



Improved Modeling of Household Food Security Decision Making and Investments Given Climate Change Uncertainty*

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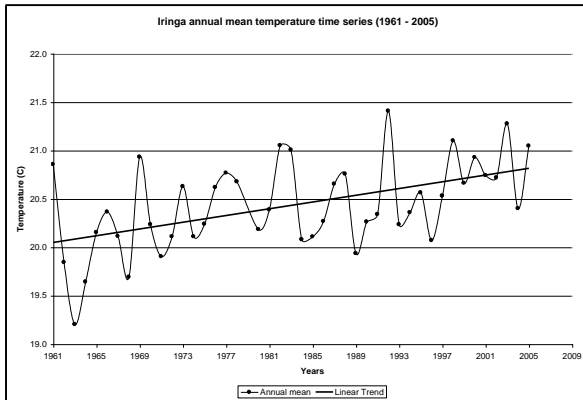
Associate Award Activities

1. Historical analysis of rainfall patterns
2. Analysis of impact of past climate variability and changes on maize yields (using climate-crop models) and on household food security and income, using the multiple-year household data.
3. Projection of future climate scenarios and their impacts on maize yield and output.
4. Farm household models incorporating projected future climate change and maize yield scenarios, to identify impacts on future household production, farm and off-farm incomes, and food security.
5. Use of farmer and key informant focus groups to guide the design and interpretation of (1) and (2), and feedback groups to discuss the outcomes of (3) and (4).
6. Outreach to key stakeholders in the pilot countries and in the U.S.
7. Time frame: Zambia (starting FY 2012); Kenya (starting FY 2013).

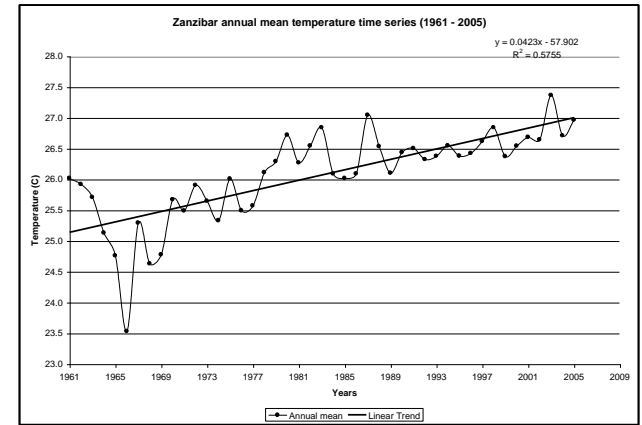
Recent Climate Change with Weather Station Statistics, Remote Sensing Data

Temperature Trends in Tanzania-- + 1.5° C in 25 yrs

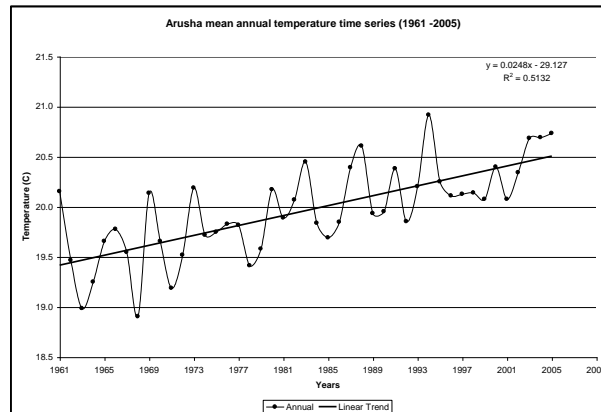
Iringa 1961-2005 (+0.7°C)



Zanzibar 1961-2005 (+1.9°C)

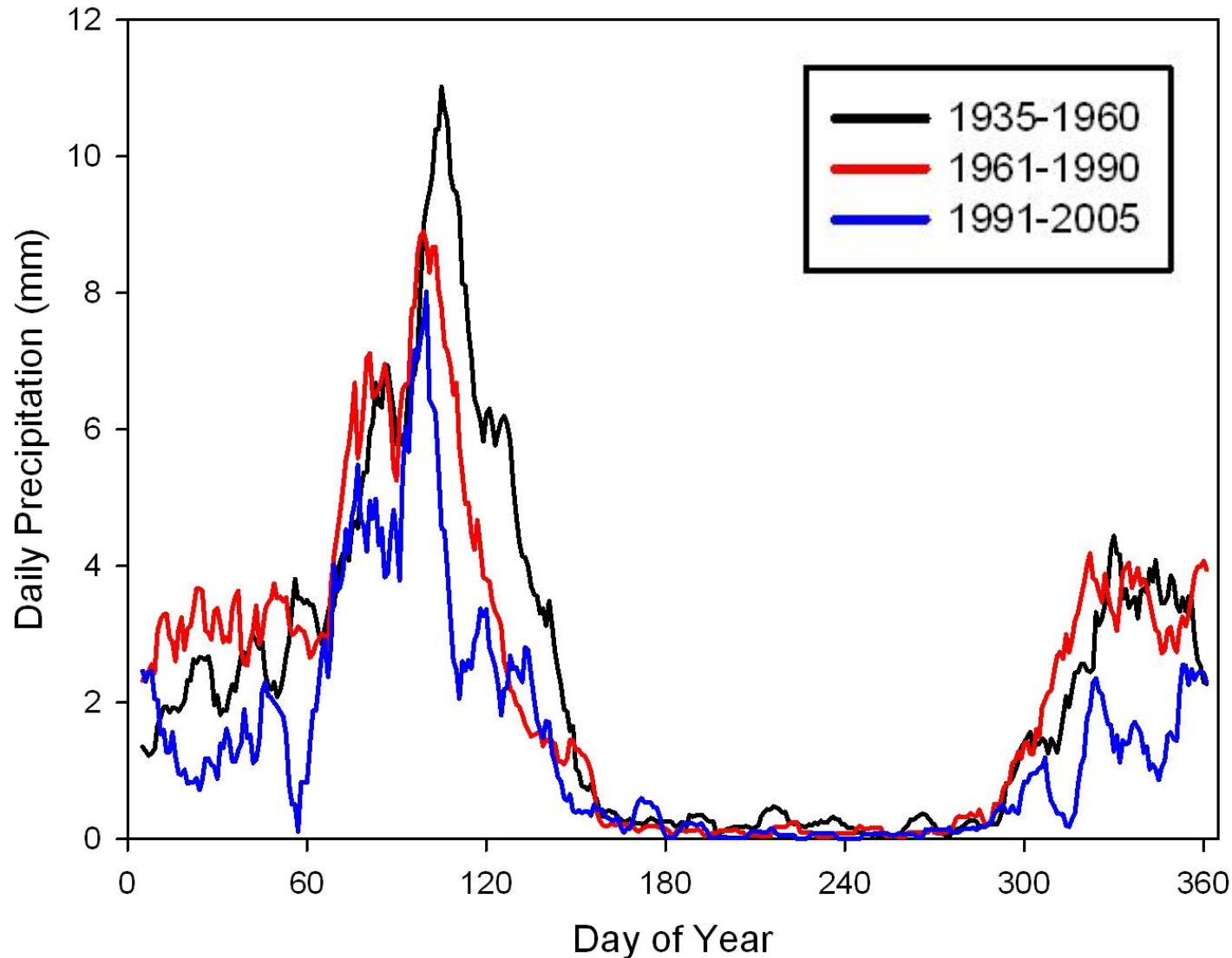


Arusha 1961-2005 (+1.1°C)



Shift in Rainy Seasons:

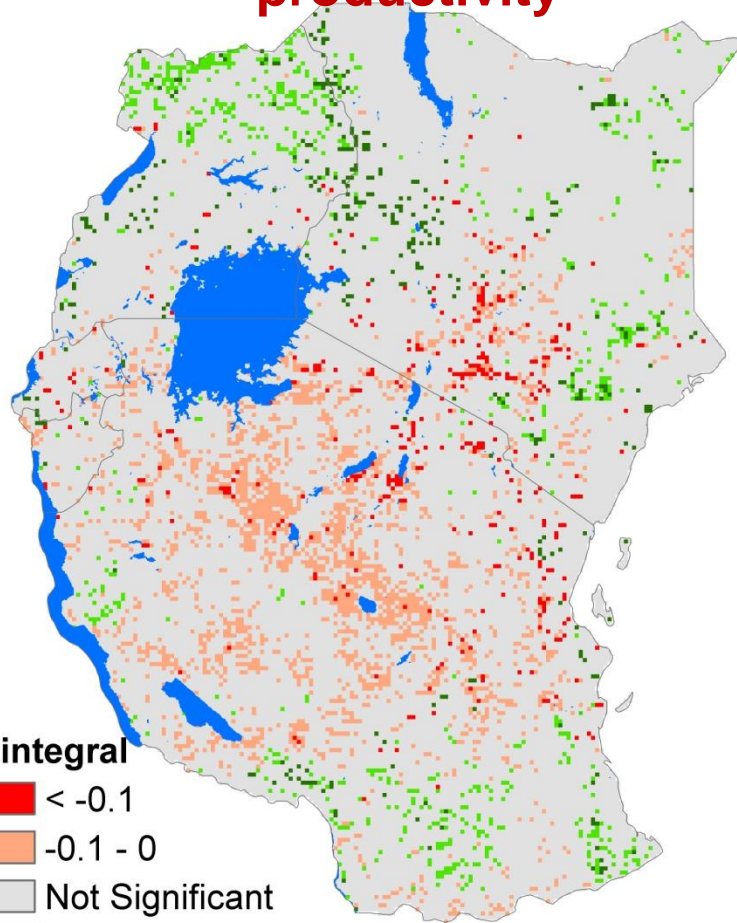
Avg. Daily Precipitation, Monduli, TZ 1935-2005



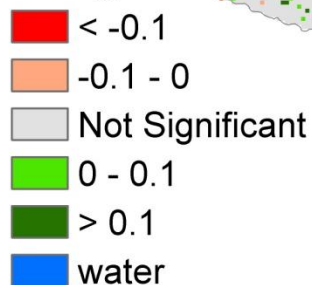
Trend in Vegetative Productivity

1982-2006 (green=increase; red=decline)

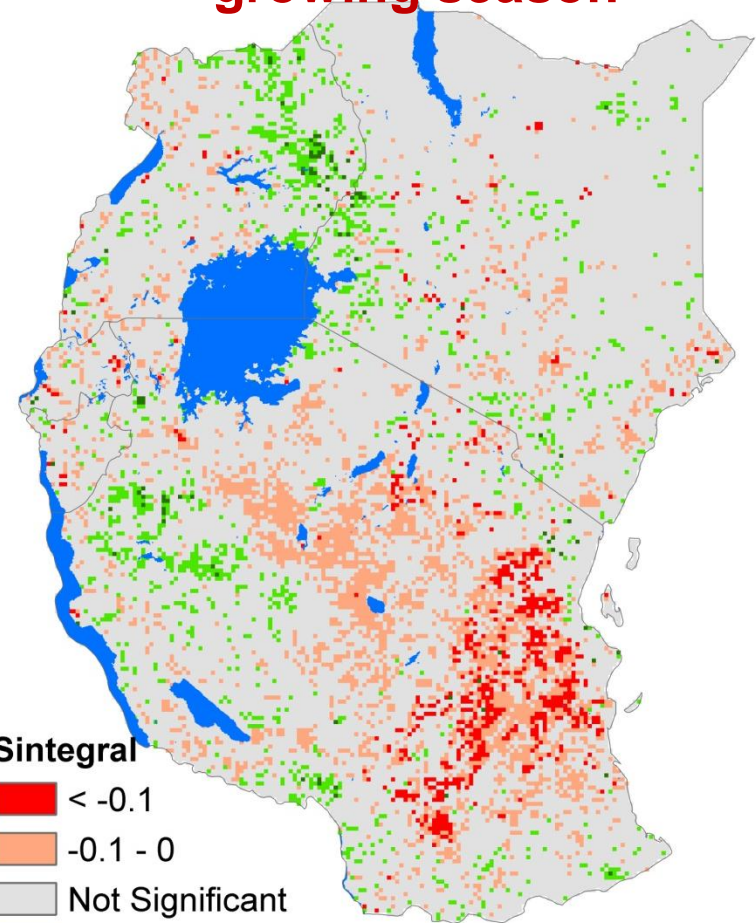
**Change in total
productivity**



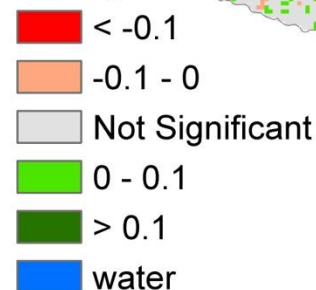
Lintegral



**Change during
growing season**



Sintegral



Analyzed GIMMS NDVI data.
Source: Qin 2011.

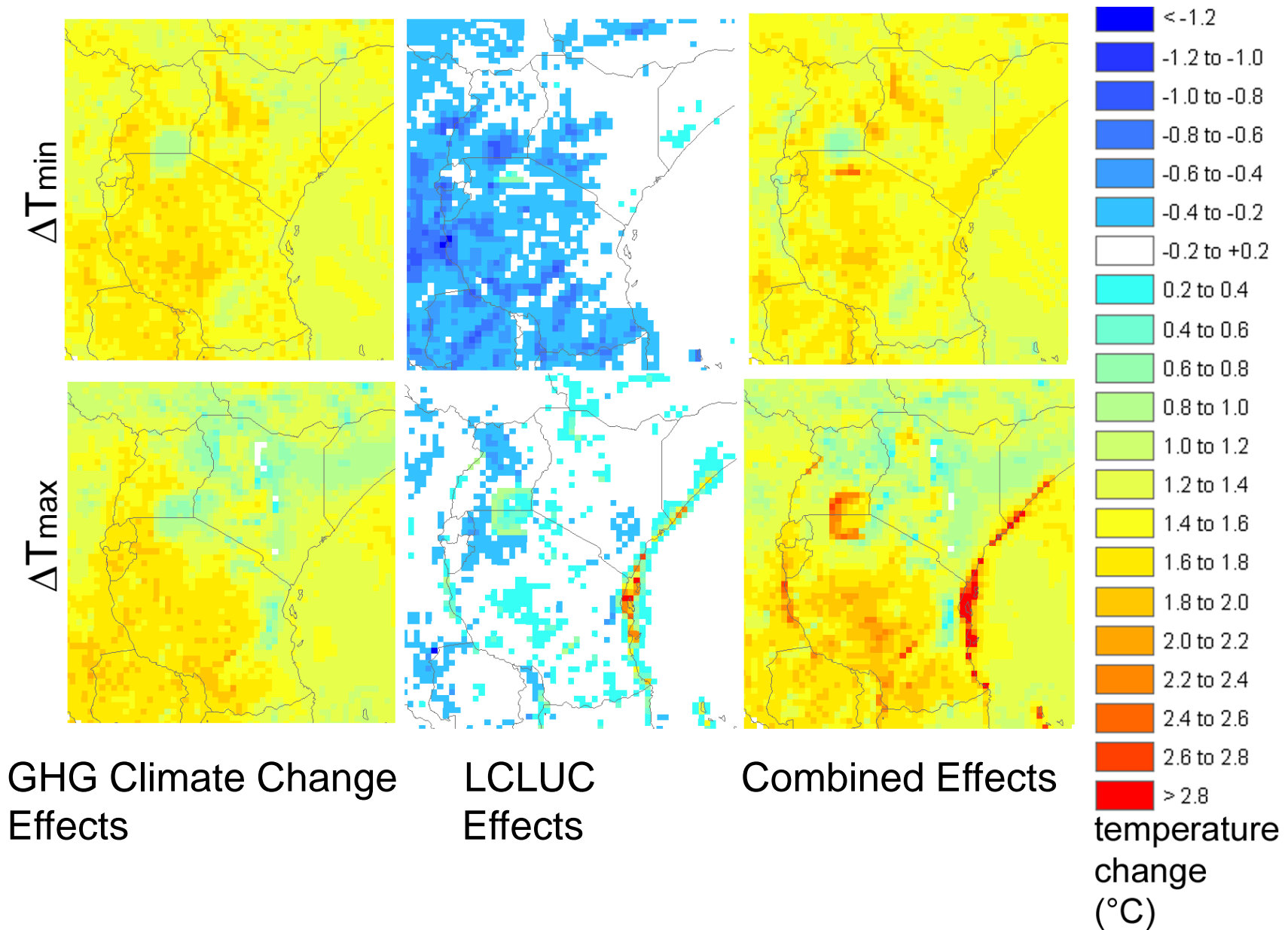
Modeling Future Climate due to

- 1) Global Greenhouse Gas (GHG) Emissions and to
- 2) Regional Land Cover/Use Change (LCLUC)

Modeling Framework

- Climate: 4 downscaled GCMs (6 km) for East Africa and Zambia, and Regional climate model for East Africa
- Crop: DSSAT CERES Maize
- Ecosystem: CENTURY
- Hydrology: SWAT
- Land use: ClipCover, LTM
- Land cover: GIMMS (TimeSat & other models), MODIS, Landsat.

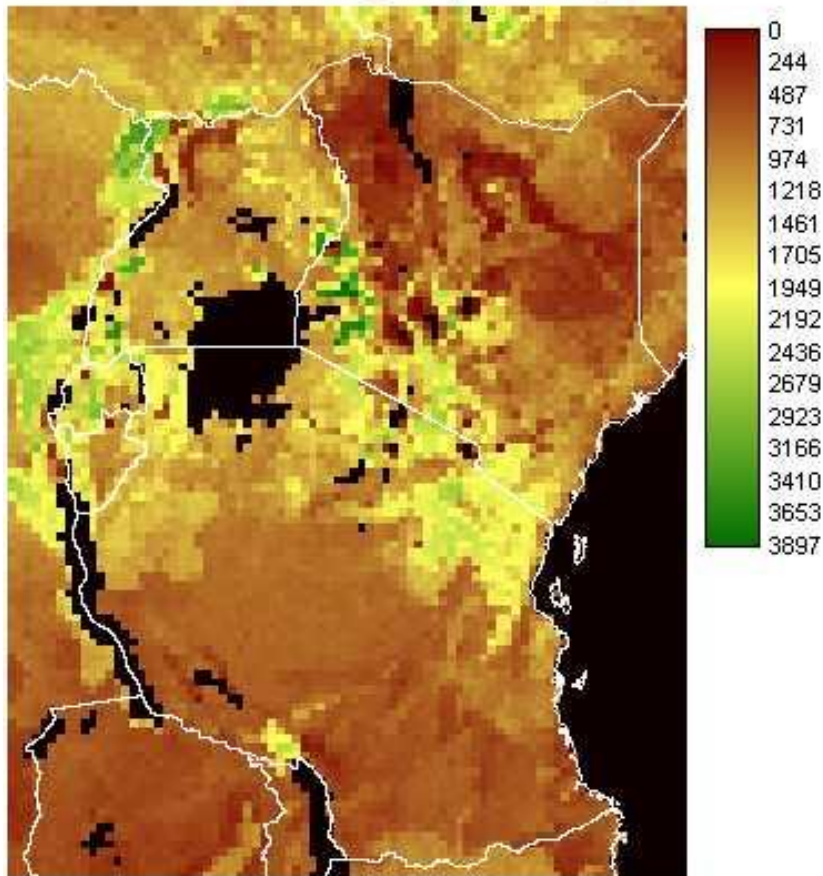
Effects of LCLUC & GHG on Temps



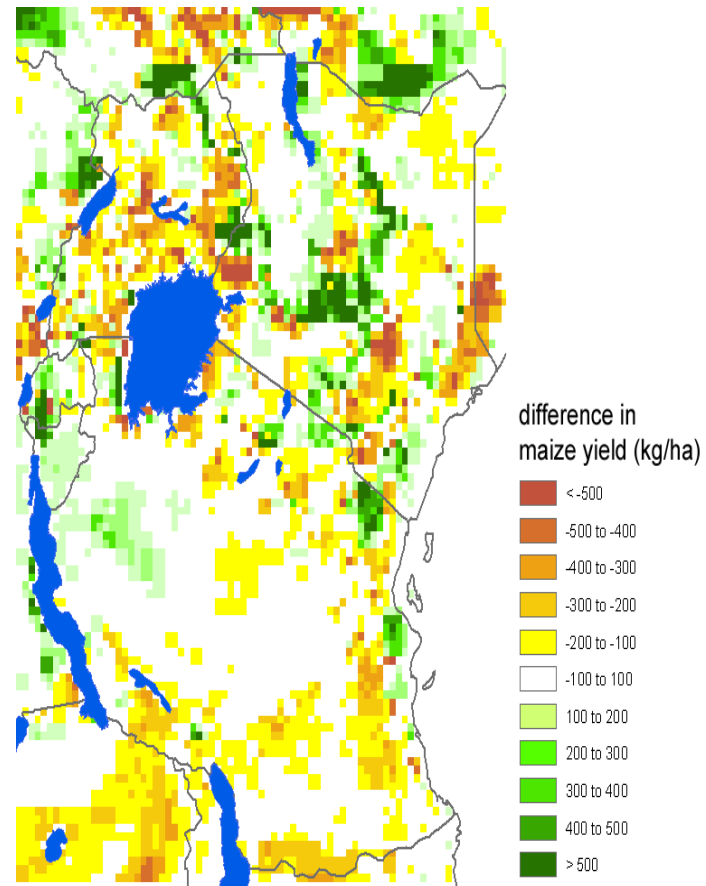
Impacts of Projected Climate on Crop Yields

Maize Yields (kg/ha)

Current



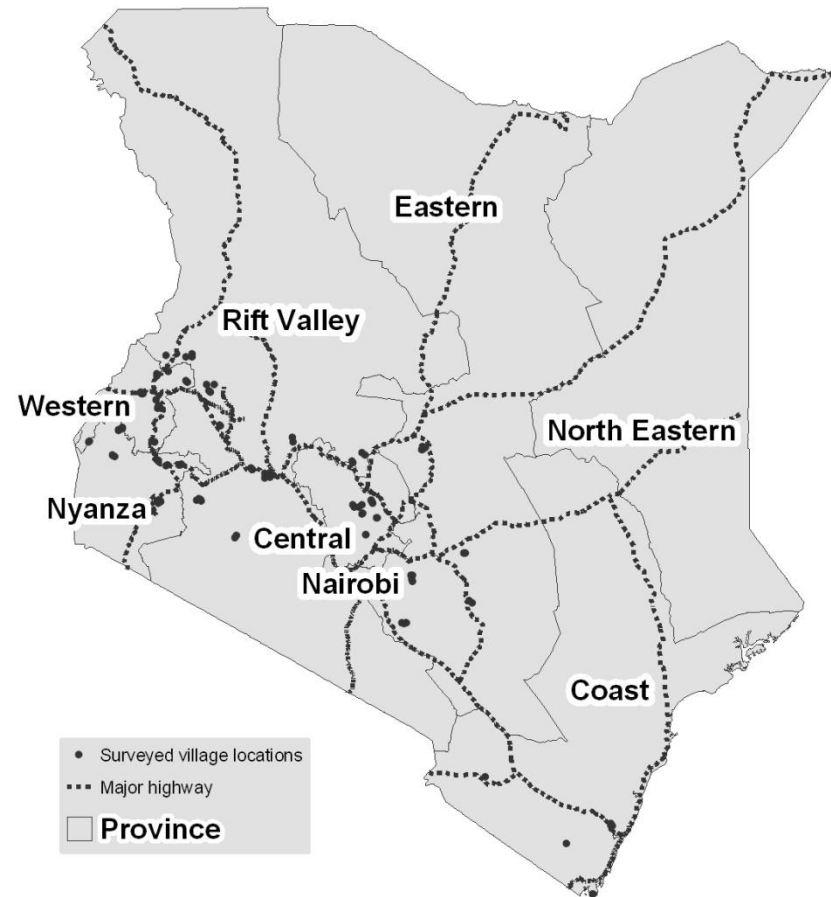
Change 2000-2050



Deterministic process based simulation models (DSSAT CERES); WorldClim, low inputs.

Kenya

- Nationally representative rural household survey; conducted by:
 - Tegemeo Institute, MSU,
Kenya Bureau of Statistics
- 5 waves: 1997, 2000, 2004, 2007, 2010
- 1243 households in all 5 panel waves



Types of data included

- Household demographics; assets
- Land use; land transactions for last 10 years
- Soil, water, environmental conservation practices
- Crop/livestock production; amt + cost of inputs
- Hired and family labor use
- Crop/livestock sales and purchases
- Selected dry food items purchased
- Food security (use of relief food; coping mechanisms)
- Nonfarm activities
- Weather patterns; climate change since 10 years

Adding Economics (1)

- Use household panel data along with high-resolution historical climate data
 - Econometric analysis to estimate relationship between climate variables and:
 - Small farm behavior (crop choice, market participation)
 - Farm household outcomes (levels & variability of yields & income, net calorie availability, other indicators of food security)

Adding Economics (2)

- Use survey data and econometric results to construct farm models to explore responses to projected changes in climate (e.g., length or variability of growing season:
 - LP farm models optimize farm production choices (crop choice, input levels) under defined set of farm constraints and environmental parameters
 - Agent-based models: allow greater diversity of farm type; may not assume optimization
 - Aggregate farm responses give landscape-level responses to climate change scenarios

Adding Economics (3)

- This is a medium/long-term research agenda
 - Econometric work alone may occupy first year
- In principle, would allow for more dynamic and theoretically consistent agricultural responses to climate change scenarios
 - shifting production potentials will drive land use/cover changes and rural resettlement
 - this may in turn feed into climate change modeling
 - will alter spatial location of supply & demand
 - trade responses conditioned by infrastructure & market institutions