2011 Implementation of the NCEP CFS V2

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NCEP/NWS/NOAA

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IPRC, University of Hawaii

Outline

- Description of CFSv2
- Skill assessment of CFSv2 hindcasts
- Examples of CFSv2 real-time forecasts
- Summary

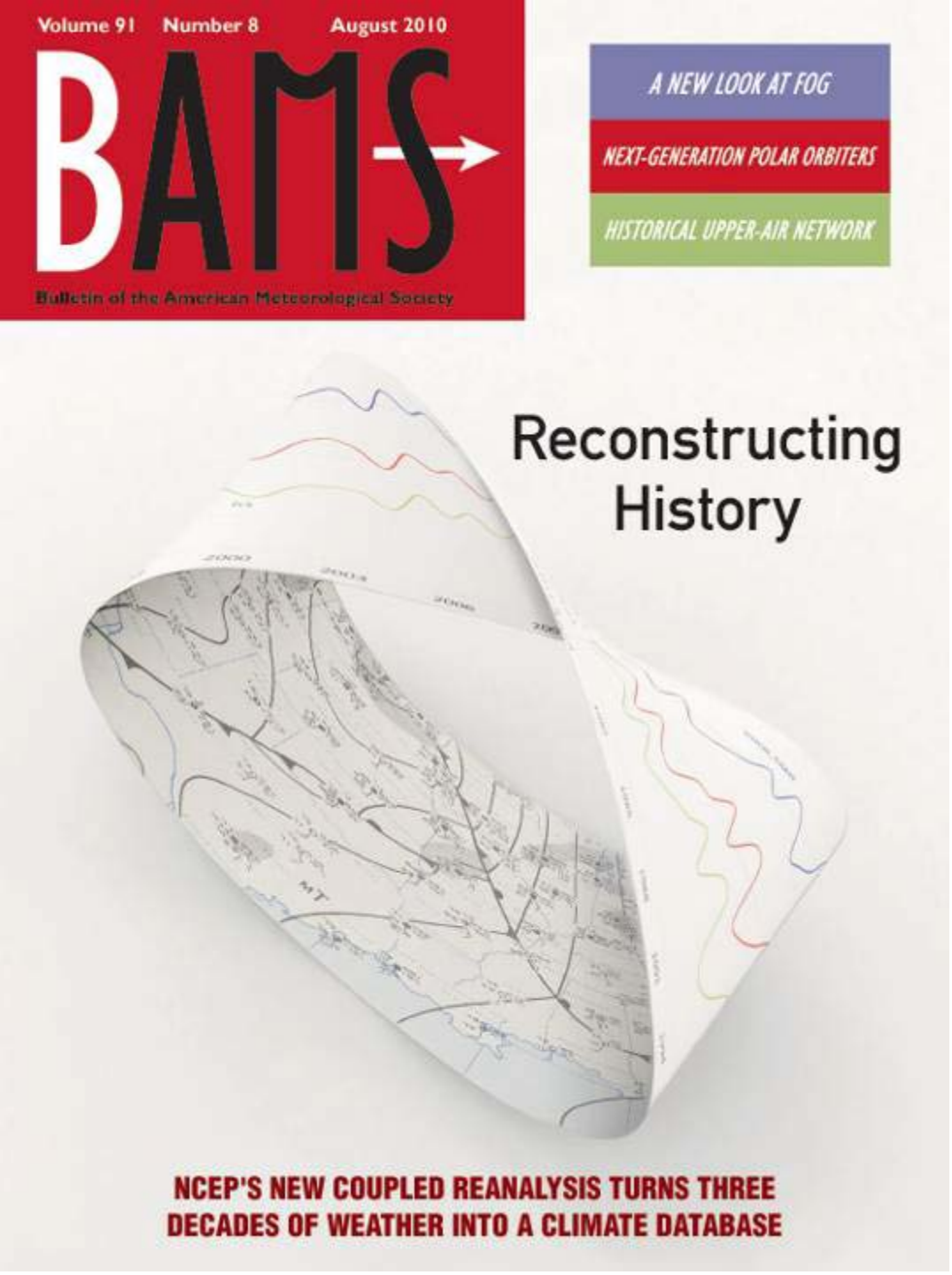
Climate Forecast System (CFS)

Attribute	CFS v1 (Operational Configuration)	CFS v2 (Q2FY11)
Analysis Resolution	200 km (T62)	38 km (T382)
Atmosphere model	1995: 200 km/28 levels Humidity based clouds	100 km(T126)/64 levels Variable CO2 AER SW & LW radiation Prognostic clouds & liquid water Retuned mountain blocking Convective gravity wave drag
Ocean model	MOM-3: 60N-65S 1/3 x 1 deg. Assim depth 750 m	MOM-4 fully global ¼ x ½ deg. Assim depth 4737 m
Land surface model (LSM) and assimilation	2-level LSM No separate land data assim	4 level Noah model GLDAS driven by obs precip
Sea ice	Climatology	Daily analysis and Prognostic sea ice
Coupling	Daily	30 minutes
Data assimilation	Retrieved soundings, 1995 analysis, uncoupled background	Radiances assimilated, 2008 GSI, coupled background
Reforecasts	15/month seasonal output	25/month (seasonal) 124/month (week 3-6)

CFS Reanalysis & Reforecast (CFSRR V.2)

- **Project Goals**
  - Improve 3-6 week forecasts and seasonal prediction skill
    - Incorporate latest technologies (atmosphere, ocean, land surface models and data assimilation)
    - Improve end-to-end consistency between hindcasts and forecasts
    - Include historical CO2 changes, solar cycle and volcanic ash (CWL)

- **Provides a tool for decision support beyond 15-day forecasts**
  - Decision support chain:
    - Reanalysis → Real-time extension to operations
    - Reforecast → Real-time Week 2 to seasonal forecasts
    - Calibrated (bias and skill mask) system (from Reanalysis and Reforecast data)
    - Operational delivery to users (including CPC)
    - CPC operational forecasts
    - Informed decisions
- **CFSRR firsts**
  - Coupled A-O-L-S system
  - Highest resolution reanalysis (direct forecast impact weeks 3-6) – T382
  - Most thorough treatment of satellite discontinuities and historical data (NESDIS)



The NCEP Climate Forecast System Reanalysis

Suranjana Saha, Shrinivas Moorthi, Hua-Lu Pan, Xingren Wu, Jiande Wang, Sudhir Nadiga, Patrick Tripp, Robert Kistler, John Woollen, David Behringer, Haixia Liu, Diane Stokes, Robert Grumbine, George Gayno, Jun Wang, Yu-Tai Hou, Hui-ya Chuang, Hann-Ming H. Juang, Joe Sela, Mark Iredell, Russ Treadon, Daryl Kleist, Paul Van Delst, Dennis Keyser, John Derber, Michael Ek, Jesse Meng, Helin Wei, Rongqian Yang, Stephen Lord, Huug van den Dool, Arun Kumar, Wanqiu Wang, Craig Long, Muthuvel Chelliah, Yan Xue, Boyin Huang, Jae-Kyung Schemm, Wesley Ebisuzaki, Roger Lin, Pingping Xie, Mingyue Chen, Shuntai Zhou, Wayne Higgins, Cheng-Zhi Zou, Quanhua Liu, Yong Chen, Yong Han, Lidia Cucurull, Richard W. Reynolds, Glenn Rutledge, Mitch Goldberg

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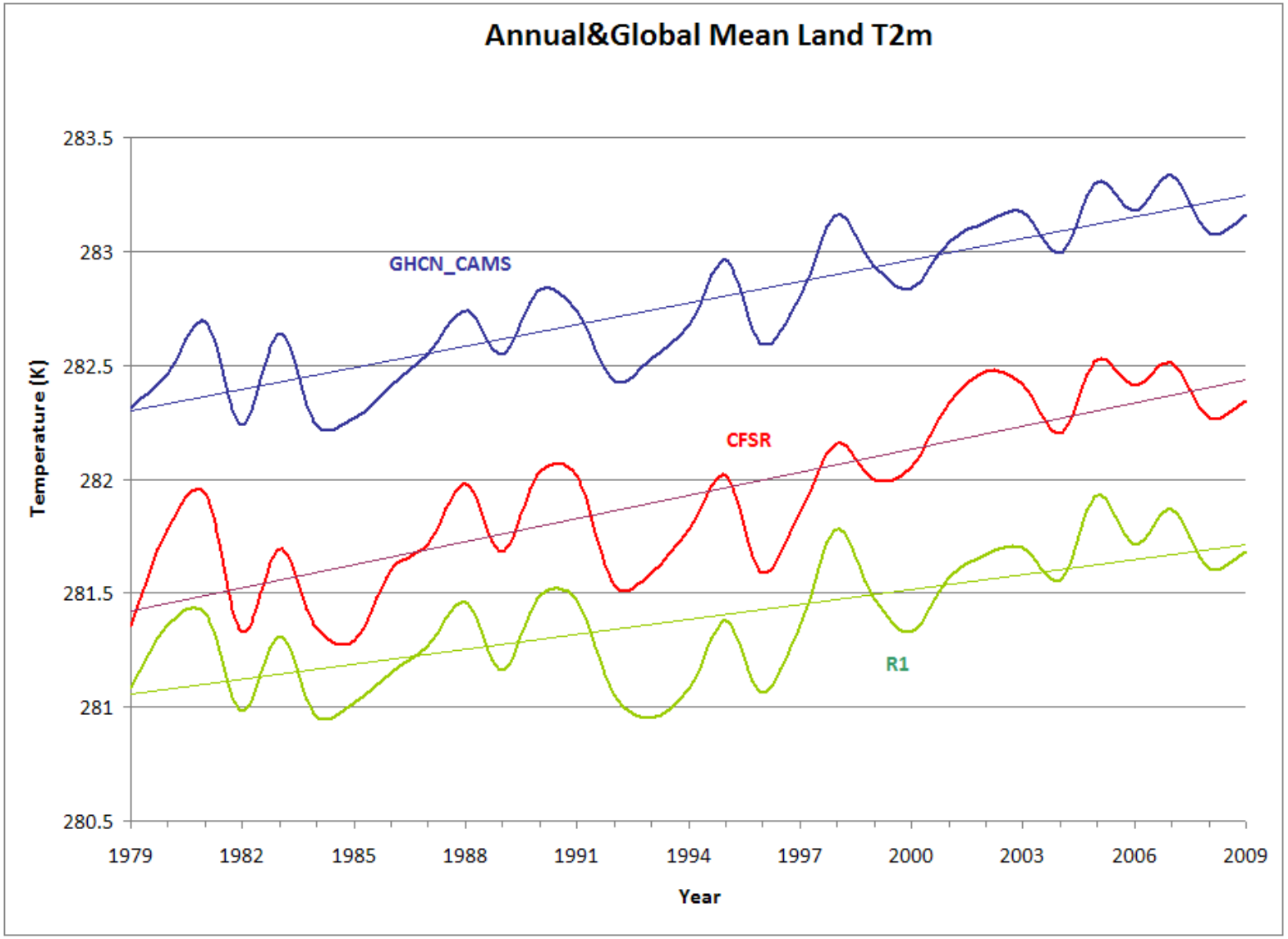
Volume 91, Issue 8, pp 1015-1057.
doi: 10

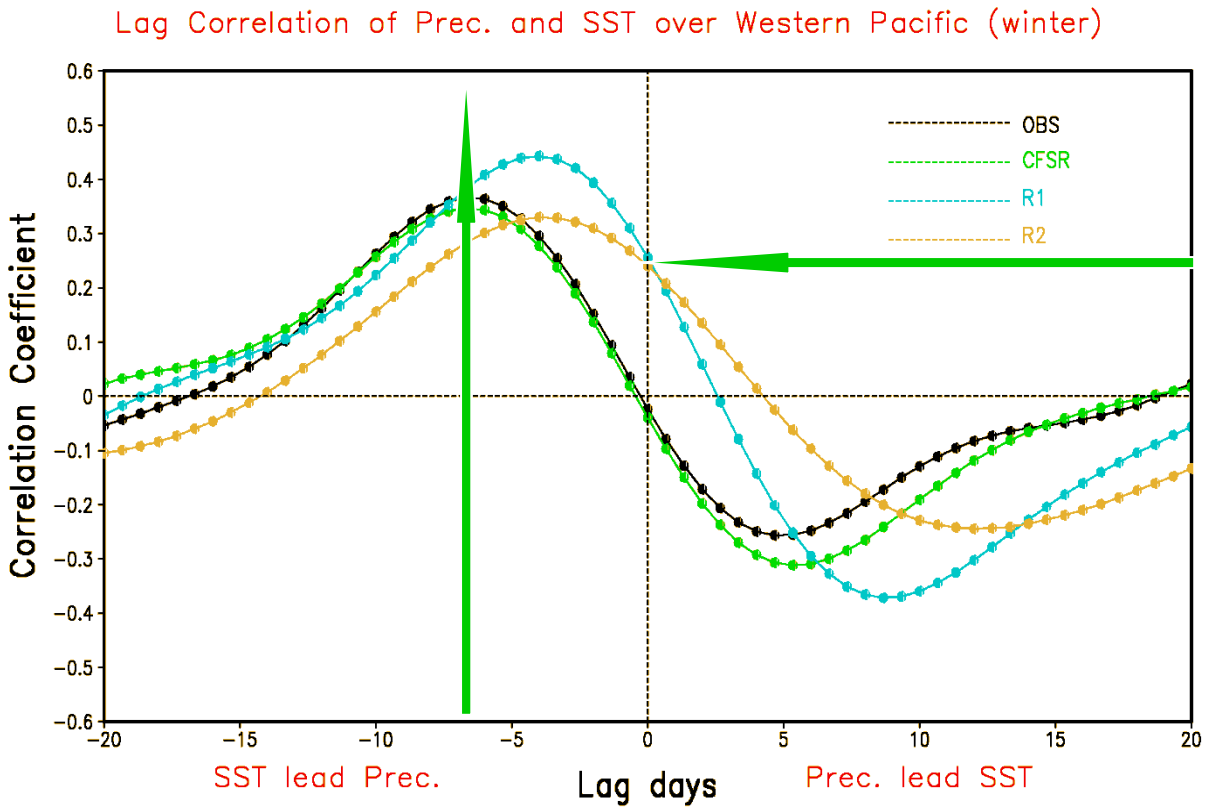


The linear trends are 0.66, 1.02 and 0.94K per 31 years for R1, CFSR and GHCN_CAMS respectively. (Keep in mind that straight lines may not be perfectly portraying climate change trends).

Courtesy: Huug van den Dool, CPC

SST-Precipitation Relationship in CFSR

Precipitation-SST lag correlation in tropical Western Pacific

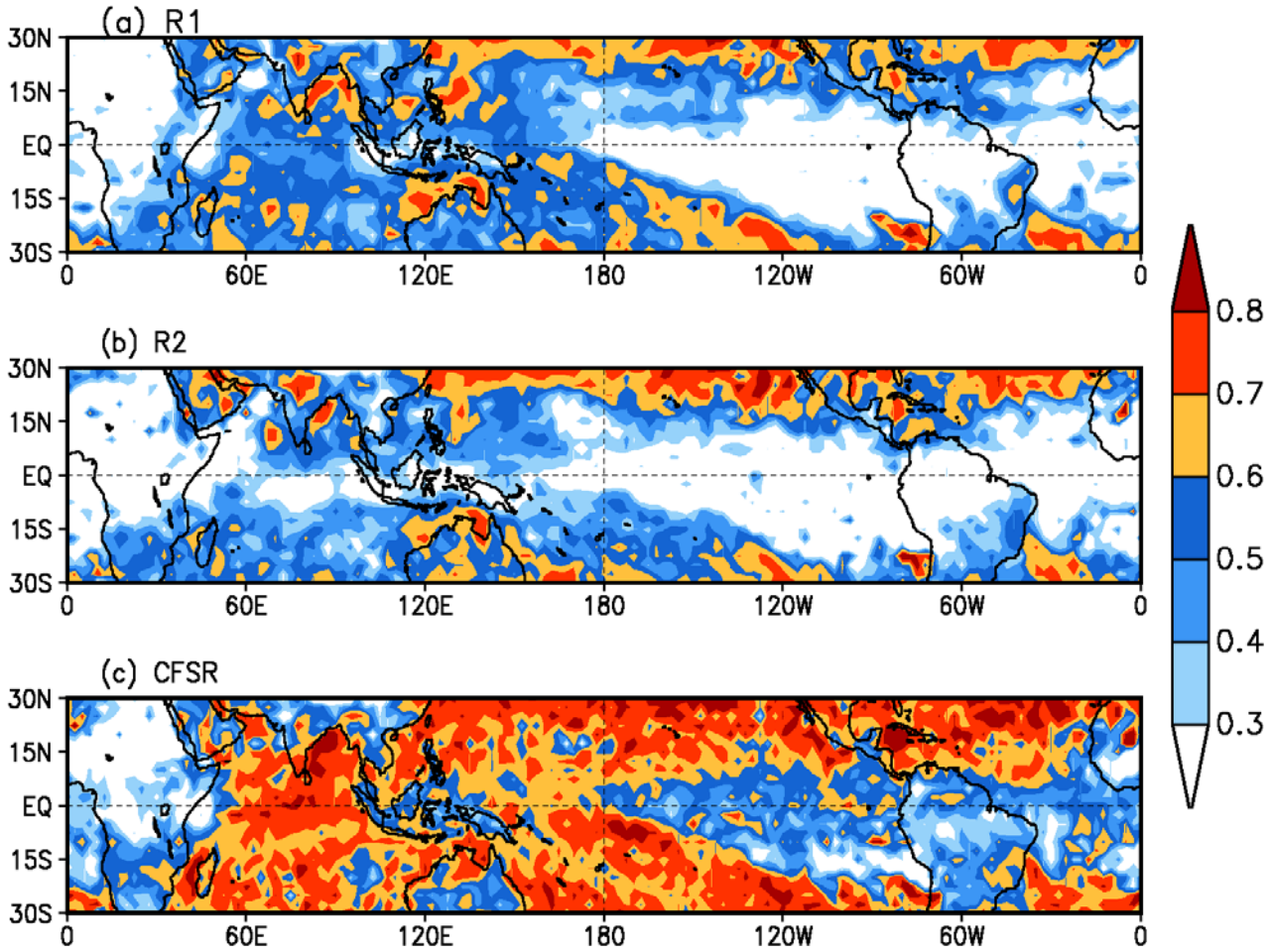


Response of Prec. To SST increase : warming too quick in R1 and R2

simultaneous positive correlation in R1 and R2

Courtesy: Jiande Wang, EMC

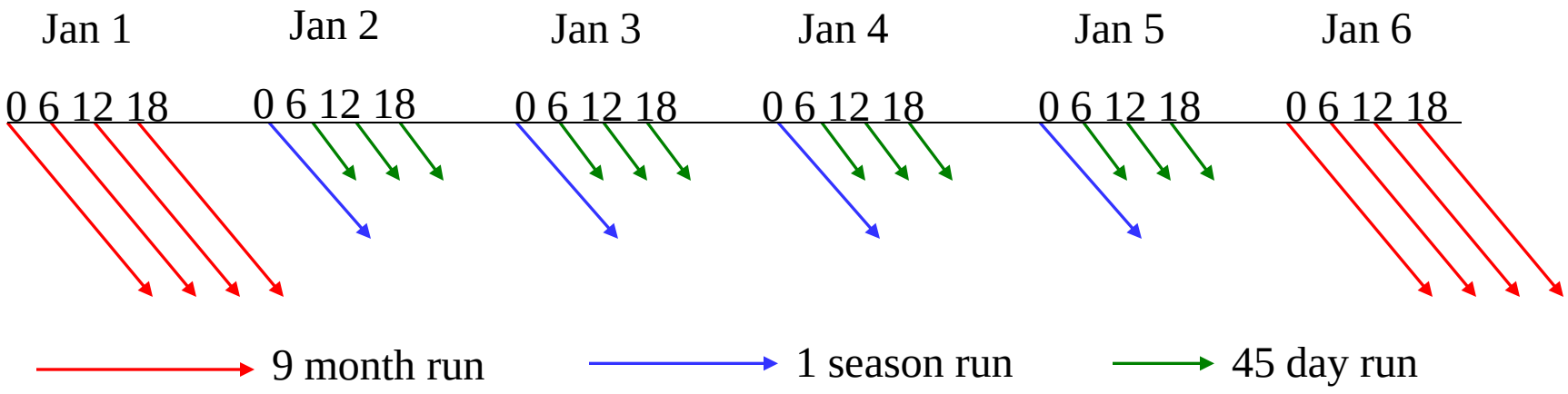
Correlation of intraseasonal precipitation with CMORPH.
(a) R1, (b) R2, and (c) CFSR.
Contours are shaded starting at 0.3 with 0.1 interval.



Courtesy: Jiande Wang et al, EMC

Hindcast Configuration for CFSv2

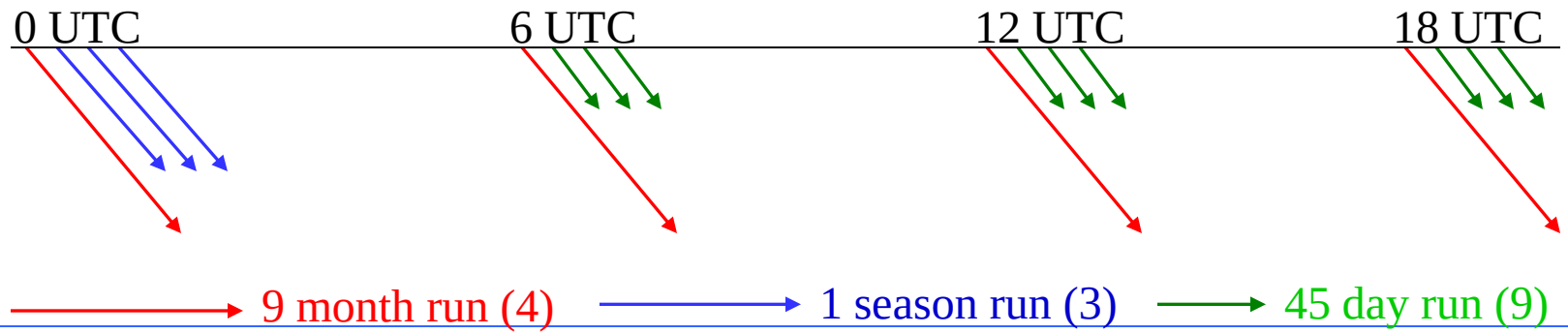
- **9-month hindcasts initiated from every 5th day and run from all 4 cycles of that day, beginning from Jan 1 of each year, over a 28 year period from 1982-2009 This is required to calibrate the operational CPC longer-term seasonal predictions (ENSO, etc)**
- **There is a single 1 season (123-day) hindcast run, initiated from every 0 UTC cycle between these five days, over the 12 year period from 1999-2010. This is required to calibrate the operational CPC first season predictions for hydrological forecasts (precip, evaporation, runoff, streamflow, etc)**
- **In addition, there are three 45-day (1-month) hindcast runs from every 6, 12 and 18 UTC cycles, over the 12-year period from 1999-2010. This is required for the operational CPC week3-week6 predictions of tropical circulations (MJO, PNA, etc)**
- **Total number of years of integration = 9447 years**



Courtesy: Suru Saha, EMC

Operational Configuration for CFSv2

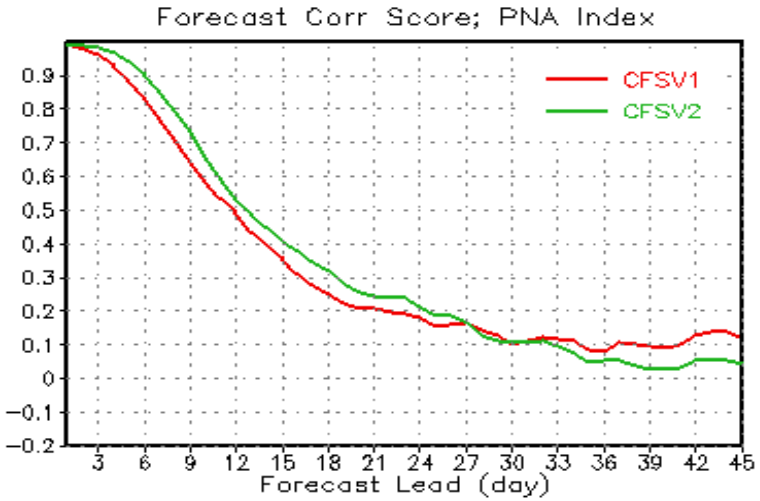
- **There are 4 control runs per day from the 0, 6, 12 and 18 UTC cycles of the CFS real-time data assimilation system, out to 9 months.**
- **In addition to the control run of 9 months at the 0 UTC cycle, there are 3 additional runs, out to one season. These 3 runs per cycle are initialized as in current operations.**
- **In addition to the control run of 9 months at the 6, 12 and 18 UTC cycles, there are 3 additional runs, out to 45 days. These 3 runs per cycle are initialized as in current operations.**
- **There is a total of 16 CFS runs every day, of which 4 runs extend out to 9 months, 3 runs out to 1 season and 9 runs out to 45 days.**

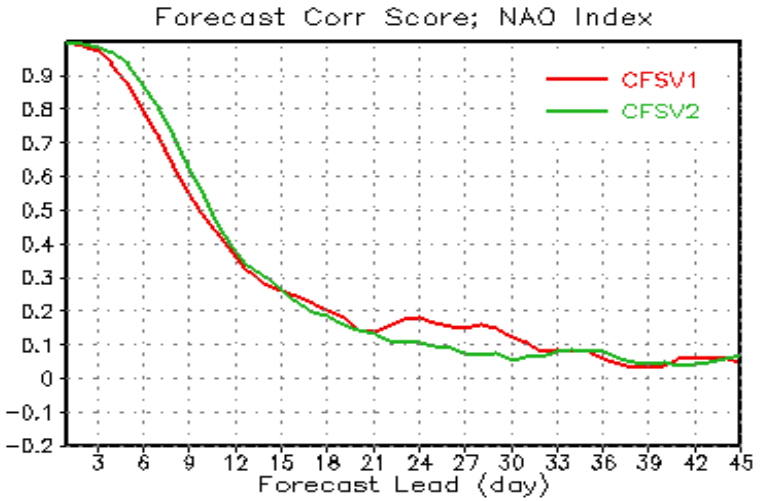


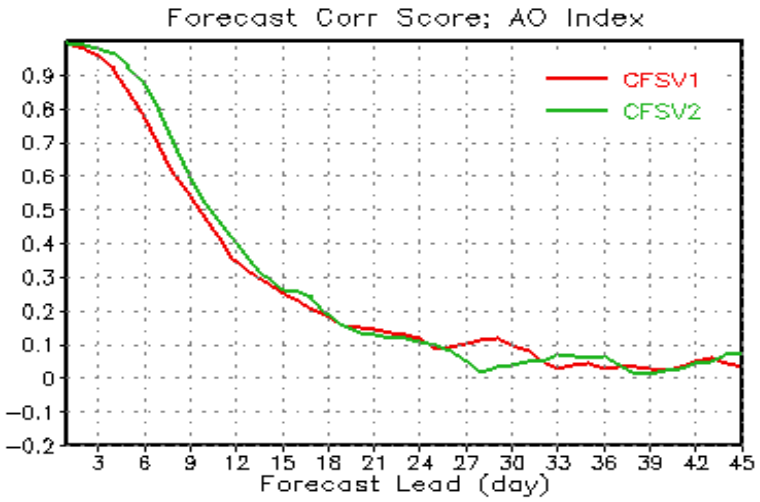
Courtesy: Suru Saha, EMC

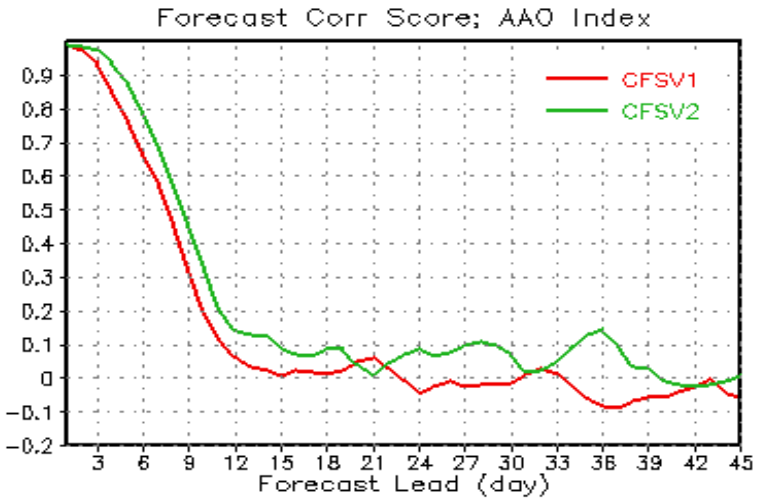
Some Skill Assessment of CFSv2 Hindcasts

Anomaly Correlation for Atmospheric Indices



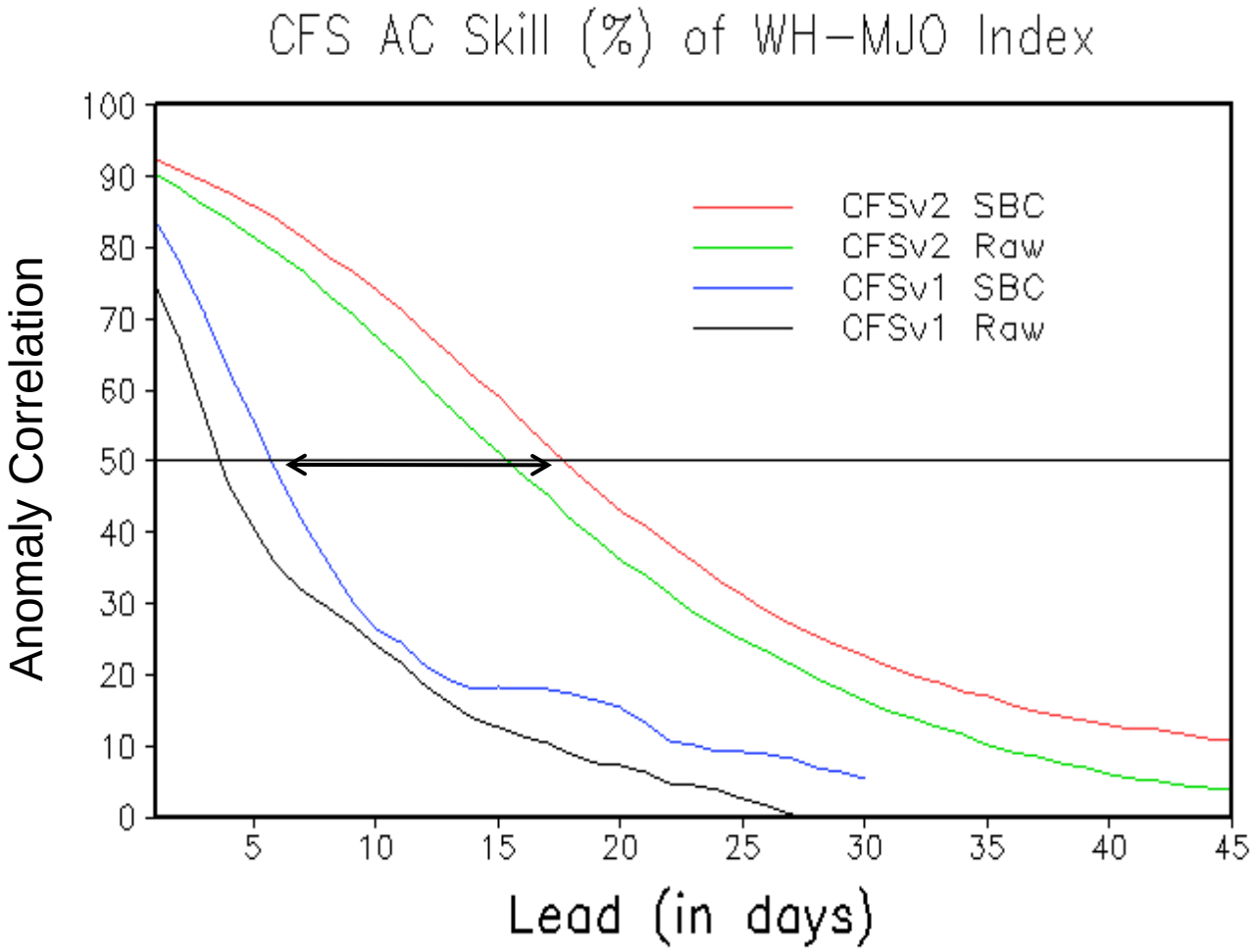




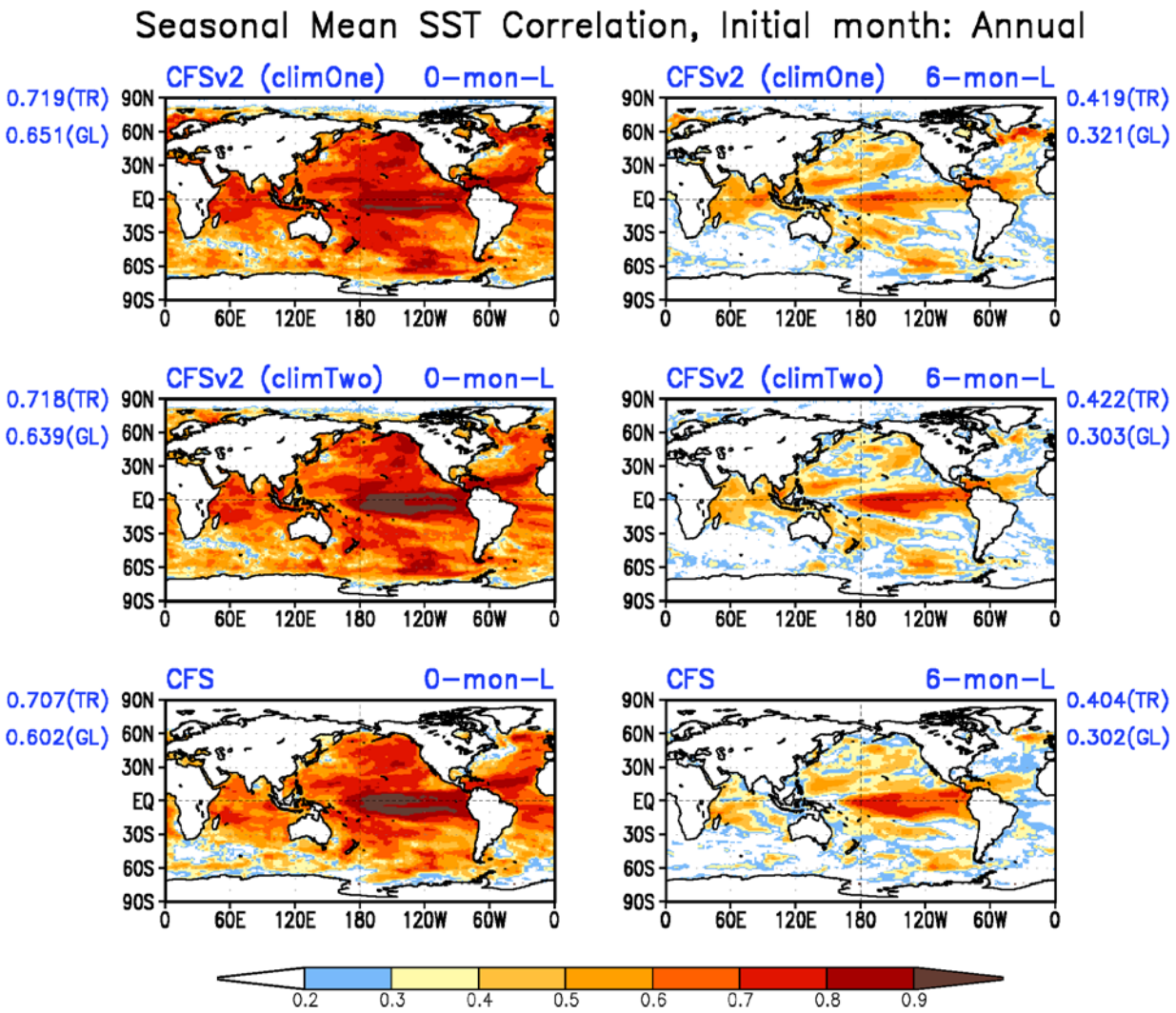


J. Schemm CPC/NCEP

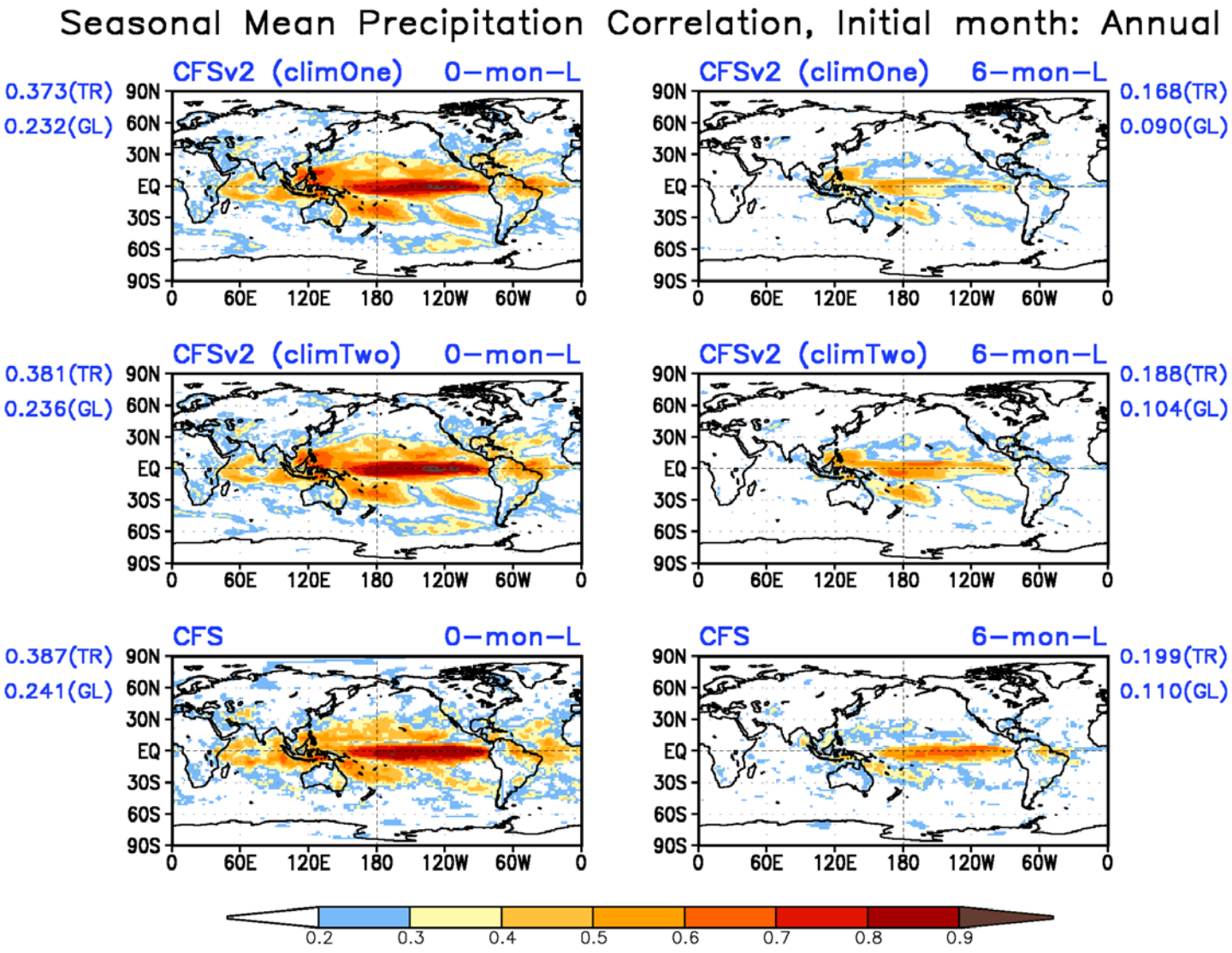
Assessment of MJO Prediction Skill



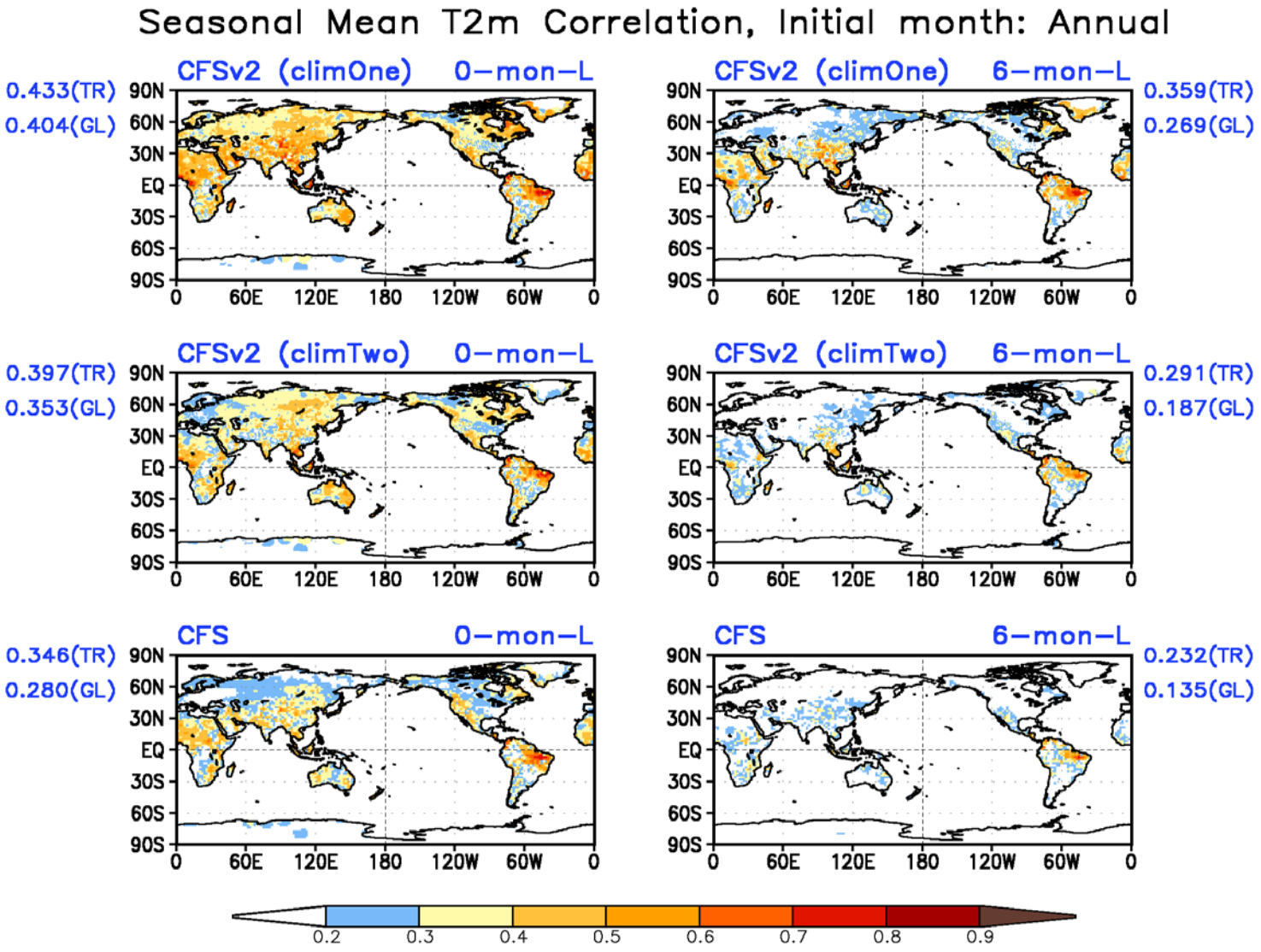
Anomaly Correlation – SST



Anomaly Correlation – Precipitation

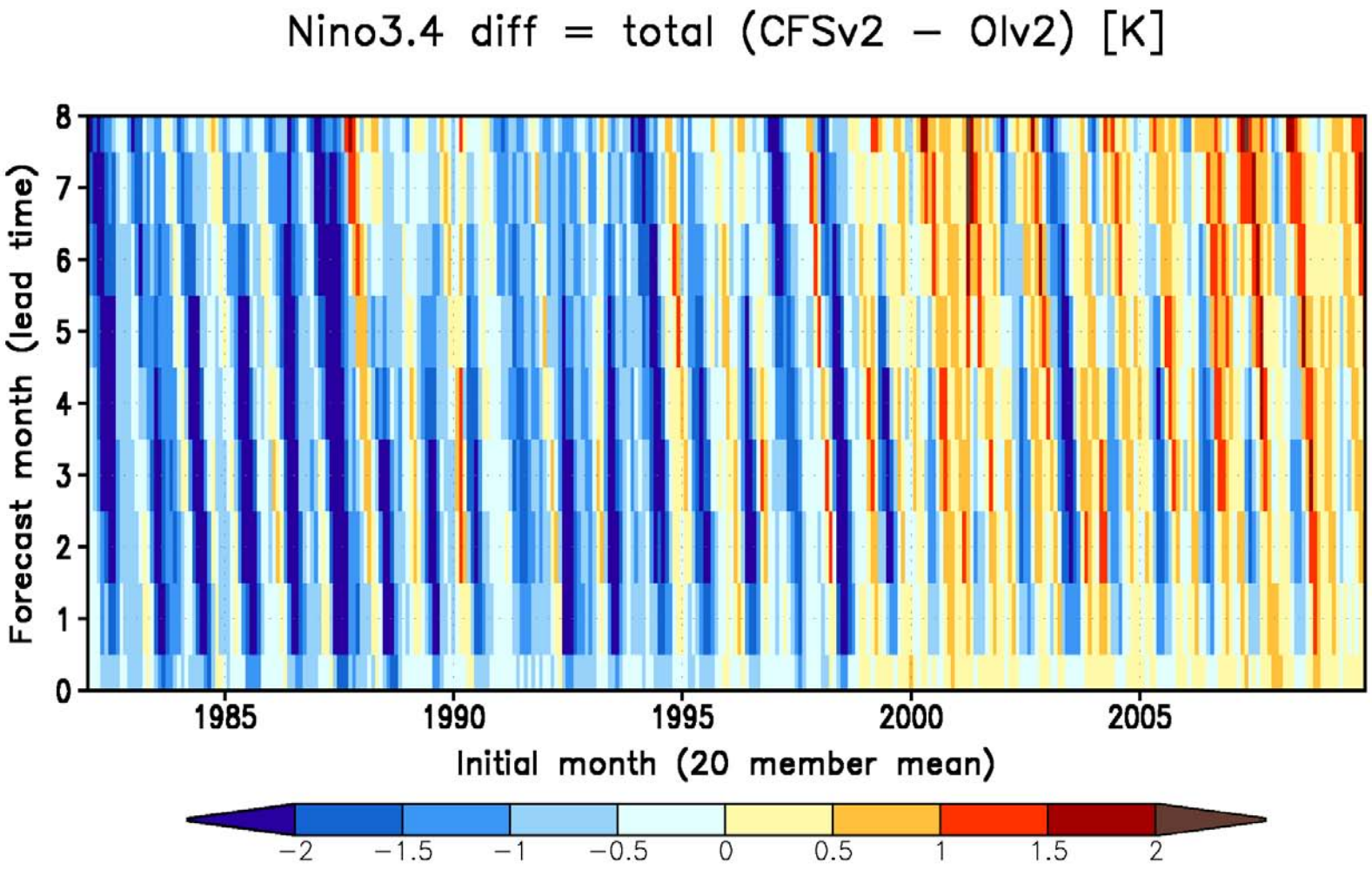


Anomaly Correlation – Sfc. Temp.



Some Cautionary Information

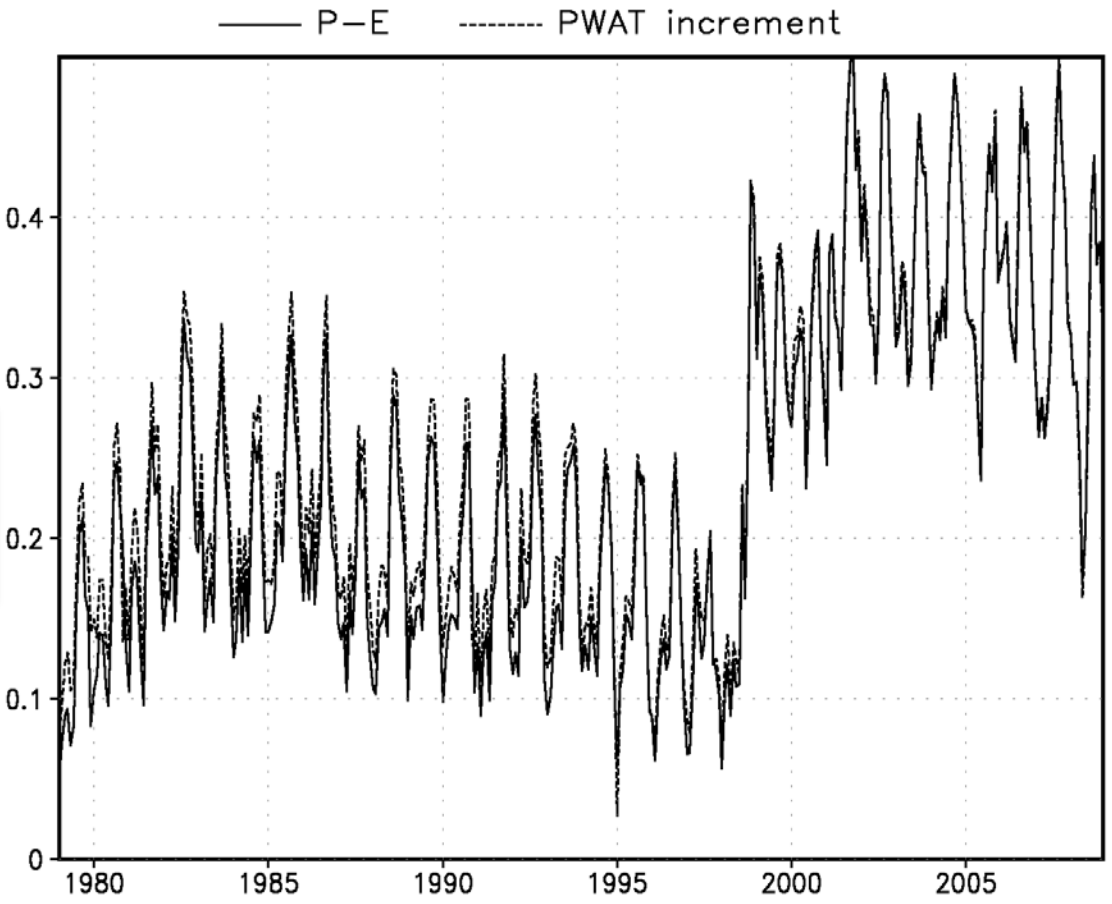
A Distinct Change in Forecast Bias after 1999



The change has something to do with changes in the CFSR after 1999 (ATOVS)

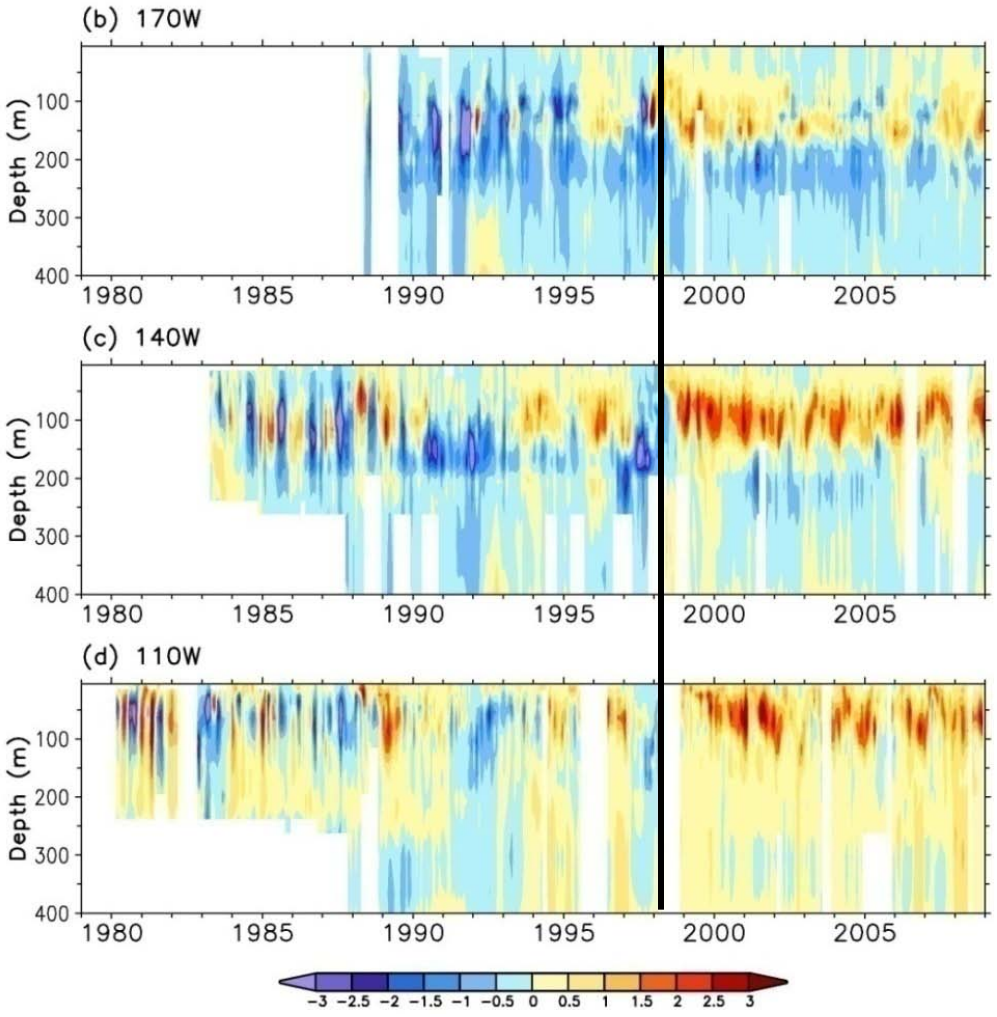
P-E

Increment in Precipitable Water

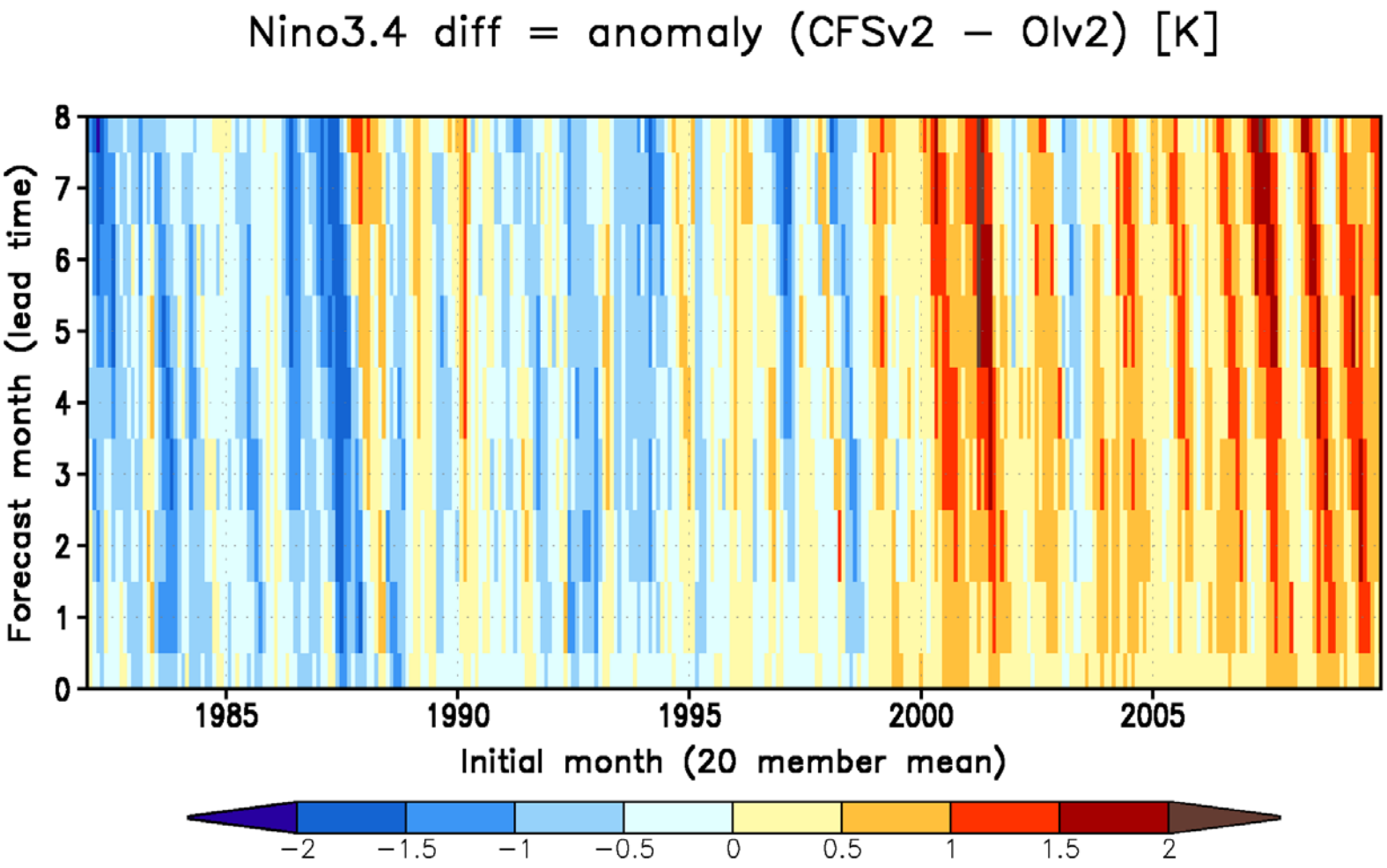


The change has something to do with changes in the CFSR after 1999 (ATOVS)

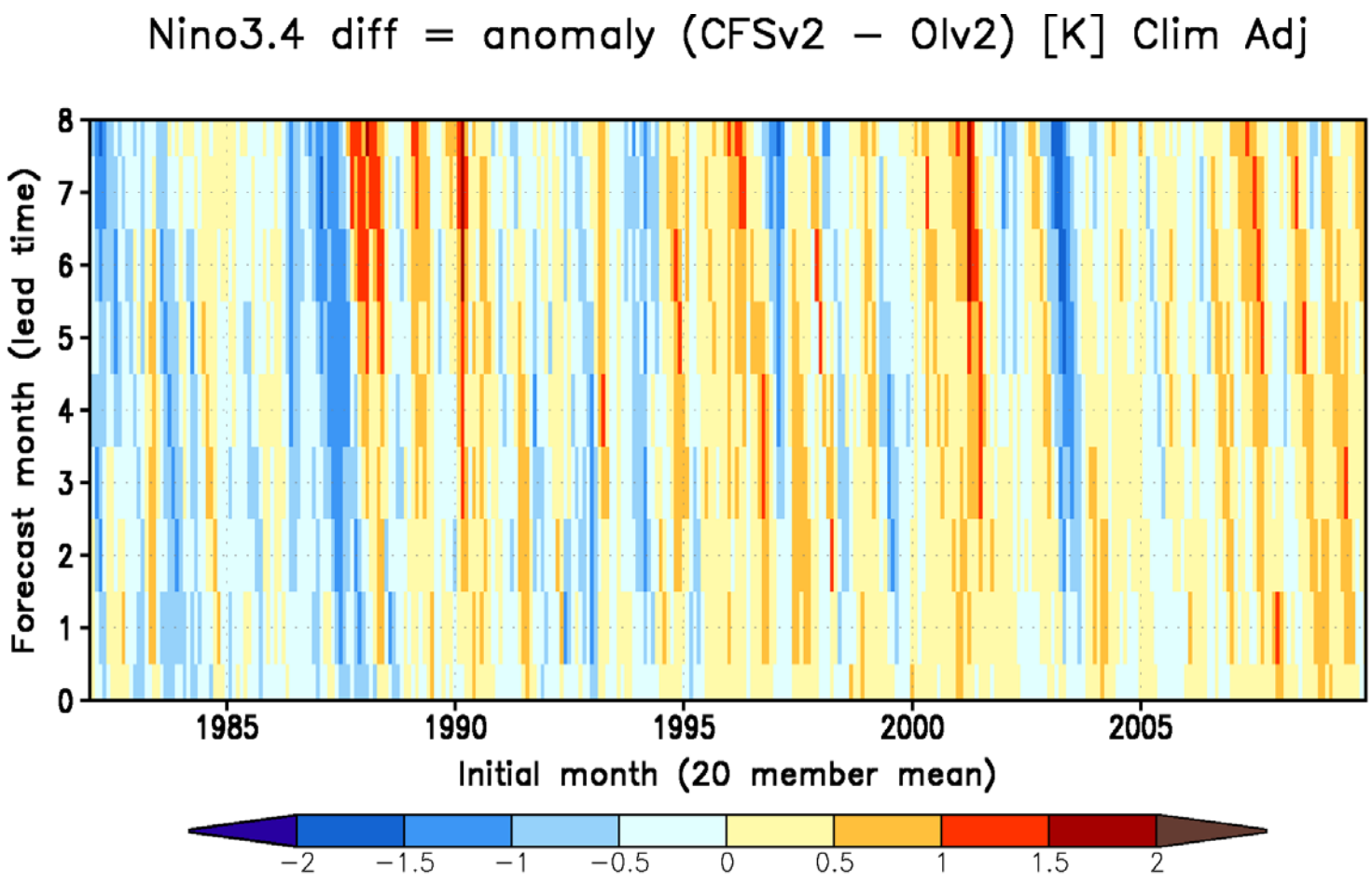
Difference in Sub-surface Ocean T "CFSR-TAO"



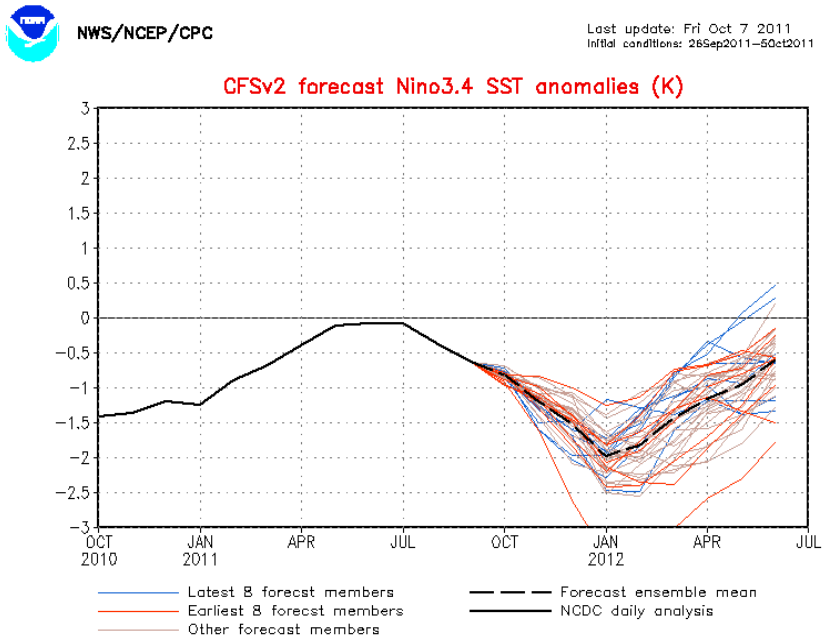
Anomaly Computed From One Climatology (1982-2009)



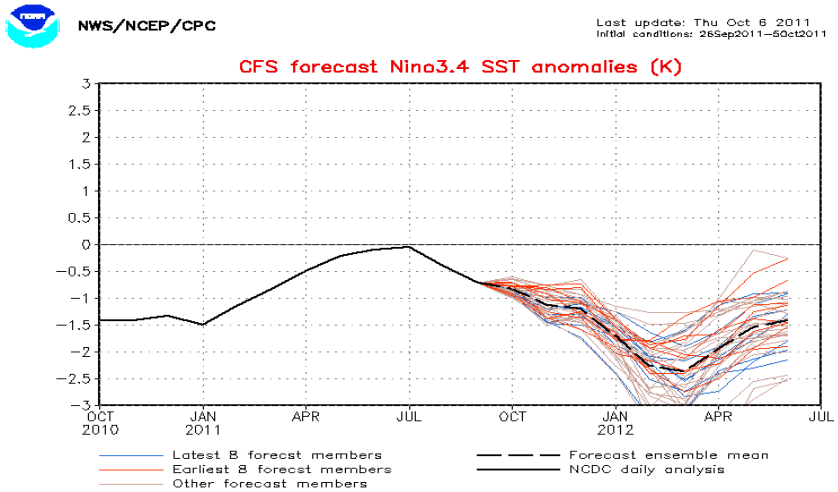
Anomaly Computed From Two Climatologies (1982-1998 & 1999-2009)

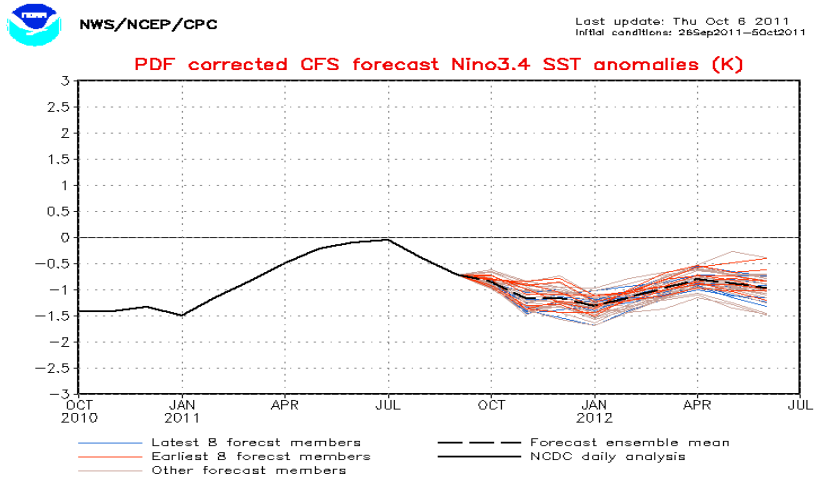


Current Forecasts: CFSv2 & CFSv1

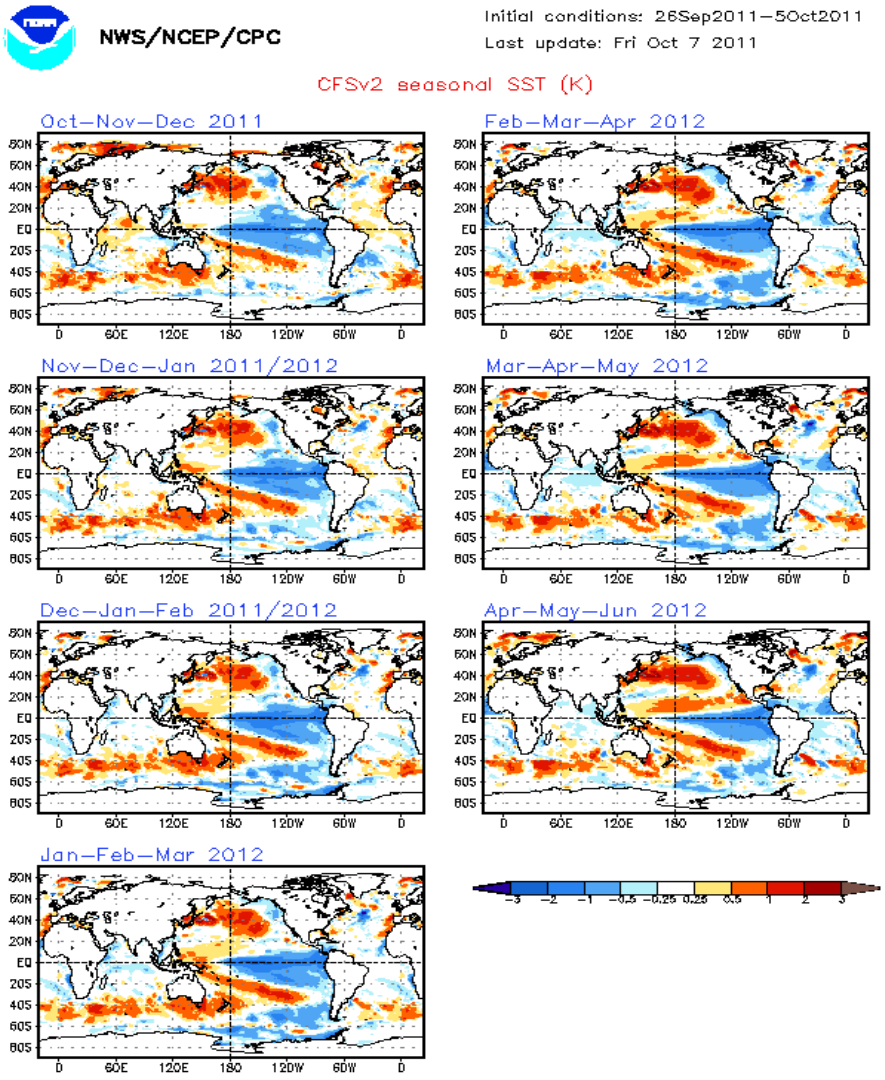


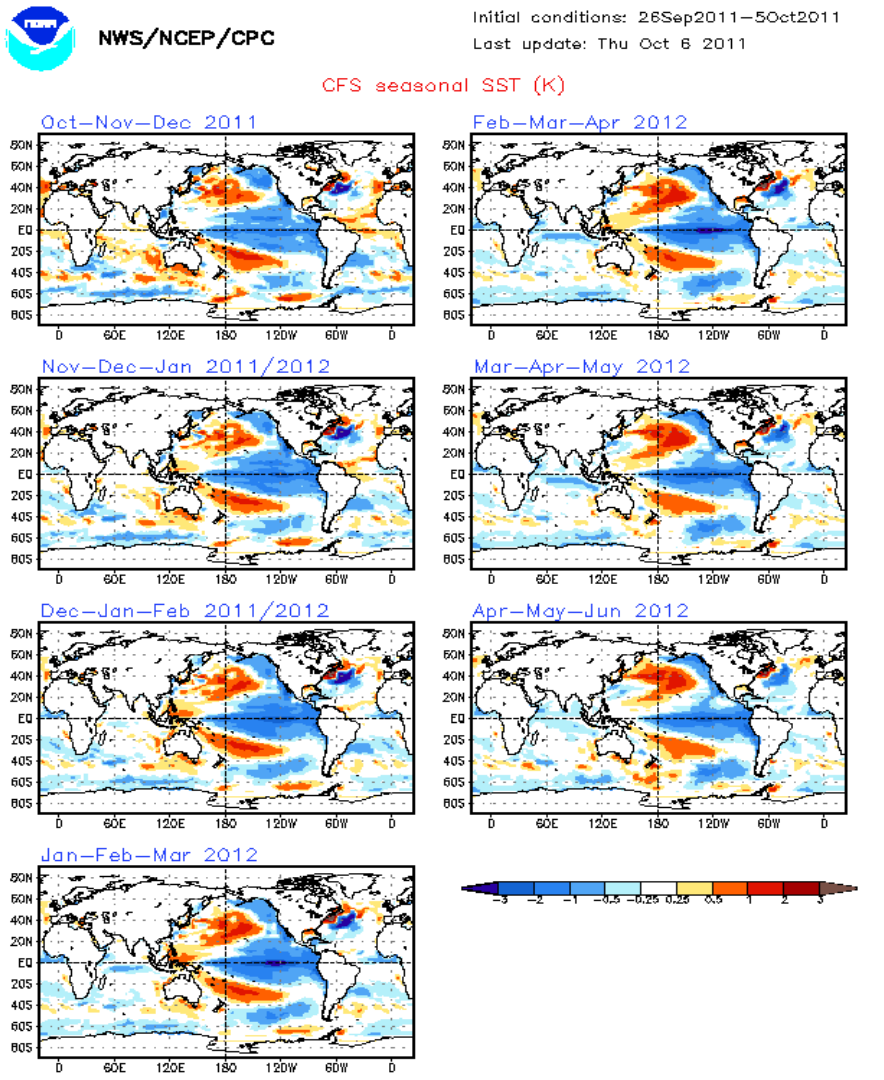
CFSv2





CFSv1


NWS/NCEP/CPC
Initial conditions: 26Sep2011–5Oct2011
Last update: Fri Oct 7 2011
CFSv2 seasonal SST (K)
Oct–Nov–Dec 2011
Feb–Mar–Apr 2012
Nov–Dec–Jan 2011/2012
Mar–Apr–May 2012
Dec–Jan–Feb 2011/2012
Apr–May–Jun 2012
Jan–Feb–Mar 2012
−3 −2 −1 −0.5 −0.25 0.25 0.5 1 2 3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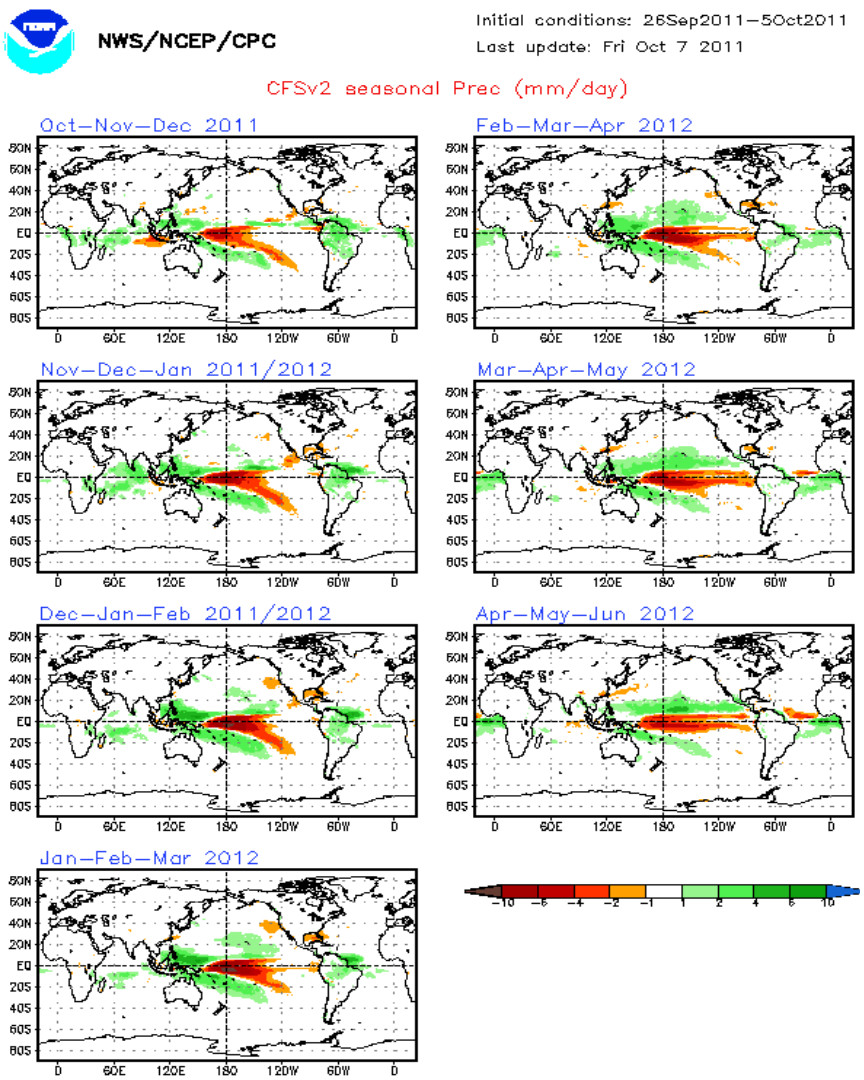
CFSv2

CFSv1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CFSv2 seasonal Prec (mm/day)
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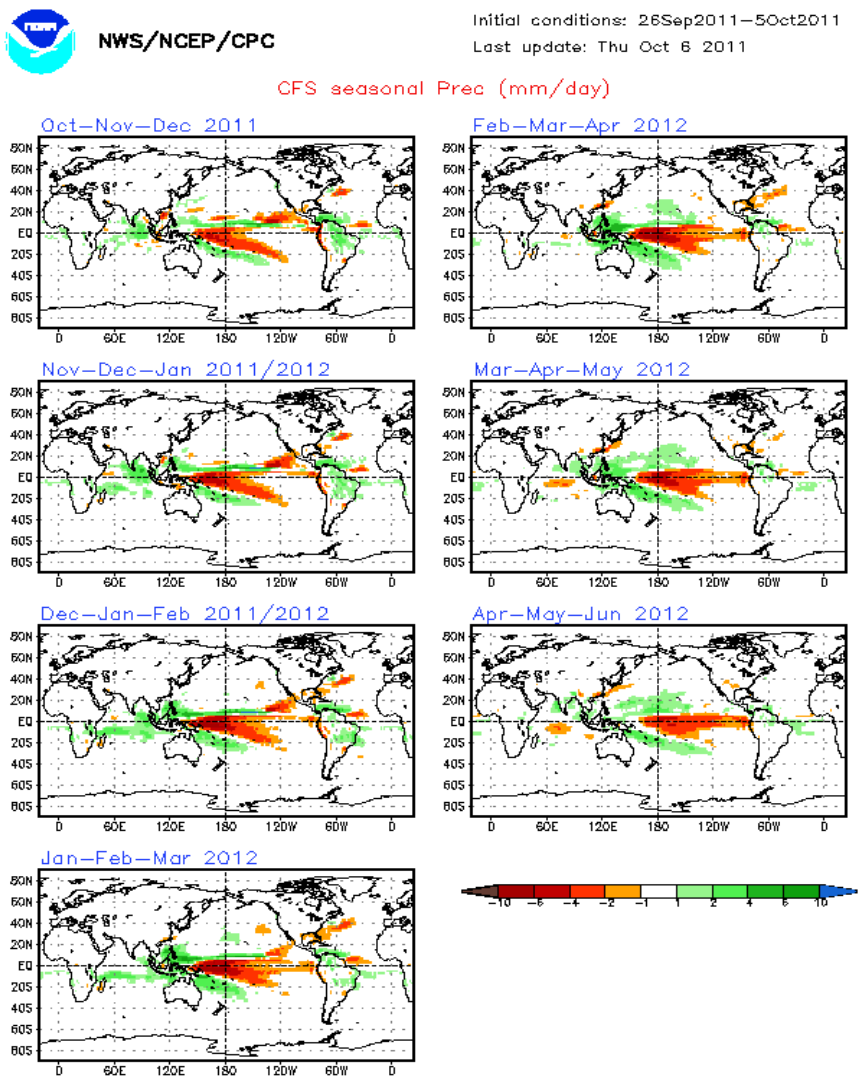
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Apr–May–Jun 2012
Jan–Feb–Mar 2012

CFSv2

CFSv1

Summary

- **CFSv2 became operational on March 30, 2011.**
  NCEP CFSv2 website; http://cfs.ncep.noaa.gov/
- **CFSv1 is run in parallel for a while (duration to be determined)**
- **Keeping CFSv1 will provide**
  - ***more breathing room, and will allow us time to get familiar with the nuances of the CFSv2***
  - ***will also allow external users to access the CFSv2 hindcasts, and calibrate their application models***
- **The real-time CFS Data Assimilation System will replace the current Climate Data Assimilation System (CDAS).**