The Colorado Basin River Forecast Center
Upper Colorado Region Annual Water Operations Conference

Water Supply Forecast

Flash Flood Forecasts

Recreational Forecasts

River Forecasts

National Weather Service Salt Lake City, Utah
March 24-25, 2004
Colorado Basin River Forecast Center

USBR-NWS Liaison

Previous: Bob Adams, Roland Springer,
Current: Chris Cutler
CBRFC AREAL STATISTICS

AREA = 303,450 SM (RANK 5TH)
COUNTIES = 558
STATES = 7
NEXRADS = 16
Two Basic Models Are Used to Forecast Streamflow

(1) Statistical Regression Models

Relates input variables such as snowpack, precipitation, climate indices to an output variable, volumetric streamflow

(2) Ensemble Streamflow Prediction

Uses historical traces of precipitation and temperature and conditions these based on current soil moisture conditions…traces can be weighted
Statistical Regression

Used since late 40’s
Simple Model - Easy to Implement
Good at predicting a single variable
Breaks down in extreme years
Non-Linear capabilities
  Neural Networks
  Power Functions
  Nearest Neighbor Analogs
Statistical Regression

Variables used…
- snow water equivalent
- precipitation
- past streamflow
- climatological signals
- SOI, MEI, etc

Future Variables…
- virtual soil moisture
SAC-SMA Virtual Soil Probe
UZTWC + UZFWC + LZTWC +LZFSC + LZFPC
City Creek, Utah (CCSU1)
ESP: A conditional forecast simulation based on:

1. Current watershed conditions and model states, snow, soil moisture, flow

2. Known historical precipitation, Temperature and streamflow (can be weighted)
NWSRFS - Three Components

- Calibration System
  - Historical Data
  - Historical Data Analysis
  - Model Calibration

- Operational Forecast System (OFS)
  - Real-Time Data Observed and Projected
  - Hydromet Analysis
  - Hydrologic/Hydraulic Models
    - Short-Term Forecasts
    - Current States

- Extended Streamflow Prediction (ESP) System
  - Hydrologic/Hydraulic Models
  - Statistical Analysis
  - Probabilistic Predictions

Interactive Forecast Program (IFP)
Collection of Models and Processes

- Simulate snow accumulation and ablation
- Compute runoff
- Distribute runoff temporally from within basin to basin outlet
- Channel and/or reservoir route streamflow
A GENERALIZED HYDROLOGIC MODEL

UPPER ZONE

LOWER ZONE

TENSION WATER STORAGE
FREE WATER STORAGE
SUPPLEMENTARY FREE WATER STORAGE
PRIMARY FREE WATER STORAGE

PERCOLATION

SURFACE RUNOFF

BASEFLOW

SUBSURFACE OUTFLOW

DIRECT RUNOFF

infiltrations & additional impermeables - into lakes? direct runoff?
runs over land? surface runoff

percolation - non-linear based on load
Ensemble Streamflow Prediction (ESP)

- Uses historical precipitation, temperature and evaporation data
- Uses current model states
- Produces mid- to long-range probabilistic forecast (weeks to months into the future)
ESP... Forecast
Wet vs. Dry Initial Soil Conditions
(Oak Ck - Sedonia, AZ)

- Dry Initial Soil Conditions
- Wet Initial Soil Conditions
Updated State Variables
Snowpack, Soil Moisture

Model Input

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10% 50% 90%

Simulated
Observed

Observations
TA, PP, QC

QPF
QTF

Yearly Historical Time Series PP & TA based on Weighting Schemes
Compute Statistics From Traces in the Window
# Analysis Period: 5/6/2002 24 - 12/6/2002 24 (MST)
# Forecast Parameters: River Flow (Max) - (CFSD)
# Forecast Interval: 1 Month
# Forecast Point:

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<th>Value 3</th>
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Note: CFSD stands for 'Critical Flow Stage Determination'.
CBRFC/AHPS PROJECT

A cooperative effort between:

CIRES
1967-2002

Colorado
University of Colorado at Boulder

NOAA-CIRES Climate Diagnostics Center

CBRFC

NOAA
Goals

Introduce probabilistic 14 day meteorological forecasts (ensembles) into a river forecast system.

Capture and display the uncertainty.

Verify the process.
Method

Medium Range Forecast Model

Downscale to Model Variables

Mean Areal Temperature and Precipitation Ensembles

ESP Model

Probabilistic River Forecasts
Cooperative Project

CBRFC & CDC (Climate Diagnostics Center)
Figure 13: CAMC2 MRF forecast mean RPSS over all reforecast years. Lead-time Lead-time (days) on the Y-axis and forecast initialization on the X-axis. A 10-day 10-day running mean has been applied. Superimposed black curve is the climatological simulated flow.
ESP peak flow

Smaller peaks because MRF is colder for first 14 days causes less melt.
ESP volumes

Smaller volumes through week 4 due to “banking” of water in colder than normal period leads to larger April – July volume.
**RUN ESP – EACH BASIN – TWO WAYS – EACH DAY**

<table>
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<tr>
<th>Week 1</th>
<th>Week 2</th>
<th>Weeks 3-52</th>
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<td><strong>HISTORICAL ENSEMBLES OF MAPS/MATS – NOT WEIGHTED BY CPC FORECASTS</strong></td>
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**Future Plans**

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<tr>
<td>1-5 day HPC</td>
<td>1-10 day TA CPC</td>
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