The Modeling Plan from CLIVAR's

Variability of the American Monsoons System Panel (VAMOS)

WCRP
World Climate Research Programme

CLIVAR
Climate Variability & Predictability
World Climate Research Programme

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 program works:

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 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.

Variability of the American Monsoon Systems (VAMOS)

The annual cycle of convection over the Americas

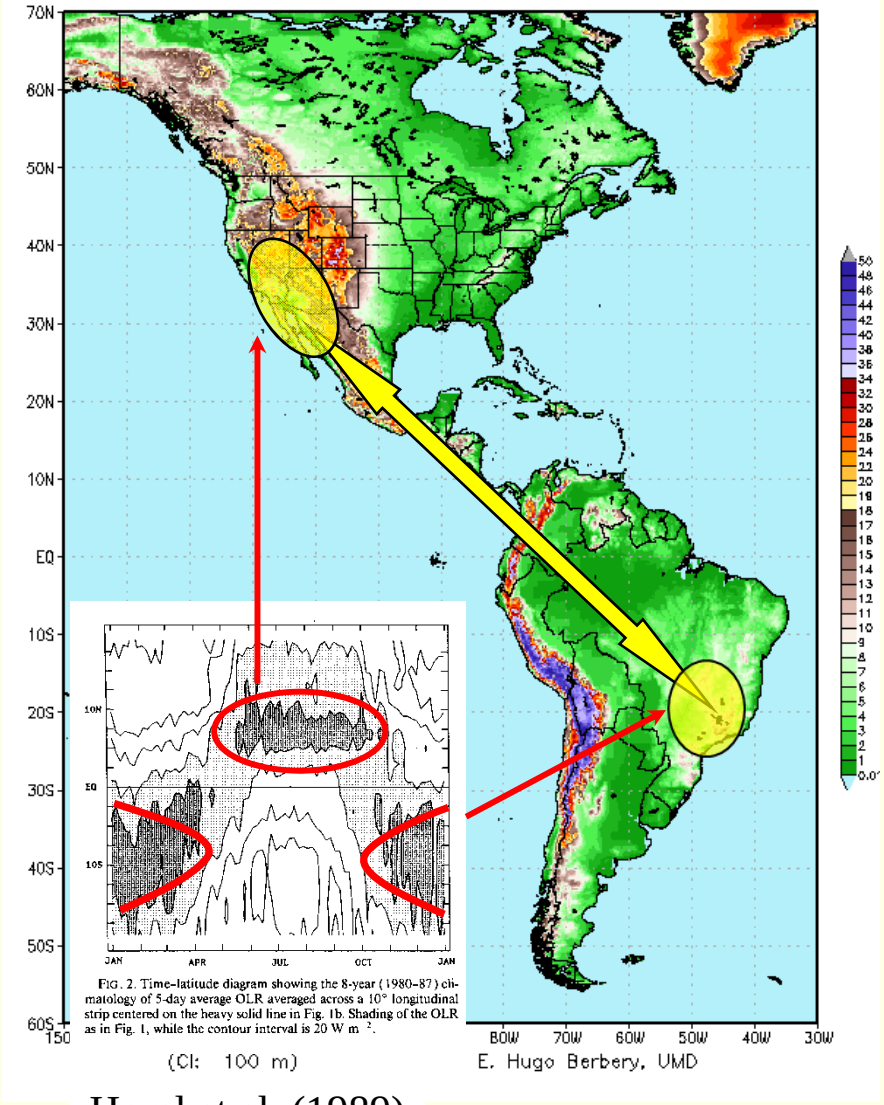
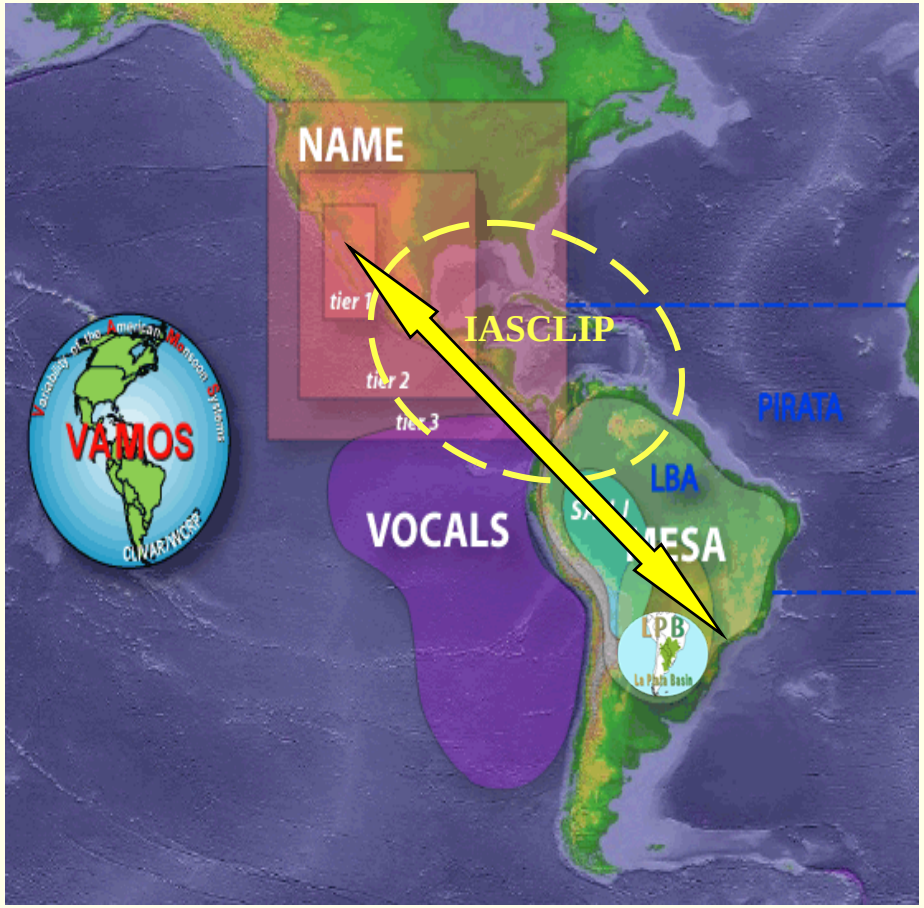


FIG. 2. Time–latitude diagram showing the 8-year (1980–87) climatology of 5-day average OLR averaged across a 10° longitudinal strip centered on the heavy solid line in Fig. 1b. Shading of the OLR as in Fig. 1, while the contour interval is 20 W m $^{-2}$.

Horel et al. (1989)



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VAMOS: 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**)

"Improved Understanding, Model Simulations and Predictions using a Multi-Scale Approach"

Cross-cuts:

- Modeling
- Extremes
- ACC

VAMOS modeling plan

1. Introduction

2. Modeling Strategy: A Multi-Scale Approach

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

Monsoon System

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.

In addition, the region of interest covers both the tropical and the extratropical Americas and surrounding oceans

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.

Modeling and observations

The VAMOS modeling strategy recognizes **three distinct, but related roles that observations play in model development and assessment**. These are

(1) to guide model development by providing constraints on model simulations at the process level (e.g. convection, land/atmosphere and ocean/atmosphere interactions);

(2) to help assess the veracity of model simulations of the various key Pan-American phenomena (e.g. low level jets, land/sea breezes, tropical storms), and the linkages to regional and larger-scale climate variability; and

(3) to provide initial and boundary conditions, and verification data for model predictions.

(Note: Research plans related to improving the basic diagnostic understanding of VAMOS programs are contained within their respective program science plans.)

Approach

- Assessment of Models (Integration NAME-MESA-VOCALS-IASCLIP)

- Requires Participation/Collaboration from both Research Groups and Operational Centers

- WGSIP (SMIP2;DEMETER);TFSP (APCC, ENSEMBLES, CTB)

- Hypothesis Driven Numerical Experimentation
- "Climate Process Team" Model
- Development/Improvement Strategies

- Need Integration between Field Activities, Data Assimilation, Research Modeling and Operational Forecasting

- Generating the "Pull" for Seasonal Prediction Products (WGSIP-TFSP)

Modeling issues

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

Modeling issues (cont.)

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

Interactions with other WCRP groups

The VAMOS modeling community will engage in regional analysis of key WCRP/CLIVAR datasets as they emerge. There are/will be three basic archives:

1. The existing WCRP dataset of climate scenario runs for IPCC AR4 (and eventually one for any AR5;

2. The upcoming runs to examine the hypothesis that "**there is still untapped predictability in the various elements of the climate system**" initiated by the TFSP and handed, with the closure of TFSP, to WGSIP to manage. This is now known as the Climate-system Historical Forecast Project.

3. Decadal timescale runs (out to 2030) now being formulated by WGSIP/WGCM.

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

Cross-Cuts

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

In summary (cont.)

It should be emphasized that to be successful, VAMOS modeling activities must maintain a multi-scale approach in which local processes are embedded in, and are fully coupled with, larger-scale dynamics.

http://www.clivar.org/organization/vamos/Publications/Vamos_Modeling_Plan_Jun08.pdf