ESP/AHPS
Probabilistic Forecasting

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1. Introduction: Probability & Ensembles
2. Overview: Ensemble Streamflow Prediction (ESP)
3. Common Suite of Products
4. Enhanced RFC PRODUCTS
5. Strengths and limitations
What is an ensemble Forecast?

An ensemble forecast is a collection of two or more forecasts that verify at the same time.
Old Hydrograph Ensemble Method
Why do you even care about ensembles ???

It is the preferred way to create Probabilistic river forecasts....

And...

A significant part of AHPS is.. Probabilistic Forecasting.
Making a Deterministic Forecast Using NWSRFS

Flow

Past <---- Future

Stages

Soil/Snow

States

Deterministic

QPFs/QTFs

Time - >

Water Predictions for Life Decisions
Making an Ensemble Forecast Using NWSRFS

Flow Past Stages Soil/Snow States

Blend

Future

Historical Precipitation and Temperature for Every year

Make a frequency distribution using each ensemble value in the window…and then a probability function…and then various products.
ESP Trace Ensemble for Crystal River at Redstone Using 1976-2001 Historical Data
ESP Statistical Analysis

PRESENT

ERROR MODEL

TIME

STATISTICAL ANALYSIS

FORECASTS AND OUTLOOKS
- WATER SUPPLY
- OTHER WATER MGMT INFORMATION
Common Suite of Probabilistic Products
Crystal River near Redstone
Observations courtesy of the US Geological Survey.
Flood Stage: 5 Feet

Latest Stage: 2.1 Feet at 0000 GMT 07/16

This is a conditional simulation based on the current conditions as of 07/16/2004.

Exceedence Probability
- 10% - 35%
- 50% - 90%
- > 90%

This probabilistic forecast is issued by the Colorado River Forecast Center.
Common Suite: 90-Day Exceedance-Stage

Crystal River near Redstone
Observations courtesy of the US Geological Survey.

Stage: 5 Feet

Latest Stage: 2.1 Feet at 0859 GMT 07/16

This is a conditional simulation based on the current conditions as of 7/16/2004.

This probabilistic forecast is issued by the Colorado River Forecast Center.
Common Suite: 90-Day Exceedance-Flow

Crystal River near Redstone
Observations courtesy of the US Geological Survey.
Flood Stage 5.5 Feet
Latest Stage 2.1 Feet at 00:00 GMT 07/16

[Graph Descriptions] [Feedback] [Test Fucking] [Precip.]
[Imposed] [Map] [Historical] [County/State] [Run/Weather Events]

Stage Flow

Change of Exceedance

Change of Exceedance during Entire Period

This probabilistic forecast is issued by the Colorado River Forecast Center.
Explanation:
90 Day Exceedance

Here are some possible scenarios to help you understand this graphic:

More wet than "normal" conditions over the forecast period.
The chances are greater for wet conditions, as indicated by the Conditional Simulation, over the entire range of possible outcomes.

More dry than "normal" conditions over the forecast period.
The chances are greater for dry conditions, as indicated by the Conditional Simulation, over the entire range of possible outcomes.

When the two simulations are very close across the entire range, the chances of the river going over a certain level is similar to the total range of past levels.
Enhanced Products From the CBRFC

Products from ESP-ADP

Products on the Web

Build your Own
Enhanced: Daily Exceedance - Flow

24 Hour Chances of Exceeding River Levels on the CRYSTAL - REDSTONE
Latitude: 39.2  Longitude: 107.2
Forecast for the period 7/15/2004 24h – 10/1/2004 24h
This is a conditional simulation based on the current conditions as of 7/15/2004

Exceedance Probability
- Green: 10 – 25%
- Yellow: 25 – 50%
- Red: 50 – 75%
- Blue: 75 – 90%
- Gray: >= 90%
Enhanced: Daily Exceedance – Flow
With Historical, Conditional, Observed

Chances of Exceeding River Levels on the CRYSTAL - REDSTONE
Latitude: 39.2  Longitude: 107.2
Forecast for the period 7/15/2004 24h – 7/16/2004 24h
This is a conditional simulation based on the current conditions as of 7/15/2004
Enhanced: Expected Value Plot

ESP Expected Value of CRYSTAL – REDSTONE
Latitude: 39.2  Longitude: 107.2
Forecast for the period 7/15/2004 24h – 10/1/2004 24h
This is a conditional simulation based on the current conditions as of 7/15/2004

- Maximum Value
- Dist. Std. Dev.
- Dist. Mean
- Minimum Value
Enhanced: Dual Plot For Comparisons

ESP Trace Ensemble of CRYSTAL - EEDSTCNE
Forecast for the period 7/15/2004 24h to 10/1/2004 24h
This is a conditional simulation based on the current conditions as of 7/15/2004

ESP Expected Value of CRYSTAL - EEDSTCNE
Forecast for the period 7/15/2004 24h to 10/1/2004 24h
This is a conditional simulation based on the current conditions as of 7/15/2004
Enhanced: Web Product

CRYSTAL - REDSTONE, NR. AVALANCHE CK, ABV (RCYC2)

RCYC2 - Hydrograph

Current: 1.8 (07/16/18), Flood Stage: 5.0, Bankfull: 3.0

Observed (USGS) - Simulated - Forecast (07/16, 22:00) - Bankfull 3.0

Hydrograph Options
- Flood Stage
- Simulated
- Raw Data
- Linear Flow

Graphs
- Precipitation
- Temperature
- Freezing Level
- Snow

Tabular Data
- Precipitation
- Temperature
- Freezing Level
- Snow

Information
- Gage Info
- Elevation/Location Maps
- Aerial/Topo 16
- Photos
Strengths For ESP Forecasting

Uses the current conditions of model to project possible scenarios.

1. Soil moisture conditions
   Accounts for Drought/Wet Conditions
2. Snow conditions
3. River flow
4. Reservoir elevations
Strengths For ESP Forecasting

Provides Probabilistic Information For Various Applications

1. Spring Flood Outlooks
2. Water Supply Forecasts
3. Drought Analysis
4. Hydropower Planning
5. Fisheries Management
6. Recreation
7. Navigation
8. Reservoir Inflow Forecasts
Current Limitations For ESP Forecasting

- River Regulation. Model Reservoir/Irrigation/Diversion operating criteria – very difficult task.
- Relies on historical MAP/MAT and simulated flows…requires good calibrations.
- How do we provide this information in a useful manner.