Climate Change Impacts on Rice Yields in Lao PDR

Drew Behnke, Sam Heft-Neal, and David Roland-Holst
University of California

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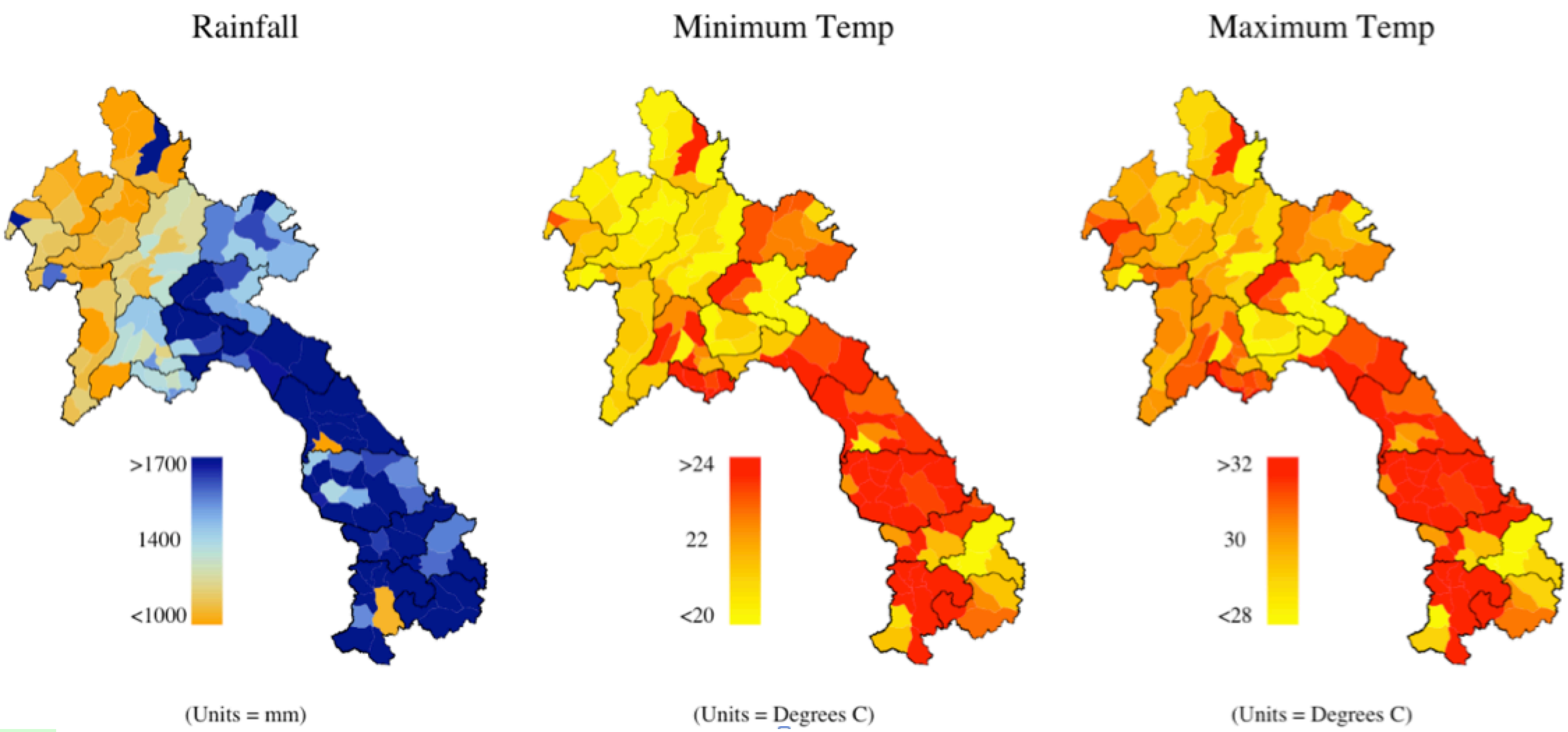
Climate Change and Food Security

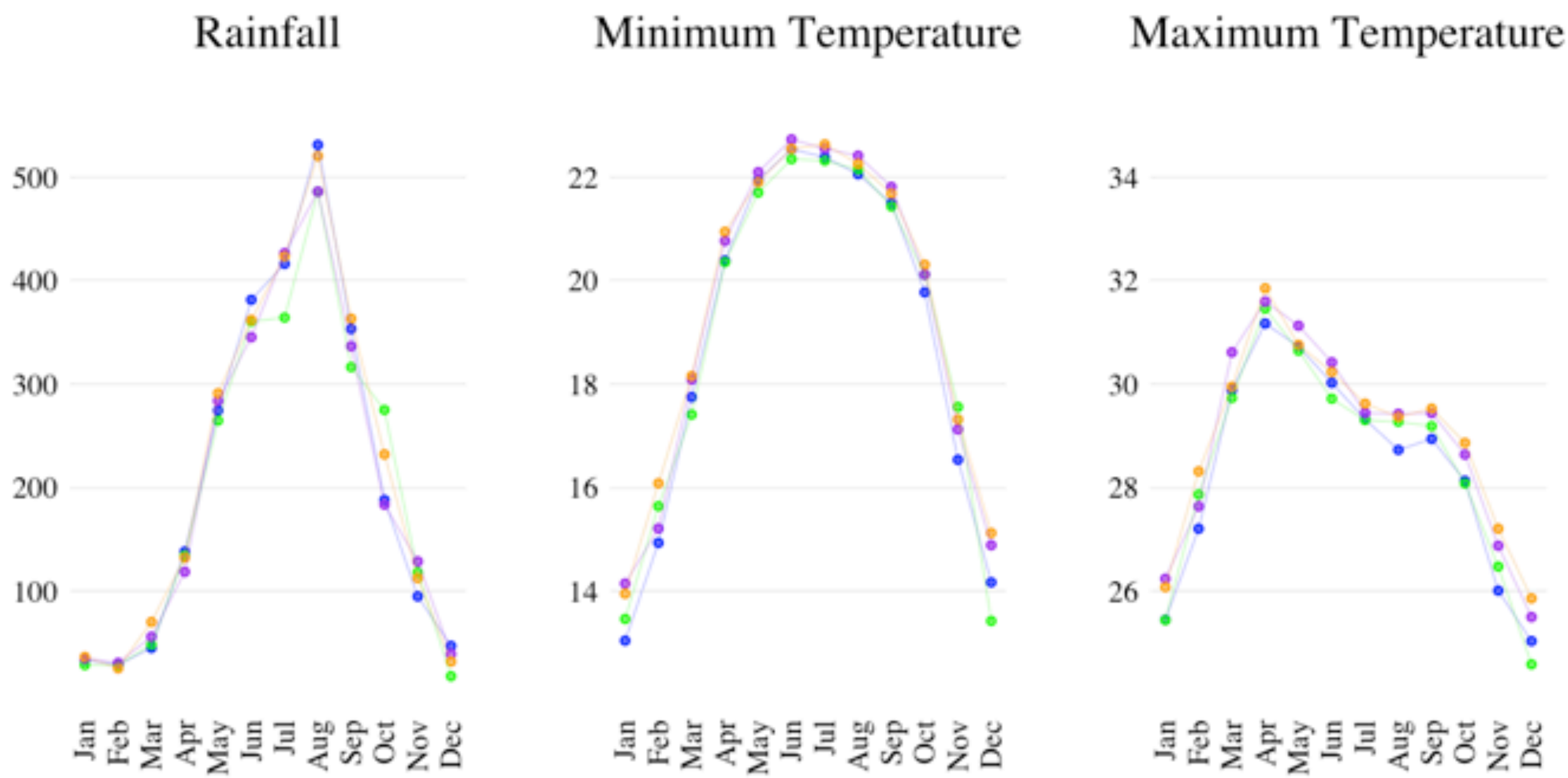
Climate Risk: About Mean and Variance

- Like sea level, the mean and variance of temperature are both rising:
  - Trend movement in climate variables will have the most lasting effects on patterns of food production, but
  - Stochastic variation is the greater and more immediate threat to local and national food security
- Adaptation needs to be learned, but we already have a lot of experience with variance.
- By improving early warning capacity, we can begin now to design and target appropriate interventions.

Mean Wet-Season Weather Conditions

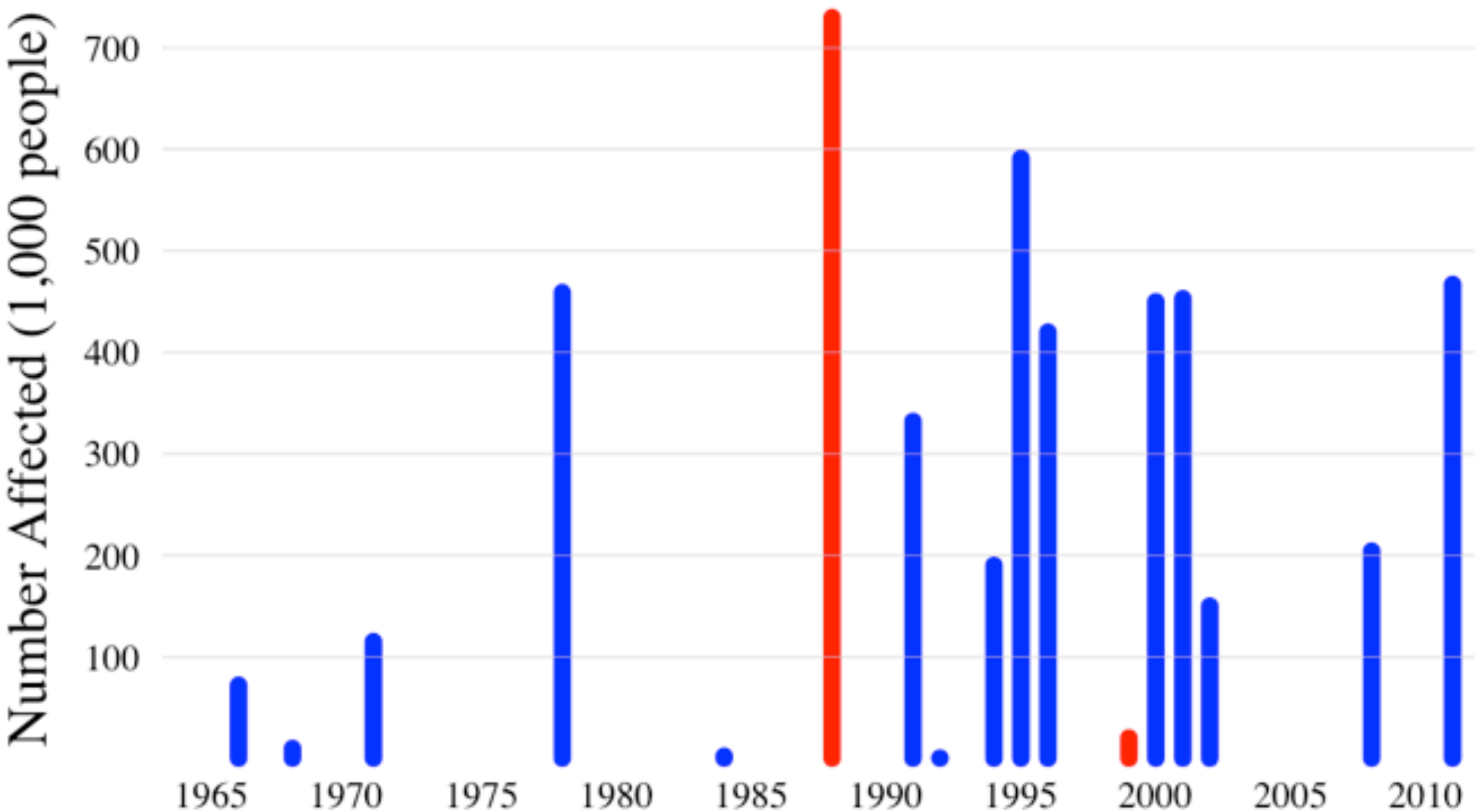


Mean Decadal Changes in Seasonal Weather Conditions

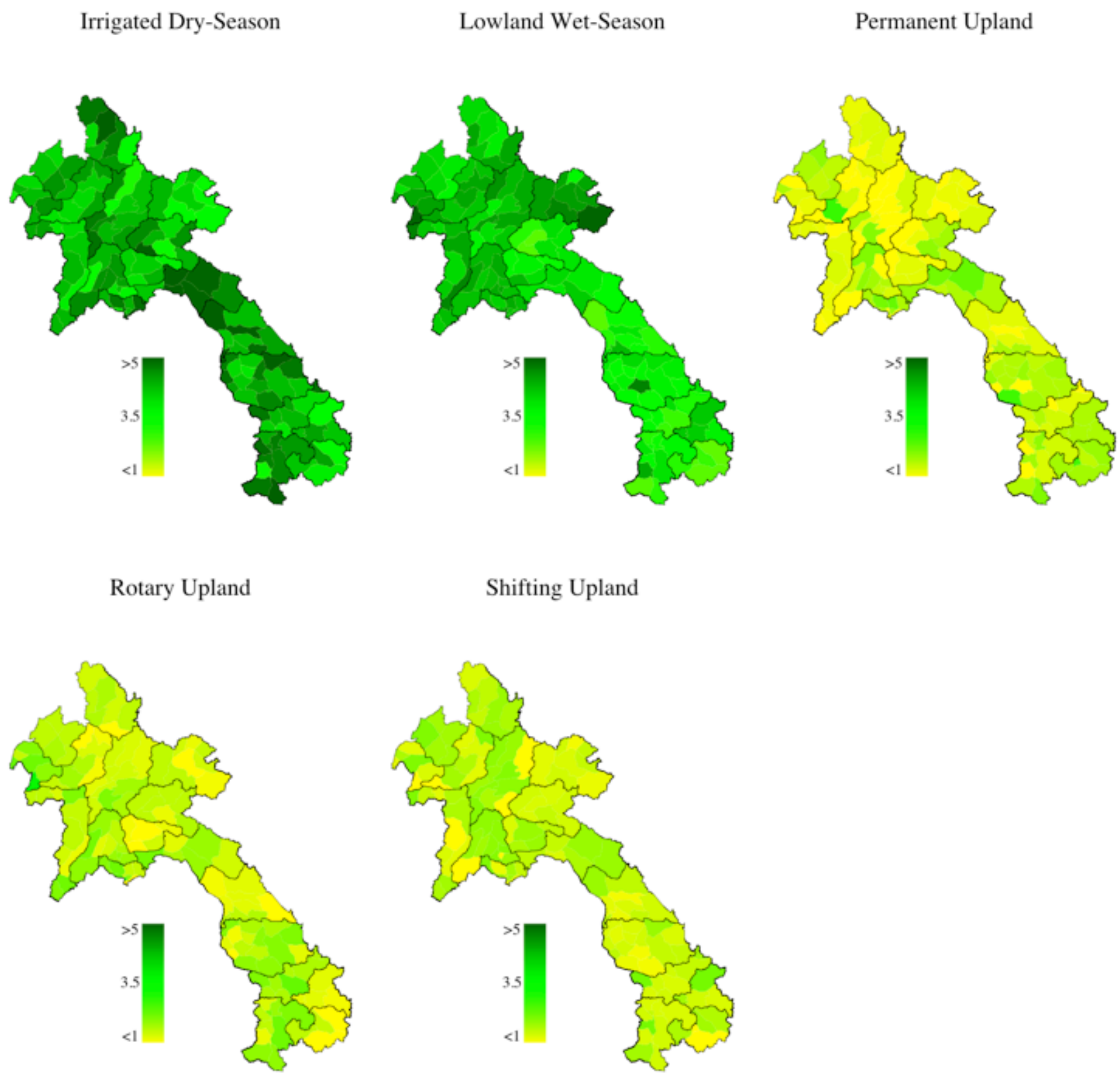


blue = 1970s, green = 1980s, purple = 1990s, orange = 2000s

Population Affected by Major Flood and Drought Events in Lao PDR

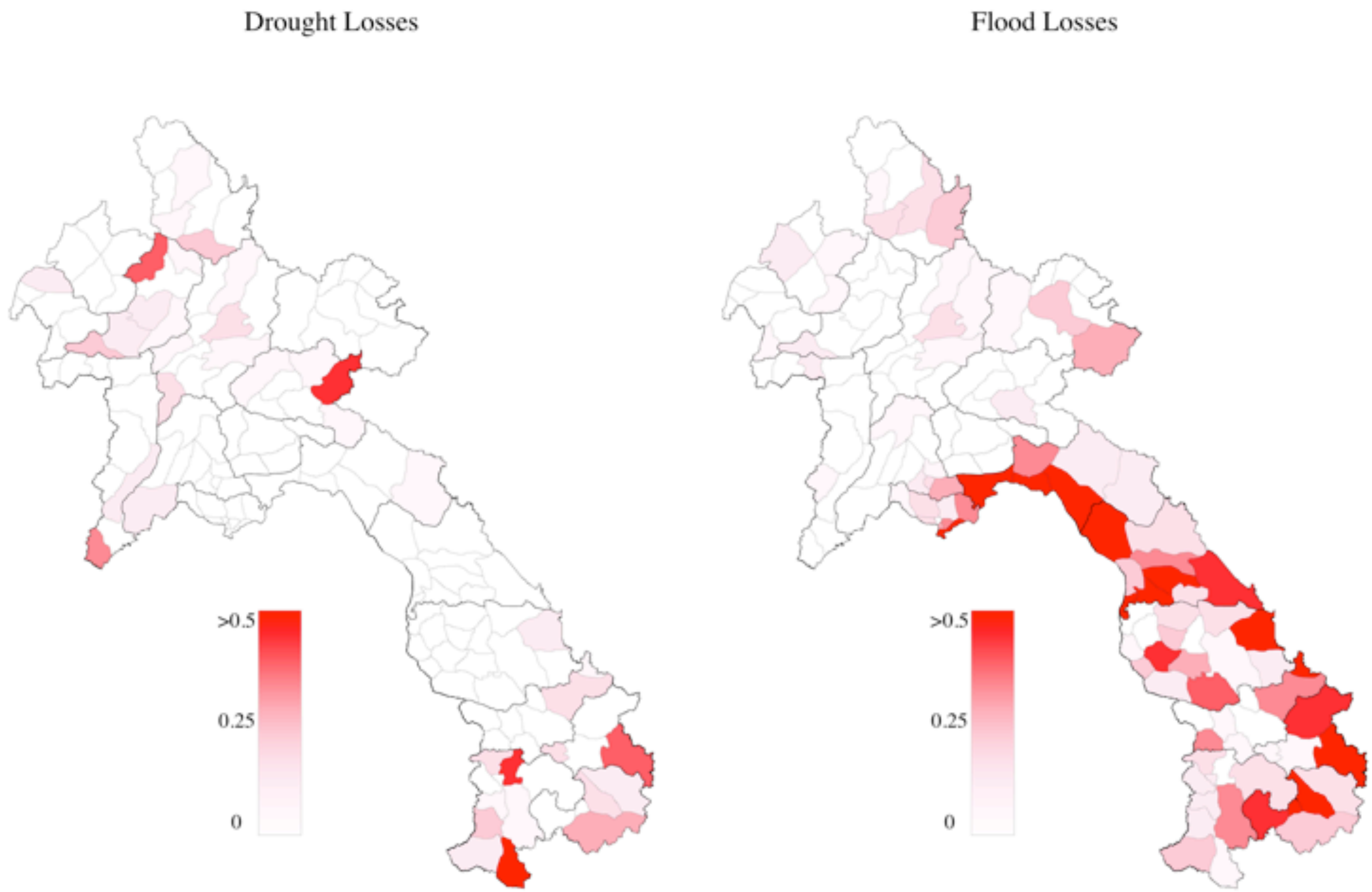


Average Rice Yields (t/ha), 2006-2012



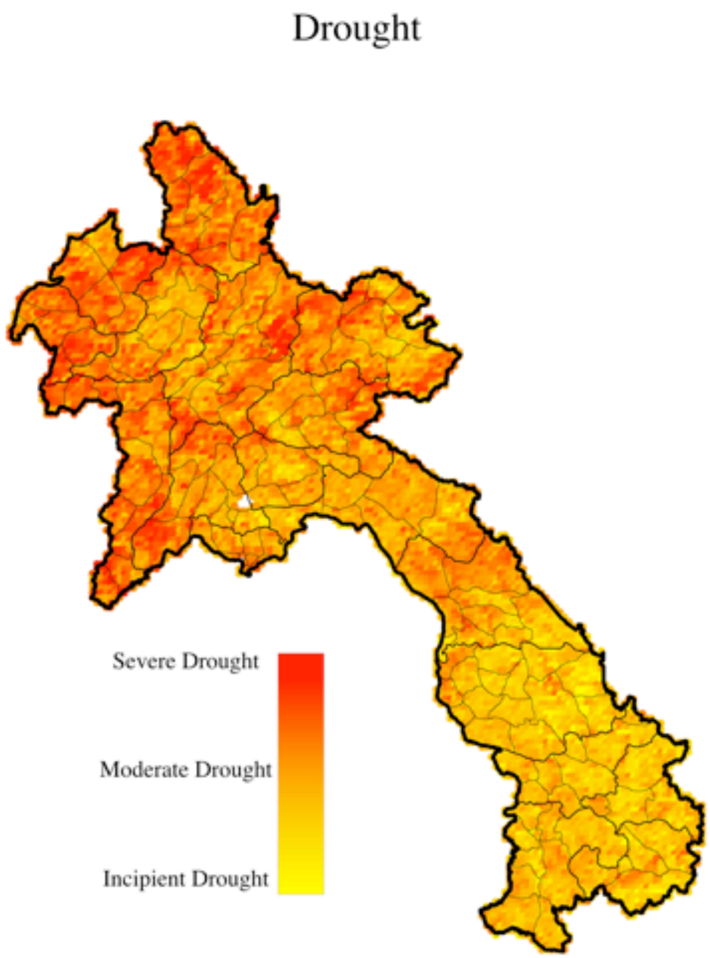
Source: Crop Statistics Yearbook (DOA, Lao PDR)

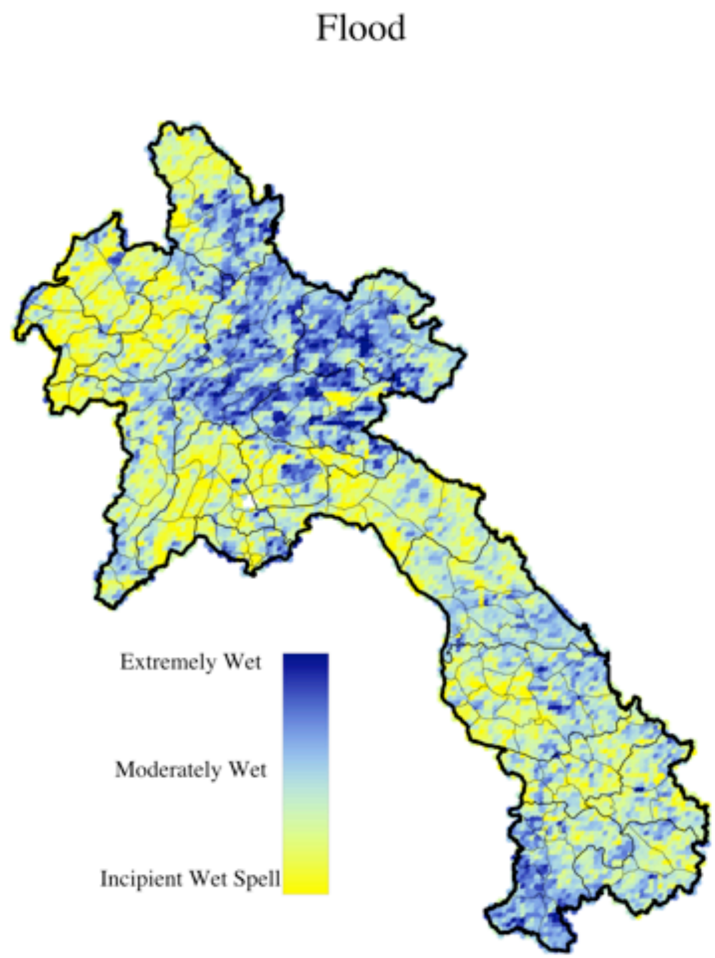
Largest Rice Area Losses by Cause, 2006-2012



Source: Crop Statistics Yearbook (DOA, Lao PDR)

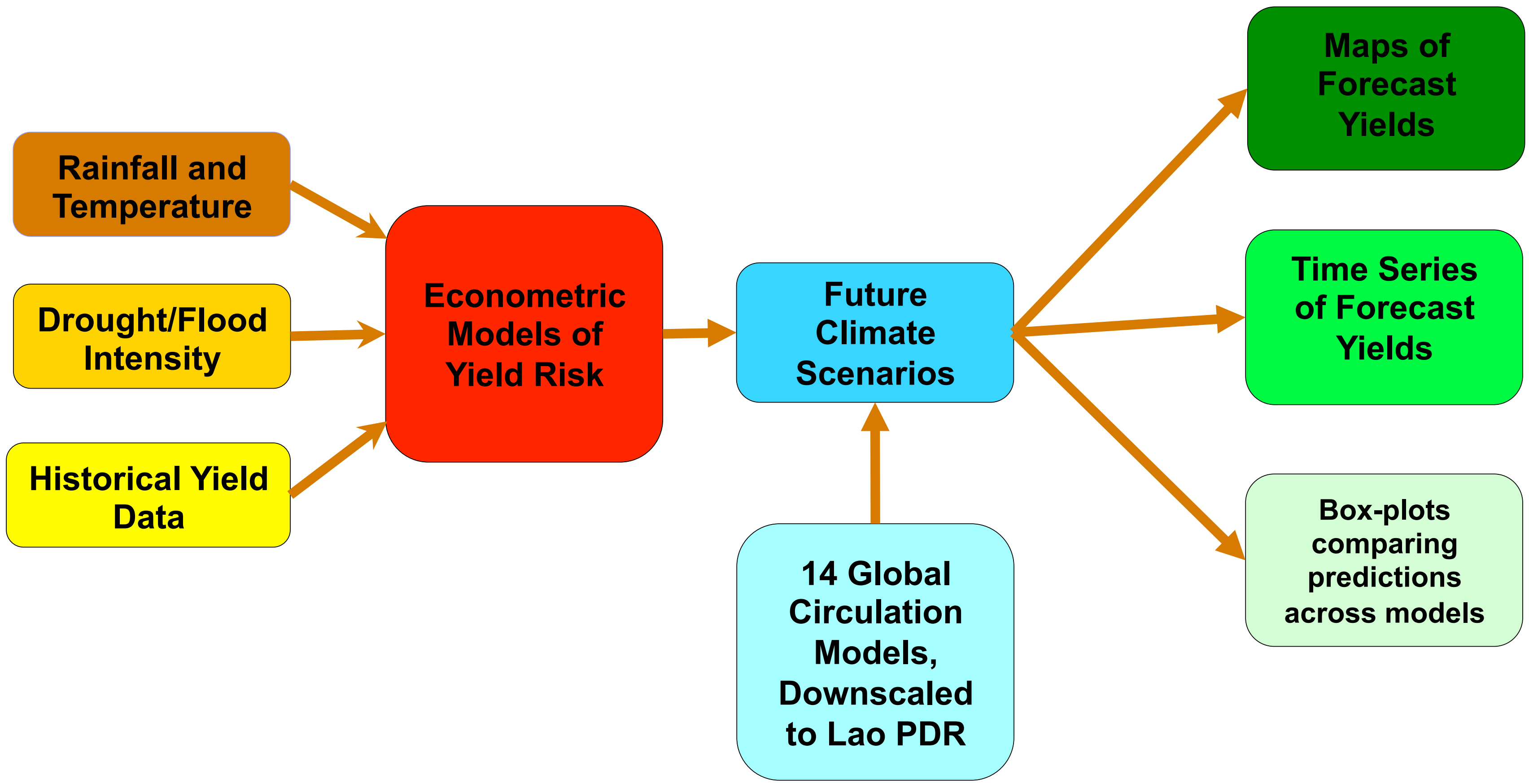
Most Extreme Growing-Season Weather Conditions, 2006-2012





Source: Drought Severity Index (DSI) described in Mu et al (2013)

Modeling Climate Risk to Rice Yields



Data Resources

Rainfall and Temperature	←	**Monthly gridded data**
Drought/Flood Intensity	←	**8-day high resolution satellite data**
Historical Yield Data	←	**Lao PDR Department of Agriculture and IRRI**

Panel Models of Average Weather Effects and Shocks

Equation 1: Trend Risk

$$\log(Y_{dt}) = \gamma_d + \theta_t + \beta_1 MinT_{dt} + \beta_2 MaxT_{dt} + \beta_3 P + \varepsilon_{dt}$$

Y_{dt} is yield for district d in year t.
The model includes province fixed effects γ_d and year fixed effects θ_t.

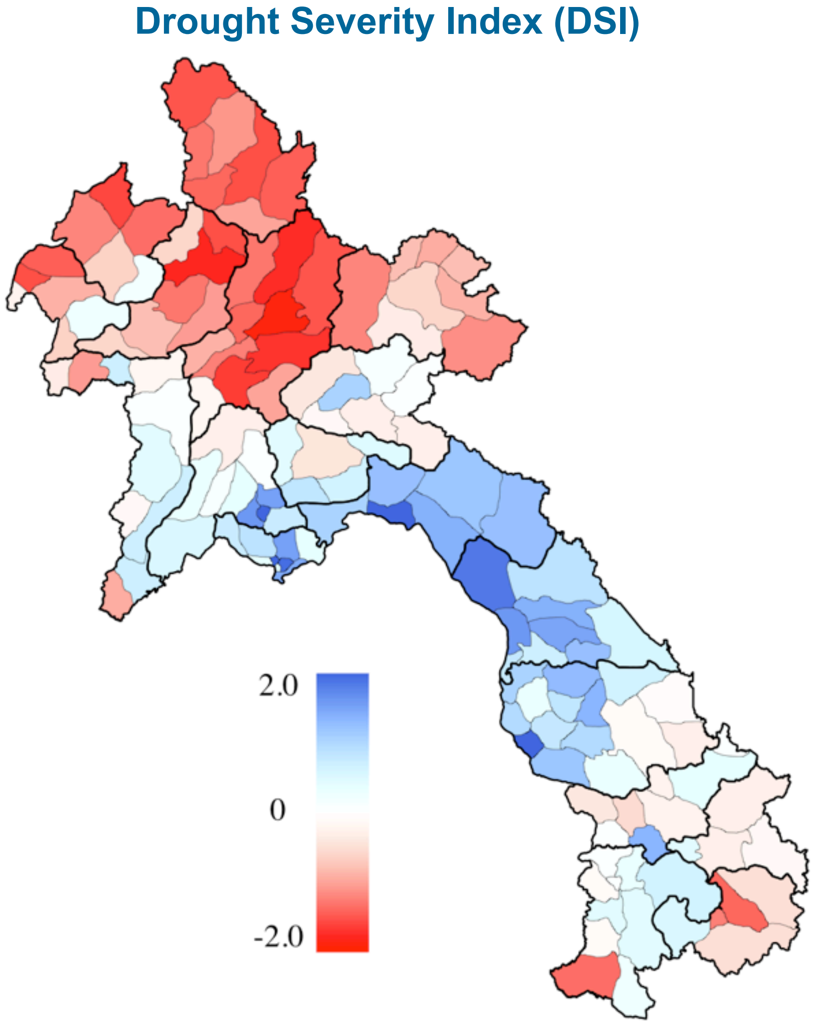
β_{1-3} represent the coefficients on our weather variables

Equation 2: Shock Risk

$$Log(Y_{dt}) = \gamma_d + \theta_t + \beta_1 Dr_{dt} + \beta_2 \mathbf{X}_{dt} + \varepsilon_{dt}$$

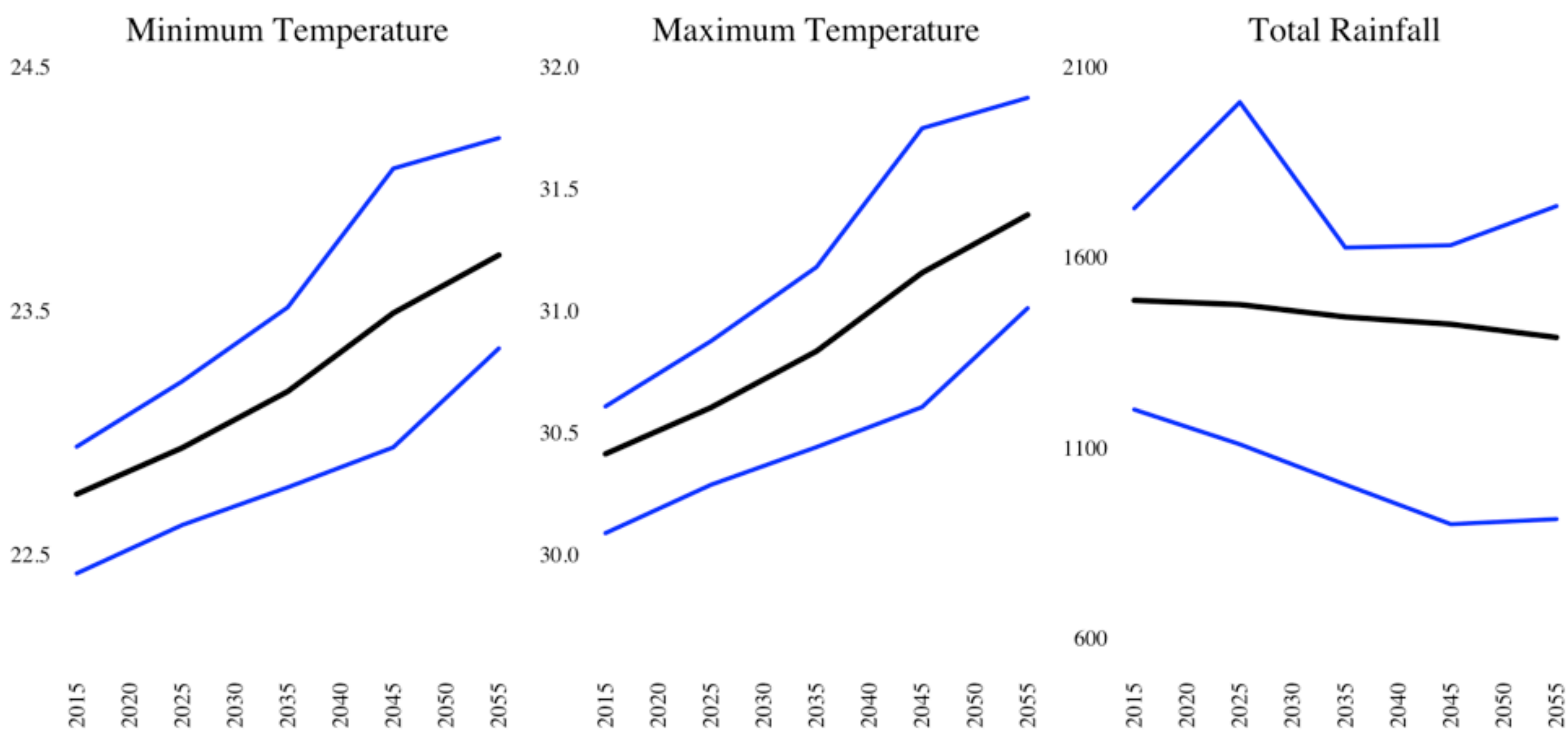
β_1 represents the coefficients on our drought measure.
X_{dt} are other controls.

Most Extreme Growing-Season Weather Conditions, 2006-2012

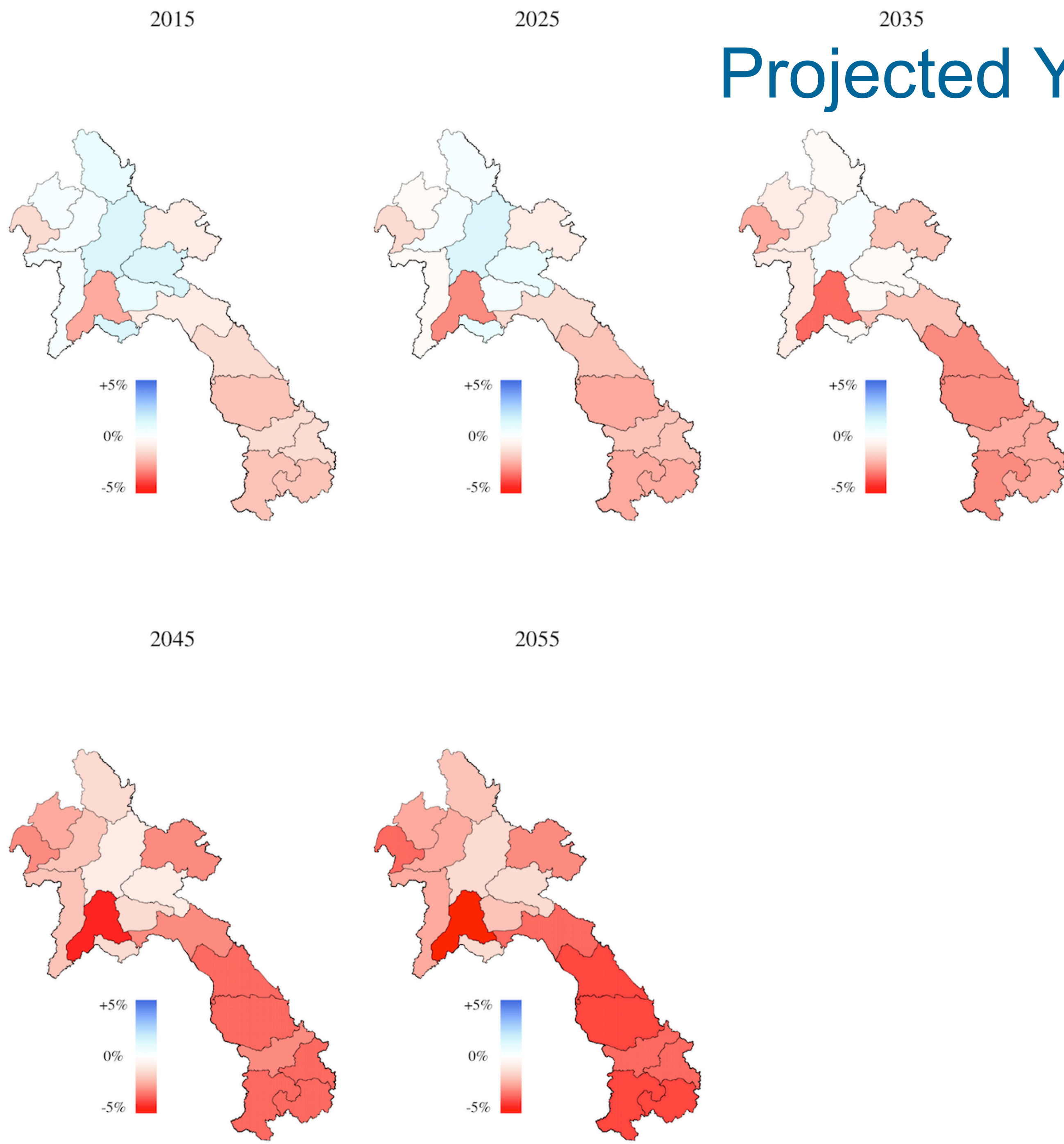


The figure shows average area-weighted DSI values for Lao PDR districts.
Blue represents greater than normal and red represents less than normal water levels.

Forecast Lao PDR Climate Conditions:
Averaged across 14 Global Circulation Models



Projected Yield Changes



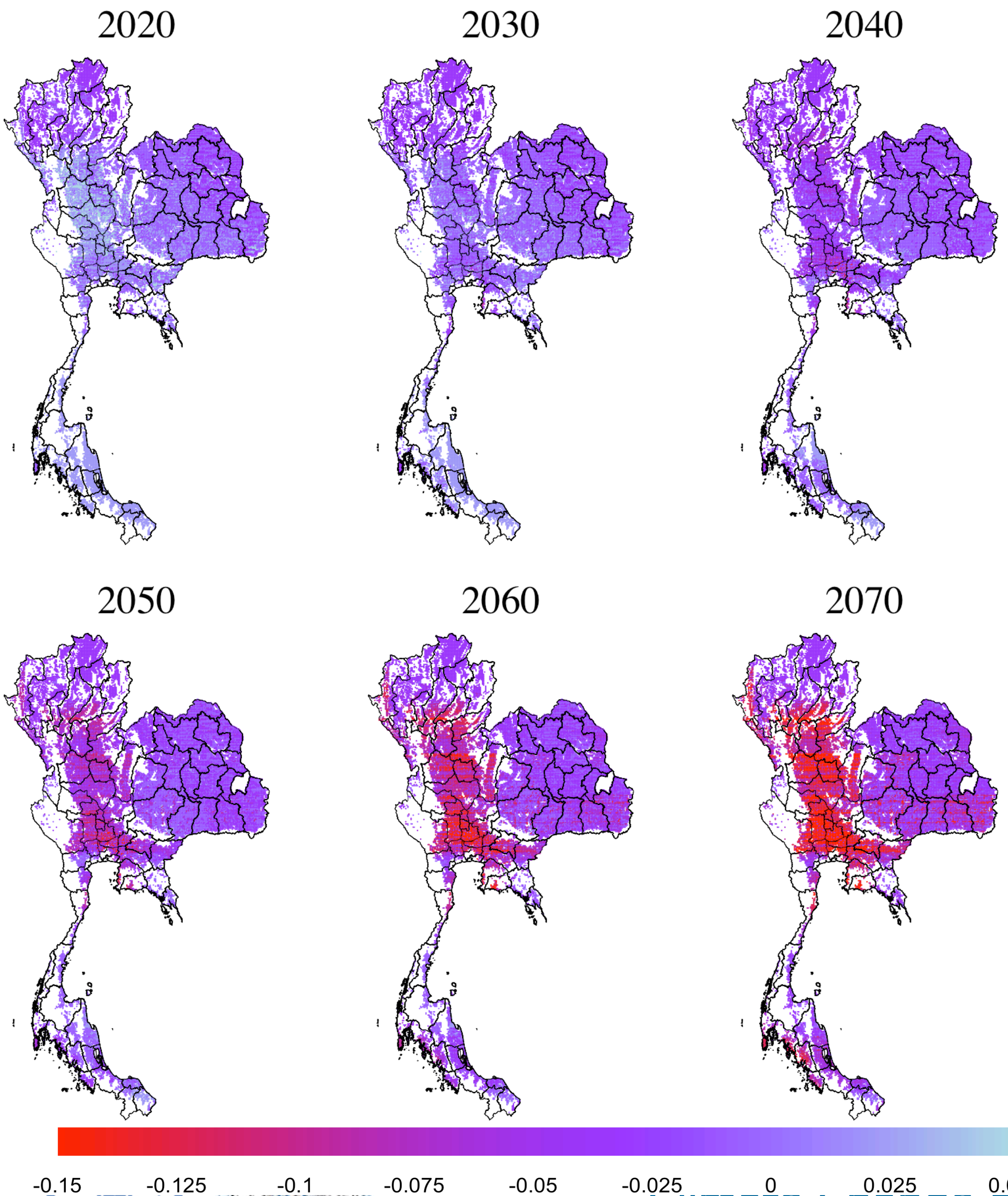
Yields may actually <u>increase</u> in some upland (lower temperature) areas for two decades, then decline with national yields.

Other provinces should be targeted for adaptation support according to emergent yield risk (red).

Estimates are <u>conservative</u> (linear model).

Yield Changes: A1B Scenario

Thailand:
Results of a non-linear model



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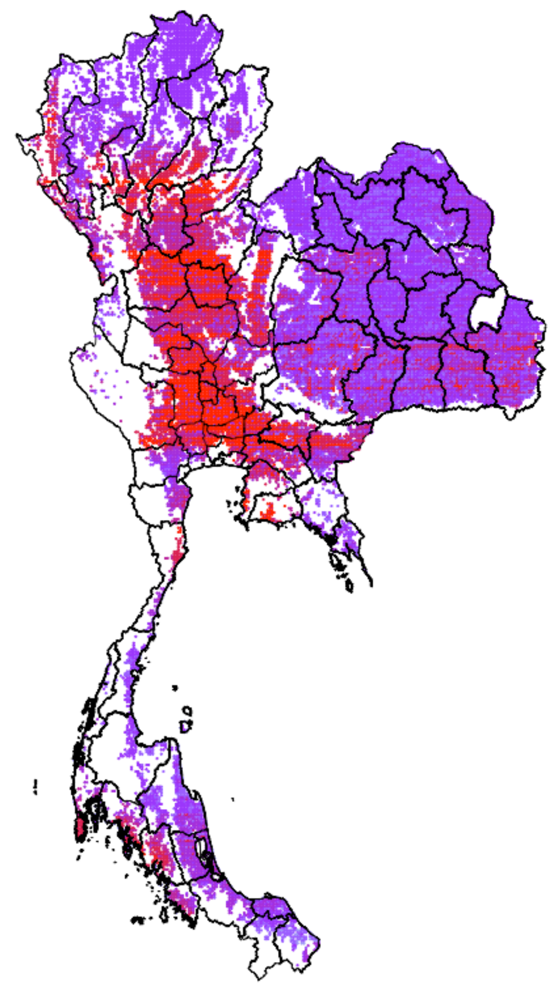

Climate Change and Fo

Preliminary Conclusions

- Climate risk to the Lao PDR rice sector in will vary significantly over space and time.
- This heterogeneity presents an opportunity, for policymakers and private stakeholders to learn adaptation.
- To support this, we propose an early warning mechanism that can identify and target risks as they emerge.
- Two generic risk categories need to be monitored:
  - Direct – risks to domestic food production
  - Indirect – risks to food security transmitted through markets