THE U.S. SEASONAL DROUGHT OUTLOOK

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1. INTRODUCTION

The U.S. Seasonal Drought Outlook is a depiction of the anticipated changes to existing areas of drought three months in the future. The

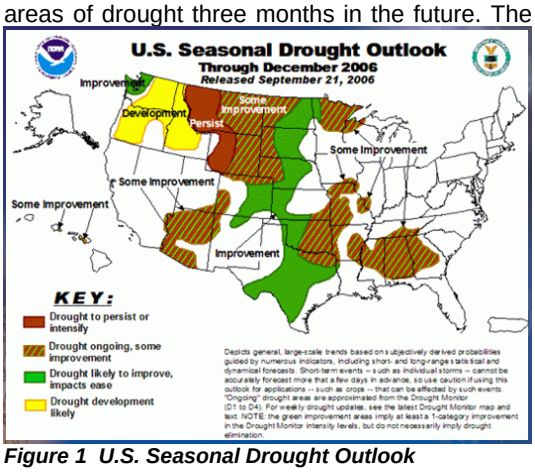

Figure 1 U.S. Seasonal Drought Outlook

outlook originated in August of 1999, with the first public forecasts released in March of 2000. The intent is to present a simple picture of where drought will improve, persist or develop. The U.S. Seasonal Drought Outlook is produced monthly and is released on the third Thursday of the month. The Drought Outlook is produced in conjunction with the CPC long range outlooks, which are major inputs to the Drought Outlook.

2. FORMAT

The U.S. Seasonal Drought Outlook is produced as a .gif and .pdf graphic. Two text summaries accompany the graphic. One is a simplified description of the forecast and some of the reasoning behind it, while the second is a much more descriptive discussion that mainly focuses on the various forecast tools and inputs. In recent years, the Drought Outlook has been made available in GIS readable shape files.

3. INPUTS TO THE OUTLOOK

The outlook starts with the D1 or greater drought areas of the most recent U.S. Drought Monitor. The forecast for these areas can be one of the following: persisting drought, worsening drought, drought ongoing with some improvement and drought improvement. Drought development can also be depicted in areas where no drought is currently observed, but there are indications that drought (D1 or greater) will develop. There are

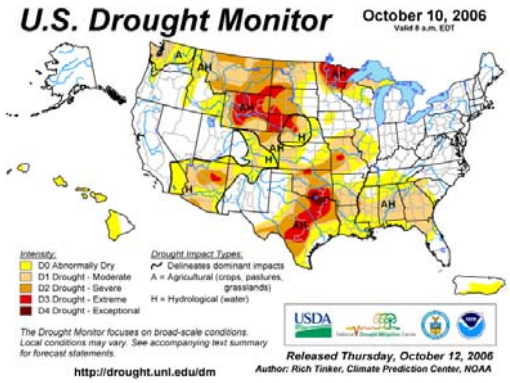

Figure 2 U.S. Drought Monitor

numerous inputs to the Seasonal Drought Outlook. Although the forecast is seasonal, and is made for 3 months into the future, drought is an integral of conditions leading up to the forecast valid time. Therefore, short term factors such as wet spells, hurricanes and major widespread rain events can have a significant effect of the future state of drought at seasonal timescales. Short range and medium range inputs, such as global model precipitation forecasts, soil moisture forecasts and the official CPC 6 to 10 and 8 to 14 day extended range forecasts are used. Long range inputs are also utilized, such as the CPC seasonal and monthly forecasts. Other inputs include: the NRCS spring/summer streamflow outlooks, western water supply outlooks, NCDC Drought Amerlioration Probabilities and of course, climatology.

4. TOOLS

The following are some of the principal tools used as inputs to the U.S. Seasonal Drought Outlook, along with a brief description. This is a list of only some of the most widely used tools, and is not comprehensive.

*CPC 2 Week Soil Moisture Forecast**
The Climate Prediction Center has developed a soil moisture tool for the next 2 weeks based on the National Weather Service Global Forecast System (GFS) model. The tool uses the daily precipitation and temperature forecast to drive the model. A detailed description of the soil model can be found in Huang et al. (1996).

*Official CPC 6 to 10 and 8 to 14 Day Forecast**

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The CPC issues 6-10 day and 8-14 day outlook maps showing temperature and total precipitation departures from normal, and are in probabilistic format. The Outlook is issued daily between 3 PM & 4 PM Eastern Time.

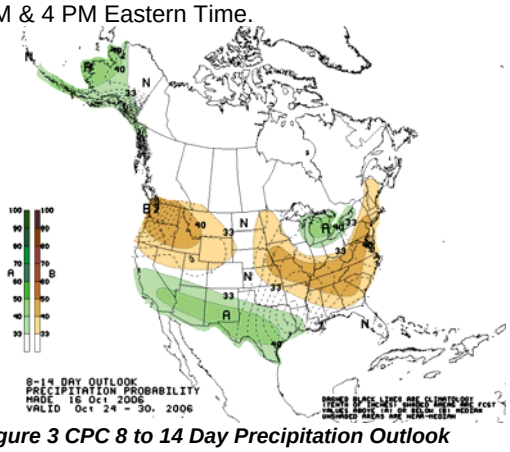

Figure 3 CPC 8 to 14 Day Precipitation Outlook

*Official CPC Seasonal Forecast**

The CPC seasonal forecasts depict temperature and precipitation departures from normal over a three month period. Numerous dynamical and statistical aids go into the production of the outlooks, which are probabilistic.

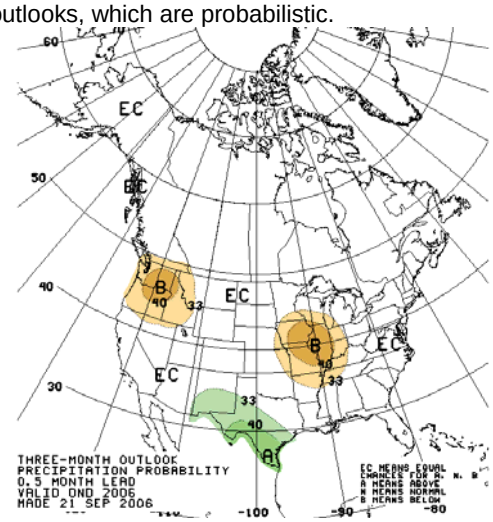

Figure 4 CPC Seasonal Precipitation Outlook

*CPC Constructed Analog Soil (CAS) Moisture**

Constructed analog on soil moisture is based on empirical orthogonal functions (EOF) from data over the lower 48 states beginning in 1932. This tool constructs a soil moisture analog from a weighted mean of past years. The weights are determined from the similarity of soil moisture conditions in prior years to a combination of recently soil moisture observations and a medium range forecast of soil moisture out to 14 days based on GFS temperature and precipitation forecasts. Then the temperature and precipitation observed in subsequent seasons in those past years are weighted in the same proportion to produce a forecast that is consistent with current soil moisture conditions. Although available throughout the year - the CAS is used only during the warm half of the year from April to September and for the shorter leads when their effects are the most pronounced and skillful. A more thorough description of the procedure is given in Van den Dool et al (2003).

* Descriptions taken from CPC's website: http://www.cpc.ncep.noaa.gov

NCDC Drought Amelioration Probabilities

NCDC calculates the probabilities for enough precipitation to ease current drought conditions in four months for the 344 climate divisions in the U.S., provided drought conditions exist. These probabilities are calculated based on long term climatology. The technical details associated with the calculation of precipitation totals needed to end or ameliorate drought and the probability of receiving the required precipitation can be found in Karl et al. 1987.

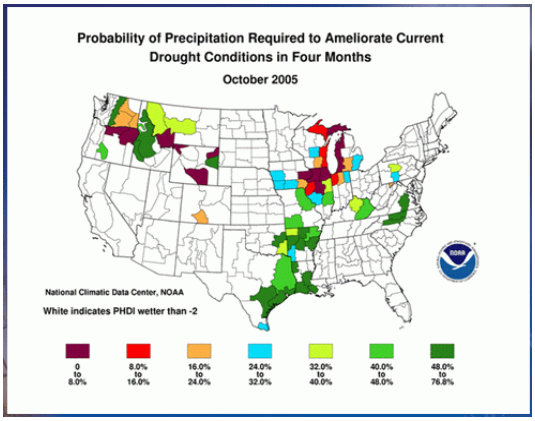

Figure 5

5. VERIFICATION

Each outlook is verified shortly after the forecast valid time. The Seasonal Drought Outlook is, in essence, a prediction of how the U.S. Drought Monitor will change during the upcoming season. The Drought Monitor valid for the time of issuance is compared with the Drought Monitor for the valid time of the forecast as seen in figure 6. The Drought Outlook Verification Score is given by the percent of the forecast domain (the U.S.) for which the forecast is correct. The score ranges from 0 to 100, with 0 meaning that the forecast was wrong every ware and 100 meaning that the forecast was correct over the entire

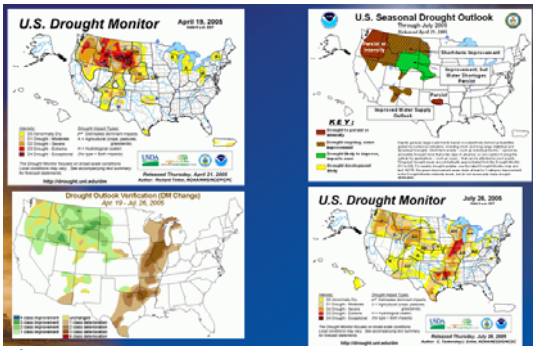

Figure 6

nation. The benchmark for the forecast is the persistence score. The persistence score is what score you would get if you just assumed that all drought was going to persist. This would amount to a first guess and would require no skill to create. The value added from incorporating the various tools mentioned in previous sections is quantified by how much greater the actual score is above the persistence score. For the past three years (July 2003 – July 2006), the average persistence score is 39%, while the average Drought Outlook Verification Score is 51%. This

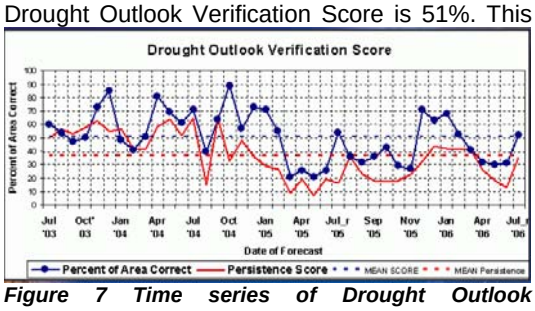

Figure 7 Time series of Drought Outlook Verification Score

represents an increase of 12%. However, these differences are not constant. As can be seen from figure 7, the greatest increase occurs during the fall and winter months. During the spring and summer, the differences tend to be smaller. At times, the persistence score actually beats the Drought Outlook Verification Score. This seasonality in the difference between the two scores is probably due to the fact that the input tools, especially for the longer leads, are more skillful during the cooler months of the year.

6. FUTURE IMPROVEMENTS AND GOALS

As the science of quantitative long range forecasting is still in its infancy, and advancements in the atmospheric and computational sciences continue, we are confident that the Drought Outlook Verification Score will increase as the years go on. We can also expect to enjoy outlooks at longer lead and higher temporal resolution with useful skill. In the near term, better seasonal temperature and precipitation forecasts are expected thanks to a new consolidation tool that has recently become operational at CPC. The tool uses as inputs four other seasonal forecast tools and weights them based on their skill, with more skilful tools weighted more heavily. The result is a more

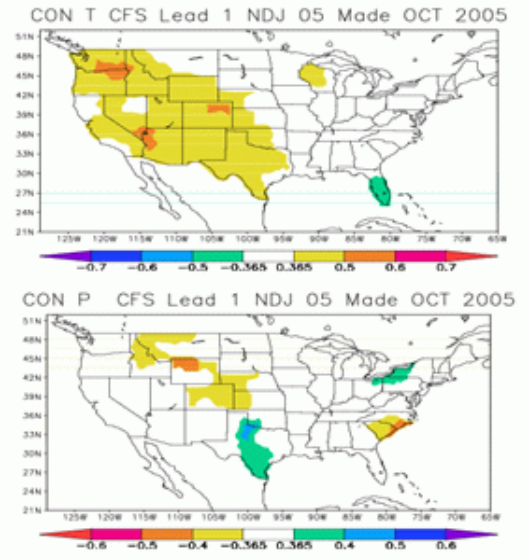

Figure 8 CPC Consolidated Forecast Tool

skillful forecast. Better seasonal soil moisture forecast are expected to become available due to projects such as the North American Land Data Assimilation System (NLDAS).

Further research leading to improved understanding of the underlying causes of drought (e.g., air-sea and land-air interactions) will also lead to further improvements. Our specific goals for the U.S. Drought Outlook are to make to outlook more objective, qualitative, accurate and useful to a wider array of users.

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