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 use of 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***

- **20th Century Reanalysis (20CR): 1871-2011;** ***initiated ~ 2009***
- **Climate Forecast System Reanalysis (CFSR): 1979-present;** ***initiated ~ 2007***

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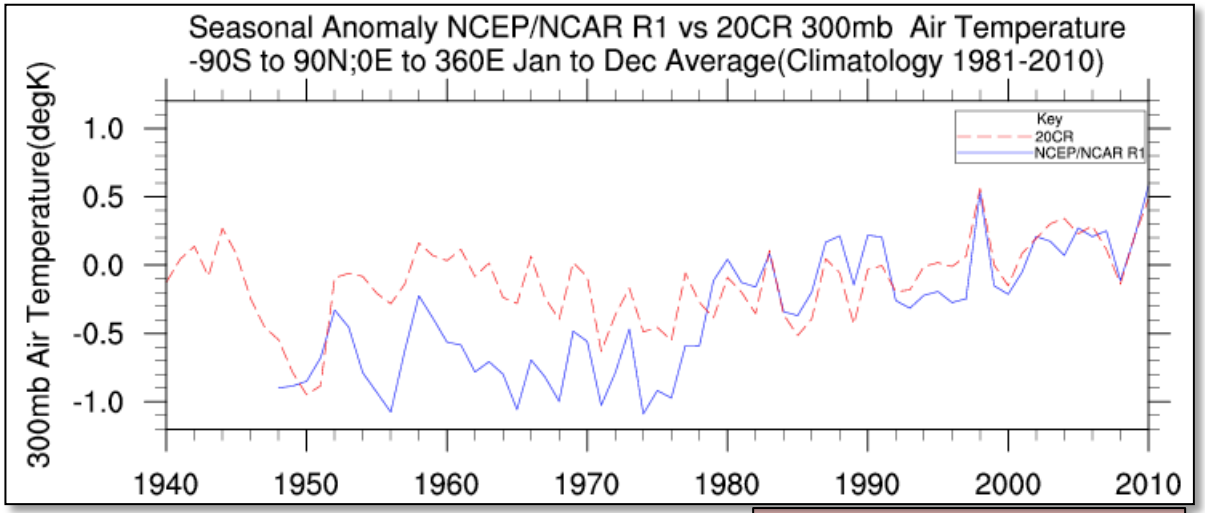
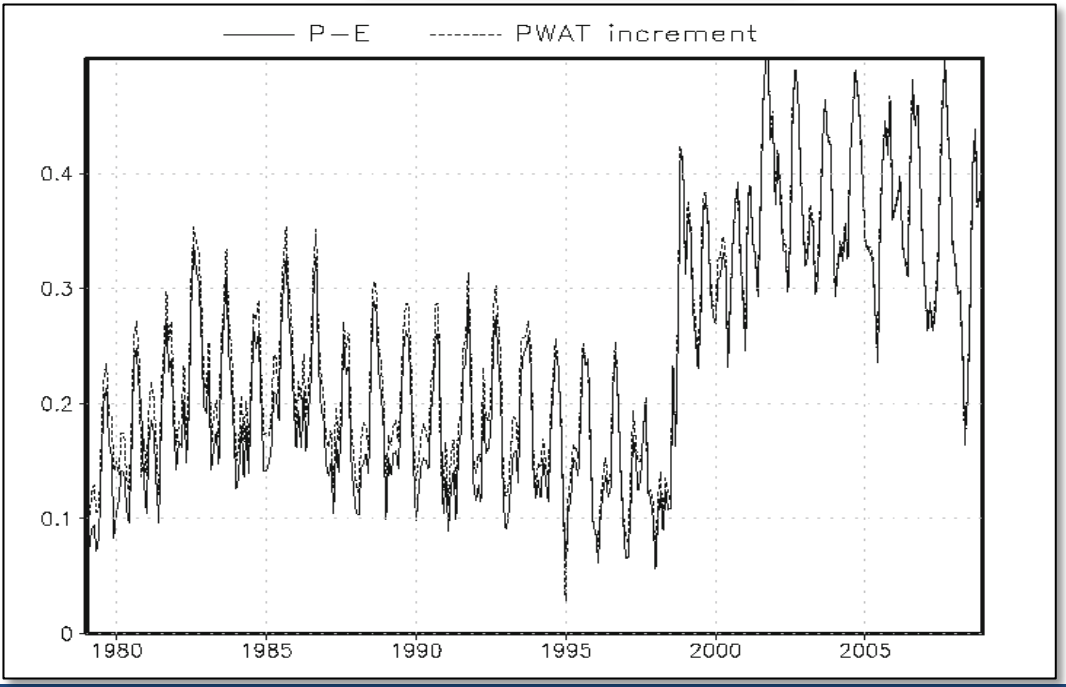
- **"…One of the major goals of executing the new CFSR was to create initial states…as consistent as possible with the next version of the CFS version 2…"**
- **20CR and CFSR, although both NOAA efforts, used different models and data assimilation systems**
- **CFSR has various discontinuities in the climate record. Some are due to**
  - **running the system in six different streams**
  - **ingest of latest observational platforms leading to changing observing system**
- **CFSR is not well suited for climate monitoring and a replacement for R1**



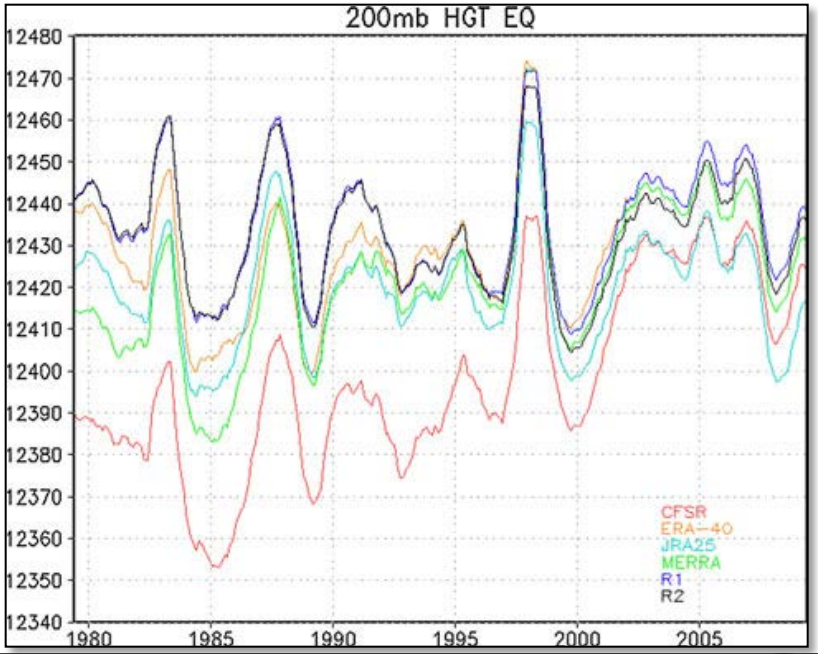
R1 vs. 20CR

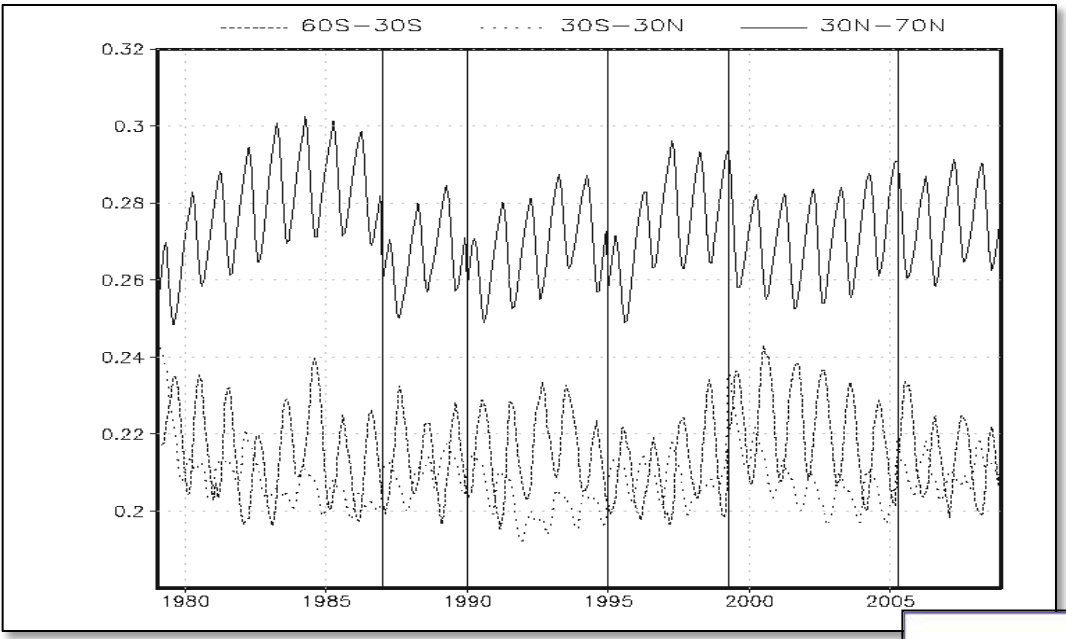
CFSR - Issues with trends

Hydrological Cycle



Tropical 200mb Z

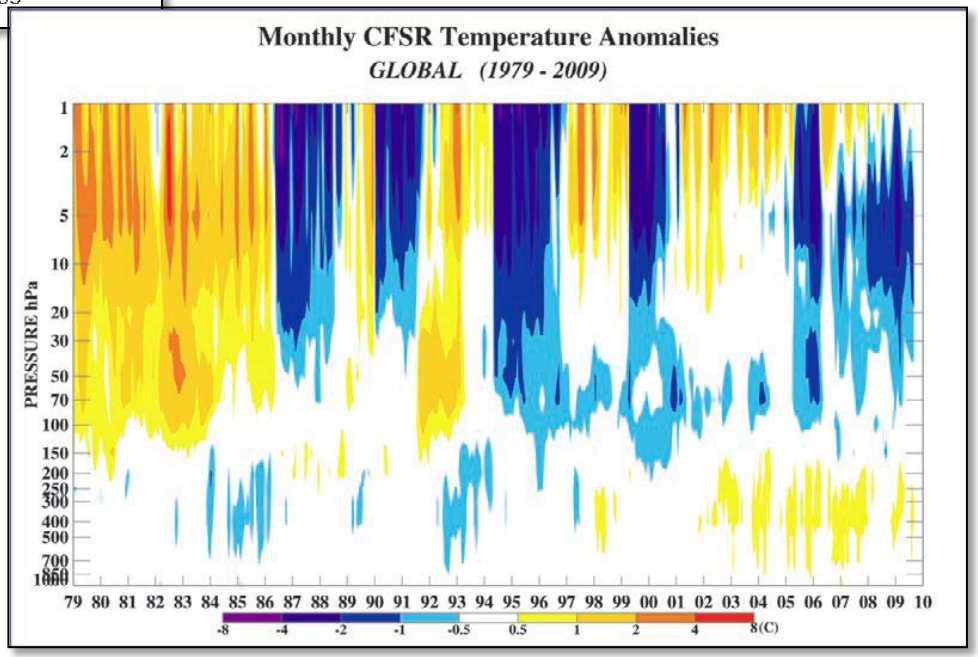




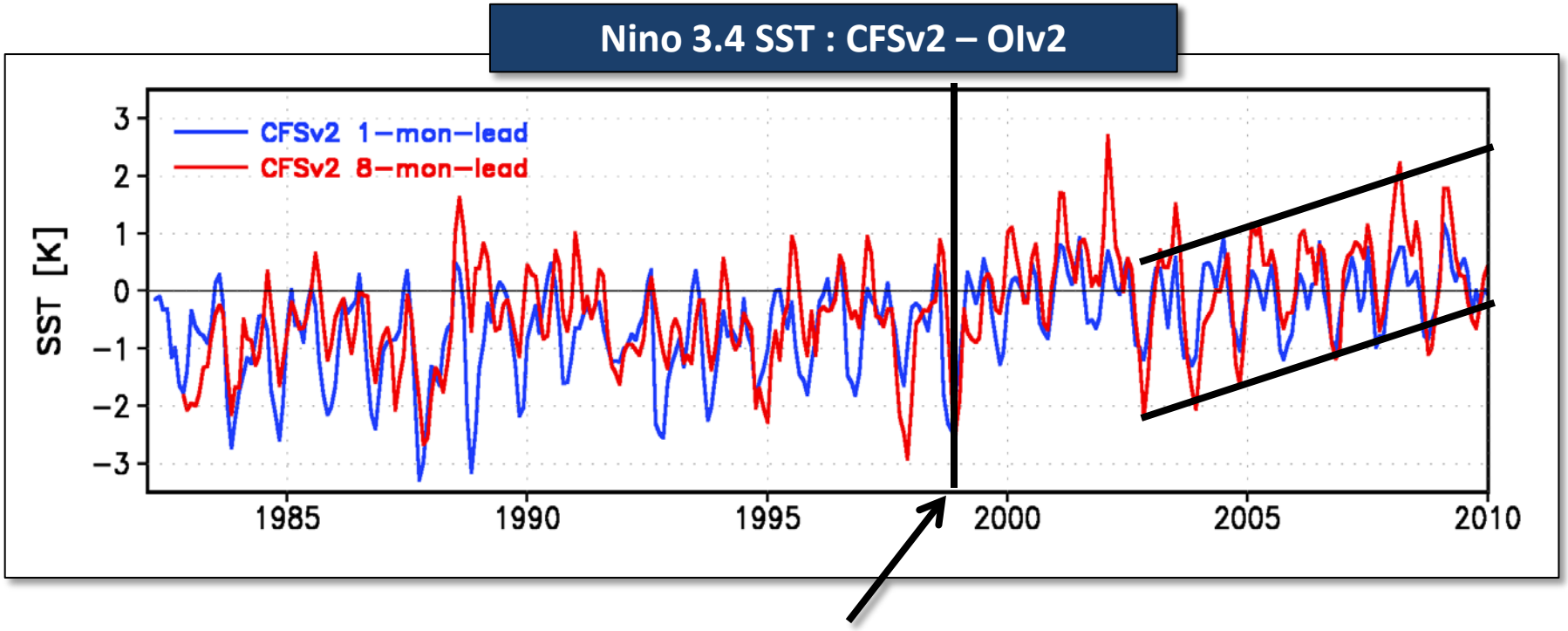
CFSR - Issues because of multiple streams

Stratospheric Temperature

Soil Moisture



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 of 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 date; 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**
- **Connect with other national (e.g., MERRA) and international (ERA-Clim; JMA) reanalysis efforts**

Thanks!!