



Current and Future Plans at NCEP for Reanalysis

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Why Reanalysis

- Good:
 - A data assimilation system which is kept unchanged over the reanalysis period.
 - Eliminates perceived climate jumps associated with changes in the data assimilation system.
 - Assimilates data sets not available or incomplete during operational use.
 - Data sets are corrected.
 - Hindcasts (sometimes called reforecasts or retrospective forecasts) are initialized with the reanalysis and are used used to calibrate subsequent real-time climate forecasts.
- Not so good:
 - DAS is consistent, but data assimilated is not.
 - A lot more satellite data now than in 1979.
 - Running a CDAS implies that certain technologies and computer algorithms are frozen in time, which in the face of ever-changing data ingest and computer configurations can be a challenge, and is ultimately impossible.

Reanalyses at NCEP

- **NCEP/NCAR Reanalysis (R1)**
 - Kalnay et al, 1996
 - 1957-Present
 - Initiated: January 1995
 - Model Resolution: T62/L28
- **NCEP/DOE AMIP-II Reanalysis (R2)**
 - Kanamitsu et al, 1999
 - 1979-Present
 - Initiated: 1998
 - updated N/N Reanalysis and not a next-generation reanalysis
- **Coupled Forecast System Reanalysis (CFSR)- 2010**
 - Saha et al, 2011
- **CFSR-Lite –??**
 - Depends upon funding/computer resources

R2

- *Similarities:*
 - same resolution as N/N Reanalysis: T62, 28 levels
 - same raw observed data
 - SSM/I data not used
 - same dependence on NESDIS temperature retrievals
- *Fixes:*
 - fixed Southern hemisphere PAOBS problem (1979-1992)
 - fixed snow cover analysis (1974-1994)
 - fixed humidity diffusion to remove spectral snow problem
 - fixed cloud tuning parameters
 - fixed snow melt term
 - fixed oceanic and improved desert albedo (Briegleb 1982)
- *Changes:*
 - only analyzing 1979-1997
 - fewer NCEP scientists and more external scientists involved
 - using the computer facilities at NERSC (Berkeley CA) instead of at NCEP
 - using the Internet for data distribution and analysis

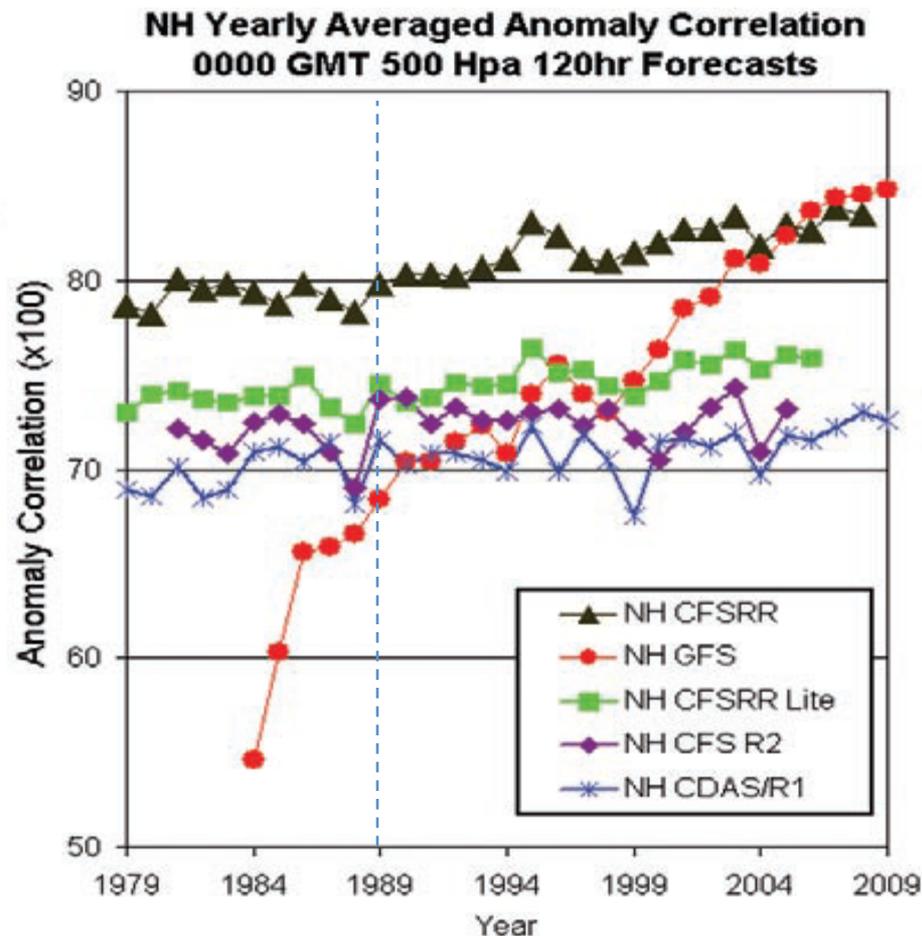
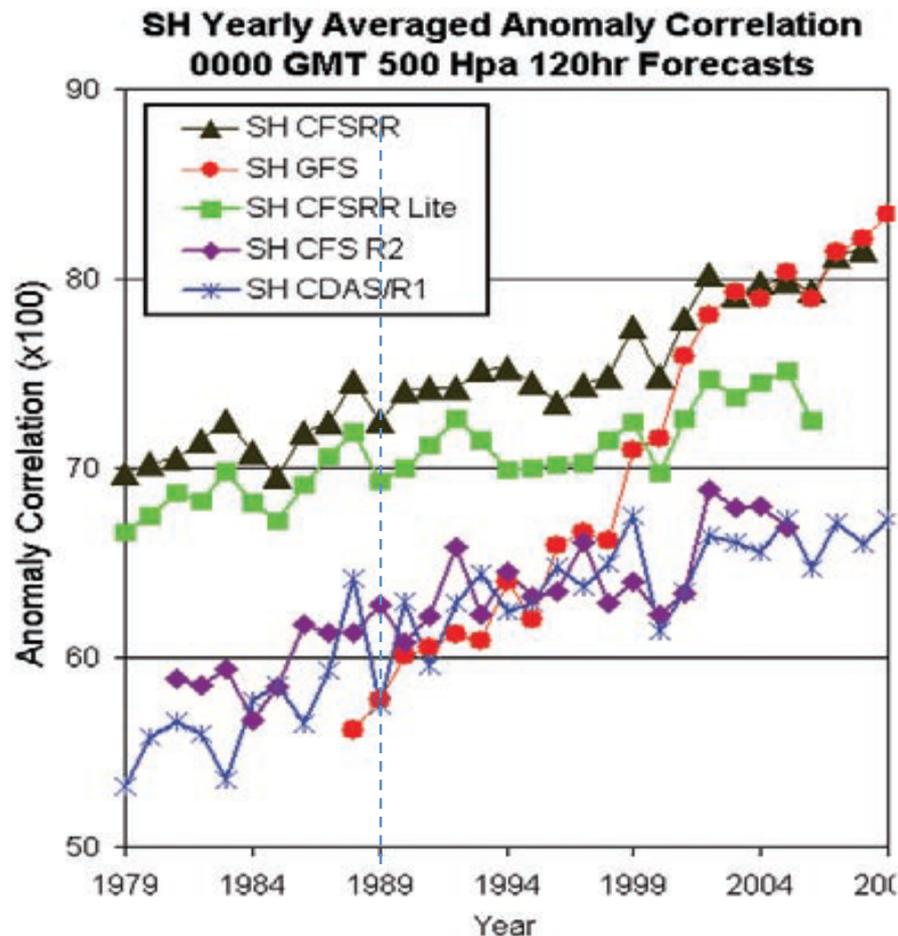
R2

- *Improvements:*
 - updated precipitation parameterization (SAS vs Pan-Grell scheme)
 - smoothed orography (needed by new convective scheme)
 - soil moisture correction based on observed precipitation
 - Hong-Pan planetary boundary layer (non-local diffusion)
 - CO₂ set to 350 ppmv (AMIP-II constant)
 - new short-wave radiation (Chou 1992)
 - radiation code run more frequently (1 hour vs 3 hours)
 - cloud-top cooling more realistic
 - updated cloud parameterization
 - better diagnostic fields of clouds
 - better snow/water budget diagnostic fields
 - snow mask interpolated from weekly to daily values
 - improved sea-ice and SST fields (AMIP-II, Mike Fiorino)
 - nudging of deep layer soil wetness removed
 - updated observational error table (assimilation system)

CFSR

- Began in 2010
- T382/L64 (0.03 hPa)
- Coupled Atmosphere, Land, Ocean, Cryosphere
- 6 Streams due to limited availability of computer resources.
- Streams were overlapped for one year
- Primary reason for being created was to be used to initialize hindcasts and CFSv2 climate forecasts (0-9 months)
- Many improvements to R1/R2
 - Use of satellite radiances
 - Higher top/more layers
 - Finer resolution
 - Different DAS and forecast model

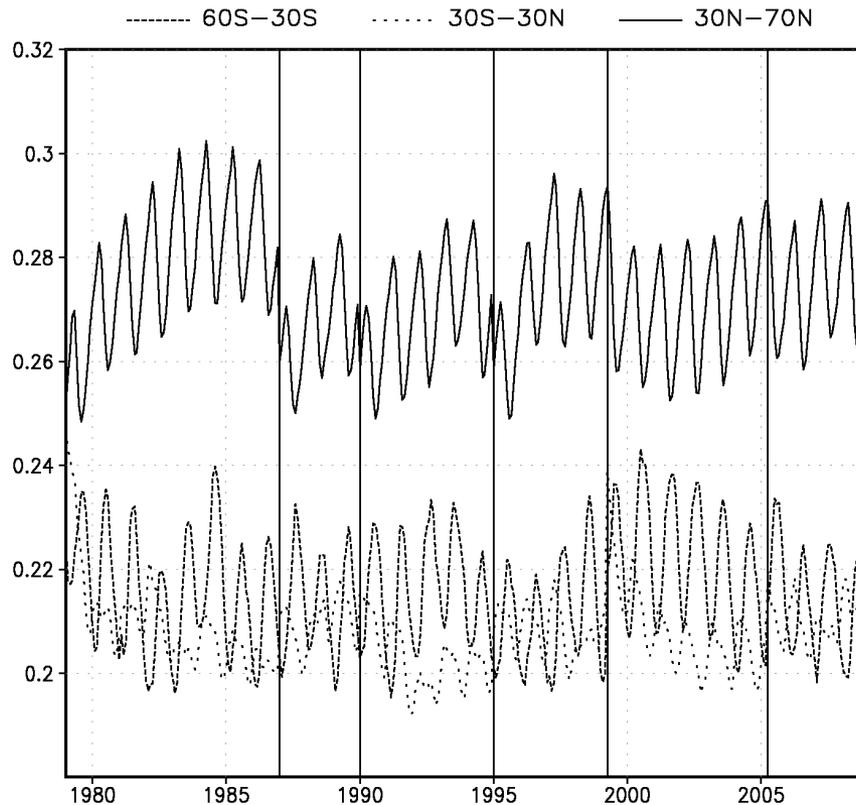
Comparison of 500 hPa Anomaly Correlation



CFSR Issues

- Stream jumps evident in many parameters
 - Soil moisture
 - Sub surface ocean temps
 - Stratospheric temperatures
- TOVS to ATOVS transition (1998)
 - Increase atmospheric water vapor
- Other issues:
 - Cool upper troposphere
 - Poor winds in ENSO region
 - Weak shear in Atlantic MDR
 - Needed to use ERA40 equatorial winds in early years
 - Couldn't resolve a good QBO
 - Incorrect ozone observation errors prevented utilization of obs in upper stratosphere

Global mean monthly soil moisture



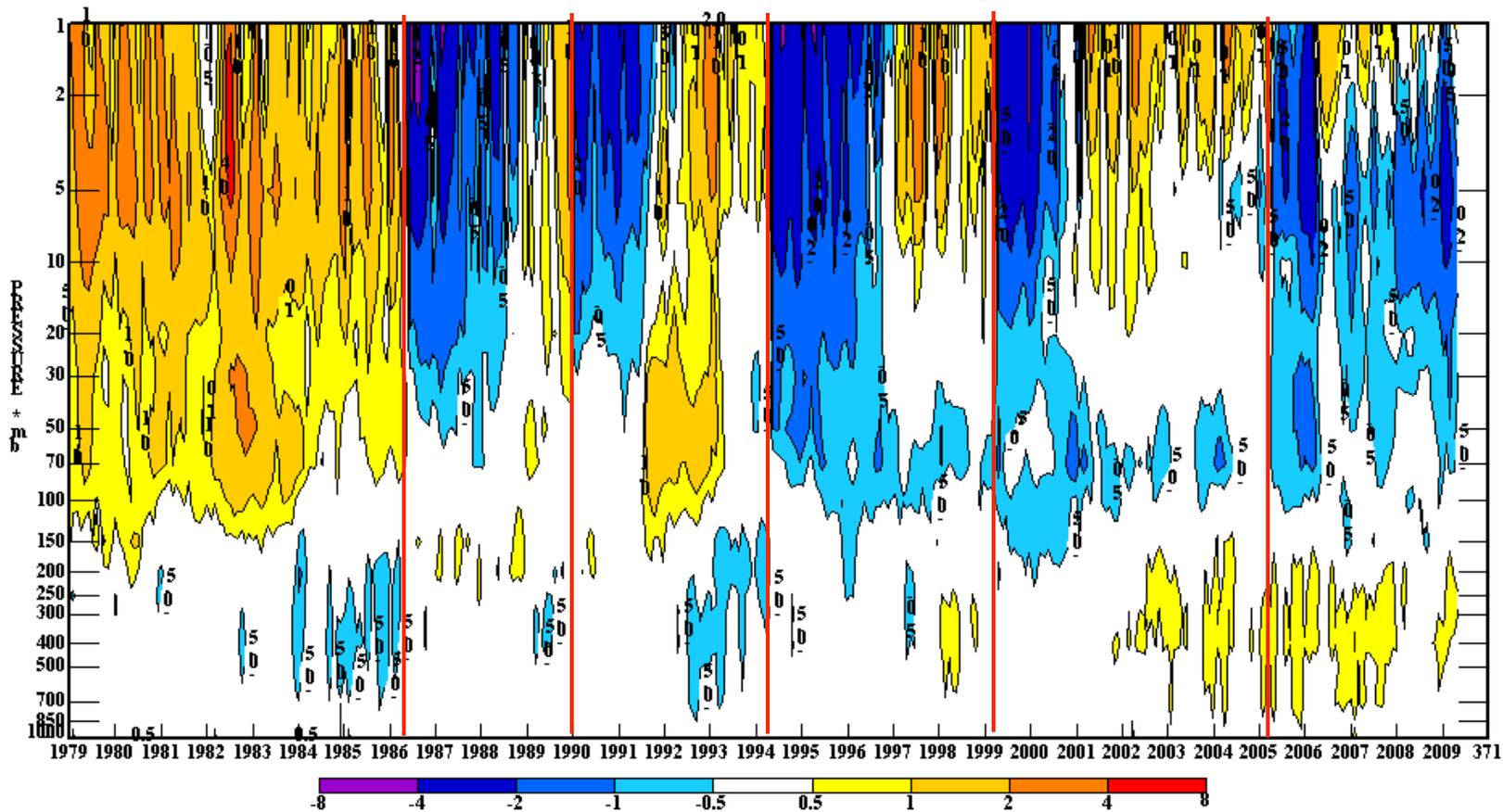
Duration of each stream

- Stream 1: 1 Dec 1978 to 31 Dec 1986
- Stream 2: 1 Nov 1985 to 31 Dec 1989
- Stream 5: 1 Jan 1989 to 31 Dec 1994
- Stream 6: 1 Jan 1994 to 31 Mar 1999
- Stream 3: 1 Apr 1998 to 31 Mar 2005
- Stream 4: 1 Apr 2004 to 31 Dec 2009

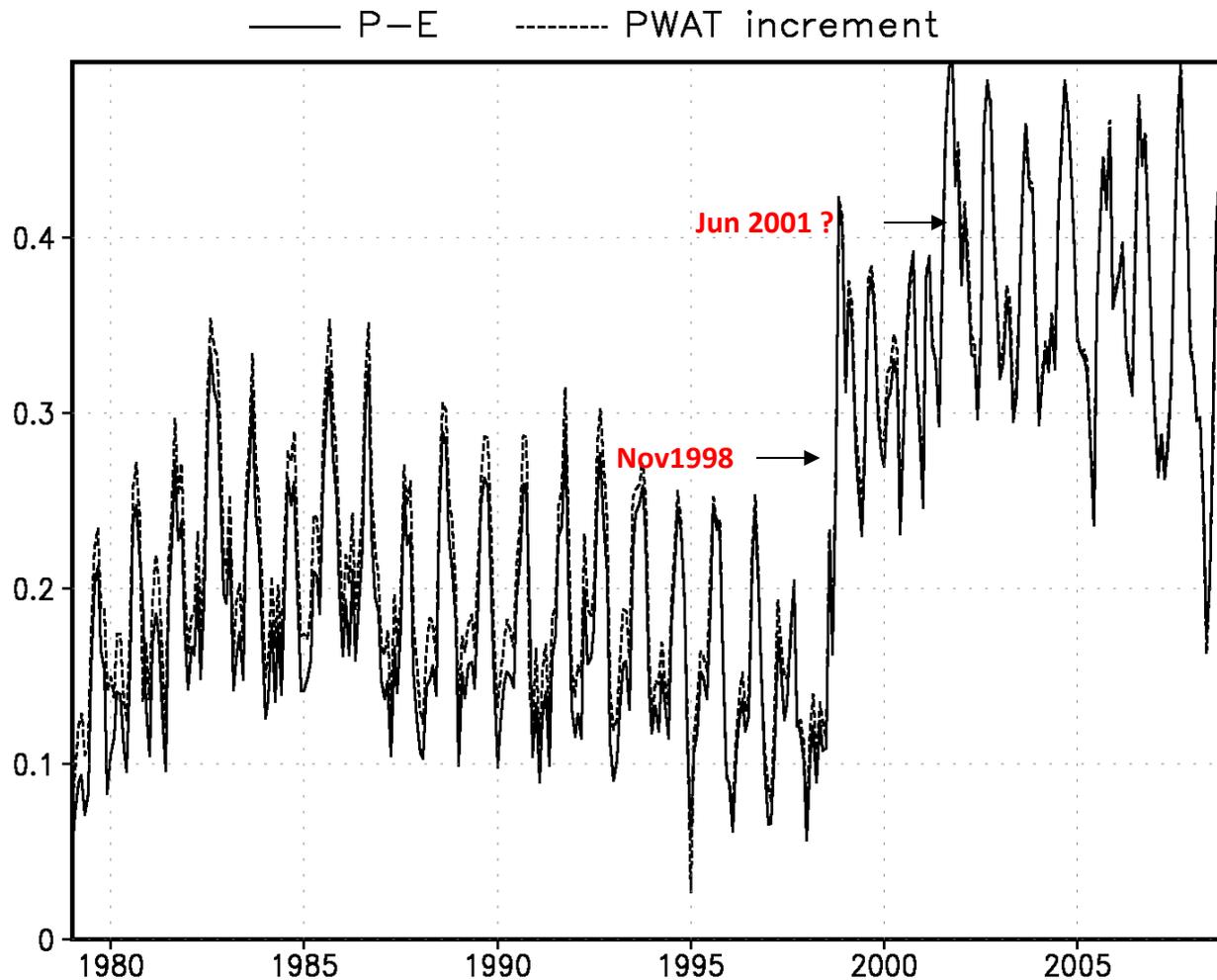
Beginning of each stream after spin-up

- Jan 1979
- Jan 1987
- Jan 1990
- Jan 1995
- Apr 1999
- Apr 2005

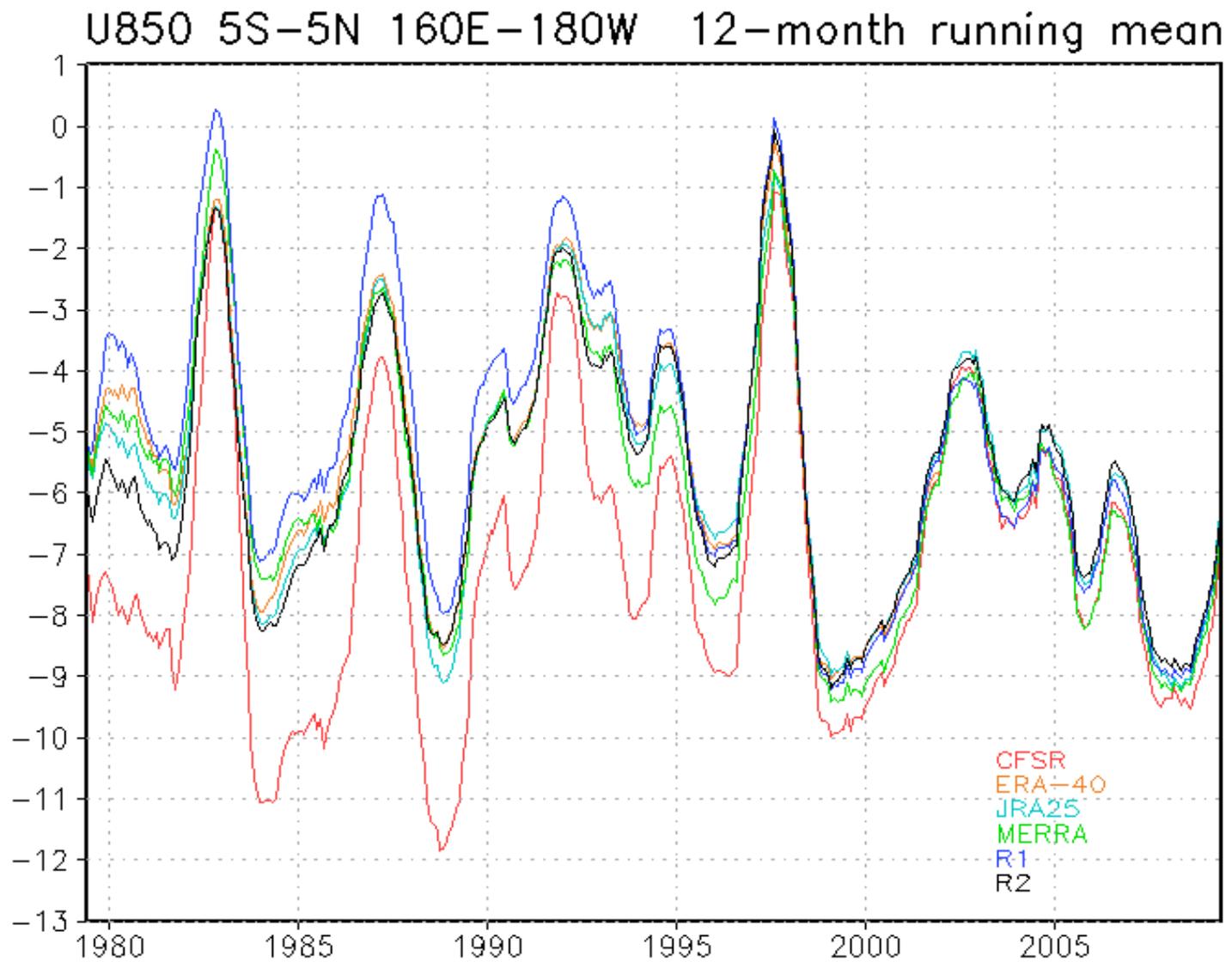
Monthly CFSR Temperature Anomalies GLOBAL (1979 - 2009)

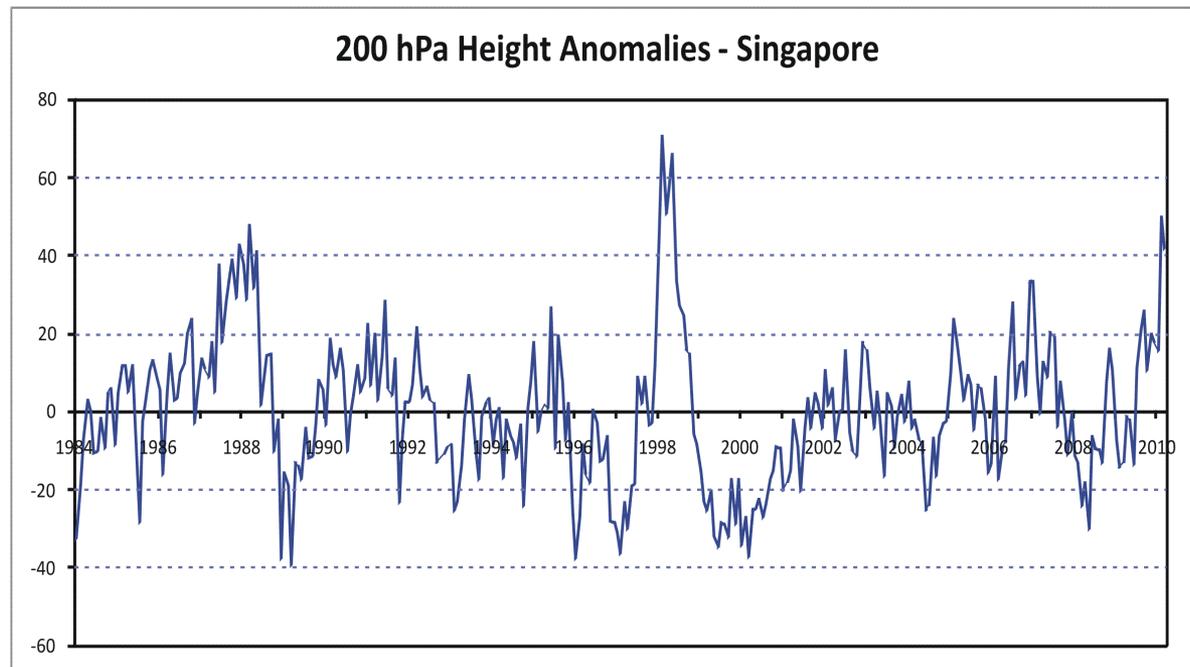
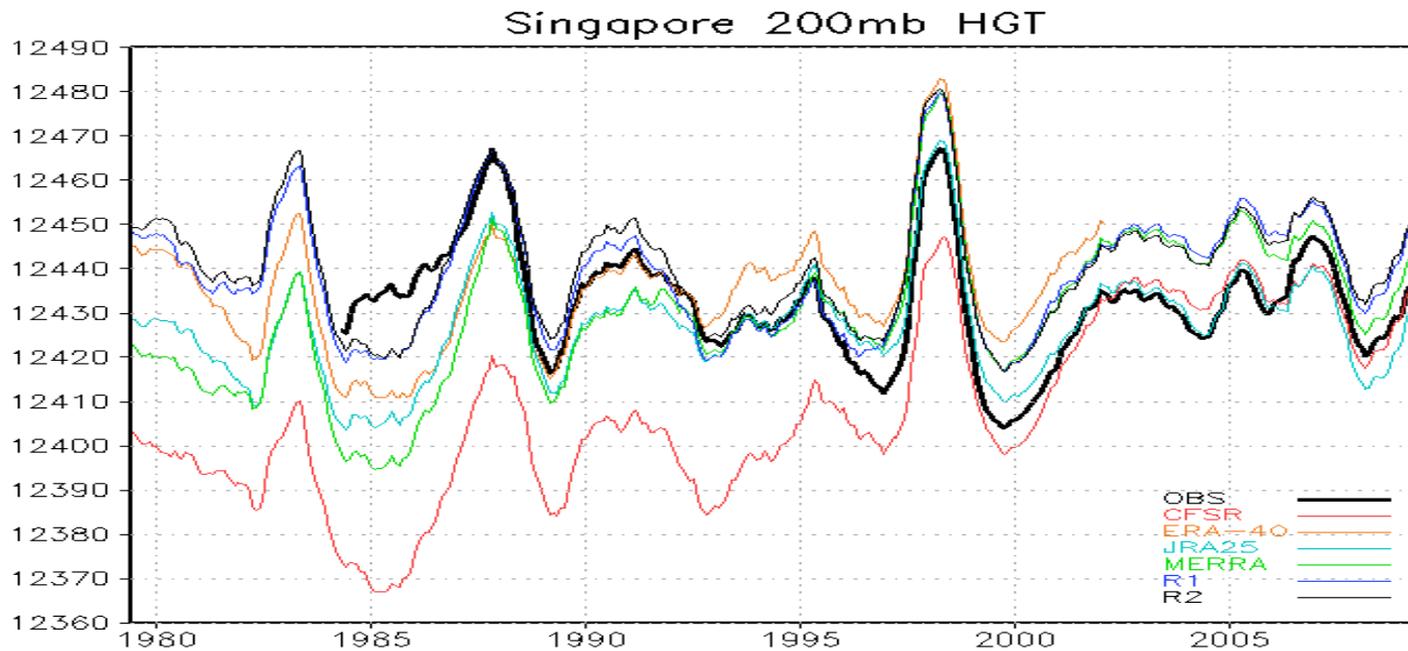


Global mean of monthly PWAT increment and P-E

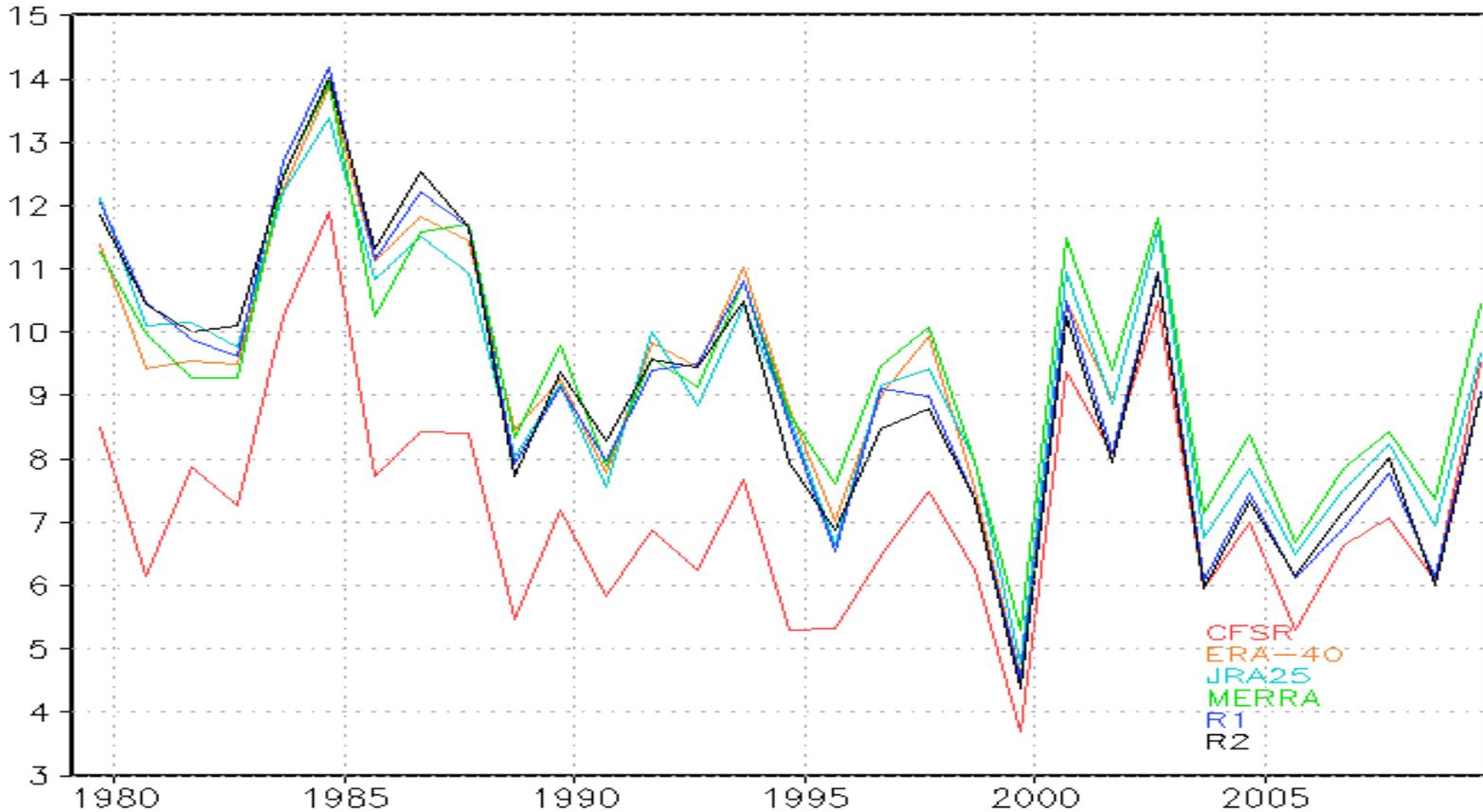


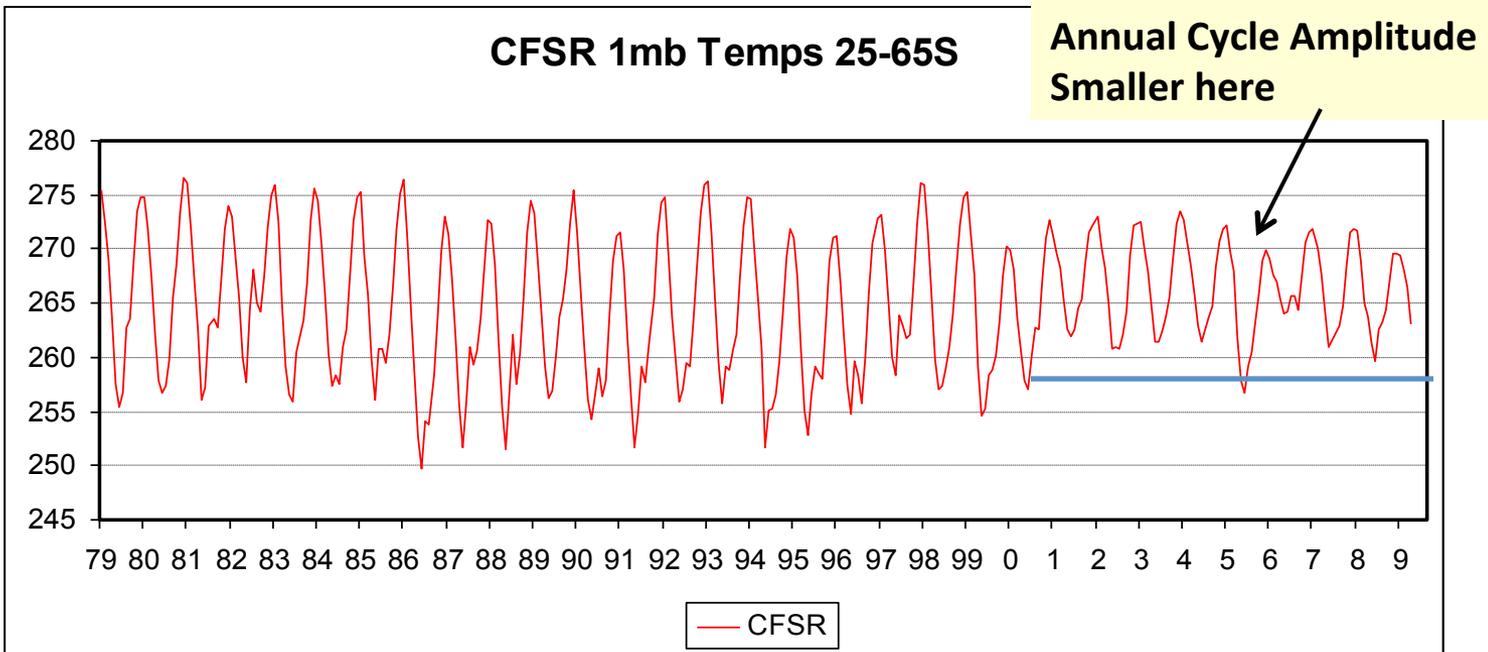
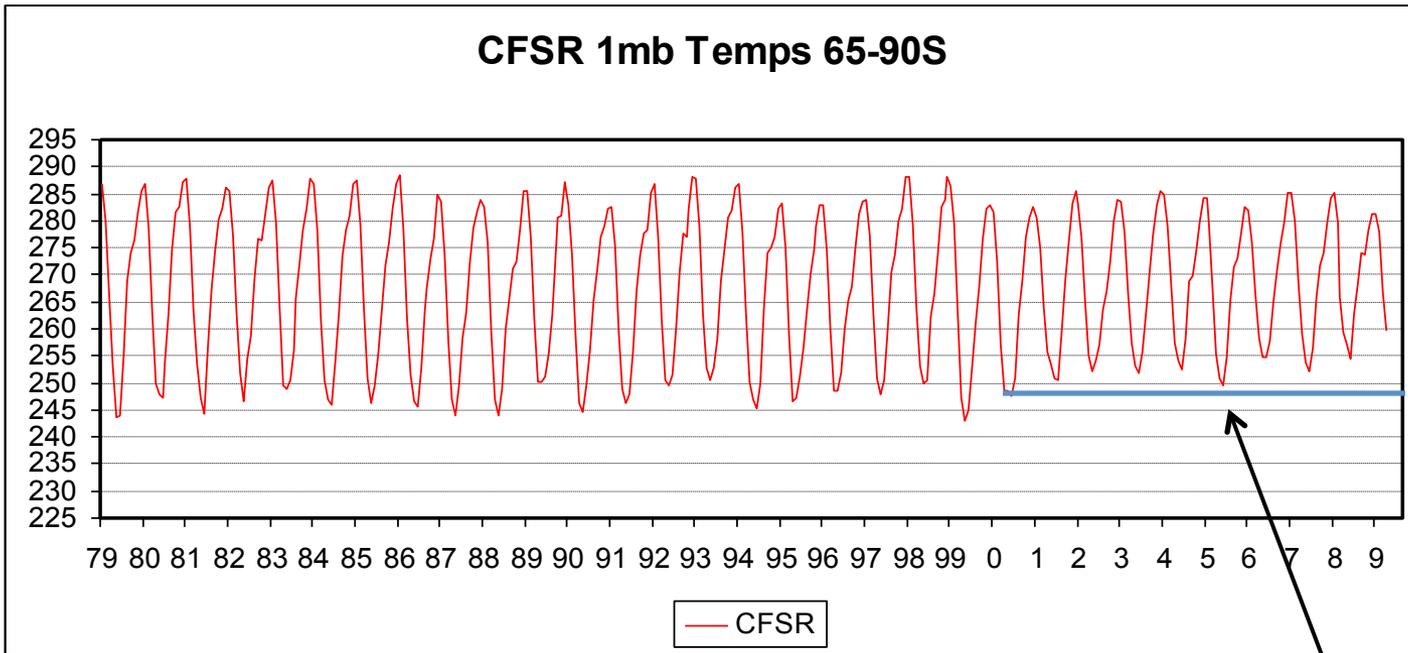
Possible cause: Transition from TOVS to ATOVS in late 1998. A fix assimilation system with that performs better with additional data after 1998/1999. Unlikely to get corrected with CFSR_L without (may be) considerable experimentation



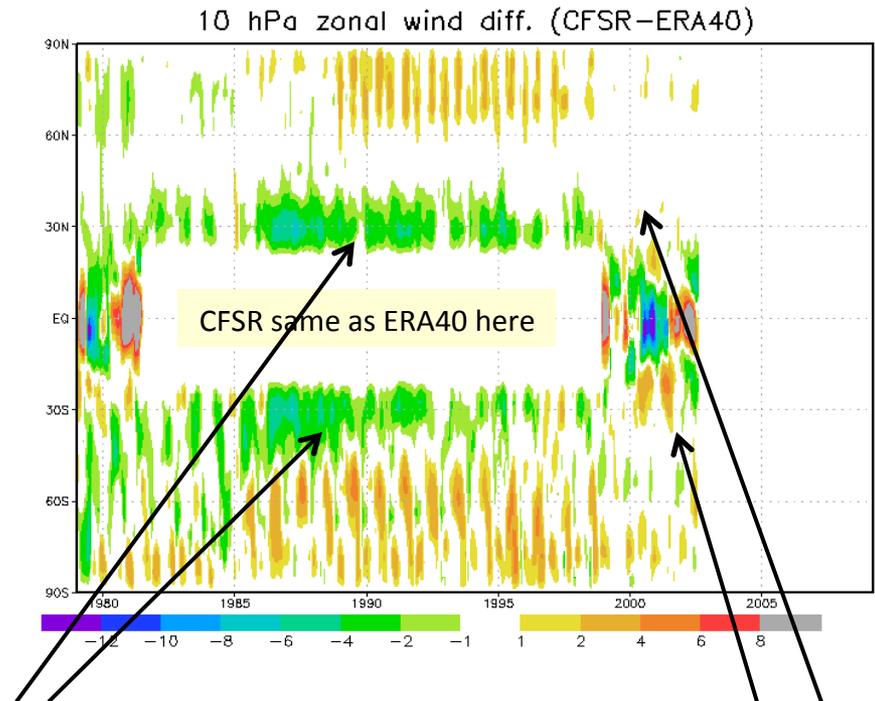
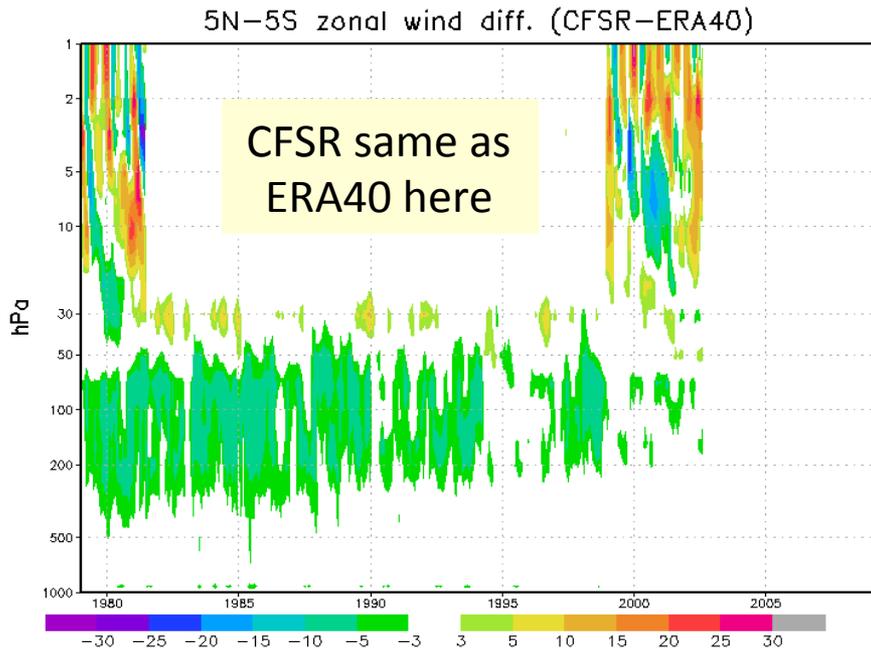


August-October 850-200 hPa wind shear Atlantic Hurricane Main Development Regions





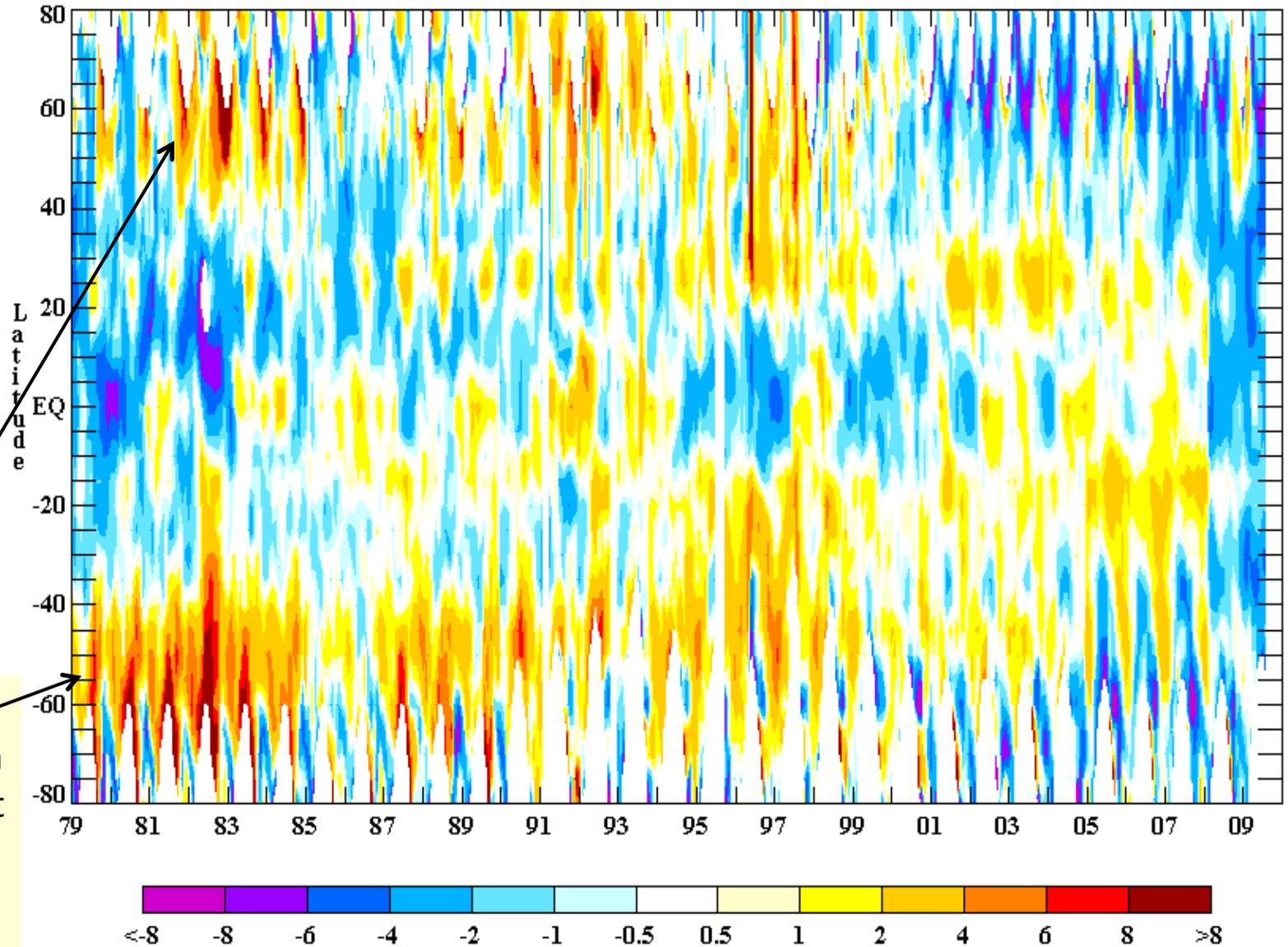
CFSR – ERA40 zonal winds



Zonal wind at adjacent latitudes react to mandated bogus winds

No reaction here

CFSR TOZ - SBUV COHESIVE (unadj_wo14)



CFSR-Lite

- Lower resolution version of CFSR (T126L64)
- Will run as one stream.
- Have address all but a few issues with CFSR
 - Hard to get QBO in early years
 - Forecast model issue
 - May still have issues in transition to AMSU (1998)
- Delayed until computer/manpower available to run and maintain.

Summary and Thoughts

- NCEP/NCAR (R1) is still widely used.
- NCEP/DOE (R2) made corrections/improvements to tropospheric elements.
- CFSR was created primarily to produce the hindcasts for bias correcting CFSv2 climate forecasts.
- CFSR-Lite have to wait for it to “save the day”
- Will and other reanalysis come with CFSv3?
- Many improvements in reanalyses has come about from the CFSR/MERRA/ERA-Interim/JRA efforts.
- Reanalysis requires a dedicated staff and computer resources!