

# Research Towards the Next Generation of NOAA Climate Reanalyses

A joint effort between NCEP, ESRL & NCDC  
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# Outline

- **Background and historical perspective**
- Shortcomings of the current generation of NOAA climate reanalyses
- Proposed research and assimilation system
- Deliverable and interactions

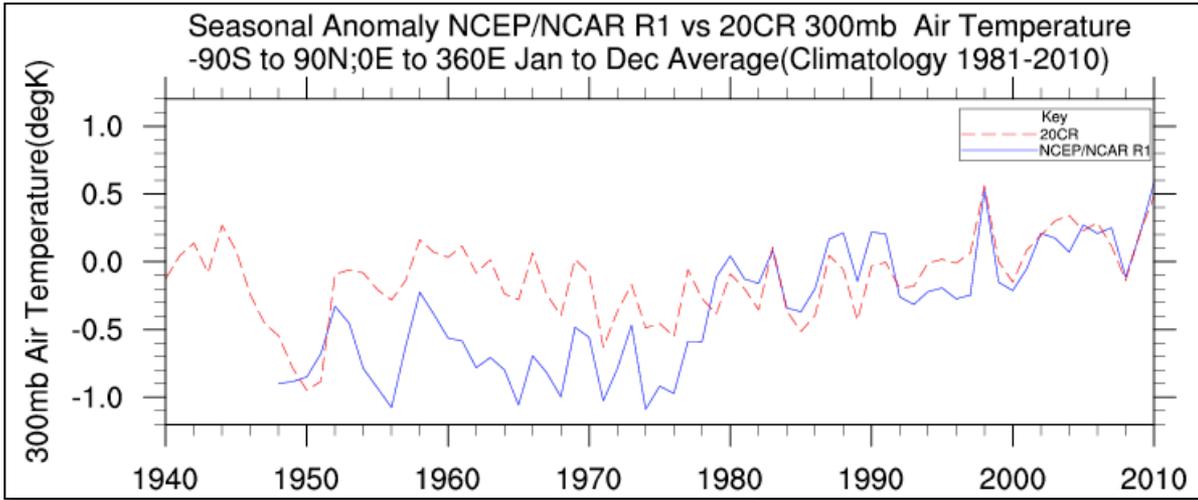
- **What is analysis?**
  - An objective method for analysis using data assimilation to estimate the state of atmosphere by forming weighted average of *observations* and *guess* generated by short-term (~ 6 hours) forecast based from a *model*
- **What is climate reanalysis?**
  - Regenerating the analyses over several decades using quality-controlled observations and a *fixed* data assimilation system to make a climate record.  
**Climate reanalysis**
    - can utilize delayed observations (that may have been missing in real-time)
    - can also make use of longer or symmetric time-windows for ingesting observations

- **NCEP/NCAR (R1): 1948-present; *initiated ~ 1995***
- **NCEP/DoE (R2): 1979-present; *initiated ~ 1998***
- **North American Regional Reanalysis (NARR): 1979-present; *initiated ~ 2004***
- **20<sup>th</sup> Century Reanalysis (20CR): 1871-2011; *initiated ~ 2009***
- **Climate Forecast System Reanalysis (CFSR): 1979-present; *initiated ~ 2007***

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- “...One of the major goals of executing the new CFSR was to create **initial states**...as consistent as possible with the next version of the CFS version 2...”
- CFSR has various discontinuities in the climate record. Some are due to
  - running the system in six different streams
  - ingest of latest observational platforms leading to changing observing system
- CPC continues to use NCEP/NCAR R1 for climate monitoring
- 20CR and CFSR, although both NOAA efforts, used **different models and data assimilation** systems

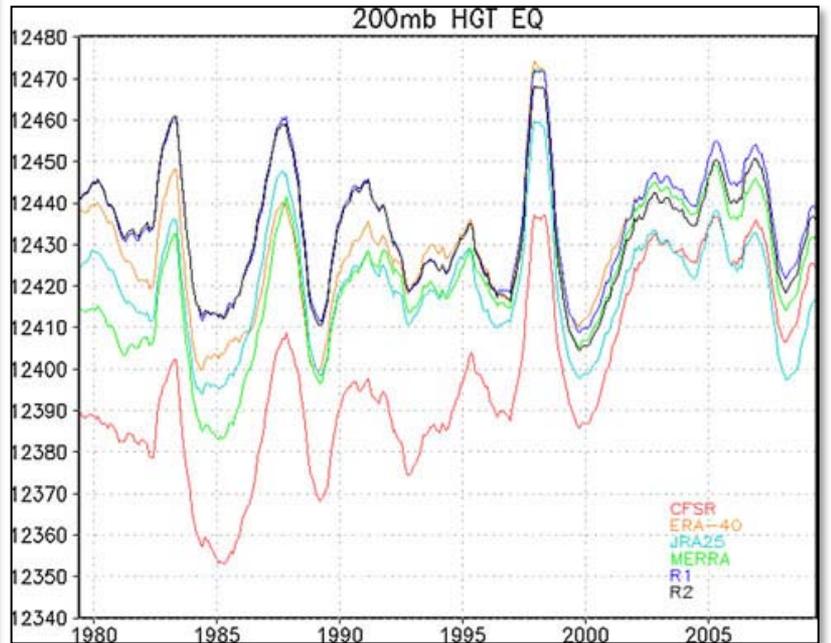
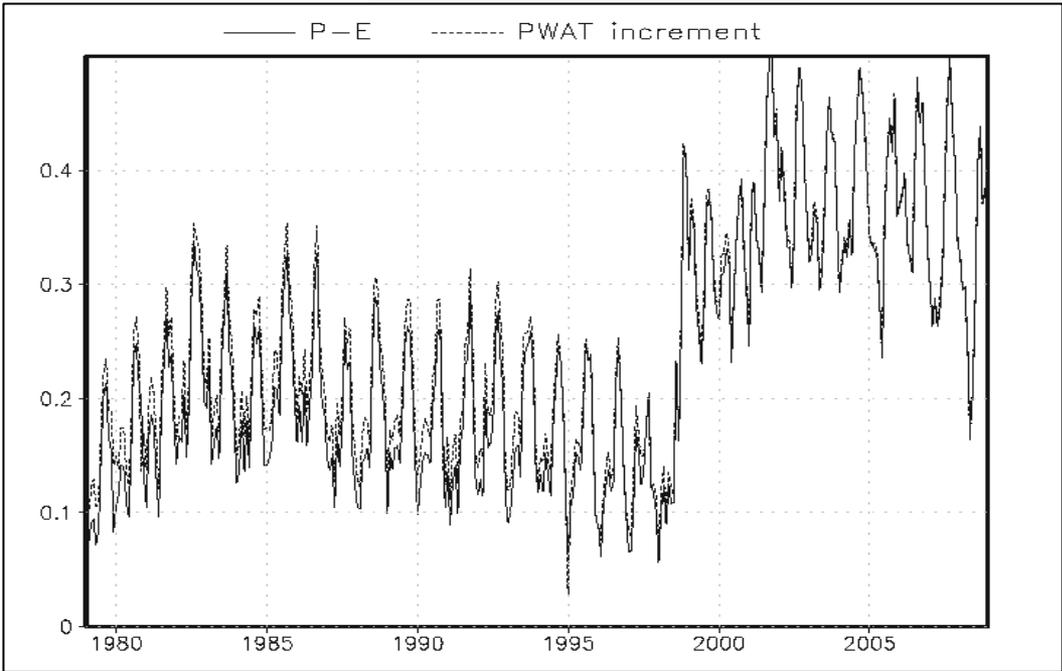


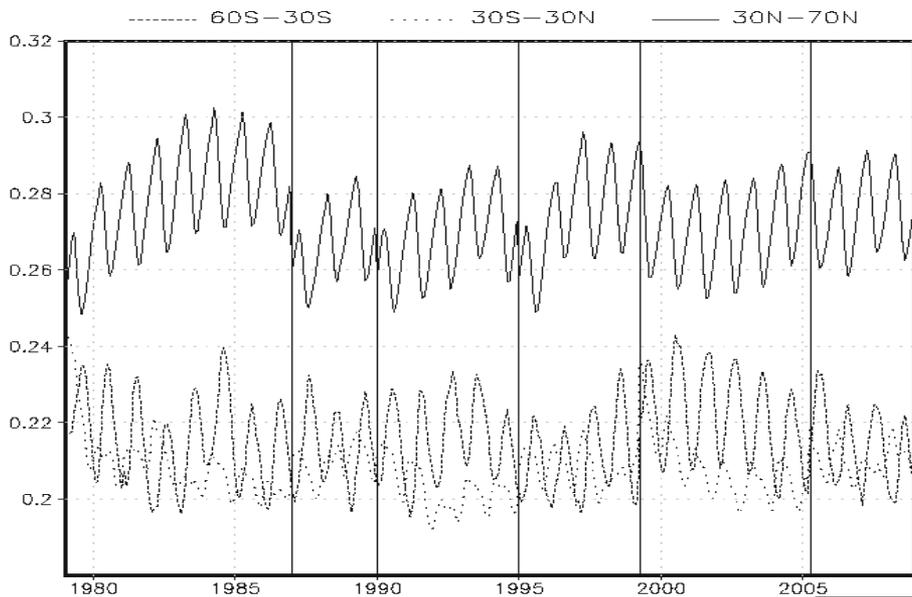
**R1 vs. 20CR**

**Hydrological Cycle**

**CFSR - Issues with trends**

**Tropical 200mb Z**

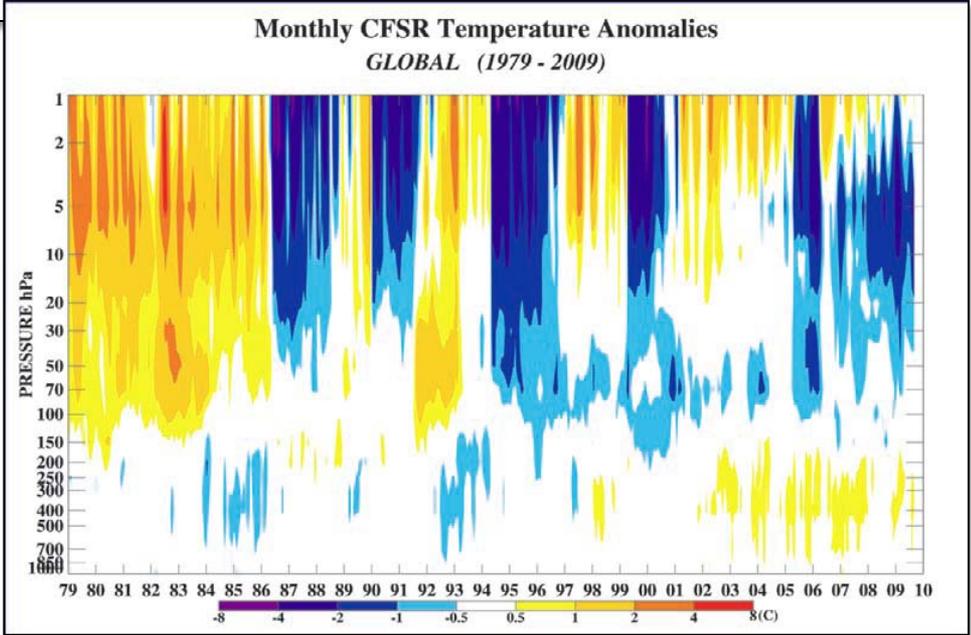




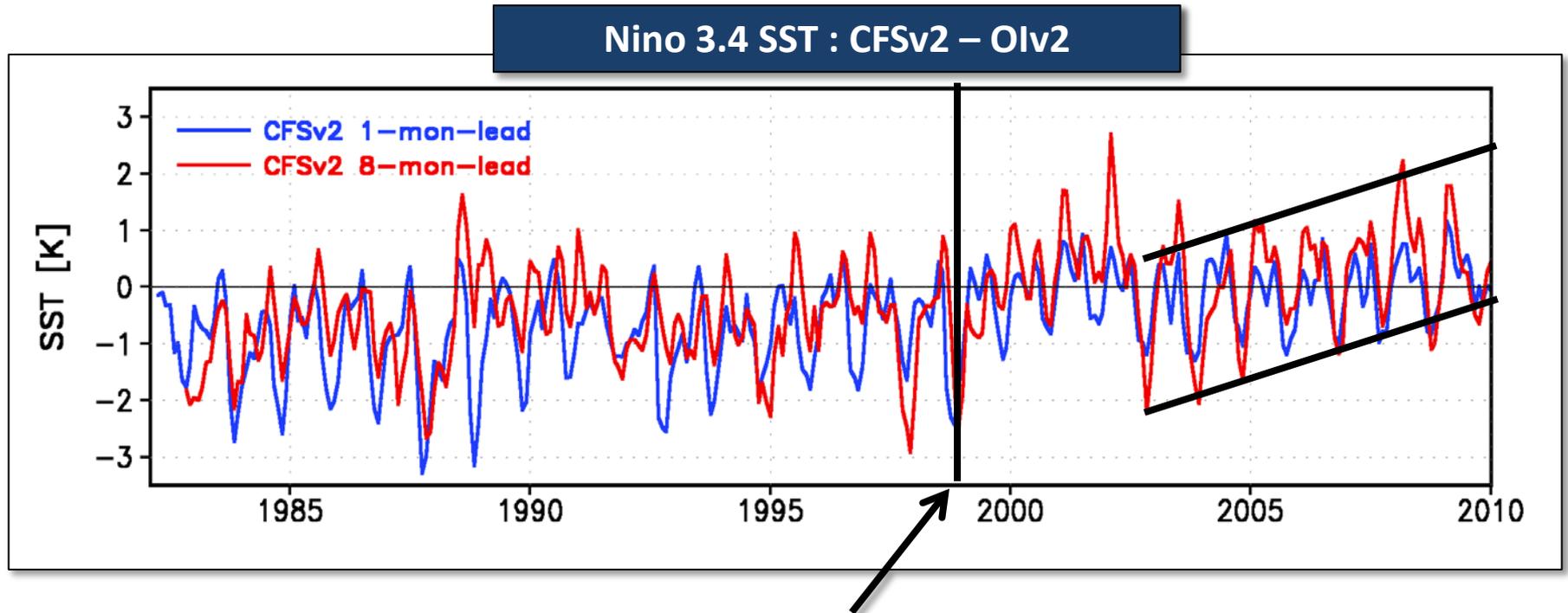
**Soil Moisture**

**CFSR - Issues because of multiple streams**

**Stratospheric Temperature**



# A Distinct Change in Forecast Bias for SST in Equatorial Pacific Before and After 1999



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- **Research towards the next generation of climate reanalysis for the atmosphere to**
  - **Understand and improve on some of the shortcomings of the CFSR**
- **Will utilize a common data assimilation infrastructure**
- **Will follow a hierarchical approach where reanalysis with higher level of complexity is informed by the previous tier reanalysis**

- **Research and development objectives**
  - **Improve bias correction procedures for the observational datasets**
  - **Observing Simulation Experiments (OSE) to**
    - **Identify spurious climate variability**
    - **Validate new algorithms for climate reanalysis**
  - **Development of observational data base**
    - **Enhance surface pressure data base**
    - **Enhance upper air observations**
  - **Test feasibility for using “future observations”**

# Methodology and Infrastructure

- **Tiered assimilation approach**
  - Boundary forced (equivalent to AMIP); 1850-present
  - Historical using only surface pressure; 1850-present
  - Modern using surface and conventional data; 1946-present
  - Satellite using conventional and satellite data; 1973-present
- **Assimilation System**
  - Hybrid GSI/Ensemble Kalman Filter (GSI/EnKF)

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- **A prototype for the next generation NOAA climate reanalysis that addresses issues with the CFSR**
- **Links with other MAPP funded reanalysis proposals**
  - **Similar efforts in ocean, land, and stratospheric assimilation**
  - **Diagnostics of datasets (e.g., surface fluxes) and comparing with benchmarks based on earlier reanalysis**
  - **Efforts coordinated as part of “Climate Reanalysis Task Force (CRTF)”**
- **Connect with other national (e.g., MERRA) and international (ERA-Clim; JMA) reanalysis efforts**

**Thanks!!**