Mapping the spatial extent of the mid-summer drought ("MSD")

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Multiple objectives of our work:

• Attempt validation of NARR in reproducing the spatial structure of the MSD over Central American region.

• Map the MSD cloud field using GOES (~10km IR) and MODIS imagery (~250m).

• Relate cloudiness (and precip) variations to fluctuations in the strength of the trade winds across the region - hopefully to downscale trade-wind variations from climate models to “useful” spatial scales…
Mid-summer drought variations have been studied for some time…

World Survey of Climatology, 1976), Ch 12: Climates of Central and South America / ed. by Werner Schwerdtfeger.
Feb mean 850mb

...for NCEP

In this region there are large differences between NCEP reanalysis and the NARR in vicinity of topography of Central America

...for NARR
July-June Difference...

NCEP and NARR very similar at 500 hPa and above...
But at 925 hPa … July minus June for NCEP and NARR

…differences only important if you want to make useful climate forecasts for populations in the region….
February mean 925mb winds from the NARR showing the different low-level jets around Central America and northern South America. Red dots are most radiosonde stations that have operated during last 20 years, black dots show the locations of PACS-SONET stations (see text). Note the lack of radiosonde sites near the maxima of the regional LLJ’s.
Of course, is the NARR any good near topography?

Managua pibals vrs NARR and NCEP
Comparison between NARR, NCEP and soundings at Salina Cruz, Mexico at 925 and 850 hPa

Salina Cruz, Mx
850 hPa

Salina Cruz, Mx
925 hPa
Key West—good agreement between NARR and NCEP
Salina Cruz 850 hPa…
poor agreement between NARR and NCEP

Note larger wave variability with NARR
MODIS “true color” imagery
(this is annual mean cloudiness for both Terra and Aqua satellites for 2004-7)
July+August cloudiness
July-June cloudiness (frequency) (vis)
(July+Aug) - (June+Sept) cloudiness (frequency)
ISCCP GOES Products


ISCCP B1U 3-hourly, ~10km at nadir, available since 1983.
Basic Mid-summer drought index:

(July+August cloudiness (or rainfall) - (June+September)

(can be normalized or not)
Managua daily 850 hPa u-wind from NARR, NCEP and obs’s…
MSD onset signal - when does it start?
MSD index...for 1990-97 (no 95-96) showing variability
1998-2003 showing variability
Max Pacific-side MSD signal

NAM signal

Role of Sea and land breezes

Max Pacific-side MSD signal

16-year mean

Mean MSD index
Do synoptic variations in the strength of the various low-level flows over the IAS region mimic the observed cloudiness signals of the MSD?

*If they do, this may help us understand better the physics of the MSD...*
Methodology...

- Synoptic time scale variability using wind indices over different regions
  - We defined positive max excursions (+t=[-1,0,+1] days) and negative minimum excursion. (- t=[-1,0,+1] days)
Methodology: use regional NARR wind indices

MSD Formula: Cloud frequency (Tb< -38C) using ISCCP GOES-IR Index ~ (July+August) - (June+Sept)
Caribbean LLJ index

(July+Aug) - (Jun+Sept)
Summary

We are continuing to explore MSD onset signals, geographical variations and accuracy of NARR - as function of observational density and distribution…

*but simple index using GOES imagery seems to explain much previously documented variability*