

The effects of Drought on Total Dissolved Solids/Conductivity in Streams and Rivers

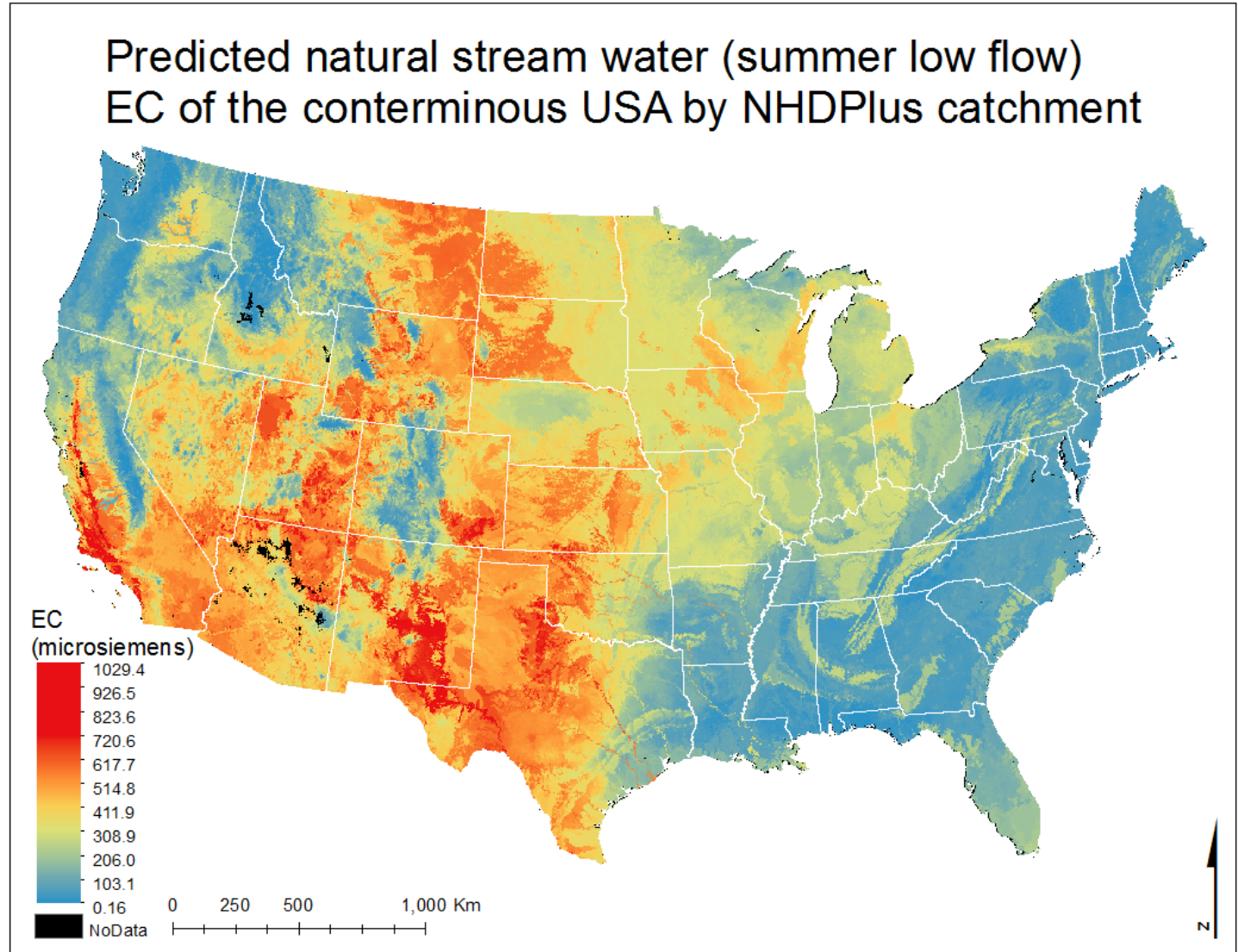
John Olson

Desert Research Institute, NV

California State University Monterey Bay

The Question: Can we predict Specific Electrical Conductivity (EC)?

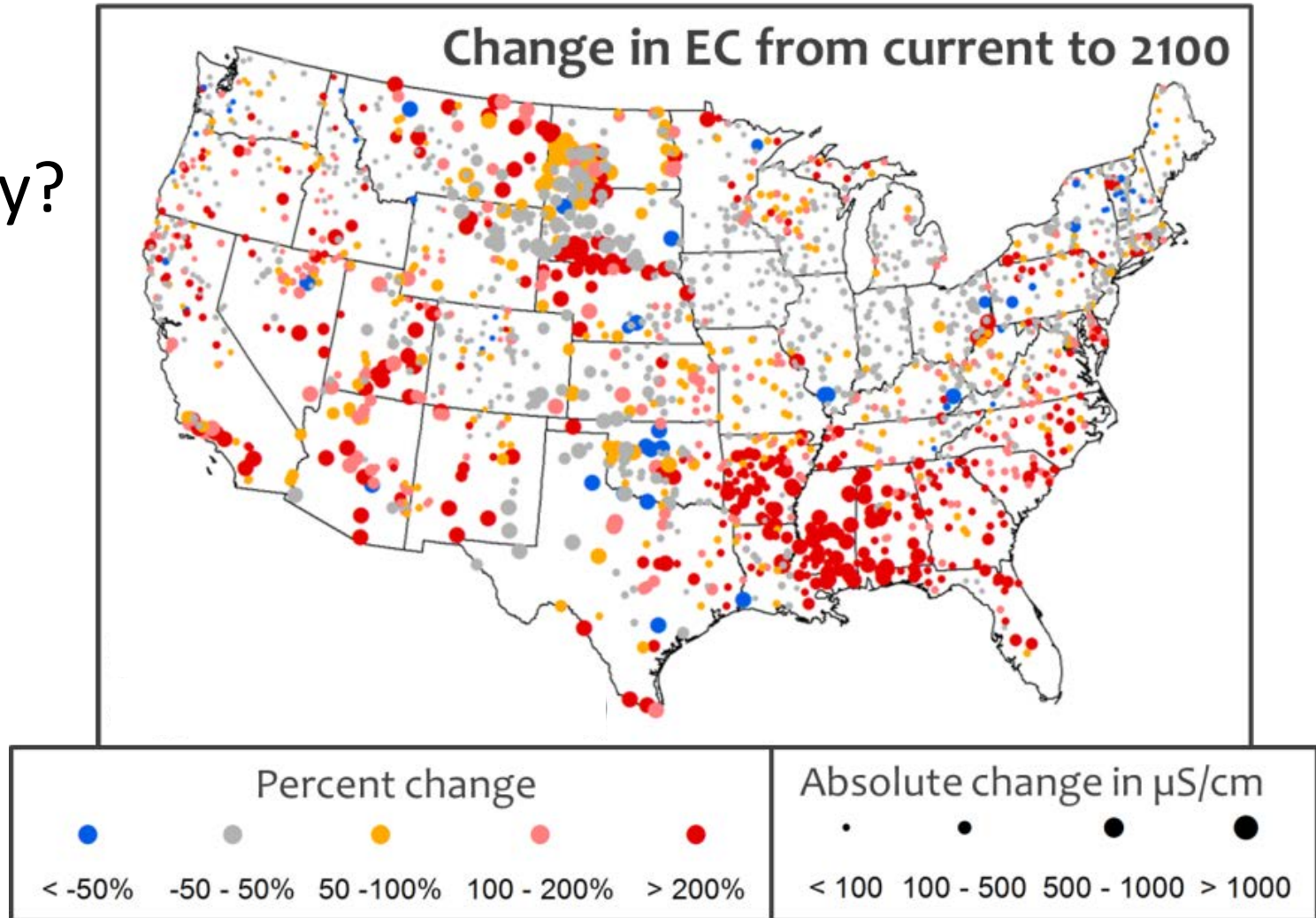
Spatially?



The Question: Can we predict Specific Electrical Conductivity (EC)?

Spatially?

Temporally?



The Question: Can we predict Specific Electrical Conductivity (EC)?

Spatially?

Temporally?

Can we model the effects of droughts on EC?

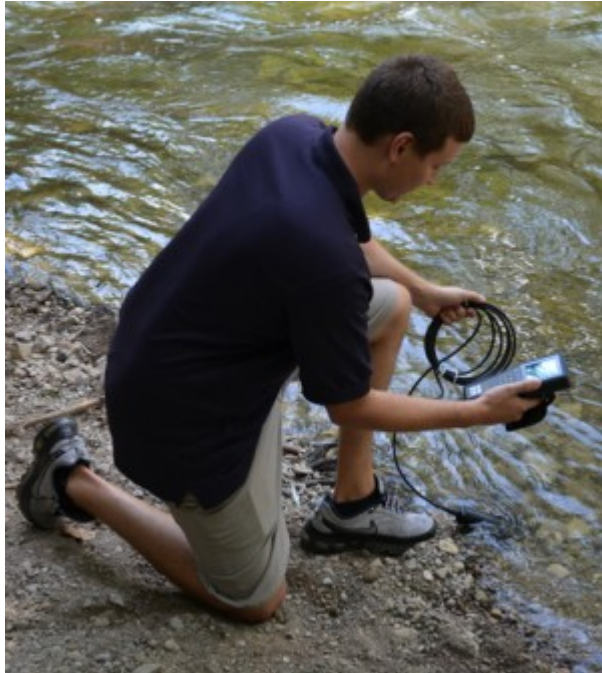
Natural Background?

Altered by Humans?

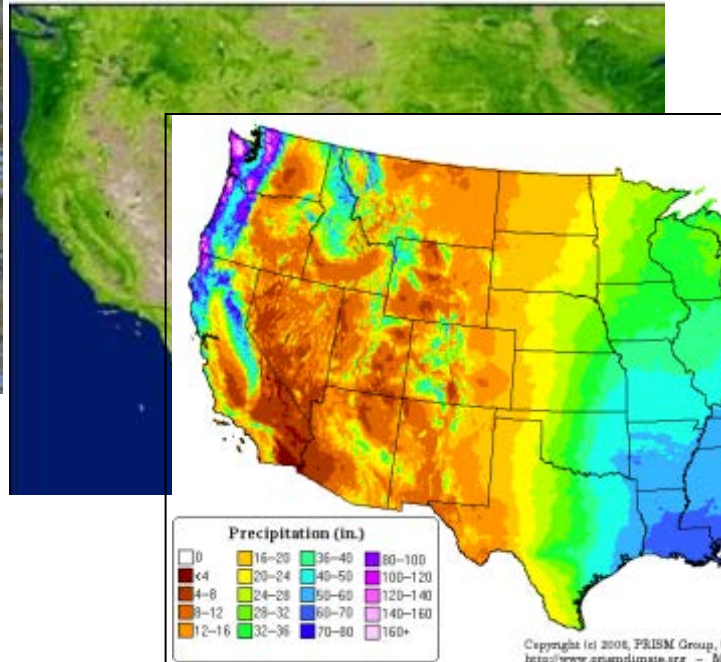
(And how would increases affect invertebrates?)

The Opportunity:

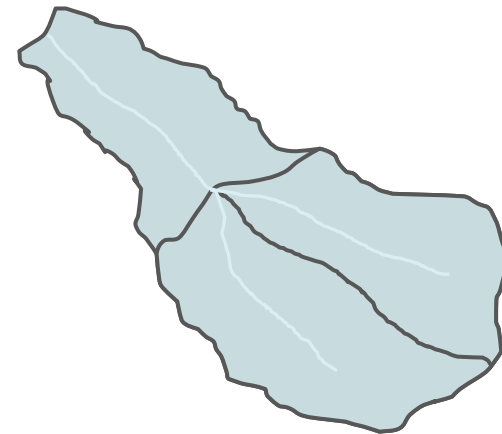
100k's Observations



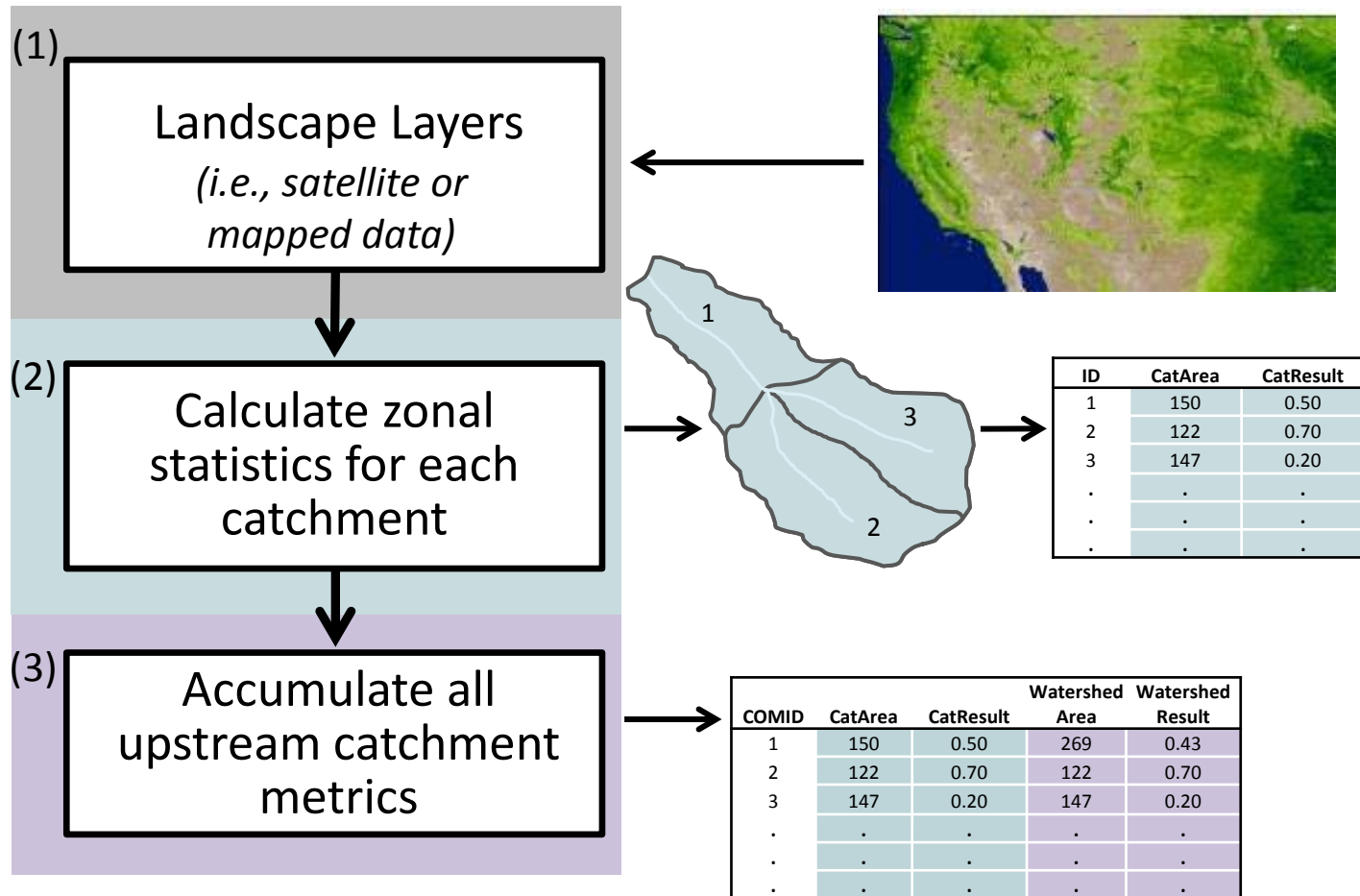
Temporal/Spatial
Climate Data



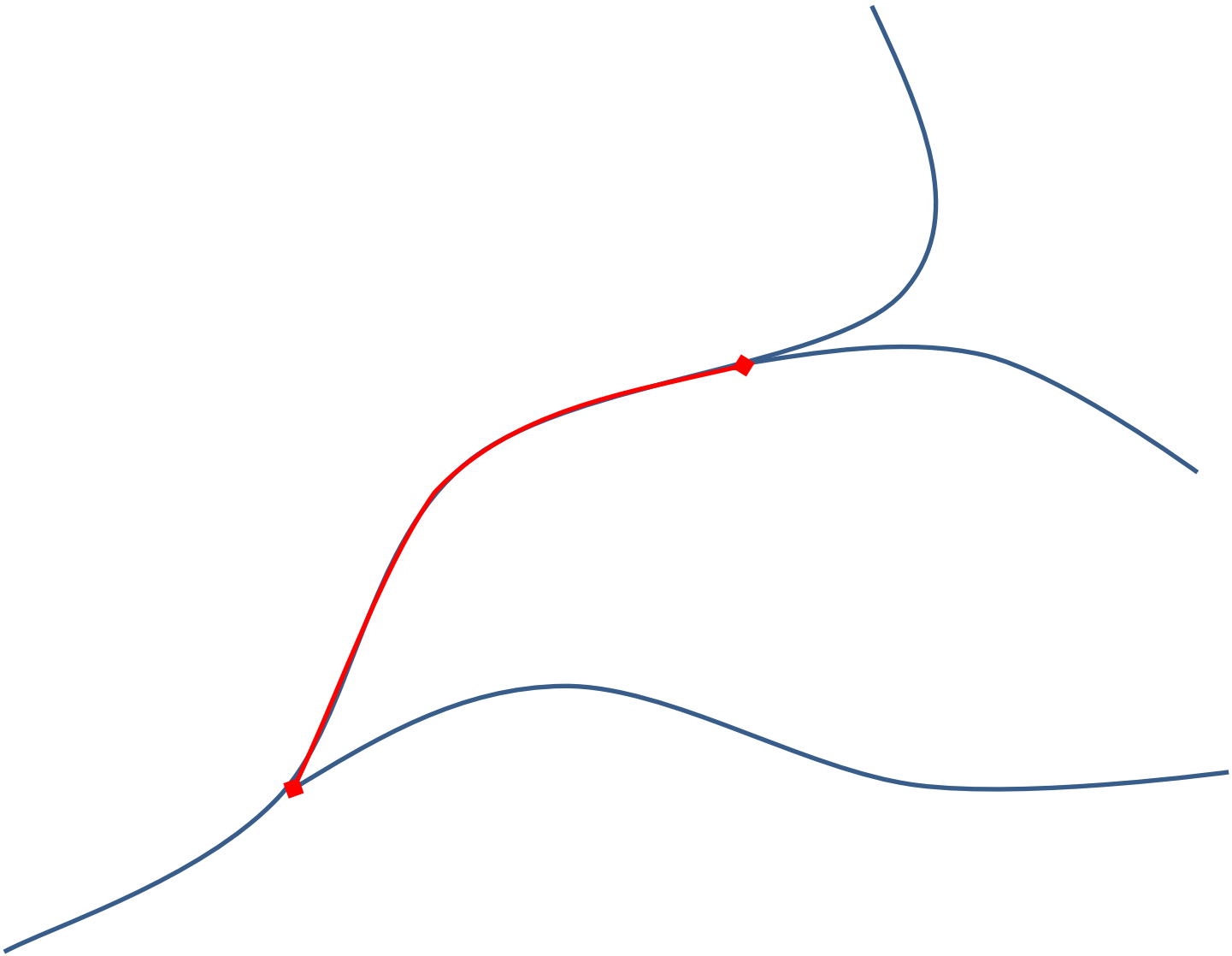
Watershed
Analysis Tools

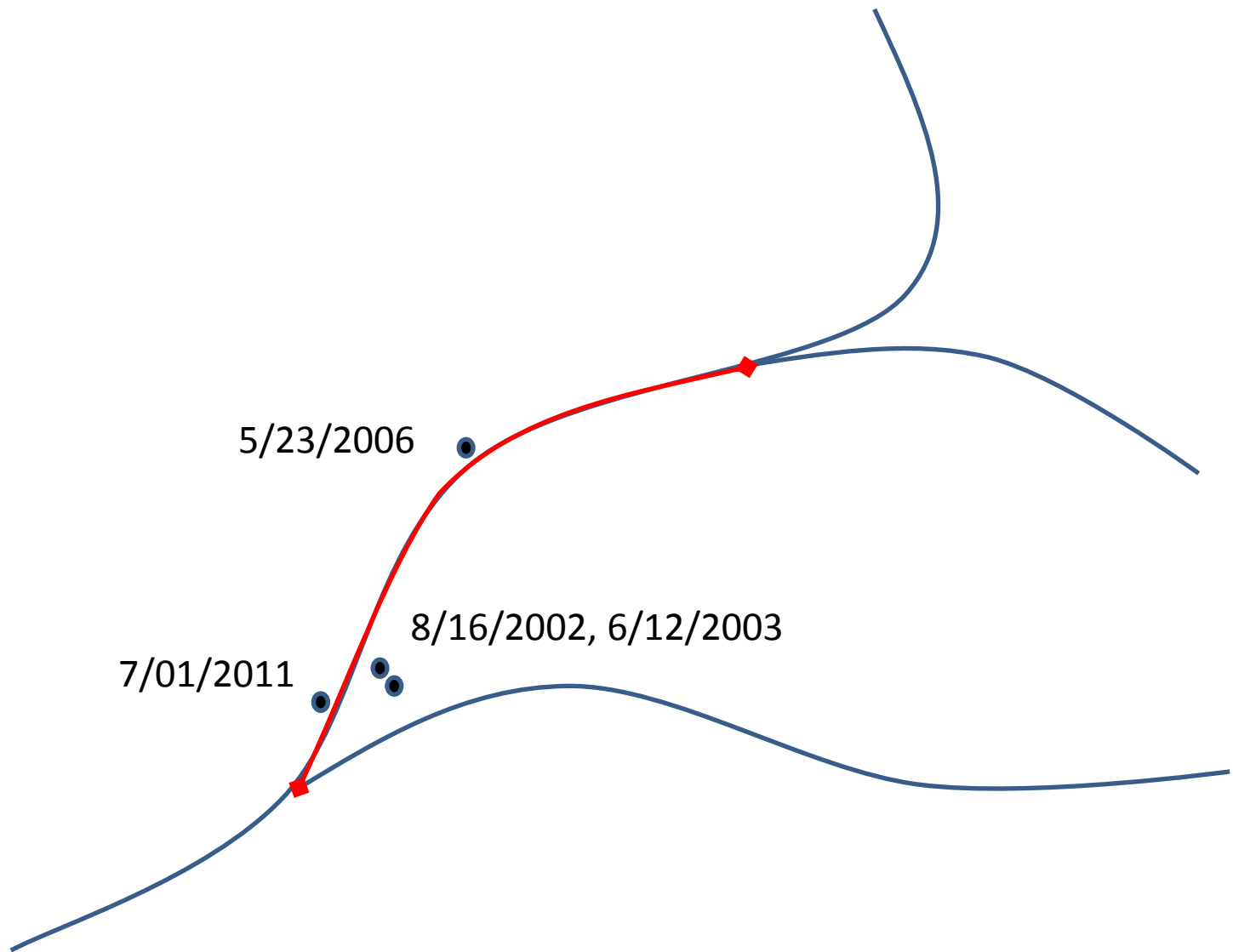


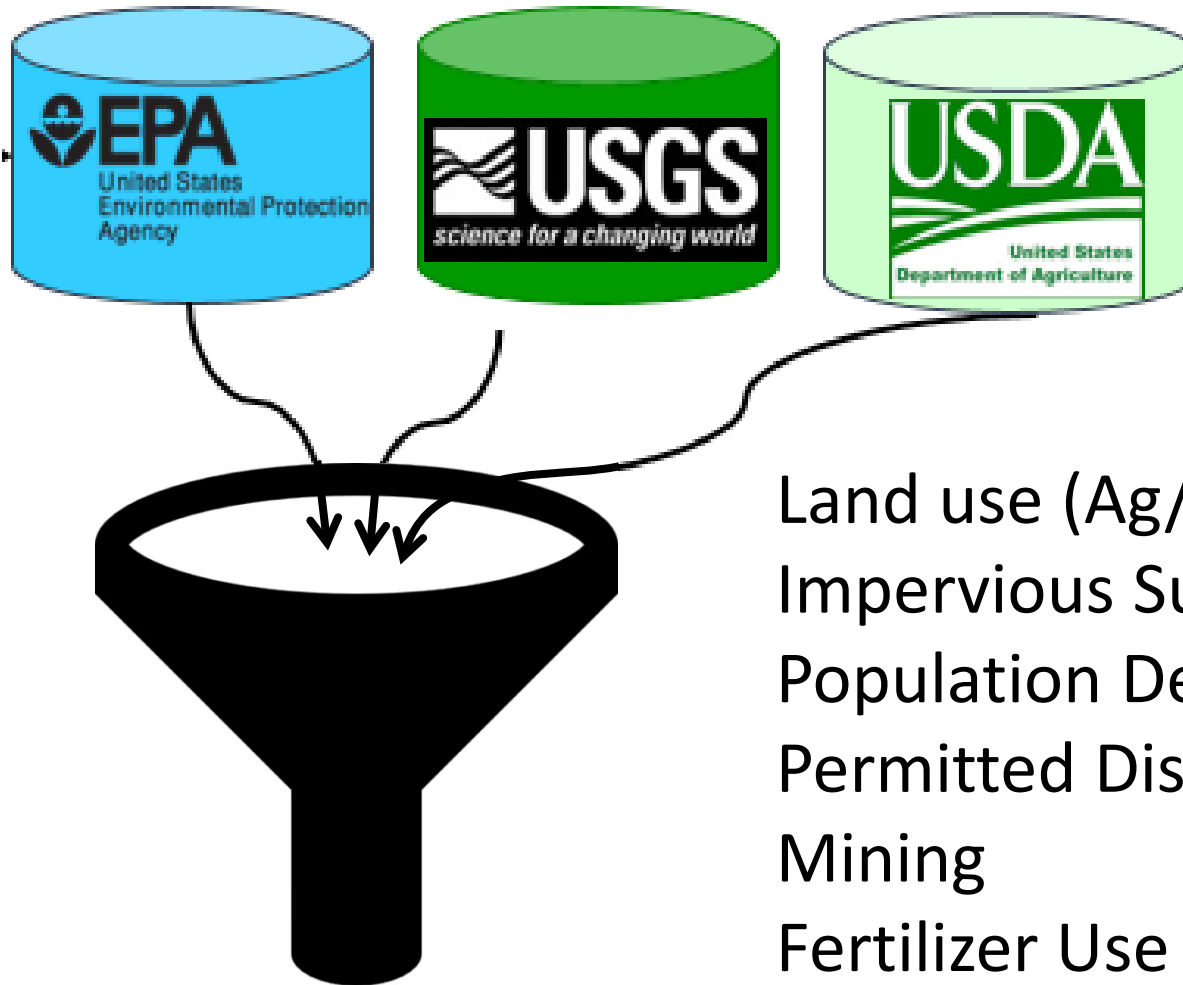
Landscape Stream Characterizations - StreamCat



Hill et al., 2015, The Stream-Catchment (StreamCat) Dataset, JAWRA.
<https://github.com/USEPA/StreamCat>

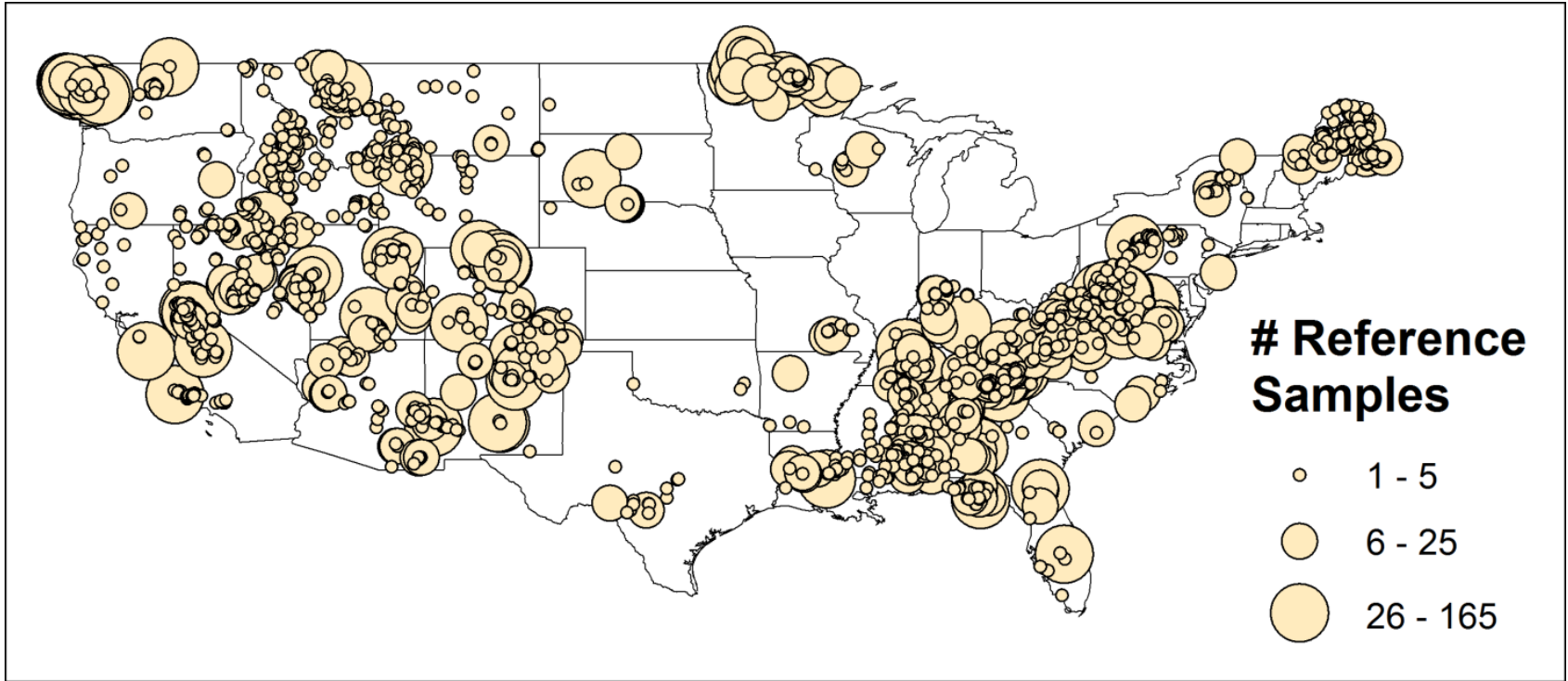






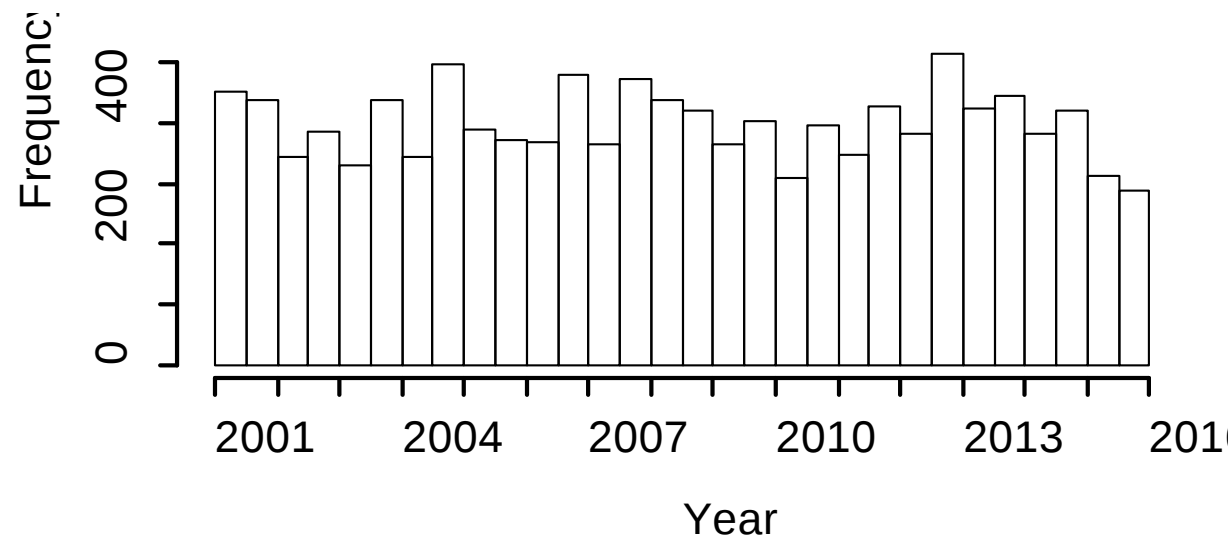
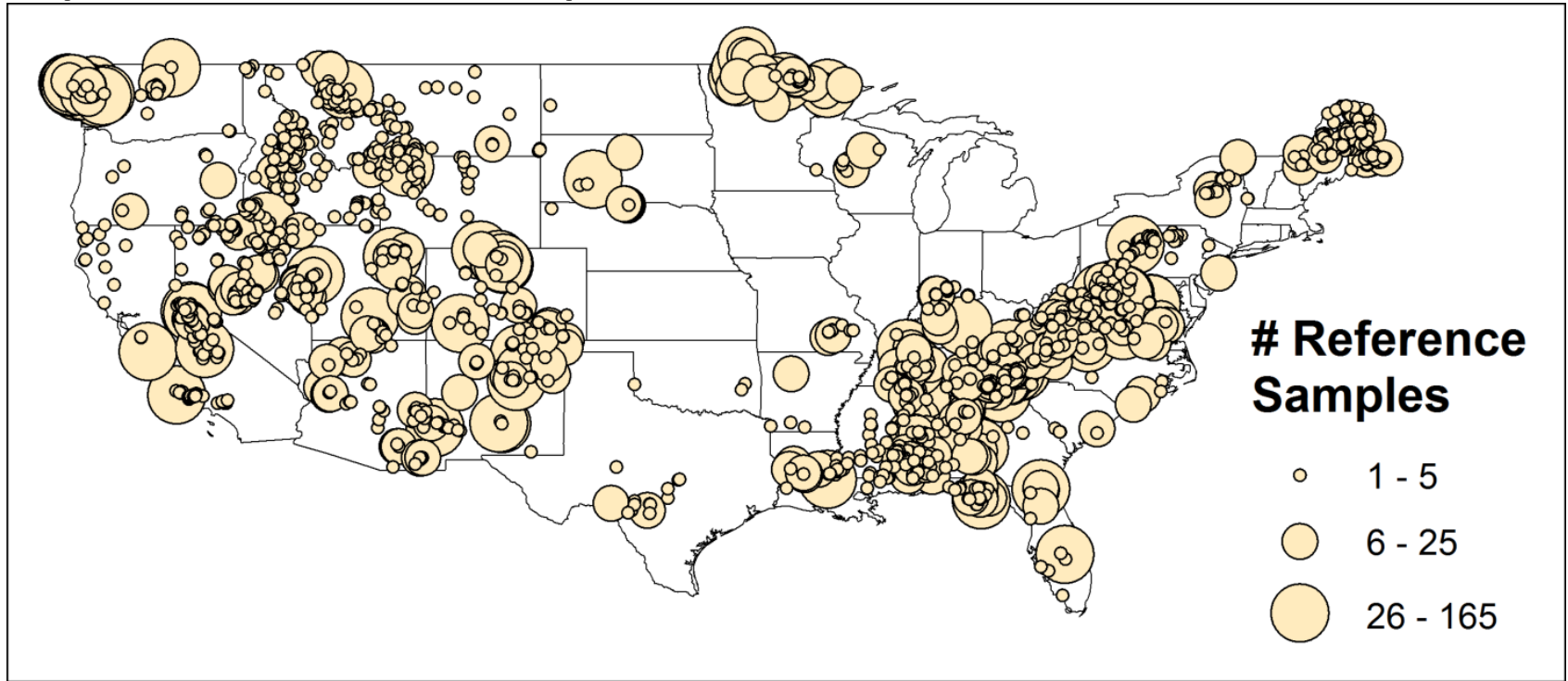
Minimally Impaired Sites

Response: Month specific EC observations 2000-2015



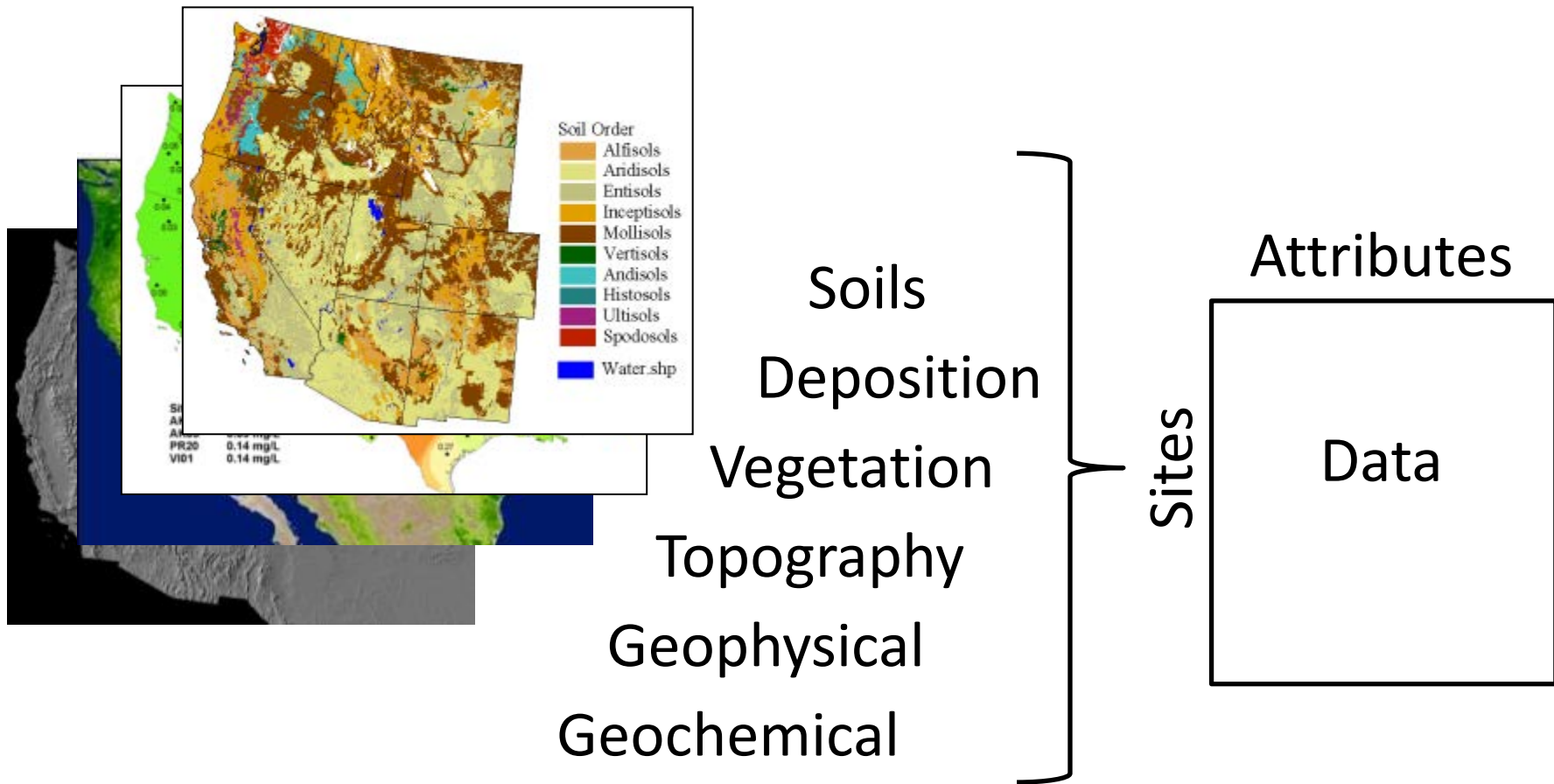
	Total	Training	Validation
Sites	1,857	1,756	101
Observations	12,780	11,961	819

Response: Month specific EC observations 2000-2015



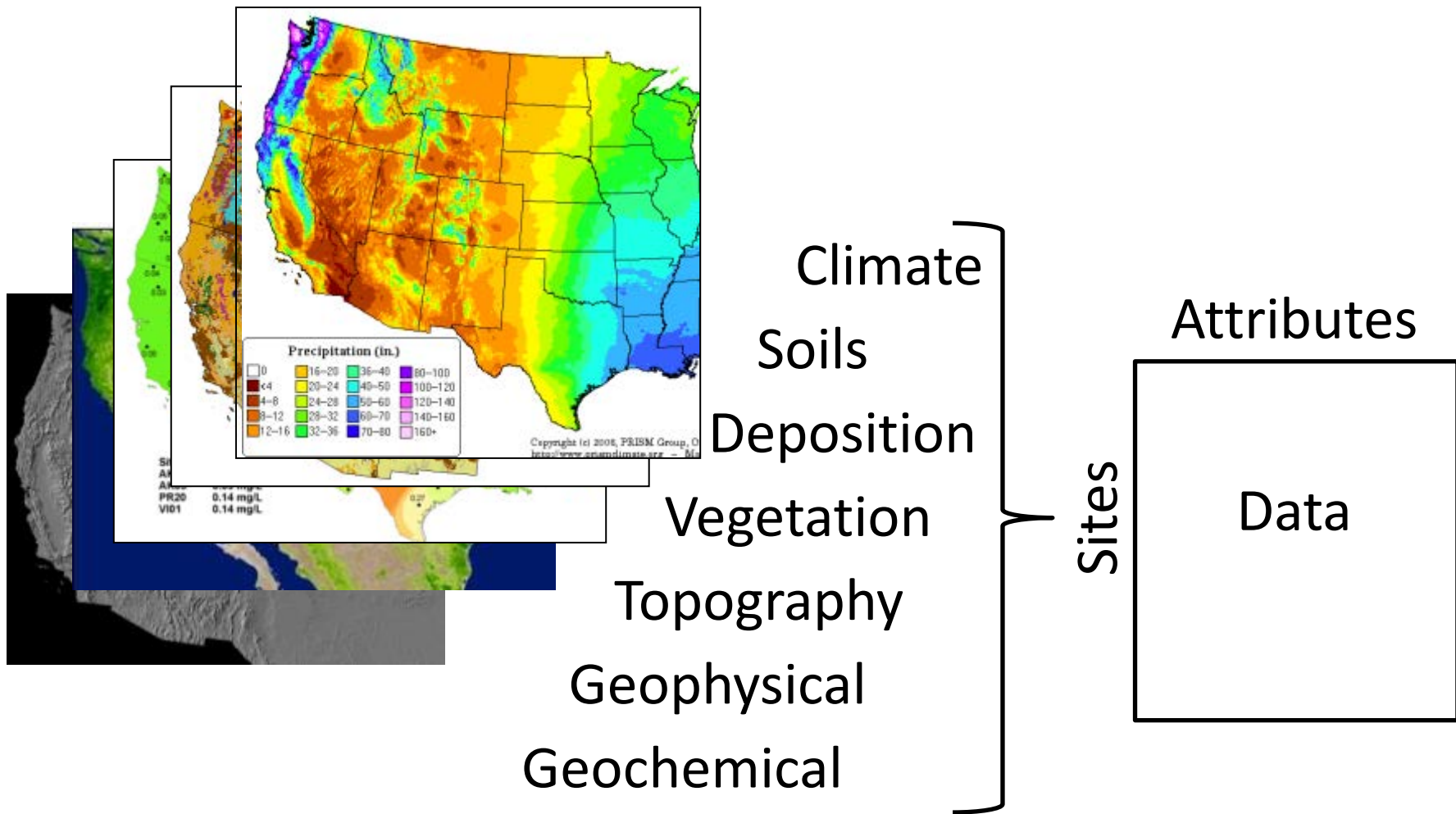
Observations/Site:
Mean: 6.5
Range: 1- 165

Predictors: Spatial/Temporal Watershed Attributes



54 Candidate Predictors

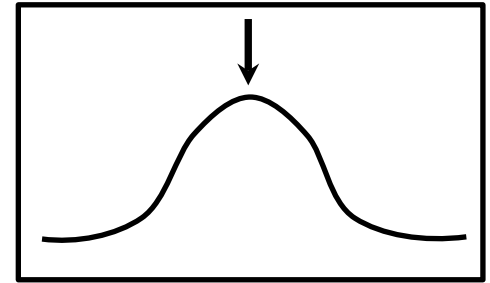
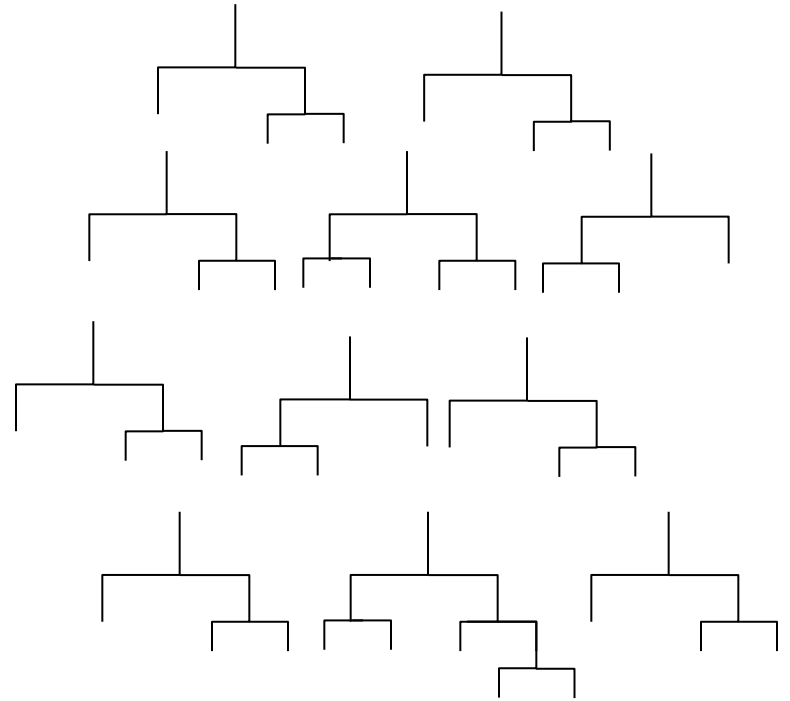
Predictors: Spatial/Temporal Watershed Attributes



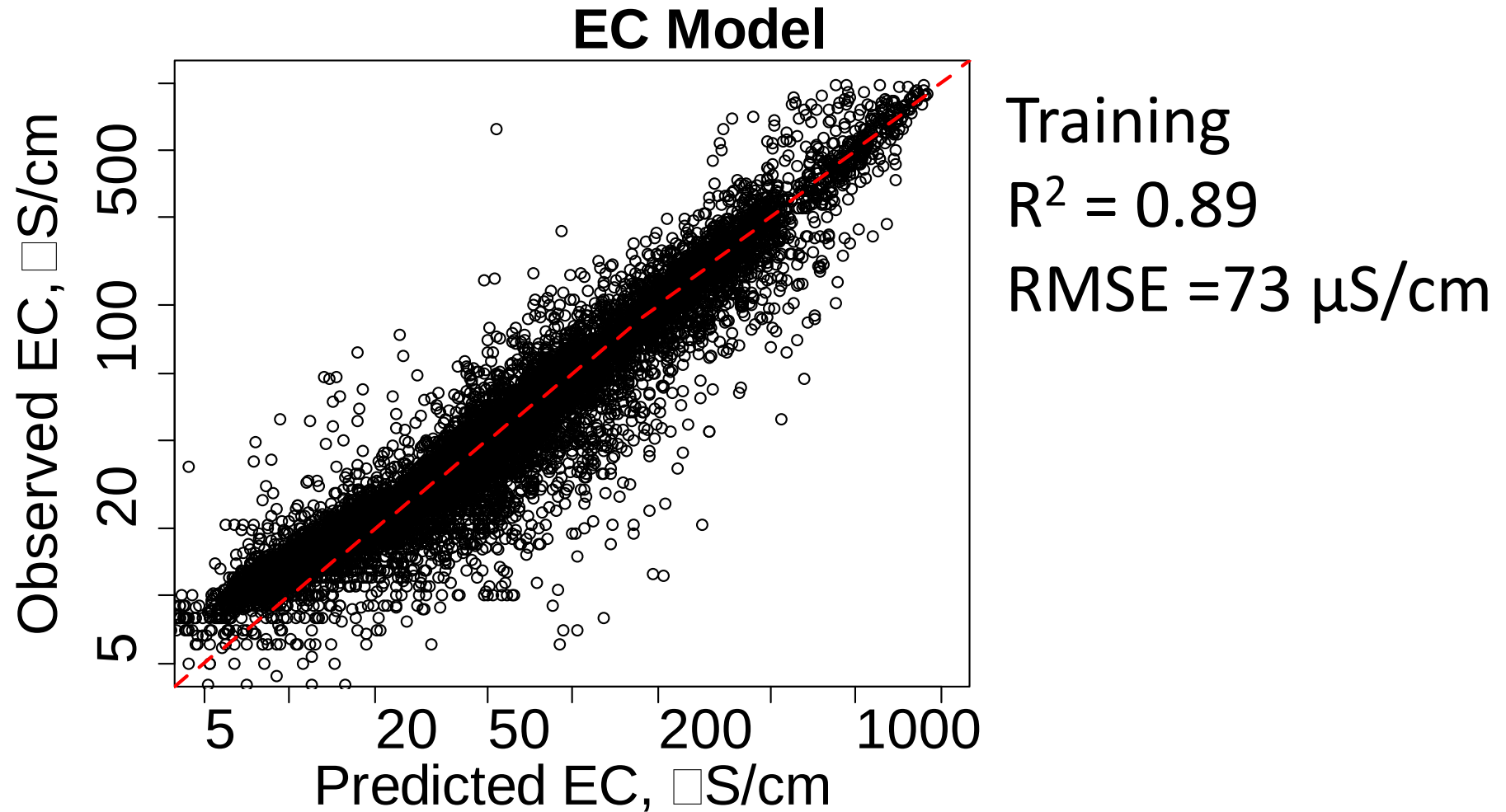
54 Candidate Predictors

Random Forest (RF) Modeling

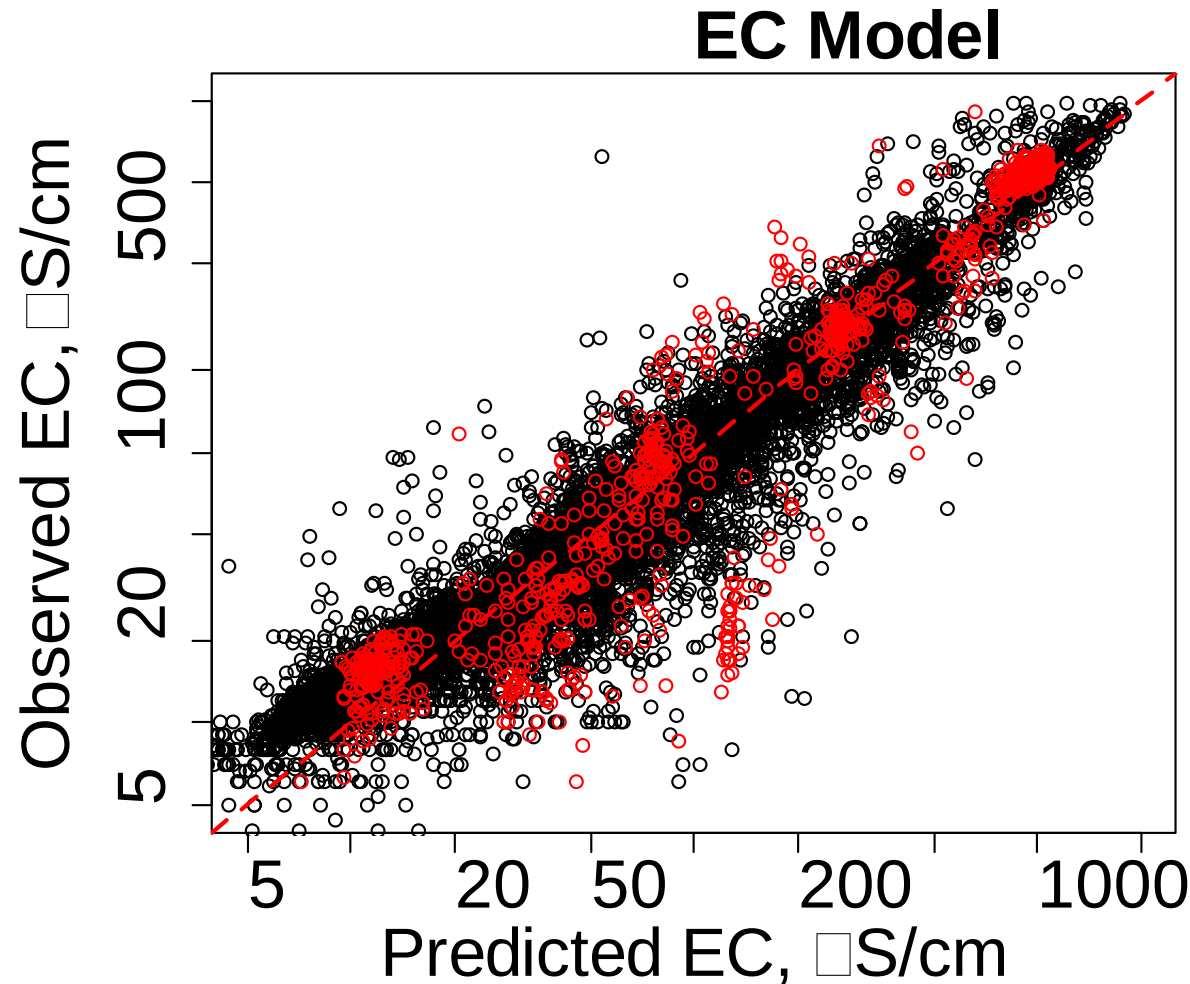
- Regression & classification trees
- Build 1000s of trees
- Predicts outcomes by averaging across trees
- Advantages:
 - Does not overfit
 - Effectively models non-linear data
 - Incorporates interactions
 - But cannot extrapolate!



Natural Background Model Performance



Natural Background Model Performance



Training

$$R^2 = 0.89$$

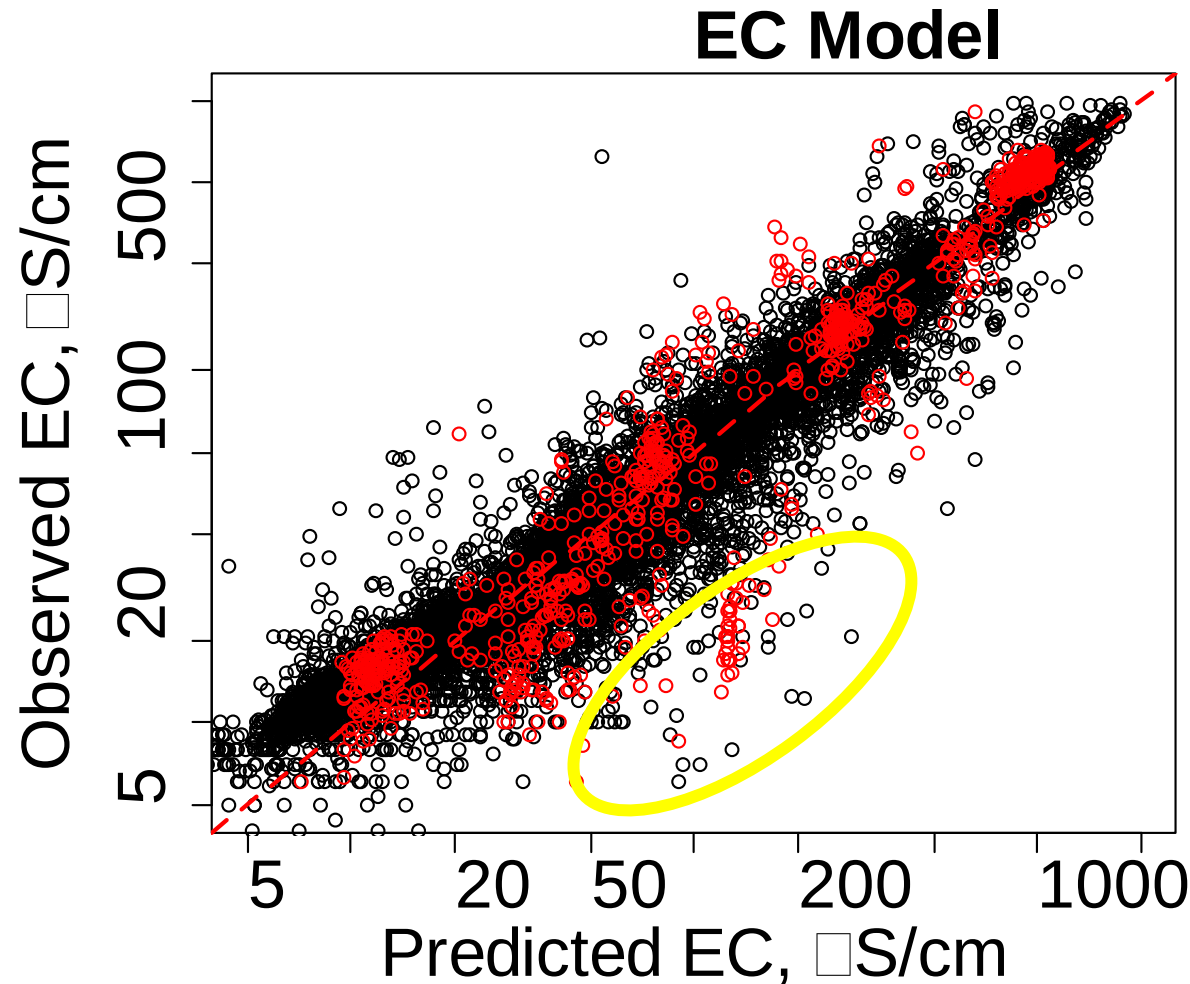
$$\text{RMSE} = 73 \mu\text{S/cm}$$

Validation

$$R^2 = 0.92$$

$$\text{RMSE} = 122 \mu\text{S/cm}$$

Natural Background Model Performance



Training

$$R^2 = 0.89$$

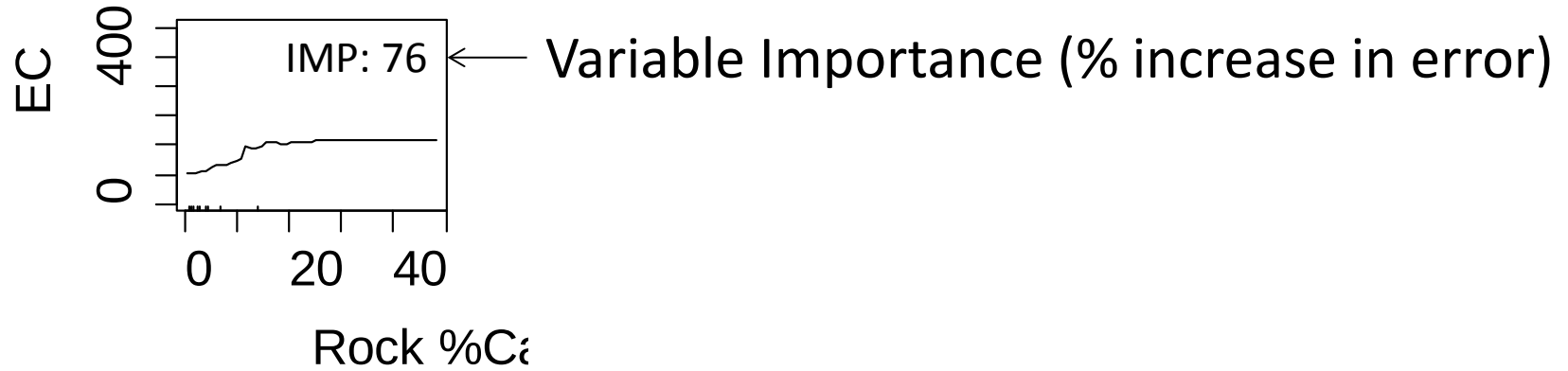
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Validation

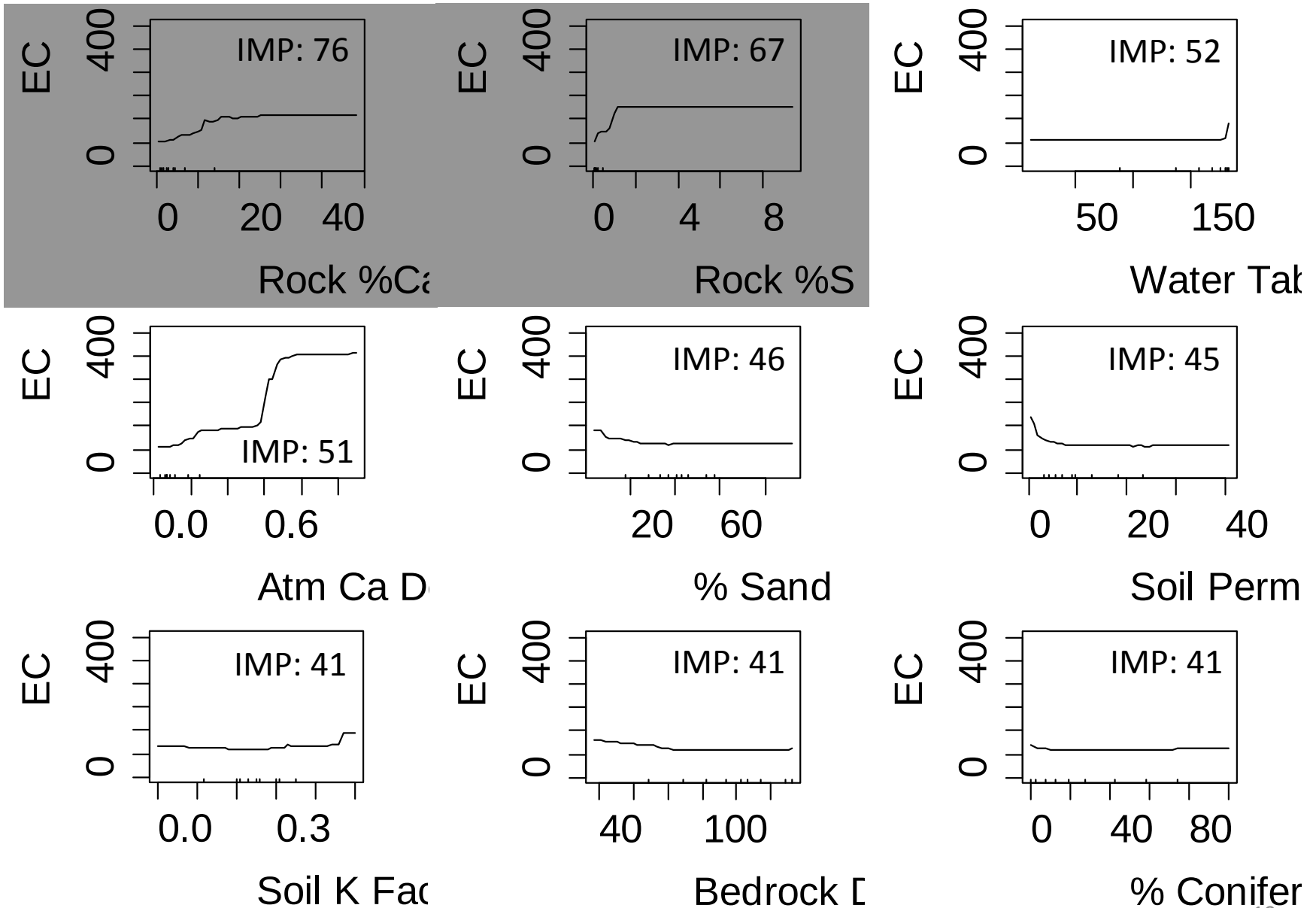
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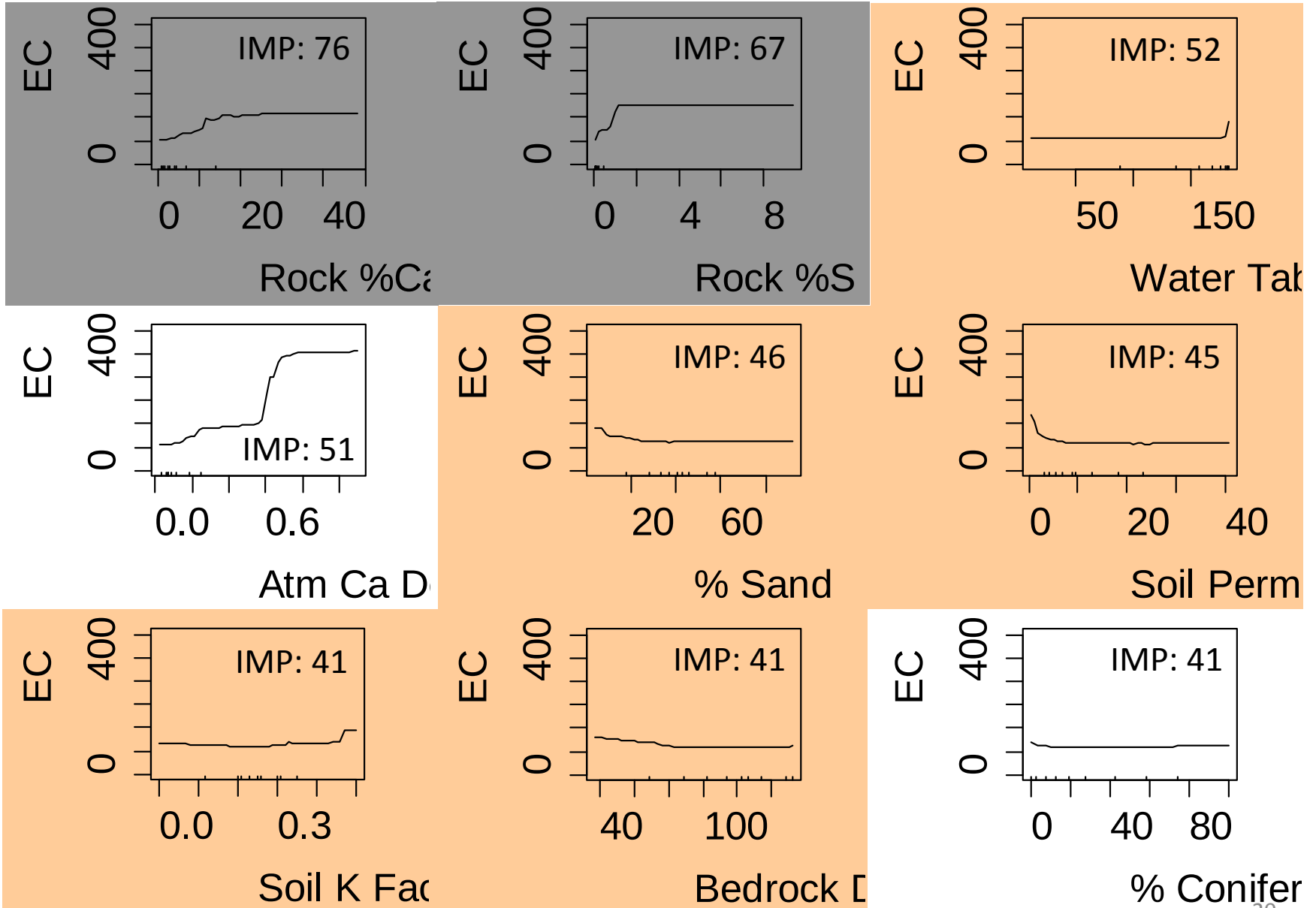
Static Predictors



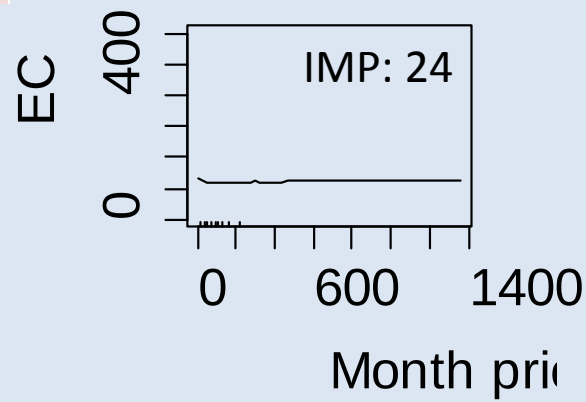
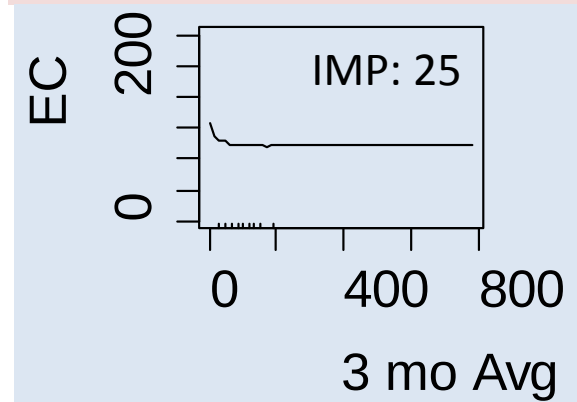
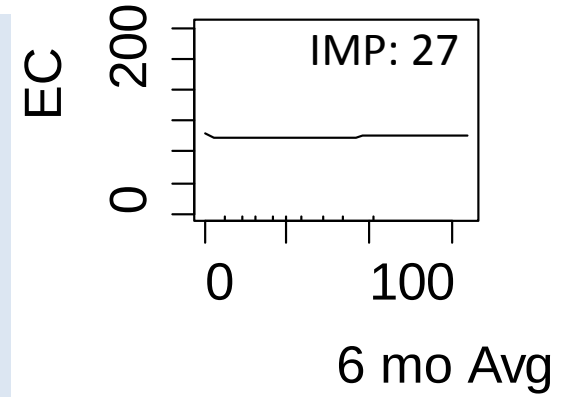
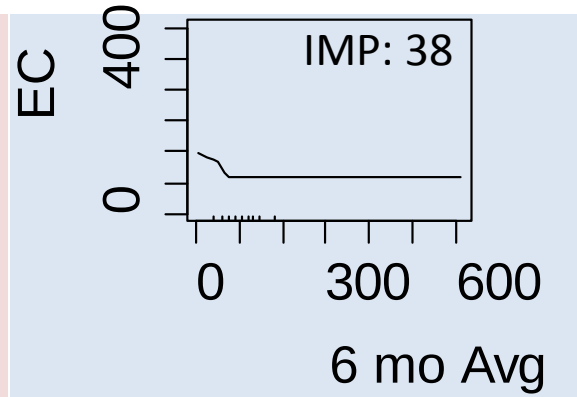
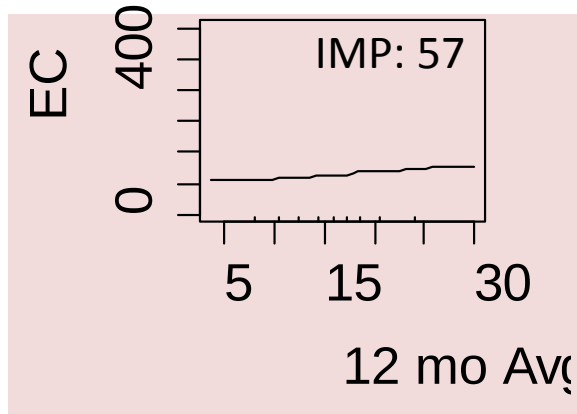
Static Predictors



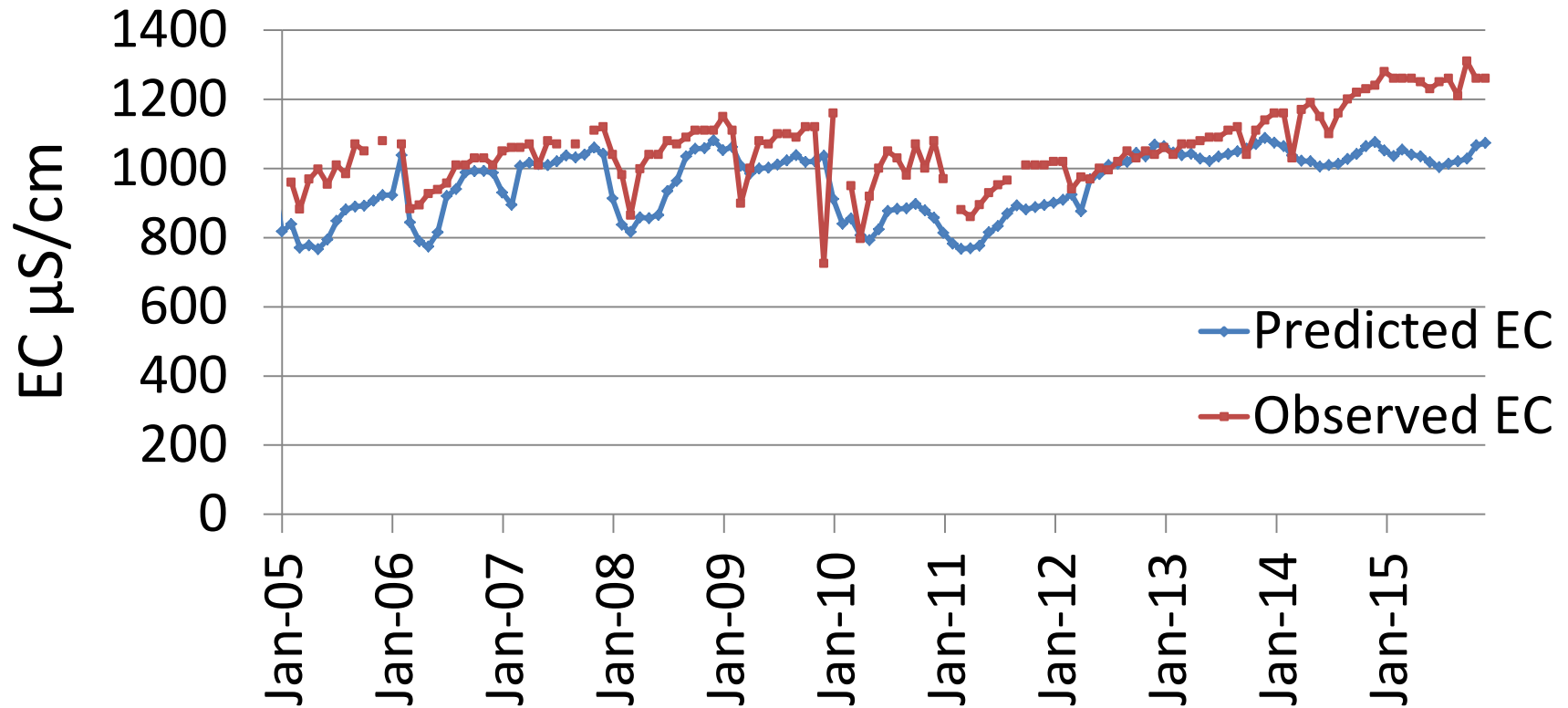
Static Predictors



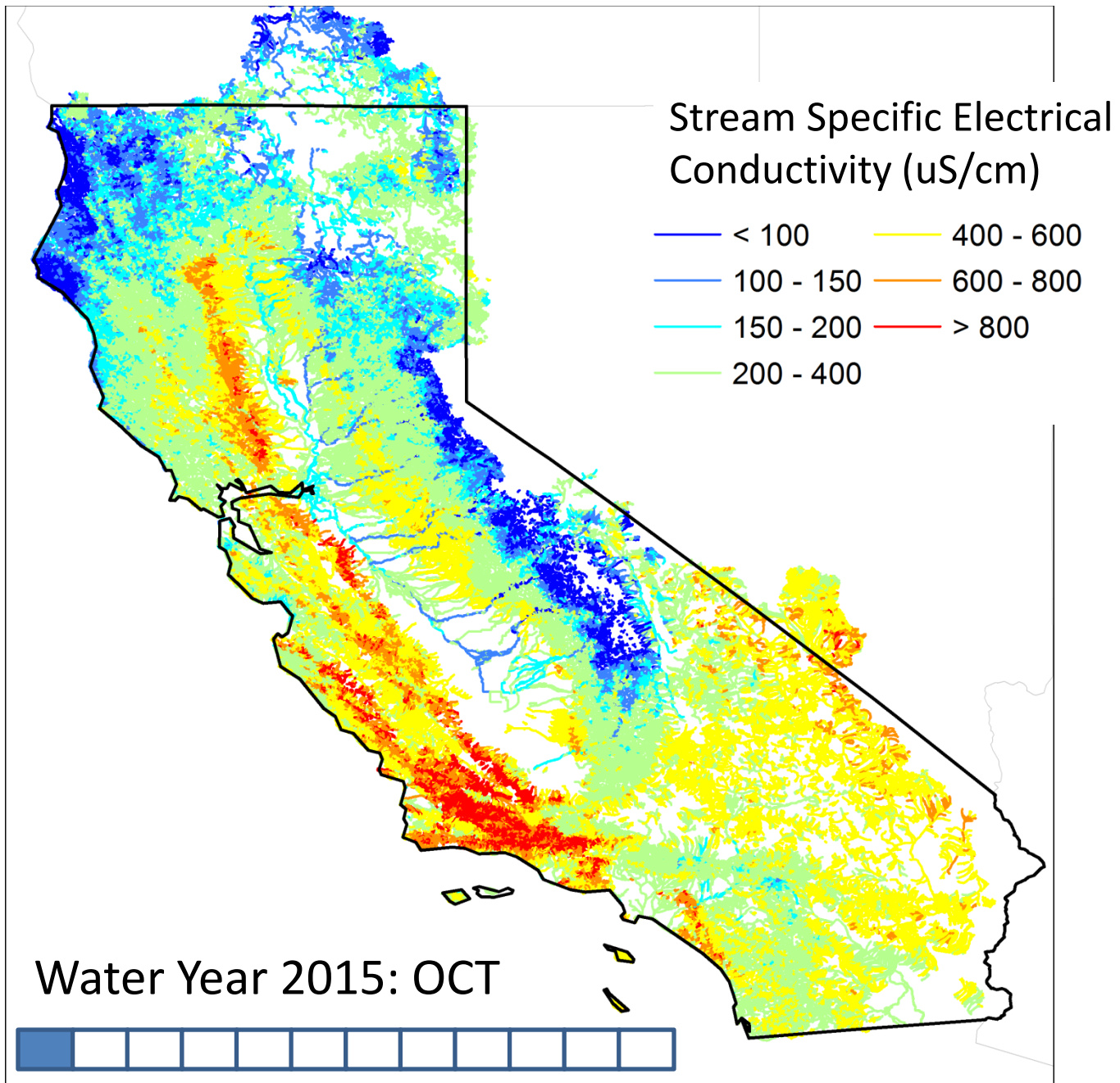
Dynamic Predictors

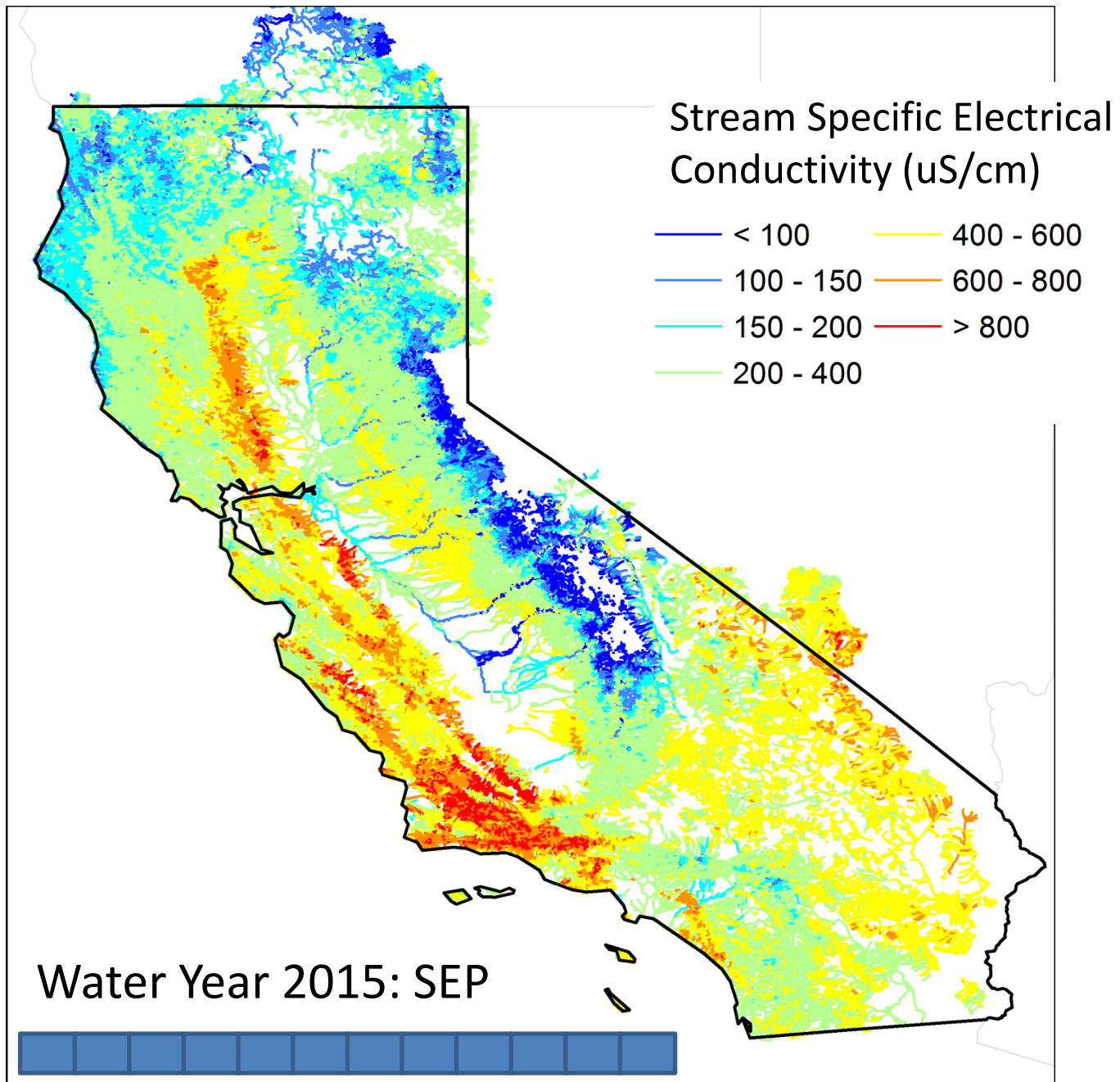


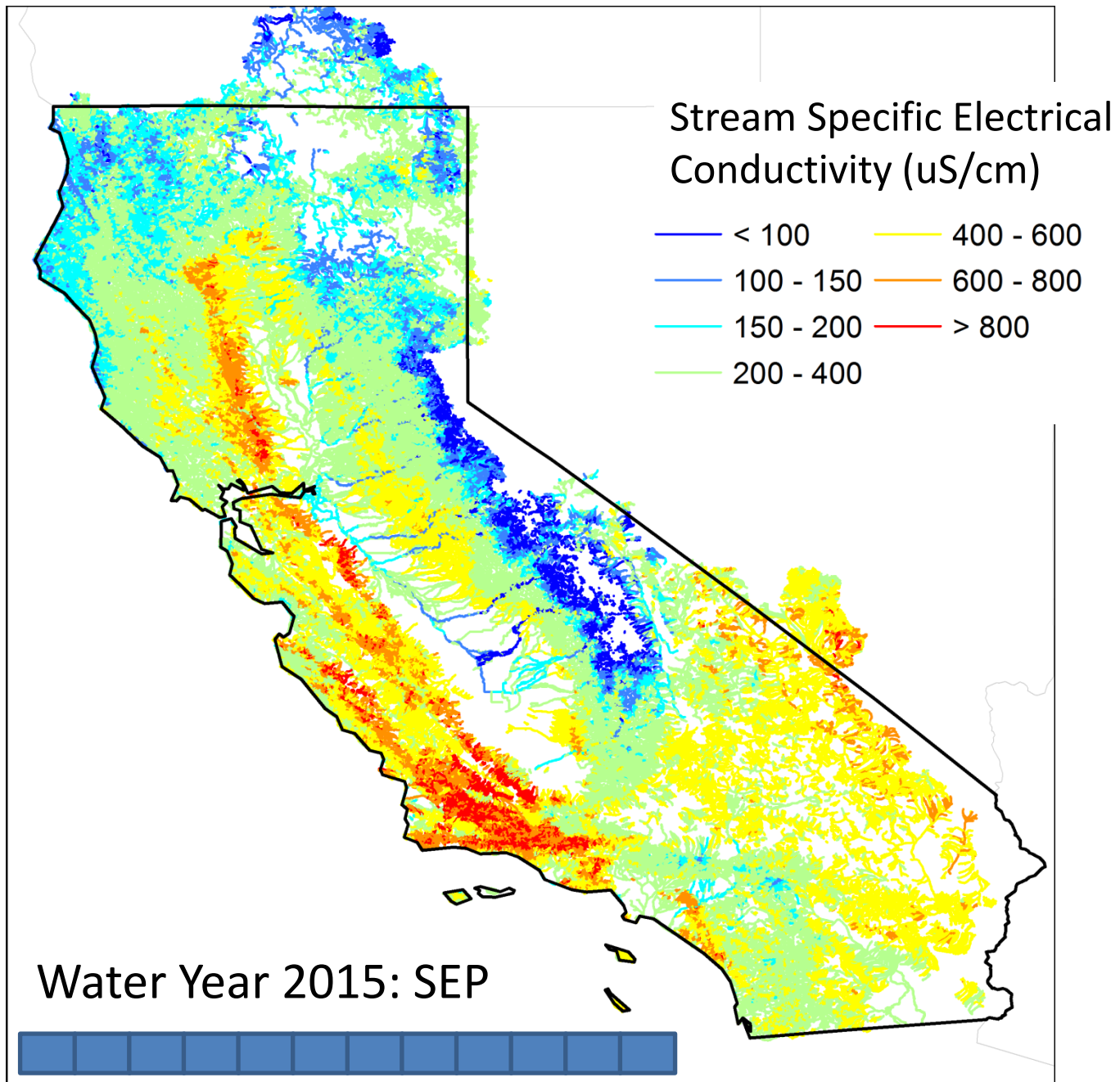
Temporal Predictions



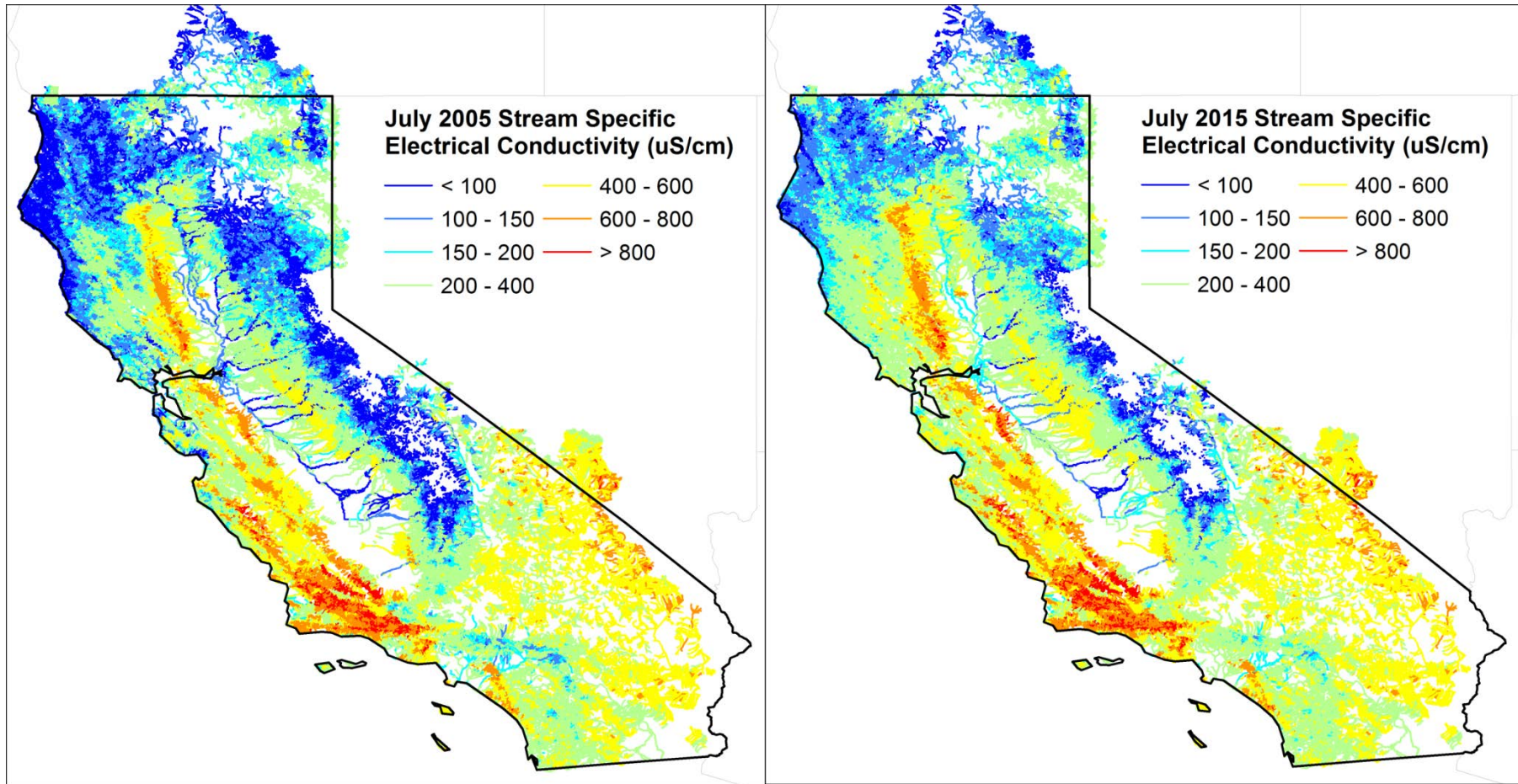
USGS Gage 11138500
Sisquoc River near Sisquoc



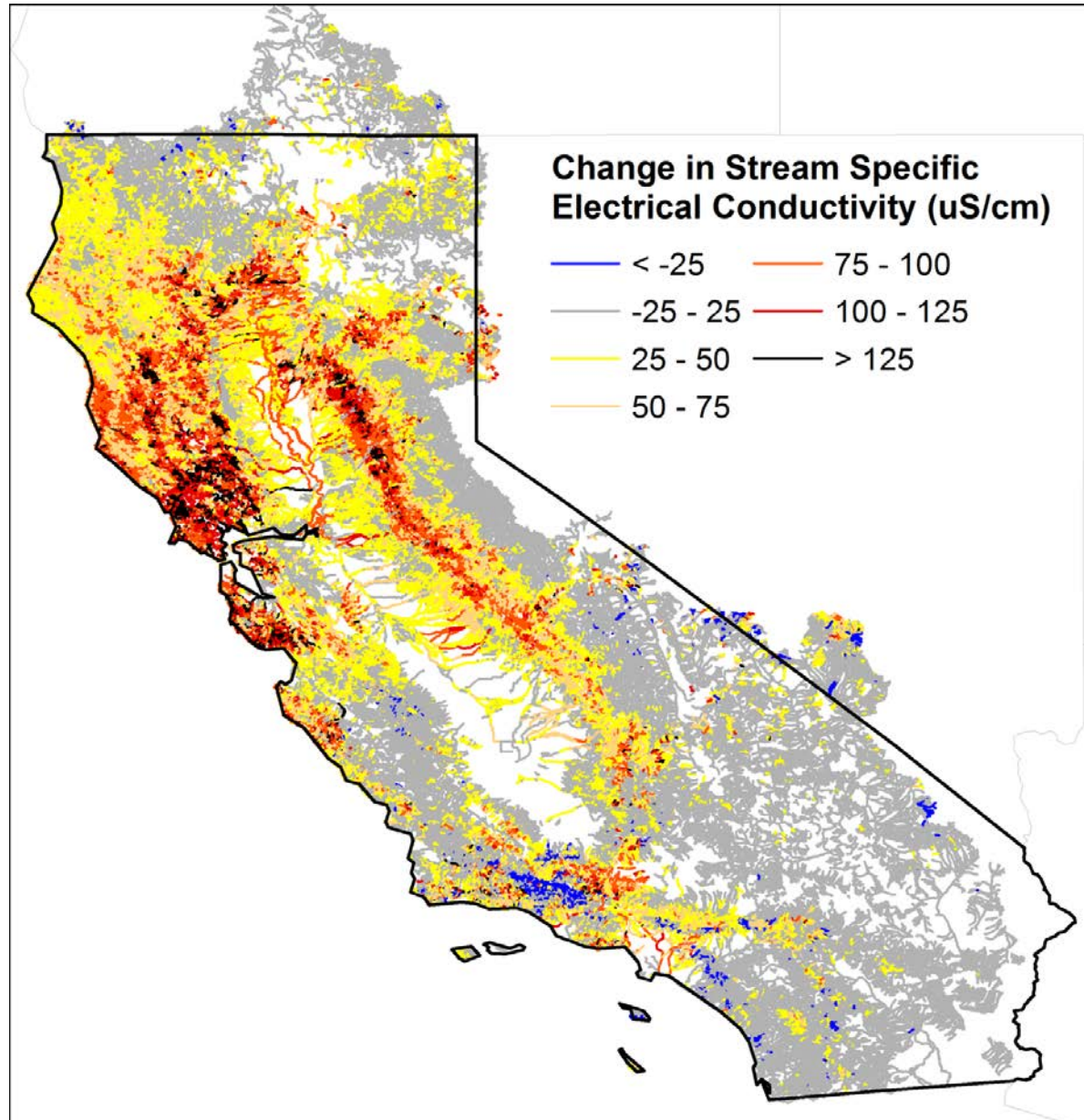




Temporal Predictions: Drought/Non Drought



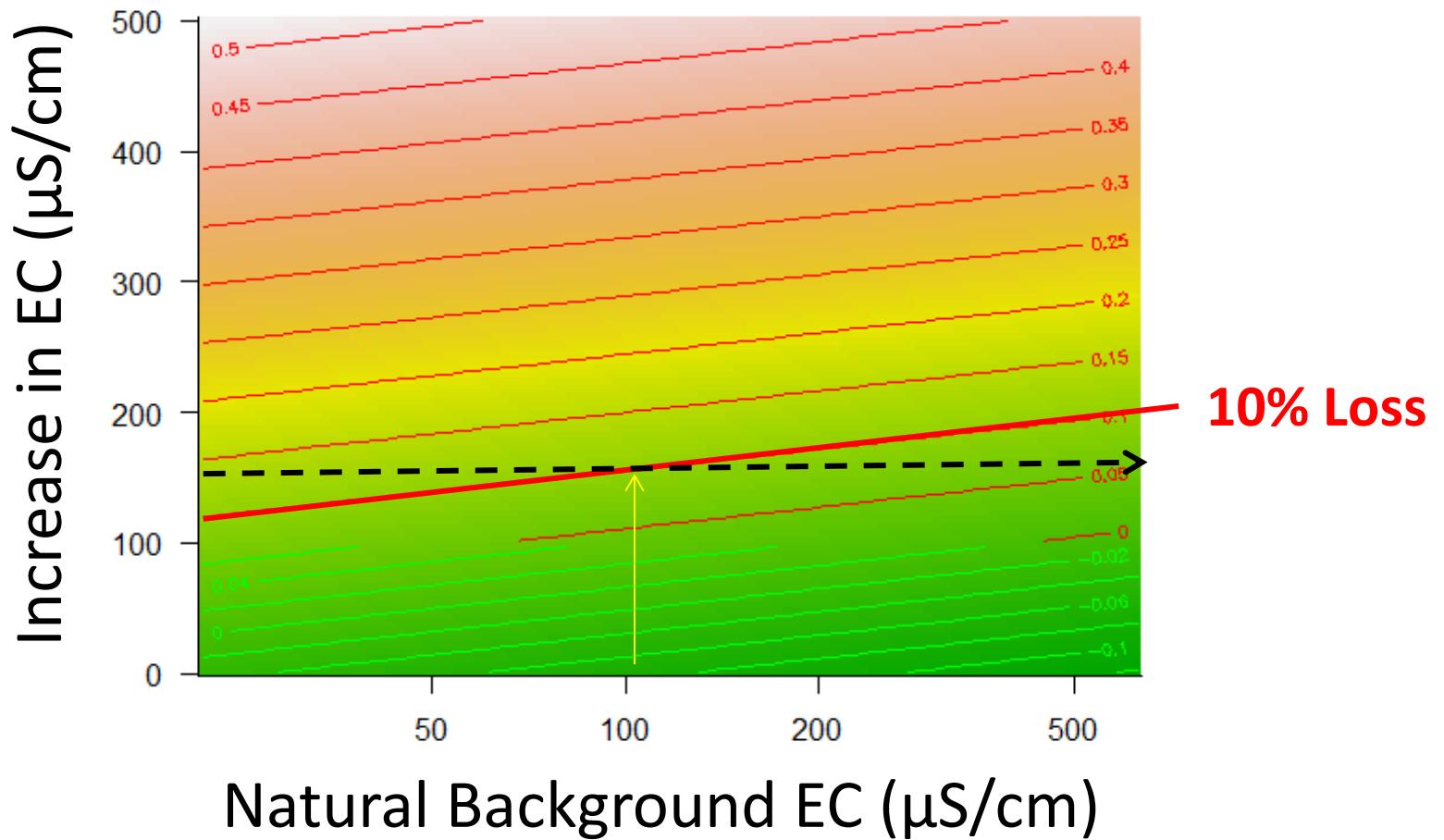
Temporal Predictions: Drought/Non Drought



A work in progress...

To do list:

- Further validation
- High EC model
- Alteration model
- Application to biological models



Questions?