SUBSEASONAL-TO-SEASONAL FORECASTING

Update on NOAA's S2S Progress

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Weather Research and Forecasting Innovation Act

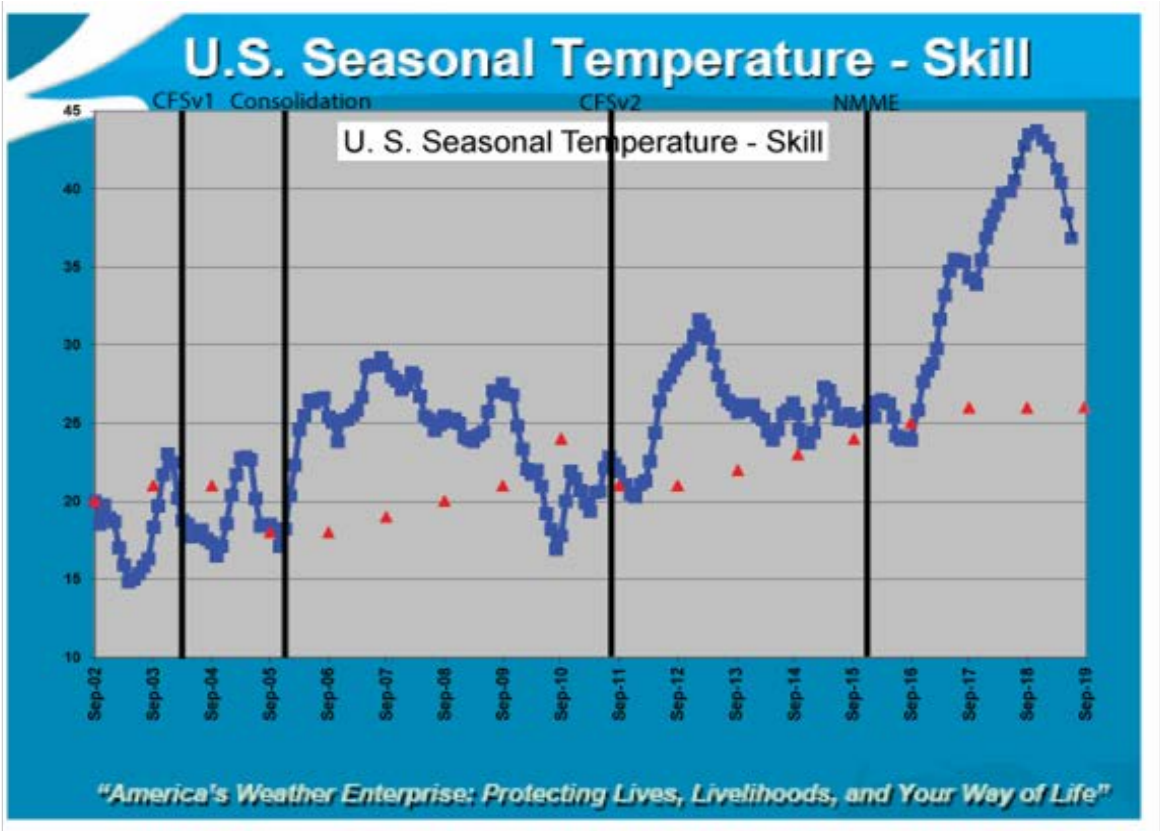
Signed into law 2017; reauthorized 2019 (in part)

Title II: Subseasonal and Seasonal Forecasting Innovation

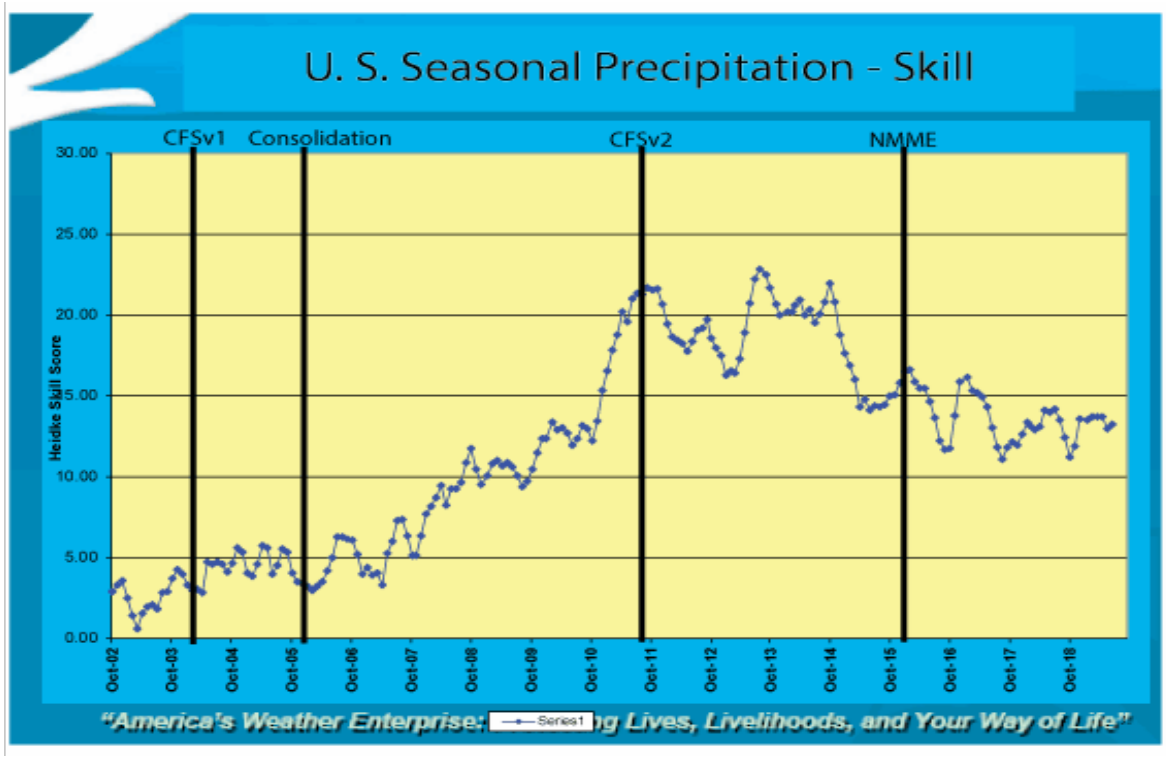
The Director of NWS and the heads of such other programs of NOAA as the Under Secretary considers appropriate, shall:

1. *Collect and utilize information in order to make usable, reliable, and timely foundational forecasts of subseasonal and seasonal temp and precip;*
2. *Leverage existing research and models from the weather enterprise to improve the forecasts under para (1);*
3. *Determine and provide information on how the forecasted conditions may impact*
    a. *the number/severity of droughts, fires, tornadoes, hurricanes, floods, heat waves, coastal inundation, winter storms, high impact weather, or others*
    b. *snowpack; and*
    c. *sea ice conditions*

GPRA: Running 48 Month Mean Two Meter Seasonal Temperature

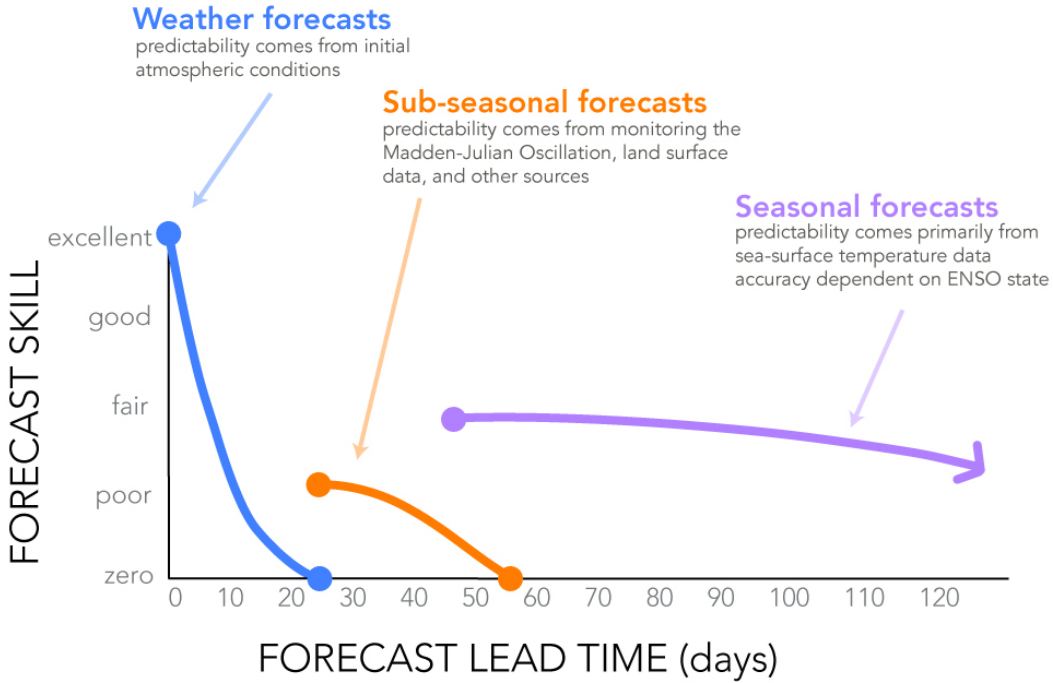


Running 48 Month Mean Seasonal Precipitation Skill



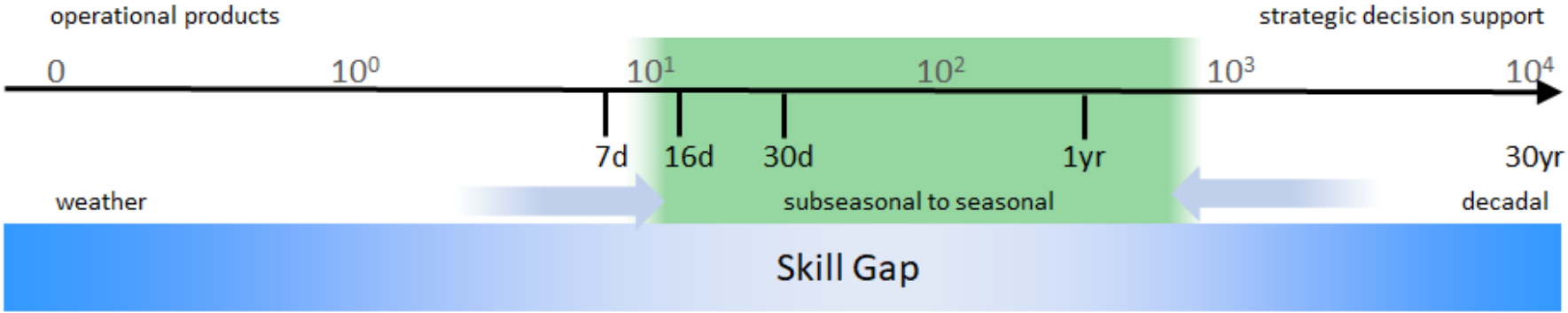
NOAA's S2S Goals

- Improve S2S forecast skill
  - Exploit predictability from tropical interactions, land surface and snow, stratosphere, ocean interactions
  - Emphasize precipitation prediction metrics/tools
- Enhance the value of S2S products for stakeholders
  - Improve coordination with users, incorporate user needs
- Both Subseasonal and seasonal forecasts need calibrated post-processed dynamic forecasts



White *et al.* 2017

Challenges



Scientific Challenges:

- Fully-couple air-ocean-land-ice modeling systems
- Improve data assimilation--better observation use
- Improve process representation and higher resolution--verify with observations
- Advance reanalysis and reforecasts needed to calibrate forecasts
- Build UFS-based multi-model ensembles

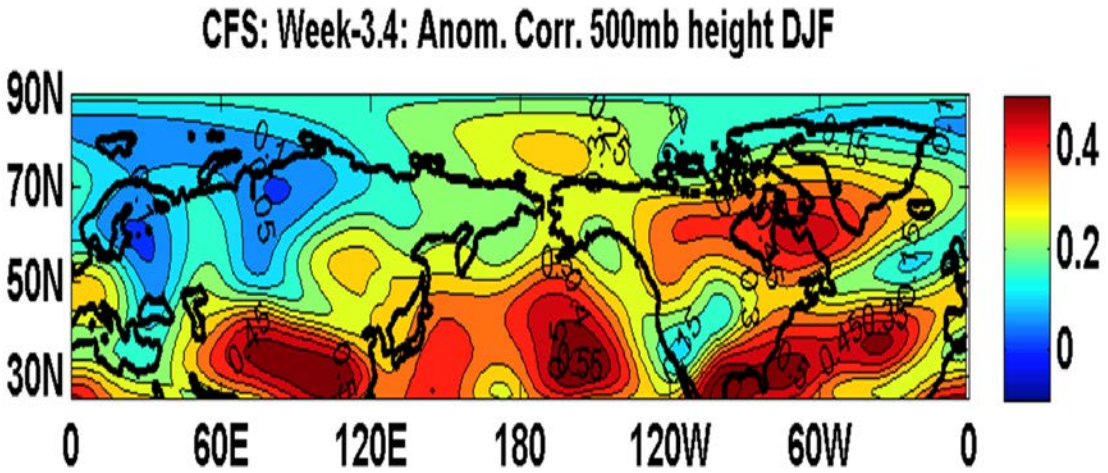
Technical Challenges:

- Improved use of Cloud-based High-performance Computing
- Common model architectures
- Uncertainty depiction, especially common metrics
- Product creation

Prediction Challenges: Systematic Errors

Major Systematic Errors Limiting S2S Forecast Skill: Inability to Predict Upper-Level Steering Flow over Western U.S. at Leads Beyond Week 2

The skill of week 3-4 predictions of DJF 500 MB heights for CFSV2: ALL dynamical models have limited ability to predict upper-level flow for western half of the US beyond week two. It is unclear if this an intrinsic limit of predictability or due to missing or misrepresented processes in these models.



S2S Requires All RLs Engaged

CPO: Observations & Research

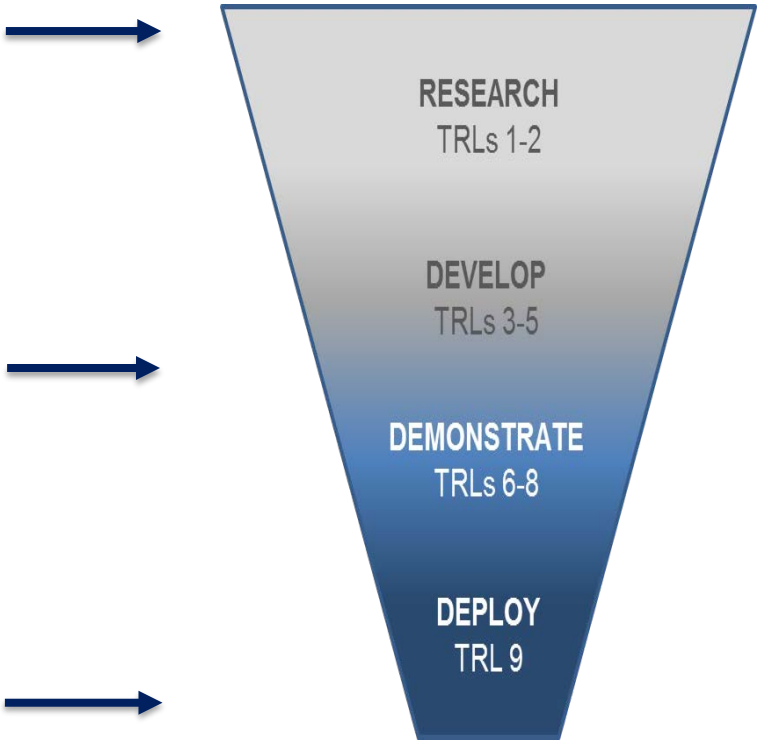
- Climate research and process studies across scale
- Global Ocean Observations
- Climate and Earth System modeling (e.g., ocean, atmosphere and land processes; Climate Process Teams)

OWAQ: Research and R2O

- Weather research and process studies across scales
- Climate Test Bed

CPC: Operational Climate Products

- One month, three months, and seasonal temperature and precipitation outlooks

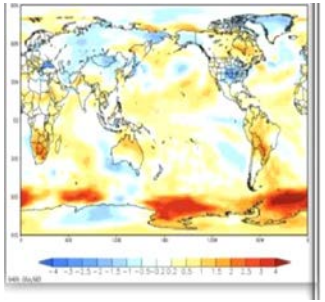


NOAA RESEARCH

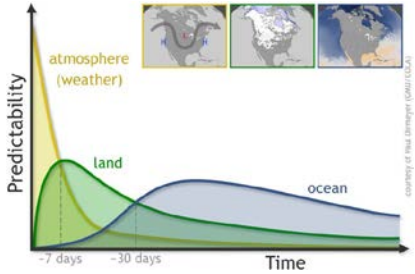
NOAA SERVICES

OAR S2S Support

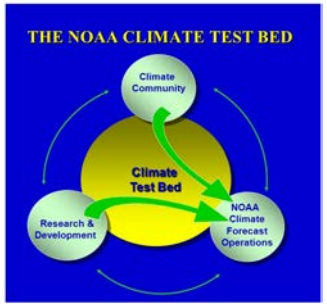
Observations



Multi-Model Ensembles
(NMME, SubX)



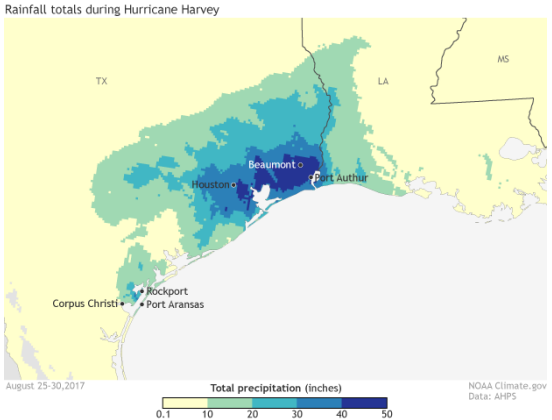
S2S Research



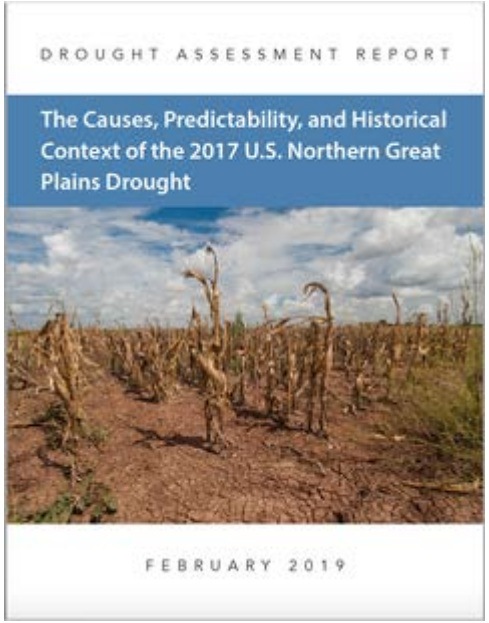
The Climate Testbed

National ESPC

OAR S2S Support



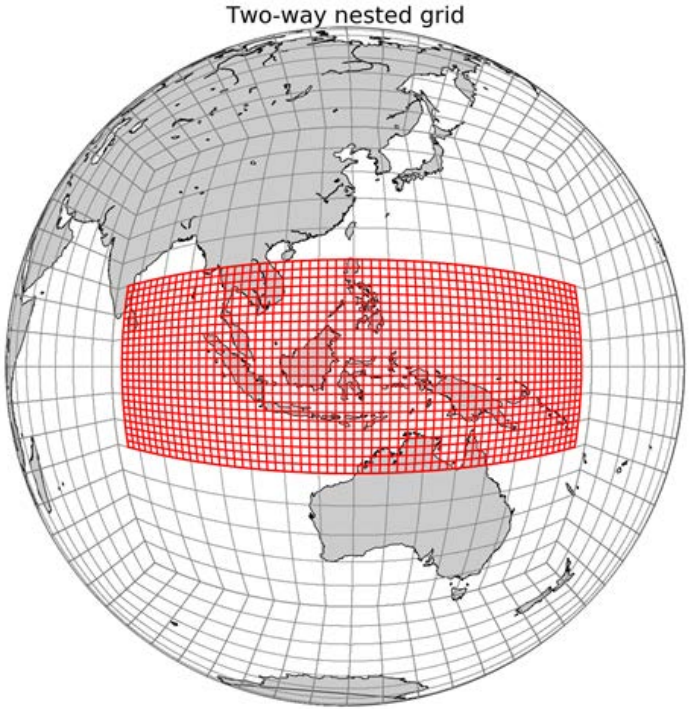
Subseasonal and extended weather prediction models Prediction Project (SubX) provided early picture of precipitation from Hurricanes Michael and Harvey



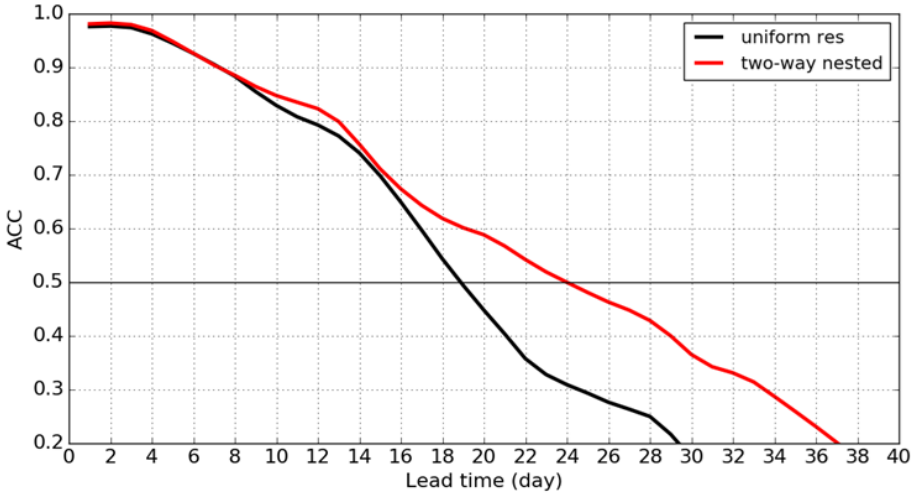
Attribution and predictability assessments of weather, water, and climate extremes

RISAs are helping build resilience to extreme events and water hazard planning in rural communities

MJO in two-way nested fvGFS

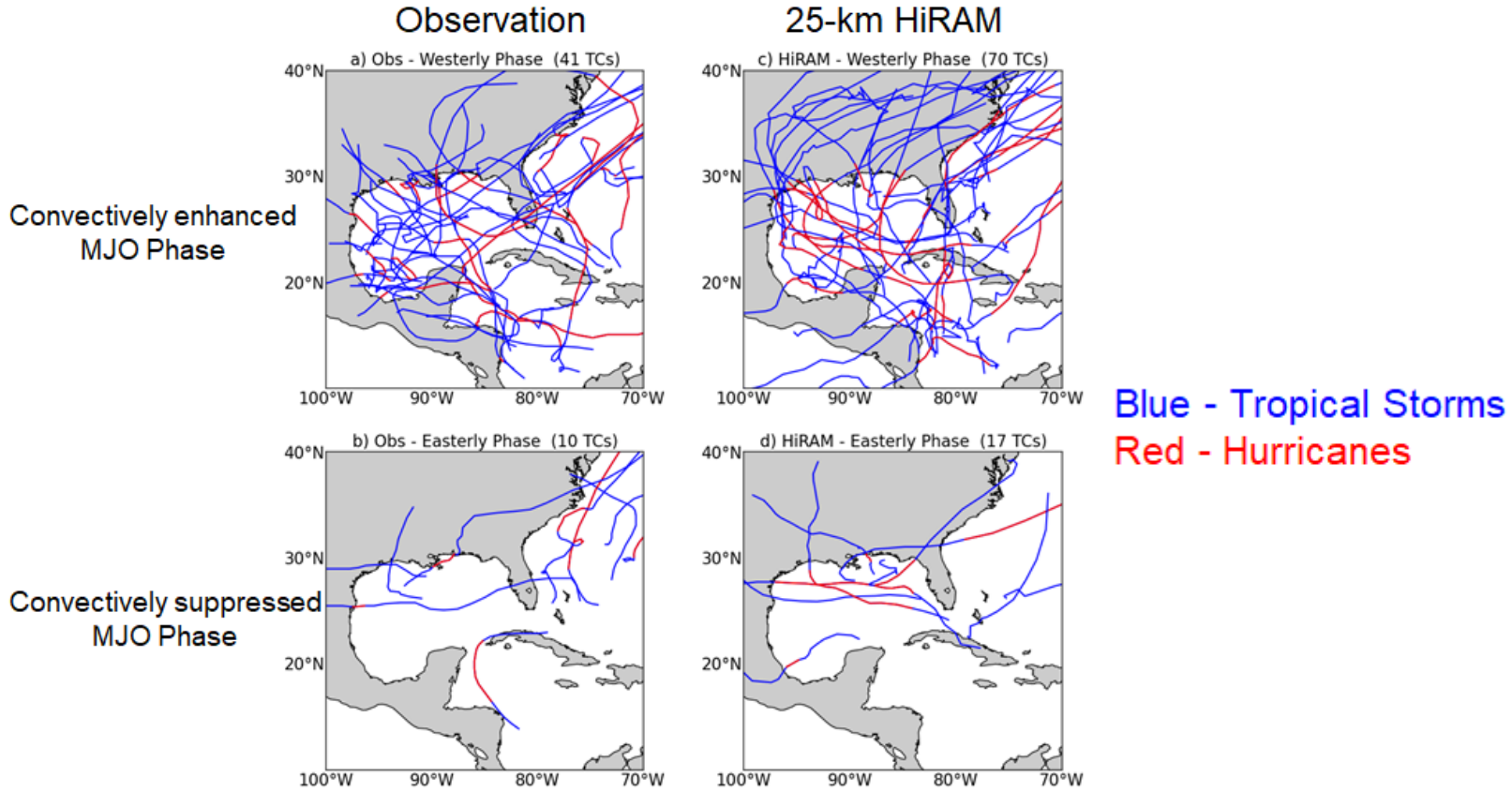


MJO prediction skill in 2011/2012 Winter

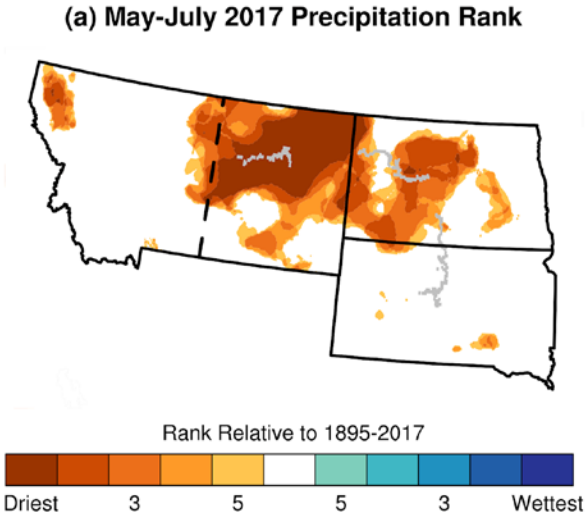


The two-way nested configuration extends skillful MJO prediction by 5 days.

MJO impact on TC Activity



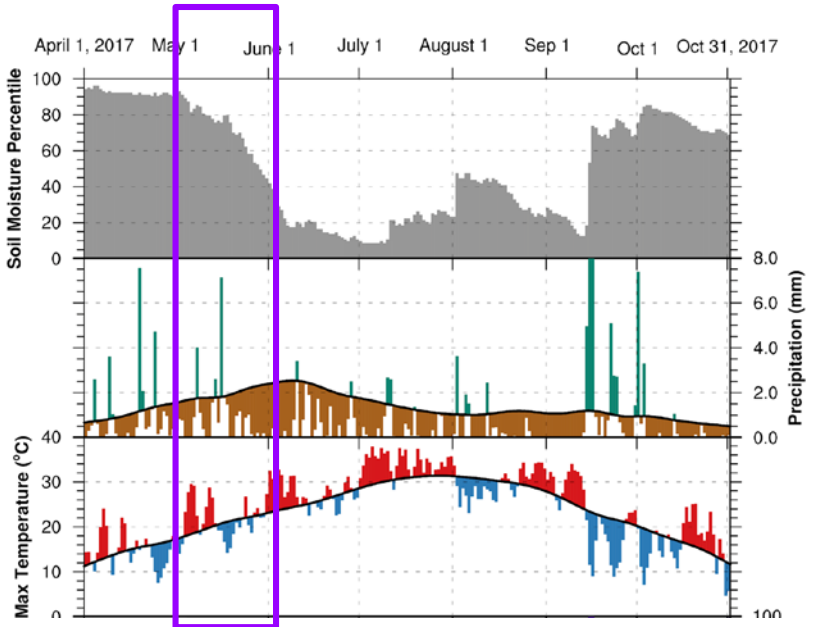
Flash Drought: May-June 2017



Rapid soil moisture decline

Record low rain during rainiest time of year

Mostly above-average temperatures



Advancing Sea Ice Prediction

Drone view into the ice

- Saildrones efficiently gather observations in places we couldn’t go otherwise (edge of sea ice)
- Comparing in situ observations to real-time forecast for the first time to identify the accuracy and errors in the forecast over Arctic water and ice
- Provides feedback to the community and allows for ground truthing and model calibration

S2S Research Program Call: FY2019 3-yr $1.5M

Addresses S2S predictive capability, understanding of precipitation via improved data assimilation, earth system model processes affecting precipitation and high-impact events, and ensemble techniques including ensemble composition, post-processing, and MMEs.

Goals
Support Weather Act, NOAA unified modeling approach
Partner with existing multi-model ensembles, NOAA/WMO/other agency datasets, leverage existing interagency partnerships (JCSDA, etc.)
Harness predictability sources across Earth system scales (MJO, ENSO, AO, QBO, etc.)
Emphasize forecast criterion of customer need: precipitation
Respond to National Academy S2S Report

Six projects selected, in final stages of awarding grants

CTB Projects

FY20 program call has been announced: https://www.grants.gov/web/grants/view-opportunity.html?oppId=319916
See full announcement and CTB information sheet

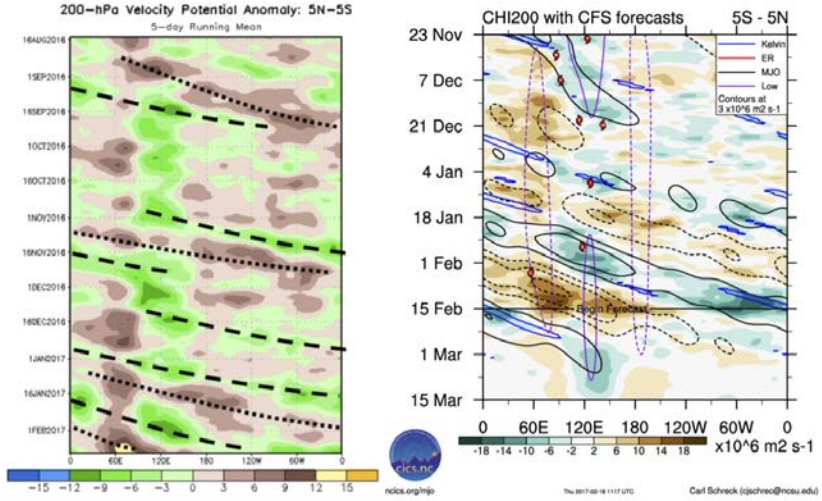
Expect $1.5M, 5-7 projects

Goals
Development and maturation of the S2S portions of the Unified Forecast System (UFS)
Maturation and implementation of data assimilation (DA), monitoring products, and data quality control (QC)
Post-processing, diagnostic and verification tools, and innovative statistical techniques leading to improvement of S2S operational predictions

Dr. Stephen Baxter and Dr. Carl Schreck: Operational Transition of Novel Statistical–Dynamical Forecasts for Tropical Subseasonal-to-Seasonal Drivers

Improving Subseasonal-to-Seasonal Tropical Forecasts

This project will leverage a newly verified methodology to improve forecasts on the subseasonal to seasonal timescale by transitioning this methodology to operations at NOAA's Climate Prediction Center (CPC). Specifically, this project seeks to improve the CPC's operational monitoring of tropical variability, operational prediction of the Global Tropical Hazards (GTH) Outlook, and ability to monitor tropical-extratropical teleconnections using analyses and forecasts from the Climate Forecast System Version 2. This new product is already in use by a number of public, private, academic, and international stakeholders and will improve CPC's capabilities.



QUESTIONS?