Variability of the American Monsoon Systems (VAMOS)

A WCRP/CLIVAR Program focused on the Climate of the Americas
VAMOS Overall Goals

• To better understand the American monsoons in the context of the global climate system.

• To improve capacity for seasonal to interannual climate predictions.

• To assess the implications of anthropogenic climate change for the Americas.
Strategy

• **To identify** climate phenomena that are scientifically important and have demonstrated potential for predictable components.

• **To encourage** partnerships between scientists in interested countries, and to **help in the development of research programs** to be sponsored by national and international agencies.

• **To promote** broad participation in field programs, both to bring local expertise to an international setting and to enhance scientific exchange and the building of scientific and technical infrastructure.
VAMOS Implementation Plan

>> (2001) <<

“VAMOS implementation is based on two internationally coordinated monsoon experiments: MESA in South America and NAME in North America.”

Their objectives are:

• A better understanding of monsoon components and their variability.
• A better understanding of the role of monsoons in the global water cycle.
• Improved simulation and monthly-to-seasonal prediction of the monsoon and regional water resources.
• Improved observational datasets.

[~2004: the unified monsoon]
The term "monsoon system" encompasses not only the summer monsoon rainfall in the tropical Americas, but also the perturbations in the planetary, synoptic and mesoscale flow patterns that occur in association with it, including those in the winter hemisphere.

The region of interest covers both the tropical and the extratropical Americas and surrounding oceans.
VAMOS (2008)

Four Complementary Science Programs

- North American Monsoon System (NAME)
- Monsoon Experiment for South America (MESA)
- VAMOS Ocean Cloud Atmosphere Land Study (VOCALS)
- Inter-Americas Study of Climate Processes (IASCLIP)

Links

NAME - IASCLIP through Tier 3
IASCLIP-VOCALS boreal summer circulation
MESA-IASCLIP boreal winter circulation
VAMOS (2008)

“Improved Understanding, Model Simulations and Predictions using a Multi-Scale Approach”
(more focus on process studies)

Cross-cuts:
- Modeling
- Extremes
- Anthropogenic Climate Change

-La Plata Basin (CLIVAR-GEWEX)
The Modeling Plan from

CLIVAR's
Variability of the American Monsoons System Panel (VAMOS)
Objectives

The VAMOS modeling plan seeks improvements to how we model the interactions between the local processes and regional and larger scale variability in regional and global models.

Model development efforts must take on a multi-scale approach that integrates across all of the science programs in VAMOS and, on the global scale, link with the wider modeling initiatives in CLIVAR and WCRP.
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.

The VAMOS modeling objectives are

1. to describe, understand, and simulate the mean and seasonal aspects of the American monsoon systems

2. to simulate American Monsoon System lifecycles, including their interactions with diurnal cycles and the intraseasonal, interannual and interdecadal variability
Cont.

3. to investigate the American Monsoon System predictability and to make predictions to the extent possible

4. to improve the predictive capability through model development and analysis techniques

5. to prepare products with a view to meeting societal needs, including scenarios of climate change of the American Monsoon Systems.
1. Introduction


3. Representation of monsoon processes for improving prediction

   A) Simulating, Understanding and Predicting the Diurnal Cycle
   B) Predicting the Pan-American Monsoon Onset, Mature and Demise Stages
   C) Modeling and Predicting SST Variability in the Pan-American Seas
   D) Improving the Prediction of Droughts and Floods

4. Data assimilation, Analysis and Assessing Observing Systems

5. Prediction and Global-scale Linkages
Basic “universal” problems relevant to American Monsoons

- Poor simulation of warm season continental climates
- Poor simulation of diurnal cycle (related to above)
  - Low Level Jets
  - PBL Processes, Stratus Clouds
  - Mixed Layer
- Poor predictions of warm season precipitation

Resolution issues

- Need to resolve key phenomena
- Application specific (e.g. regional impacts, extreme events)
- Computational issues: need for long runs, large ensembles
Physics issues

- Limitations of convection parameterizations, but intimately linked to surface interactions, atmospheric boundary layer, clouds, etc.

- Schemes largely untested at high resolution

Prediction issues

- Role of SSTs (especially other than ENSO)

- Role of land surface feedbacks (strength, time scales)

- Role of intraseasonal variability (e.g. MJO)

- Seasonal and Decadal differences in predictability

- Current Level of Quality
In summary

Science Themes

• Diurnal Cycle of Precipitation and Clouds
• Monsoon Onset, Mature State, and Demise
• SST Variability in the Pan-American Seas
• Improving the Prediction of Droughts and Floods

(i) Metrics and Assessing Prediction;
(ii) Numerical Experiments, Data Assimilation, Analysis, Model Improvements.

Extremes in CLIVAR’s Variability of the American Monsoons System Panel (VAMOS)

- Links to USCLIVAR drought studies
- The case of the La Plata Basin
In preparing the working document, the VAMOS Extremes Task Force considered

(1) issues that were coherent across VAMOS program areas,
(2) aspects of extremes that could be somewhat unique to VAMOS, and
(3) how to capitalize on existing and on-going efforts within the climate community (e.g., USCLIVAR; CEOP).

Based on this we believe that our definitions of extremes should be cast in terms of seasonal to intra-seasonal departures from climate normals, even if the dynamical understanding of specific types of extreme events requires examination at shorter timescales, such as analyzing the underlying synoptic meteorology.
Report from the VAMOS Extremes Task Force

VAMOS is in a unique position to utilize its continental perspective in linking extremes in warm season climate behavior to the circulation structures defined as the monsoon systems.

Such a perspective would constitute a multi-scale approach to understanding the subtle interplay of processes occurring at different space and time scales within monsoon systems, such as terrain heating, vegetation-atmosphere coupling, land-sea breezes, regional moisture flux patterns, synoptic disturbances and teleconnections.
Social impact of extremes: seeking to quantify the cost of specific extreme events (human lives, infrastructure damages, animal and vegetation damages, biodiversity, ...).

• The NCDC routinely documents the Risk and cost for the United States. They call Billion Dollar events: http://www.ncdc.noaa.gov oa/reports/billionz.html. They list events for each year and give the dollar amounts for the damage.

• Similarly, severe disasters at the national level are catalogued and quantified in various ways by the Emergency Events Database (EM-DAT, http://www.emdat.be/).
Thanks!