NOAA MAPP Program S2S Activities

Focus on select products/capabilities/metrics

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MAPP
Modeling, Analysis, Predictions, and Projections

MAPP Mission and Priority Areas

Modeling, Analysis, Predictions and Projections

- MAPP is a NOAA OAR/Climate Program Office competitive grants program to address NOAA's global coupled modeling, prediction & projection needs
- We coordinate with other NOAA programs and Line Offices, and with other agencies via USGCRP, US-CLIVAR/GEWEX and contribute to WCRP/WWRP research e.g. S2S Prediction Project
- We support R&D projects, as well as transition (R2O) activities via the Climate Test Bed

MAPP's Priority Areas:

- Prediction Across Timescales
- Drought and Other Applications
- **Reanalysis and Data Assimilation**
- Climate and Earth System Modeling
- Climate Projections

Takeaways from this talk

MAPP S2S work is interconnected with other MAPP/CPO activities, strong linkages with US-CLIVAR/GEWEX programs and the WWRP/WCRP S2S Prediction Project

Past MAPP research contributions have led to S2S prediction products/capabilities for NOAA, the National ESPC, NIDIS and other stakeholders including in the private sector

A wealth of on-going leading research efforts by the MAPP program community developing new S2S capabilities

A robust contribution to the NOAA response to the S2S Weather Bill

CPO's role in developing S2S capabilities

- CPO and predecessor Office of Global Programs long-term observations of the climate system (e.g. TOGA-CORE) have provided the basis for current S2S capabilities (e.g. predicting the El Nino or the Madden Julian Oscillation)

- The CPO Climate Variability and Predictability Program developed foundational understanding of processes underpinning S2S predictions via numerous interagency field campaigns (e.g. DYNAMO, YMC, NAME, etc..)

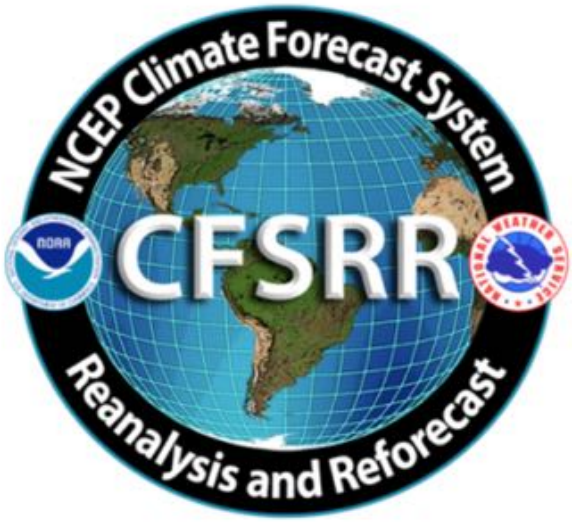
- CPO has played a leading role in S2S research partnerships as part of the US Global Change Research Program (USGCRP), US-CLIVAR and international programs such as GEWEX

- To date, MAPP has been the first/leading NOAA program working to develop S2S predictions involving the external community, extending key internal NOAA work

Climate Forecast System (CFSv2)

- MAPP and predecessor programs have co-supported Climate Forecast System v2 development over many years
  - Physical processes, land modeling and data assimilation, reforecasts, post processing and evaluation

- CFS is the operational NWS seasonal forecast system, also used for experimental subseasonal prediction at NOAA and by many others



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NMME system for seasonal prediction - a multi agency, multi-year MAPP/CTB project

NCEP CFS

GFDL FLOR/CM

EC CMC

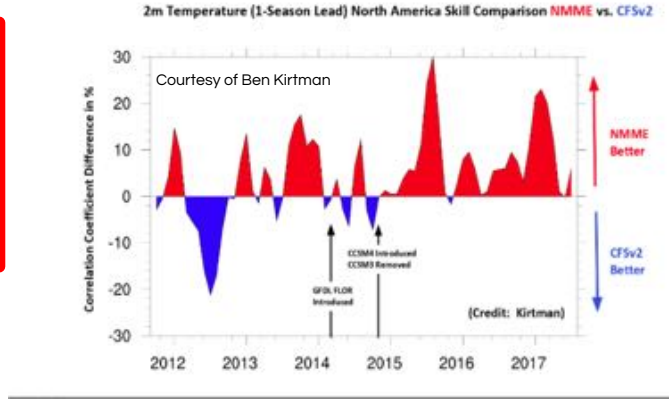
NASA GEOS

NCAR CCSM

NCAR CESM

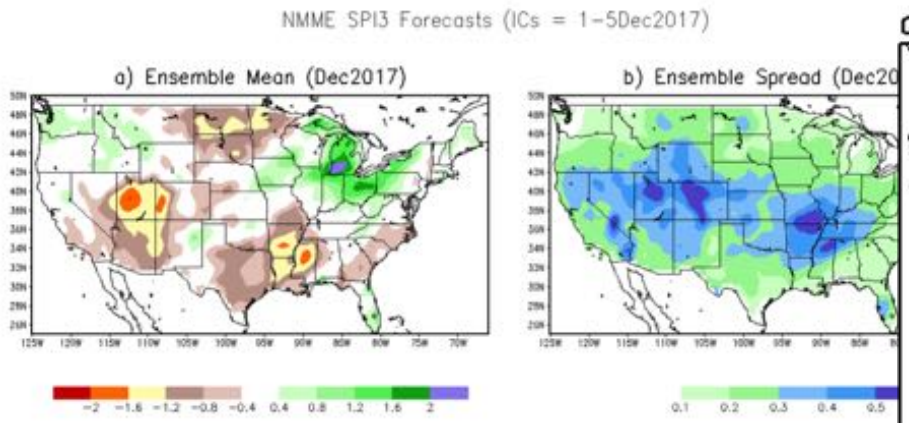
NMME

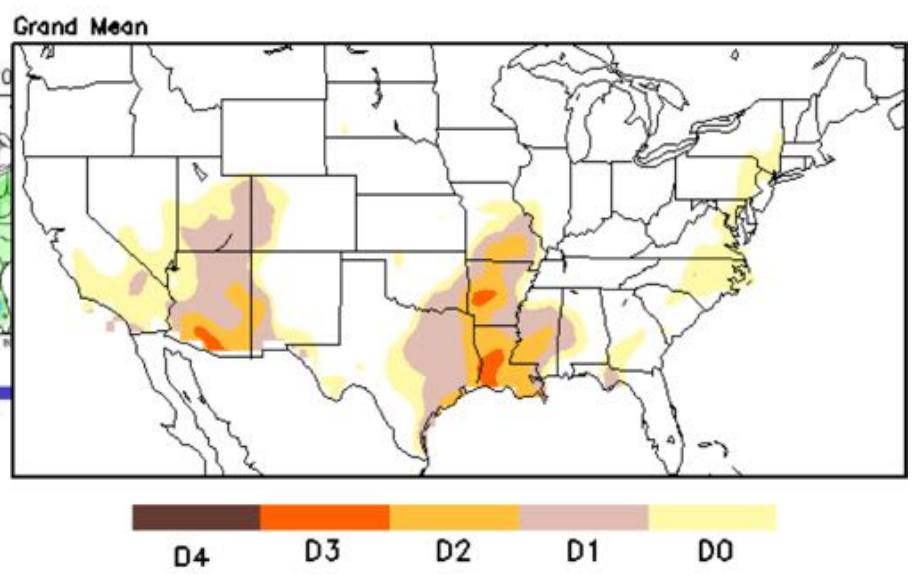
- Monthly seasonal forecasts, real time since 2011
- 30 years of hindcasts
- Both operations and research platform
- Still needs improvement, but better than any single model



NMME related products/capabilities

NMME products used for the official CPC seasonal temperature/precipitation outlook, and the drought outlook; and external stakeholder products including NIDIS and private sector..

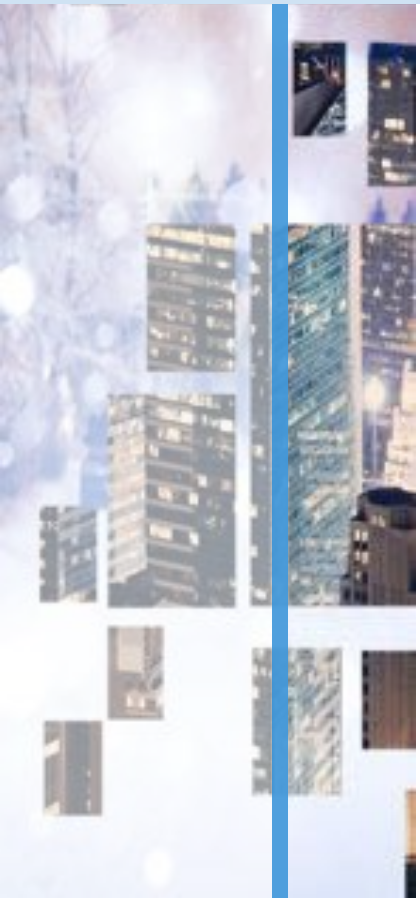




Courtesy of CPC Drought Briefing team

An example from the private sector

Courtesy of Mike Ventrice, Weather Company



NOAA Data in Sub-Seasonal/Seasonal Platform

- **0-hr GFS Operational Model**
  - Utilized for a real-time "Observations" dataset
- **CFSv2 Weekly Model**
  - Utilized in Week 3-5 Forecasts
  - Product Suite Available
- **NMME Climate Models**
  - Utilized in Month 1-7 Forecasts
  - Product Suite Available

The Weather Company
An IBM Business

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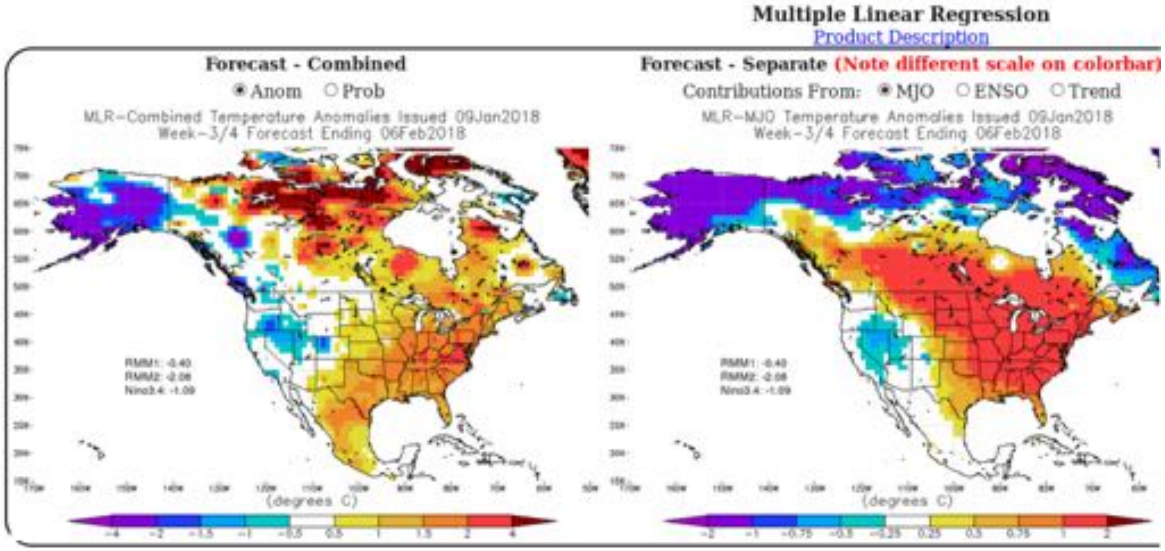
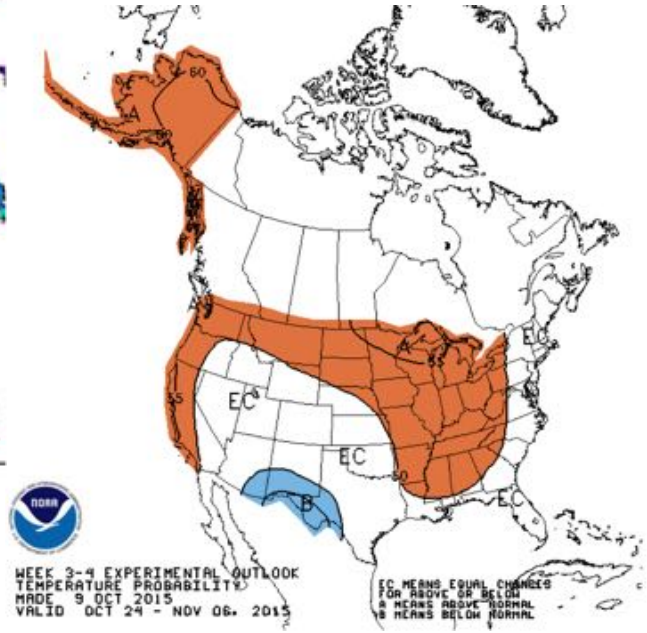
New Week 3-4 Temperature and Precipitation Forecast Tools

Tested over 2014-2017 as part of a MAPP Climate Test Bed project, now used for the NCEP CPC Experimental Week 3-4 Outlook





Tools are statistical approaches that leverage the MJO/ENSO phase or amplitude

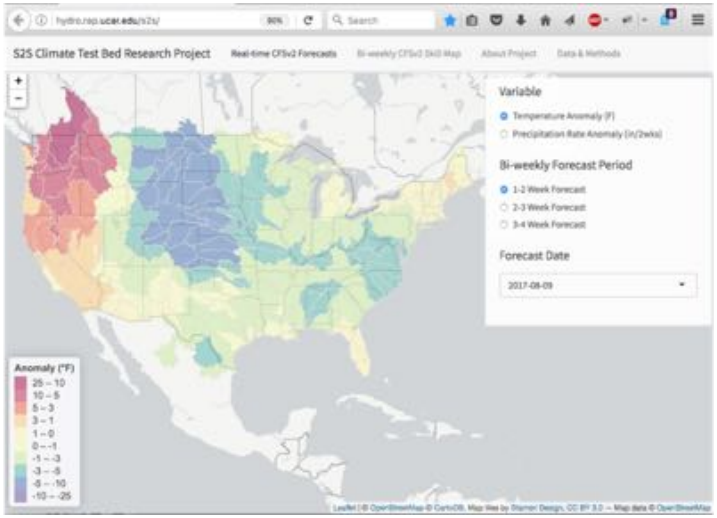
Courtesy of Nat Johnson

Examples of on-going MAPP projects exploring new S2S capabilities

MAPP/Climate Test Bed (CTB) projects

- Severe Weather Forecast Tools
- NMME Post-processing Protocol
- Flash drought monitoring and prediction
- NMME for hydrology/water management (right)
- Hybrid statistical-dynamical teleconnection prediction
- Improving operational ocean monitoring
- Alaska fires
- Global excessive heat outlooks
- SubX (next slide)

S2S Climate Outlooks for Watersheds



real-time prototypes of initial products
http://hydro.rap.ucar.edu/s2s/
Courtesy of Wood A et al.

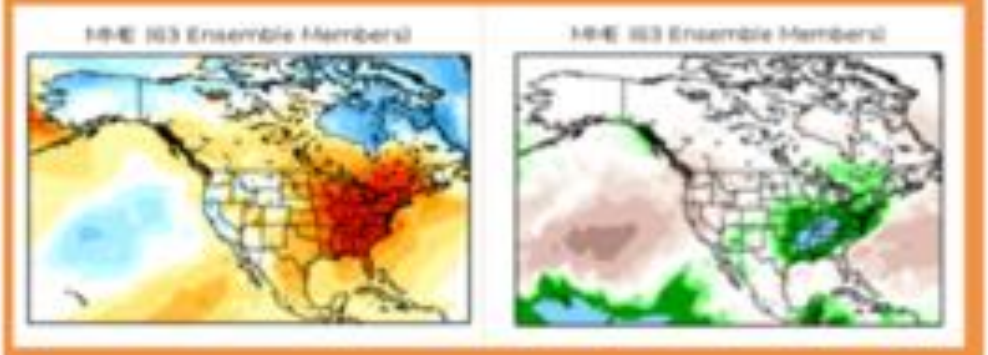
FY18 call for CTB S2S predictions work

The Subseasonal eXperiment (SubX)

By the Numbers...

- **7** Global Models
- **17** Years of Retrospective Forecasts
- **1** Year of Real-time Forecasts
- **3-4** Week guidance for CPC Outlooks

Real-time Multi-model Forecasts



SubX Team

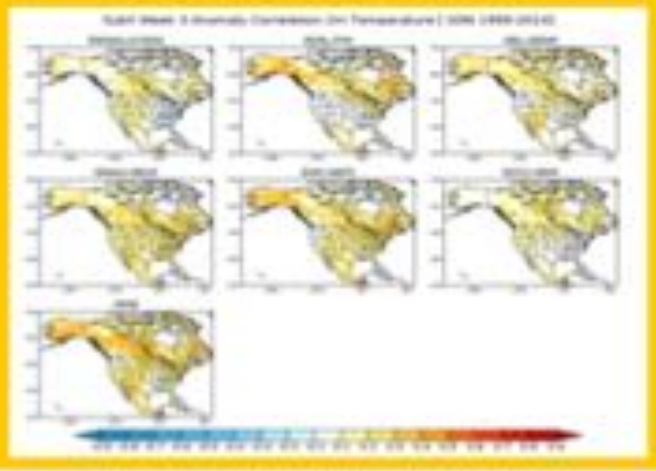
NOAA · NASA · George Mason University · Environment and Climate Change Canada · CIRES · U.S. Naval Research Laboratory · FIU · IRI

IRI Data Library

Forecast & Hindcast data publicly available

http://iridl.ldeo.columbia.edu/SOURCES/.Models/.SubX/

Skill Evaluation



http://cola.gmu.edu/kpegion/subx

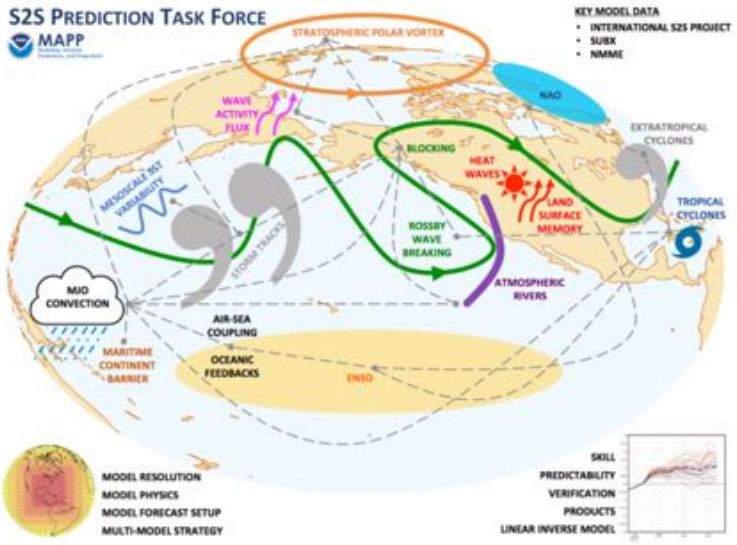
MAPP Modeling, Analysis, Predictions, and Projections · Office of Naval Research Science & Technology · National Weather Service · NASA · Environment Canada · NOAA Climate Test Bed

Courtesy of Kathy Pegion

MAPP S2S Prediction Task Force

Subseasonal to Seasonal (2016-2019)

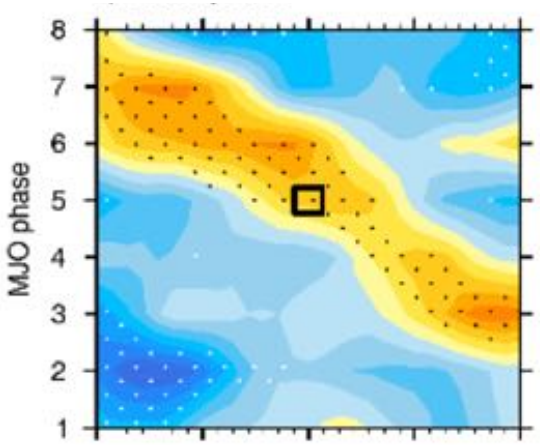
Bridge the gap in prediction skill and products between traditional weather and seasonal lead times



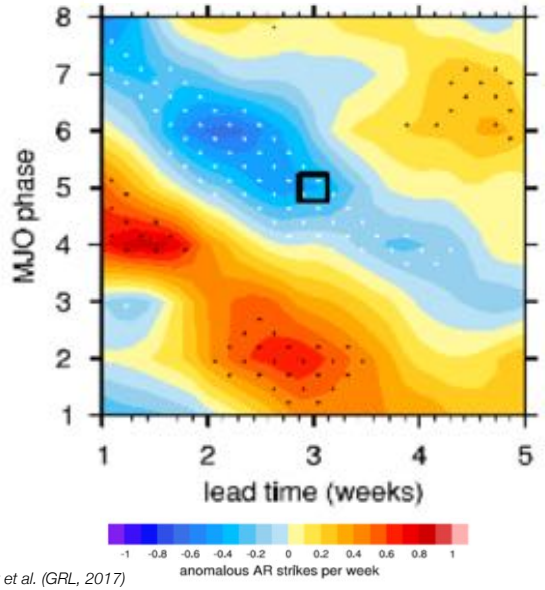
More on the S2S Prediction Task Force during my “research opportunities” talk tomorrow..

Skill in Atmospheric River Forecasts over the Pacific Northwest

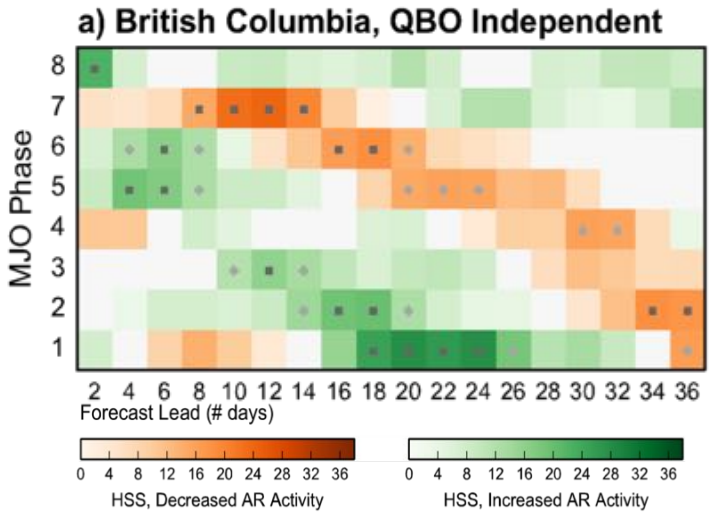
QBO: winds from **east**



QBO: winds from **west**

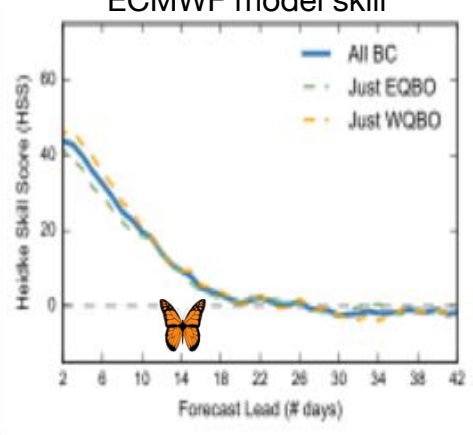


Baggett et al. (GRL, 2017)
Composites of 7-day average activity
ERA-Interim



Mundhenk et al. (NPJ Climate, 2018) forecasts for 5-day average activity
MERRA-2

ECMWF model skill

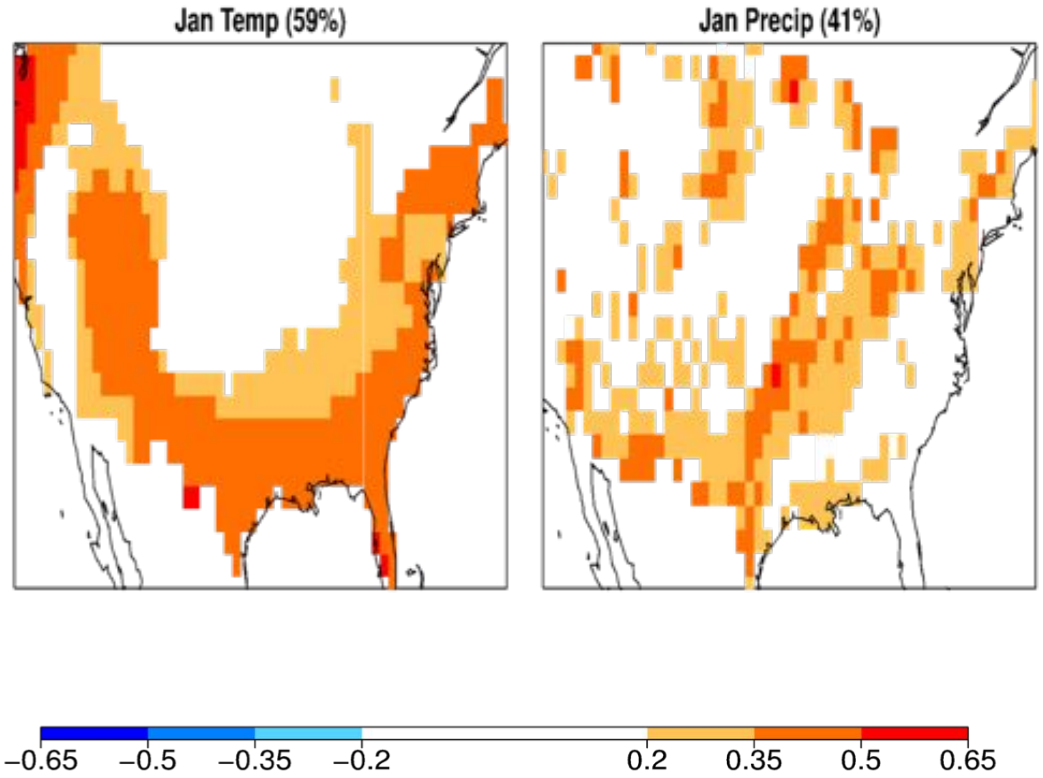


Heidke Skill Score

prediction skill 30+ days ahead of time using a statistical model based solely on the MJO & QBO

current research by Elizabeth Barnes, Eric Maloney, Cory Baggett & Bryan Mundhenk (CSU); MAPP Award: NA16OAR4310064

Subseasonal Predictability of T and P in CFSv2

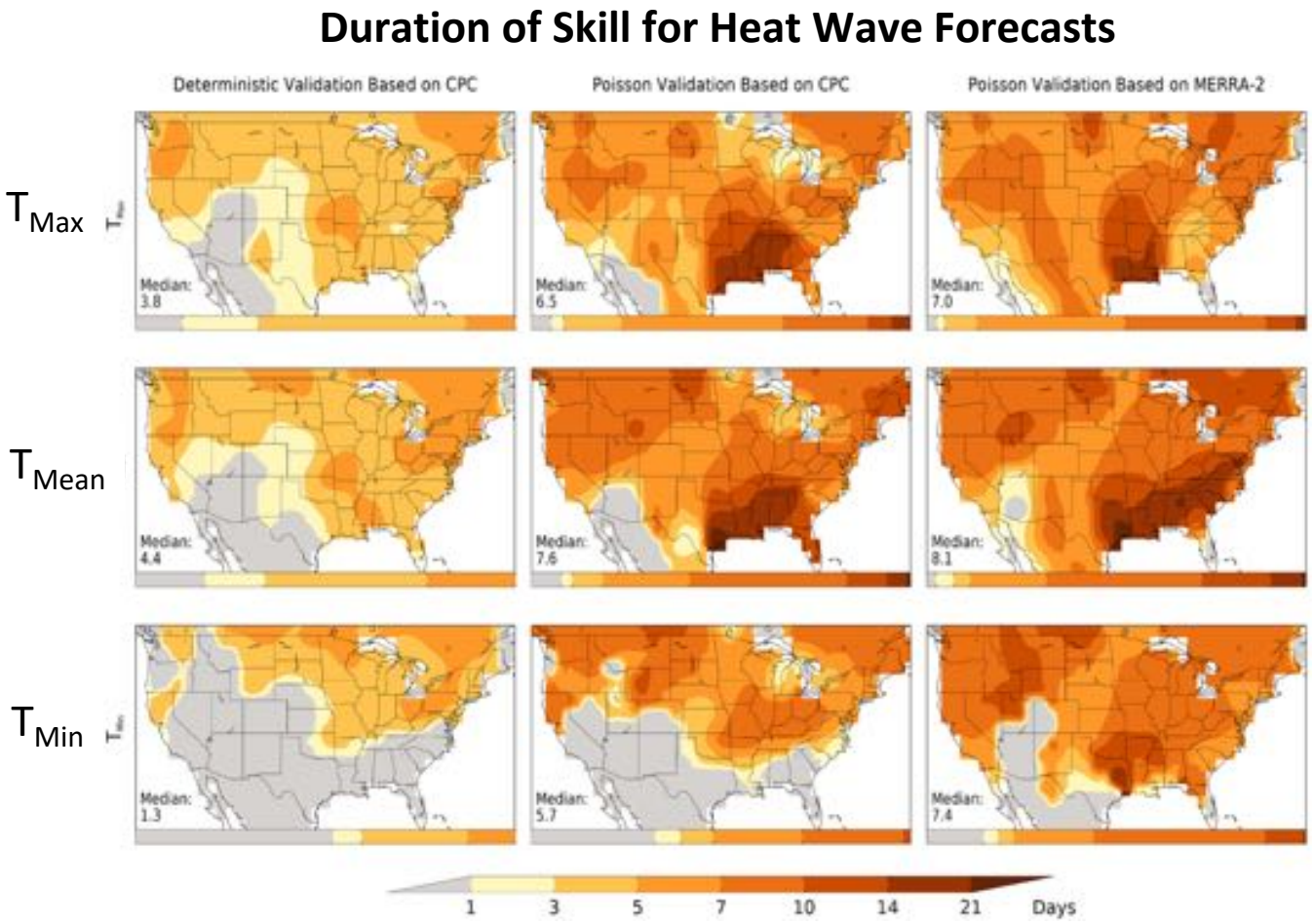


Correlation skill of week 3–4 temperature (left) and precipitation (right) CFSv2 hindcasts over CONUS during January, 1999-2010 (12 years).

- CFSv2 shows some skill for predictions of week 3-4 temperature and precipitation
- Skill detected at grid points and by spatial optimization methods
- Statistical significance established by rigorous permutation test
- Most predictable components are related to ENSO

Courtesy of Tim del Sole

North American Heat Wave Predictability



Lead time (in days) beyond which the skill of NCEP CFSv2 model forecasts of extreme heat fall below that of a climatological forecast for Tmax (top), Tmean (middle), and Tmin (bottom); different validation approaches against CPC temperature observations and MERRA-2 temperature analyses.

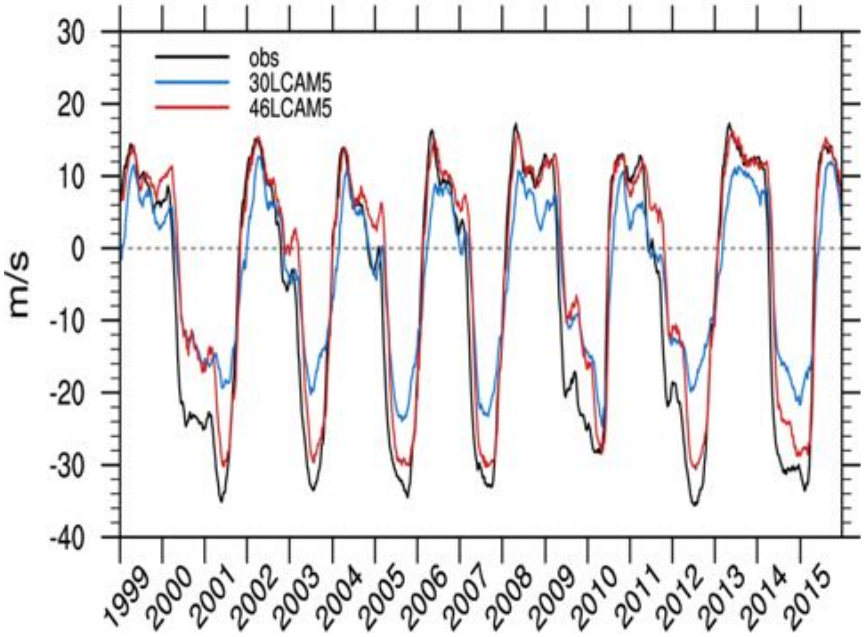
Courtesy of Trent Ford

MAPP Awards: NA16OAR4310066, NA16OAR4310095

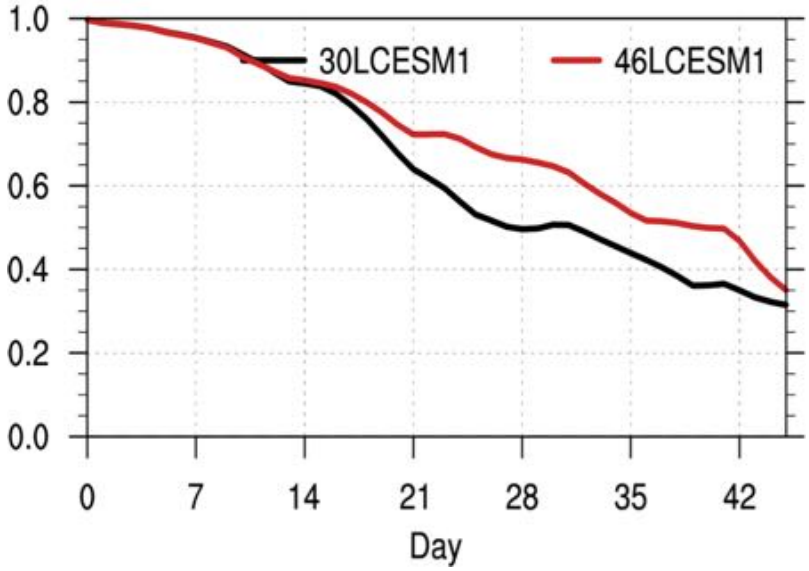
Impact of stratosphere on S2S Prediction

- Use 30-level (low-top) and 46-level (stratosphere resolving) CESM1 to evaluate influence of the stratosphere on S2S predictive skill
- 1999-2015 hindcast set using SubX protocol, 10 ensembles

Week 4 QBO forecast (U 2S to 2N, 30 hPa)



ACC: 65-90N polar cap Z at 100 hPa



Preliminary analysis shows that the higher top model can improve predictive skill in the polar region.

Courtesy of Judith Perlwitz and Jadwiga Richter

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