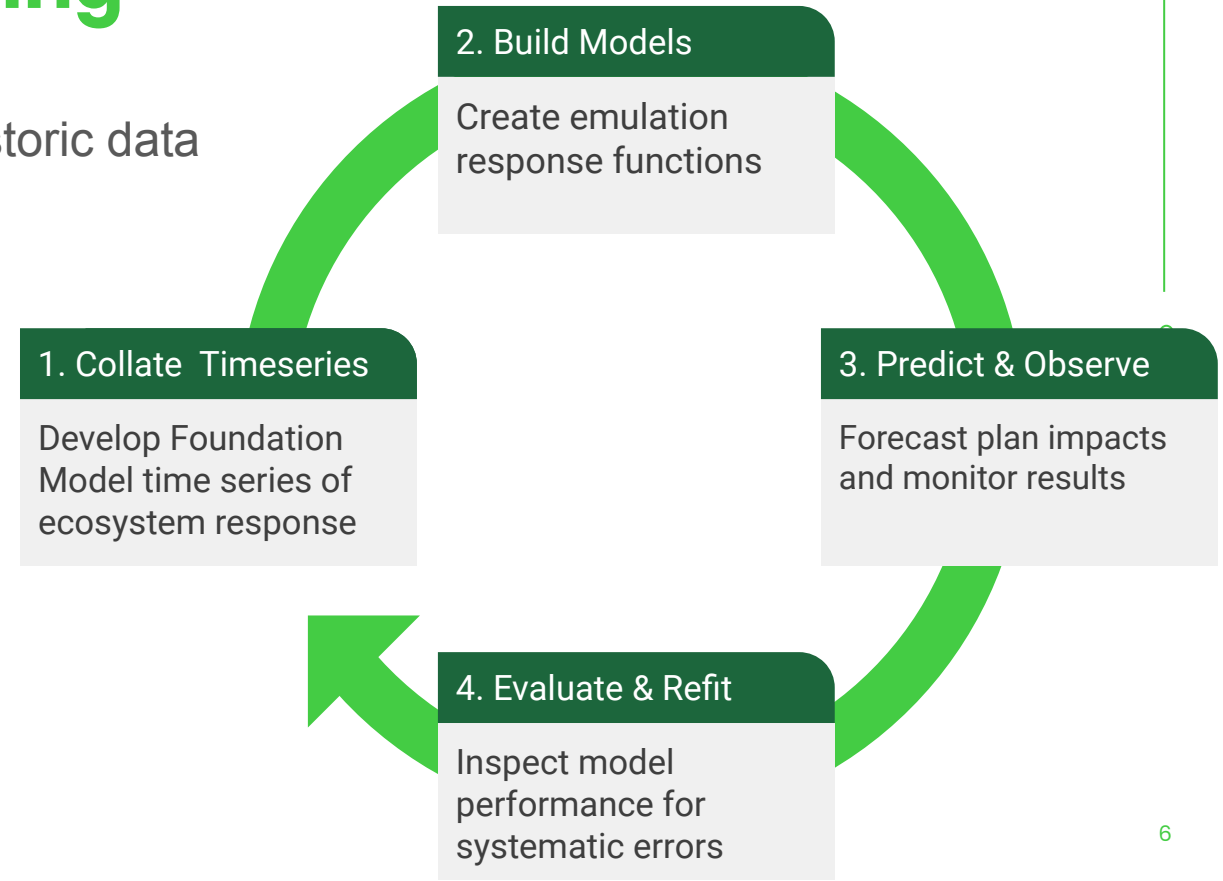
Adaptive Management

1. Plan
2. Forecast & Monitor
3. Evaluate Outcomes
4. Reassess & Revise

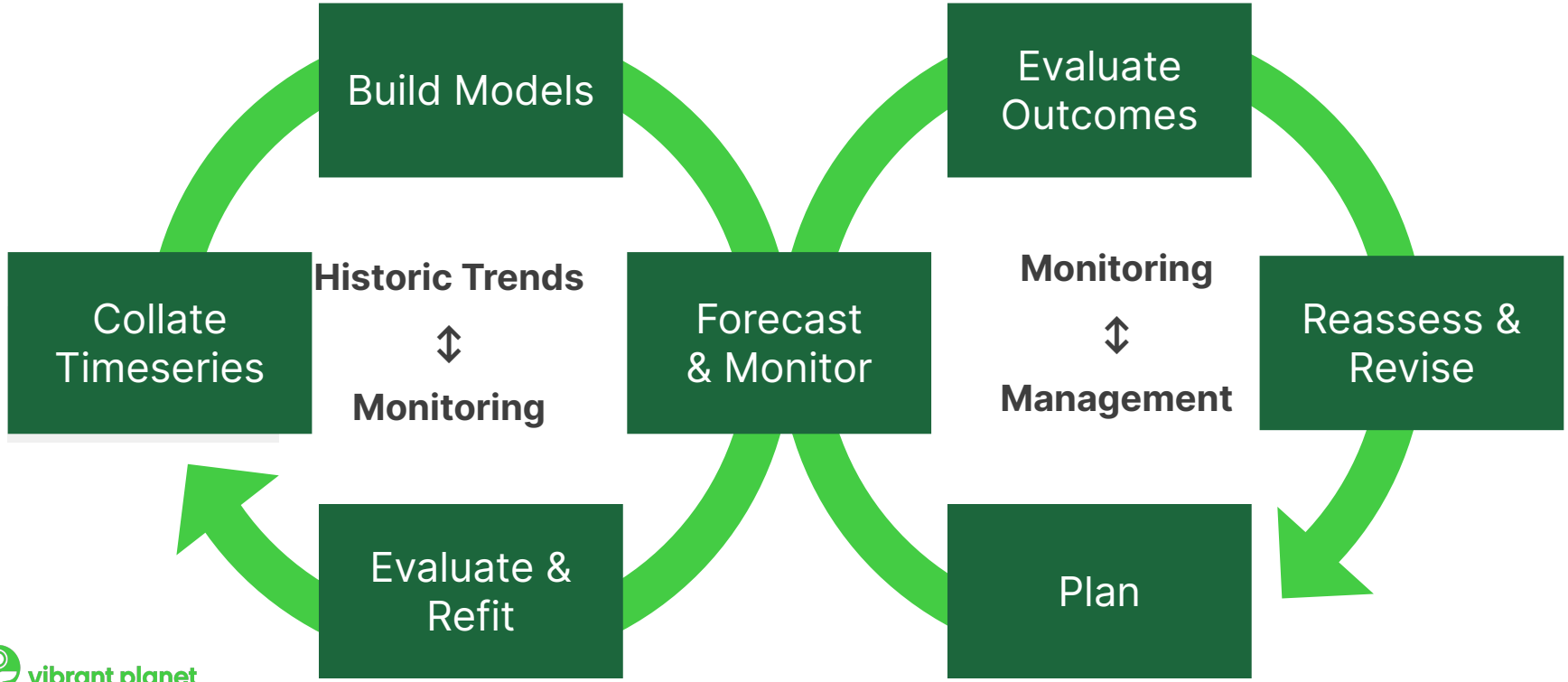


Iterative Modeling

1. Explore and collate historic data
2. Build models
3. Predict and observe
4. Evaluate and refit



Linking Trends, Monitoring, and Impact



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Emulating ET for Adaptive Management

- Forest management impacts
- Post-disturbance water resources planning – FIRO
- Landscape-scale resilience and water availability

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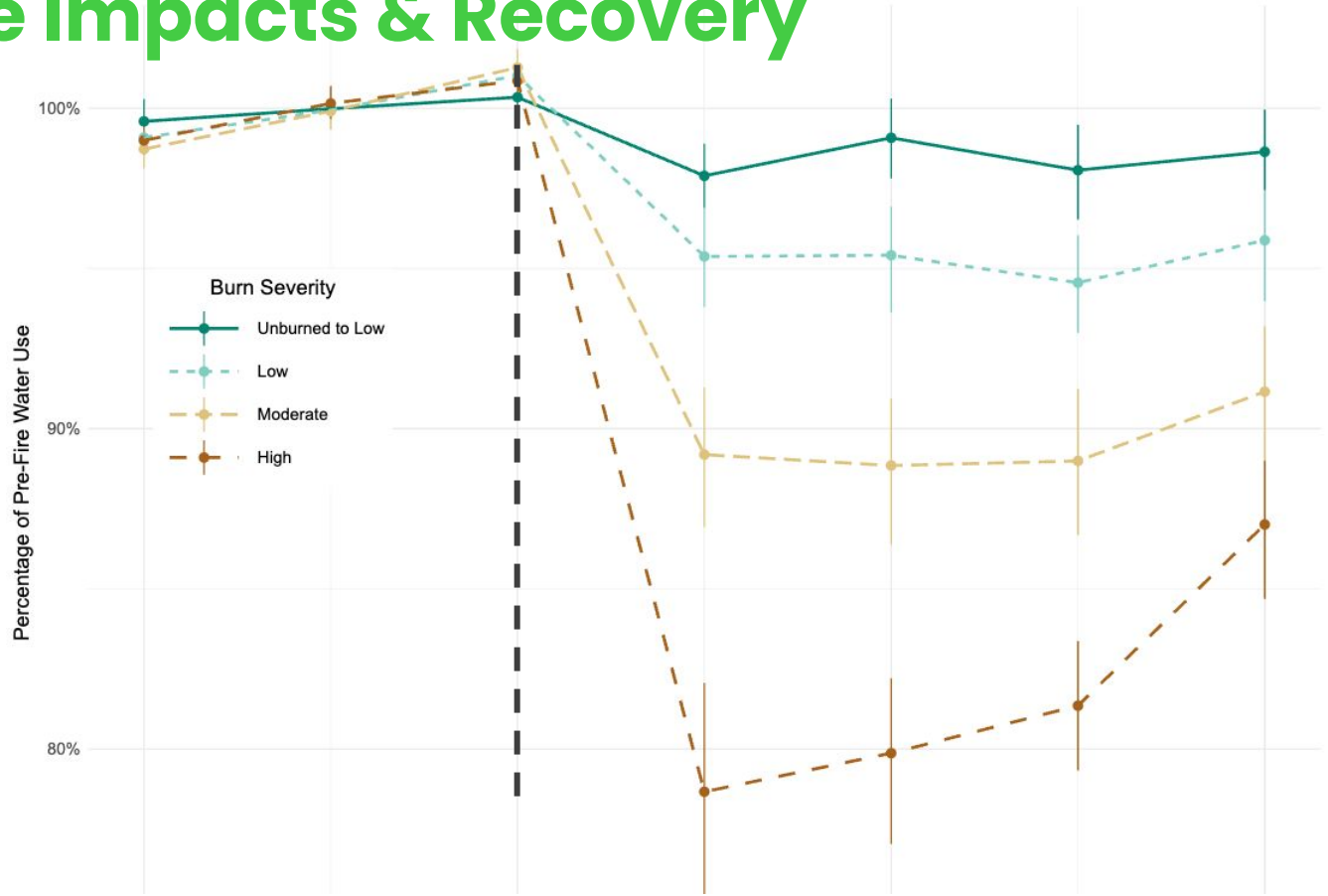
Exploratory Work

Post-Fire Impacts & Recovery

Summarized OpenET data for the 2018 Kerlin Fire



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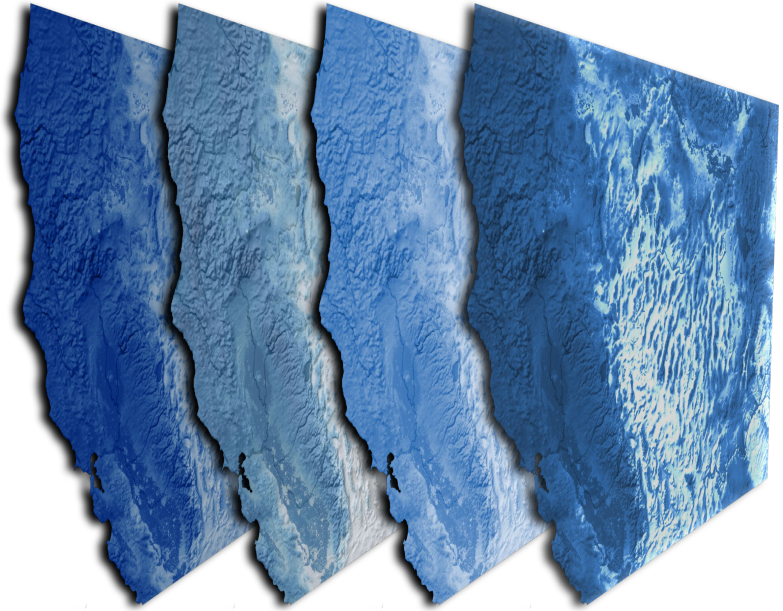
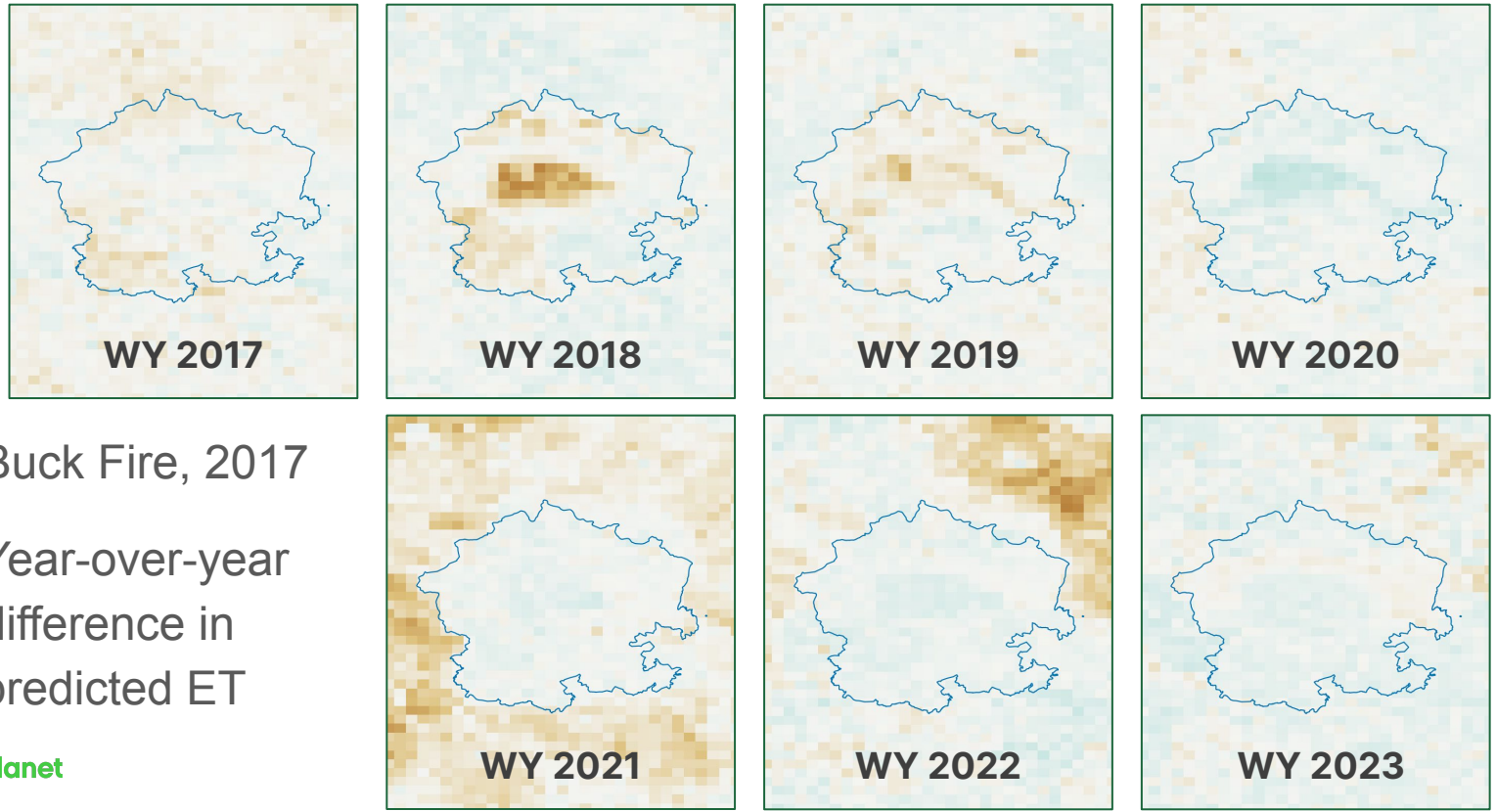
Current Model Form & Inputs

- LSTM (Long short-term memory)
- Water year ET
- Inputs
  - Weather (PET, CWD)
  - Geomorphology
  - Vegetation type and structure*
  - Historic loss*



*- Will be replaced with in-house products

Modeled Fire Response



- Buck Fire, 2017
- Year-over-year difference in predicted ET

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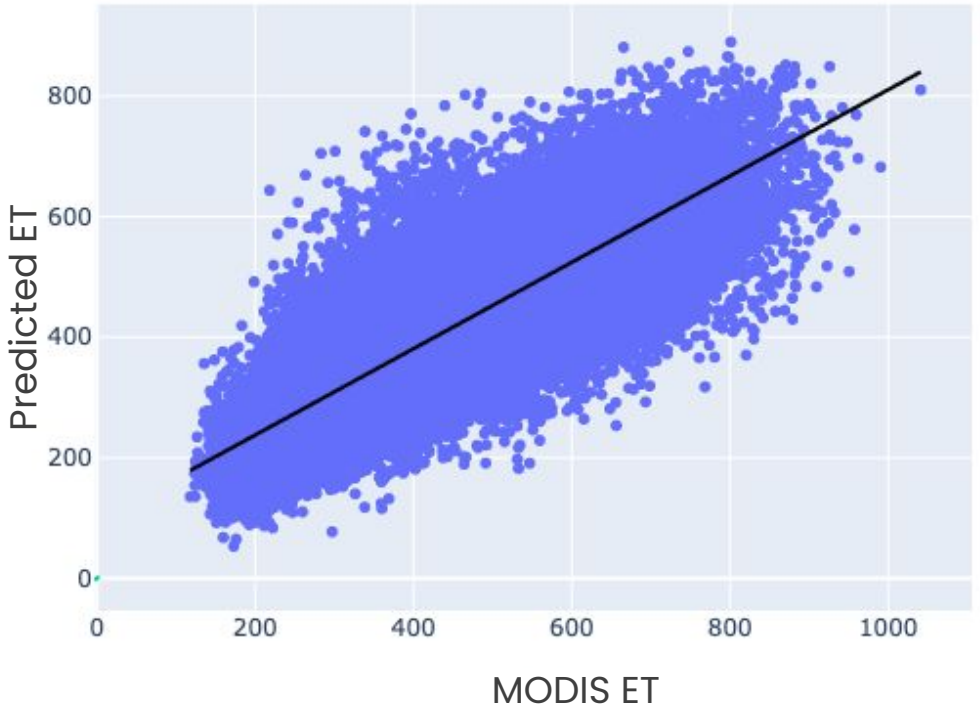
Global Model Metrics (prototype)

- Good performance with minimum tuning
- Median RMSE: 48.8639
- Median Bias: -10.7886
- Should reduce noise with higher resolution ET



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Next Steps

- Compare ET sources
  - MODIS, OpenET, ESPA, others?
- Extend time series
- Evaluated against disturbed watersheds water balance data