

Influence of Sea-Surface Temperature on the Diurnal Cycle of the North American Monsoon System

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Objective:

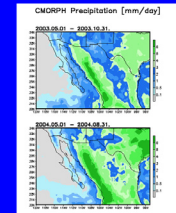
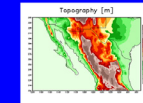
- To examine the diurnal cycle of cloudiness and precipitation over Mexico and Southwest
- To explore the interaction between diurnal cycle of NAMS and that of the SST over the adjacent oceans
- To diagnose the NCEP operational GFS model in reproducing the NAMS diurnal cycle

Data:

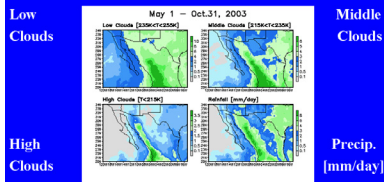
- Cloudiness**
Full-resolution IR data of Janowiak et al. (2001)
- Precipitation**
CMORPH/RMORPH satellite precipitation estimates of Joyce et al. (2004)
- SST**
Multi-Platform-Merged (MPM) SST analysis of Wang and Xie (2006)
- Resolution**
6.25° lat/lon; 3 hourly

Mean Precipitation and Topography

- Heavy rainfall is observed over both the west and east coasts of Mexico



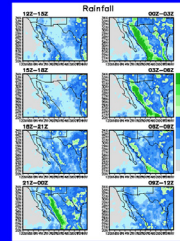
Mean Precipitation and Cloudiness



Clouds have wider and smooth distribution than precipitation; There is an east-west shift in the maximum positions;

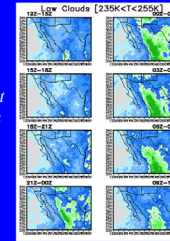
3-Hourly Mean Precipitation

- Precipitation starts at morning time;
- It reaches maximum in late afternoon;
- Diurnal cycle over the west and east coasts is in phase;



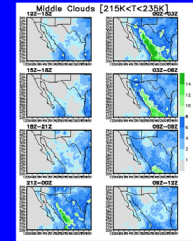
3-Hourly Mean Low Clouds [235K-255K]

- The maximum amount of low clouds appears ~3 hours later than that for the precipitation



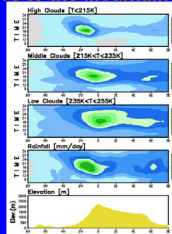
3-Hourly Mean Mid Clouds [215K-235K]

- The diurnal cycle of middle and high clouds is basically in phase with that of the precipitation;



Diurnal Cycle of Cloudiness and Precipitation Relative to the Mountain

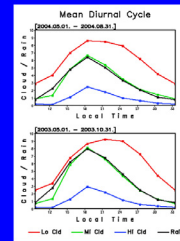
- Mean values are calculated over a latitude band 22°N – 32°N, relative to the mountain ridge;
- Cloud / precip. Starts over high elevation in the morning, moves toward coast as it reaches maximum;
- High clouds are located over west of low clouds



Mean Diurnal

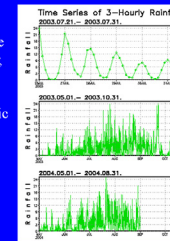
[22°N-32°N; 5° W/E to the Ridge]

- Diurnal cycle of low clouds has a flatter tail than that for the high/middle clouds and the precip.



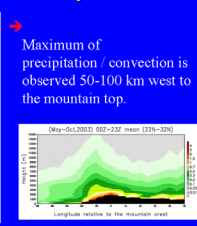
Time Series of Mean Precipitation

- Phase of diurnal cycle relatively is stable;
- Magnitude presents changes of synoptic and intraseasonal time scales.

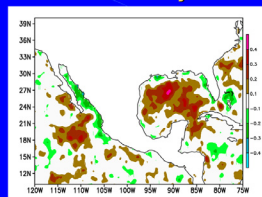


East-West Section of Mean cloudiness / Precipitation

- Maximum of precipitation / convection is observed 50-100 km west to the mountain top.

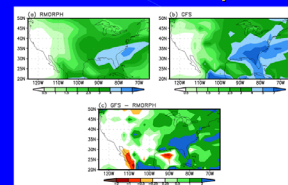


SST – NAMS Diurnal Cycle Interaction



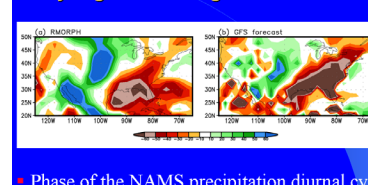
- Intensity of diurnal cycle of NAMS precipitation averaged over the core monsoon region presents positive / negative correlation with that of SST over GOM and GOC, respectively.

GFS Model Performance: 2003-2005 JJA mean Precipitation



- NAMS precipitation in GFS is weaker than that from the gauge-corrected satellite estimates of RMORPH

GFS Model Performance: Day-Night Percentage Difference



- Phase of the NAMS precipitation diurnal cycle is not well reproduced by the GFS

Summary:

- Variations of cloudiness and precipitation associated with the North America Monsoon System (NAMS) are dominated by diurnal cycle;
- Clouds and precipitation start from higher elevation in the morning, move toward the coast as they reach the maximum in late afternoon;
- The phase of the diurnal cycle is relatively stable, while the magnitude presents changes of synoptic and intraseasonal time scales;
- Maximum of precipitation and convection appear 50-100 km west to the mountain crests;
- The intensity of the NAMS convection is positively (negatively) correlated to that of the SST over GOM and GOC, respectively;
- NAMS diurnal cycle is not well reproduced by the current version of NCEP GFS