Climate research initiatives in Ethiopian Institute of Agricultural Research

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

The First Participatory Research Workshop and Project Meeting
Sheraton Hotel
Aug 11-12, 2014
Research Programs in EIAR

- Crop
- Livestock
- Soil and Water
- Agricultural Mechanization
- Agrometeorology, GIS & Biometrics
- Agricultural economics & Research Extension & Farmer Linkage
- Nutrition and Food Sciences
- Biotechnology
Major climate related research Thematic areas
Improving understanding of climate induced risks

Observed trends and future changes in climate extremes

**Extreme indices**: Climate Variability and Predictability (CLIVAR) Expert Team on Climate Change Detection and Indices (ETCCDI):

- Consecutive dry days
- Consecutive wet days
- Number of very heavy precipitation days
- Precipitation on extremely wet days
- Max 1-day precipitation amount
- Coldest nights
- Warmest nights
- Coldest days
- Warmest days
- Diurnal temperature range
- Warm spell duration indicator
- ............
Assessing Spatio-temporal distribution drought

Standardized Precipitation Index (SPI)

- Frequency of occurrence of drought (1980-2010) for selected severities and their spatial distribution
- Possible changes due to climate change

2 data sources

- SPI derived from observed station rainfall data
- Gridded SPI data (from IRI data library)
Improving understanding of climate induced risks

Variability and trend in selected Intra-seasonal Rainfall Features

- Start of season-Onset
- End of season-Cessation
- Length of Growing Period
- In-season Dryspell,

- Possible changes due to climate change
VALIDATION OF GLOBAL SATELLITE DATASETS FOR USE IN CROP MODELING

• NASA/ POWER DATASETS
  – Rainfall
  – Maximum Temperature
  – Minimum Temperature
  – Solar Radiation

• Performance Evaluation
  – Correlation coefficient, Bias, Mean absolute error, RMSE

• Bias correction
• Archiving
Climate Change Scenarios for impact and adaptation studies

Assessment of GCM Skill over Ethiopia through:

- Climatology of rainfall and temperature
  - Magnitude
  - Seasonal cycle
  - Spatial pattern

- Climatology of Circulation patterns
- Large scale Weather systems: AEJ, TEJ and LLG
Comparison of GCM (CMIP5) based projections

Multi-GCM: 20 CMIP5 GCMs
Multi-RCP: 2.0, 4.5, 6.0 & 8.5
Multi-period: 2030s, 2050’s, 2080’s

Figure 2: Change in annual mean temperature(°C) 2050-2074 Vs 1980-2004

Figure 11: Annual mean temperature (°C) 1980-2100 (RCP8.5)

Figure 6: Change in annual mean rainfall(mm/day) 2045 - 2070 Vs 1980 - 2004 (RCP8.5)

Figure 10: Annual mean rainfall(mm/day) 1980-2100 (RCP8.5)
Climate Change Scenarios for impact and adaptation studies

A need for high resolution projections for impact and adaptation study in agriculture sector

Downscaling

Dynamical

- RegCM (ICTP)

Statistical

- ASD (Multiple Linear Regression)
- Delta Method
Climate Change Scenarios for impact and adaptation studies

Dynamical Downscaling: using RegCM 4.1 of ICTP

- Sensitivity experiments to obtain the most accurate convective schemes (Dry-1997 & wet years-1998)
  - Circulation (TEJ, AEJ, LLJ)
  - RF & T magnitude and spatial pattern

- Simulated Vs observed climatology (CRU and GPCP)

- Generating projection till 2100, analysis and mapping
RegCM is able to fairly reproduce the dominant atmospheric circulation patterns linked to rainfall over Africa.

Temp Climatology during ONDJ: CRU, Emanuel on land and Grell on ocean, Grell on land and Emanuel on ocean, Emanuel and Grell-FC

Rainfall Climatology during JJAS: GPCP, Emanuel on land and Grell on ocean, Grell on land and Emanuel on ocean, Emanuel and Grell-FC
• Downscaled (50km) Future climate change projection of rainfall and temperature generated for the whole country at 50km resolution
  • ECHAM GCM under A1B SRES, up to 2100
Statistical Downscaling

- Automated Statistical Downscaling Model (ASD)
  - A2, A1B emission scenarios
  - Projection data set for PPT and TMAX and TMIN for a network of 170 stations
- Delta Method
  - Selected Sites
  - 20 GCMs
  - All RCPs
CC Impact Assessment: crop production

Crop Model

- Genetic coefficient
- Management
- Soil

Calibration & validation

Change in climate

Crop Model

Kept constant

Assessing Impact

Change in variety, management,..

Identifying and evaluating adaptation options

Apps
- APSIM
- DSSAT

AgMIP
The Agricultural Model Intercomparison and Improvement Project

ICRISAT
Science with a human face
Piloting application of climate forecast and advisories by smallholder farmers

- **NMA**
  - Seasonal Forecast
  - Ten-daily forecast

- **EIAR**
  - Downscaling seasonal forecast
  - Adding advisories to the forecast/multidisciplinary team of experts
  - Training farmers, DAs, Extension experts

- **BoA/DAs**
  - Taking the forecast to farmers and assisting them in the implementation

- **Farmers**
  - Implementation and feedback
Improving farmers’/stakeholders access to tailored climate products

Agro-weather tools for climate smart agriculture

Advisory Generation
- Take seasonal and medium range forecast as input
- Advisory related to: choice of crop & variety, fertilizer, herbicides, irrigation, harvest,…

Communication
- Translation of advisories into local languages farmers can understand

Dissemination
- SMS (short Number)
- Interactive Voice Response
- Smart phone applications
- Website
Dynamical/RCM Based Seasonal forecasting forecasting

- Downscaling NOAA CFS seasonal forecast using RegCM 4.2.
Upcoming initiatives

• Developing/testing systems for drought monitoring and yield estimation: government funded
Thank You