MONSOON EXPERIMENT IN SOUTH AMERICA (MESA)-SYNERGY WITH CEOP-CIMS

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VAMOS is an internationally coordinated, joint CLIVAR – GEWEX program aimed to:

CEOP-CIMS?

-describe, understand, and simulate the mean and seasonal aspects of the American monsoon systems,

-simulate American Monsoon System lifecycles and diurnal cycles as well as the intraseasonal, interannual and interdecadal influences,

-investigate American Monsoon System predictability and to make predictions to the extent possible,

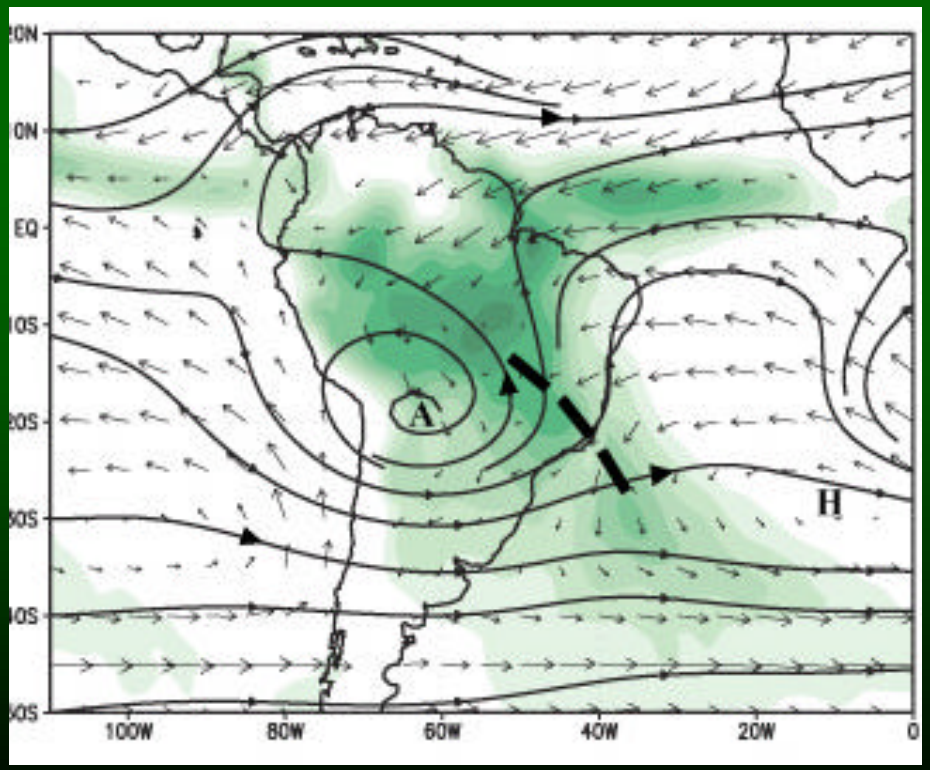
-improve the predictive capability through model development and analysis techniques, and

-prepare products in view of meeting societal needs,

including scenarios of climate change.

MESA IMPLEMENTATION

HYPOTHESIS:
The SAMS provides a physical basis for determining the degree of predictability on short- and long timescales over the region.



MESA PRIORITY RESEARCH AREAS (PRA):

Better understanding and simulation of:

- **diurnal and mesoscale processes (PRA-I);**
- **intraseasonal variability (PRA-II)**
- **interannual and longer time variability (including ACC issues) (PRA-III);**
- **monsoon evolution and variability (PRAs-I, II, III).**

MESA scientific issues and modeling objectives

A better undestanding and improved simulation is expected on:

- Diurnal cycle and seasonal evolution of the SAMS
- 3-dimensional description of the low-circulation east of the Andes.
- Mesoscale convective processes
- Role of aerosols from biomass burning in SAMS
- Dynamics of the SA see-saw pattern
- ITCZ-SACZ interaction
- Influence of MJO on SAMS
- Relative roles of internal vs forced low-frequency variability
- Land surface forcing – Impacts of land use change
- Role of remote and local SST – South Atlantic
- Global response to SAMS forcing
- Sources and limits of predictability on SAMS region

Model simulation improvements are needed in reproducing:

- The seasonal cycle of SAMS
- Diurnal Cycle of circulation and precipitation
- Monsoon onset
- Mean and variability of the SACZ

Additional MESA modeling issues

- To what extent do model systematic errors affect seasonal predictability in the region?
- Why do models have deficiencies in reproducing the SACZ? Missing coupled A-O mechanisms in the AGCMs?
- Will seasonal predictability change as a function of land cover changes?
- Can soil moisture memory help for seasonal predictions for South America? Need to improve soil moisture obs.
- Dealing with the complexities of orography. Higher resolution models and/or dowscaling with regional models?
- Atlantic SST forcing: (i) understanding tropical versus extratropical contributions.
- How can intraseasonal variability in the SAMS can be improved in the models? Can instraseasonal oscillations be a source of short term climatic predictability?
- At the end, can we expect that model improvements and observational techniques will improve predictability in regions such the highly populated and economically important one in SE South America?
- Better seasonal climate predictions, more accurate projections of climate change scenarios for the future?

CEOP-CIMS objectives

- Document the seasonal march of the monsoon systems, assess their driving mechanisms, and investigate their possible physical connections.
- Pan-Monsoon Studies
- Aerosol-monsoon Water Cycle Interaction

Key issues:

- How do land surface and oceanic features interact to govern the timing, magnitude and location of monsoonal circulations?
- What are the similar and different aspects of monsoonal systems over the Austral-Asian and the South American regions under the 'same' large-scale climate system?
- To what extent are the monsoonal systems interconnected and what are the implications of these regional studies to the larger global climate system?

CEOP Intern-Monsoon Study (CIMS)

Aerosol-monsoon water cycle interaction

Background/Goals

Sorting out the impacts of aerosol forcing of the monsoon water cycle:
"direct effect": aerosol scatters and/or absorbs solar radiation, thus cooling the earth surface and changing the horizontal and vertical heating contrast.
"indirect effects": aerosol increases the number of cloud condensation nuclei, prolongs life time of clouds, and inhibits the growth of cloud drops to raindrops.

CEOP Unique Contribution

to carry out validation and physics-perturbation experiments, using global, regional and cloud resolving scale models, with focus on diurnal cycle, and seasonal variability through Pan-monsoon Studies.

CEOP Implementation Approach

Coordination with INDOEX, ACE-Asia, ABC, BASE-Asia, and PARAGON to maximize the use of existing observations, both satellite and in-situ, and to formulate a common strategy for model validation and improvement.
Link with AERONET, MPLNET, ADNET, and EARLNET
Development of multi-platform data of aerosols, radiation, and water cycle in four monsoon reference sites:

- the Gangetic - Himalayas region _for the Indian Monsoon
- Tibetan Plateau and Yangtze River Basin
- sub-Saharan and the West Africa monsoon
- Amazonia and La Plata Basins for the South American monsoon

Downscaling approach and "telescoping" validation strategy from global to regional

MESA Time table

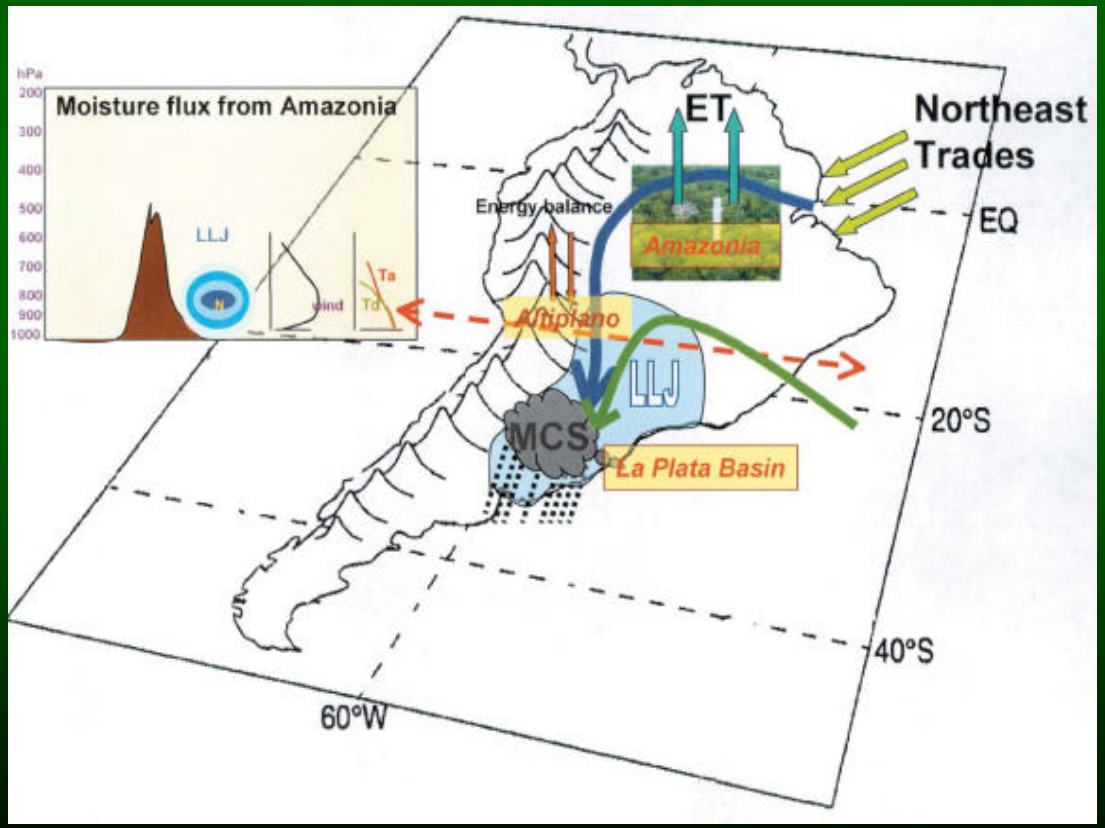
Meeting outcomes:

- MESA implementation Plan
- MESA milestones
- MESA Timeline
- MESA SWG TORS

YEAR (2001+)	01	02	03	04	05	06	07	08 …
SALLJEX Planning	…-------							
SALLJEX Preparations	----------							
SALLJEX Data Collection		----------						
SALLJEX Post-field activities			----------					
PLATEX Planning			----------					
PLATEX Preparation					---------			
PLATEX Data Collection						----------		…
MESA Principal Research	… ----------							…
MESA Data Management		----------						…

SALLJ Science goal

To understand the role of the South American low-level jet in moisture and energy exchange between the tropics and extratropics and related aspects of regional hydrology, climate and climate variability



SALLJEX
WCRP
CLIVAR / VAMOS-GEWEX
Field Campaign

SALLJEX Objectives

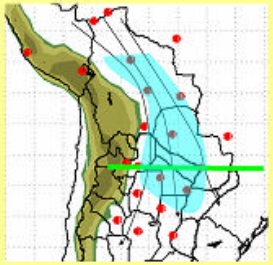
- Diurnal variations of the SALLJ
- Detailed description of the 3-dimensional structure of the SALLJ
- The relationship between MCCs and the SALLJ
- Description of the heat low over the Chaco and NW Argentina

Learning from SALLJEX: LLJs and MCS

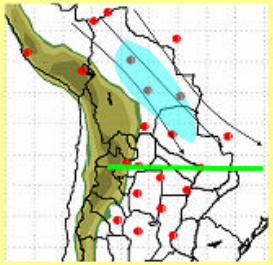
Observations and Modeling simulations confirm that LLJ actually feeds the moisture for the MCSs

SALLJ event (LLJ in Bolivia)

Chaco Jet Event (CJE)
SALLJ also extends south of 25S

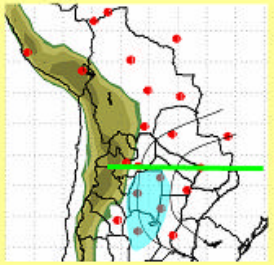


No Chaco Jet Event (NCJE)
SALLJ does not extend south of 25S



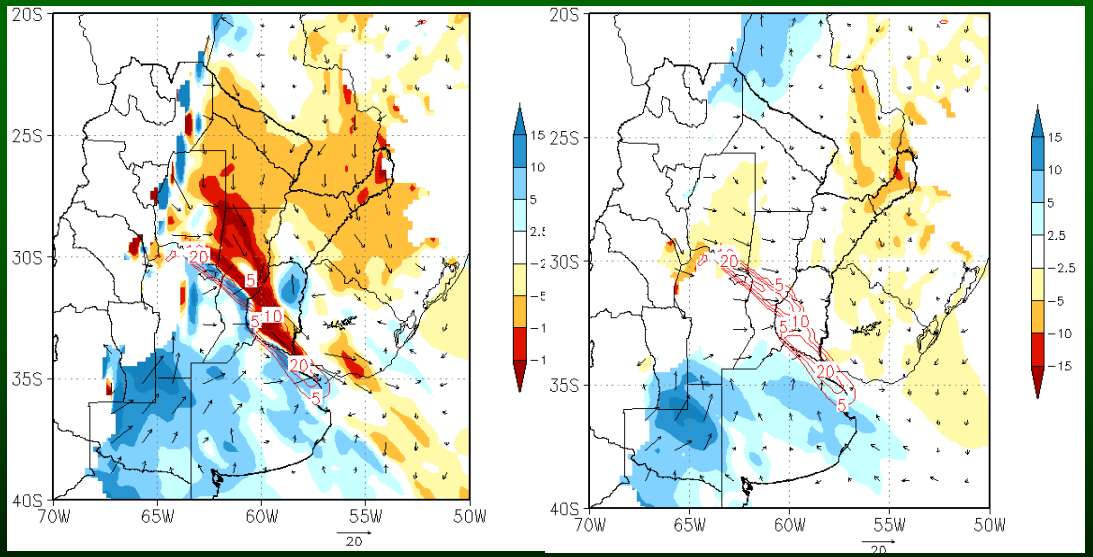
NO SALLJ event

Low Level Jet-Argentina (LLJ-ARG)
LLJ exits only south of 25S



66% of MCS occur during CJE and NCJE

In 93% of CJE events convection occurs south of 20S



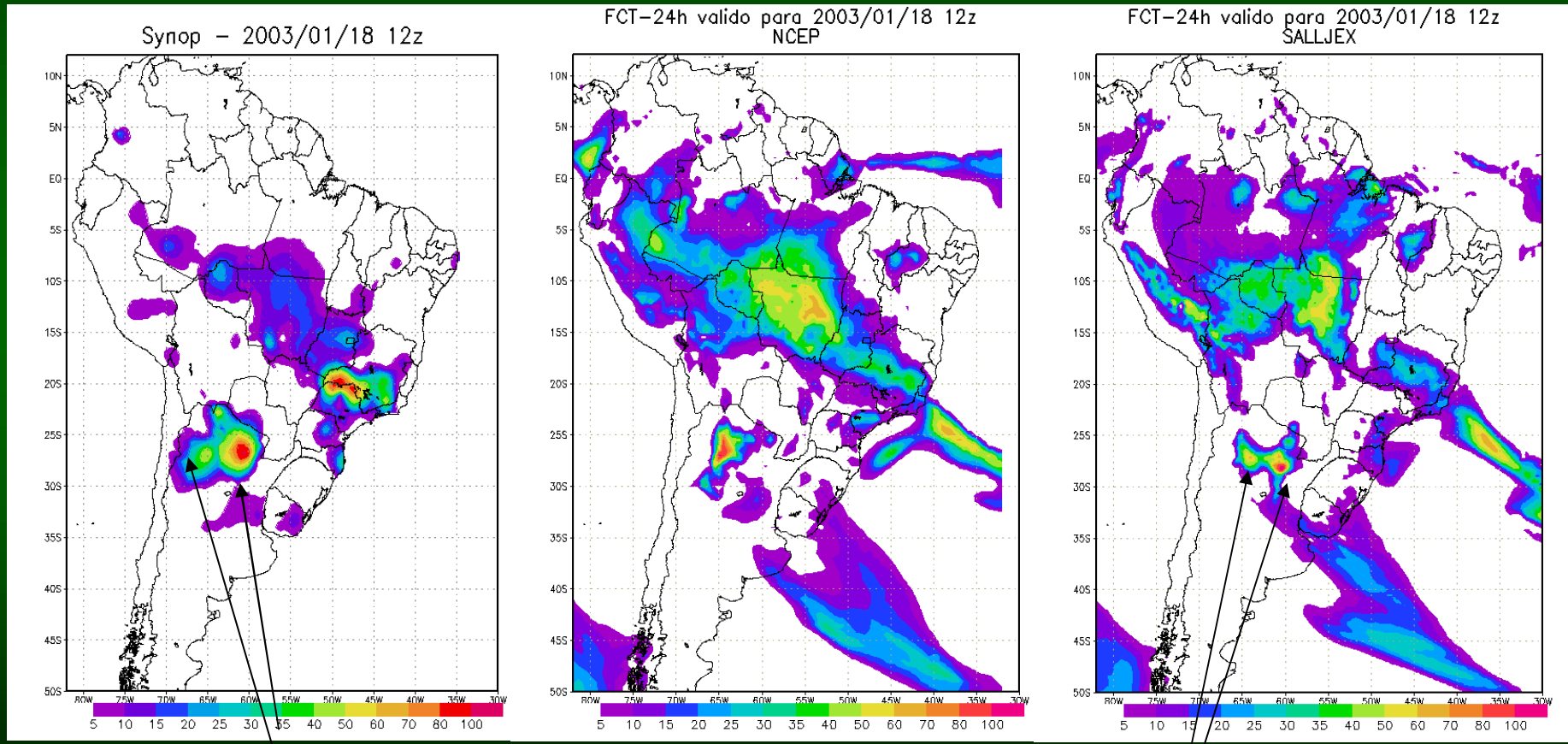
Large synergism between MCS and LLJs.

MCS exert a large impact on low and upper circulation

Ageostrophic wind (left) and geostropic wind (right) at 850 hPa on 06Z19DEC2002 (Difference between control and NLH runs)

PRECIPITATION FORECAST WITH THE REGIONAL ETA MODEL WITH SALLJEX DATA -CPTEC (24h)

OBSERVED **NCEP INITIAL DATA** **PSAS WITH SALLJEX**



2 centers

2 centers

Rozante and Cavalcanti, 2004

A MESA Modeling Roadmap is needed!

(the activities in blue are planned for the future)

- **MESA Modeling Assessment**
  - Regional modeling assessment during SALLJEX (from short to seasonal time scales)
  - Seasonal simulation assessment (SALLJEX season, WGSIP)
  - IPCC AR-4 model simulation assessment
  - Predictability studies for SALLJEX
  - Diurnal cycle assessment

- **Hypothesis Driven Numerical Experimentation**
  - Synergism between SALLJ and MCS
  - Mechanisms associated with the NW Argentinean heat low
  - Sensitivity simulations to soil moisture
  - Coupled simulations for the SACZ
  - Basic mechanisms of diurnal cycle
  - Coupled simulations to understand the multi-scale framework sustaining the SAMS variability
  - Interdecadal variability and changes of basic state

A MESA Modeling Roadmap

- **Model and Prediction improvement**
  - Shaved-Eta vertical coordinate
  - Regional climate modeling on seasonal time scales
  - Regional downscaling of climate simulations for ACC scenarios in SAMS
  - Super-modeling ensemble for seasonal prediction
- **Data Assimilation activities**
  - SALLJEX data assimilation
  - Land data assimilation
- **Model development**
  - …

MESA DELIVERABLES

- More comprehensive understanding of South American climate variability and predictability;
- Strengthened multinational scientific collaboration across South America;
- Observing system design for monitoring and predicting the South American monsoon system;
- Measurably improved climate models that predict South American monsoon variability

MODELING EXPERIMENTS IN VAMOS
Relevant to CEOP-CIMS

- Predicting the Pan-American Monsoon Onset, Maturation and Demise
- Improving the Prediction of Droughts and Floods