What Makes Communities Resilient to Drought?

Dan Blaustein-Rejito [1] Ian Bolliger [2] Hal Gordon [3] Andy Hultgren [3] Yang Ju [4] Kate Pennington [3] Sara Stoudt [5]

University of California, Berkeley: DS421

[1]GSPP [2]ERG [3]ARE [4]LAEP [5]Stats

danr@berkeley.edu *bolliger@berkeley.edu* *halgordon@berkeley.edu*
hultgren@berkeley.edu *yangju90@berkeley.edu* *kate.pennington@berkeley.edu*
sstoudt@berkeley.edu

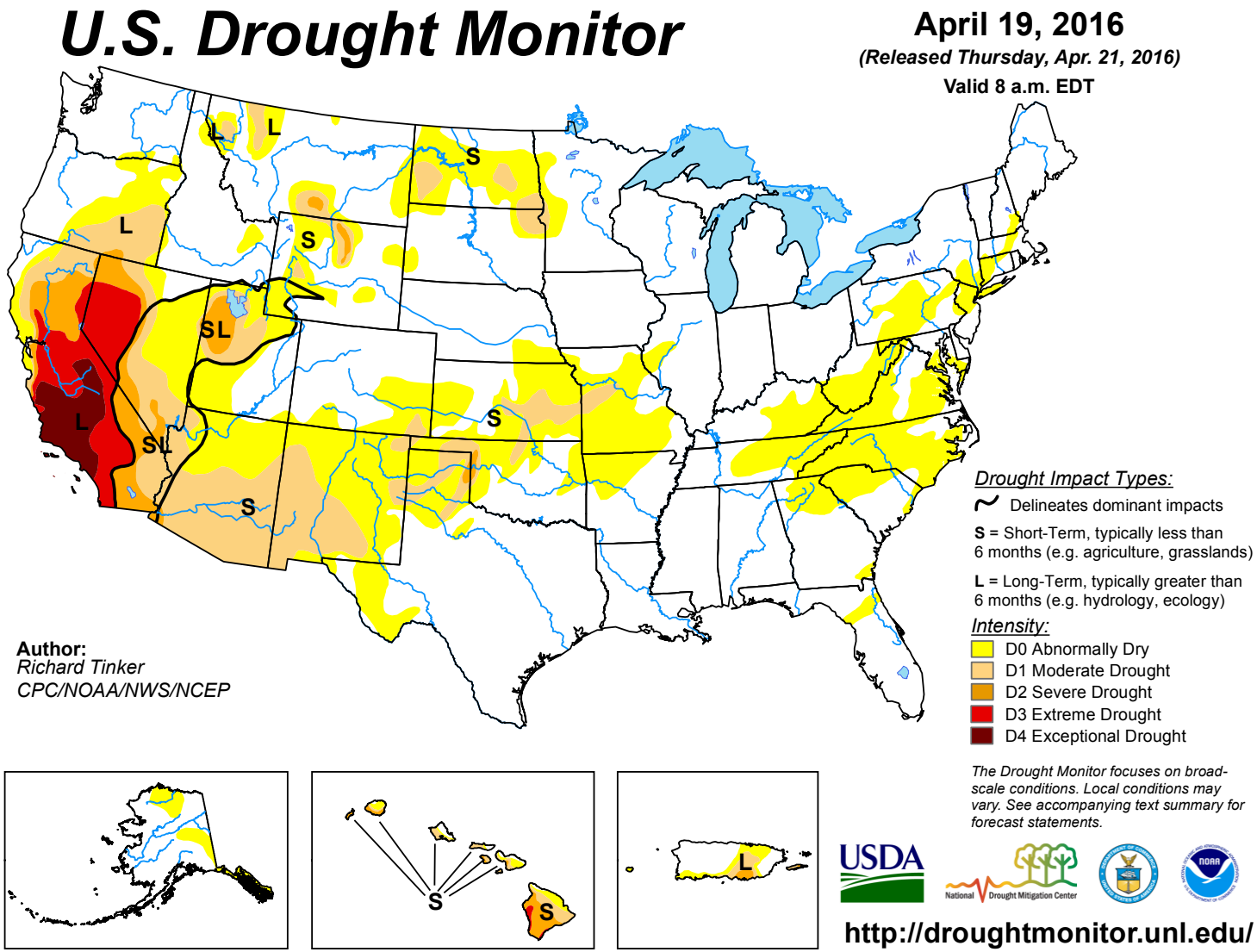
April 26, 2016

Overview

Drought

- In April 2016 in the United States:
  - 14% of land was in drought and 34% was abnormally dry.
  - 84.3 million people live in drought-affected areas, and 17.5 million live in areas experiencing exceptional drought
- In California:
  - 90% of the state is in drought and more than 50% is in severe to exceptional drought.
  - 84.3 million people live in drought-affected areas, and 17.5 million live in areas experiencing exceptional drought

Drought, April 19, 2016



Drought

- Climate change is likely to increase the length and severity
- Resilience, not just risk of drought, will have far reaching implications for welfare changes from climate change.

Stage 1 Data: 2005-2014

Left Hand Side

- **US Drought Monitor:**
  - Scale from 0-4 updated weekly
  - we create a 1-year, 3-year, and 5-year measure

Right Hand Side

- **Mortality:**
  - Annual CDC WONDER database
  - Over-65 and all-ages
- **Yields:**
  - Annual USDA crop yield
  - Corn, soybeans, and wheat
- **Employment:**
  - United States Bureau of Labor Statistics

Stage 2 Data

Left Hand Side

- $\hat{\beta}$ from the first stage.

Right Hand Side

- **American Community Survey:**
  - Annual (2005-2014) survey conducted by US Census
  - Over 65, Under 5, Race, Ethnicity, Sex, Work in farming or ranching, Household Income, Household water bills
- **Water Usage:**
  - EPA Facility Registry Service
  - Count of facilities from high water use industries (agriculture, manufacturing and energy) per county

Model

First Stage Equation

$$y_{i,t} = \beta_i D_{i,t} + \alpha_i + \tau_i t + \gamma_{s,t} + \epsilon_{i,t} \quad (1)$$

Where:

- $D_{i,t}$ refers to the number of days in U.S. Drought Survey bins 2-4 in county i and year t
- α_i are county fixed effects controlling for time-invariant differences between counties
- τ_i is the coefficient on a county level linear time trend
- $\gamma_{s,t}$ are state-by-year fixed effects controlling for state level time trends common across all counties $i \in s$

Model

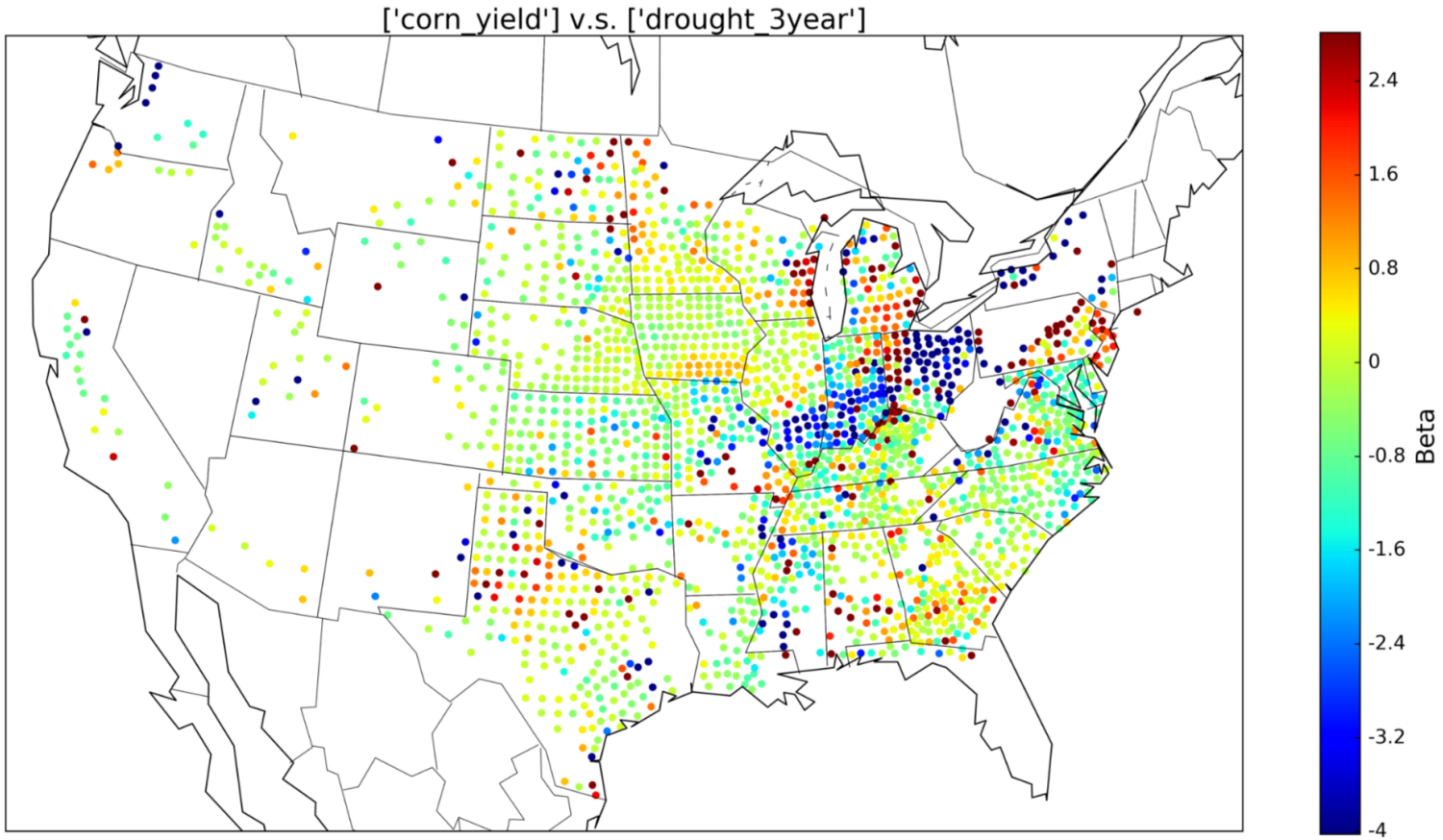
Second Stage Equation

$$\beta_i = \rho_0 + \boldsymbol{\delta}\mathbf{X}_i + \nu_i \tag{2}$$

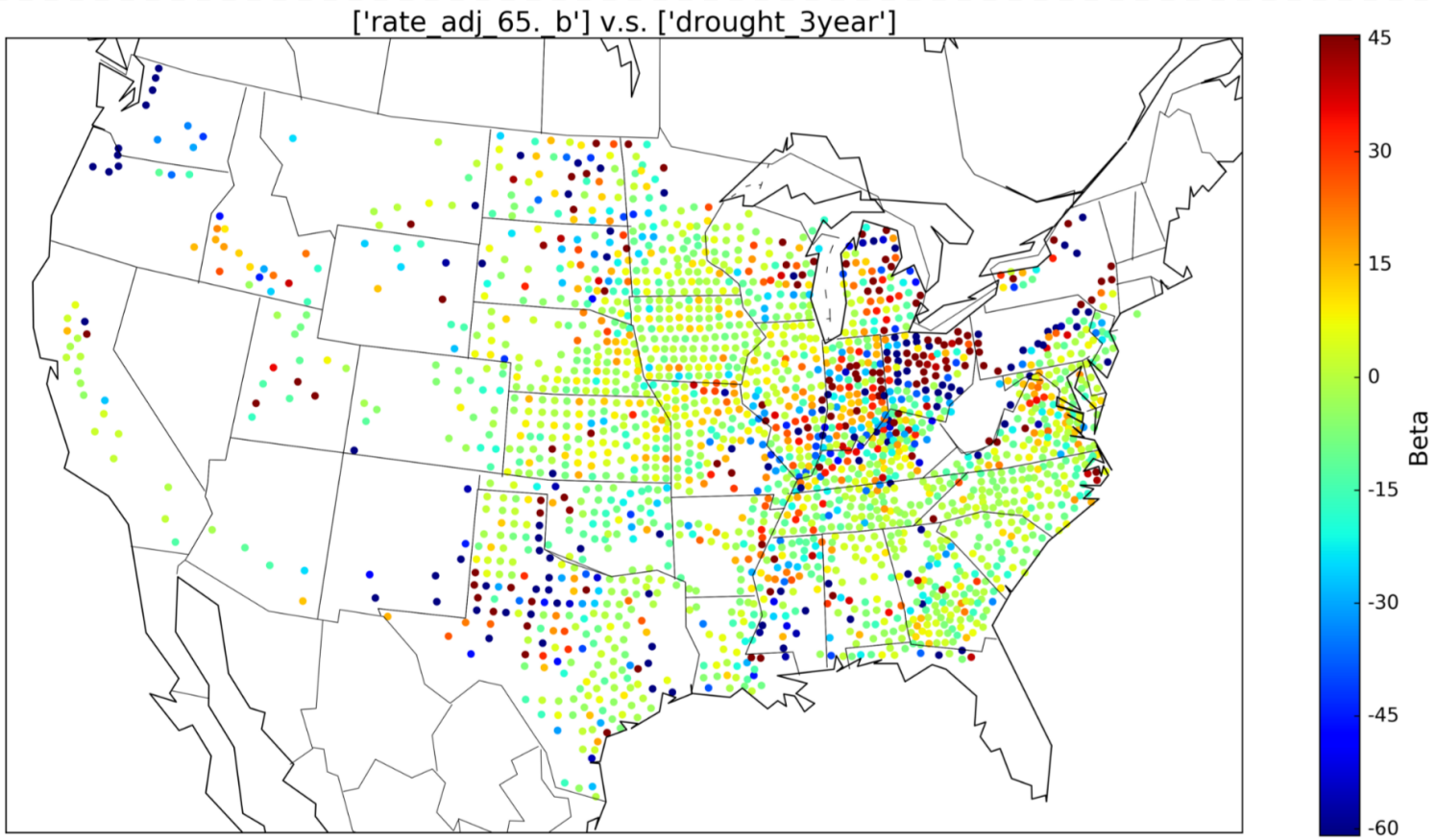
Where:

- β_i come from Eq.(1) for a given outcome
- $\mathbf{X}_i$ represents a vector of county characteristics such as urban/rural, proportion below age 5 or above age 65, home ownership, median cost of residential water bill
- $\boldsymbol{\delta}$ is a vector of the associated coefficients for state level time trends common across all counties $i \in s$

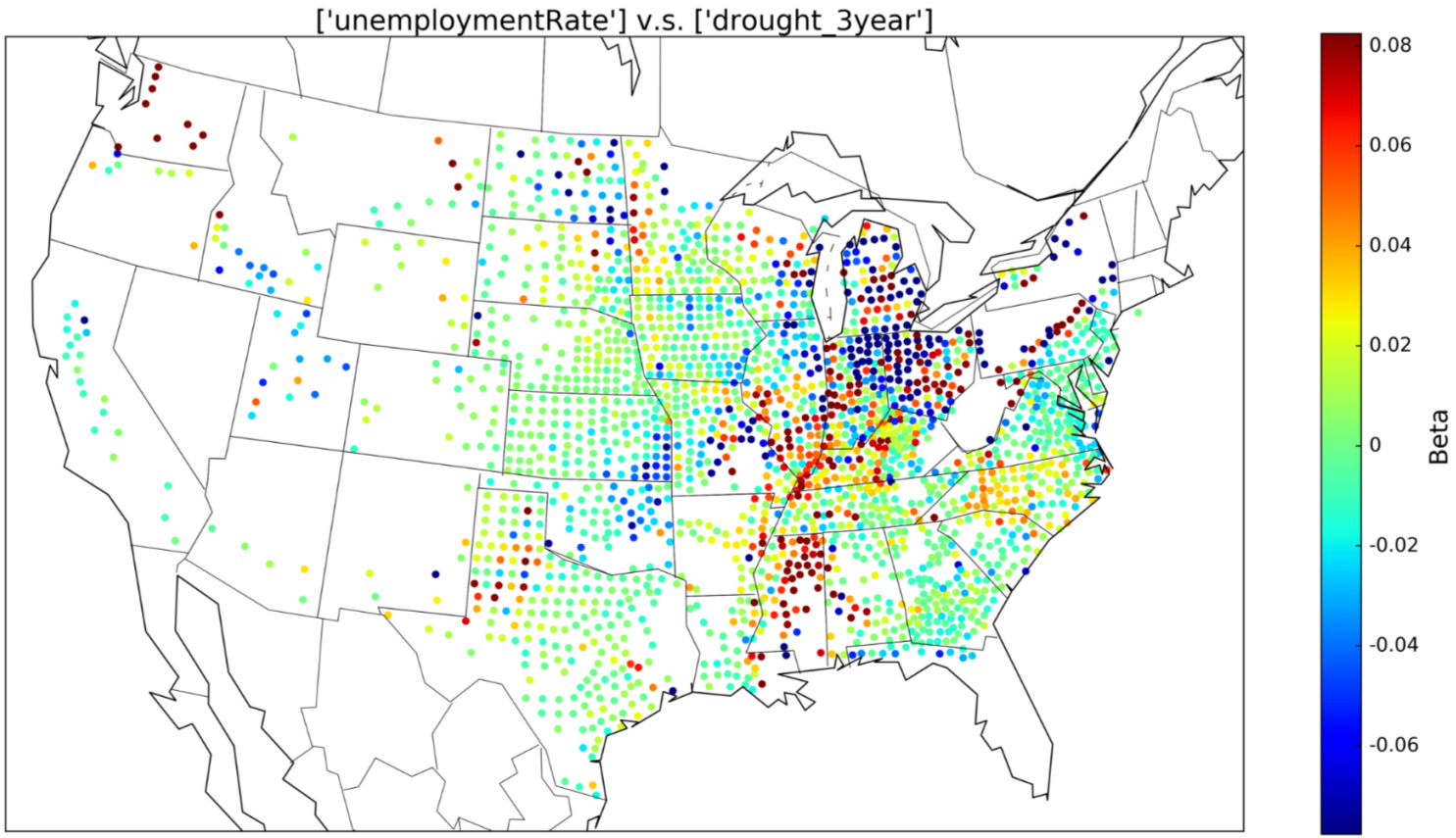
β of 3-yr Drought on Corn Yield



β of 3-yr Drought on Mortality



β of 3-yr Drought on Unemployment



Now, look at our Shiny!

The End