Advanced Hydrologic Prediction Services (AHPS)

At LMRFC

AHPS is the next generation of NWS hydrologic products and services. In AHPS, the time period for forecasting is increased. Routine deterministic forecasts are now done for 5 days instead of 3 days. By using historical data, predictions of hydrologic parameters can be made for periods ranging from days to as much as a year in the future. These forecasts can utilize climate forecasts when strong signals are shown. These extended products are prepared using an ensemble of possible flows using Ensemble Streamflow Prediction (ESP). Following is a description of ESP.

Why do Ensemble Forecasting – The uncertainty in the future precipitation is considerable and single valued forecasts of future precipitation are very difficult on the basin scale. The uncertainty in these precipitation forecasts must be quantified in order to make informative hydrologic forecasts. Ensembles are a very convenient method of handling uncertainty, similarly to how meteorological models use ensembles to handle uncertainty in initial conditions.

ESP Stream Traces – ESP stream traces, often referred to as "spaghetti plots" are the basis for the generation of all other products. ESP generates historical traces shown (Figure 1) and conditional traces (Figure 2). At first glance, these appear identical but are generated differently and represent different types of information. In Figure 1, ESP runs the LMRFC hydrologic model with observed MAPs from March 30, 1957 - June 28, 1992, a 35 year period, to generate a 35-year historical hydrograph. For the 90-day period from March 30-June 28 for each of the 35 years, the flows for each year are "cut out" to create the spaghetti plot of historical stream traces.

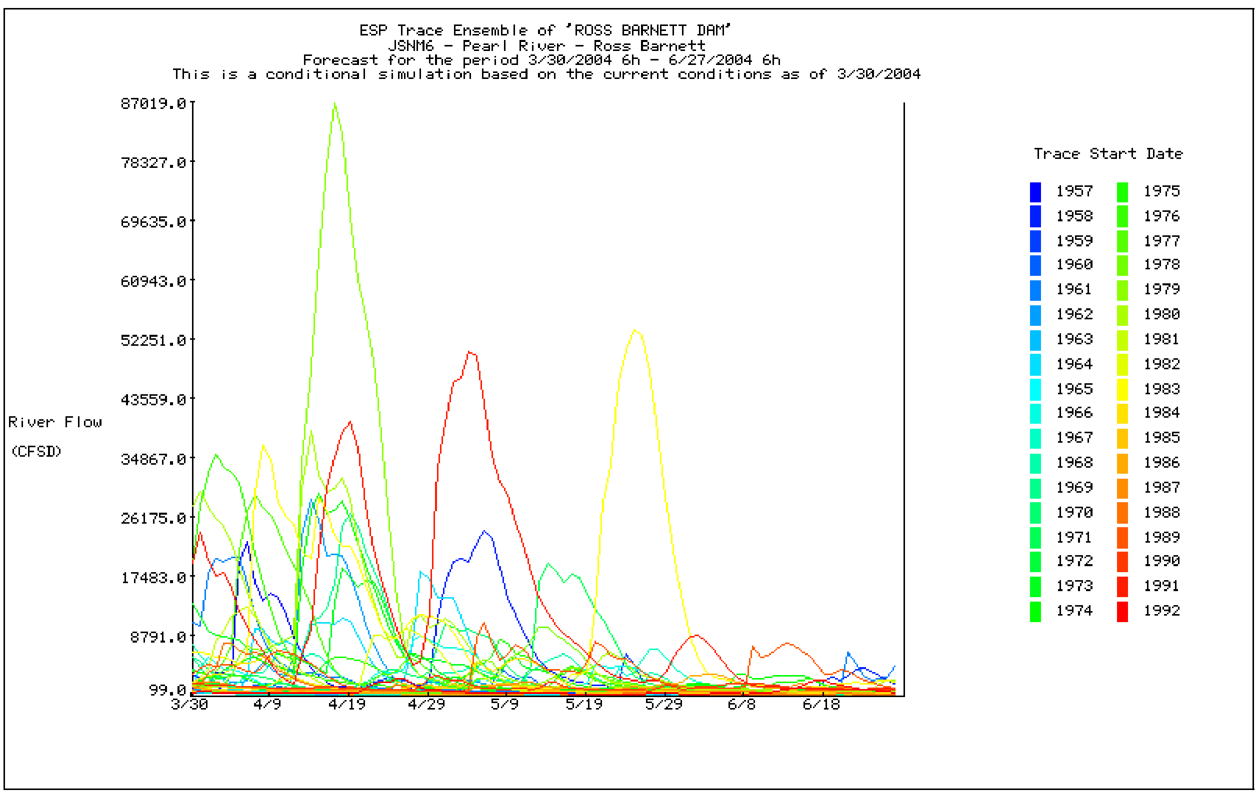

Figure 1 Historical simulation traces (spaghetti plots)

Conditional stream traces represent forecast flows for the same 90-day window, March 30 - June 28; in this case for the years from 1957-1992. For each year, ESP runs the LMRFC hydrologic model starting with soil moisture conditions on March 30 of this year, i.e. conditional on soil moisture conditions this year. For each year, ESP runs using precipitation for 90 days from March 30-June 28 for each year in the historical record and generates the flows. The conditional traces are “conditional” on soil moisture conditions for this year and rainfall from previous years and serve as ensemble members.

Historical or conditional traces are normally discharge values. Using a rating curve, these values can be converted to stage and both historical and conditional stage plots are available.

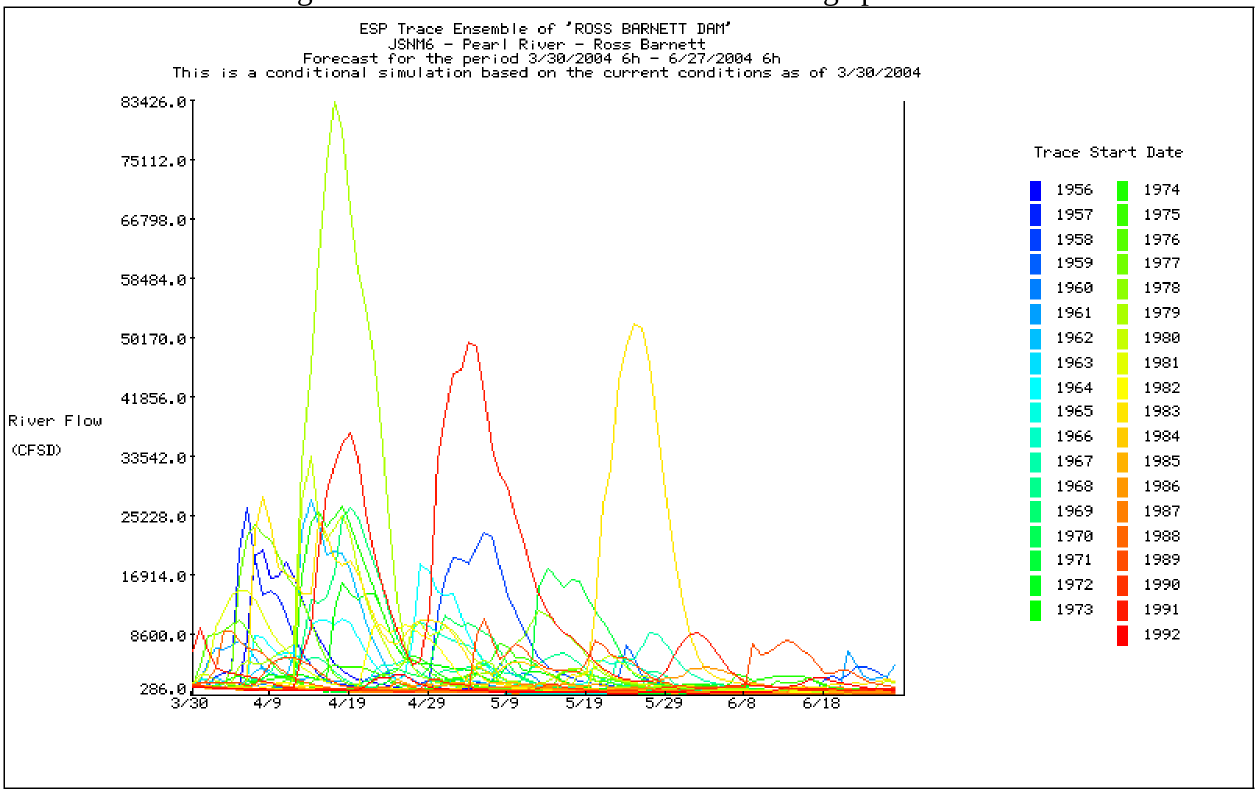

Figure 2 Conditional simulation plots (spaghetti plots)

AHPS/ESP Statistics – The historical or conditional discharge spaghetti plots are the basis for all long-range ensemble products for AHPS. Statistics may be computed from these stream tracesfor specific time periods (each week, month) and displayed in a variety of ways. For example, statistics can be displayed for selected time intervals(Figure 3); displaying the expected value for each day (max, min, mean, and standard deviation for the day) (Figure 4); or the entire distribution may be used to determine the likelihood of important values being exceeded (Figure 5). Forecasts can be generated for maximum or minimum stages, volumes, and time to peak.

Time Interval Flow Probabilities – Figure 3 shows a distribution of weekly flow volumes based on the conditional traces. Each week, the distribution of flow volumes for that week is displayed. This information can help a water resource manager determine the likelihood of filling a reservoir or meeting specific water demands at that location. The time period for the analysis is can range from a single day to a months. The flow intervals can also be changed; stage levels at as many as

10 flow intervals could be displayed.   These analyses can also look at maximum, minimum, or mean values during the time period.

Expected Value Graphics – Figure 4 is a graph of expected values. For each day, this graph will display the maximum, minimum, mean, and standard deviation of the daily discharges. This graphic will alert users to the days when major floods have occurred and are likely to occur and how variable the data are with time. From this graphic, a user can determine how likely it is for flooding to occur in the next 90 days.

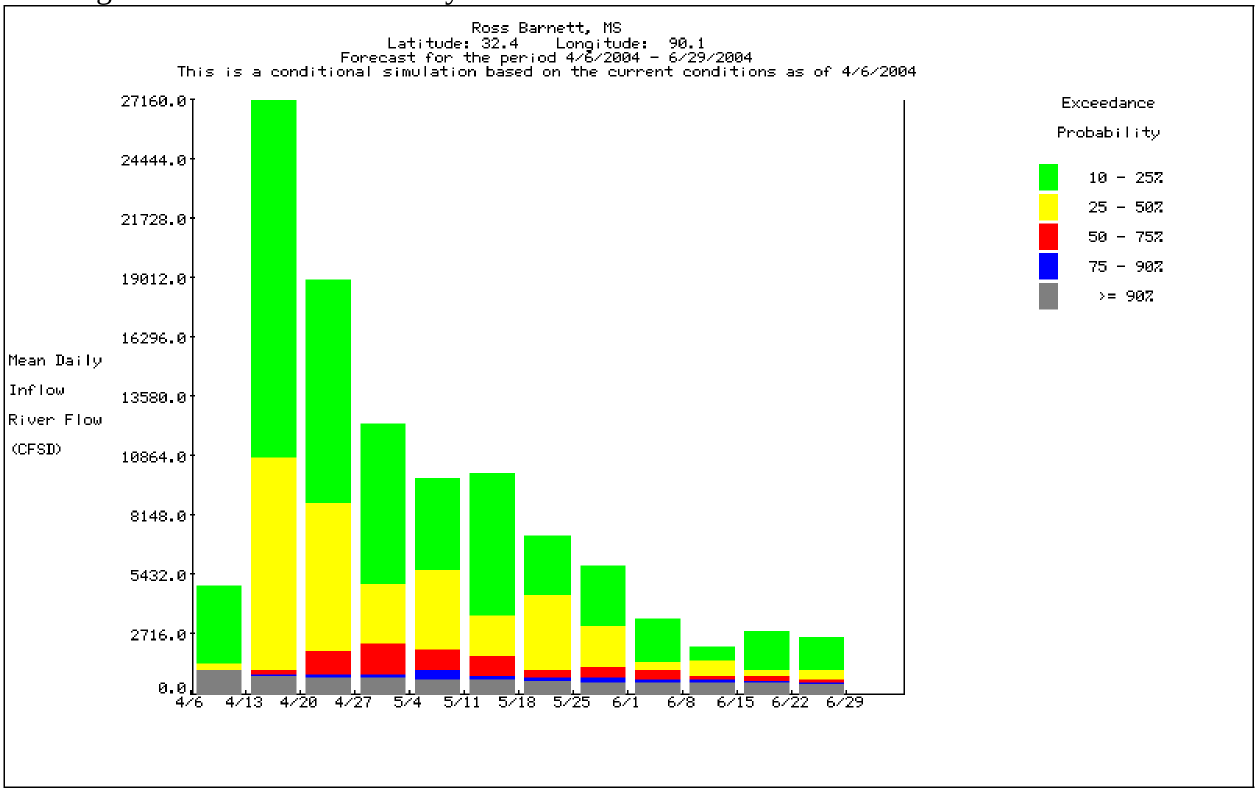

Figure 3 Weekly flow volume interval example.

Exceedence Graphics – Figure 5 is a graphic showing the probability of a specific discharge being exceeded. This graphic displays the probability distributions for both the historical and conditional simulations. With both simulations displayed, a user can determine if the basin is wetter or drier than normal. Using Figure 5 as an example, how can a user tell if the basin is wetter or drier than normal? At the 10% excceedence probability, the conditional simulation is about 34,000 cfsd; the historical simulation about 43,000 cfsd. From this analysis since the 10% exceedence flow for the historical simulations is more than the 10% exceedence for the conditional simulation, we can infer that current conditions are drier than normal. ESP can use the empirical, normal, log-normal, Weibull, or Wakeby distributions to determine exceedence.

AHPS at LMRFC – LMRFC currently has ESP setup to generate statistics for the next 90 days. These figures and graphs are updated each Monday in the afternoon. Flow volume intervals are currently set for weekly flow volumes. The interval for the flows and the probability levels all can be changed based on user needs and requirements. For exceedence probability graphics, the normal distribution is used. The empirical, normal, log-normal, Weibull, and Wakeby distributions are also available.

In addition to generating spaghetti plots and expected value and exceedence graphics based on discharge, analogous graphics can be generated for stages.

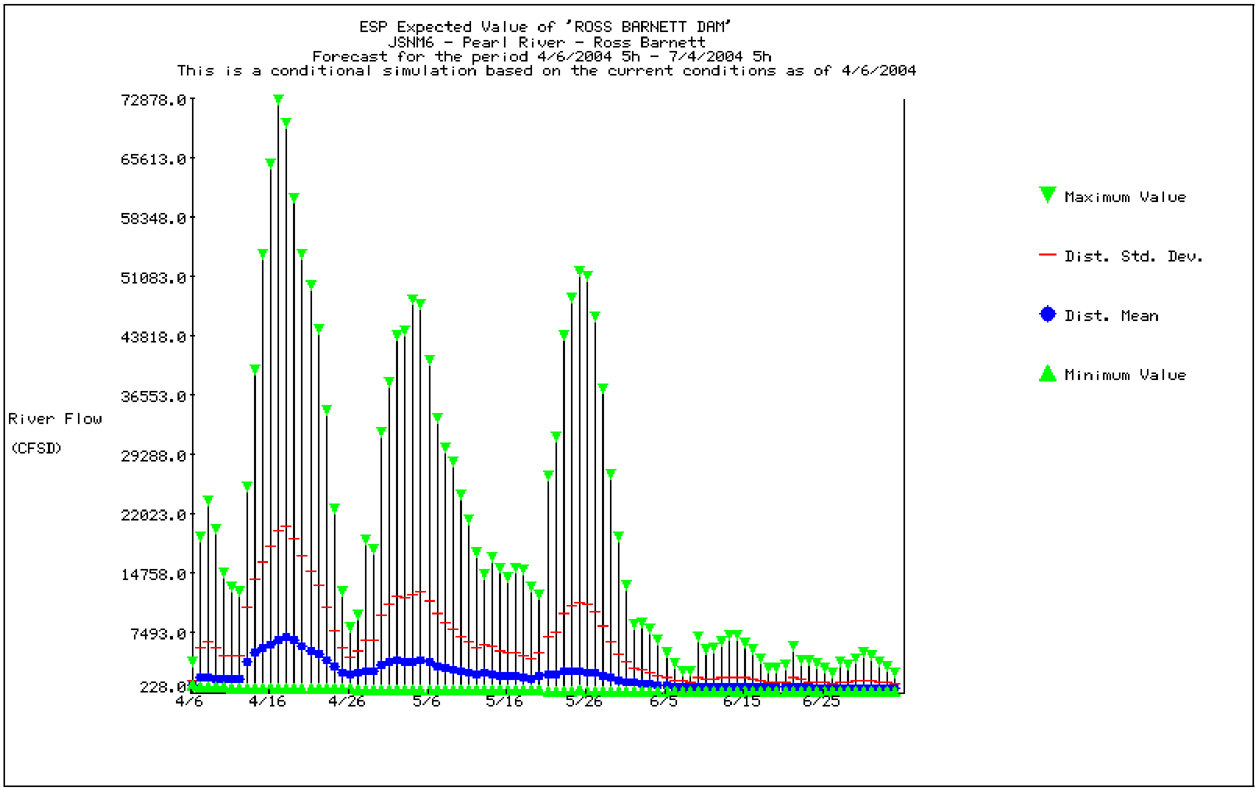

Figure 4 Expected value graphic.

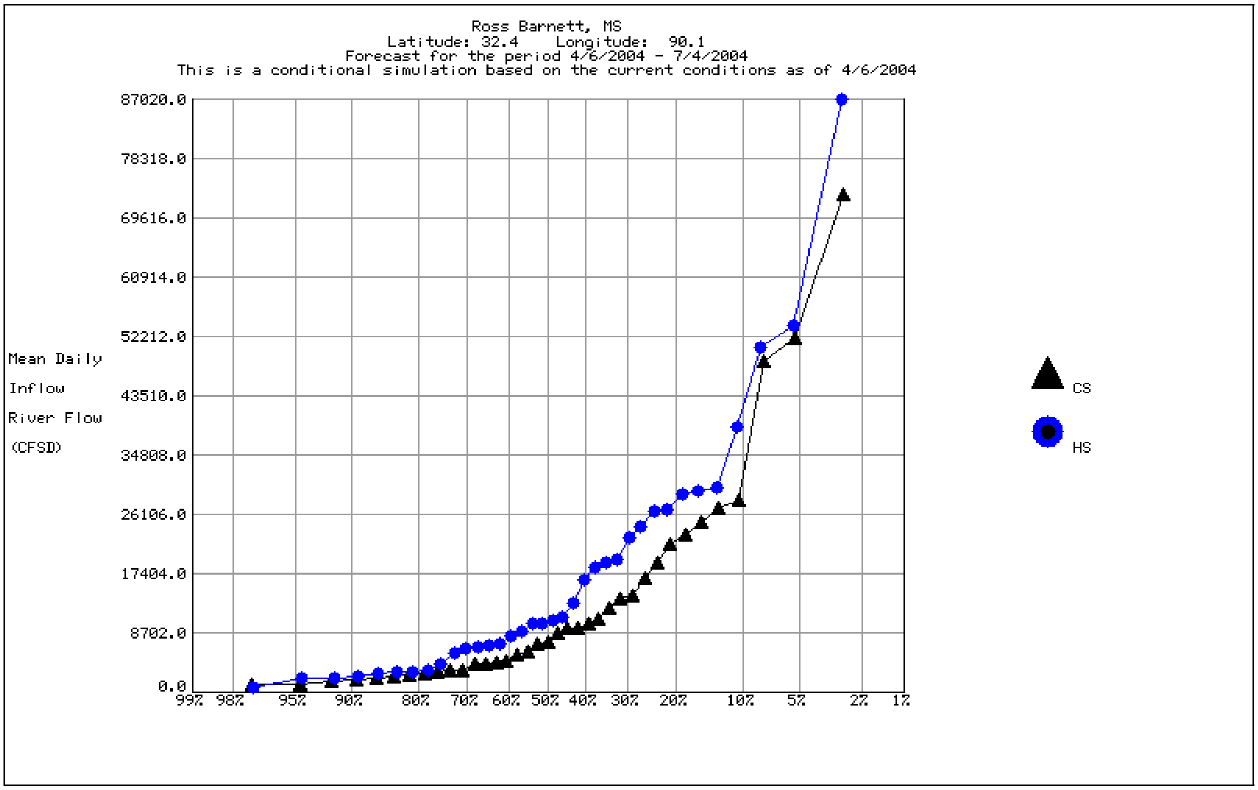

Figure 5 Exceedence probability graphic.