Joint Seminar Series — Summaries

NOAA Climate Test Bed
Center for Ocean-Land-Atmosphere Studies
Earth System Science Interdisciplinary Center
UM Department of Atmospheric and Oceanic Science

Research to Operation and Operation to Research

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"This Climate Test Bed (CTB) Joint Seminar Series is going to focus on the CTB strategic priorities; specifically composed of the Research to Operation (R2O) component, i.e. NCEP Climate Forecast System (CFS) improvement, multi-model ensemble, climate forecast products, and the Operation to Research (O2R) component of using CFS for scientific research."

— *Opening address by Fiona Horsfall,*
Director of NOAA Climate Test Bed

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Regional and Seasonal Improvements in the Skill and Value of CPC 3-Month Outlooks

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O'Lenic *et al.* (2008) reported on the use of an objective technique which, on dependent data from 1995 through 2004, improved the average Heidke skill score of CPC's operational ½-month-lead 3-Month temperature and precipitation outlooks from 22 to 24, for temperature, and from 8.8 to 12.1, for precipitation.

This paper extends that work by calculating the increase in the percentage of the time non-EC (equal chances) probabilities are predicted, over the 1995-2004 dependent data period. The fraction of the map covered by non-EC probabilities is one metric of usefulness which users are quite sensitive to. Reducing the area covered by EC (33.33…% for each of the three tercile categories) is highly desirable.

Each map in the top row of Fig. 1 shows the average Heidke skill score (HSS, lines, see Appendix) over 1995-2004 for 30 official (OFF) forecasts of ½-month lead precipitation, made in real-time.

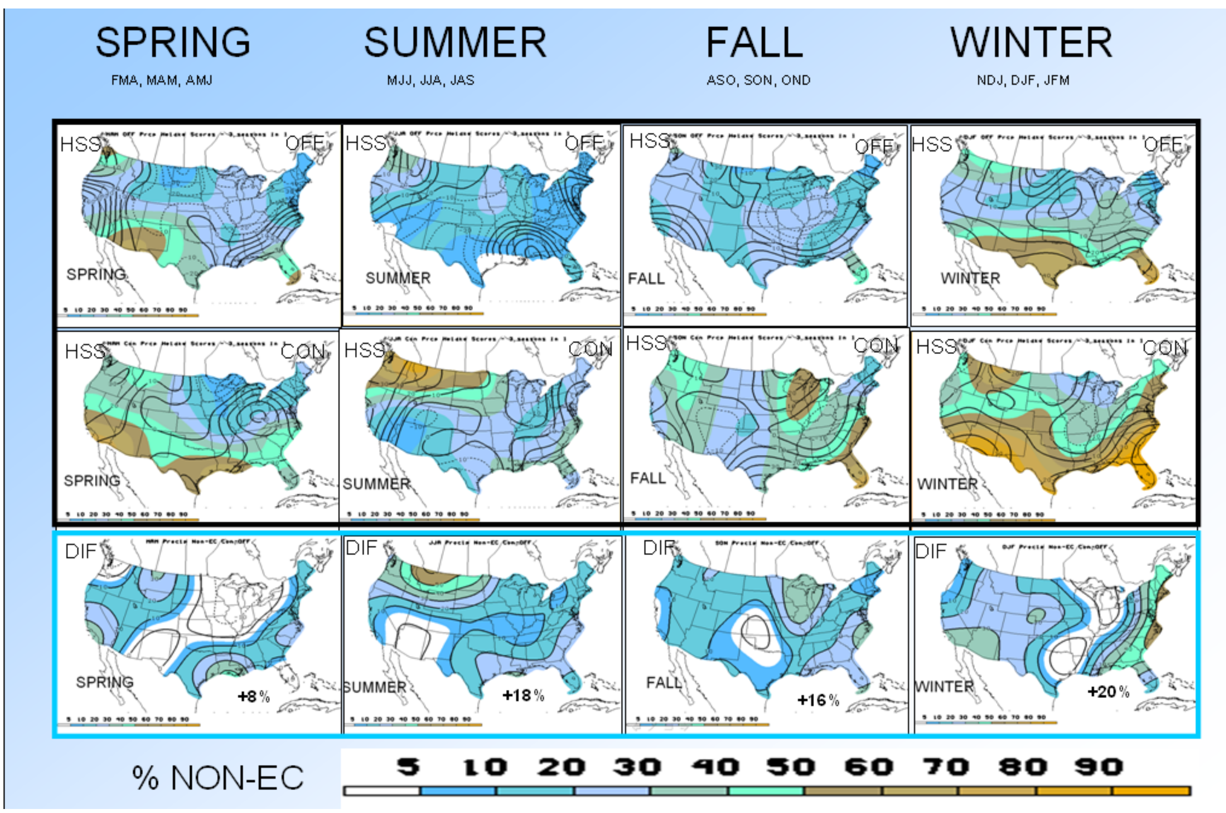

Fig. 1. Average Heidke skill score (HSS, lines) over 1995-2004 for 30 official (OFF) forecasts (top row) made in real-time and retrospective objective consolidation (CON) forecasts (middle row) of ½-month lead 3-month precipitation. The colored shading indicates the percent of the time that forecasts with other than equal chances forecasts were made. The scale is indicated by the bar at the bottom of the diagram. Lines and colors in the bottom row of maps indicate the difference between CON and OFF % non-EC forecasts.

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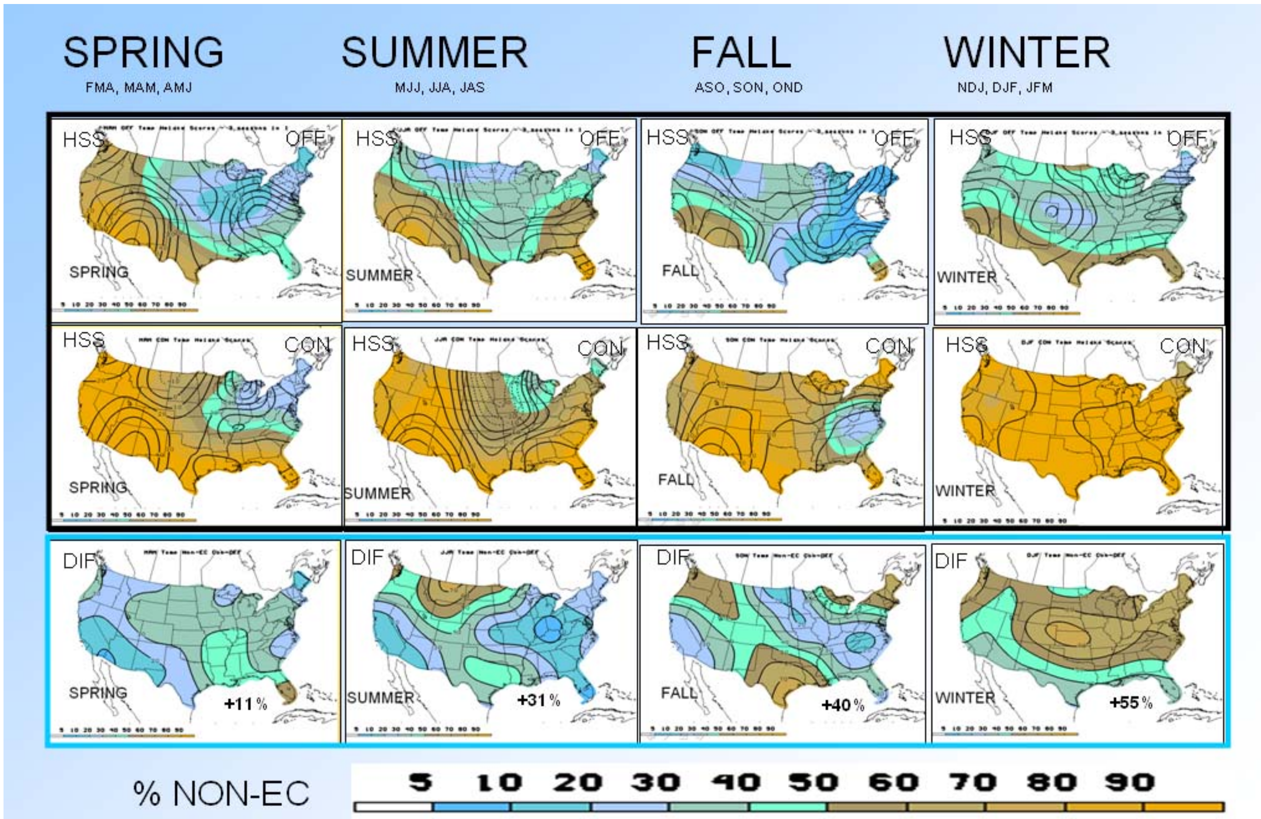

Fig. 2. Same as Figure 1 except for the temperature forecast.

The second row from the top shows the same information as the top row, except for forecasts made using an objective technique (Unger *et al.*, 2009) to numerically combine the identical set of forecast tools which were available to the forecasters in real-time during 1995-2004. This is referred to as the consolidation (CON). These tools include the 2-tier NCEP coupled model described in Ji and Leetmaa (1995), the optimum climate normals (OCN, or trend) (Court, 1967-68), the canonical correlation analysis (CCA) (Barnston, 1997), and the screening multiple linear regression (SMLR). The latter two tools are multi-variate statistical techniques.

The lines and colors in the set of maps on the third row show the arithmetic difference between the CON and OFF maps in rows 1 and 2. A number near the bottom right side of each map shows the map average of this difference. The CON technique averages a higher percentage of non-EC forecasts than did the OFF by 8%, in spring, 18%, in summer, 16%, in fall, and 20%, in winter. Since the trend is relatively small for 3-month precipitation, these improvements are smaller than those for temperature, but still large enough to be noticeable to users.

The results for temperature are shown in Fig. 2.

The consolidation technique produces large increases in non-EC forecast percentages for temperature (Fig. 2): 11%, for spring, 31%, for summer, 40%, for fall, and 55%, for winter. This large increase is due, in part, to the fact that the trend is more strongly reflected in temperature than it is in precipitation (Fig. 1).

Since these results are on dependent data, we show, in Fig. 3, the result of using the CON technique in operational ½-month lead 3-Month temperature outlooks since 2006. There is a clear break in the time series of 48-month running mean HSS which commences when the CON was implemented into CPC operations in early 2006. This performance is evidence that the CON technique is a reasonable way to present forecasters with an accurate first-guess from which to begin forecasting.

Appendix

The Heidke skill score (HSS) is a categorical score which compares the accuracy of a forecast of interest (e.g., 3-month outlooks) with that of a reference forecast, such as climatology (random) forecasts:

$$HSS = (c-e)/(t-e)*100\%$$

where c = # gridpoints forecast correctly
e = # gridpoints expected correct randomly
t = # gridpoints in total

In a 3-class, tercile system, $-50 \leq HSS \leq 100$.

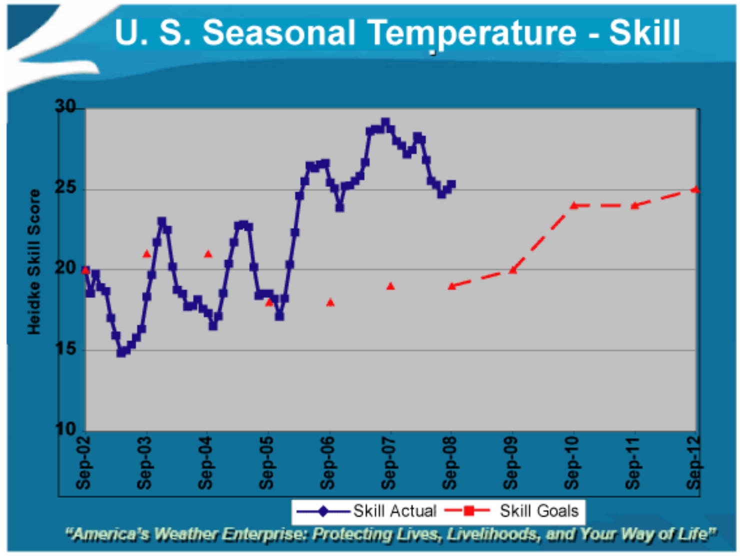

Fig. 3. 48-month running mean of the Heidke skill score of real-time, operational ½-month lead 3-month temperature outlooks from September 2002 through September 2008 (blue line) (GPRA score). The red line is the GPRA goal.

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