Intercomparison of Reanalyses Dynamic Variables in the Stratosphere:

Results from the SPARC-Reanalysis Intercomparison Project

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SPARC Reanalysis Intercomparison Project (S-RIP)

- SPARC is one of the four core projects of the WCRP
- S-RIP is one of the SPARC projects to:
  - **compare** all (or some of the newer) reanalysis datasets for various key diagnostics;
  - **understand the causes of differences** among reanalyses;
  - **provide guidance on the appropriate usage** of various reanalysis products; and
  - connect such activities with future improvements in the reanalysis products by **establishing collaborative links** between the reanalysis centres and the SPARC community.
- S-RIP focuses on tropo-strato-lower mesospheres
- S-RIP home page… http://s-rip.ees.hokudai.ac.jp/

SPARC Reanalysis Intercomparison Project

- **Chapters:**
  - *1: Introduction*
  - *2: Description of the Reanalysis Systems*
  - ***3: Climatology and Interannual Variability of Dynamical Variables***
  - *4: Climatology and Interannual Variability of Ozone and Water Vapour*
  - *5: Brewer–Dobson Circulation*
  - *6: Stratosphere–Troposphere Coupling*
  - *7: Extratropical Upper Troposphere and Lower Stratosphere*
  - *8: Tropical Tropopause Layer*
  - *9: Quasi-Biennial Oscillation and Tropical Variability*
  - *10: Polar Processes*
  - *11: Upper Stratosphere and Lower Mesosphere*

Chapter 3

- ***3: Climatology and Interannual Variability of Dynamical Variables***
  - ***Use four most recent reanalyses to create a Reanalysis Ensemble Mean (REM)***
    - ***CFSR***
    - ***ERA-Interim***
    - ***MERRA***
    - ***JRA55***
  - ***Concentrate on Temp, u, v, and vvel winds***
  - ***Will present following conditions:***
    - ***Monthly Means of REM (1981-2010)***
    - ***Variability of the REM over 1981-2010 period***
    - ***Monthly mean agreement of the ensemble members (for T and u) over this period***
    - ***Time variation of the agreement of the ensemble members***

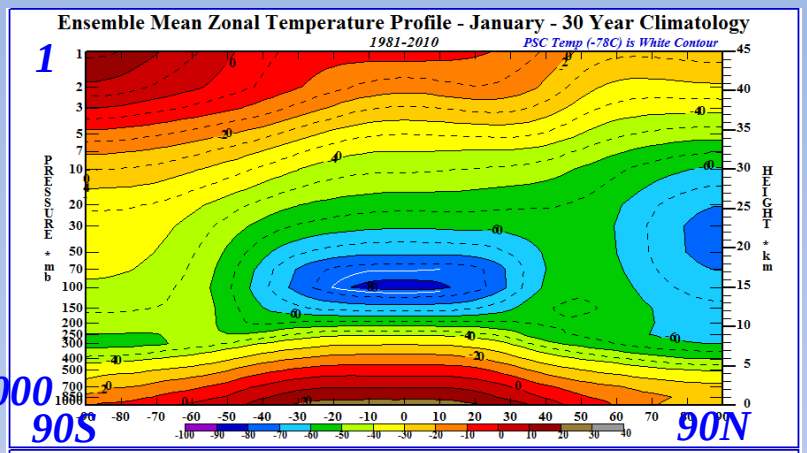
Reanalysis Characteristics

- ***Reanalysis, resolution, and top level of model***

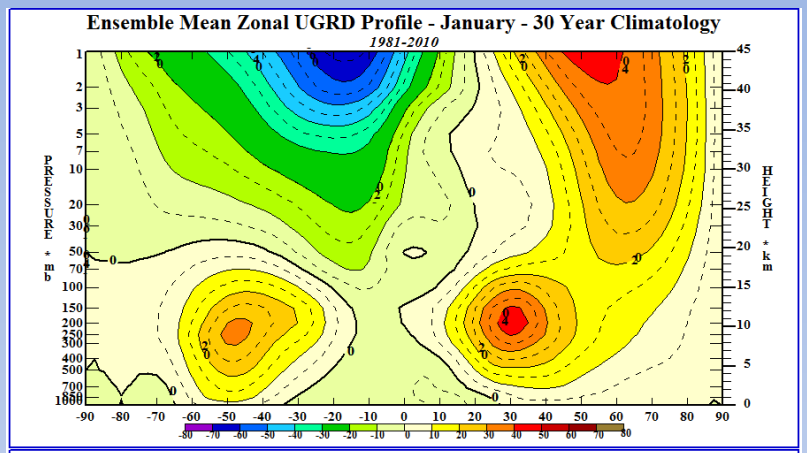
Dataset	*Center*	*Horizontal resolution*	*Number of vertical levels*	*Model top*
NCEP-CFSR	*NCEP*	*T382 (T574 for 2010-)*	*L64*	*0.26 hPa*
MERRA	*NASA*	*(2/3)x(1/2)*	*L72*	*0.01 hPa*
ERA-Interim	*ECMWF*	*TL255*	*L60*	*0.1 hPa*
JRA-55	*JMA*	*TL319*	*L60*	*0.1 hPa*

- ***Note:***
  - ***Other reanalyses (JRA-25, ERA-40, NCEP R-1, NCEP R-2, and 20CR) are also analyzed wrt. the REM in Chapter 3 but not shown in this talk***

January – Ensemble Mean and Variability



$\overline{T_m}$



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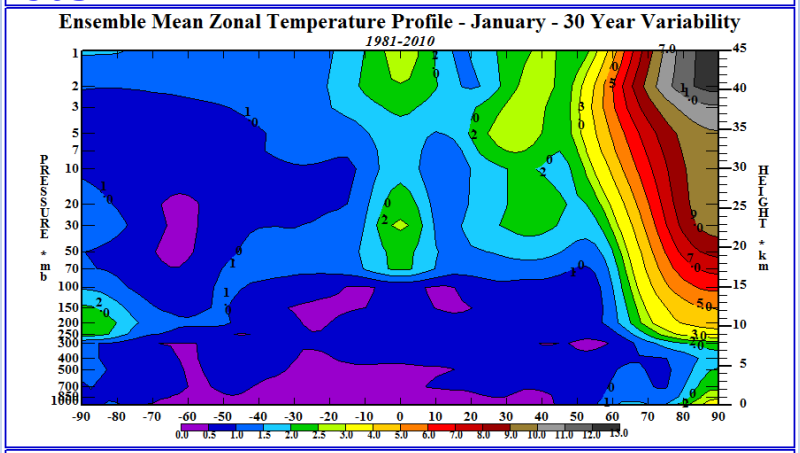
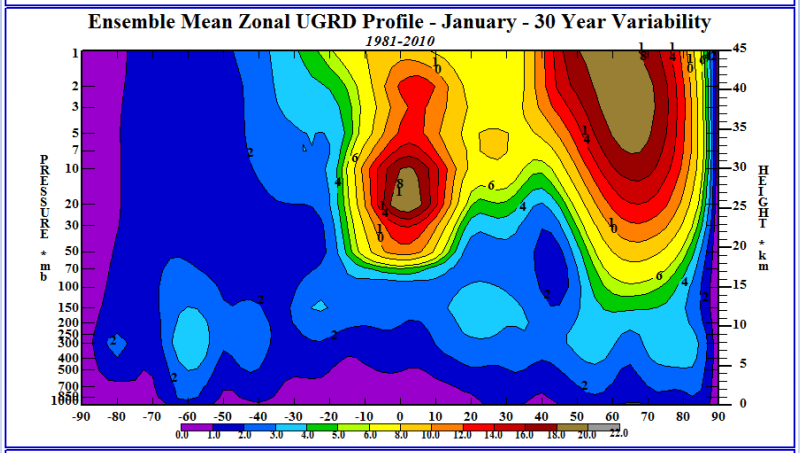


$\overline{T_m}'$



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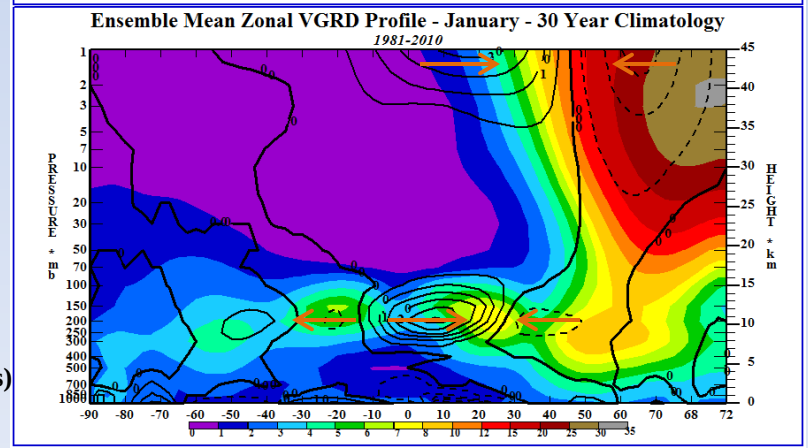
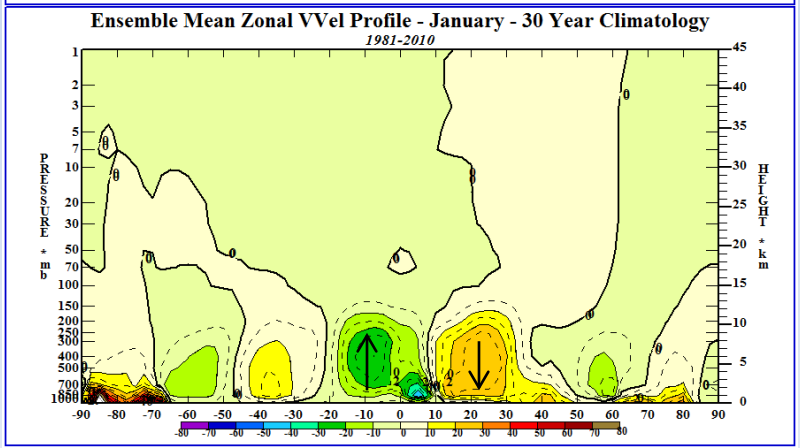


$\overline{v_m}$ (lines)

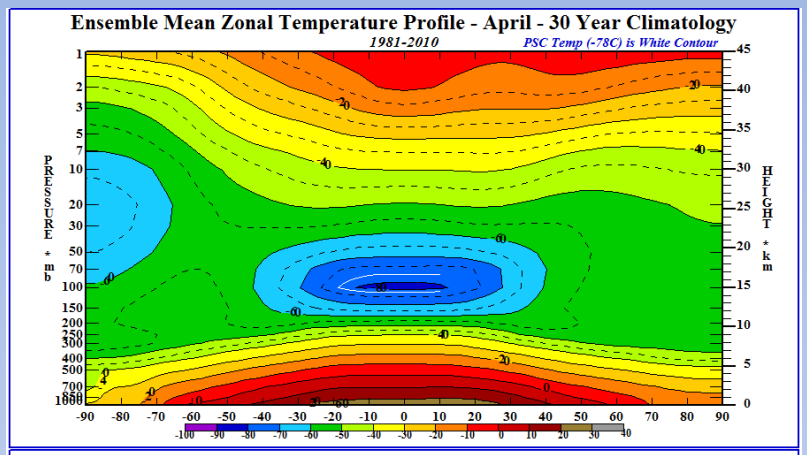
$\overline{v_m}'$ (contours)



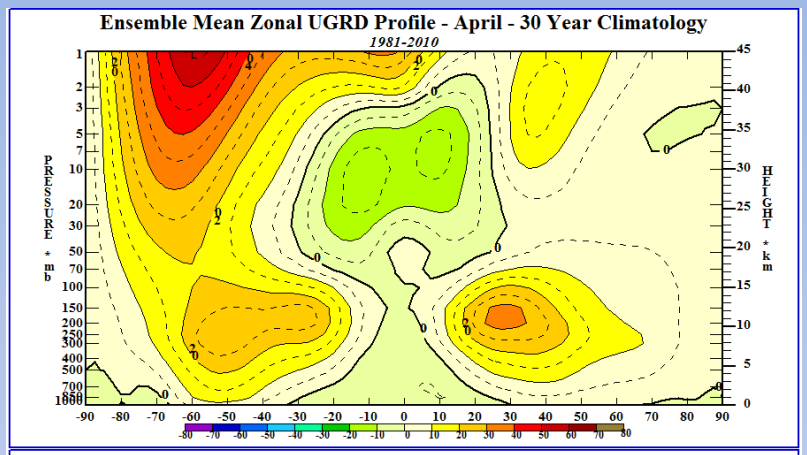
Vvel
ω
(Pa/sec)

April – Ensemble Mean and Variability

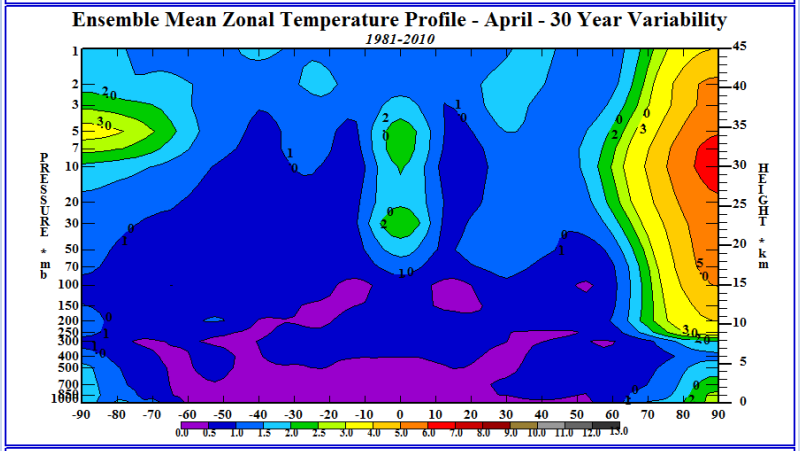
T_m



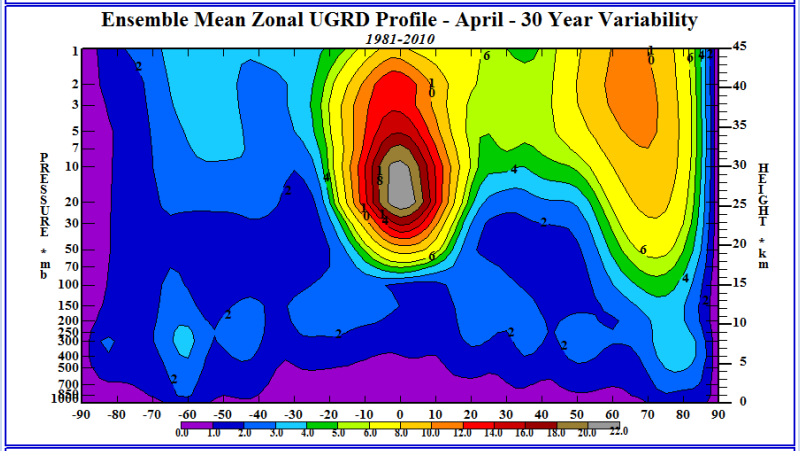
u_m



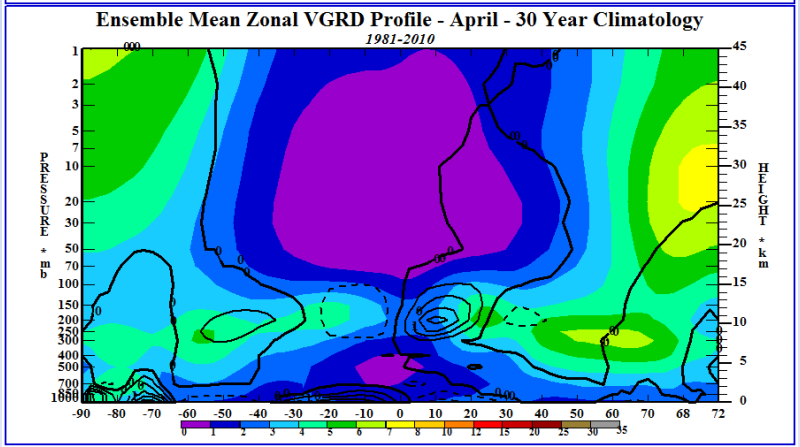
$\overline{T_m{}'}$



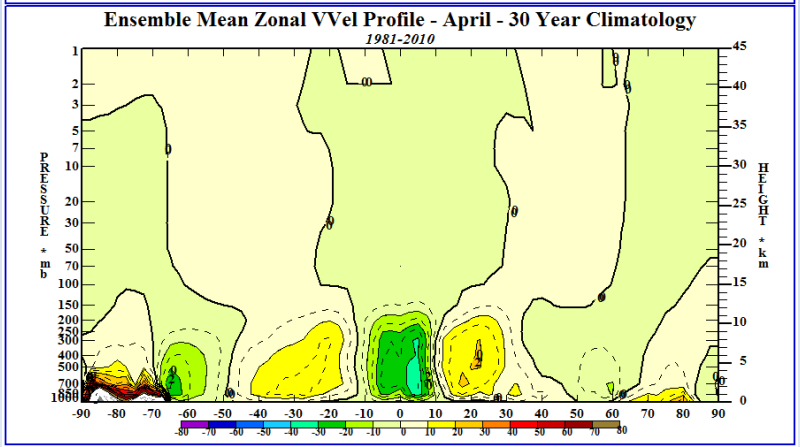
$\overline{u_m{}'}$



v_m and $\overline{v_m{}'}$

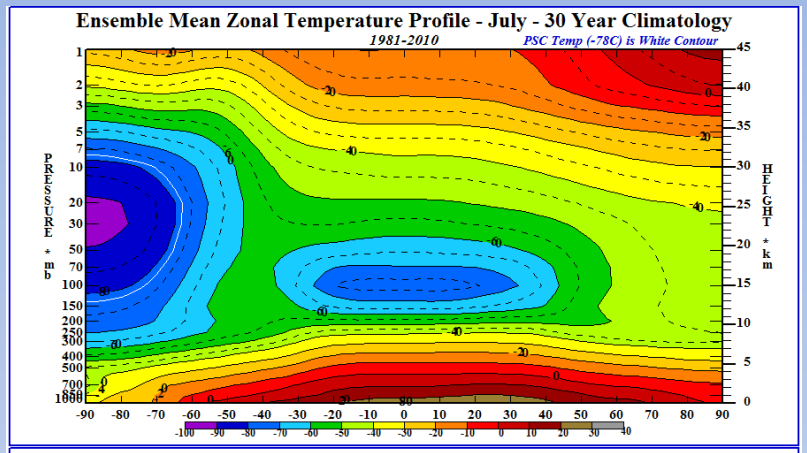


Vvel ω (Pa/sec)



July – Ensemble Mean and Variability

T_m



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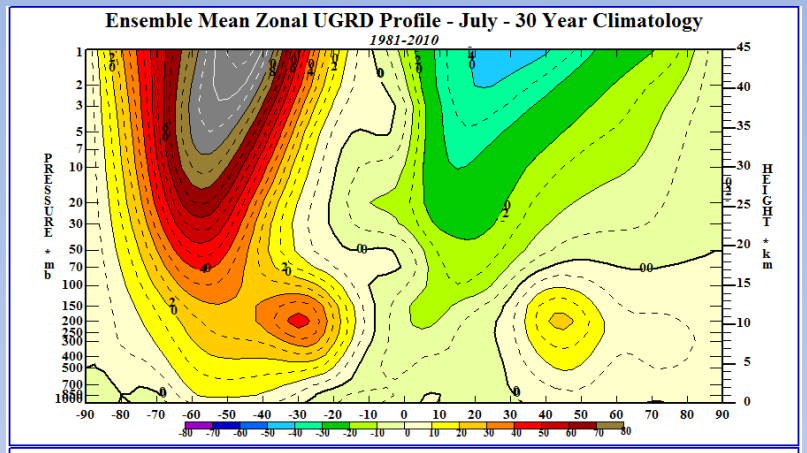

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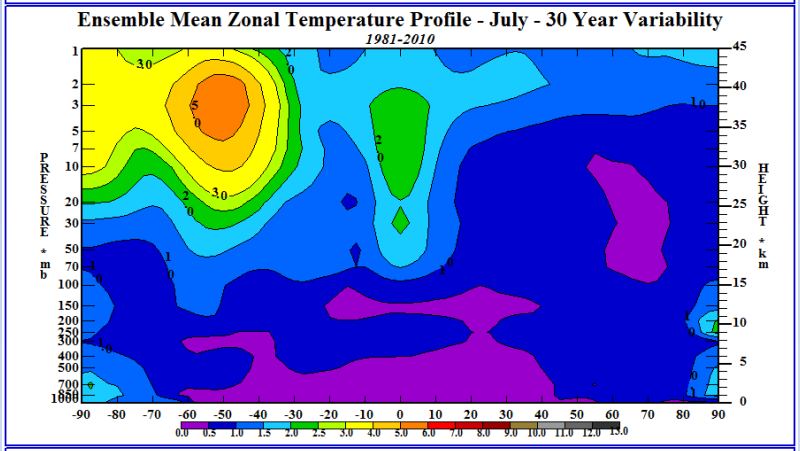

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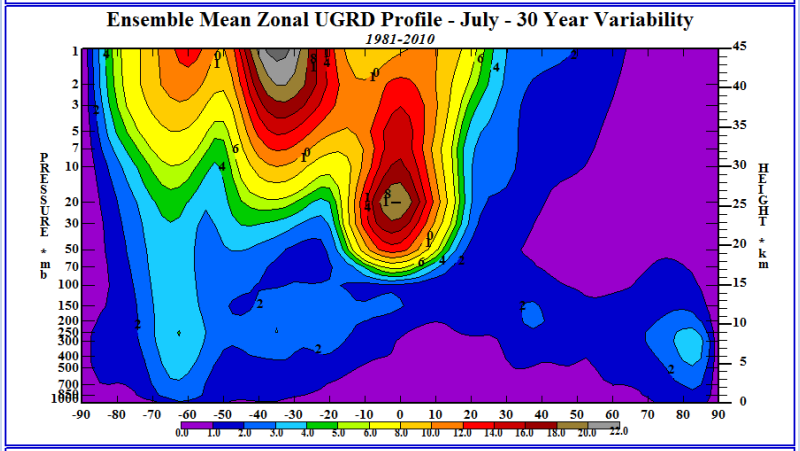
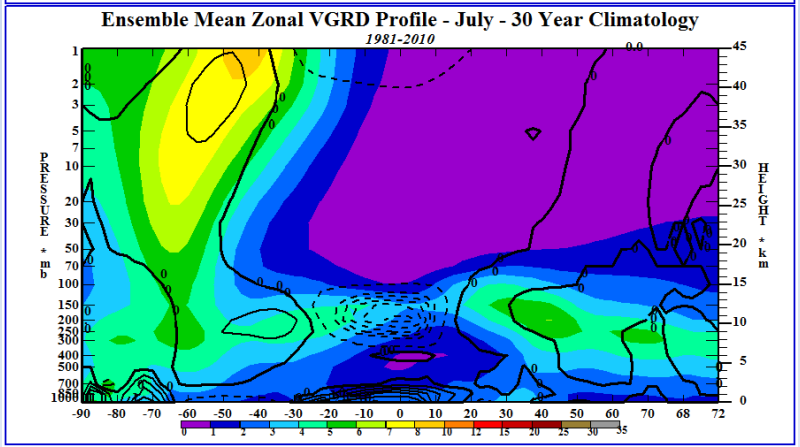
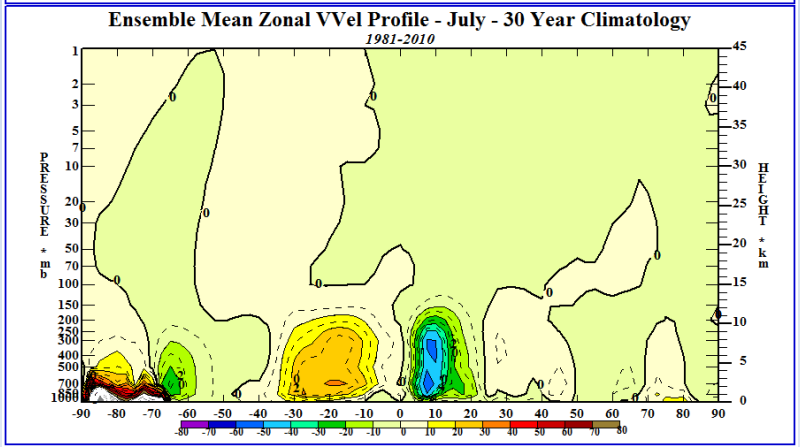


v_m and $\overline{v_m{}'}$

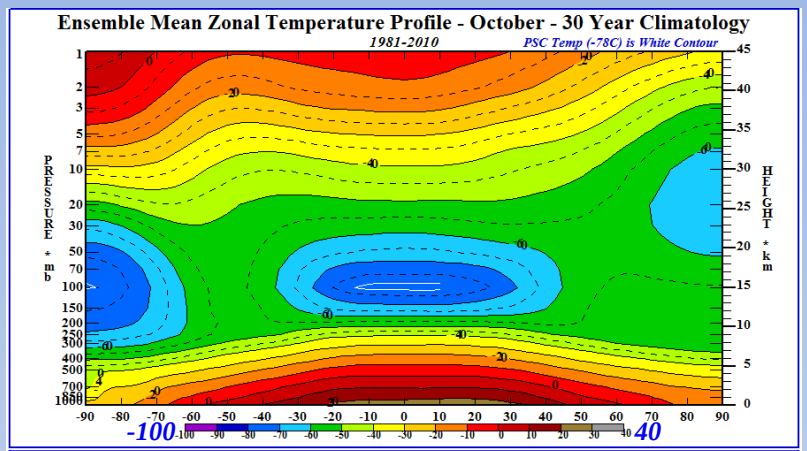


Vvel ω (Pa/sec)

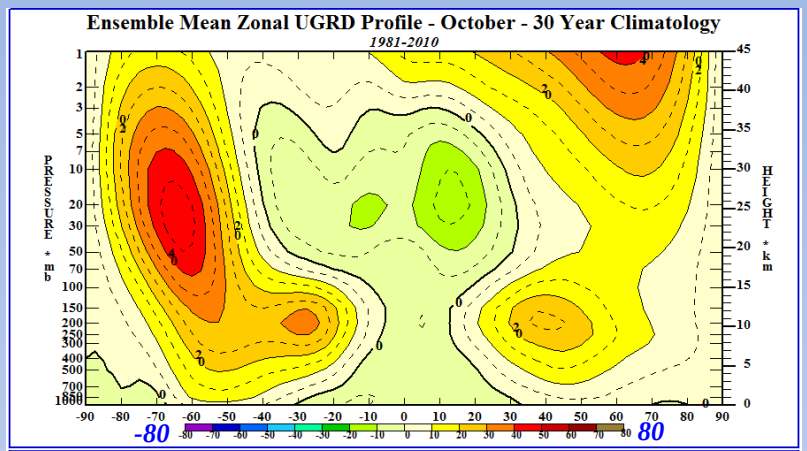


October – Ensemble Mean and Variability

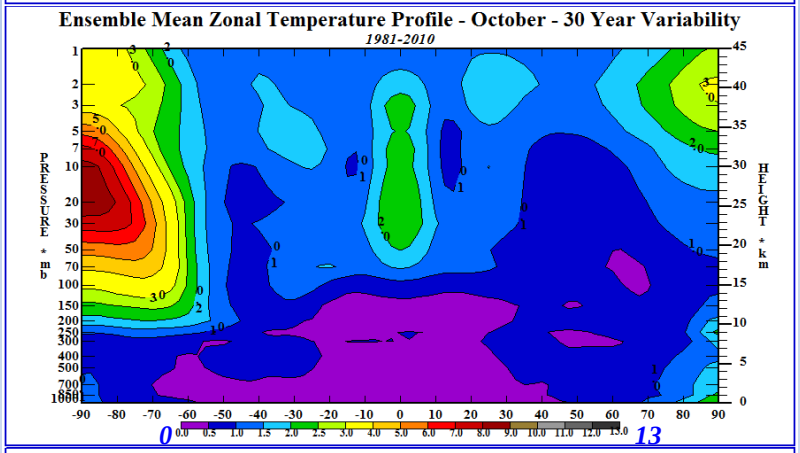
T_m



u_m



$\overline{T_m'}$



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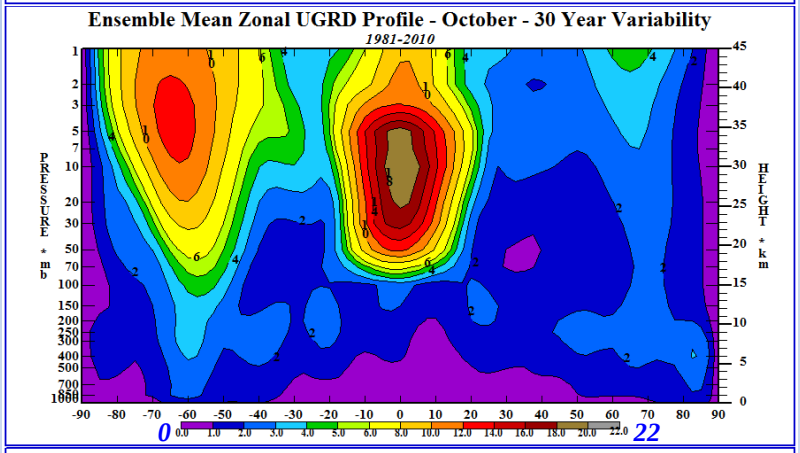
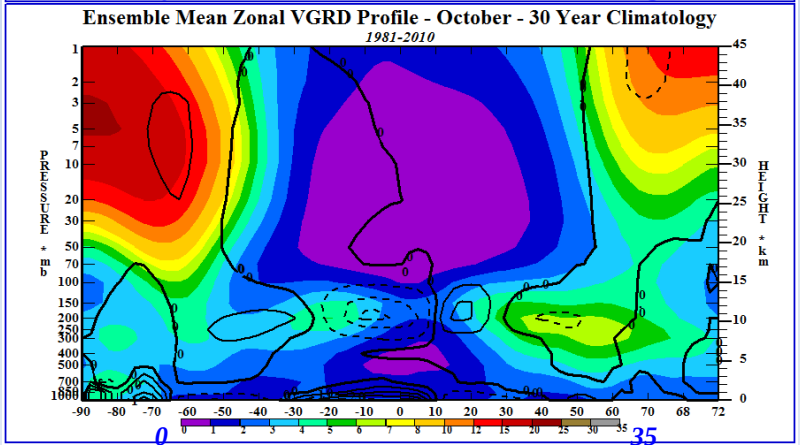
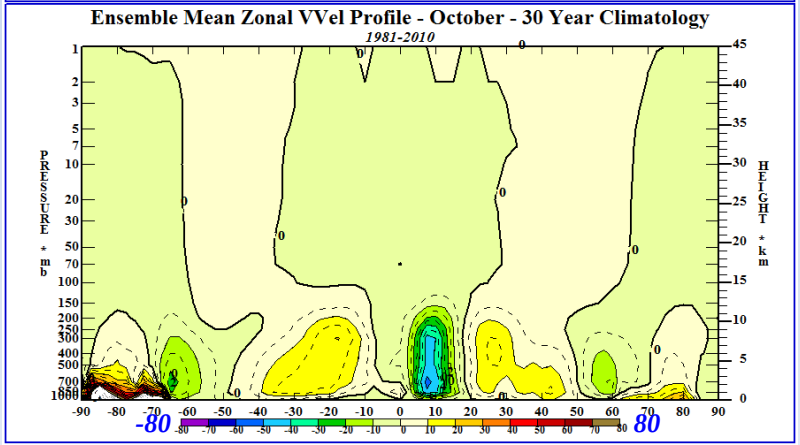


v_m and $\overline{v_m'}$

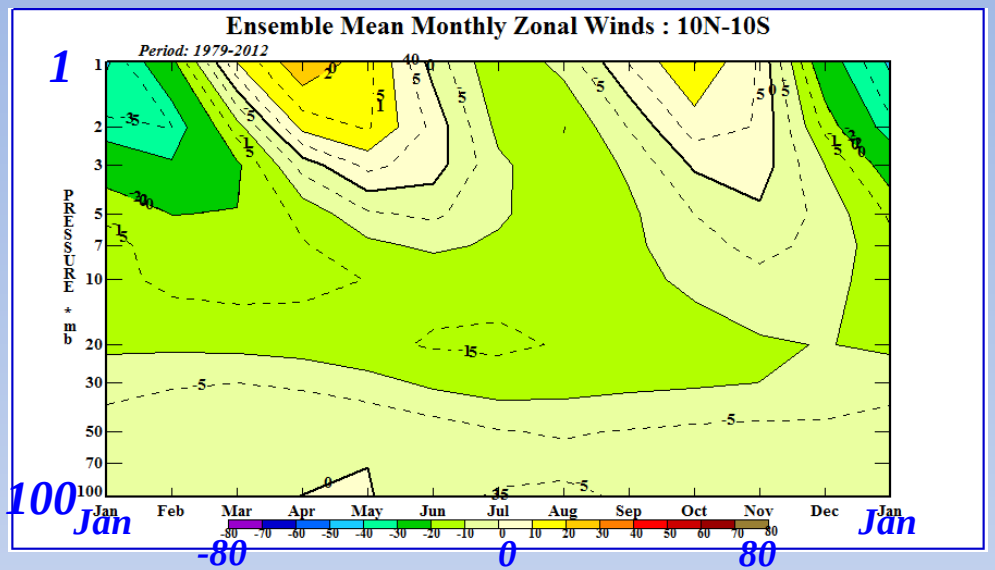


Vvel ω (Pa/sec)

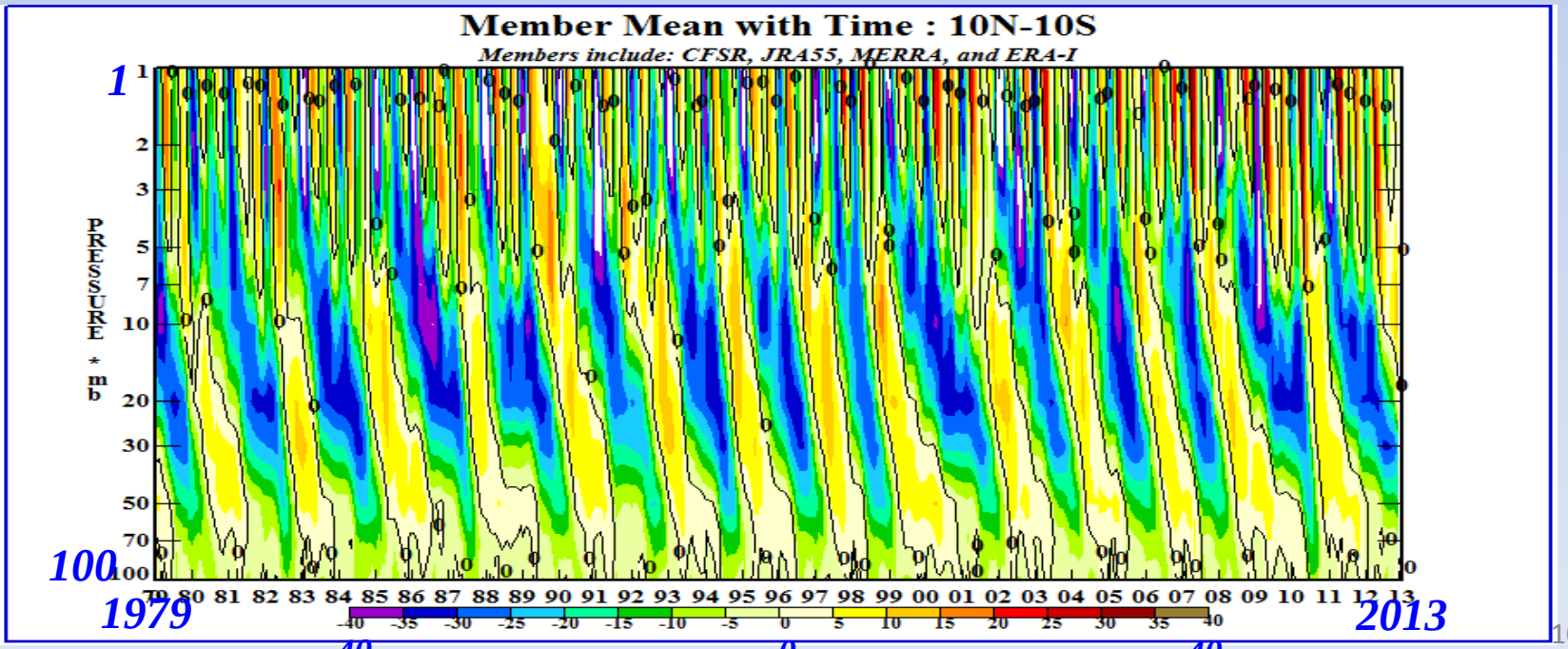


REM Zonal Winds Features at Equator

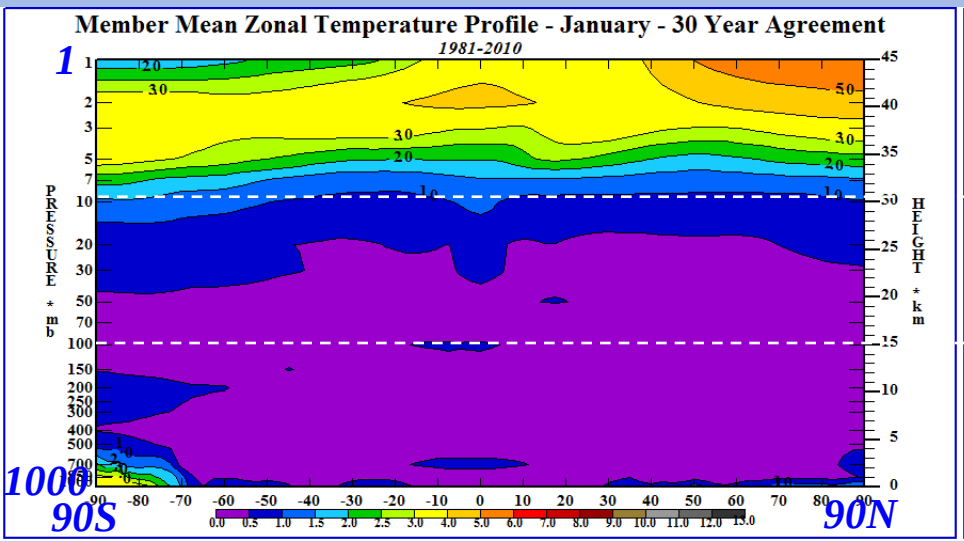
Monthly <u>Means</u> Shows SAO

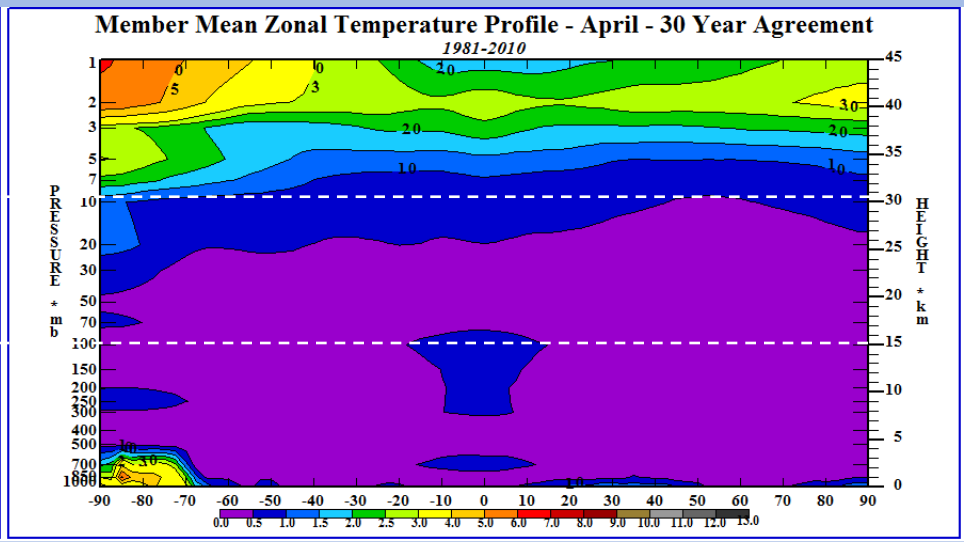


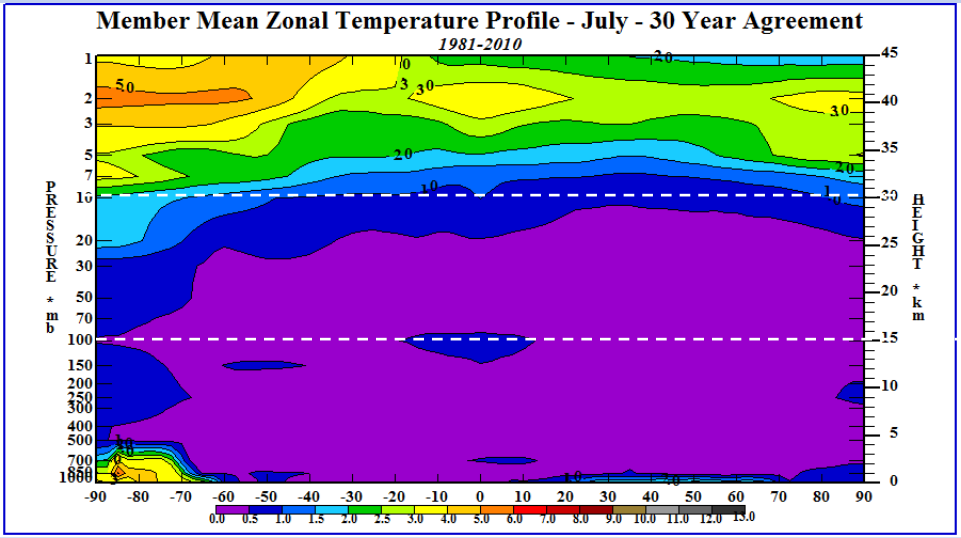
<u>Departure</u> from Monthly Means Shows QBO

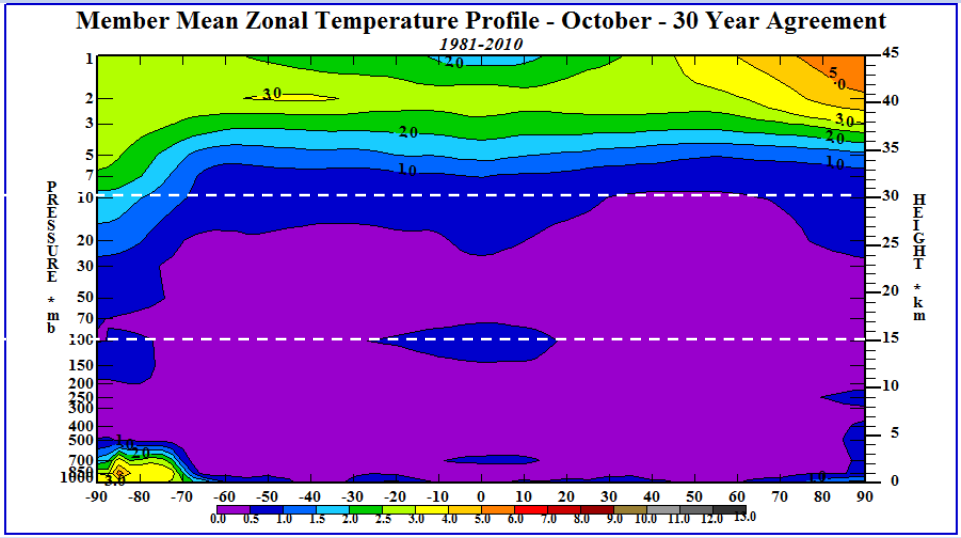


Agreement of Members' Temperature Decreases with Height









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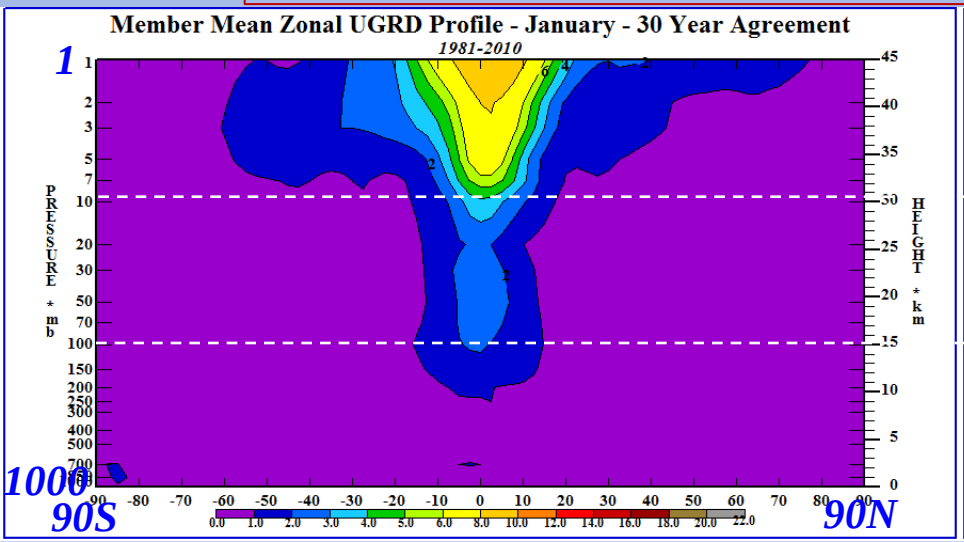
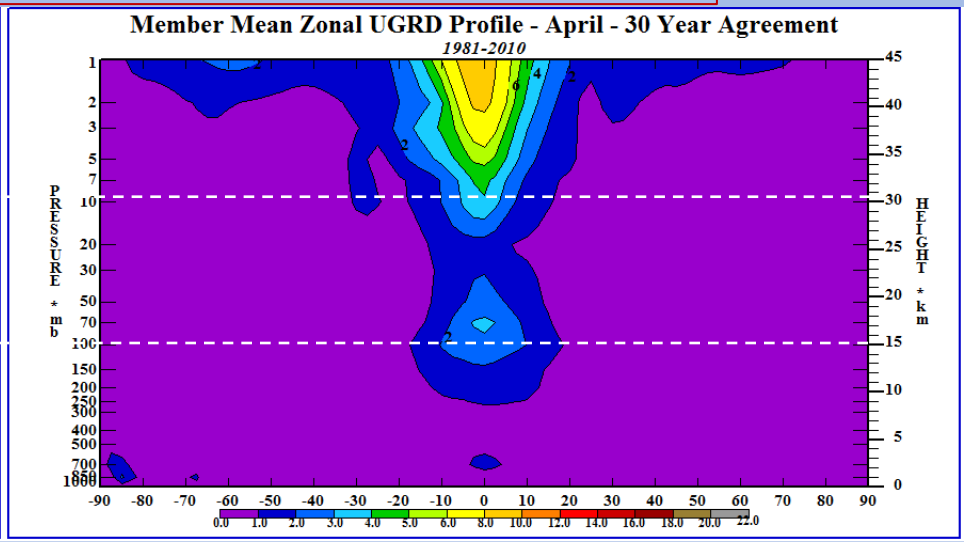
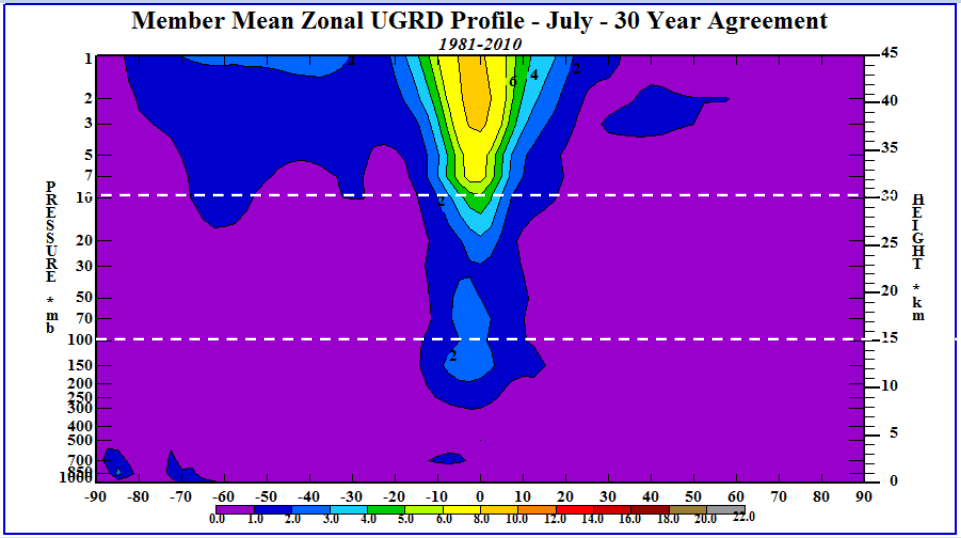
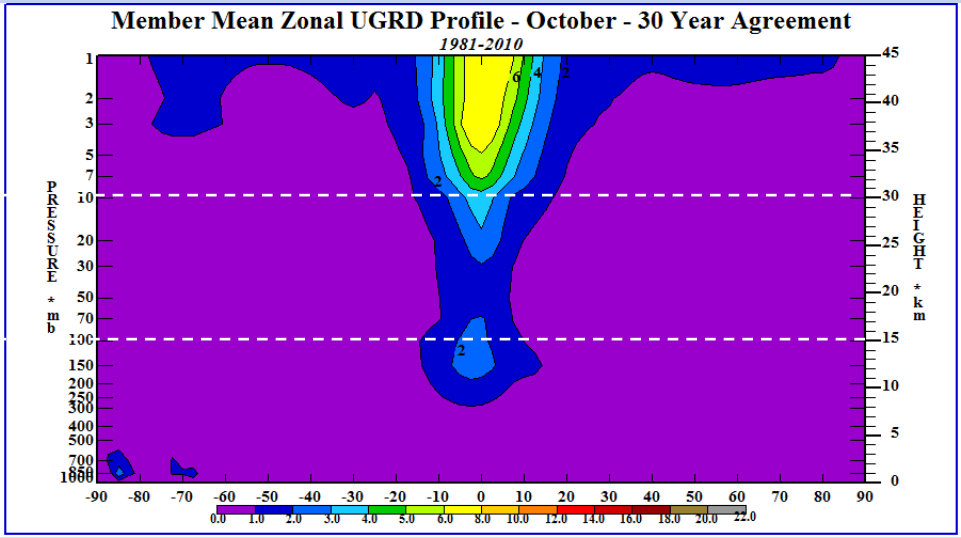
Agreement of Members' Zonal Wind Decreases in QBO and SAO Region









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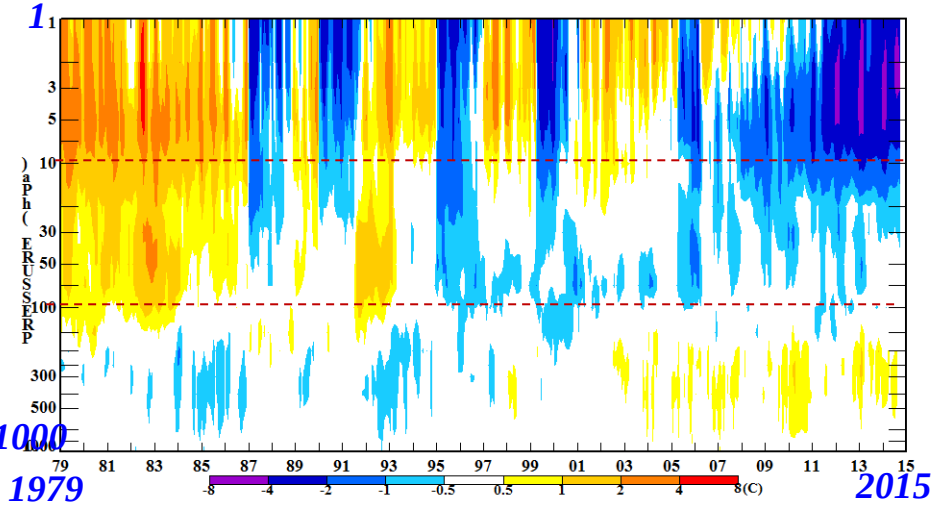
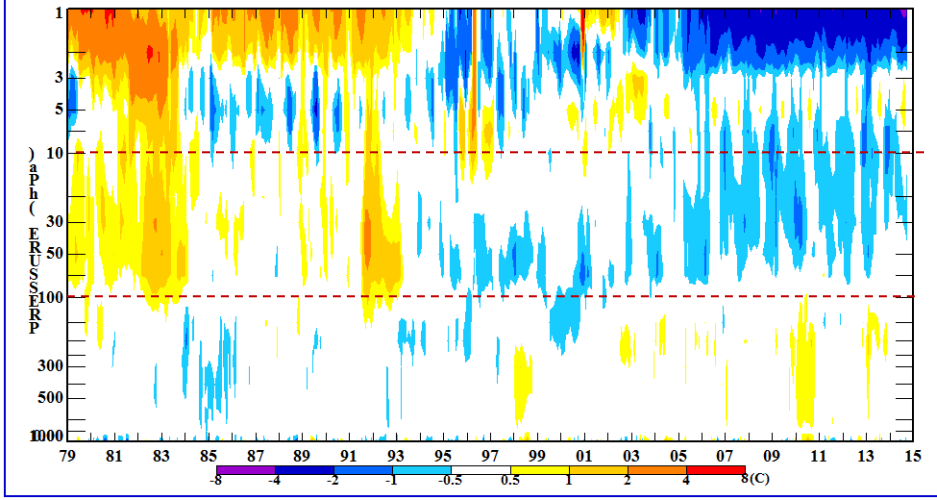
Individual Member Global Mean Temperature Anomaly

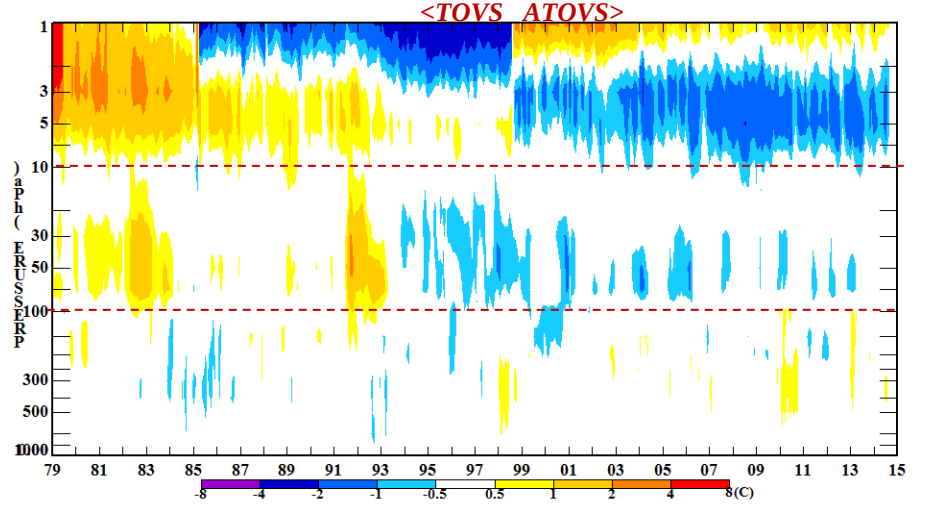
CFSR



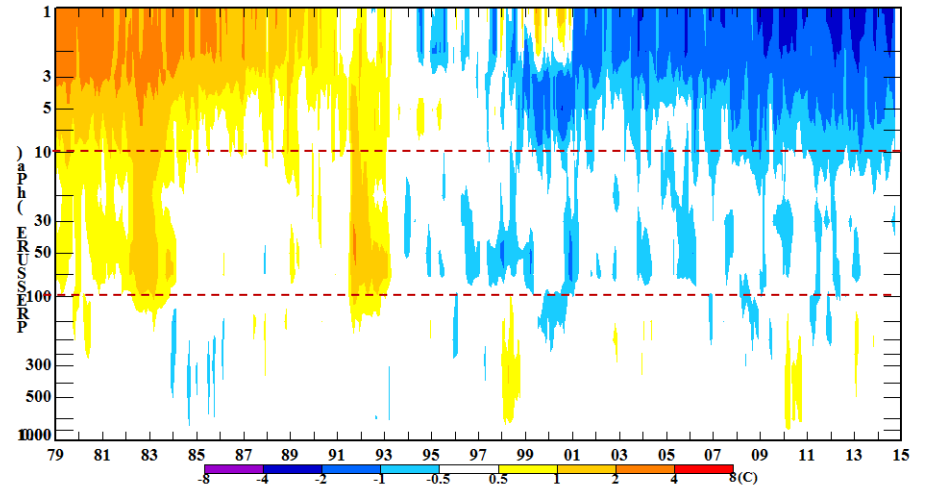
MERRA



ERA-I



JRA55

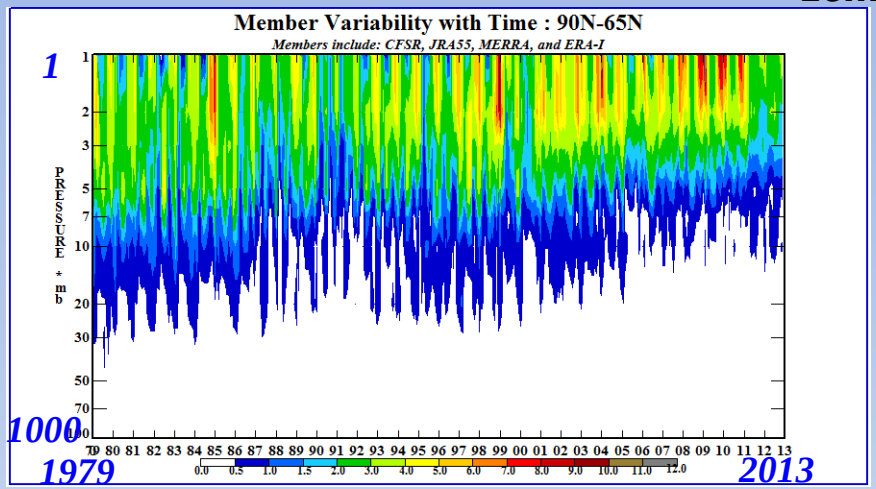


-8 -4 -2 -1 -.5 .5 1 2 4 8

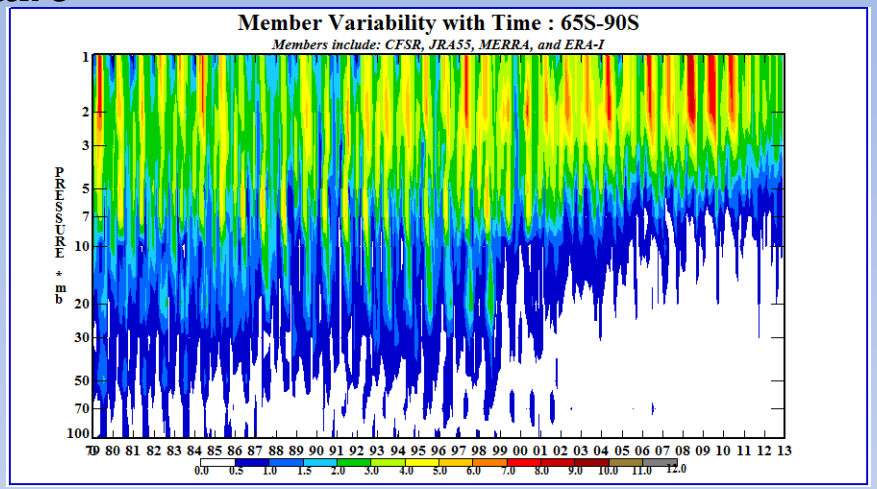
Member Variability Over Time

Temperature

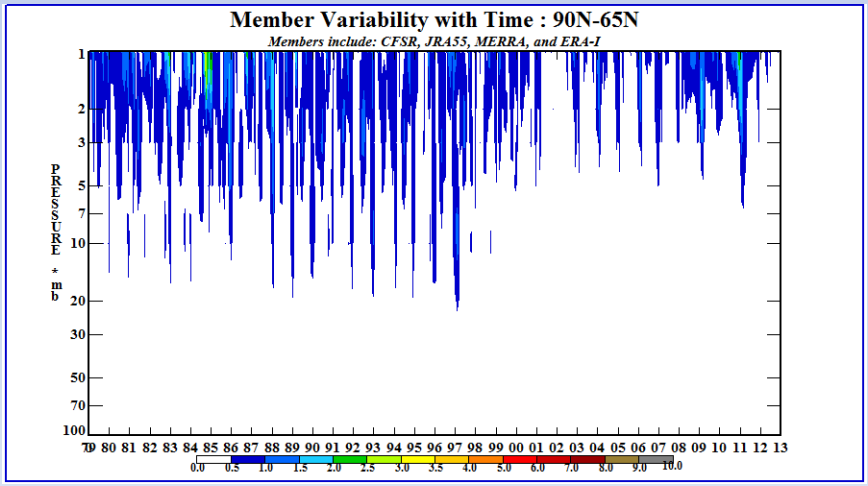
90N-65N

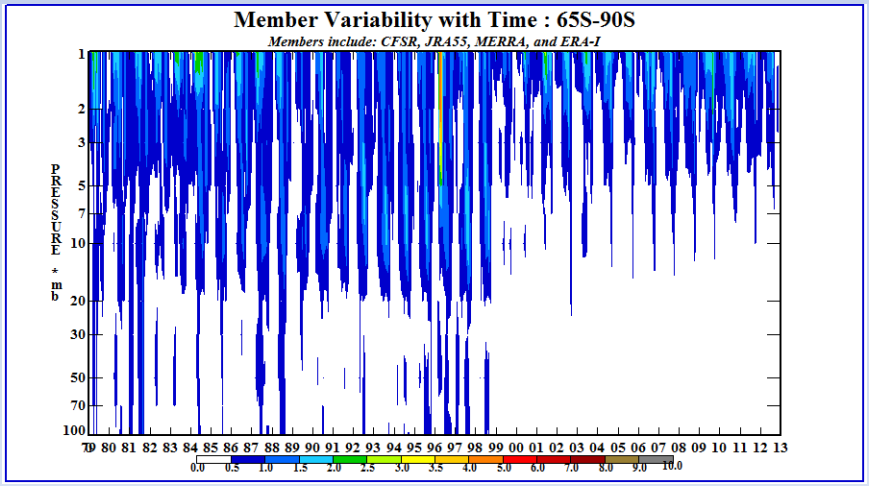


65S-90S



Zonal Winds





Amplitude of Annual Temperature Cycle

90N-65N

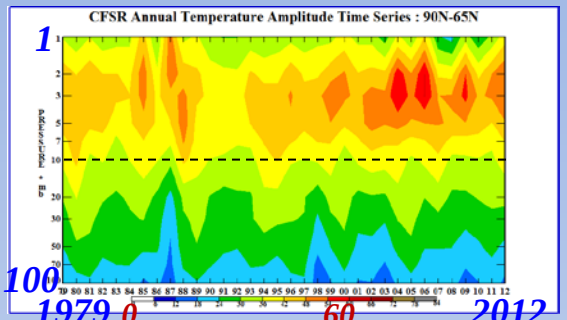
65S-90S

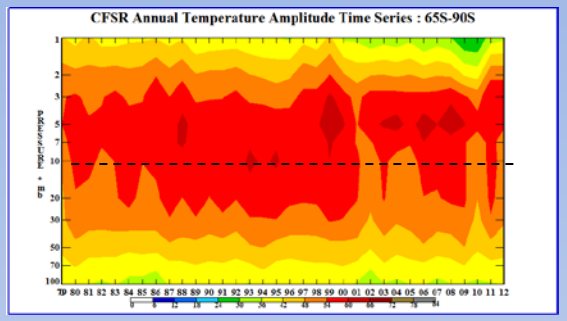
CFSR

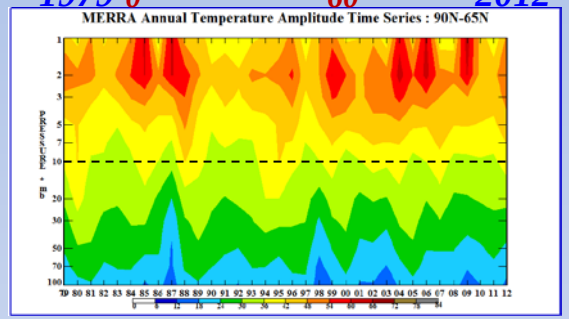
MERRA

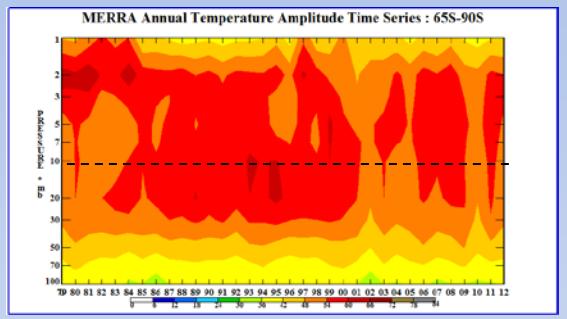
ERA-I

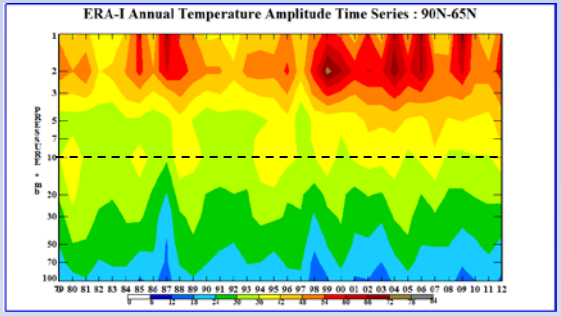
JRA55

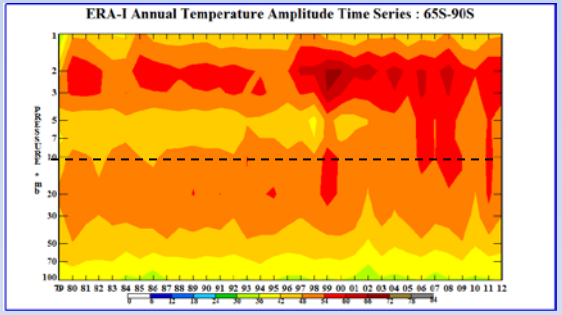


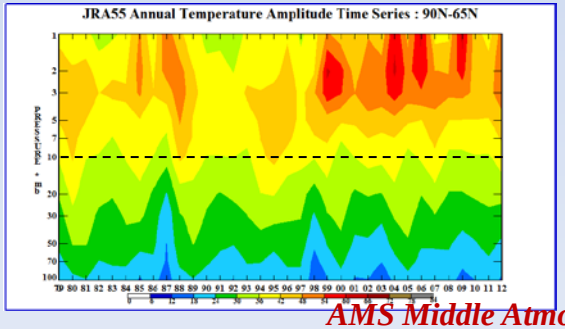


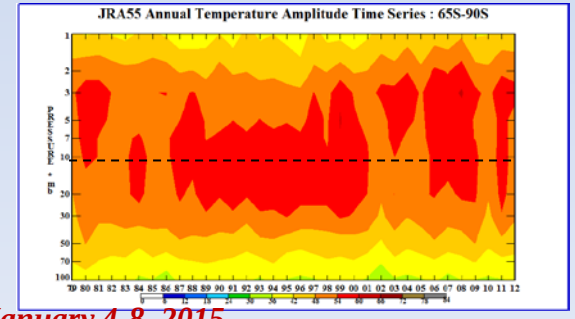












Summary

- An Ensemble mean of the four most recent reanalyses was generated over the 1981-2010 period.
- Individual members of agree to within 1° in troposphere and lower stratosphere, but show increasing disagreement upward through the mid and upper stratosphere.
- Greatest disagreements occur in the first 10 years, improve after 2000.
- This is a point of work for future reanalyses, i.e., to improve the agreement in the upper stratosphere, especially during the TOVS (SSU) period (1979-1998/2005)
- Other S-RIP chapters will examine how fluxes and derivatives are affected by these disagreements

S-RIP SPARC Reanalysis Intercomparison Project

Any Time Left for Questions?