GEOSHARE:
Geospatial, Open-Source Hosting of Agriculture, Resources and Environmental Data

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What is GEOSHARE?

Mission: GEOSHARE develops maintains a freely available, global, spatially explicit database on agriculture, land use, and the environment accompanied by analysis tools and training programs for new scientists, decision makers, and development practitioners.

Vision: We envision a vibrant global network contributing to this shared infrastructure, enhancing capacity for analysis in developing countries, and applying these geospatial tools to guide decision making related to food security, land use, environmental sustainability and poverty reduction.

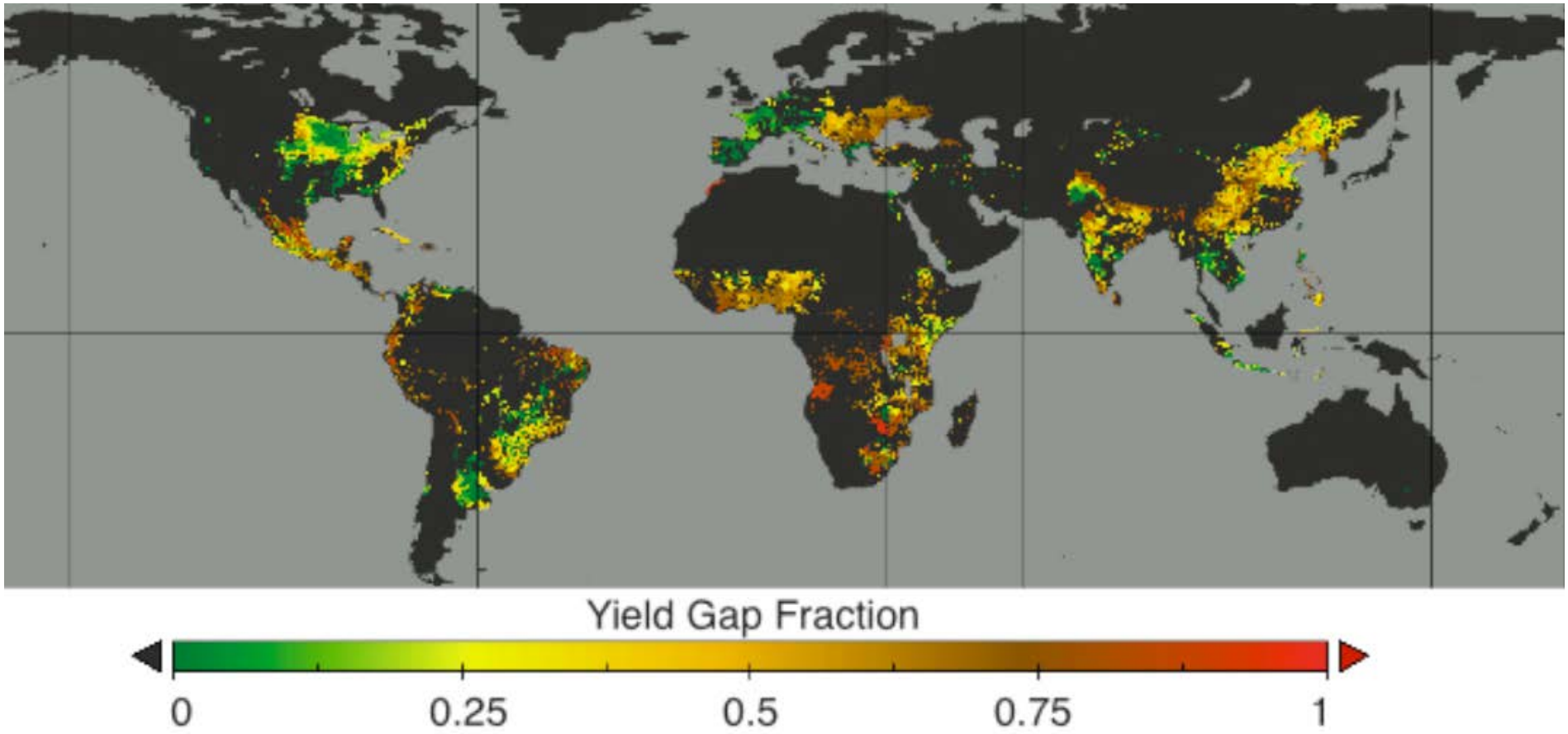
Motivation for GEOSHARE

- Feeding 9 billion people in 2050 in the face of a changing climate, while preserving the environment and eliminating extreme poverty, is one of the most important challenges facing us today.

- Agriculture is at the heart of this challenge:
  - Farming/land use change account for quarter of global GHG emissions
  - Land-based activities are very sensitive to climate change
  - Agriculture remains the predominant source of income for the world's poorest households and is therefore central to poverty reduction

- Key questions facing decision makers all require time series, spatial data:
  - Potential for boosting yields to meet projected growth in global demand
  - Optimal use of REDD+ funds to limit deforestation and sequester carbon
  - Impact of water scarcity on agricultural output
  - Impact of climate change on global agricultural productivity
  - Impacts of increasing climate extremes on vulnerability of the worlds' poor

Spatial detail is key in identifying yield gaps for crops (e.g., maize circa 2000)

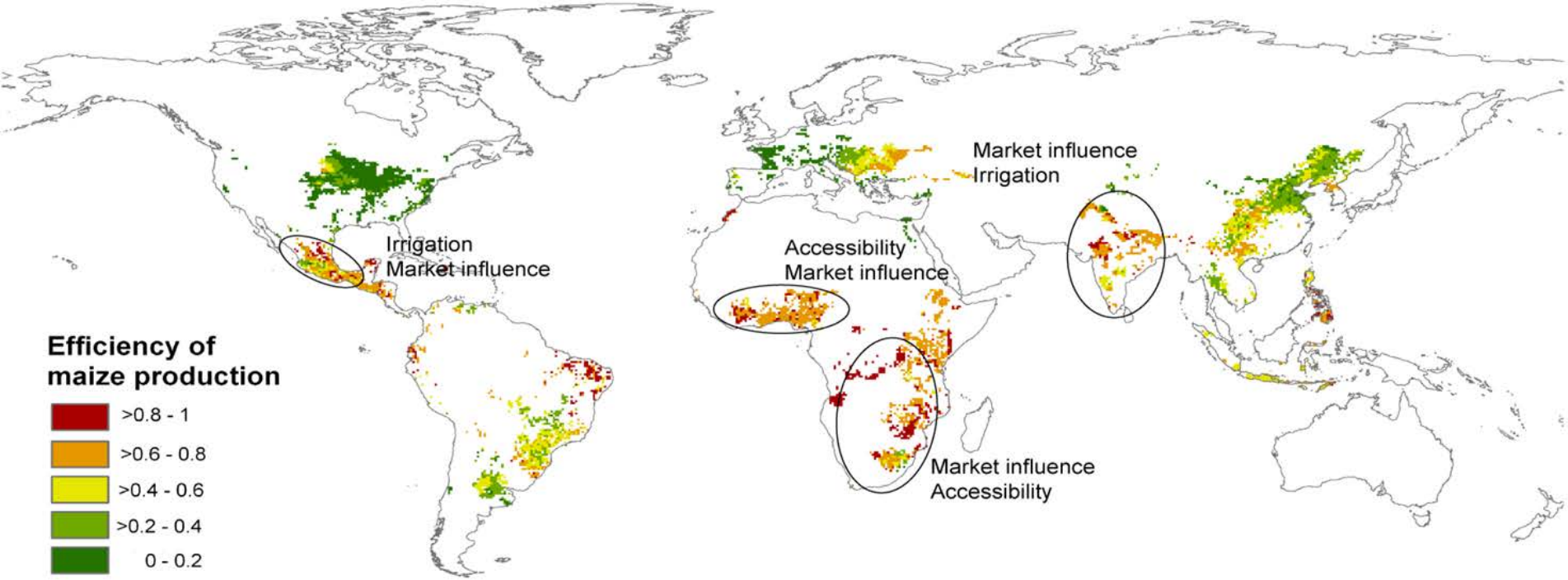


Gap = (*1 – Actual yield/Climatic potential yield*)

So 0 = on the production frontier, 1 = no productivity

Source: Licker et al. (2010)

As well as explaining their causes: Factors affecting maize production inefficiency

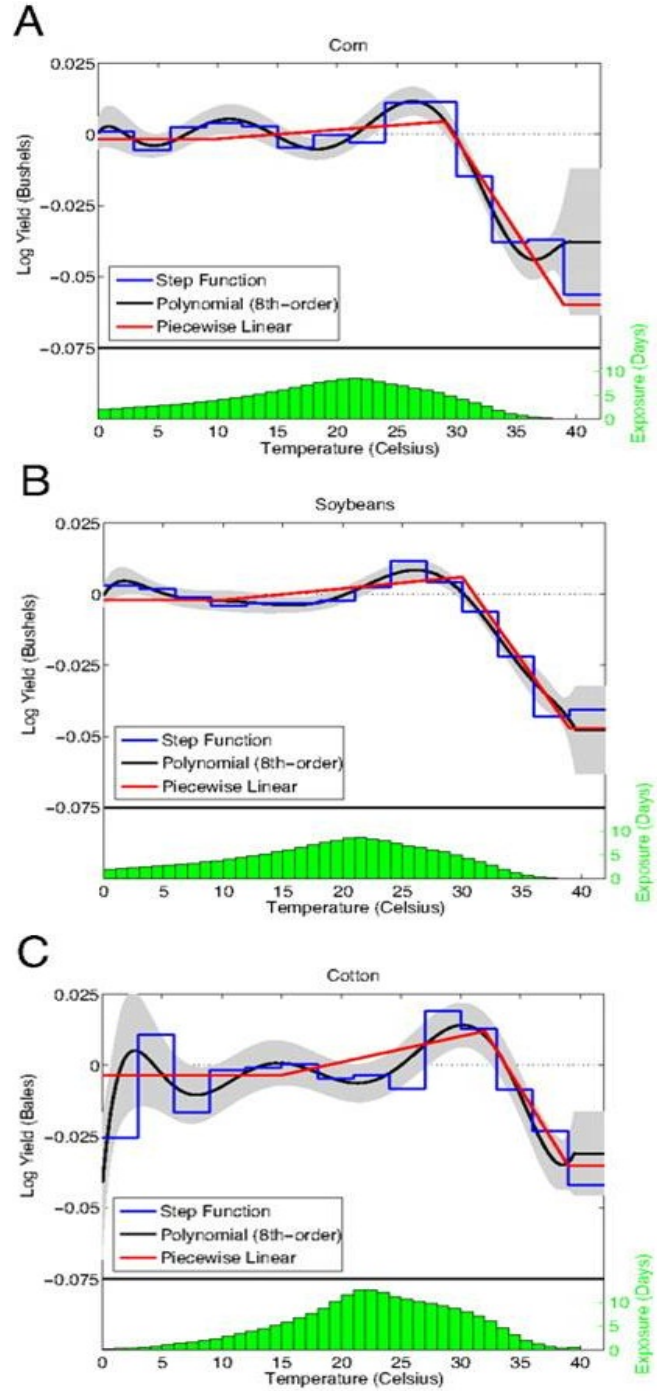


Darkened areas are more efficient – serve to "set the frontier".
Circled areas are inefficient; primary source of production inefficiency is identified

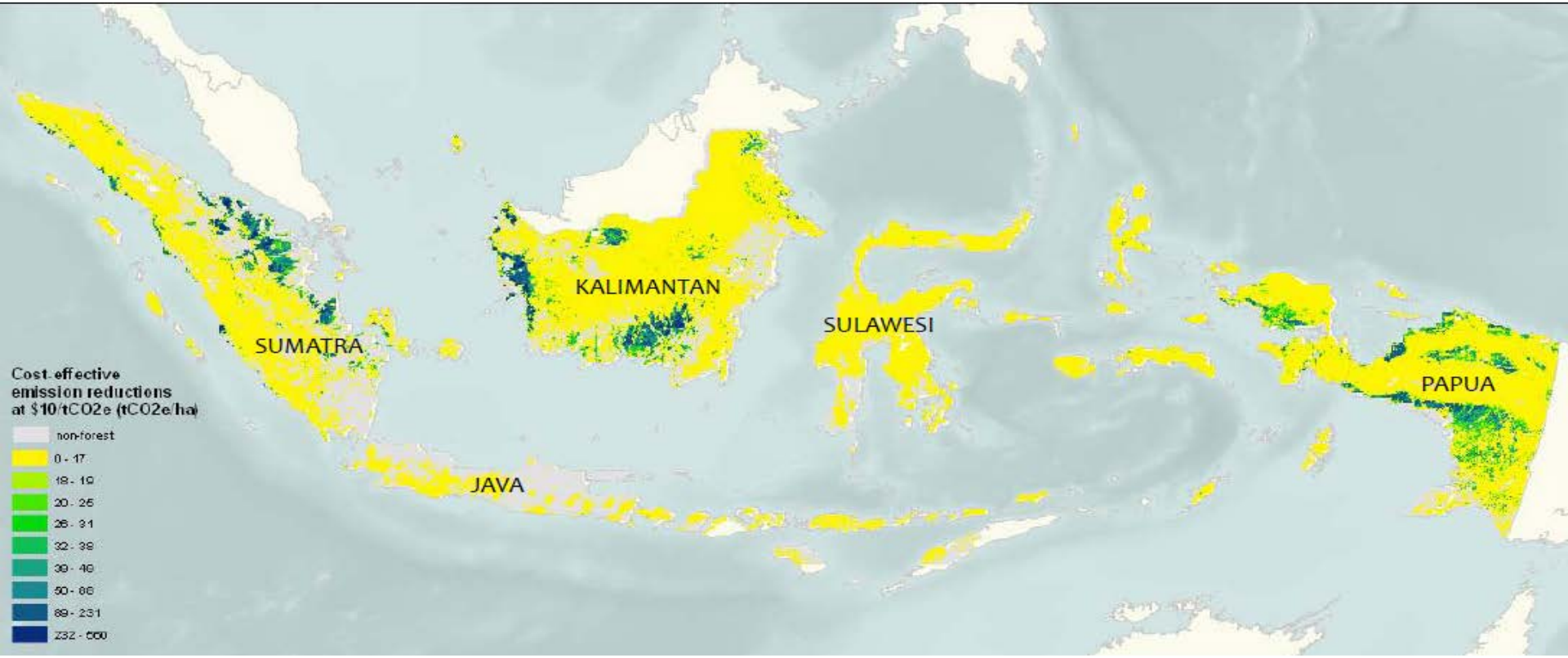
Source: Neumann et al. (2010), frontier production function estimated based on the Monfreda et al. (2008) data set

Combining time series and cross-section data is key to identifying threshold effects of climate on yields

- Schlenker and Roberts (2009):
  - pair US counties' crop yields with fine-scale weather dataset
  - incorporates the distribution of temperatures within each day and across all days in growing season
- Yields increase with temperature:
  - up to 29° C for corn
  - up to 30° C for soybeans
  - up to 32° C for cotton
- Temperatures above these thresholds are very harmful to yields



Time series spatial data are being used to design REDD payments in Indonesia



Land-cover response to carbon price of $10 tCO_2e paid for emission reductions below business-as-usual levels. Darker blue represents greater voluntary abatement of emissions from deforestation in response to incentive payments.

Source: Busch et al. (2011: in preparation), *Climate and revenue benefits of economic incentives to reduce emissions from deforestation in Indonesia*

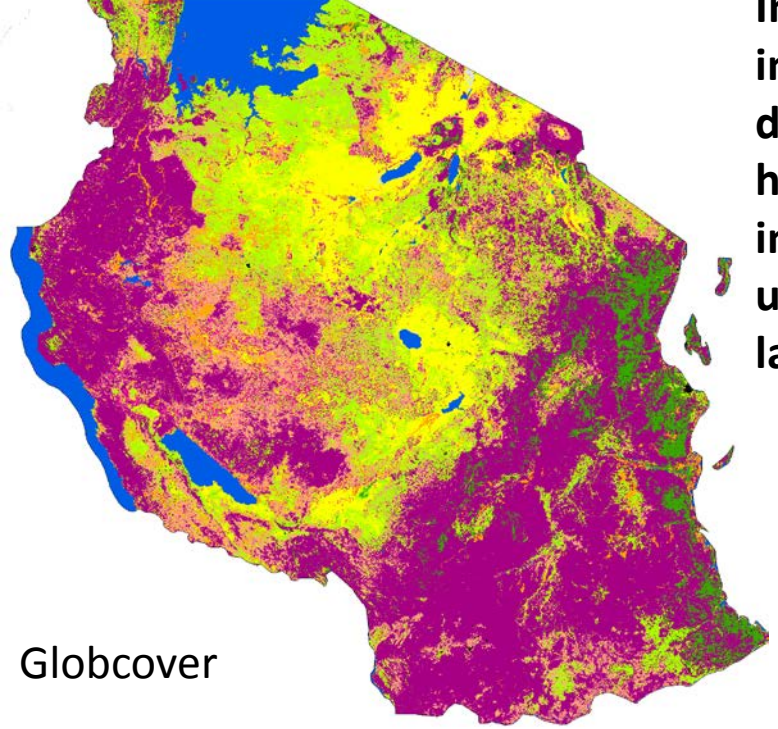
So what is the problem?

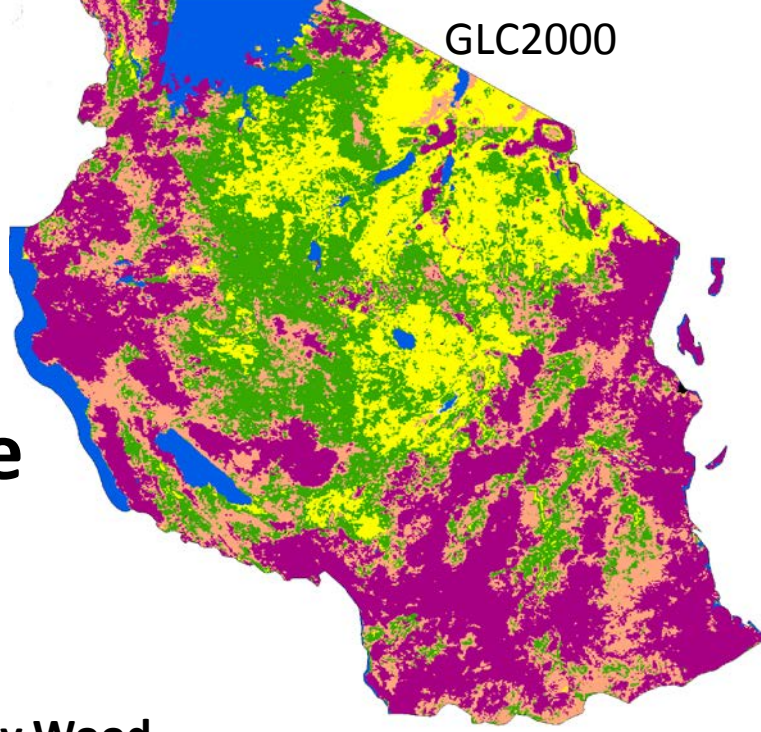
- Most spatial datasets:
  - Are regional or national, *not global;* while many of the problems are global in scope
  - Global (and many regional) data sets are *incompatible:* causes problems of inconsistency which are expensive and often impossible to resolve at the end of the data pipeline; compatibility must be designed in at outset

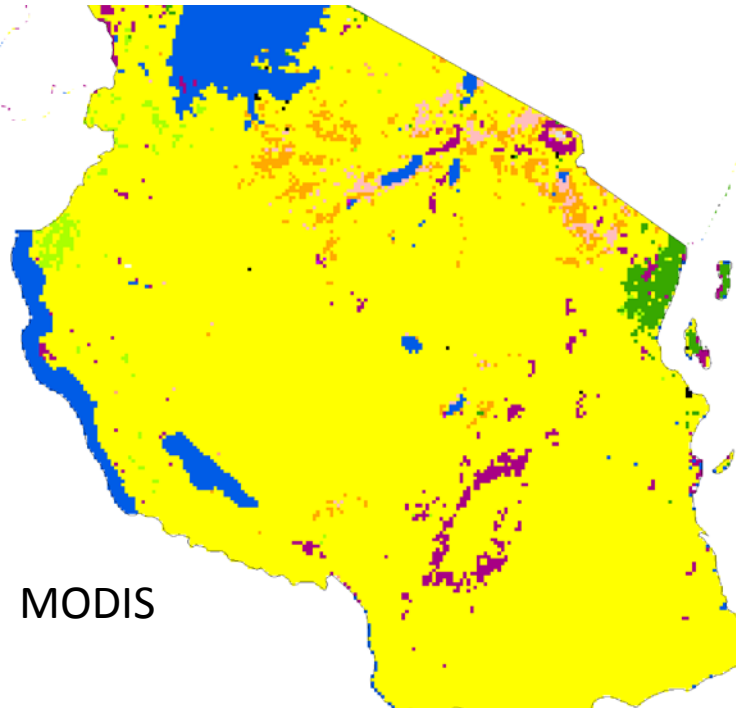
In spite of improving satellite data, there remain huge discrepancies in our understanding of land cover

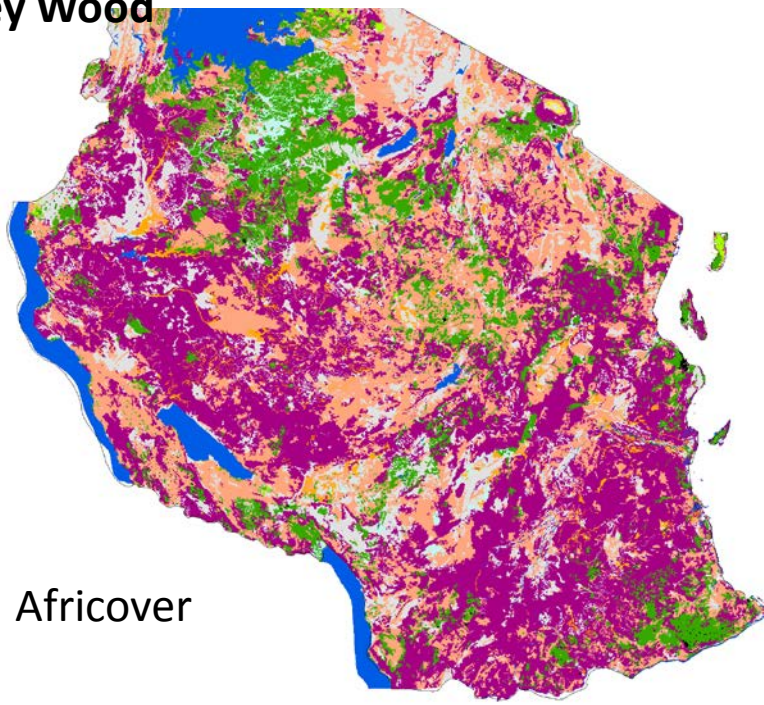
Alternative views of Tanzania

Provided by Stanley Wood









- Crop
- mixed crop
- shrubs
- savannah
- grassland
- forest
- unvegetated/error
- urban
- Water

Our Diagnosis*

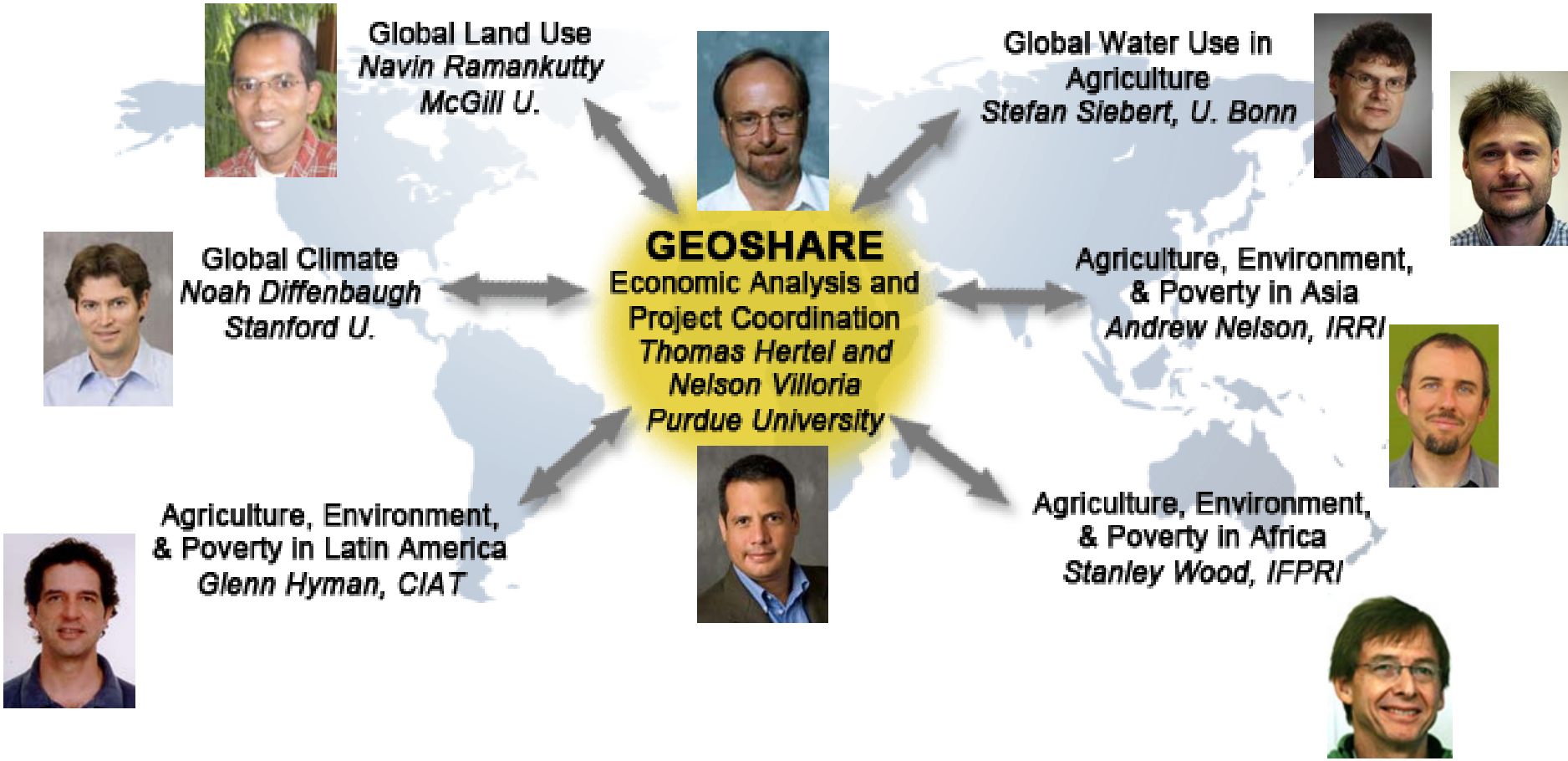
- The data currently available to understand how global and local phenomena affect the agriculture-environment-poverty nexus are insufficient to advance needed discovery and enable effective decision making.

- Most geospatial datasets for agriculture are limited:
  - Regional or national in scope instead of global
  - If global, then mutually incompatible, one-time efforts, lacking inter-operability
  - If they publicly available, specialized knowledge and costly software licenses significantly limit access

- This lack of information has greatly inhibited the ability of scientists, practitioners and policy makers to address the socio-economic and environmental impacts of contemporary policy issues related to poverty reduction and the long run sustainability of the world food system.

* Original proposal sponsored by the UK Foresight Programme. Available at http://www.agecon.purdue.edu/foresight/

GEOSHARE features a scalable structure with regional and global nodes



Purdue IT architecture: Rudi Eigenmann (ECE), Carol Song and Lan Zhao (ITAP), Chris Miller (Library Science).

Data needed to understand tradeoffs between agriculture and the environment

Resources:

- Land (soil)
- Water
- Solar radiation
- Germplasm
- Energy
- Assets
- Population

Economic and institutional factors:

- Land tenure
- Market Access
- Credit Availability

Environmental and socio-economic outcomes:

- Poverty Alleviation
- Landscape protection
- Soil degradation
- Carbon fluxes
- Biodiversity

Agriculture and Forestry sectors

Management:

- Planting/harvest dates
- Irrigation
- Fertilization
- Plant protection
- Labor
- Mechanization

Marketed products:

- Food
- Fiber
- Fuel
- Timber
- Carbon credits

GEOSHARE Objectives

- *Provide a* globally consistent, temporally opportune, and locally relevant *database* for better decision making.
- *Assist decision makers*, policy analysts and researchers seeking to use geospatial data and analysis tools to inform activities relating to agriculture, poverty, land use and the environment.
- *Build capacity* throughout the world in individuals who can effectively bridge disciplines to make decisions and to identify solutions to complex resource use and development problems using geo-spatial data and analysis tools.

Pilot Project begins May 2012

- Funding from three sources:
  - UK Department For International Development: $ 440k
  - UK Department for Environment, Food and Rural Affairs: $ 100 k
  - USDA's Economic Research Service: $100 k
- Proof of concept:
  - two regional case studies to support decision makers in Asia and Africa
  - Integrate regional and global data bases
  - Delivery data and decision tools through HubZero infrastructure
- Donor's forum in early 2014:
  - Demonstrate success of proof of concept from pilot project
  - Secure long term funding for GEOSHARE