

Visualizing Organismal Thermal Stress Over Time

Anthony F. Cannistra
tonycan@uw.edu

DEPARTMENT
OF BIOLOGY



Motivation:

- Anthropogenic climate change is having a dramatic effect on Earth's natural systems. **These changes influence the health of organisms by changing the amount of energy available to them**, especially those that rely on their environment for their body temperature (“cold-blooded” species like lizards, snakes, and insects).
- An organism is in “thermal stress” when its body temperature exceeds or falls below a laboratory-derived “preferred temperature range.”
- We have models which can translate environmental conditions into organismal body temperatures.
- Conservation Biologists and reserve planners want to know **what species are likely to be influenced by climate change, how often, and over what portions of the landscape.**

The Data:

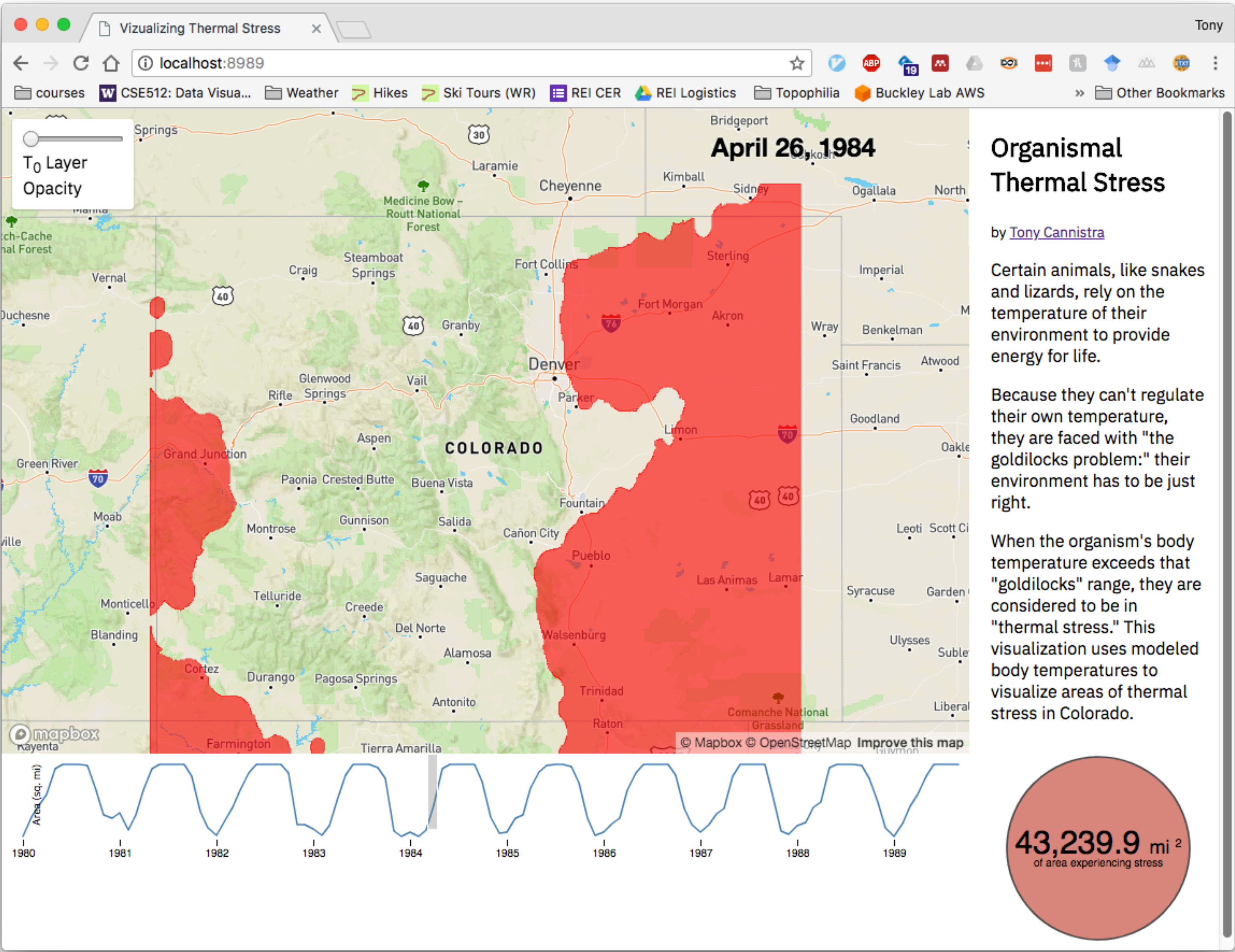
- Environmental data and a set of laboratory-derived biophysical parameters are fed into a biophysical model, which produces estimates of organismal body temperature.
- We run this model over the state of Colorado, USA, every day for 20 years of historical climate observations, and apply an upper biophysical threshold to these data to create a “stressed area” polygon for each day.

The Implementation:

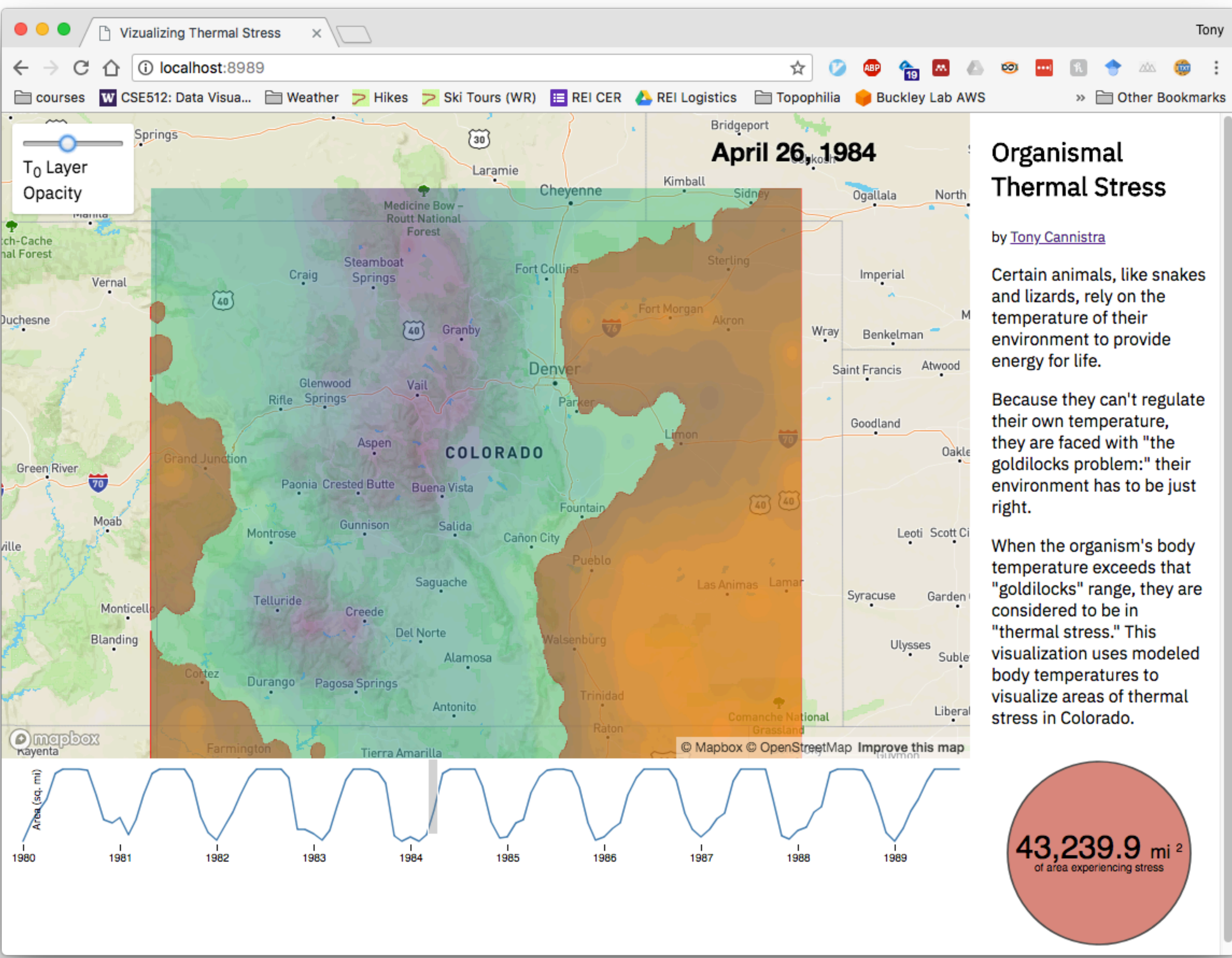
- Python for model data aggregation and reprojection; AWS S3 for data hosting; D3.js and Mapbox.js visualization.

The Viz:

- Marks:** Map, containing polygon of the stressed region for a particular day and the option to view raw model output; Line Chart, plotting amount of estimated “stressful area” for modeled organism over time; Number demonstrating the number of square miles of area shown as stressed.
- Interactions:** User can brush across the line chart to visualize the spatial extent of a selected day's organismal stress. The raw model output data can also be visualized using an opacity slider.
- Allows for temporal and spatial exploration of biophysical model output and “stressed area” output (derived by applying an upper threshold to the data—an area is in the stress polygon if organismal body temperatures are above an upper biophysical threshold)



Viz with a particular day (April 26, 1984) selected.



Viz with raw model output data overlaid upon the stressed area.

Future Work:

- Improved Data:** the biophysical model parameters and threshold are contrived for the purpose of examining the visualization mechanics; in the future we will use actual biophysical parameters and **future climate projections** to operationalize this viz.
- Spatial Comparisons:** current interactions are jittery, which makes it difficult to judge whether particular areas are consistently stressed. We will develop a method to highlight frequently-stressful locations.
- Moonshot:** on-the-fly biophysical model parameterization. An interface which allows a conservation biologist to enter known biophysical model parameters and thresholds and examine future projections of organismal stress for arbitrary organisms of interest would be invaluable for planning and forecasting purposes. This requires an infrastructural overhaul of the current implementation.