Subseasonal Forecasting Developments at the Climate Prediction Center

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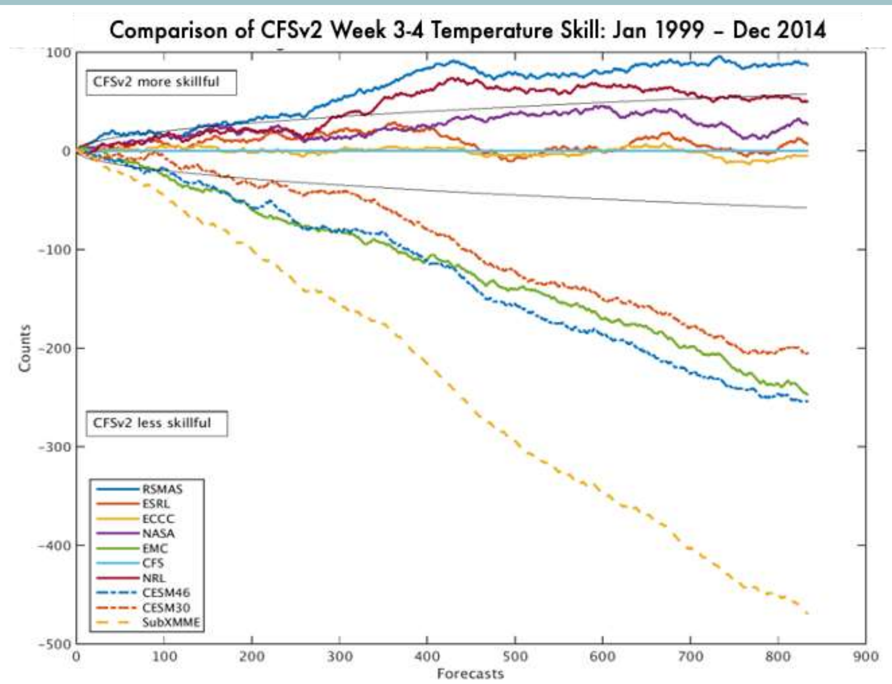
Subseasonal forecasts for the week 3-4 period have been produced at the Climate Prediction Center (CPC) since September of 2016 and remain a focus of climate forecast development. The Subseasonal Prediction Experiment (SubX) has shown that the use of a multi-model ensemble (MME) in subseasonal prediction can improve forecasts relative to individual models for the week 3-4 timescale (LaJoie et al, CDPW 2019; Pegion et al., 2019).

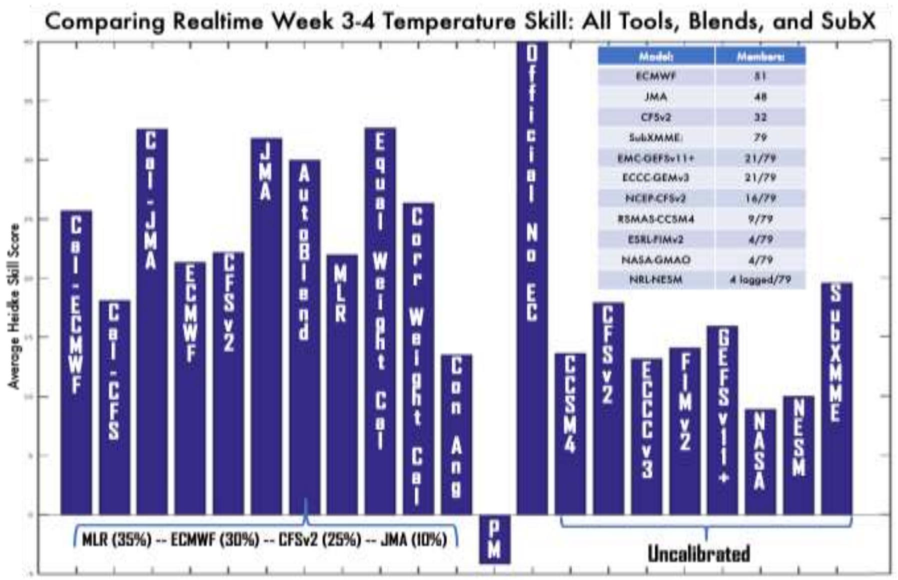
Improvements to week 3-4 forecasting are being tested using the SubX forecast system. These include calibration of probability forecasts and the addition of new models to the MME. We summarize the verification skill of the CESM1 models, calibration developments using BJP and ELR methods, and compare the realtime skill of the Week 3-4 operational tool suite, including the SubX forecast system. Additional verification of realtime calibration skill and a hybrid SubX-Operational multimodel ensemble is currently underway.

Latest Additions to SubX Database



Comparing forecast skill of CFSv2 with the SubX model suite. The SubXMME has a 78% chance of providing a more skillful forecast. The recent CESM1 models have a 65% (46L) and 62% (30L) chance and SubX-GEFS has a 65% chance.

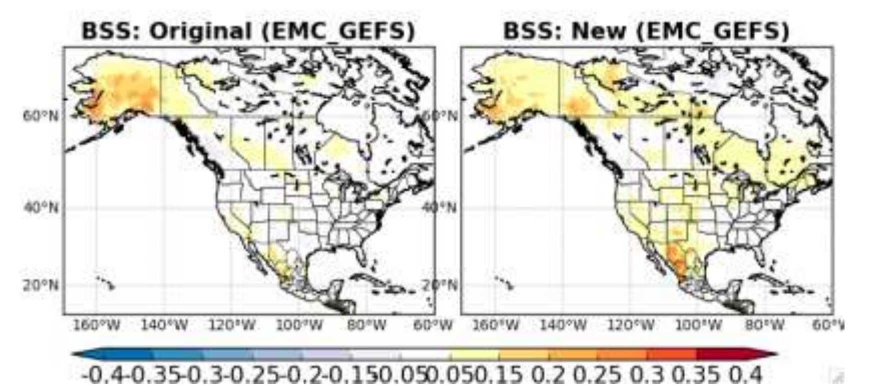
Comparison of Realtime Skill



Average HSS for each Week 3-4 temperature forecast tool, estimated across recent 2+ years. The Official forecast scores best. Calibrated JMA is best scoring operational dynamical model. Equal- and Correlation-Weighted blends use Calibrated ECMWF, CFSv2, and JMA. SubX models are not calibrated.

SubX Calibration

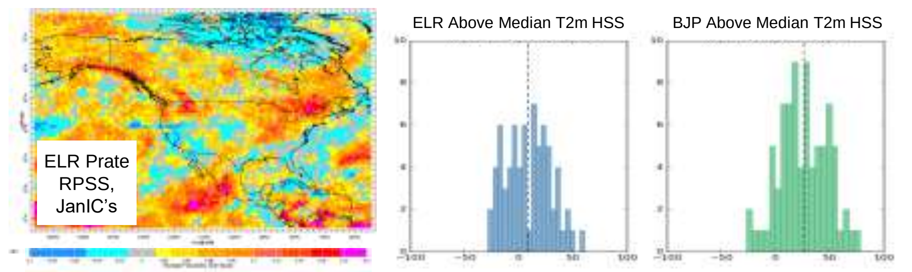
Bayesian Joint Probability (BJP) calibration (Schepen et al. 2018, Strazzo et al. 2019) has been used to post-process sub-seasonal and seasonal forecasts at CPC, and increases skill and reliability over raw model hindcasts. Recently, we updated our climatology calculation to better represent week 3-4 climatology used in calibration, increasing probabilistic skill over our original method.



Brier Skill Score (BSS) using original climatology calculation method in BJP (left) and updated method (right) for October t2m forecasts in SubX EMC_GEFS

SubX Calibration

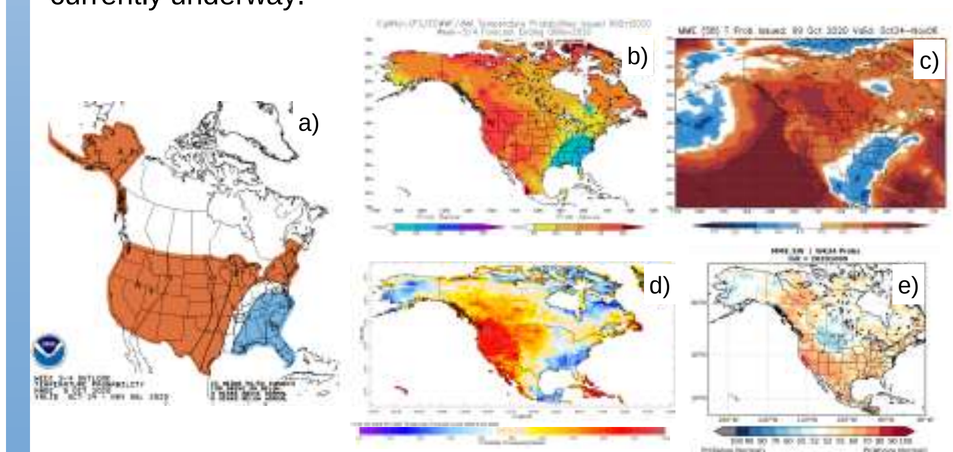
A new method of calibration, extended logistic regression (ELR) was developed in partnership between the International Research Institute (IRI) and CPC for a mini-multi model ensemble (miniMME) of SubX EMC-GEFS, CFSv2, and ESRL-FIM. While ELR increases skill over raw models, temperature forecasts are more skillful when calibrated with BJP. However, ELR currently provides calibrated SubX precipitation, which is unavailable in BJP.



Precip rank probability skill score (RPSS) for ELR miniMME Jan inits. (left) and histogram of ELR and BJP t2m Heidke Skill Scores (HSS) Jan inits. (right)

Example Forecast (10/9/2020)

Example of official forecast and forecast tools including operational dynamical models, raw SubX, and calibrated SubX models (ELR and BJP). Tools are in broad agreement, with some differences in raw and ELR calibrated SubX over AK (c and d); and the southeast in BJP (e). BJP will swap sign in regions of low skill, leading to the difference shown here. Real-time assessment of ELR and BJP is currently underway.



CPC Official Forecast for Oct 9 2020 (verifying 10/24-11/06) (a); CFSv2, ECMWF, and JMA equal weighted model guidance (b); SubX MME model guidance (c); ELR calibrated miniMME (d); BJP calibrated equal weight of CFSv2 and ESRL_FIM (e)

Pegion K, Kirtman BP, Becker E, et al (2019) The Subseasonal Experiment (SubX): A multi-model subseasonal prediction experiment. Bull Amer Meteor Soc. https://doi.org/10.1175/BAMS-D-18-0270.1
Schepen A, Zhao T, Wang QJ, Robertson DE (2018) A Bayesian modelling method for post-processing daily sub-seasonal to seasonal rainfall forecasts from global climate models and evaluation for 12 Australian catchments. Hydrol Earth Syst Sci 22:1615–1628. https://doi.org/10.5194/hess-22-1615-2018
Strazzo S, Collins DC, Schepen A, et al (2019) Application of a Hybrid Statistical–Dynamical System to Seasonal Prediction of North American Temperature and Precipitation. Mon Wea Rev 147:607–625. https://doi.org/10.1175/MWR-D-18-0156.1