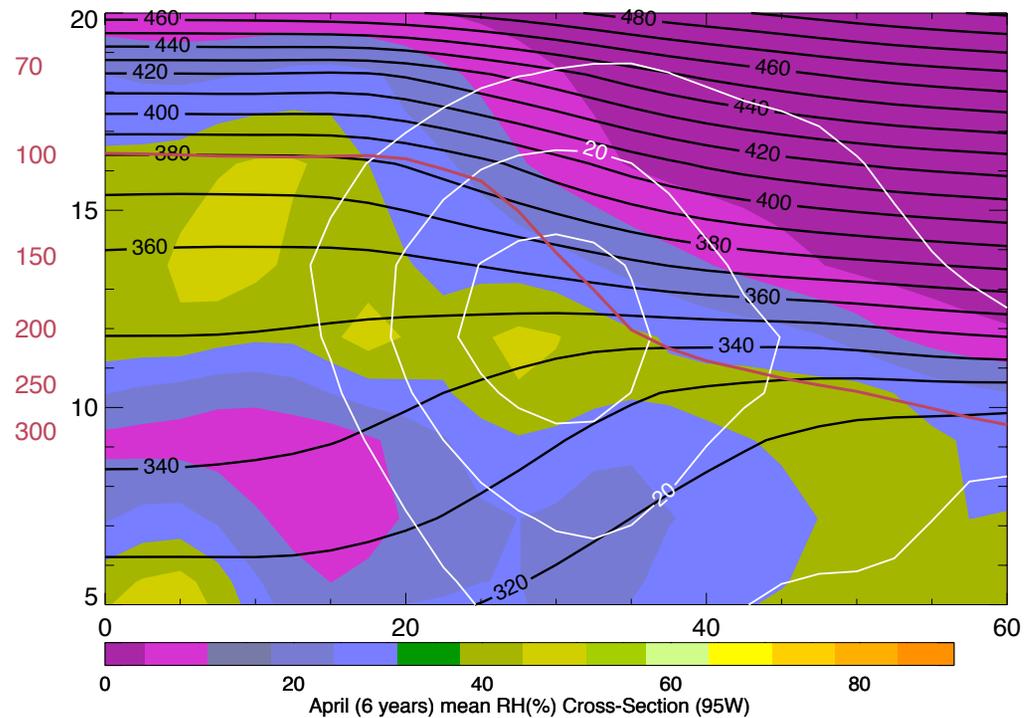
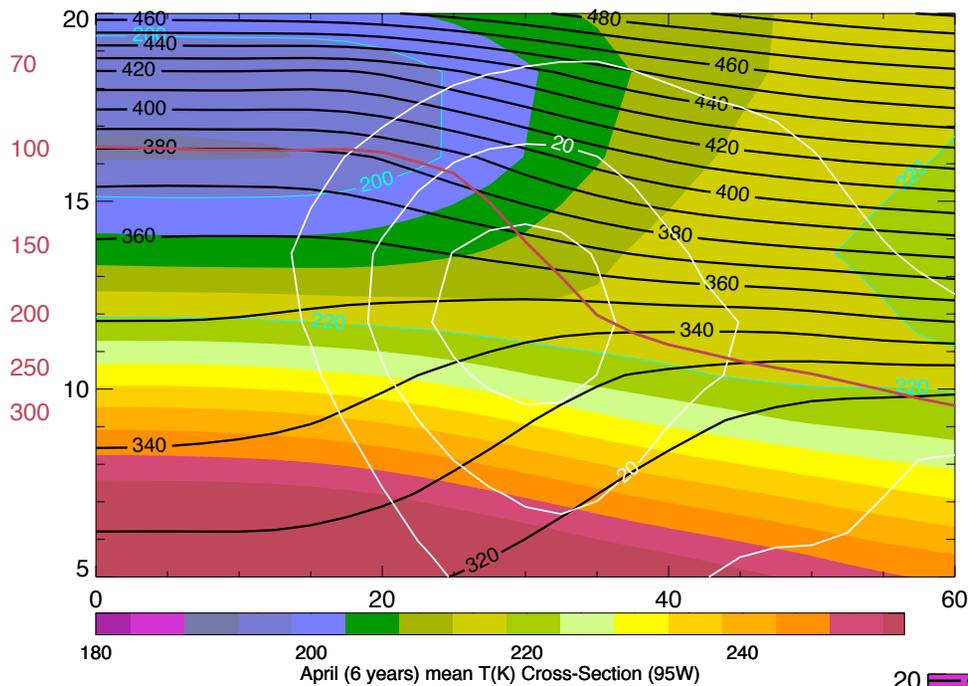


Meteorological Overview of MACPEX and SPARTICUS

L. Pfister, M. Legg, K. Rosenlof
NASA/ARC and NOAA/ESRL

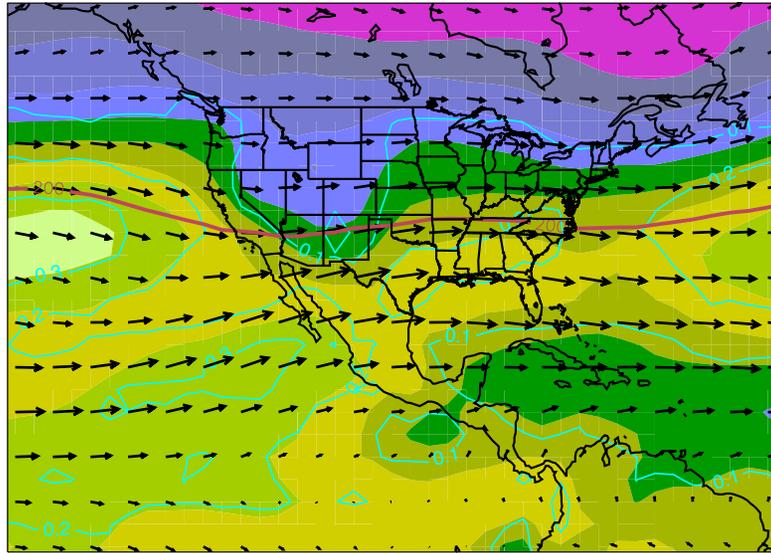
Outline

- Synoptic cirrus – mechanism of formation, year-to-year and monthly variation of incidence, relationship to ENSO
- Convection incidence (“anvil” cirrus) – year to year and monthly variation
- Movie loop for April, 2011 showing cirrus for different flights in met context
- Context for water vapor measurements

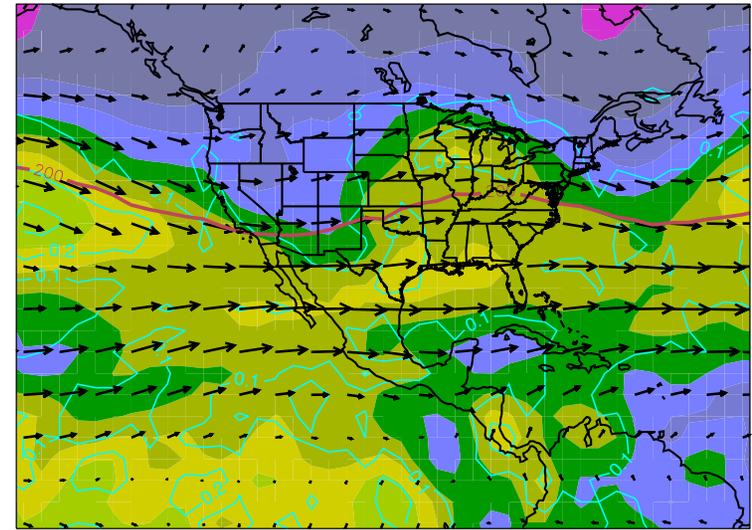


X-sections (6 year mean April) at 95W (Ellington).
 Trop about 12 km at our latitude, but varying strongly.
 Shifts poleward produce upward motion at 200mb and below
 Bulge in RH near 200mb (and lower RH above) expected based on theta surface slopes

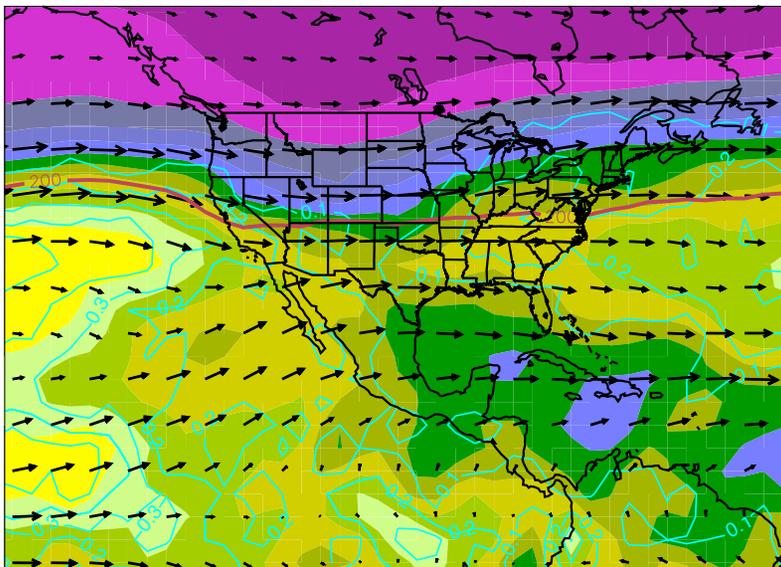
Look at RH, and incidences of RH > 80% at 200 mb



0 20 40 60 80 100
april 13_Year_Average mean RH and Incidence of RH > 80% (200mb)



0 20 40 60 80 100
april 2010 mean RH and Incidence of RH > 80% (200mb)

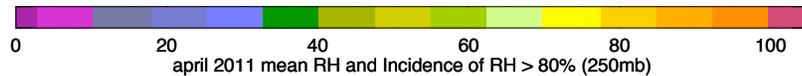
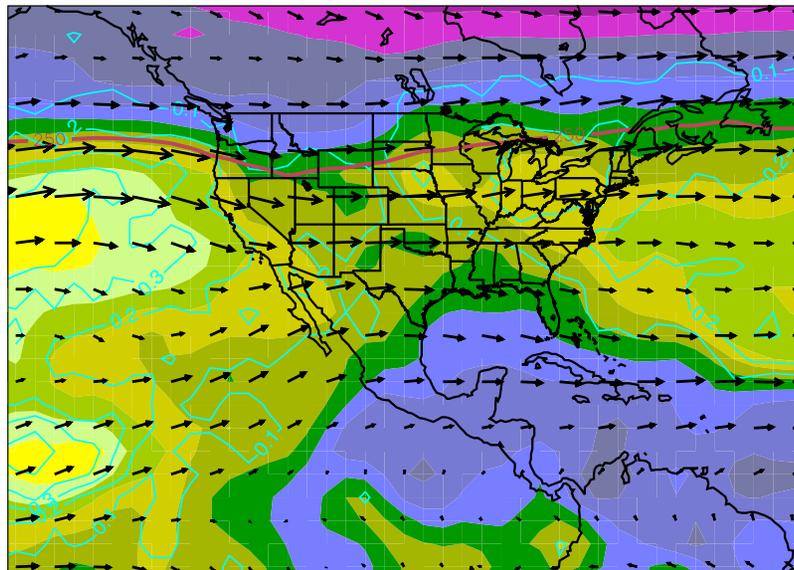
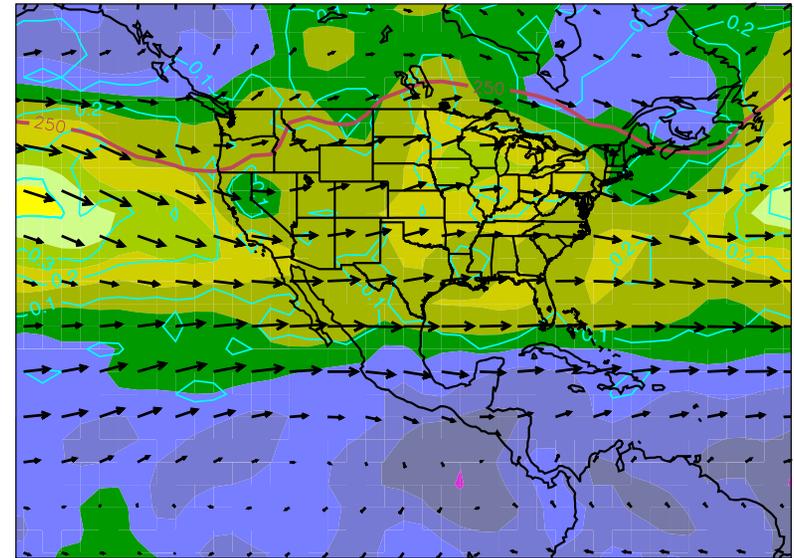
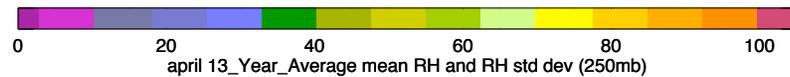
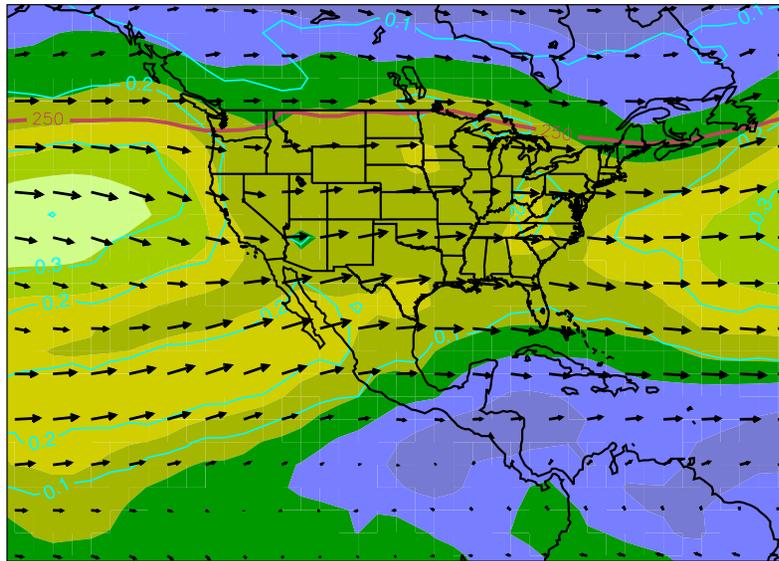


0 20 40 60 80 100
april 2011 mean RH and Incidence of RH > 80% (200mb)

13 year mean (upper left), compared with SPARTICUS April (above) and MACPEX (left). Qualitatively, incidences of RH>80% go with mean RHs.

Incidence of RH>80% is greater during SPARTICUS April than MACPEX

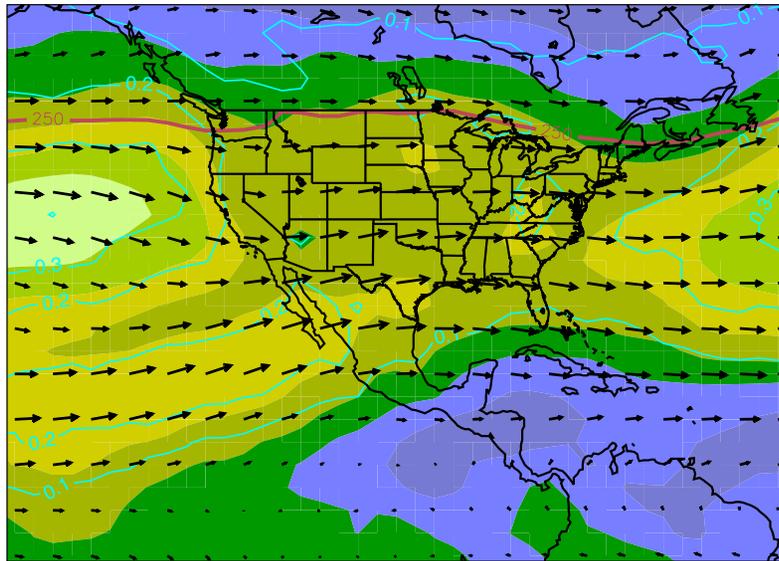
Look at RH, and incidences of RH > 80% at 250 mb



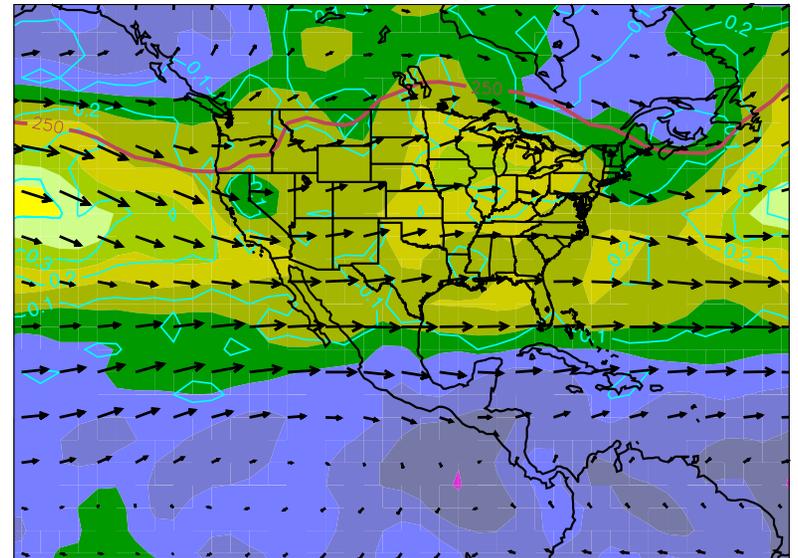
As at 200mb, 2011 (MACPEX) incidence of high values of RH over ARM region is lower than the average, and slightly lower than 2010 (SPARTICUS). 2011 is a La Nina year, 2010, an El Nino. Tropical link is weaker in 2010.

300mb incidences are lower (not shown).

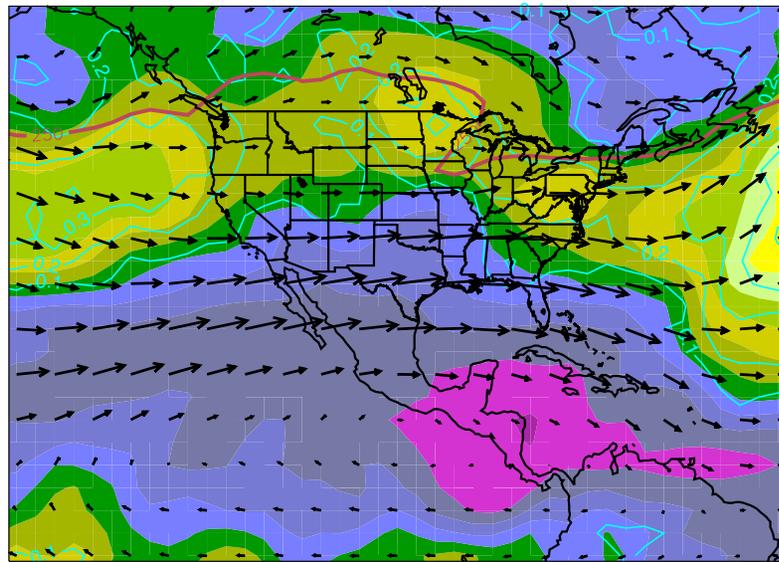
Link to ENSO?



0 20 40 60 80 100
april 13_Year_Average mean RH and RH std dev (250mb)

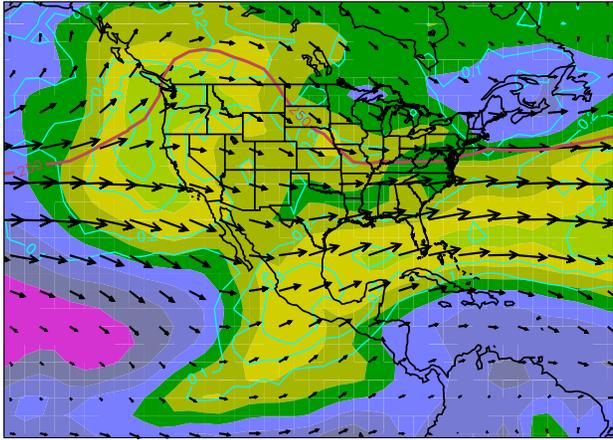


0 20 40 60 80 100
april 2010 mean RH and Incidence of RH > 80% (250mb)



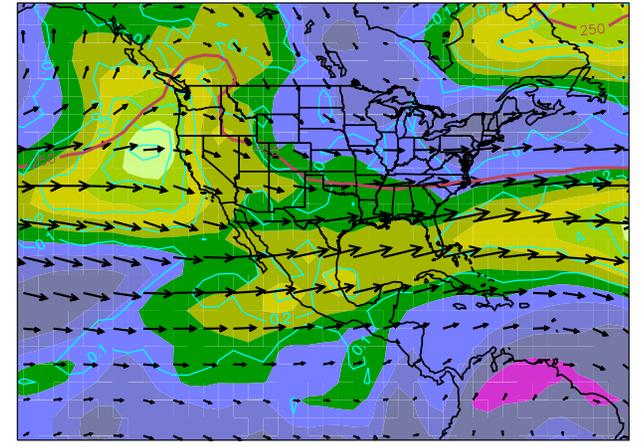
0 20 40 60 80 100
april 1998 mean RH and Incidence of RH > 80% (250mb)

El-Nino years for April were 2010 and 1998, which show a relatively Dry eastern tropical Pacific at 250 mb, especially 1998 (a very strong El Nino). The ENSO link is ambiguous in the ARM region except for the strong El Nino. (At 200mb, equatorial region is anomalously moist During El Nino)

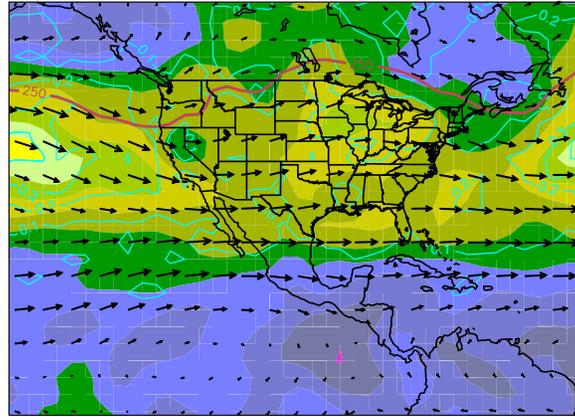


0 20 40 60 80 100
January 2010 mean RH and Incidence of RH > 80% (250mb)

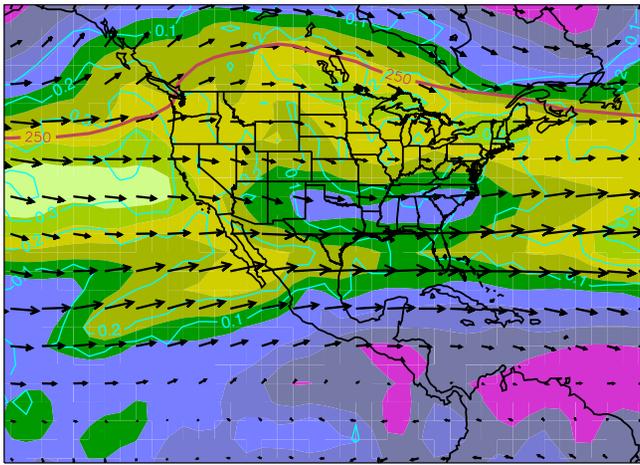
Evolution of RH during SPARTICUS. Max RH At 250mb, except during June.



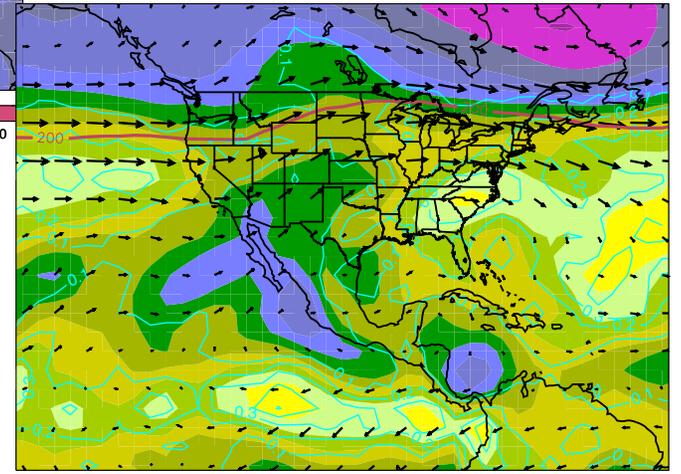
0 20 40 60 80 100
February 2010 mean RH and Incidence of RH > 80% (250mb)



0 20 40 60 80 100
April 2010 mean RH and Incidence of RH > 80% (250mb)

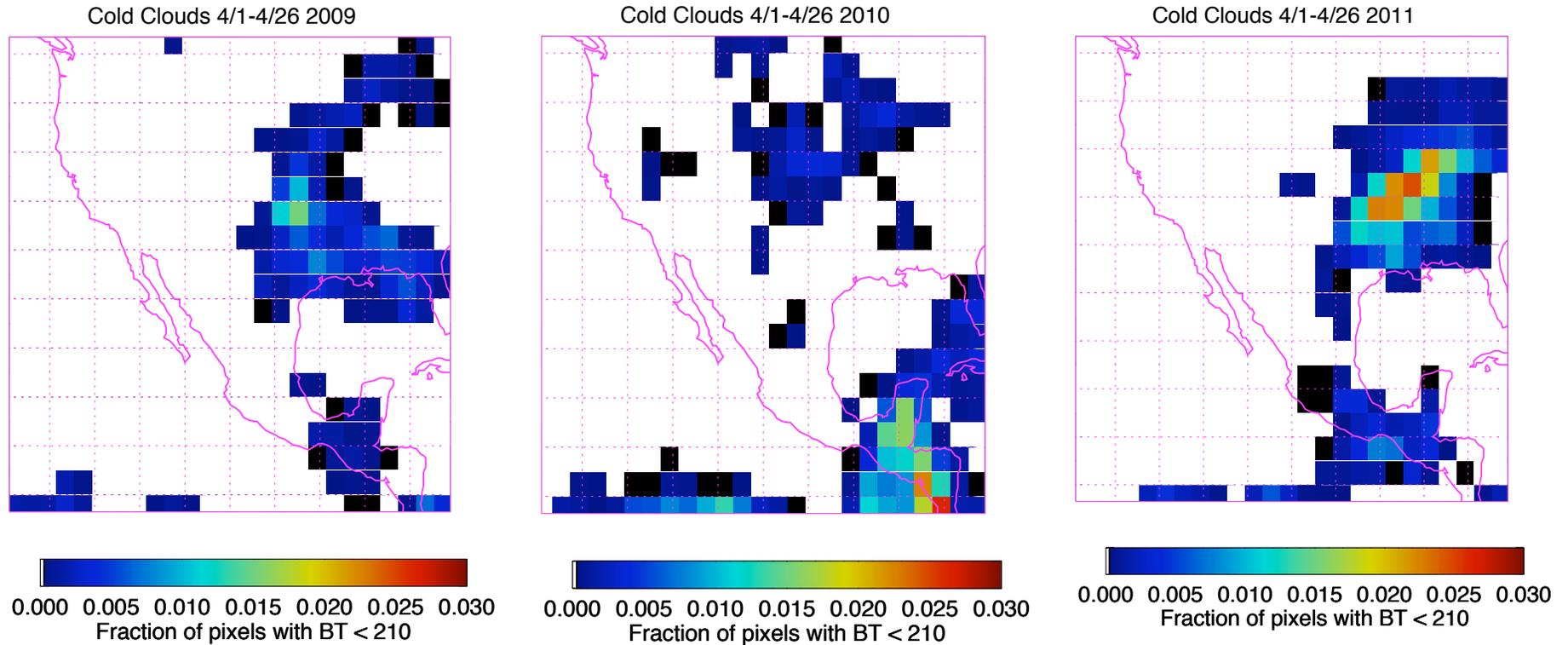


0 20 40 60 80 100
March 2010 mean RH and Incidence of RH > 80% (250mb)



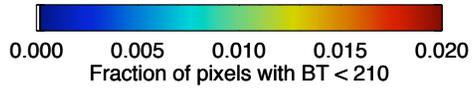
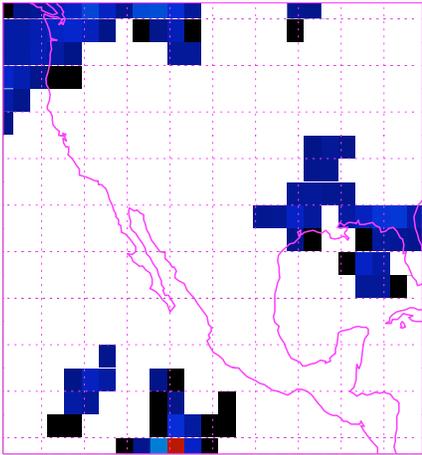
0 20 40 60 80 100
June 2010 mean RH and Incidence of RH > 80% (200mb)

Incidence of Convection during April

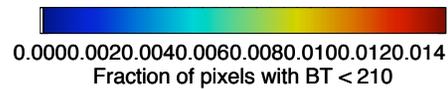
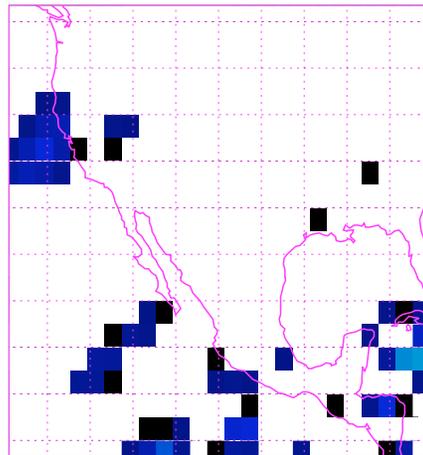


Use incidence of very cold clouds (-63C) as a crude proxy for convection.
2011 was a very good year for convection, 2010 was not (in April).

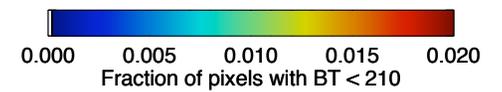
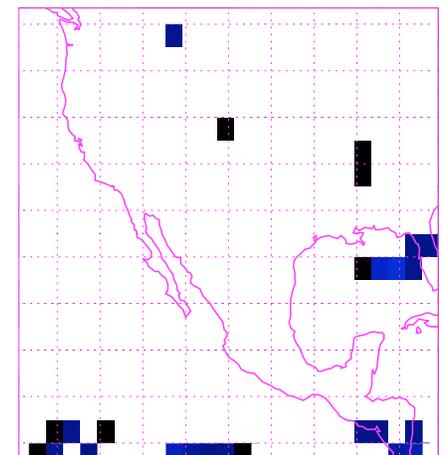
Cold Clouds 1/1-1/31 2010



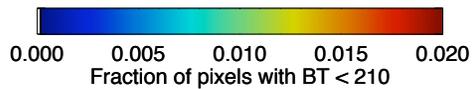
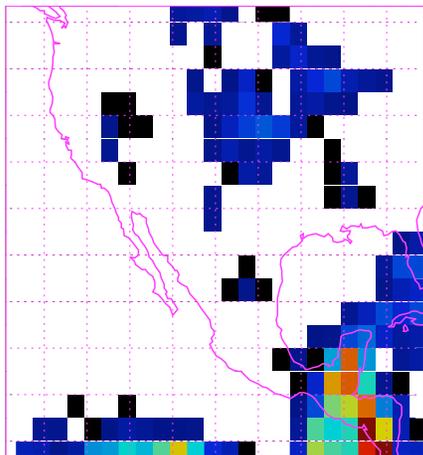
Cold Clouds 2/1-2/28 2010



Cold Clouds 3/1-3/31 2010

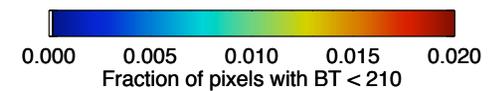
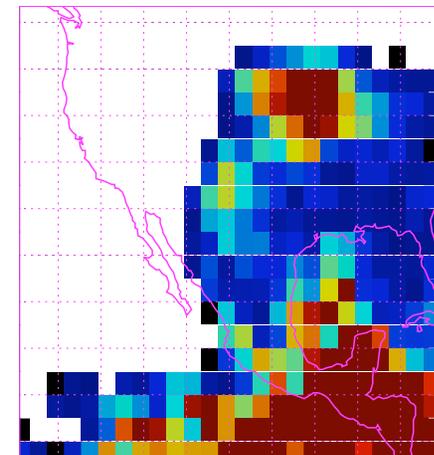


Cold Clouds 4/1-4/26 2010



Can see the obvious –
 Not much convection
 In January-March, with
 A clear increase in April
 And especially June.

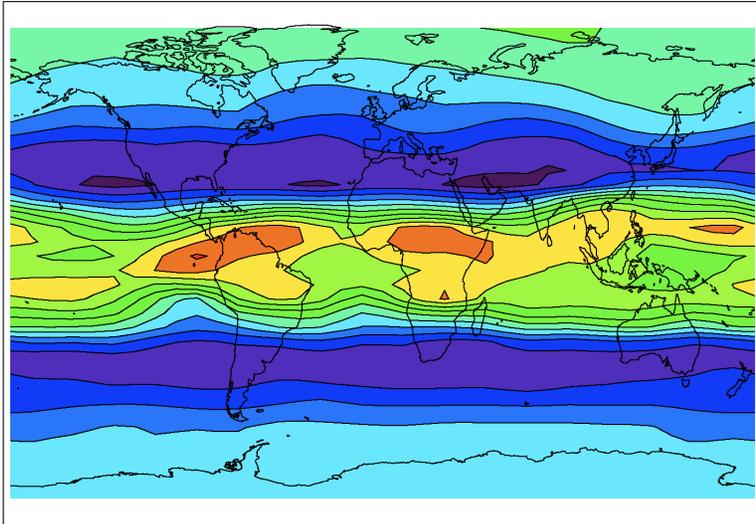
Cold Clouds 6/1-6/30 2010



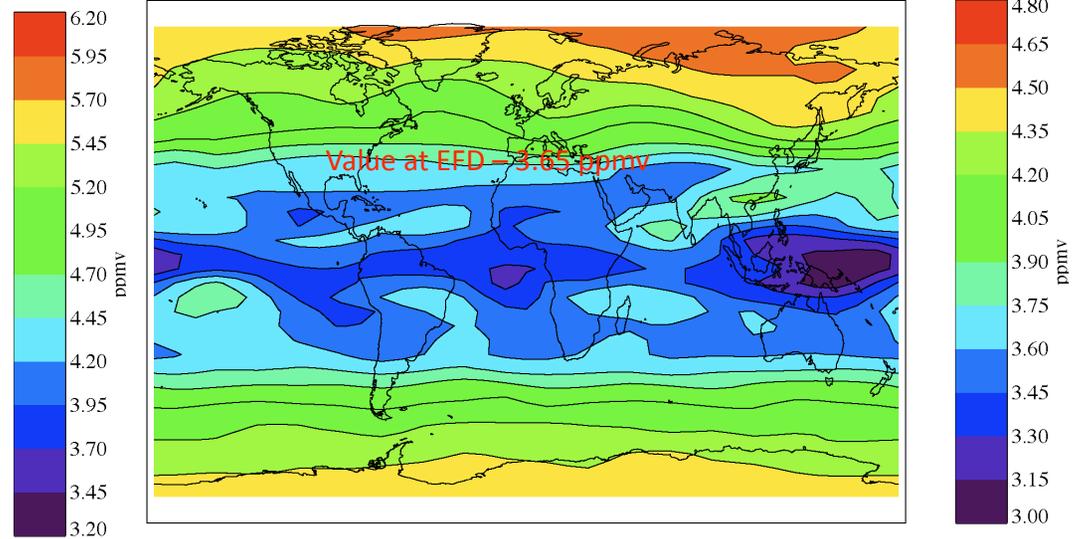
Movie of MACPEX 2011

- Note significant amount of convection
- Significant cirrus in northwest flow not directly associated with flow from the tropics
- Clear cases of flow from the tropics

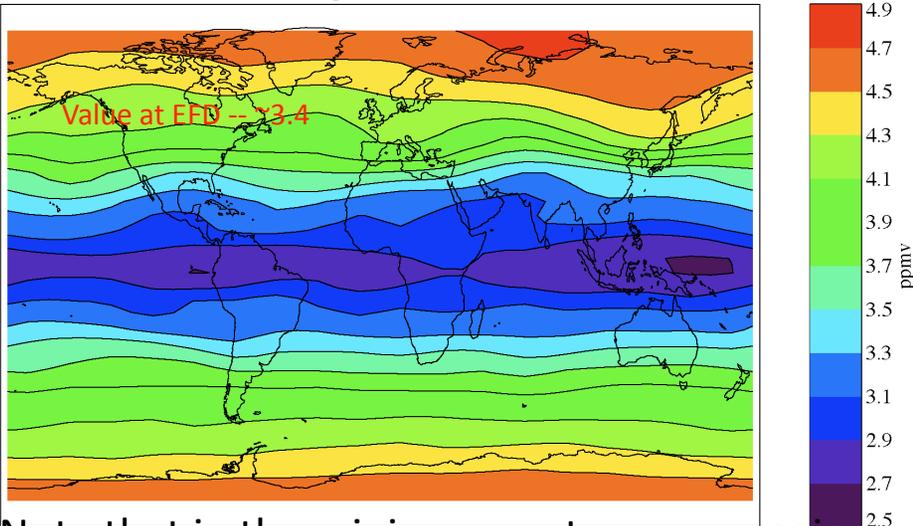
April, 121 mb



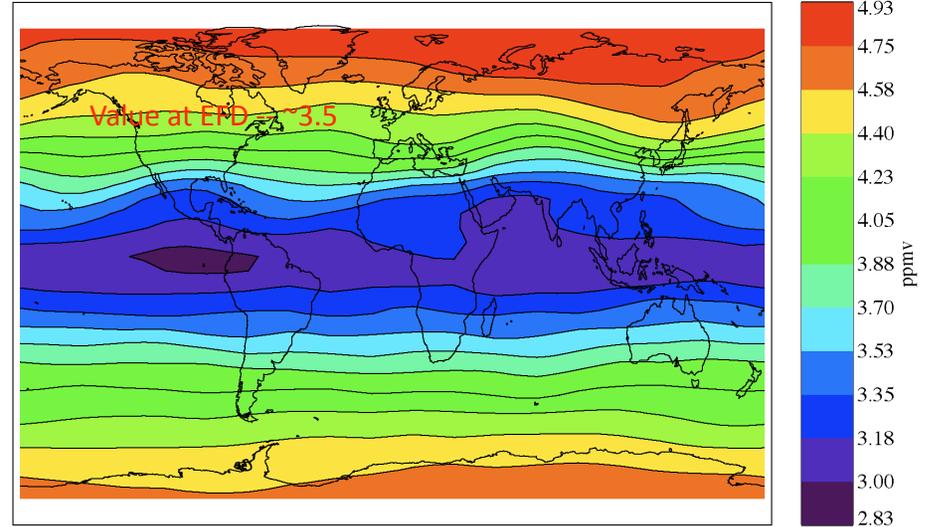
April, 100 mb



April, 82 mb



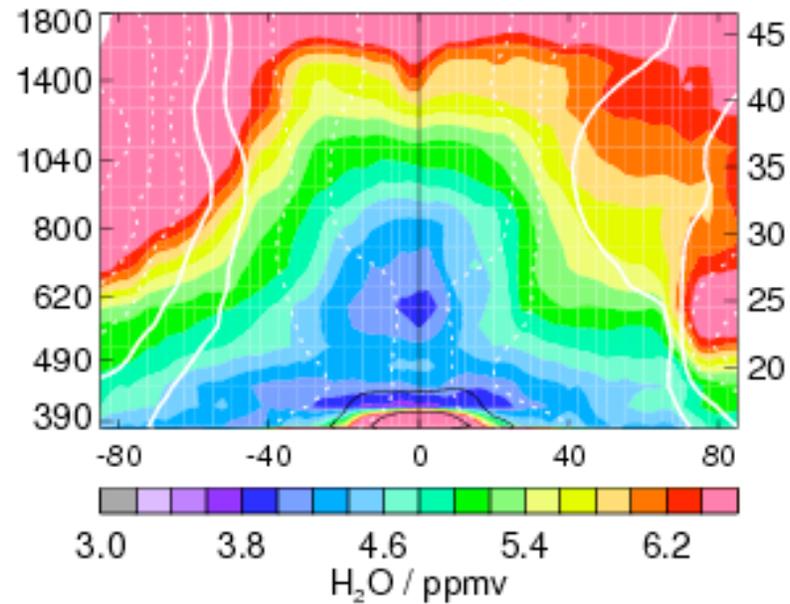
April, 68 mb



Note that in the minimum water vapor region above 100mb is in a gradient region – expect flight to flight variations

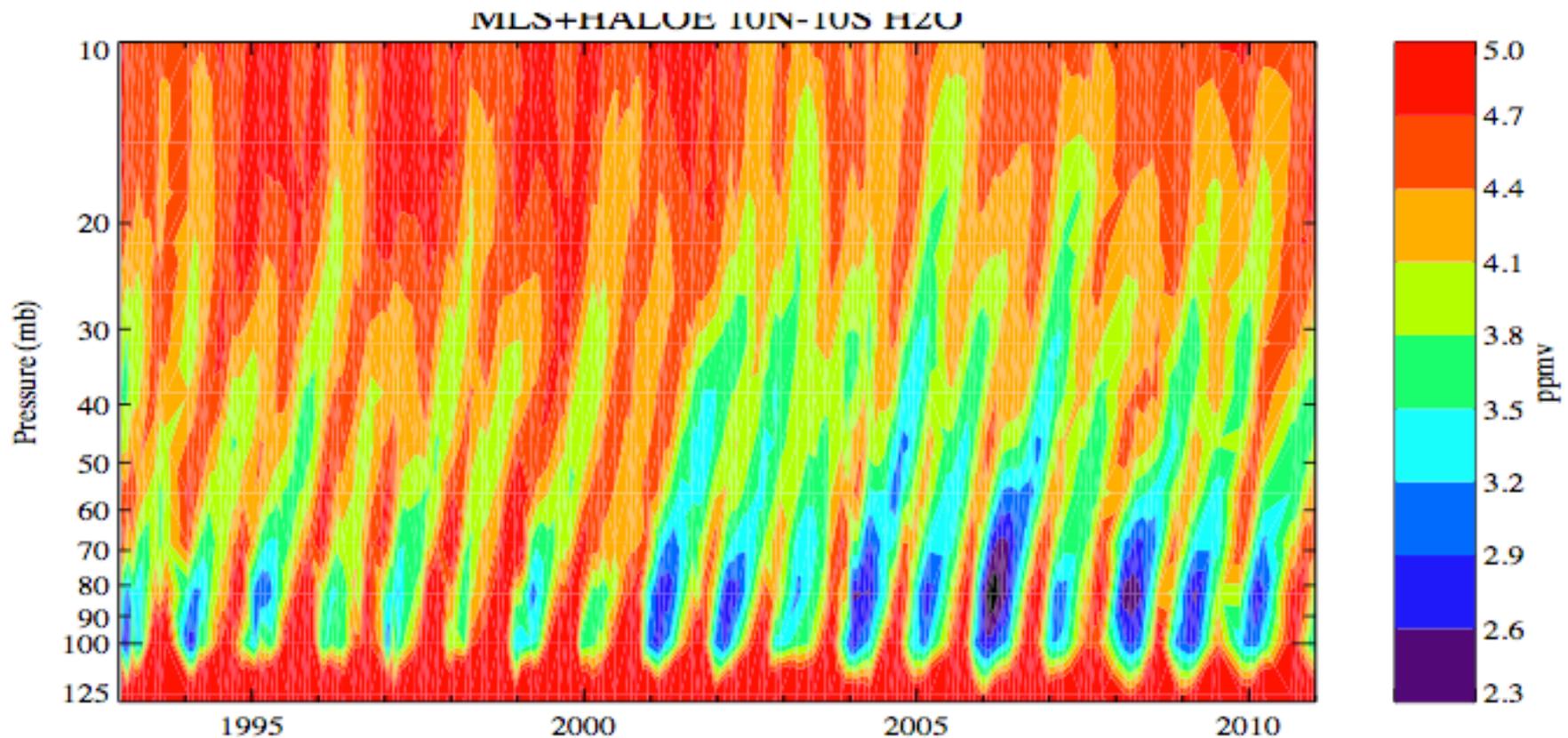
MLS 2005-2010 averages

Data Version: v03-32-c02
Produced on: June 24, 2011



April, 2011 MLS plot (from MLS site). Point here is that near 100mb, low Water vapor from the cold winter tropical UTLS spreads poleward. At higher levels, There is confinement by a “tropical pipe.”

Water Vapor Intercomparison background



From Rosenlof, 2011 (WCRP), a consistent water vapor time height section in the equatorial zone. Water vapor clearly varies year to year. 2011 minimum appears to be about 3.5 ppmv, which is quite a bit wetter than previous Houston campaigns (e.g., MidCix, 2004; CR-AVE, 2006).

Summary

- Incidences of high RH (largely “synoptic cirrus” during April maximize over our region at 250mb. Flow from tropics stronger during 2011 than 2010. Link to ENSO in our region is marginal except for strong El Nino.
- Evolution January-June does show maximum of high RH in April. June incidence of high RH actually maximizes at 150mb, above Learjet ceiling.
- Convection in April is over the south central US – significant interannual variability. Evolution through the SPARTICUS period shows very little until April.
- Water vapor structure during April has significant horizontal gradients near the minimum point at ~80-90 mb.
- Interannual variability in minimum will be significant. This year we are at about 3.8 or so ppmv for minimum in tropics during winter, substantially wetter than many previous years.