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Status of Week 3-4 Activities at the Climate Prediction Center

Jon Gottschalck[1], Adam Allgood[1], Steve Baxter[1], Muthu Chelliah[1], Dan Collins[1], Dan Harnos[1], Luke He[1], Michelle L'Heureux[1], Kyle MacRitchie[1,2], Peitao Peng[1], Matt Rosencrans[1], Augustin Vintzileos[3] and Qin Zhang[1]

[1]*Climate Prediction Center, NOAA/NWS/NCEP, College Park, Maryland*
[2]*Innovim LLC., Greenbelt, Maryland*
[3]*University of Maryland - ESSIC/CISC-MD*

The Week 3-4 outlook period is within a time range that primarily no longer benefits from predictability due to atmospheric initial conditions (*i.e.*, Week-2) and is at times in a range too short to reliably benefit from slowly evolving parts of the climate system (ocean, land, *etc.*) known to aid longer time scale prediction (monthly to seasonal outlooks). Consequently, the Week 3-4 time range often suffers from low predictability and it is important to understand this limitation to manage expectations for potential forecast skill. This article describes the current status of this activity at the Climate Prediction Center. The initial experimental product format is outlined followed by the current input to the experimental outlooks. Verification of the first year of experimental outlooks and user survey feedback to date is also described along with current development work.

The experimental product is released once per week every Friday at approximately 3 PM Eastern Time (ET). The first experimental outlook was released on September 18, 2015 and the outlooks have continued in realtime to present each week. The product package consists of two outlook maps and a text discussion describing the forecast rationale and challenges or issues of the current forecast. The outlooks maps (Figure 1) display the forecast probabilities of the favored category (above or below average) for the two-week period mean temperature and total precipitation. The purpose of the product is to (1) provide an outlook for mean temperature / total precipitation for the current Week 3-4 outlook gap and (2) provide advance notice of potential large-scale pattern changes to assist decision makers.

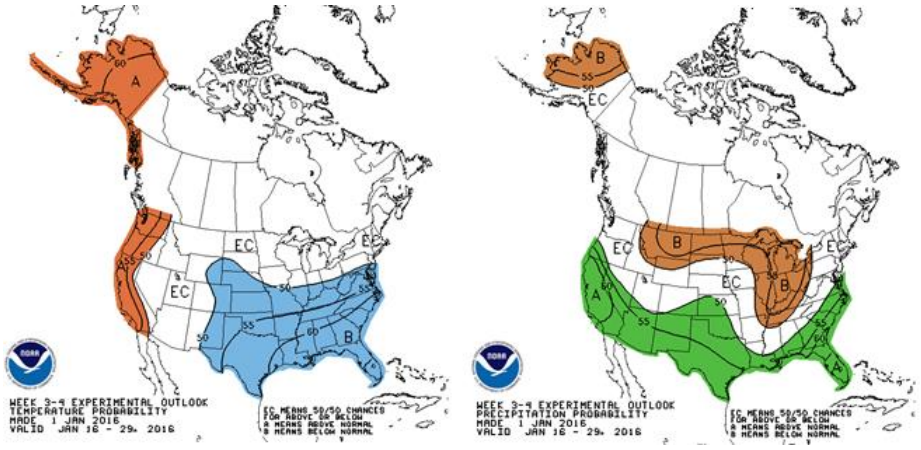

Fig. 1 Forecast maps for the experimental product released on January 1, 2016. The shading depicts the favored category (blue/orange or brown/green for below/above average temperature or precipitation respectively. The contours represent the probabilities of the favored category. The white areas (labeled EC for equal chances) are regions where forecast signals are weak and each forecast category (above or below) are equally likely.

The input that contributes to the outlooks are somewhat diverse and includes utilizing relationships associated the Madden Julian Oscillation (MJO). These include connections between MJO strength and phase and North America temperature and precipitation patterns as well as lead-lag relationships to important higher latitude variability such as the Arctic Oscillation (AO) or North Atlantic Oscillation (NAO). Statistical

Correspondence to: Jon Gottschalck, Climate Prediction Center, NOAA/NWS/NCEP, 5830 University Research Court, College Park, MD; E-mail: Jon.Gottschalck@noaa.gov

guidance used in the forecast process includes (1) a MJO-ENSO phase model (Johnson et al. 2014), (2) a Multiple Linear Regression model that uses daily Nino3.4 index information, MJO indices and linear trends as predictors for Week 3-4 temperature and precipitation (Harnos *et al*. 2016) and (3) constructed analogues based on 200-hPa streamfunction to construct a forecast objectively based on closely matching analogues. The Coupled Linear Inverse Model (C-LIM), developed at the Earth System Research Laboratory (ESRL), tropical forecast is used to serve as a complement to dynamical model tropical forecasts (Newman et al. 2009) as well.

Available dynamical model guidance plays an important role in the outlook. Output from the NCEP Climate Forecast System (CFS), the European Centre for Medium Range Weather Forecasts (ECMWF) and the Japan Meteorological Agency (JMA) modeling systems is available to the forecaster for several variables including 500-hPa and 200-hPa height, temperature and precipitation. The model data is bias corrected based on available reforecasts for systematic errors across all forecast lead times.

Figure 2 shows the verification of the experimental outlooks during the first year of release. For temperature, the forecast skill has nearly been entirely positive throughout the period, although high variability in the scores from week to week do exist at times. The average Heidke Skill Score (HSS) over the period is +55. On average, the precipitation forecasts have demonstrated little forecast skill with an average HSS of +3 over the period, although there have been periods of positive skill during individual weeks.

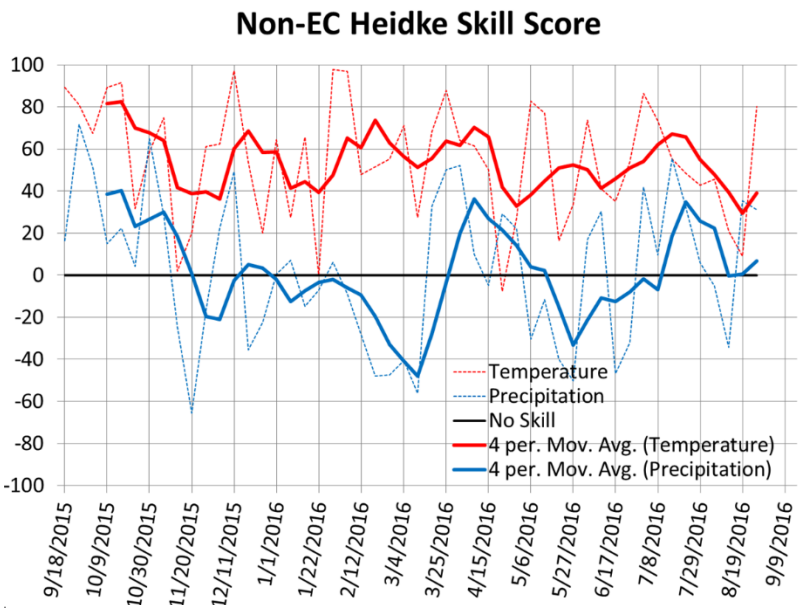

Fig. 2 Time series of Heidke Skill Score (HSS) for the period from September 18, 2015 through August 26, 2016. The red/blue lines represent temperature and precipitation respectively and the solid lines show monthly running means.

The Climate Prediction Center has collected comments on the experimental product package (outlook maps and a text discussion) over the past year. It is the interpretation of CPC from these survey results that the experimental product package has been received positively overall. Survey questions where a quantitative response was requested (ranking from 1 to 10 with 10 being highest) focused on two areas, (1) technical quality of the product/service (e.g. forecast accuracy, timeliness, problems with display) and (2) how easy you found the product/service to interpret or use. The results indicated an average score for both questions of just below 8. In addition, when asked whether the National Weather Service (NWS) should prepare and release this type of product, 95% of the respondents answered yes. See Figure 3.

Work on the project over the next year will include the migration of the current experimental forecast tool suite to operational platforms to ensure reliability. We also plan to obtain, process and include in the forecast tool suite dynamical model output from Environment Canada, apply additional post processing strategies to the dynamical model forecasts as well as explore additional statistical methods for forecast tool development including objective consolidation strategies. CPC also plans to continue to collaboratively interface with partners on other initiatives targeting this time period.

In summary, CPC began issuing experimental Week 3-4 temperature and precipitation outlooks in September 2015. A two-stream approach in tool development is being used with work targeting both

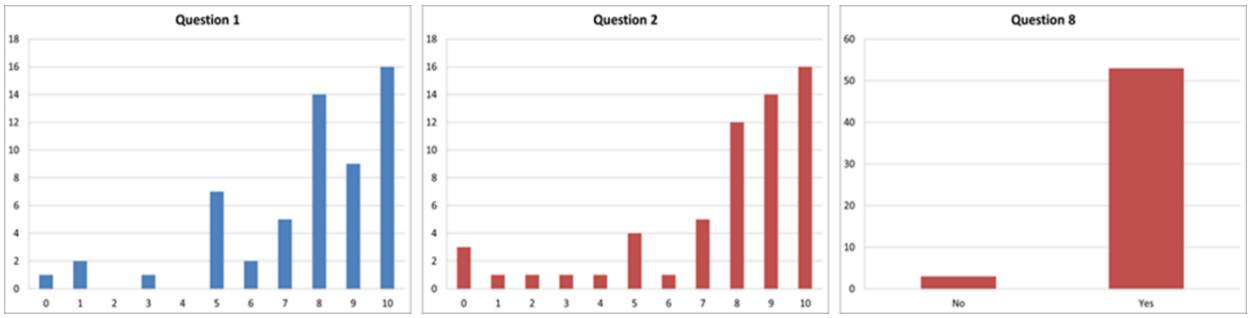

Fig. 3 Survey results to date with the number of respondents on the x-axis and the ranking from 1-10 on the y-axis. The specific questions for each chart are outlined in the text.

dynamical model guidance and statistical forecast tools. Forecasts of opportunity are likely to serve as the backbone of product. On average, skill scores to date for temperature have been positive while no consistent forecast skill has been demonstrated for precipitation. Available stakeholder feedback has generally been positive to date. CPC will continue to leverage other resources from other initiatives where possible to improve our understanding at this forecast time scale as well as to build upon current experimental services.

References

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