Responding to Climate Variability and Change: A Rapid Prototype For Assessing Impacts of Uncertainty in Climate Observations and Model Projections on Decision Support

By
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Climate Thread #1

Societal Benefit

Decision Topic

What is the impact of climate change (temperature and precipitation) and its uncertainty on the change to agriculture yield in Central America and how will it impact water resource management decisions in that region?

Uncertainty Analysis

Examine the uncertainty at every level (measurements to forecasts) and determine the impact on a specific decision.

Information Products and Services

- Temperature Forecasts
- Precipitation Forecasts
- Decision Support Tools

→ IPCC Scenario Impact Assessments

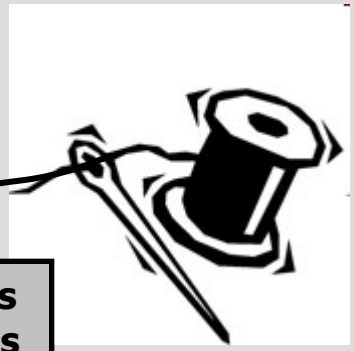
→ SERVIR and DSSAT – Central America and Mexico

Science Knowledge and Models

- Regional Climate Models (RCM) → WRF – Central America
- Global Climate Models (GCM) → NCAR Community Climate System Model (CCSM); NASA GISS Global Climate Model

Measurements

Global Temp and Humidity
Global Precipitation
Soil Moisture
Lake Levels
NDVI



Instruments and Missions

Contributions from MODIS and AVHRR instruments along with TRMM mission (Precipitation Radar instrument).

Relevant GEO Tasks and CEOS Actions*

- CL-09-01 Environmental Information for Decision-making, Risk Management and Adaptation
- WA-06-02 Droughts, Floods, and Water Resource Management
- WA-06-07 Capacity Building for Water Resource Management
  WA-06-07d_3* Space observations and modeling for land hydrology
- WA-08-01 Integrated Products for Water Resource Management and Research
- AG-07-03 Global Agricultural Monitoring
  AG-07-03a_4* Integrate remote sensing into selected models for agricultural mgmt
- AR-09-02 Interoperable Systems for GEOSS
  AR-09-02b_1* AVHRR vegetation data product generation

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Target Decision Support Systems and Central American Partners

- Decision Support System for Agrotechnology Transfer (DSSAT)
- SERVIR, Regional Monitoring and Visualization System for Mesoamerica
- Regional Committee on Hydraulic Resources (CRRH), part of the Central American Integration System (SICA) (Dr. Max Campos and Patricia Ramirez)

GCMs, RCMs, and Integrated Impact Models Utilized

- Global Circulation Models (GCMs)
  - Range of GCMs and emissions scenarios capture uncertainties related to
    - Model / climate sensitivity
    - Societal pathways / greenhouse gas concentrations
- Regional Climate Model (RCM)
  - NCEP WRF simulations at 32km and 3 hourly resolution
    - 1970-2000 base period and 2020-2050 A2 and B1 emissions scenarios
  - NCAR CCSM3.0 GCM and NCEP/DOE Reanalysis-2 (1980-2000) provide boundary conditions for RCM
- Integrated Impact Models
  - Agricultural
    - DSSAT
  - Integrated Water Models
    - WatBal; WEAP

Targeted Satellite and *In-Situ* Datasets and Products for Input

- TRMM / High Resolution Precipitation Products (Precipitation)
- AQUA-AIRS/AMSU/HSB (Temperature)
- AVHRR and MODIS (Vegetation and Moisture)
- On-ground station data, and gridded reanalysis products, for calibration and validation

Uncertainty Analysis

- **Enable risk-informed decision making on water resource management focused on consequences**
- **Empower strategic resource investments that consider uncertainty in the decision making process**
- **Utilize uncertainty analysis methods that are interpretable, approachable, and defendable**
  - **Response surface methodology**
  - **Propagation of errors**
  - **Methods that rigorously and transparently incorporate expert knowledge**

Innovative Methods for Communicating and Displaying Uncertainties for Decision Support

- Isolating the few important factors impacting decision support from the trivial many
- Focused on incorporating all available information and sources rather than subjectively biased selections
- Incorporate insightful graphical communication that enables exploratory analysis of critical factors
- Provide unequivocal answers to decision-makers that clearly communicate uncertainty and risk

Products of this Pilot Thread

- **Link on CEOS SEO website for near-real time, quantitative climate variability and change decision support tool for agricultural and hydrological applications (linked to WGISS climate diagnostics site)**
- **Links on SERVIR, CRRH, and SICA websites for near-real time, quantitative climate variability and change decision support tool for agricultural and hydrological applications**
- **Peer-reviewed report(s) in open literature**

Potential roles of CEOS and GEO in enhancing decision support systems through better understanding of climate observational uncertainties and their impacts

Identification of areas where CEOS could provide more information through:

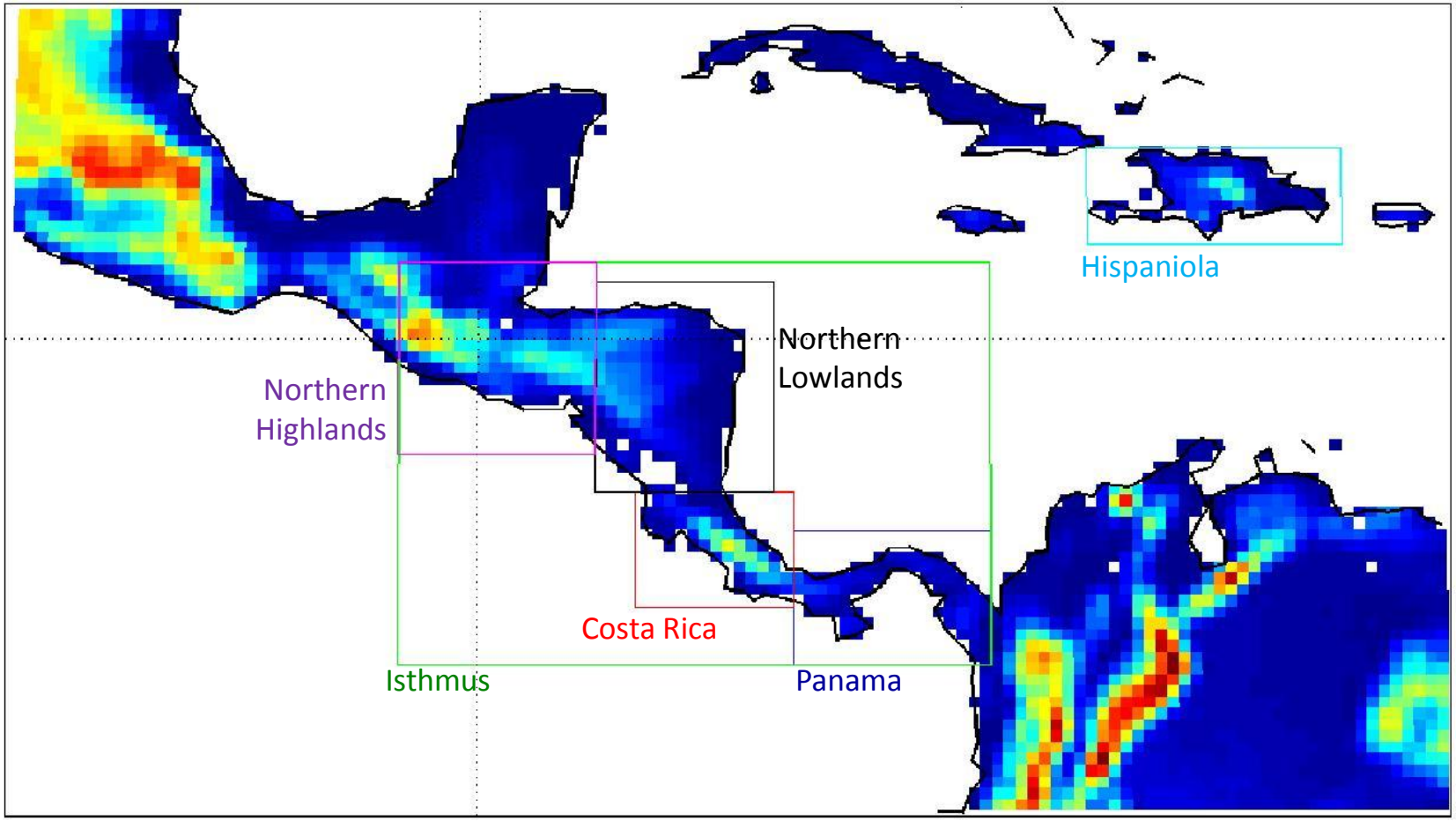
- Development and validation of innovative integrated decision support tools
- Assessment of the success of data policies in terms of ensuring local data input to DSSAT and SERVIR
- Assessment of the needs and opportunities for capacity building in Mesoamerica (e.g., which groups, subject matter, etc)
- Identification of areas where new scientific understanding is needed to improve products, assimilation systems and models, and decision support tools

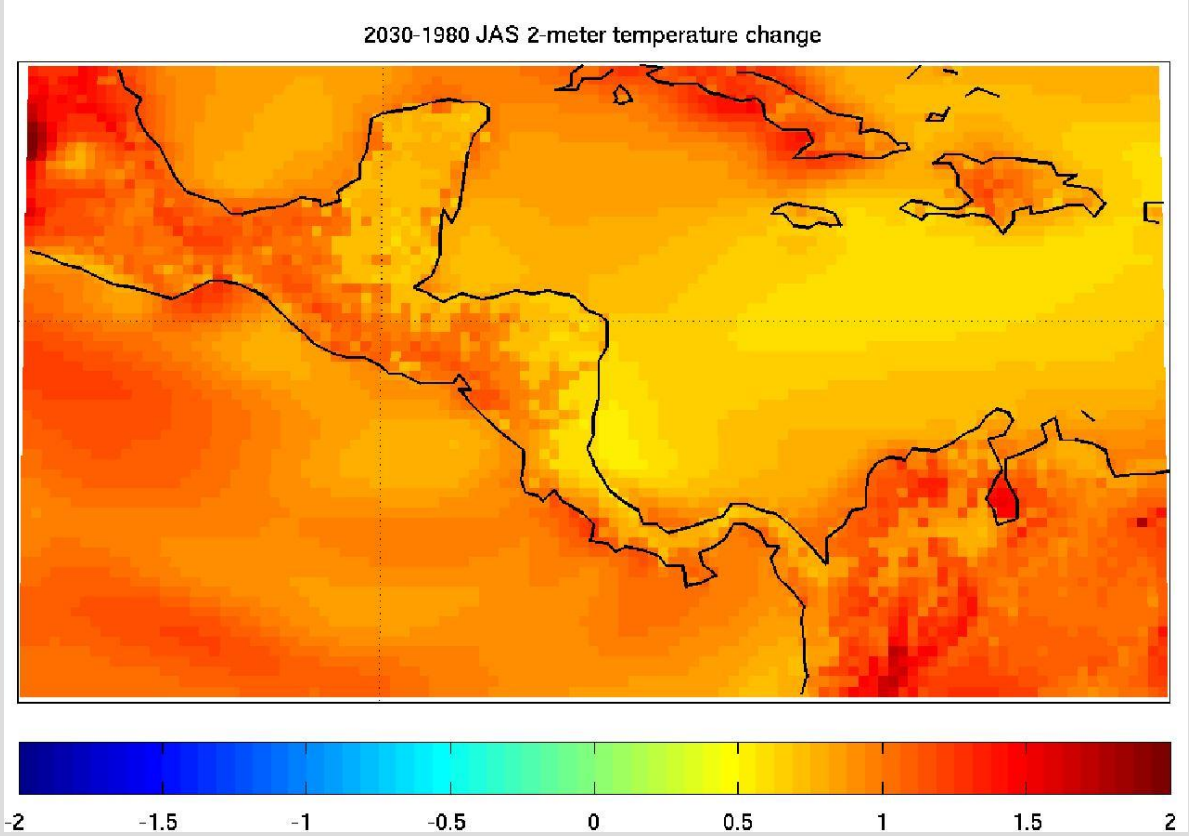
Schedule

- GCM runs with IPCC scenarios for target area, completed
- Regional model (WRF) runs for projecting changes in precipitation and temperature in target area, completed

- Analysis of input dataset uncertainties, underway
- Links to decision support tools (DSSAT and SERVIR), underway
- Analysis of impact of uncertainties in observations and model projections on decision support, May-October, 2009
- Report writing phase October 2009-January 2010

Domain Elevation and Sub-regions





2020-2040 A2 summer scenario minus 1970-1990 20th Century summer simulation

- Mountains warm faster than surrounding lowlands.
- There are large changes across short distances (in Costa Rica, for example) that could not be captured in the coarser CCSM.