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

NASA GHA PROJECT OVERVIEW AND BRIEF PROGRESS REPORT

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NASA IDS: Seasonal Prediction of Hydro-Climatic Extremes for the Greater Horn of Africa (GHA)
The Third Participatory Research Workshop and Project Meeting
24th October 2017
Outline

1. NASA GHA Project Goal and Objectives
2. Brief Progress Report
3. Final thoughts: the way forward
NASA GHA Project Goal

“To understand and, where possible, 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**

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<th>GHA Countries</th>
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<tr>
<td>1 Burundi</td>
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<td>2 Djibouti</td>
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<td>3 Eritrea</td>
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<td>10 Tanzania</td>
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<td>11 Uganda</td>
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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

Analysis of Large-scale Drivers

Objective Regionalization

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.
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

- 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

Retrospective Forecast Experiment

- NOAA Coupled Forecast System (CFS, v2): Nov-Dec-Jan 2017/2018
- NASA GMAO: Oct-Nov-Dec 2017

VegOut-GHA

CFS v2: Nov-Dec-Jan 2017/2018
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

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

03/01/2014 06/01/2014 09/01/2014 12/01/2014

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

(Hahn Chul Jung, Augusto Getirana at NASA GSFC & SSAI, UMD)
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 (Halleslassie 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
  - GMAD-ESF
  - YegOut
  - CFS-Hybrid
  - Statistical Regression
  - Machine Learning

- Drought and Floods Frequency, Severity, Forecasts, and Impact Models/Products

- Climate Model Projections
  - CMIP5

- Seasonal Forecasts (Seasonal Models & Products)
- Long-term Projections (Future Climate Scenarios)

- Decision Makers/Users

Participatory System Design and Evaluation

- Objective Regionalization
  - Distinct GHA Climatic Subregions

- 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


Book Chapters (Peer Reviewed) n = 3


Publications Under Review (n = 7)


Professional Conference/Workshop Presentations (> 10)


Publications and Presentations

Profession Journal Publications
1. Bulletin of the American Meteorological Society (3)
2. Remote Sensing (2)
3. Scientific Data (2)
4. Journal of Climate (2)
5. Journal of Applied Meteorology and Climatology
7. Agricultural Water Management
8. Hydrology and Earth System Sciences
9. Hydrological Sciences Journal
10. Journal of Water Resources Planning and Management
11. Journal of Geoinformatics & Geostatistics
12. Water International
14. Climate Dynamics
15. Information
16. Food Security

Books

❖ Several presentations at Professional Meetings, Workshops, & Seminars
Final Thoughts: the Way forward

• We have all these encouraging research outputs:
  (New and improved models, published papers, etc.)
  – Then what?
    • What efforts should be done to implement?
    • What should be the focus or priority?
  – How do we use the new models?
    • National Met/Hydro-services and Regional Centers?
  – How do we pursue our research?
    • International and local experts collaboration
  – How do we get human and financial resources
Thank You

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