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

NASA GHA Project Overview and brief progress report

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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**

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

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 define the WPG and CIO SST indices.

Ben Zaitchik
Hamada Badr

Paul Block
Ying Zhang

Chris Funk
Greg Husak

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

- 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

Objective 2

Participatory System Design and Evaluation

Retrospective Forecast Experiment

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etc.

CFS v2: Jul- Aug –Sep 2015

NASA GMAO: Sep-Oct-Nov 2015
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)
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 Agrotechnology 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**
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

Predicting Climatic/Hydrologic Extremes in the GHA under Evolving Climate Conditions

- Retrospective Evaluation of Drought Prediction Models
  - Statistical Methods
  - Dynamical methods
  - Statistical Projection

- Drought & Flood Forecast Systems and Indicators
  - CFS v2
  - GMAO-ESF
  - VegOut
  - CFS-Hybrid
  - Statistical Regression
  - Machine Learning

- Seasonal Forecasts (Models & Products)
- Decision Makers/Users
- Long-term Projection (Future Climate Scenarios)
- Drought & Flood Impact Analysis and Crop Model
  - CSM-DSSAT
  - CREST
  - EMM
  - FEWS NET Food Security Maps
  - Crop Calendar
  - Others

- Drought & Flood Impact Models/Products

Participatory System Design and Evaluation

- Objective Regionalization
  - Distinct GHA Climatic Subregions
  - Hierarchical Clustering based on precipitation reanalysis using: CRU data, FEWS-data, NMA Merged satellite data

- Analysis of Large-scale Drivers
  - Ocean-Atmosphere-Land system

- Evaluation of Forecast Methods
  - Retrospective Forecast Experiments

Apply Seasonal Forecast System to Prediction of Socially-relevant Impacts on Crops, Flood Risk, and Economic Outcomes
Engagement Methods - Tools for Analysis

- Workshops
- Webinars
- Interviews
- Listening Sessions
- Surveys

- 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

**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

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