Summer 2001 Southwest Monsoon Climate Assessment for Fire Management

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Discussion

From a meteorological perspective the southwest monsoon began in the U.S. sector during the week of June 17. That is, a shift in the 500 mb subtropical ridge and moisture advection up from Mexico allowed for the development of thunderstorms across southern Arizona during much of this week. Phoenix declared the official onset of the monsoon on June 20 based on the traditional climatological definition of three consecutive days having a dew point of 55 degrees or greater.

The onset, strength and duration of the southwest monsoon have been identified by many decision-makers and planners as important for assessing resource requirements and fire use planning. Unfortunately, these characteristics of the monsoon system are not yet at a high degree of reliable predictability. However, as research on the monsoon progresses, experimental climate predictions continue to be developed and improved, and even now can be utilized in the decision-making process with the understanding that current forecast skill may be quite low. These tools do represent the currently best available science, and this assessment summarizes various predictions for the summer 2001 season.

The official NOAA Climate Prediction Center (CPC) forecast has little to say regarding precipitation anomalies during the monsoon season in the southwest; though the temperature forecast is strongly skewed towards the above normal category, there is no forecast confidence for precipitation anomalies across the region (Figure 1).

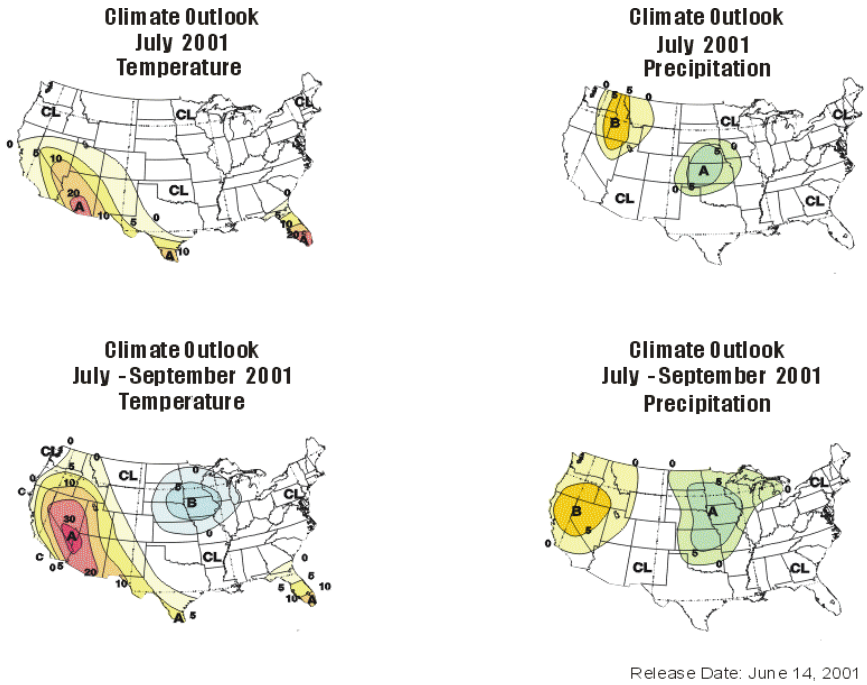

Figure 1. July and July-September 2001 temperature and precipitation anomaly outlooks from NOAA/CPC.

CEFA has available other monthly climate forecasts that are considered experimental in nature based on numerical climate models. The International Research Institute (IRI) provides CEFA with several hundred climate forecasts per month that include output from three different models and variations of the initializations used to make the predictions. For example, Figure 2 shows the July precipitation anomaly forecast for the European Community - HAMburg (ECHAM) model. This particular forecast shows positive precipitation anomalies over New Mexico during July. Another separate model (CCM3; not shown) yields a similar pattern for July. However, both models show no significant anomalies during August and the ECHAM leans towards below average precipitation during September. It is probably more prudent for fire management concerns to focus on the sign of the anomalies from these models rather than the actual values. Thus, from a strictly precipitation perspective these models suggest an average to above average strength of the monsoon during July, but average to below average during August and September. Taken literally, the models would also indicate an eastward shift of the monsoon pattern such that positive precipitation anomalies would occur more directly over New Mexico and Colorado rather than Arizona and Utah. The observed impacts of the monsoon are often bipolar in this regard, that is, Arizona and New Mexico are usually not identically affected.

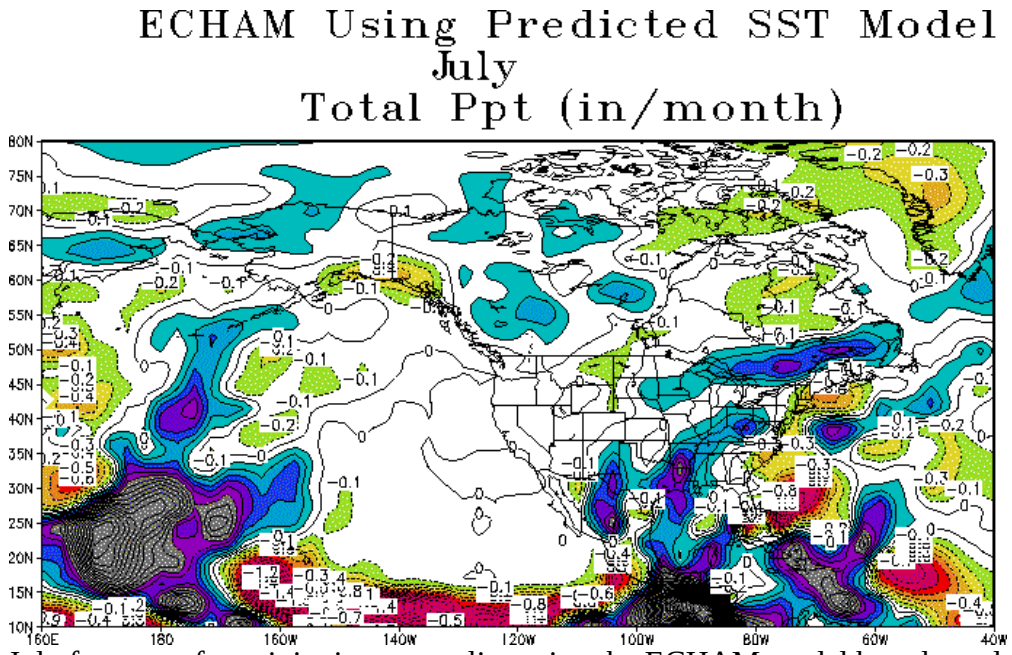

Figure 2. July forecast of precipitation anomalies using the ECHAM model based on global predicted sea surface temperatures.

Another numerical model (NCEP global spectral model (GSM)) available for consideration is run at the Scripps Experimental Climate Prediction Center (ECPC) and provides weekly to monthly to seasonal forecasts of several variables relevant to fire management. Figure 3 shows the July precipitation anomalies based on an early June forecast. In general, there is some consistency in the anomaly signs (positive) and location (New Mexico and Colorado) between this model and the IRI versions. August anomalies for the same region from the same model are similar in appearance (not shown).

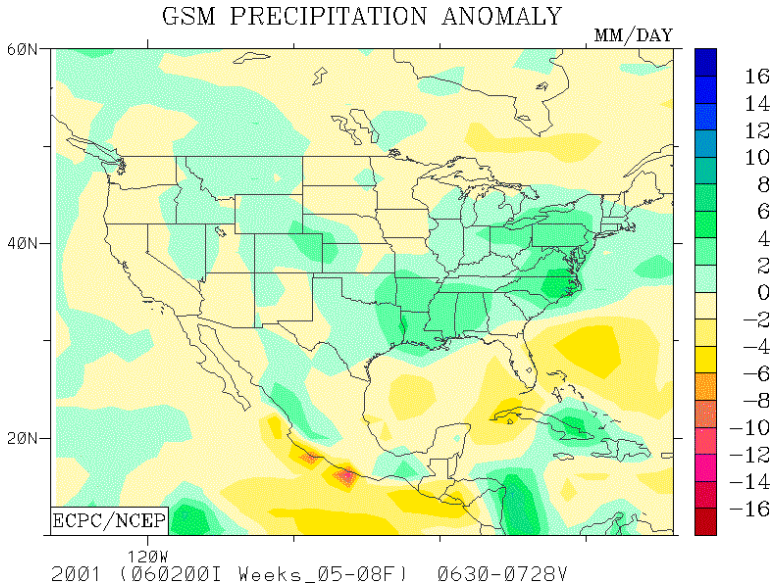

Figure 3. July precipitation anomaly forecast from the ECPC global spectral model.

A regional model (RSM) similar to the ECPC GSM provides output at higher spatial resolutions (60km). The August precipitation anomalies for this model are shown in Figure 4 along with moisture advection (arrows). This particular model indicates a tendency towards overall dry conditions throughout the monsoon region, with scattered areas of positive anomalies. This same model maintains the dry conditions through August (not shown), but an increased risk of dry thunderstorms across Nevada and southern Idaho could be inferred from the moisture advection output. Note a strong westerly flow across Arizona, then turning northward over Nevada and Idaho.

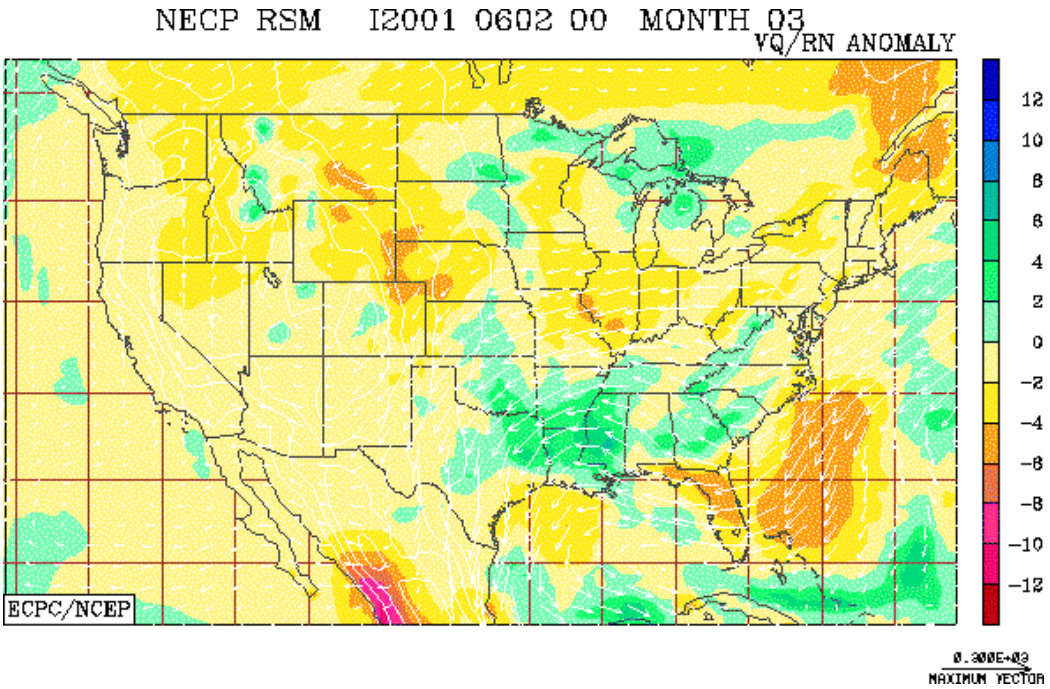

Figure 4. Scripps ECPC RSM precipitation and moisture advection anomalies for August.

Perhaps of more relevance to the southwest fire season is relative humidity (RH). Figure 5 shows RH anomalies from the ECPC RSM for the week of 30 June – 7 July. Positive anomalies are shown for much of the monsoon region, a pattern that persists in this model output for most of July. This could be suggestive of above average monsoon strength, in terms of both low-level atmospheric moisture and precipitation. This forecast pattern is persistent through July. We are currently awaiting model runs for August and September to make an assessment further into the season. The weekly forecasts are updated each weekend.

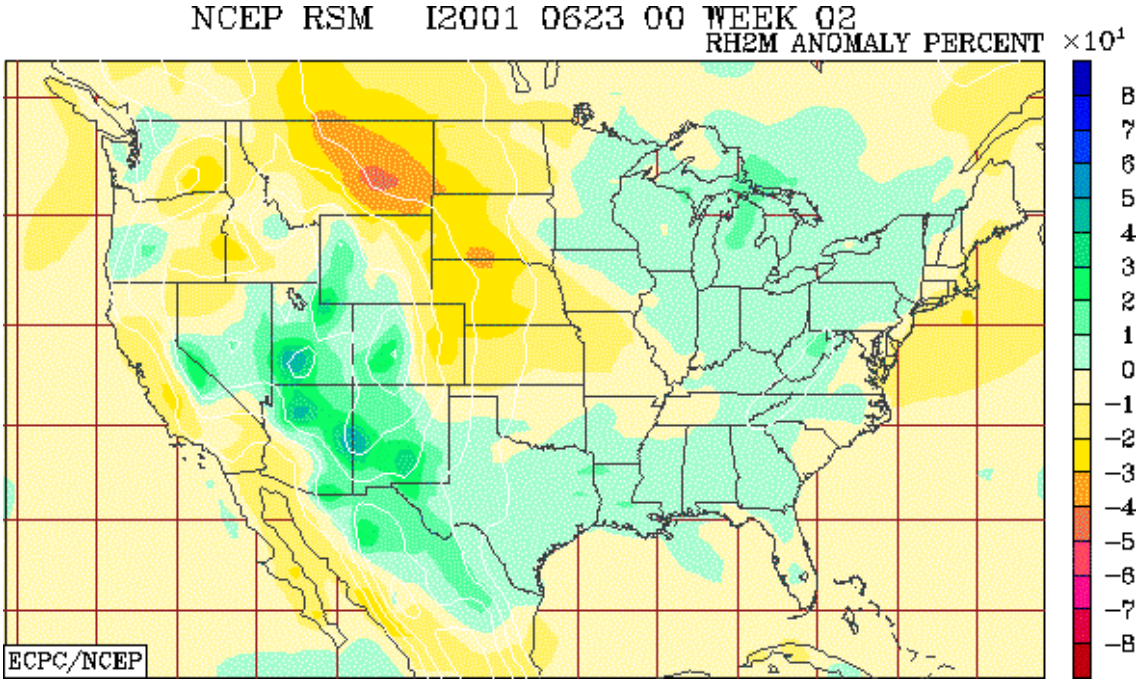

Figure 5. ECPC relative humidity anomalies for the period 30 June – 07 July.

A very new experimental monsoon forecast product is under development at the NOAA/CIRES Climate Diagnostics Center. This tool uses historical precipitation data and several predictor variables to produce a regression based forecast. Figure 6 shows a map of the four-corner states with regions indicating the percent chance of above or below average precipitation for the June through September season. The presentation format in Figure 6 is similar to CPC's long-lead outlooks. Below average precipitation probabilities are shown eastward from the four-corners region, while most of the remaining areas have probabilities for above average. There is a fairly large area of New Mexico for which no forecast skill could be resolved at this time.

Discrepancies between the numerical and statistical models, and even between numerical models, highlight differences in methodology, but more importantly the infancy of experimental climate prediction. Even at maturity, climate prediction, as now occurs with weather prediction, will still be best left to human interpretation. In the various models discussed above, there are differences in location and magnitude of the anomalies, but one can look for consistency in the sign of the anomaly. Thus, the models are in general agreement in portraying positive precipitation anomalies over the monsoon region, but the specific locations of these anomalies is much more difficult to resolve at this time, such as saying New Mexico will receive the brunt of the monsoon versus Arizona.

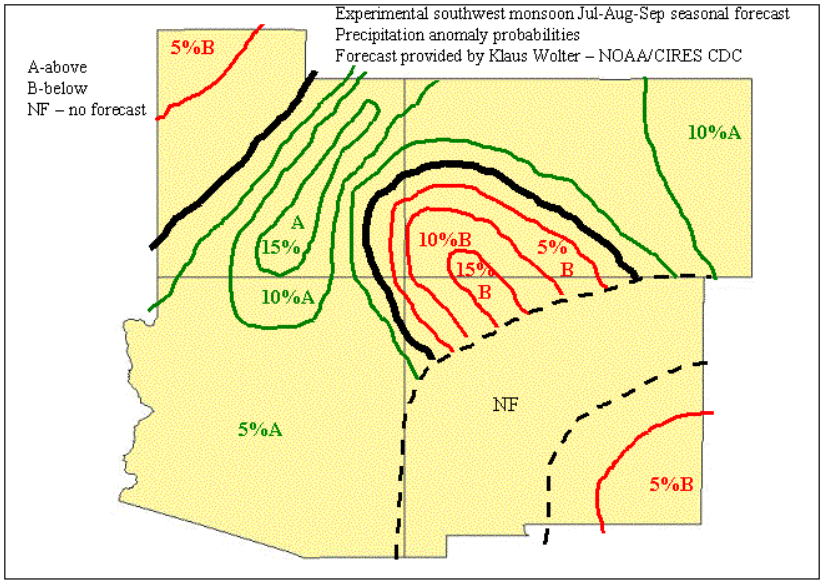

Figure 6. A statistical based experimental monsoon forecast product produced at the NOAA/CIRES Climate Diagnostics Center. Regions of above and below average precipitation with corresponding probability values are given for the June through September seasonal period.

The various numerical model forecast products noted in this discussion are available in the assessments section at the CEFA web site: www.dri.edu/Programs/CEFA. A study will be undertaken by CEFA starting September 2001 to determine in a quantified form the atmospheric characteristics of the monsoon in relation to fire danger and fire occurrence. A monsoon forecast and information section is being added to the CEFA web site on the assessment page.

Assessment Summary Highlights

1) The IRI and ECPC GSM experimental predictions are consistent in suggesting generally above average precipitation over New Mexico and Colorado during July. However, the statistical forecast indicates most of the precipitation anomalies to be over Arizona and Utah, though strong regional variability is shown and a fairly large portion of New Mexico cannot be resolved at this time.
2) The ECPC RSM weekly precipitation forecasts suggest a typical onset time (around first week in July).
3) Not enough information is available at this time to forecast monsoon duration.
4) The ECPC RSM weekly relative humidity forecasts also support a typical onset time, but above average anomalies in terms of low-level moisture over much of the monsoon region, especially Arizona and Utah. This suggests above average lag fuel moistures and a significant reduction of fire danger during July.
5) Moisture advection anomalies from the ECPC RSM in conjunction with average to below average RH anomalies over the Great Basin suggest an increased risk of dry thunderstorms across Nevada and Idaho during August.

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