The South American Monsoon System

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Multi-scale interaction in the tropics and monsoon regions

- Diurnal Cycle
- Synoptic waves
- Intraseasonal Variability
- Seasonal Cycle

Land-Atmosphere-Ocean Interactions
Orographic forcings

(WCRP/IMS 2008)
Multi-scale interaction in the tropics and monsoon regions

Solar forcing

Diurnal Cycle

Synoptic waves

Intraseasonal Variability

Seasonal Cycle

Variability on interannual and longer time scales

Land-Atmosphere-Ocean Interactions

Orographic forcings

(WCRP/IMS 2008)
Challenges associated with climate in South America

- Biggest continental portion over tropical regions
- South America Monsoon System
- Andes
- Several regions largely influenced by the tropical oceans
Seasonal Cycle

Climatological Daily Means of OLR and 200-hPa streamlines
Precipitation seasonal cycle

Grimm (2011)
DJF climatological mean precipitation

Monsoon Core

SACZ South Atlantic Convergence zone

ITCZ

clim precip DJF 1979–1999 CMAP [mm/day]
Monsoon or not?

GEOS-1 DAS climatology of 900-hPa wind

Zhou and Lau (1998)
The Andes and the South American Monsoon System

**OBSERVATIONS**

Simulations made only considering the presence of the Andes

Mean horizontal wind field (vector)

Cross section of mean meridional wind

Campetella and Vera (2003)
200-hPa circulation - DJF

(Streamlines and mean wind speeds)

Bolivian High

Nordeste Low
Monsoon Mature phase

Climatological seasonal mean precipitation (shaded, NCEP reanalysis), & vertically integrated moisture fluxes (arrows, CMAP)

(Vera et al., 2006, J. Climate)
The South American Low-Level Jet

SALLJ spatial structure depicted by NOAA/P-3 missions in SALLJEX

SALLJ diurnal cycle at 700 asl depicted by SALLJEX observations (Nicolini et al. 2004)
The Andes and the South American Monsoon System

DJF Precipitation as simulated by RegCM3 model

(Ilsen et al., 2010)
DJF Low-level (800 hPa) moisture transport/winds as simulated by RegCM3 model

(Ilsen et al., 2010)
The Andes and the South American Monsoon System

Upper-level (200-hPa) winds

Surface latent heat (colors) and 800-hPa wind convergence (arrows)

DJF Simulations with RegCM3

(Ilsen et al., 2010)
The Diurnal Cycle in South America

Temporal frequency of cold clouds (infrared brightness temperature $T_b \leq 235$ K)

Falvey and Garreaud (2008)
Nighttime-early morning (0600–1200 UTC) minus daytime (1800–0000 UTC) total DJF precipitation for (a) TRMM-PR and (b) RegCM3. (da Rocha et al. 2008)
MCS activity in South America

MCS mature stage time occurrence frequency. Bars in green represent the period November 15 to December 31, in black January 1 to February 15 (Zipser et al. 2004)

MCS event on 17 January 2003

Night (SESA)

Afternoon (SACZ)
MCS activity in South America

Subtropical South America has the largest fractional contribution of PFs with MCSs to rainfall of anywhere on earth between 36 N and 36 S

(Zipser et al. BAMS, 2006)
Diurnal Cycle – MCS - Synoptic Waves


SALLJ Days:
- Days in which synoptic waves reinforce the low-level jet.

During SALLJ Days:
- More favorable environment for MCS development
- Higher frequency of MCS occurrence (41%)
- MCS are bigger and last longer

(Salio et al. 2007)
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Questions?

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