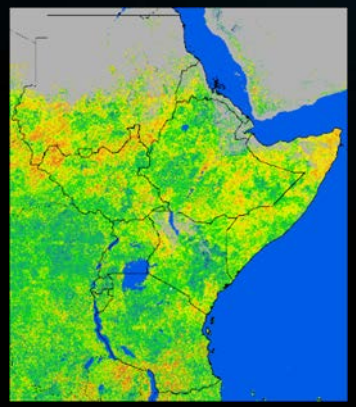
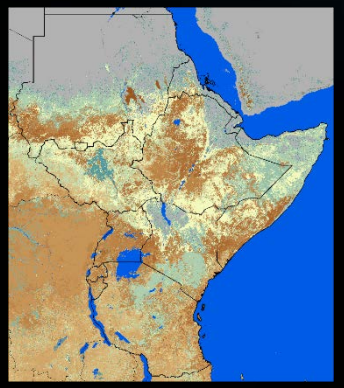
Seasonal Prediction of Hydro-Climatic Extremes in the Greater Horn of Africa (GHA)

NASA GHA Project
Overview and brief progress report



Tsegaye Tadesse
Principal Investigator and Coordinator
Associate Professor
Climatologist and Remote Sensing Expert
National Drought Mitigation Center (NDMC)
University of Nebraska-Lincoln (UNL), USA



Outline

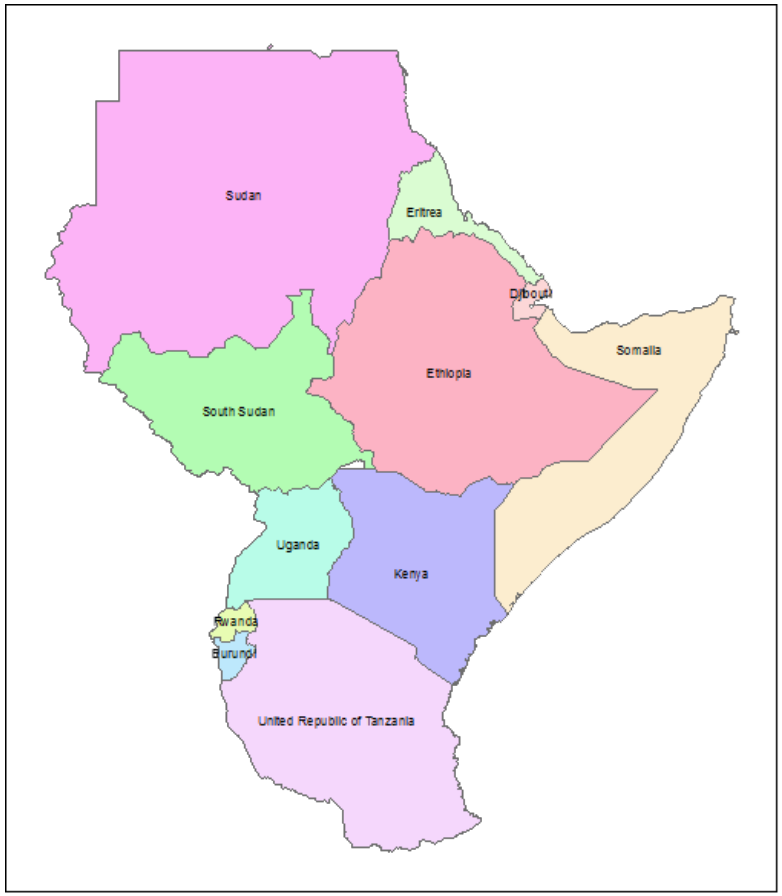
- NASA GHA Project Goal and Objectives
- Brief Progress Report
  - Objective 1
  - Objective 2
  - Objective 3
  - Objective 4
- Highlight the project activities and plan

NASA GHA Project Goal

"To understand and extend the predictive time horizons for extreme drought and flood in the GHA given the challenges of an evolving climate baseline and diverse information needs to support mitigation strategies."

NASA Theme: Understanding Earth system Vulnerabilities to Climate Extremes

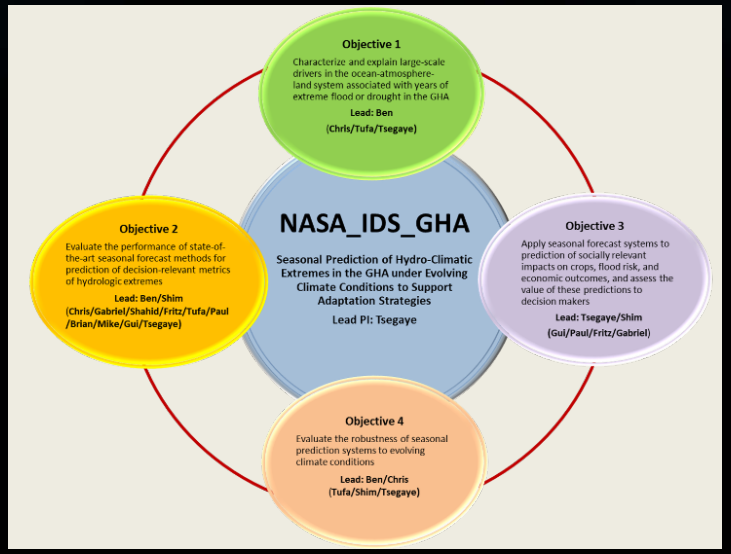
GHA Countries



	GHA Countries
1	Burundi
2	Djibouti
3	Eritrea
4	Ethiopia
5	Kenya
6	Rwanda
7	Somalia
8	South Sudan
9	Sudan
10	Tanzania
11	Uganda

Project Objectives

1. Characterize and explain large-scale drivers in the ocean-atmosphere-land system associated with years of extreme flood or drought in the GHA.
2. Evaluate the performance of state-of-the-art seasonal forecast methods for prediction of decision-relevant metrics of hydrologic extremes.
3. Apply seasonal forecast systems to prediction of socially relevant impacts on crops, flood risk, and economic outcomes, and assess the value of these predictions to decision makers.
4. Evaluate the robustness of seasonal prediction systems to evolving climate conditions.

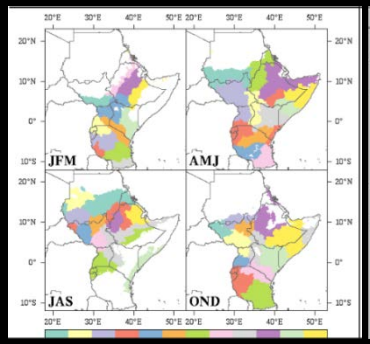


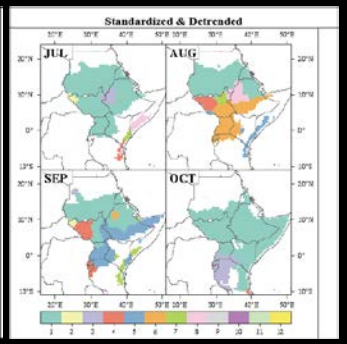
Objective 1

Characterize and explain large-scale drivers in the ocean-atmosphere-land system associated with years of extreme flood or drought in the GHA

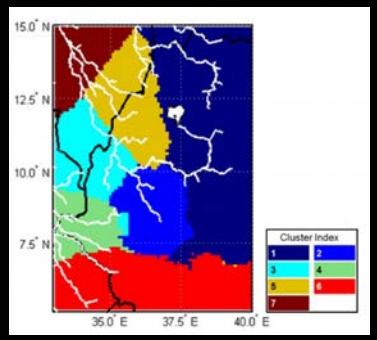
Objective Regionalization

Analysis of Large-scale Drivers





Ben Zaitchik
Hamada Badr



Paul Block
Ying Zhang

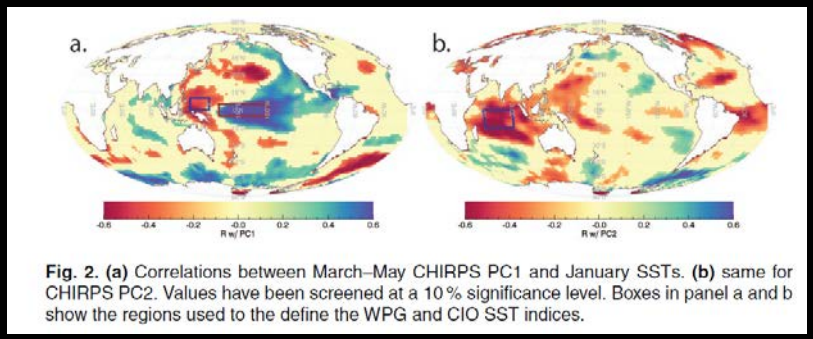


Fig. 2. (a) Correlations between March–May CHIRPS PC1 and January SSTs. (b) same for CHIRPS PC2. Values have been screened at a 10 % significance level. Boxes in panel a and b show the regions used to the define the WPG and CIO SST indices.

Chris Funk
Greg Husak

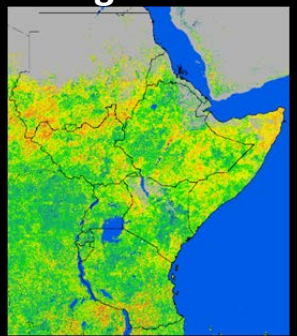
Shrad Shukla
Saleh Satti

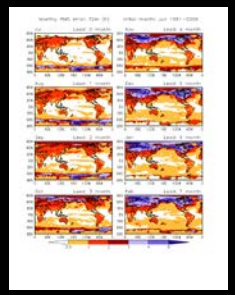
Objective 2

Evaluate the performance of state-of-the-art seasonal forecast methods for prediction of decision-relevant metrics of hydrologic extremes

Participatory System Design and Evaluation

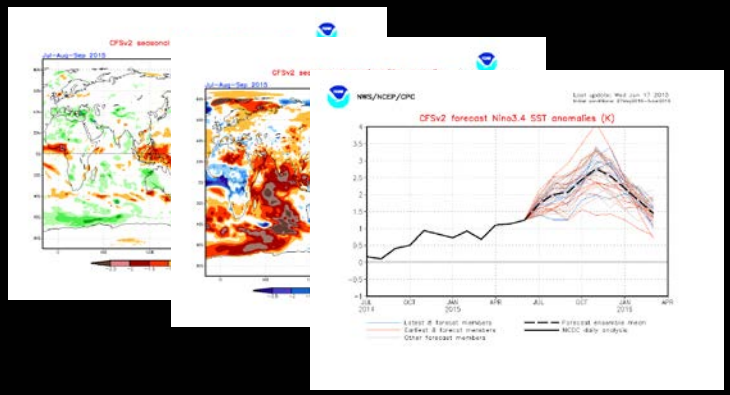
VegOut





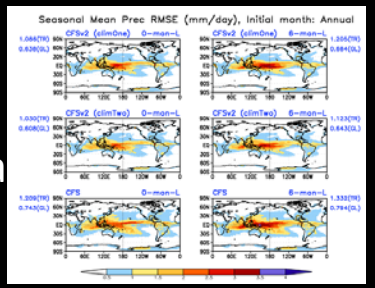
- NOAA Coupled Forecast System (CFS, v2)
- NASA GMAO Experimental Seasonal Forecasts (ESF)
- NDMC VegOut Experimental Forecast Tool
- CFS-Statistical Hybrid
- Statistical Regression
- Machine Learning Algorithms

CFS v2: Jul- Aug –Sep 2015

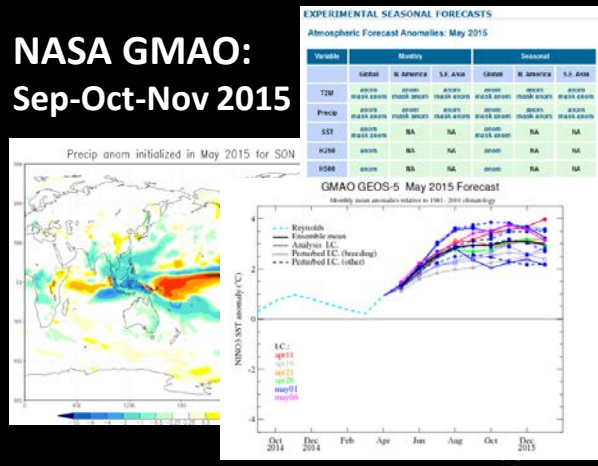


Retrospective Forecast Experiment

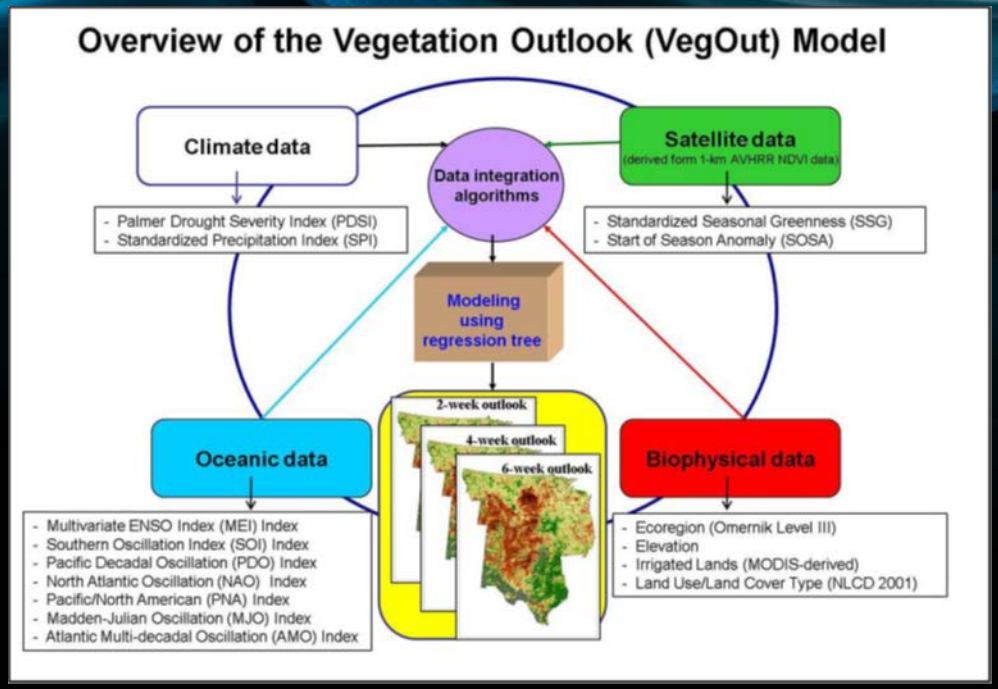
Ben Zaitchik
Chris Funk
Paul Block
Shrad Shukla
Saleh Satti
etc.

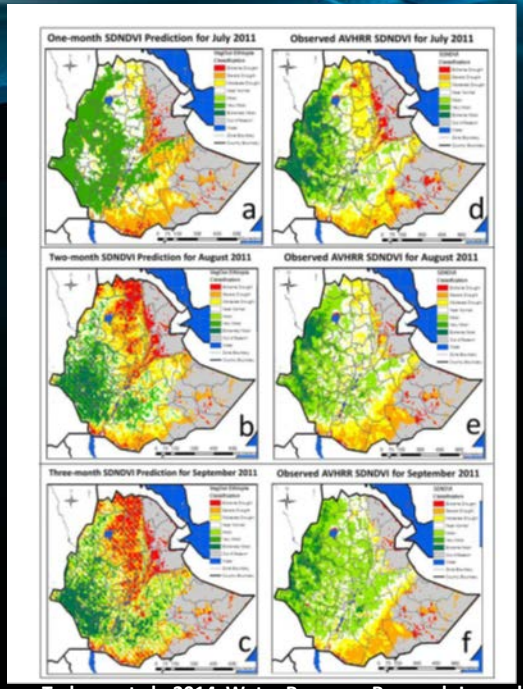


NASA GMAO: Sep-Oct-Nov 2015



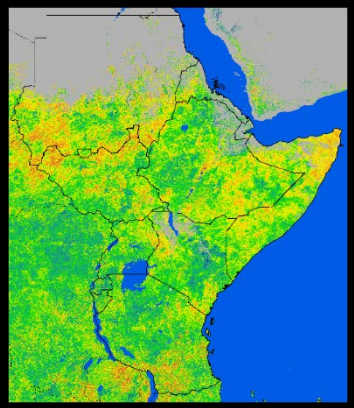
NDMC VegOut Experimental Forecast Tool



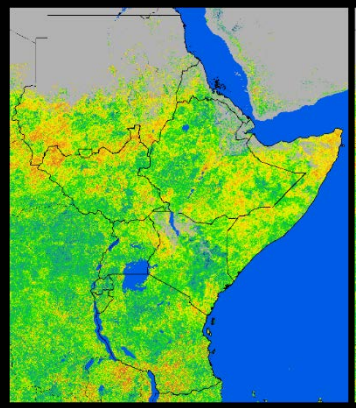


Source: Tadesse et al., 2014. Water Resource Research Journal

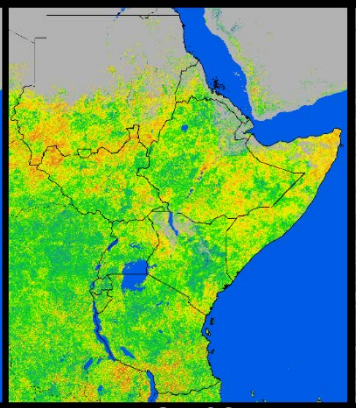
Satellite-based dekadal (10-daily) Standardized Seasonal Greenness (SSG) Outlooks



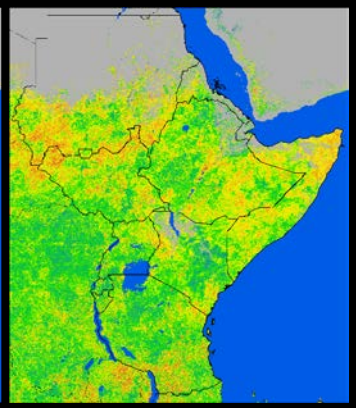
SSG2102
20-31 July 2002



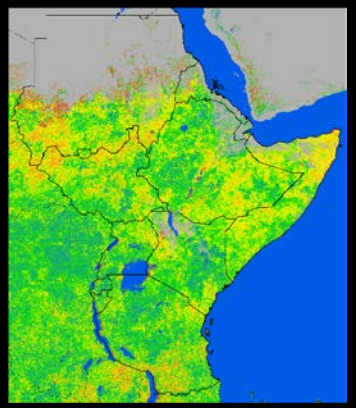
VegOut01
1-10 August 2002
(10-day Outlook)



VegOut06
20-31 September 2002
(2-month Outlook)



VegOut09
20-31 October 2002
(3-month Outlook)



VegOut12
20-31 November 2002
(4-month outlook)

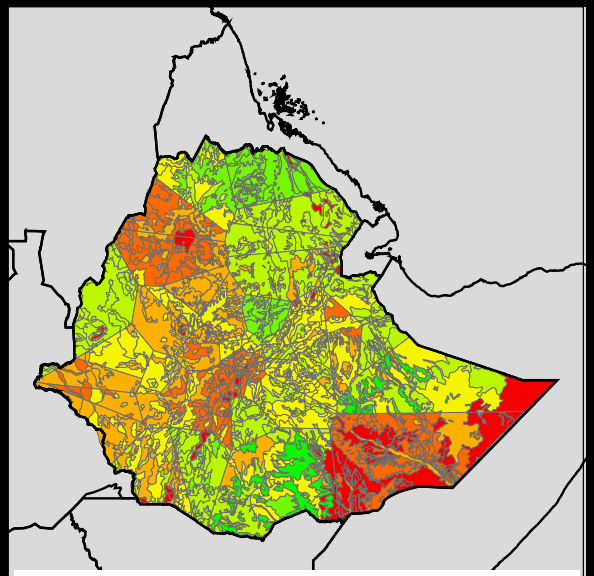
Objective 3

Apply seasonal forecast systems to prediction of socially relevant impacts on crops, flood risk, and economic outcomes, and assess the value of these predictions to decision makers

Impacts Models

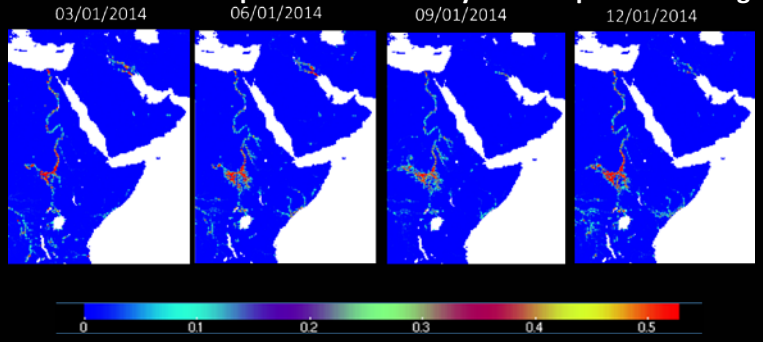
- Crop System Modeling-Decision Support System for Agro-technology Transfer (CSM-DSSAT)
- Land Information System (LIS) Model or Coupled Routing and Excess Storage (CREST)
- Ethiopia Multi-market Model (EMM)
- FEWS NET Food Security Projections

Participatory System Design and Evaluation



CSM-DSSAT: Crop Production 1980-2010
(Credit: Gui Baigorria, UNL)

Flooded Fraction Map in the GHA: LIS-HyMAP output at 0.25 deg



(Credit: Hahn Chul Jung, Augusto Getirana at NASA GSFC & SSAI, UMD)

Objective 4

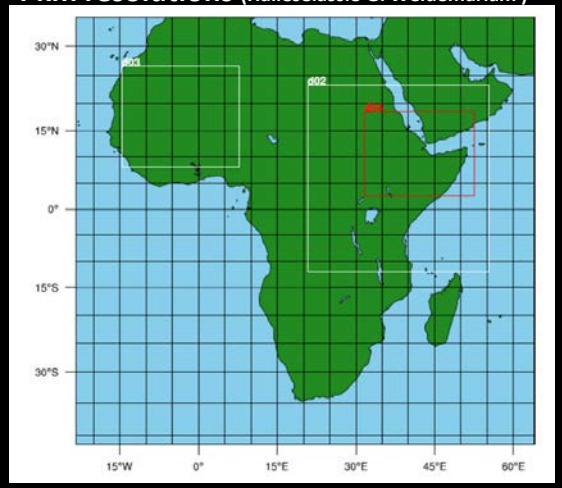
Evaluate the robustness of seasonal prediction systems to evolving climate conditions.

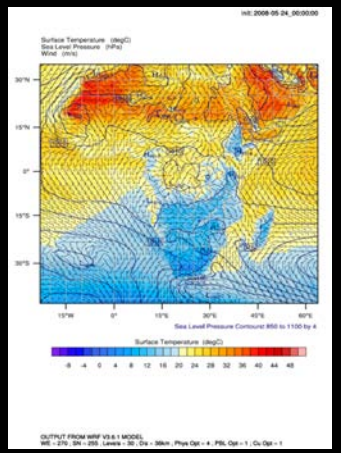
Evolving Climate Conditions

CMIP5 Projections

Stakeholder engagement

Simulations are configured for 36,12, & 4 km resolutions (Haileselassie G. Weldemariam)

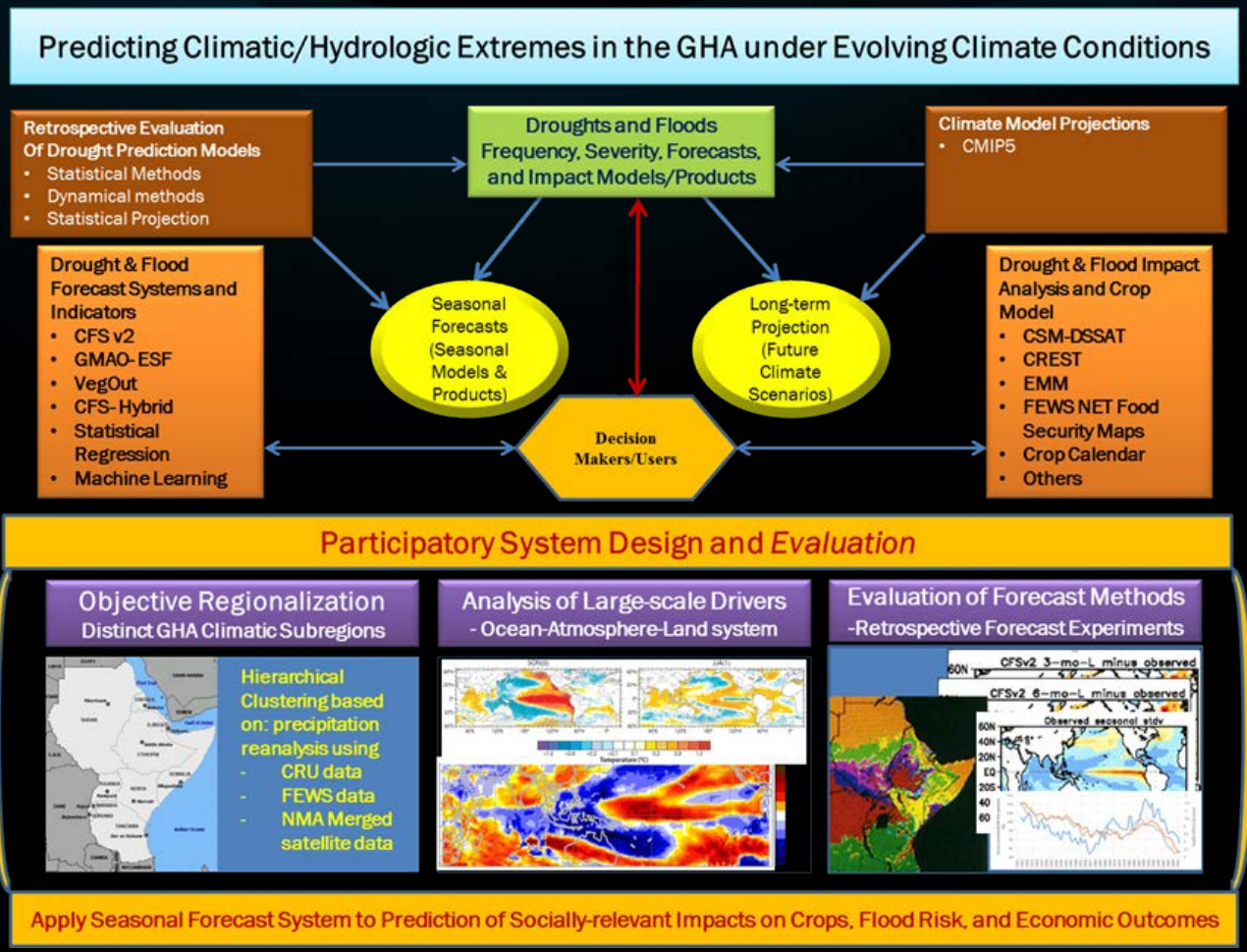




Simulation of 10 years each under RCP4.5 and RCP8.5

- Model verification (2001-2010),
- baseline (2010-2020) and
- change detection(2061-2070)

Schematic diagram of the project



Engagement Methods - Tools for Analysis

Workshops

Webinars

Interviews

Listening Sessions

Surveys

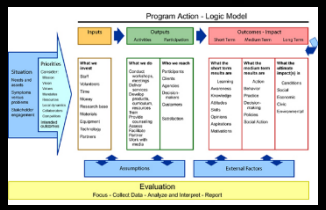
Sticky wall activity at the Lincoln DCV Workshop 2010

Attendees using clickers at the Bastrop, Texas 2009 Drought Tools Workshop.

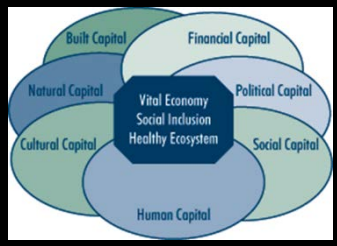
- Qualtrics Survey Software

- Sticky Wall
- Clickers
- Adobe Connect-Webinars

- Small groups (World Café)
- Logic Models
  - Resources-Activities-Outputs-Outcomes(short- & long-term)



- Community Capital Framework Model with Appreciative Inquiry technique



Summary of Project Activities and Plan

Year 1-2 (to present)

1. Perform objective regionalization of the GHA to define climatically coherent regions
2. Build climate, satellite, oceanic, and environmental data that have been used for model development & evaluation
3. Analysis of large-scale drivers and mechanisms of association for extreme wet/dry anomalies
4. Implementation of models to forecast impacts at a seasonal time scale
5. Assessment and evaluation of the existing forecast systems in the region
6. Participatory Research: First "User Interaction-oriented Seminar/Workshop" and a webinar on 19th June 2015.

Year 3

1. Examine case studies on forecast & response of major drought & flood
2. Complete the evaluation of the performance of global/regional seasonal forecast methods
3. Complete assessment and evaluation of the existing forecast systems
4. Apply impacts models relevant to decision makers in forecast mode
5. Examine changes in forecast potential under evolving climate conditions
6. Participatory research: including workshops and webinars.
7. Recommend users information requirements to implement a scientifically robust and responsive EWS to stakeholder information needs

Thank You

For more information

Dr. Tsegaye Tadesse, NDMC, email: ttadesse2@unl.edu

University of Nebraska Lincoln