VAMOS Modeling and Data Assimilation For Improved Prediction:
A Multi Scale Approach

Extensive Contribution from the VAMOS Modeling Community
The overarching goal of VAMOS modeling is to improve the prediction of warm season precipitation over the Americas, for societal benefit, and to assess the implications of climate change.
VAMOS

• To describe, understand, and simulate the mean and seasonal aspects of the American monsoon systems,
• To simulate American Monsoon System lifecycles, including diurnal cycles and the intraseasonal, interannual and interdecadal interactions with, and influences on, them,
• To investigate American Monsoon System predictability and to make predictions to the extent possible,
• To improve the predictive capability through model development and analysis techniques, and
• To prepare products with a view to meeting societal needs, including studies of the impacts on the American Monsoon Systems of scenarios of climate change.
Sub-programs

- NAME (North American Monsoon Experiment)
- MESA (Monsoon Experiment for South America)
- VOCALS (VAMOS Cloud Atmosphere Land Study)
- IASCLIP (IntraAmericas Study of Climate Processes)
- VAMOS Modeling Integrates Across These Sub-Programs
VAMOS Modeling Plan (Jun 2008)

• VAMOS has adopted a multi-scale approach, which includes monitoring, diagnostic and modeling activities on local, regional, and continental to global scales.

• VAMOS modeling activities maintain a multi-scale approach in which local processes are embedded in, and are fully coupled with, larger-scale dynamics.
VAMOS Modeling Plan (Jun 2008)

- **Modeling Strategy: Multi-Scale Approach**
  - Simulating, Understanding and Predicting the Diurnal Cycle
  - Predicting the Pan-American Monsoon, Onset, Mature and Demise Stages
  - Modeling and Predicting SST Variability in the Pan-American Seas
  - Improving the Prediction of Droughts and Floods

- **Data Assimilation, Analysis and Assessing Observing Systems**

- **Prediction and Global-Scale Linkages**
FMA2006 CMAP Precipitation Anomaly vs. All Model, All Ensemble Average  FMA2006 (Aug2005 and Dec2005 IC) Precipitation Anomaly  (*note color scale change for model images)
FMA2007 CMAP Precipitation Anomaly vs. All Model, All Ensemble Average  FMA2007 (Aug2006 and Dec2006 IC) Precipitation Anomaly (*note color scale change for model images)
FMA2007 NCDC SST Anomaly vs. All Model, All Ensemble Average FMA2007 (Aug2006 and Dec2006 IC) SST Anomaly

NCDC SST Anomaly, FMA2007 Seasonal Average

All Model, All Ensemble Average; August 2006 IC, FMA 2007 Seasonal Average SST Anomaly

All Model, All Ensemble Average; December 2006 IC, FMA 2007 Seasonal Average SST Anomaly
Vera et al. 2006
The number of years, out of 47, when the seasonal precipitation over land from the 21C simulation is less than the fifth lowest from the 20C simulation.

Extreme Seasonal Precipitation: Ranking in 21C relative to 20C

Probability of EXTREME SUMMER DROUGHT increases by 2X – 4X
Surface Current in CCSM4 Simulations
Local SSTA-Latent Heat Flux Correlation

HRC

LRC
Local SSTA-Latent Heat Flux Correlation

HRC

HRC-LRC
Local SSTA-Latent Heat Flux Correlation

HRC

OBS
Surface Current in CCSM4 Simulations

LRC

HRC
CCSM3.0 model forecasts: Anomalies for MAM2011 (RSMAS, University of Miami)

This is a coupled ocean-atmosphere forecast from CCSM3.0 initialized in January 2011. There are 4 ensemble members. The climatology is based on similar seasonal hindcasts for the period from 1981-1998. The contours show one standard deviation of the ensemble spread while the shaded values are the ensemble mean. There are 6 ensemble members.
Climate Prediction: Living With Uncertainty

IRI Multi-Model Probability Forecast for Precipitation for July-August-September 2011, Issued June 2011


Rainfall Prediction for JAS 2011

Temperature Prediction for JAS 2011
VAMOS Modeling (Jun 2012)

• Taking Credit For Successes
  – Model Improvements
  – Improved Understanding (process studies and field campaigns),
  – Improved Predictions,
  – Quantified Predictability

• Contributions to Coordinated Activities
  – IPCC, WGSIP, VAMOS, CHFP, CMIP5, VOCALS, IASCLIP, NAME, MESA, LPB, CLARIS, CORDEX …

• How To Coordinate Ongoing Activities into a Coherent Narrative?

• Enabling/Facilitating Collaborative Science?
  – Exchange of Ideas

• Future of VAMOS Modeling?