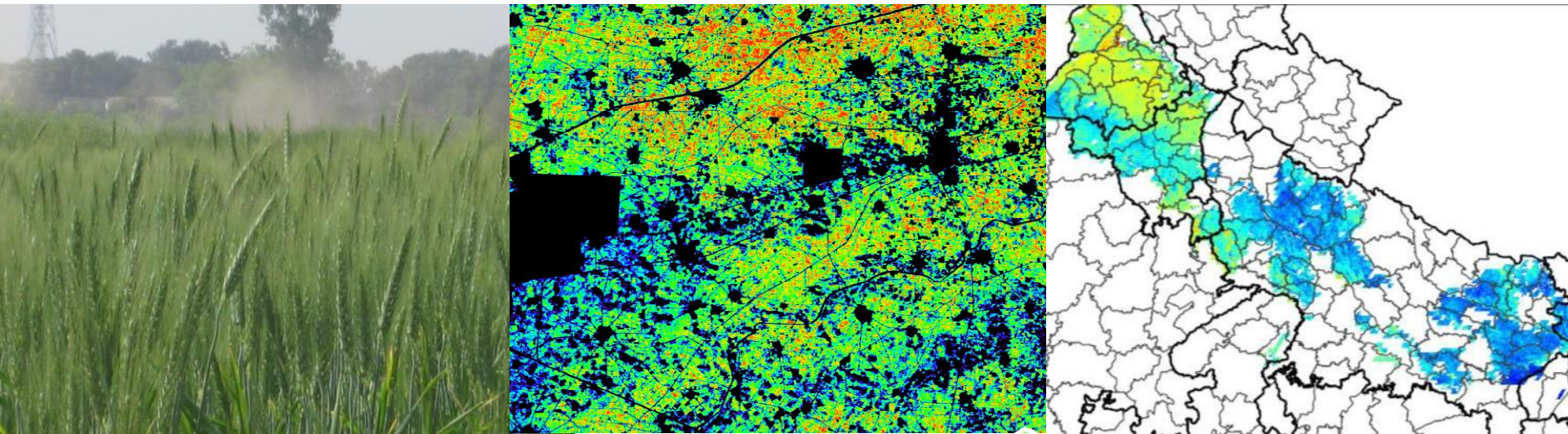


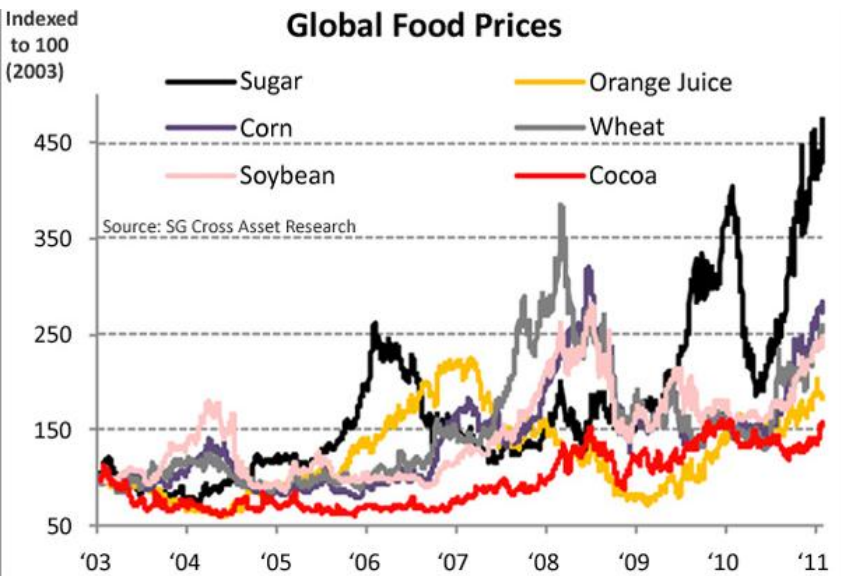
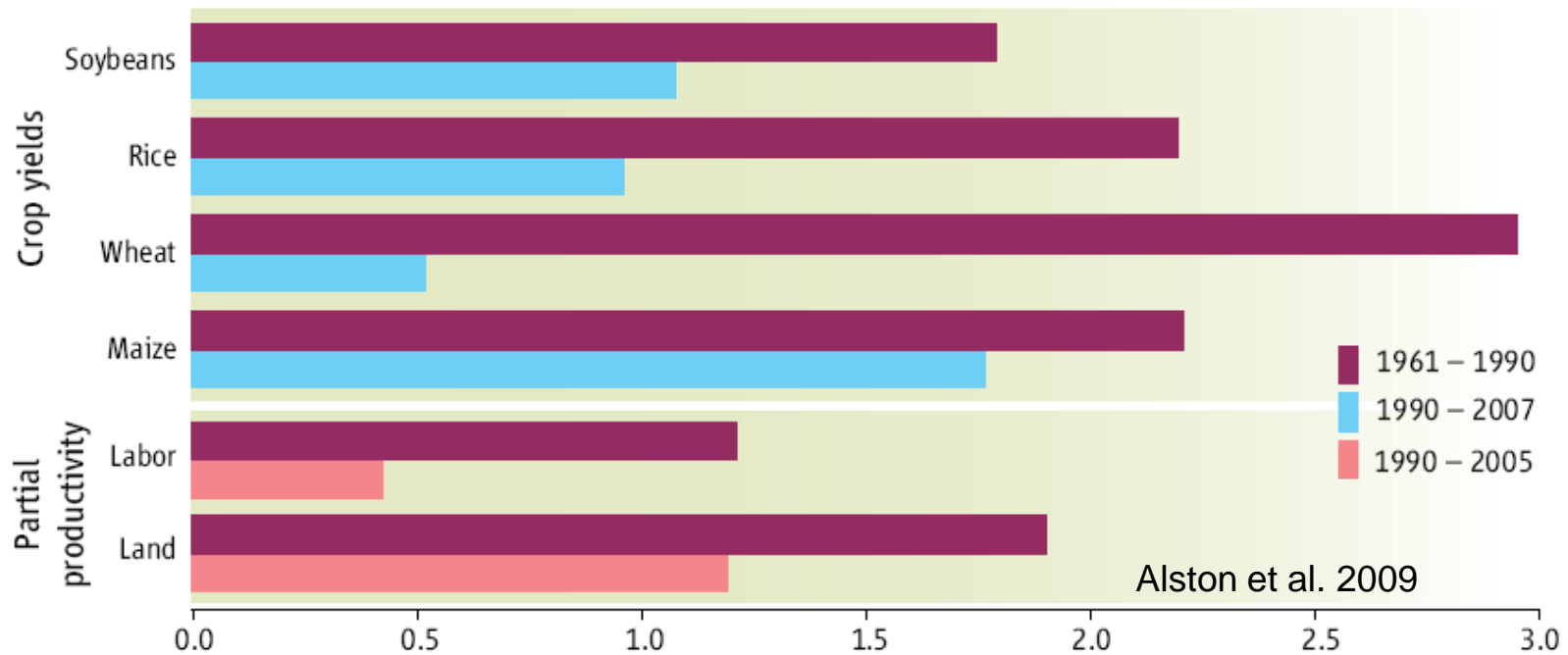
New Investigator Project: Agricultural Applications Of Multi- Year Remote Sensing



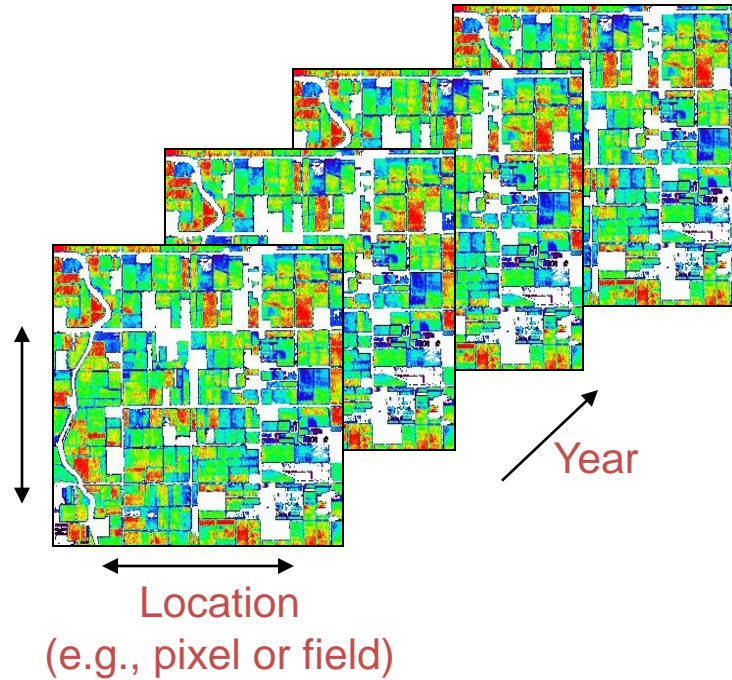
David B. Lobell

Assistant Professor, Environmental Earth System Science
and Center Fellow, Program on Food Security and the Environment
Stanford University
dlobell@stanford.edu

The need for agricultural informatics

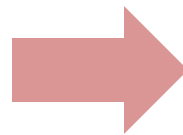


Why Multi-Year Remote Sensing?



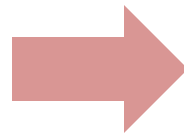
With 5+ years, one can:

1) See persistent features in the landscape vs. idiosyncratic variations



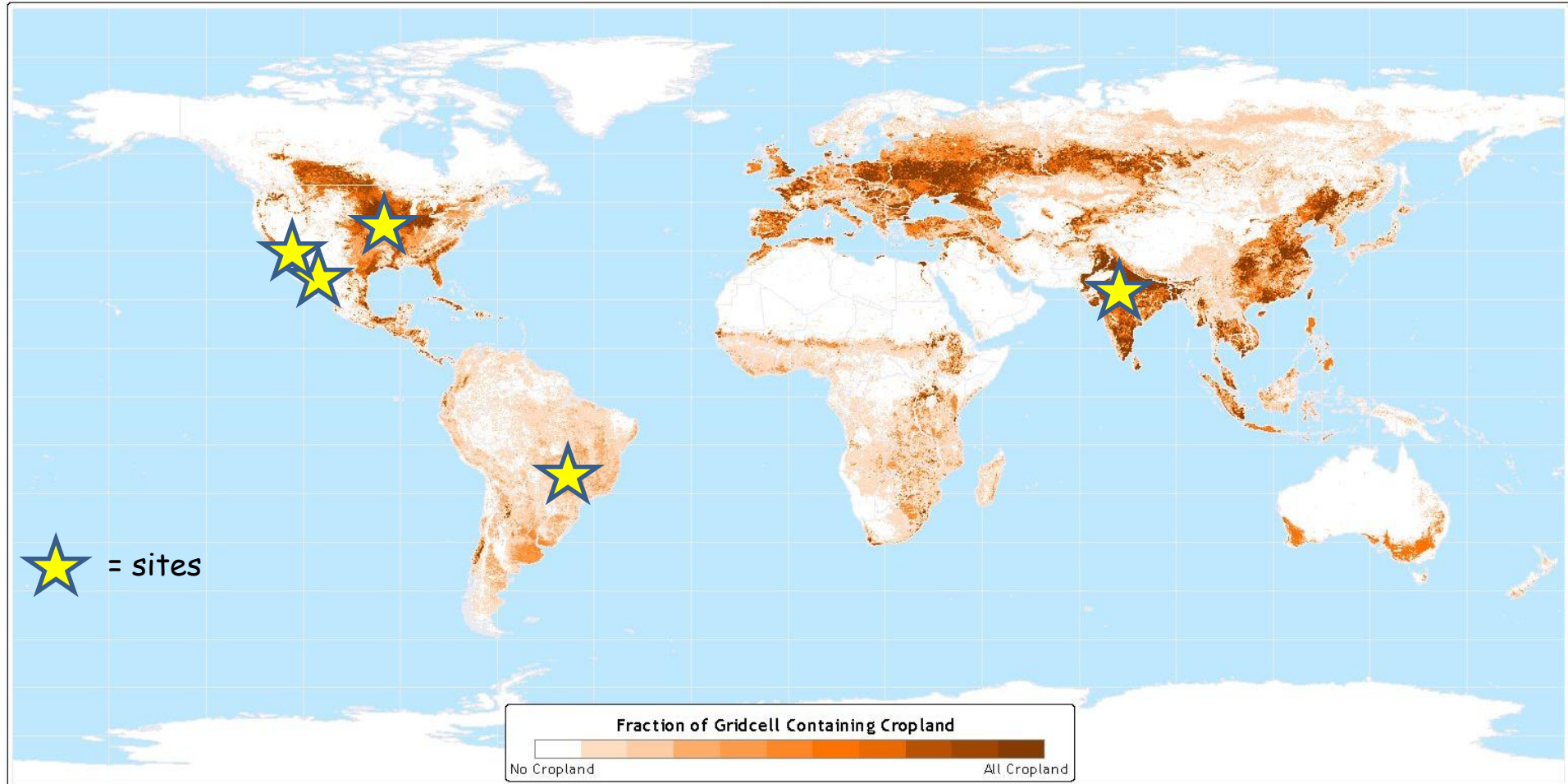
Map soil properties and/or measure their effects on crops

2) Observe many more combinations of weather and management

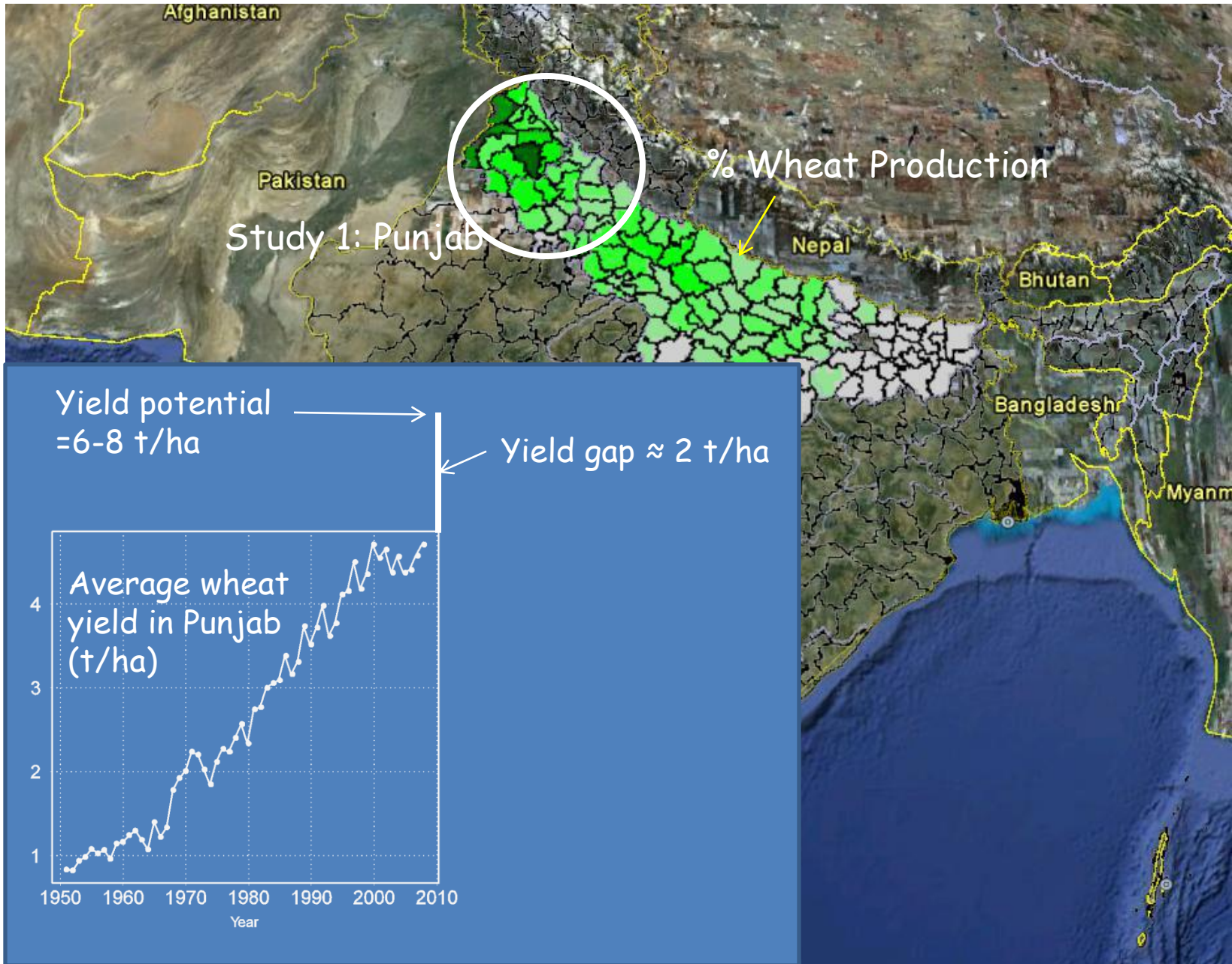


Learn about the drivers of crop growth, development, and yield

NIP Project Locations



Wheat in India



Q: Why are yield gaps so big and persistent?

Traditional approach:

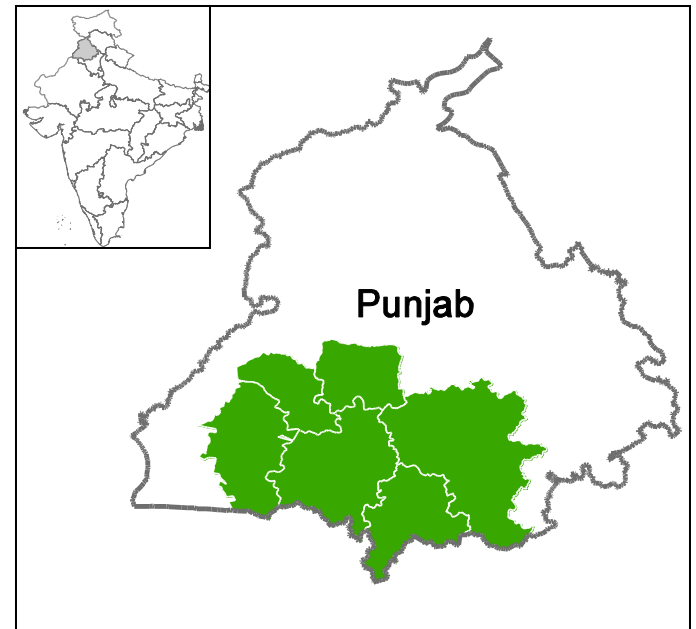
- Run a survey of 30+ farmers and ask about yields, management.
- Possibly perform on-farm experiments.

Limitations:

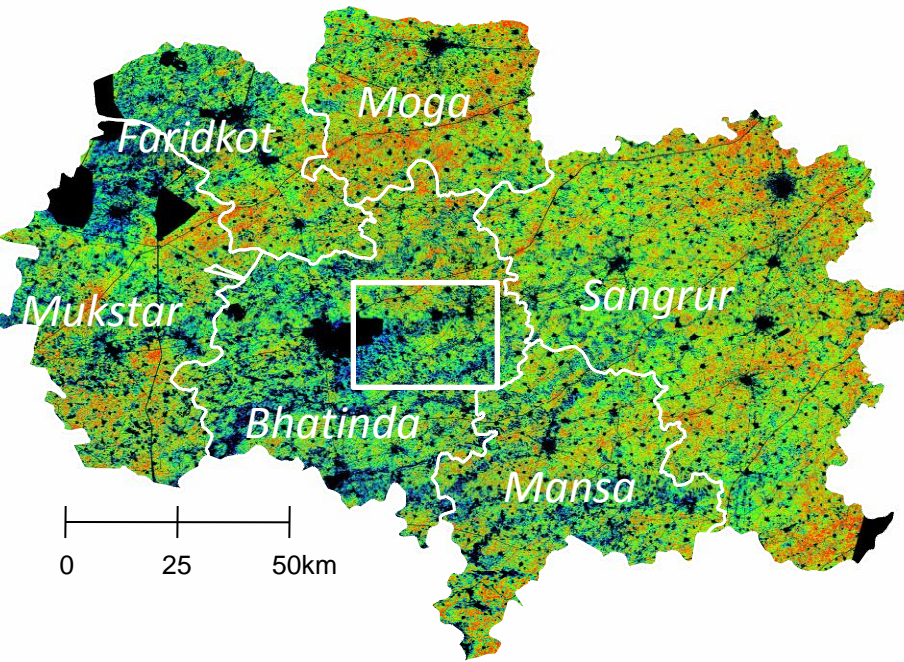
- There are typically too many interactions to see significance at these sample sizes.
- Hard to know how representative fields are of larger areas
- Hard to know how representative years are of other years

Our approach:

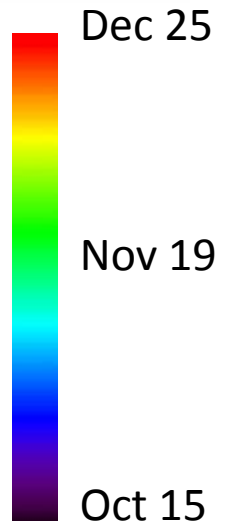
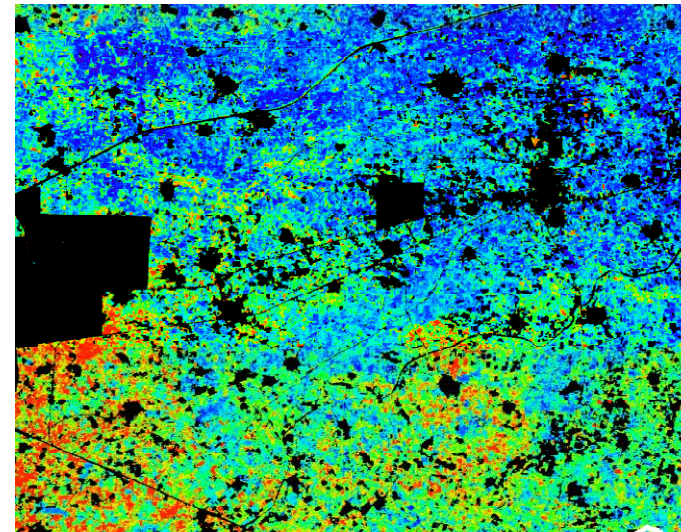
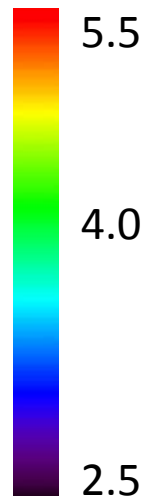
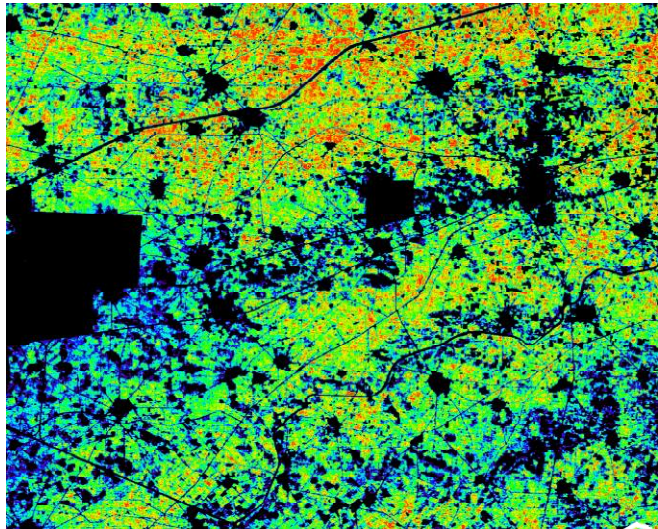
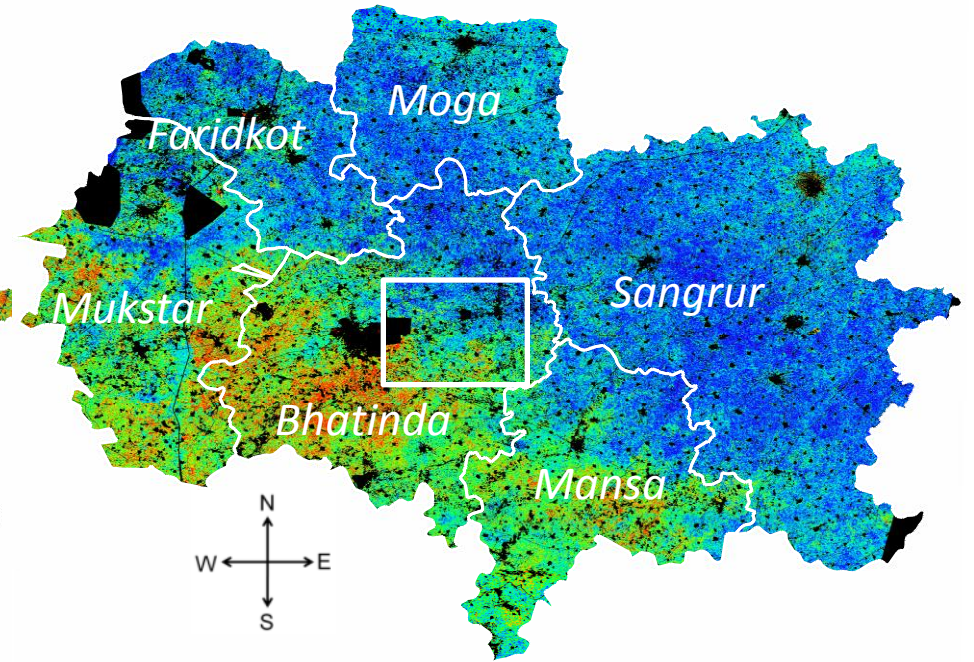
- Use Landsat to estimate yields on each field for 2000-2009
- Use ancillary data on management, soils
- Perform sanity checks with local experts



2002 Wheat Yield in Punjab (Mg/ha)

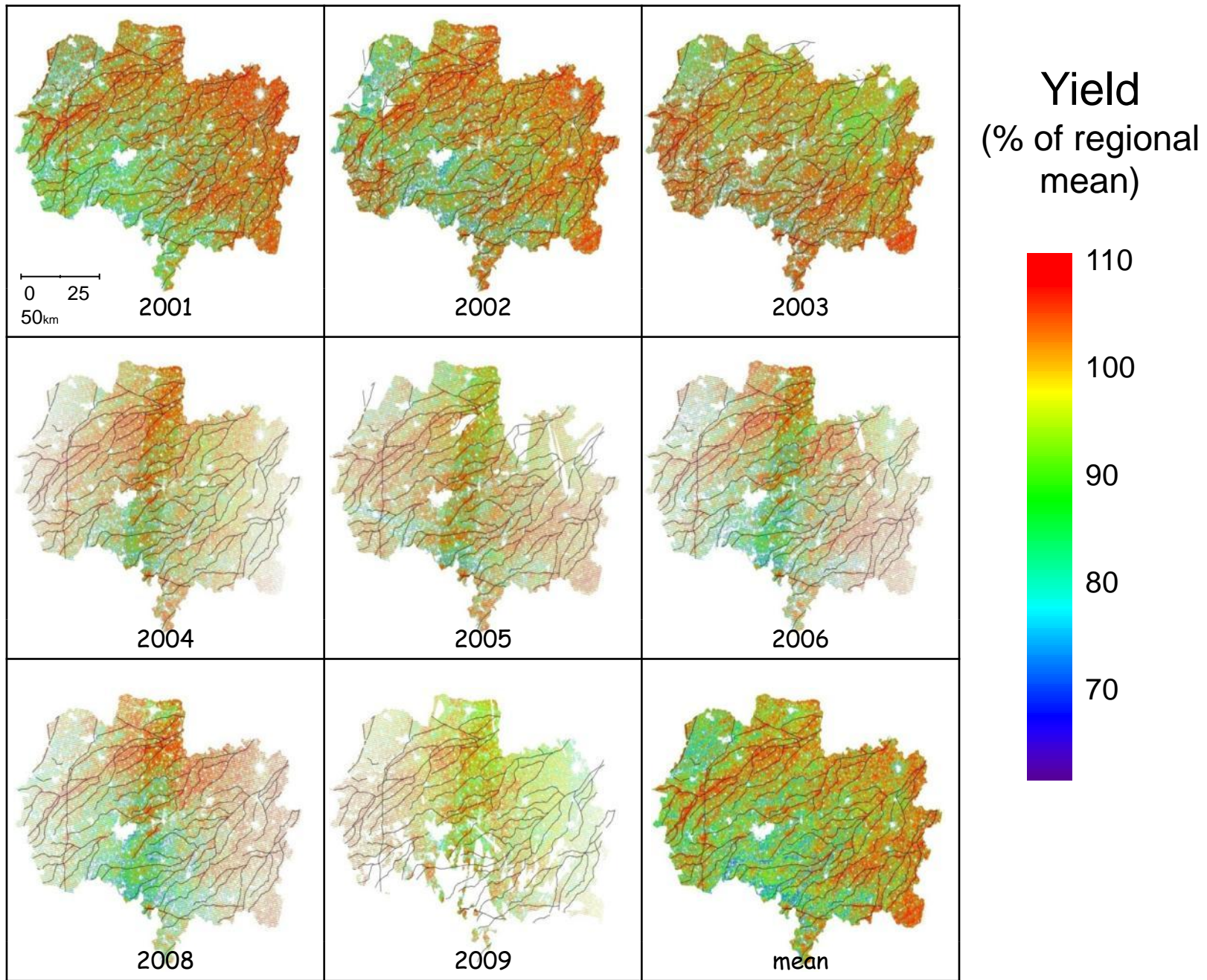


2002 Planting Date in Punjab

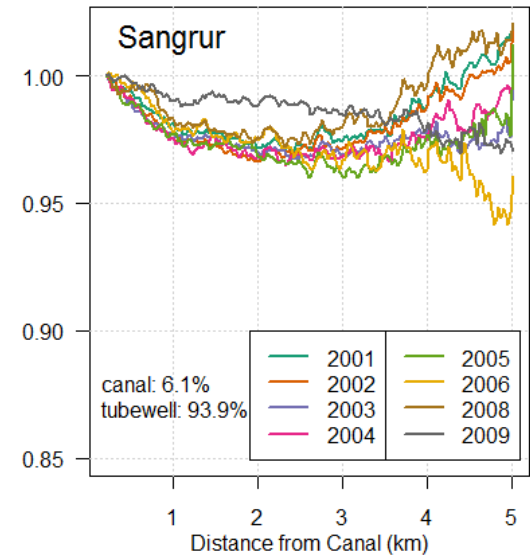
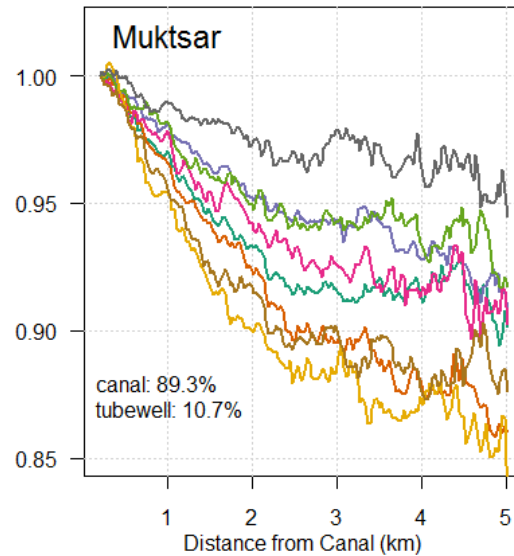
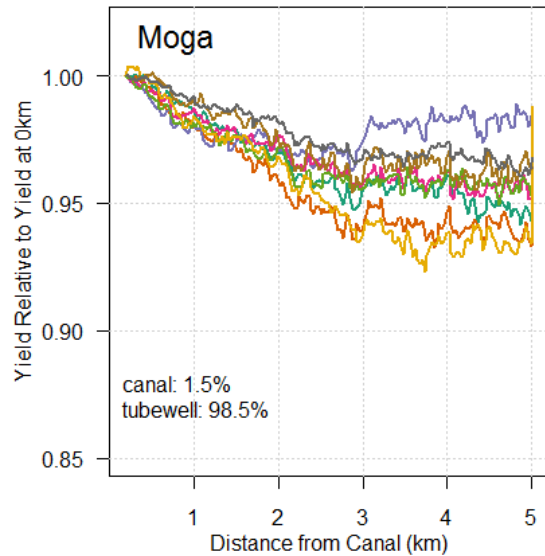
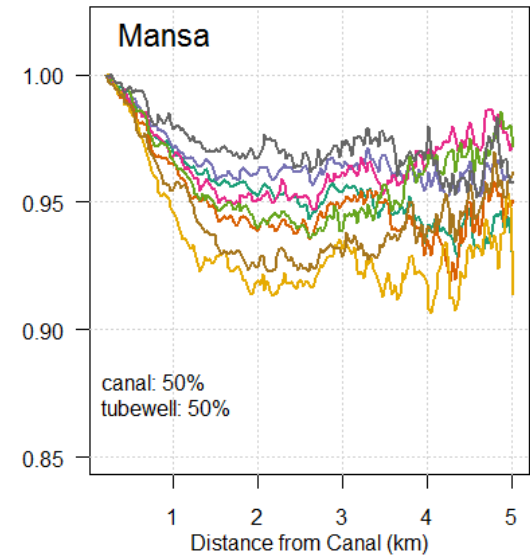
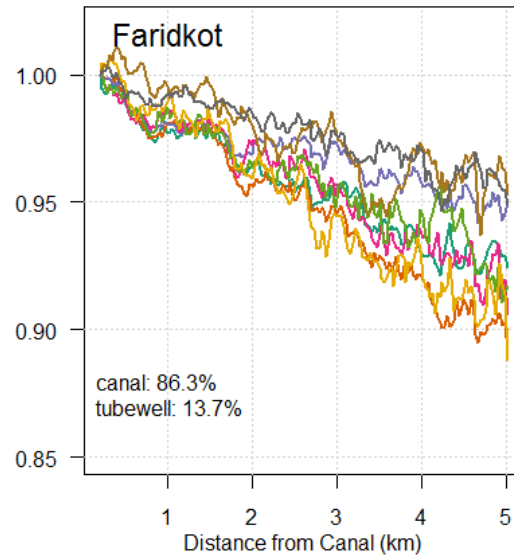
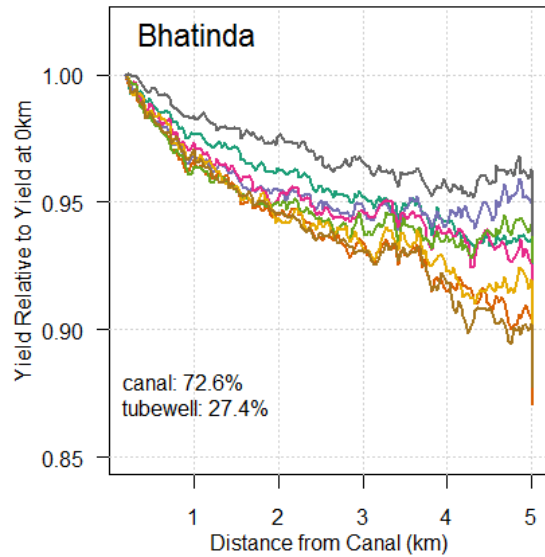


5 km

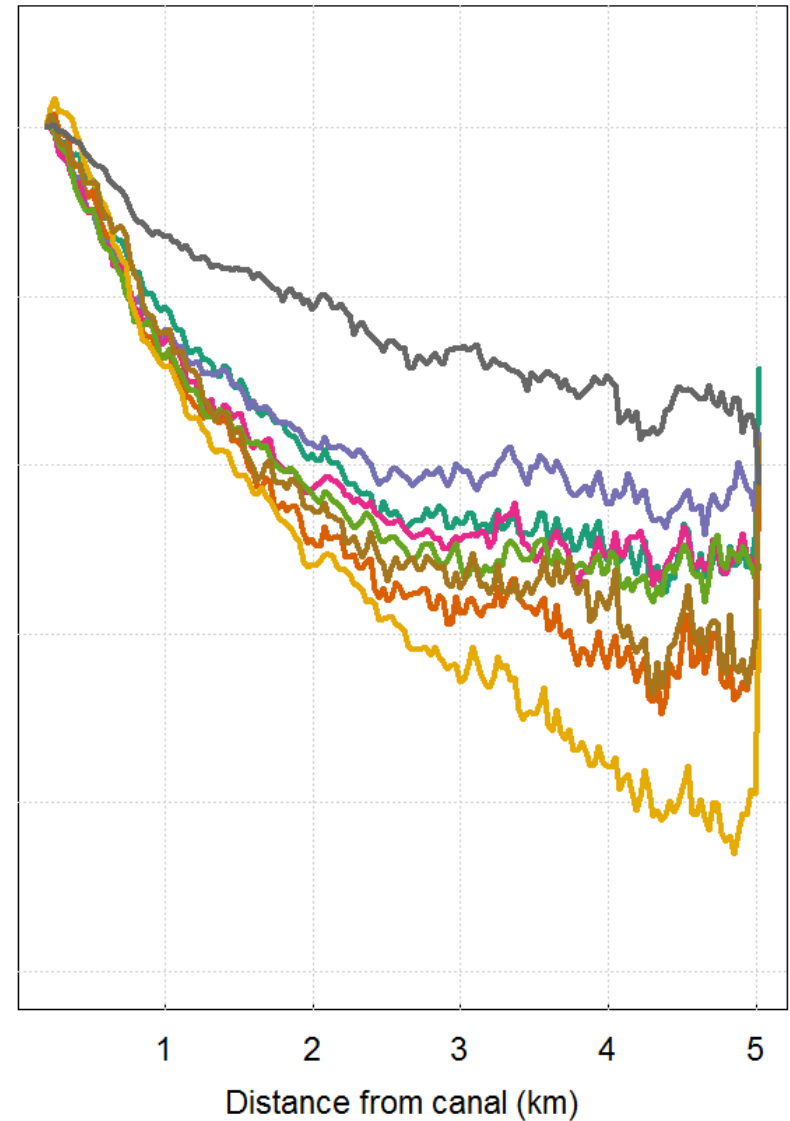
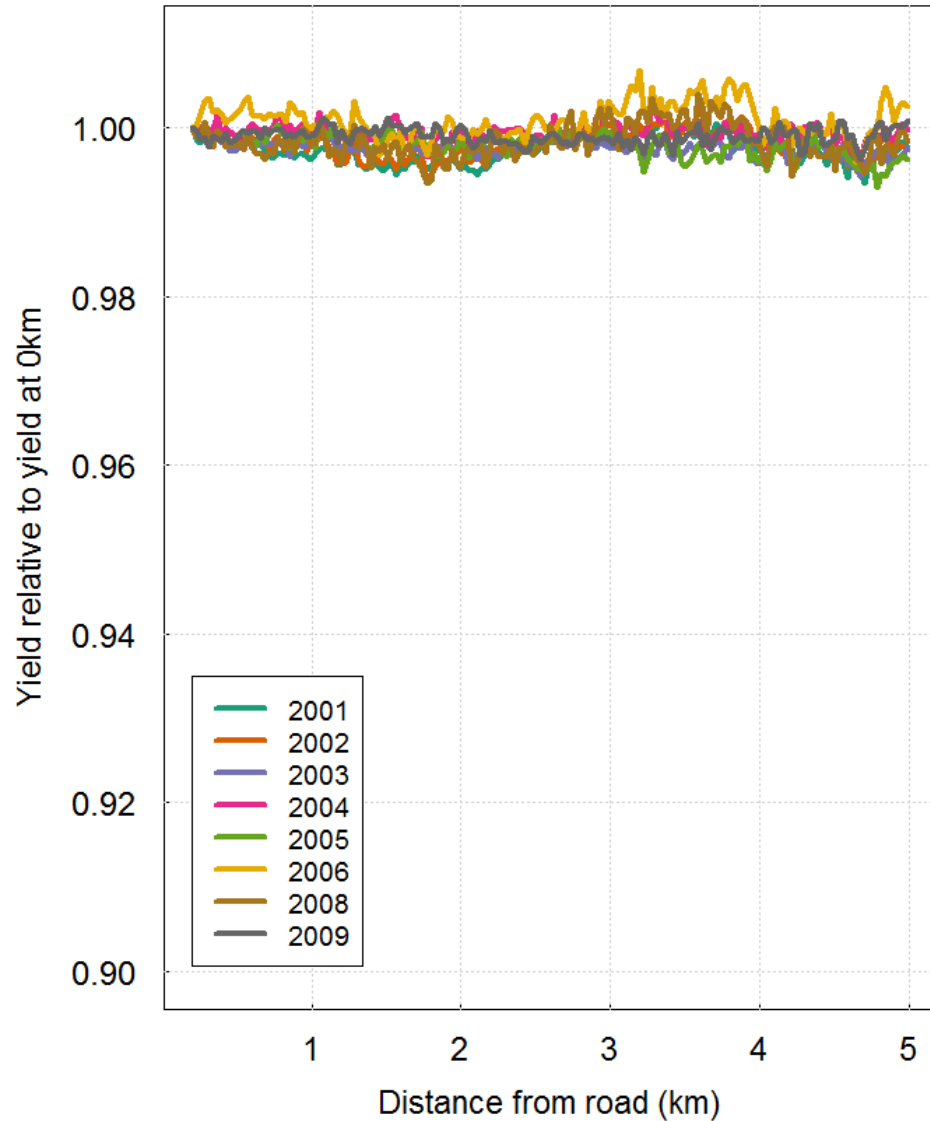
Lobell et al. 2010, *Field Crops Research*



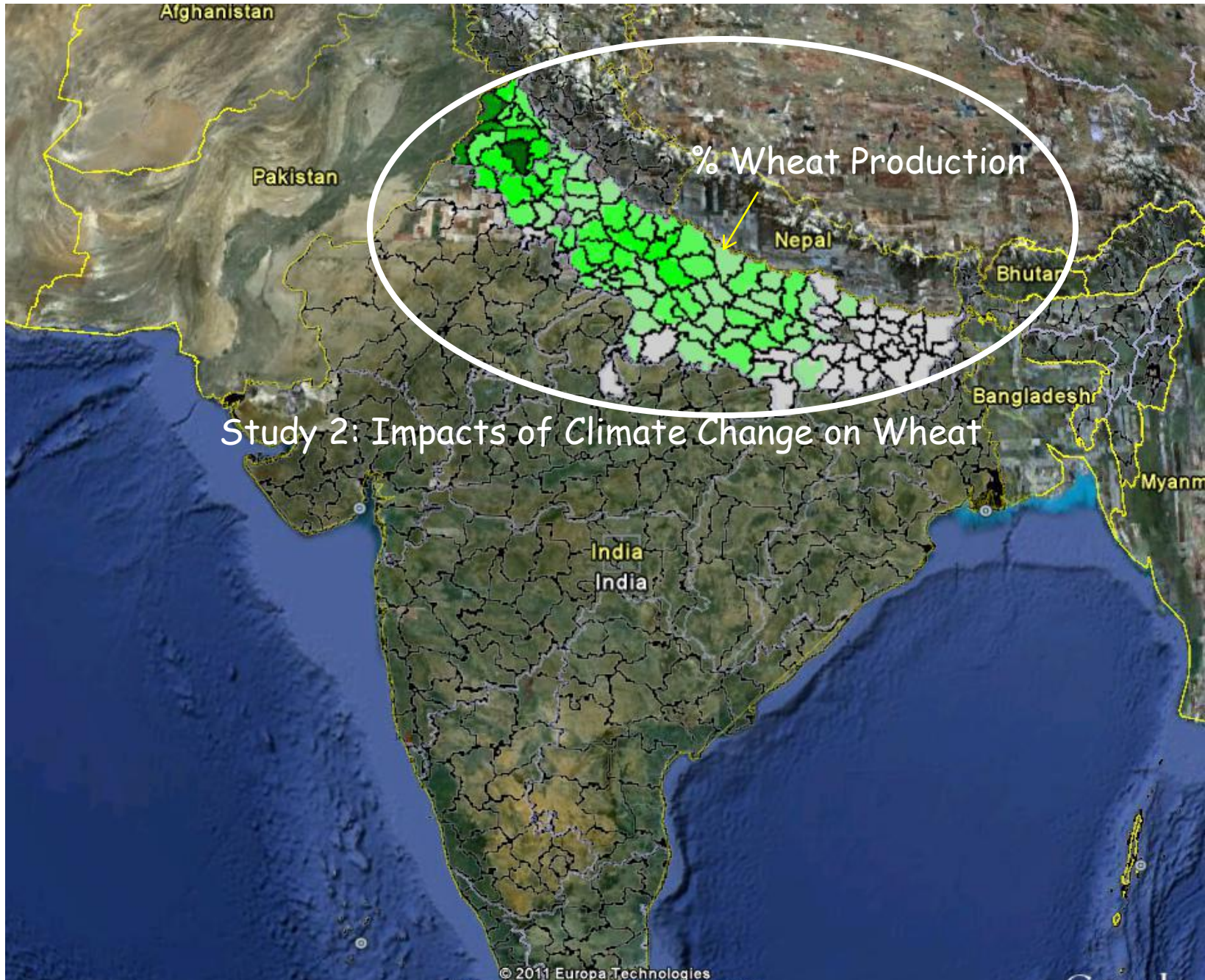
Distance to canal is important, especially in districts that rely more on surface water for irrigation



Some hypothesized factors are important, some aren't



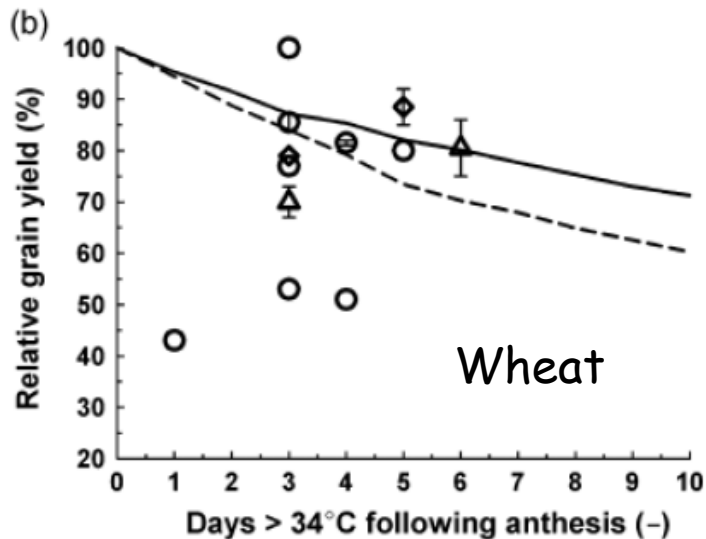
Wheat in India



Study 2: Impacts of Climate Change on Wheat

Q: Do extreme temperatures have special effects that models are missing?

- Some suggestion from experiments that temperatures above 34 °C (93 °F) can greatly speed up senescence and lower yields
- Most models don't have this effect, implying they may be missing something important in future climates.
- Is adapting to extreme heat an important adaptation need?



Asseng et al. 2011

Traditional approach:

- Run more experiments
- Test models on these data

Limitations:

- Relatively slow and expensive
- Hard to know how well it relates to field conditions

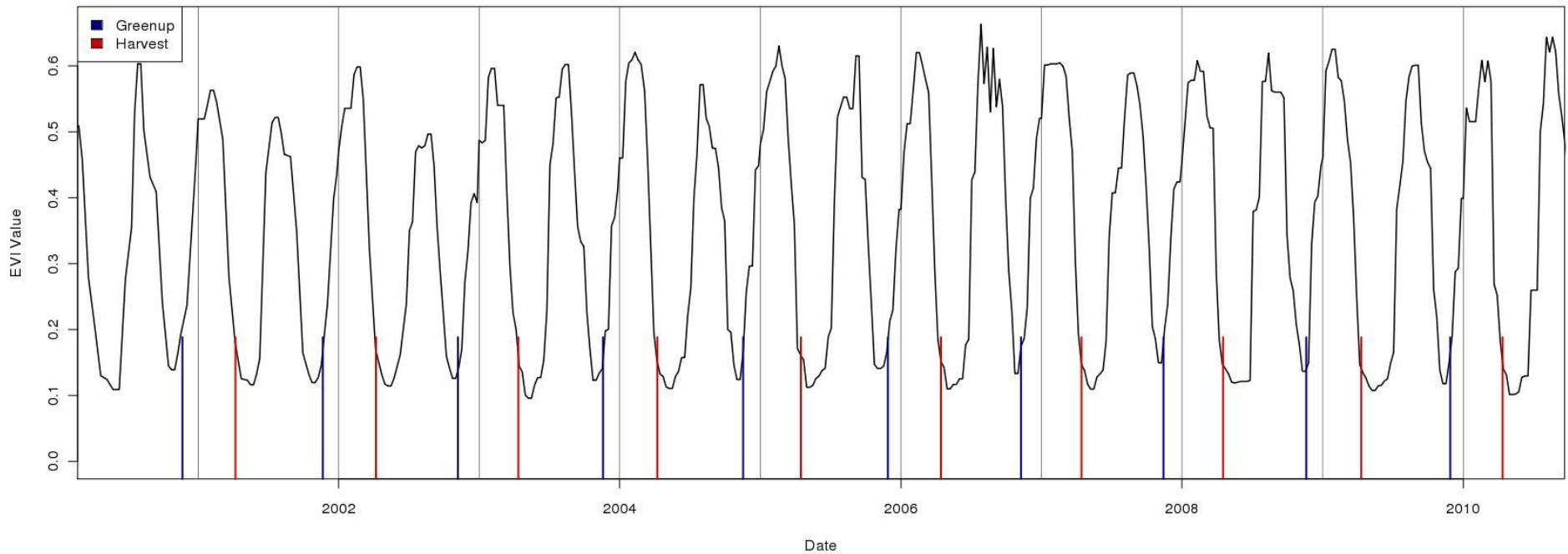
Our approach:

- Use MODIS to look at phenology in region for 2000-2010
- Compare season length with weather predictors

Q: Do extreme temperatures have special effects that models are missing?

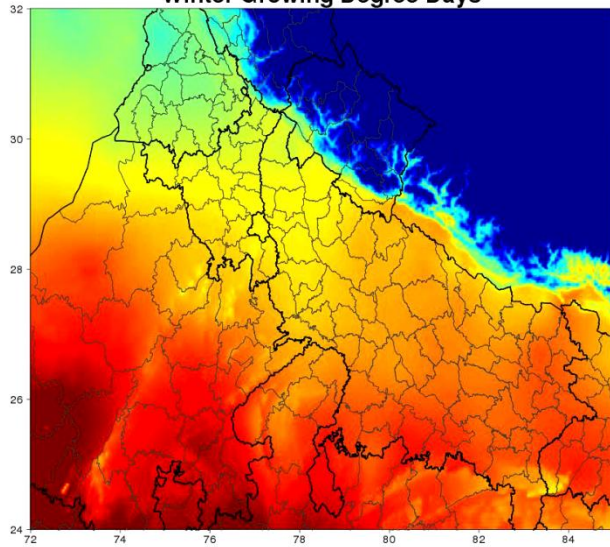
Estimates of green-up and green-down for a wheat pixel, using MODIS + Timesat

Typical EVI profile of winter planted wheat - Bathinda, Punjab

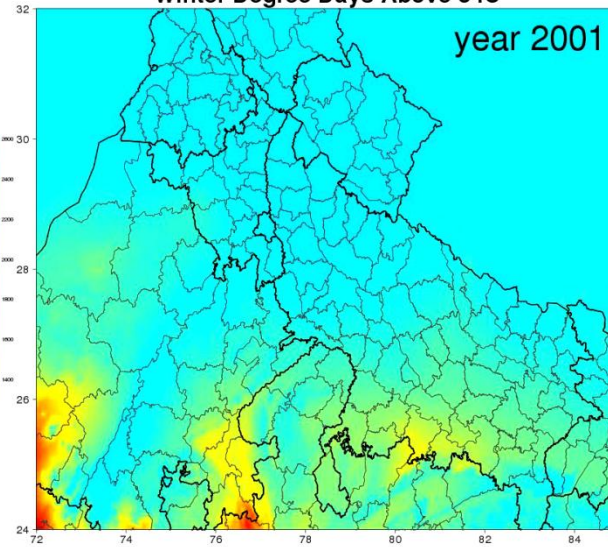


Q: Do extreme temperatures have special effects that models are missing?

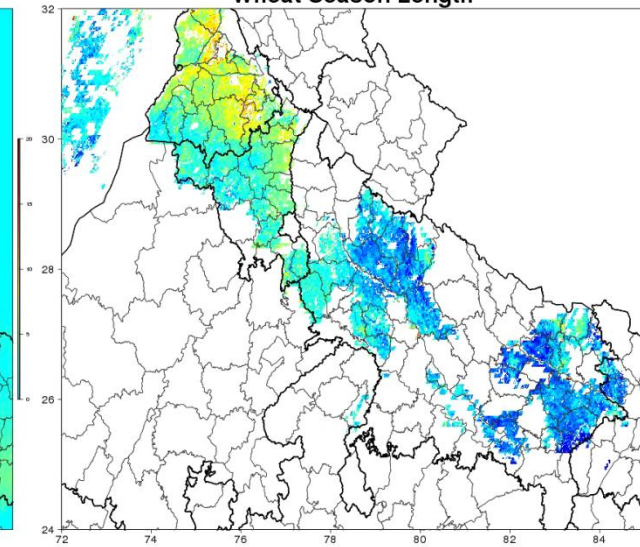
Winter Growing Degree Days



Winter Degree Days Above 34C

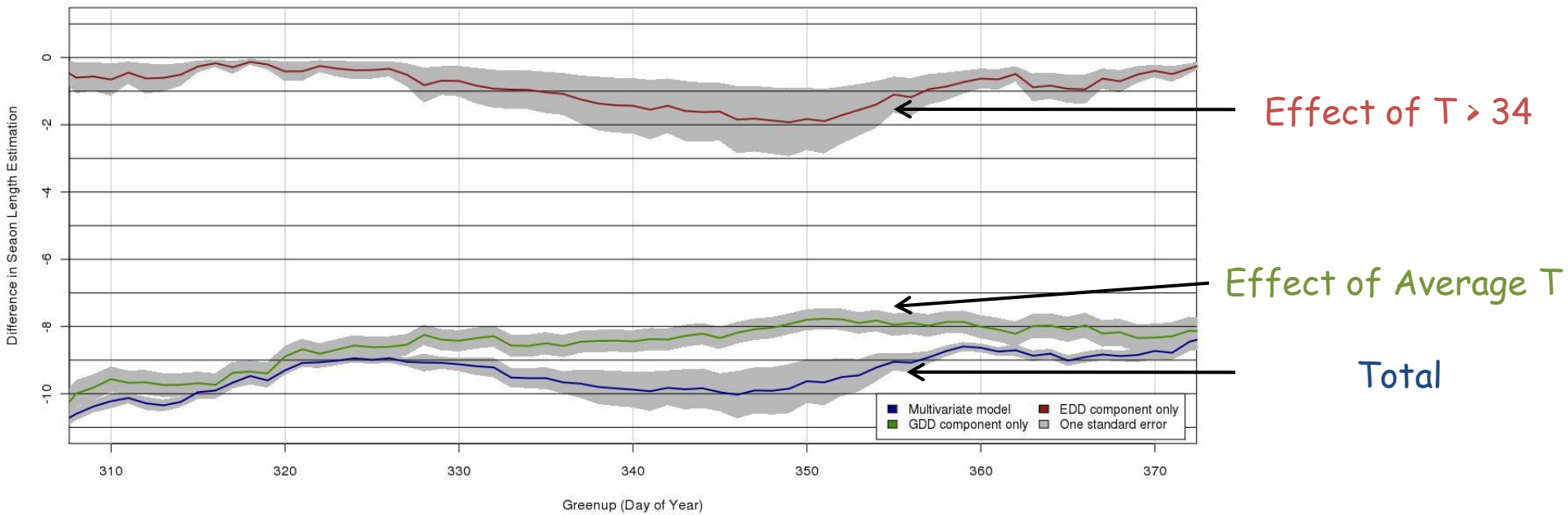


Wheat Season Length



Q: Do extreme temperatures have special effects that models are missing?

MODIS-based prediction of shortening of season for +2 C warming



Summary

- There are unique aspects to multi-year records that present opportunities for understanding agricultural systems
- With many sensors now having many years of data freely available, this should be an area of considerable growth
- Not shown: multi-year Landsat and MODIS can identify soil salinity and sodicity much better than single year data, in US and Mexico

For More Information

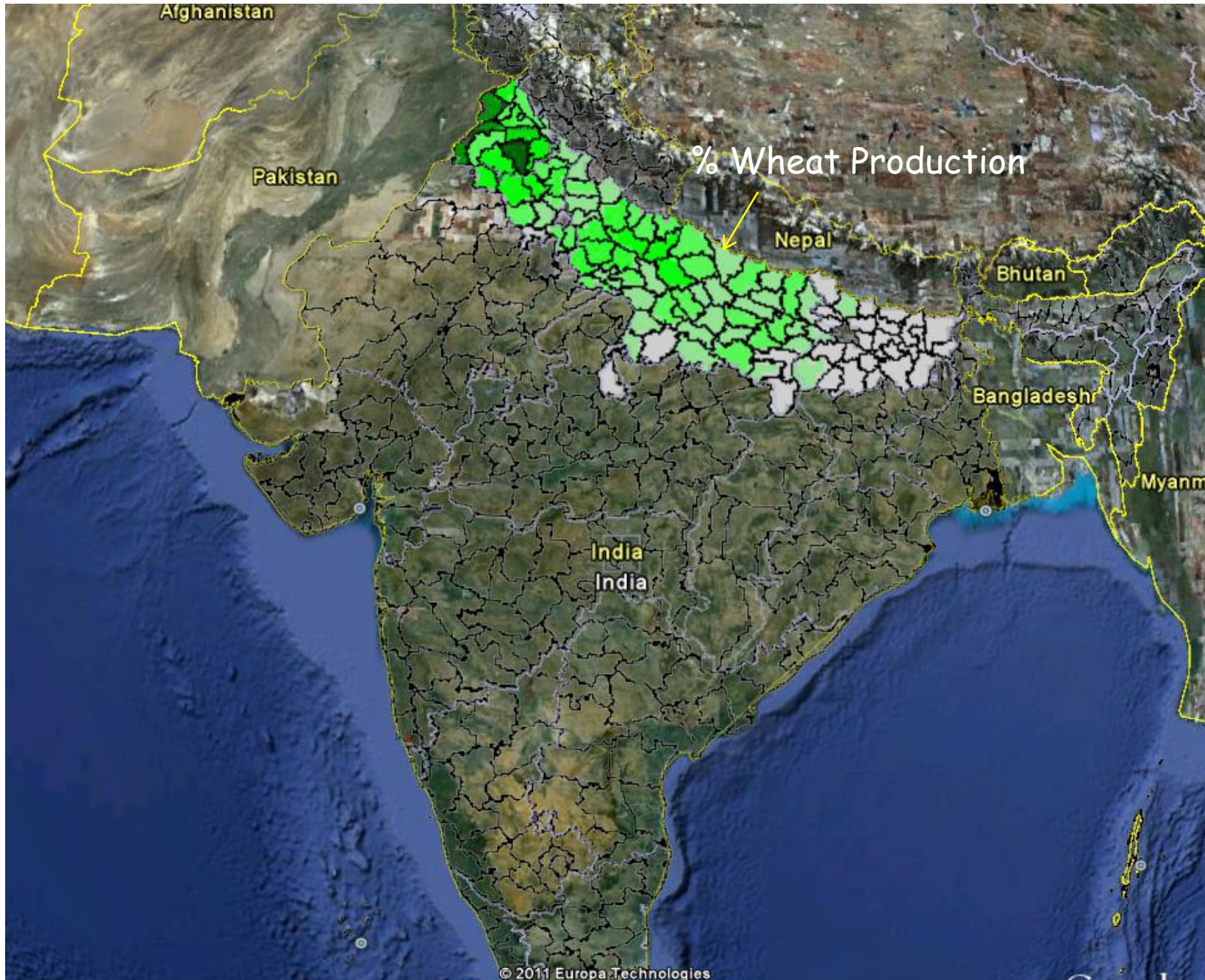
Some References:

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- Lobell, D.B., Ortiz-Monasterio, J.I. and Lee, A.S., 2010. Satellite evidence for yield growth opportunities in Northwest India. *Field Crops Research*, 118: 13-20.
- Seifert, C., J.I. Ortiz-Monasterio, and D.B. Lobell. 2011. Satellite-based detection of sodicity impacts on wheat production in the Mexicali Valley. *Soil Science Society of America Journal*, in press.
- Loarie, S.R., D.B. Lobell, G.P. Asner, and C.B. Field. 2010. Land-cover change and surface water drive large albedo increases in South America. *Earth Interactions*, in press.
- Loarie, S.R., D.B. Lobell, G.P. Asner, Q. Mu, and C.B. Field. 2011. Local climate benefits of limiting sugarcane expansion to existing agricultural lands in Brazil. *Nature Climate Change*, in press.

Thanks for your attention.

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Wheat in India



Remote Sensing of Crop Yields with Landsat

