AHPS Verification for Ensemble Streamflow Forecasts

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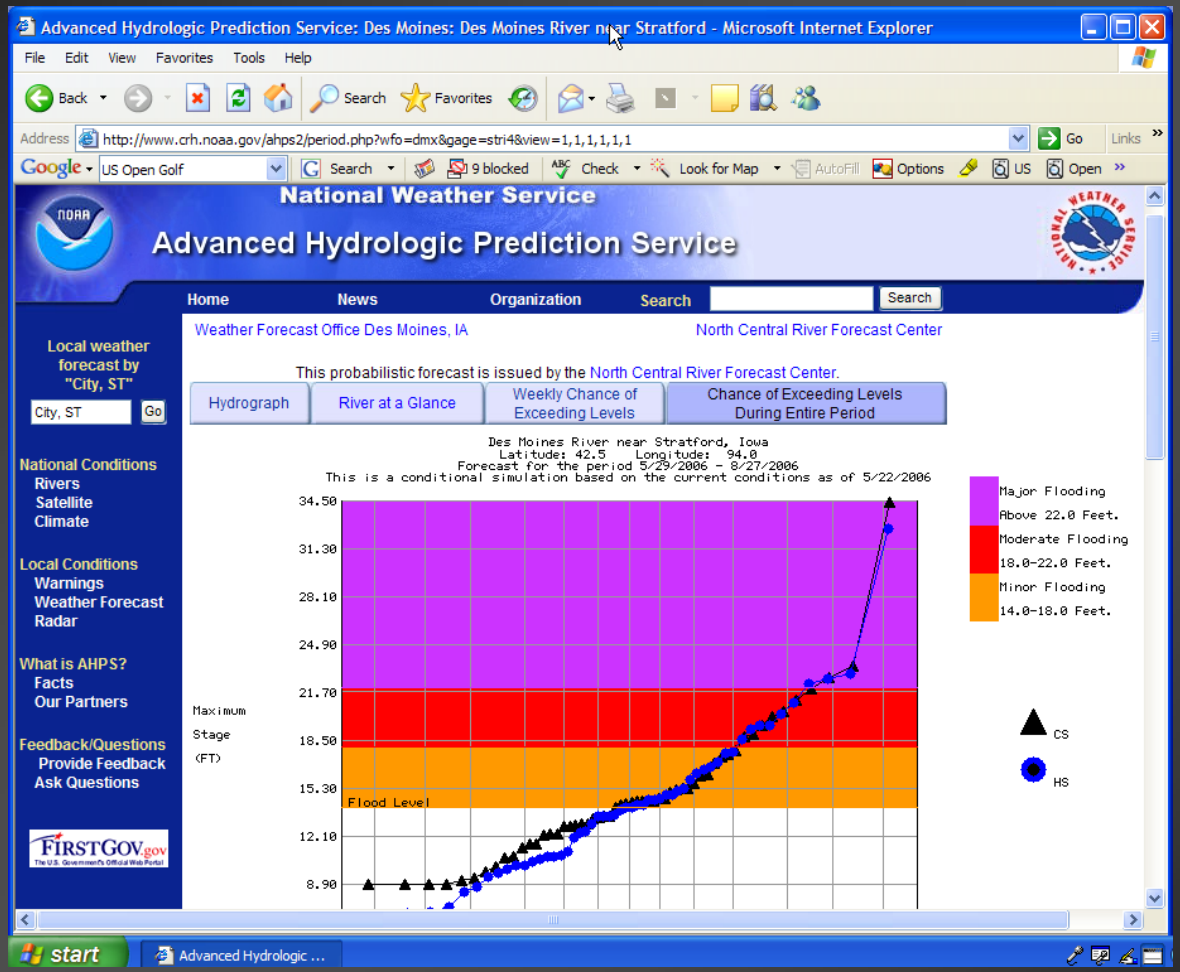
UMBC

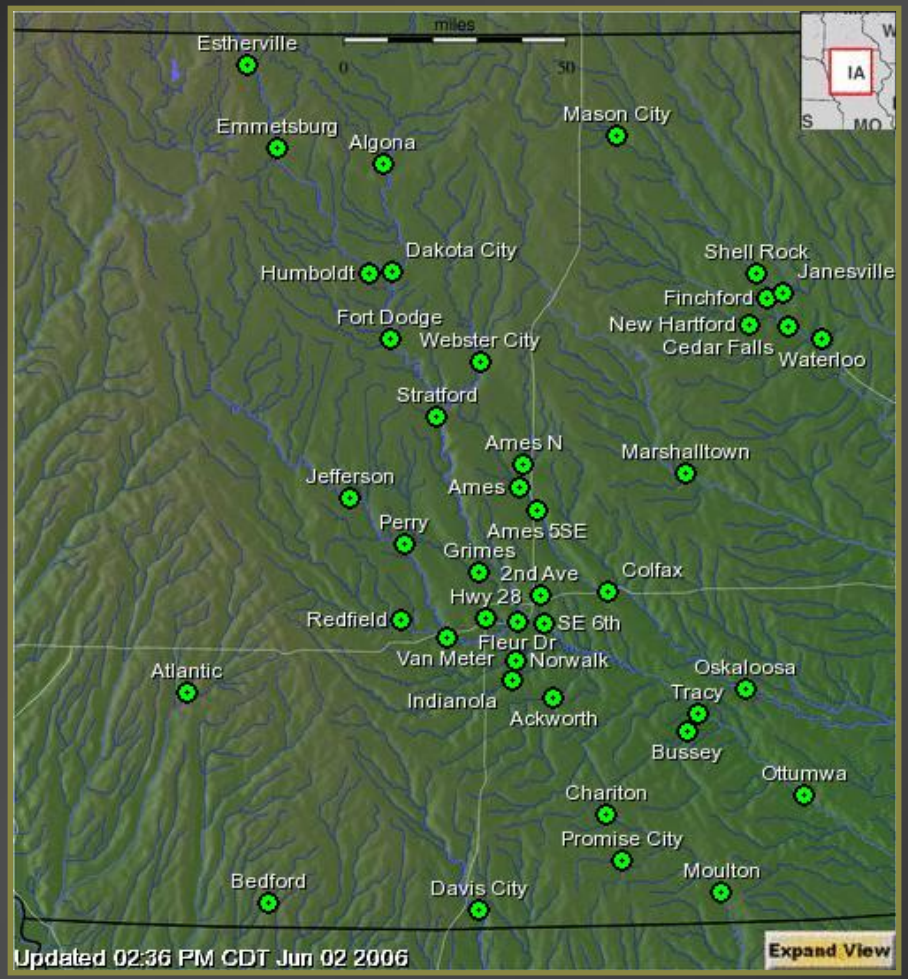
Support provided by the
NWS Office of Hydrologic Development

Advanced Hydrologic Prediction Service



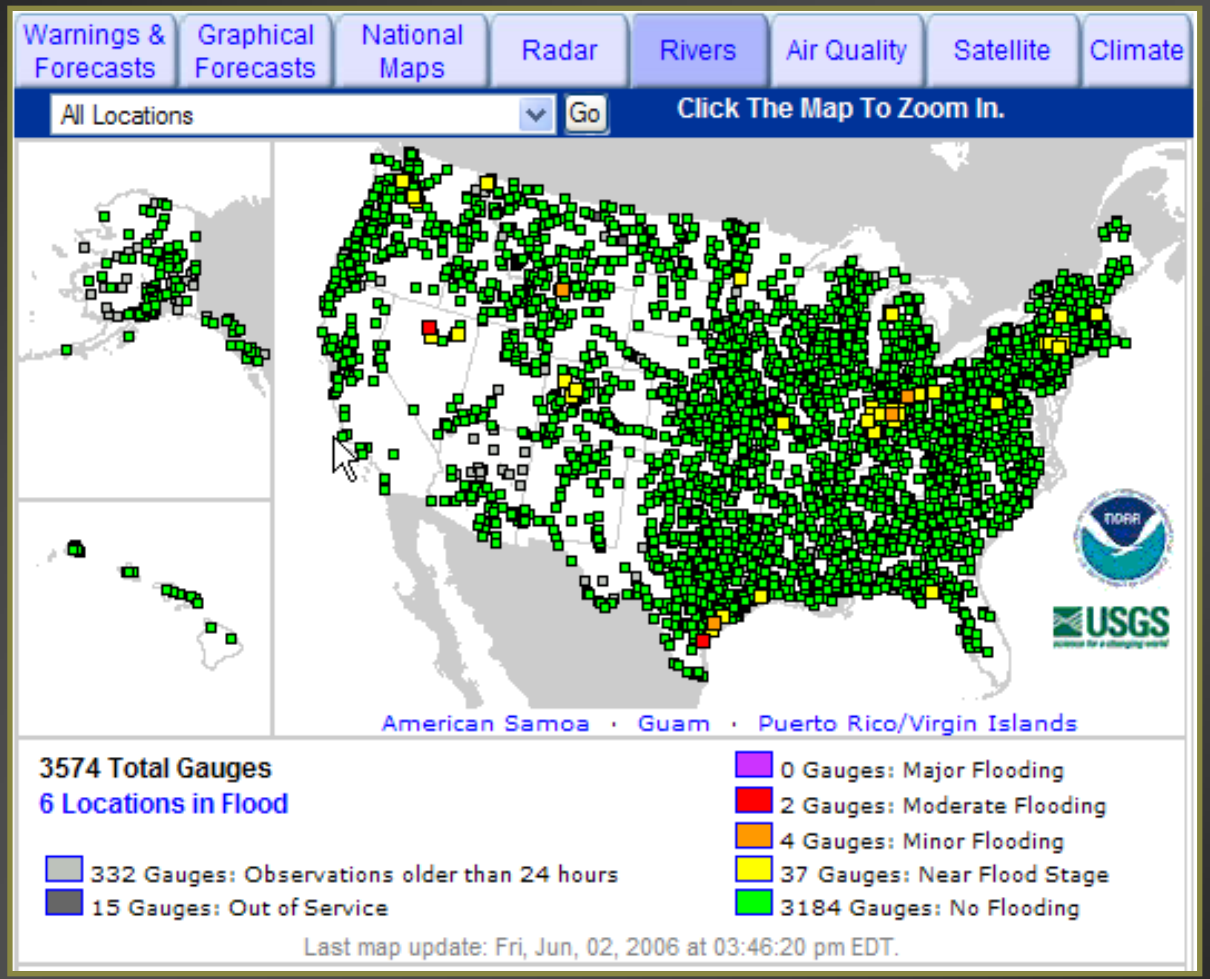
- Ensemble streamflow forecasts

Advanced Hydrologic Prediction Service



- Ensemble streamflow forecasts
- Multiple forecast locations

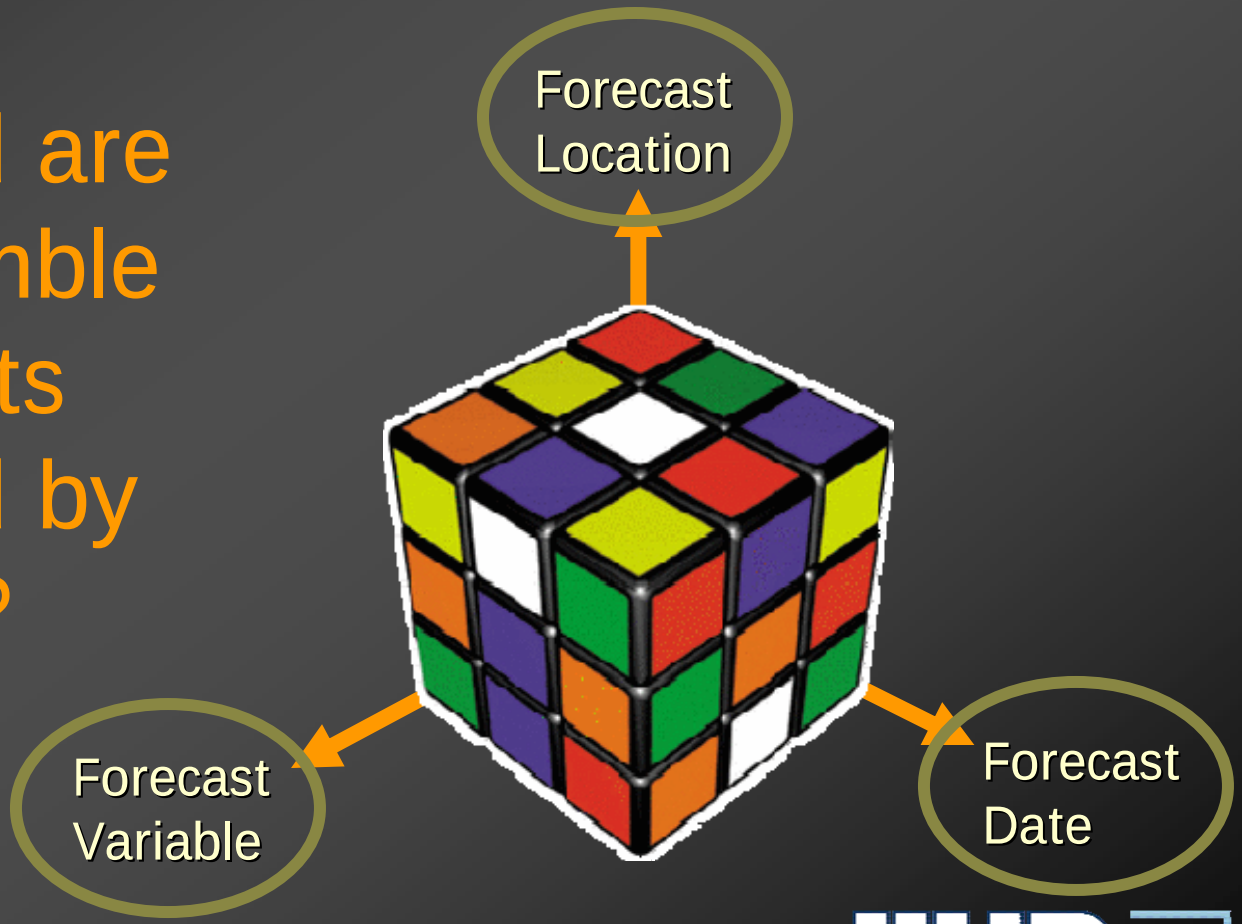
Advanced Hydrologic Prediction Service



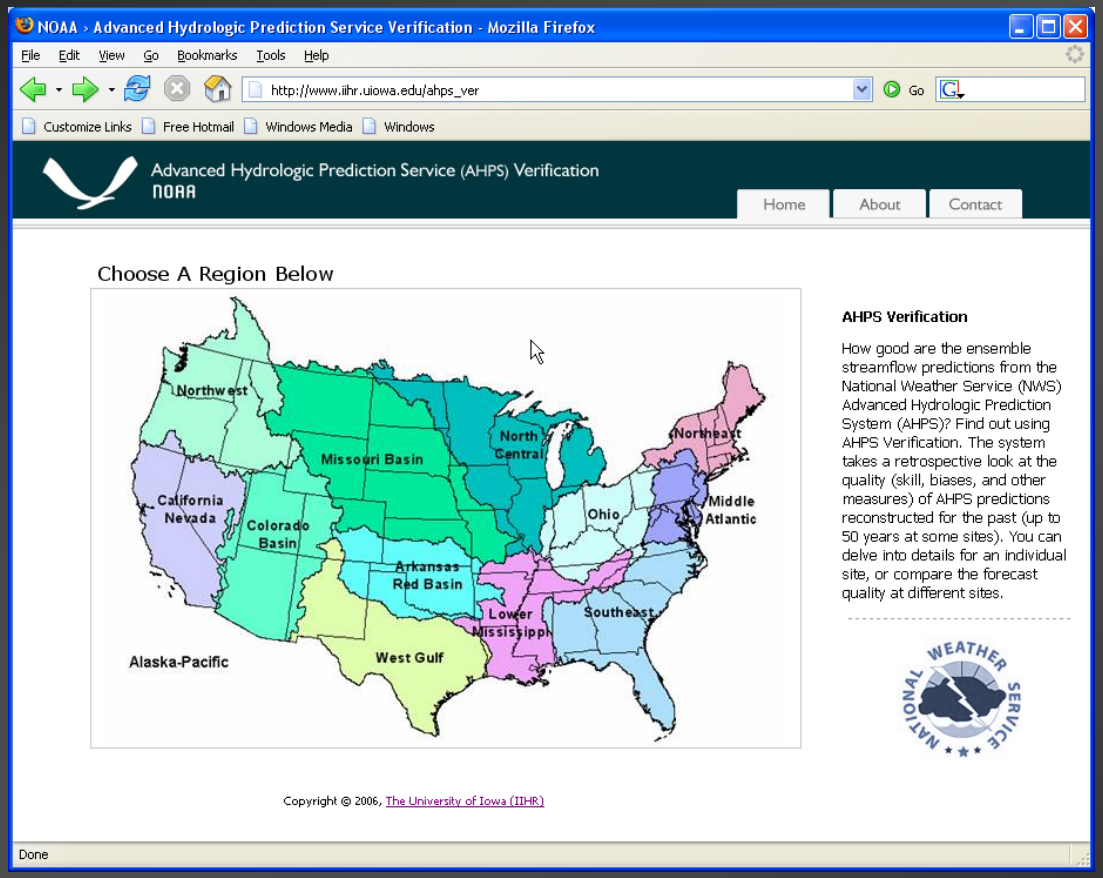
- Ensemble streamflow forecasts
- Multiple forecast locations
- Throughout the United States

AHPS Verification

How good are the ensemble forecasts produced by AHPS?



AHPS Verification System



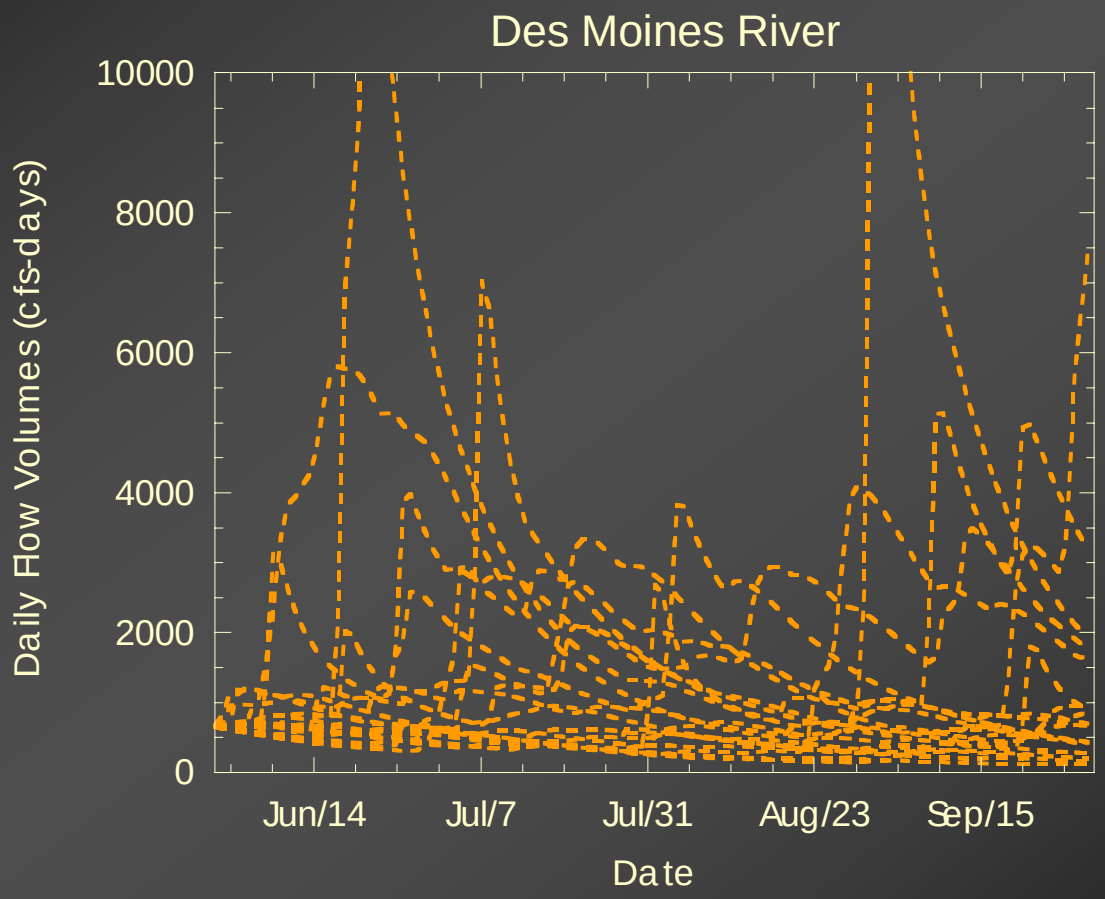
http://www.iihr.uiowa.edu/ahps_ver

Web-based tools for online access, analysis, and comparison of retrospective AHPS forecasts for River Forecast Centers (RFCs)

Verification Data Archive

Verification Data Archive

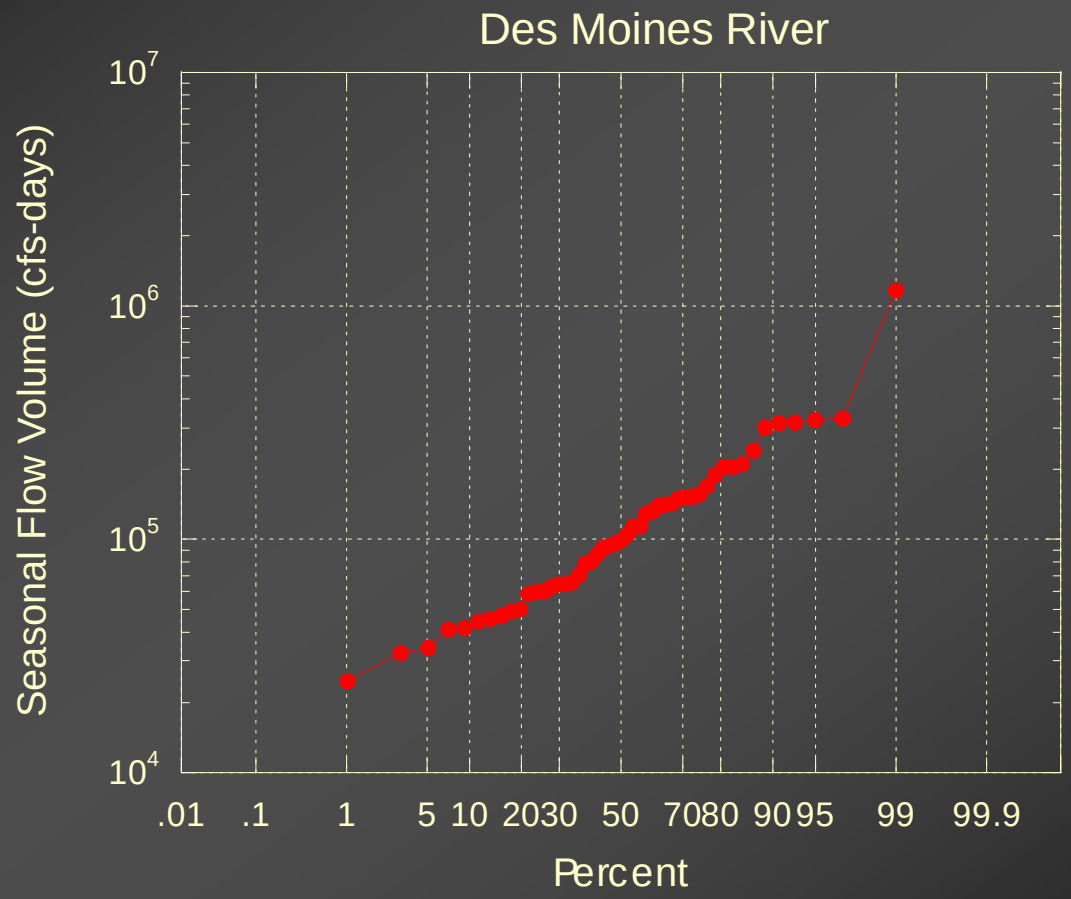
Ensemble Streamflow Predictions



- Retrospective forecasts for a 50-year period

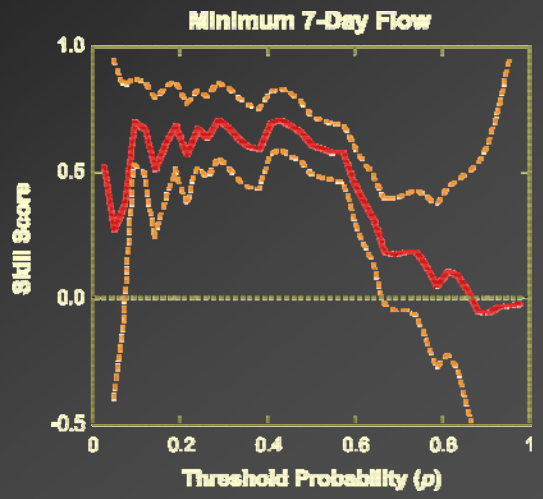
Verification Data Archive

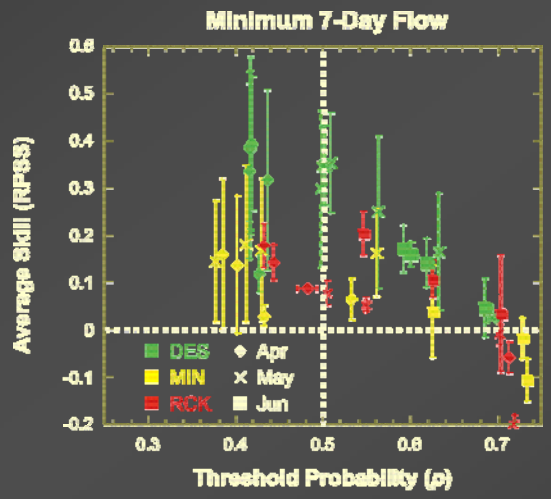
Conditional Distribution Forecast

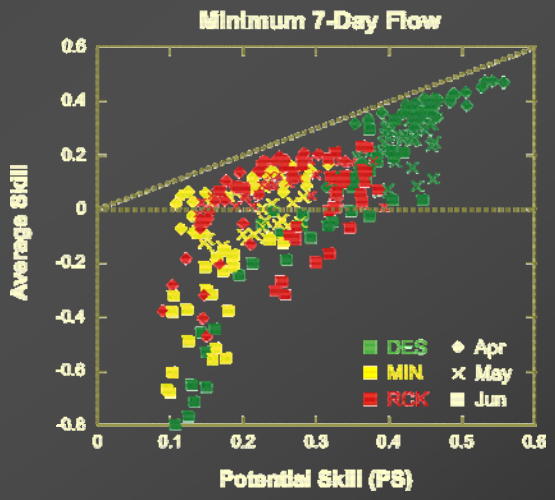


- Retrospective forecasts for a 50-year period
- Processed ensemble forecasts & observations

Verification Data Archive







- Retrospective forecasts for a 50-year period
- Processed ensemble forecasts & observations
- Verification results

AHPS Verification Concepts

- Use measures that help diagnose attributes (e.g., biases) limiting forecast skill
- Utilize non-dimensional measures of forecast quality to allow comparisons at many locations or forecast times

Verification Measures

- Skill
  - Accuracy of the forecast relative to another forecasting technique (climatology)
- Bias
  - Average differences between forecasts and observations
  - Unconditional (overall average) and conditional (depends forecast issued) biases

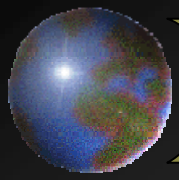
Distributions-Oriented Measures

- Skill Score Decomposition:

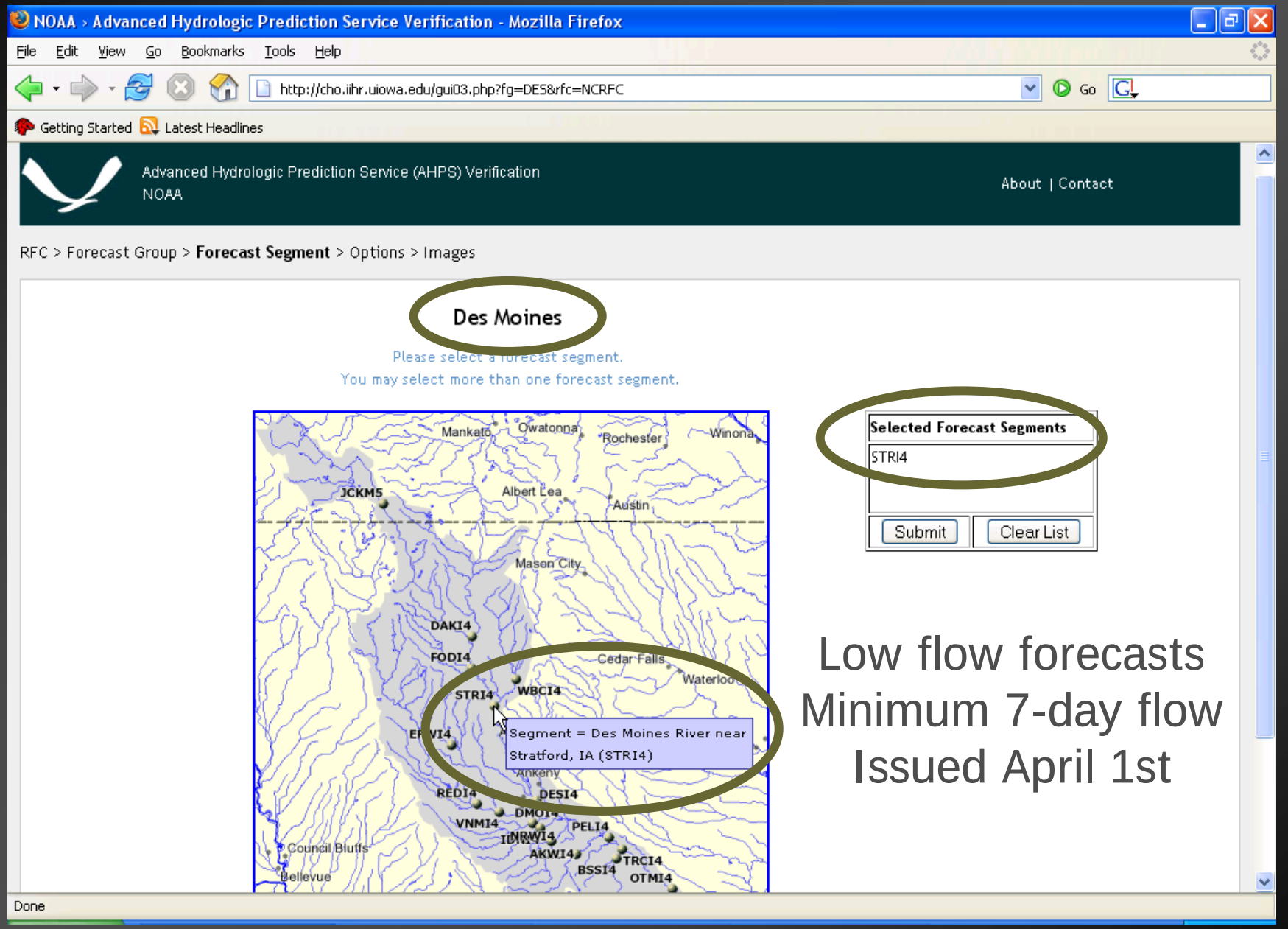
(SS) Skill — *(RES) Resolution* — *(CB) Conditional Bias* — *(UB) Unconditional Bias*

$$SS_{MSE} = \rho_{fx}^2 - \left[\rho_{fx} - \frac{\sigma_f}{\sigma_x}\right]^2 - \left[\frac{\mu_f - \mu_x}{\sigma_x}\right]^2$$

Potential Skill — *Slope Reliability* — *Standardized Mean Error*



Single Forecast Location/Time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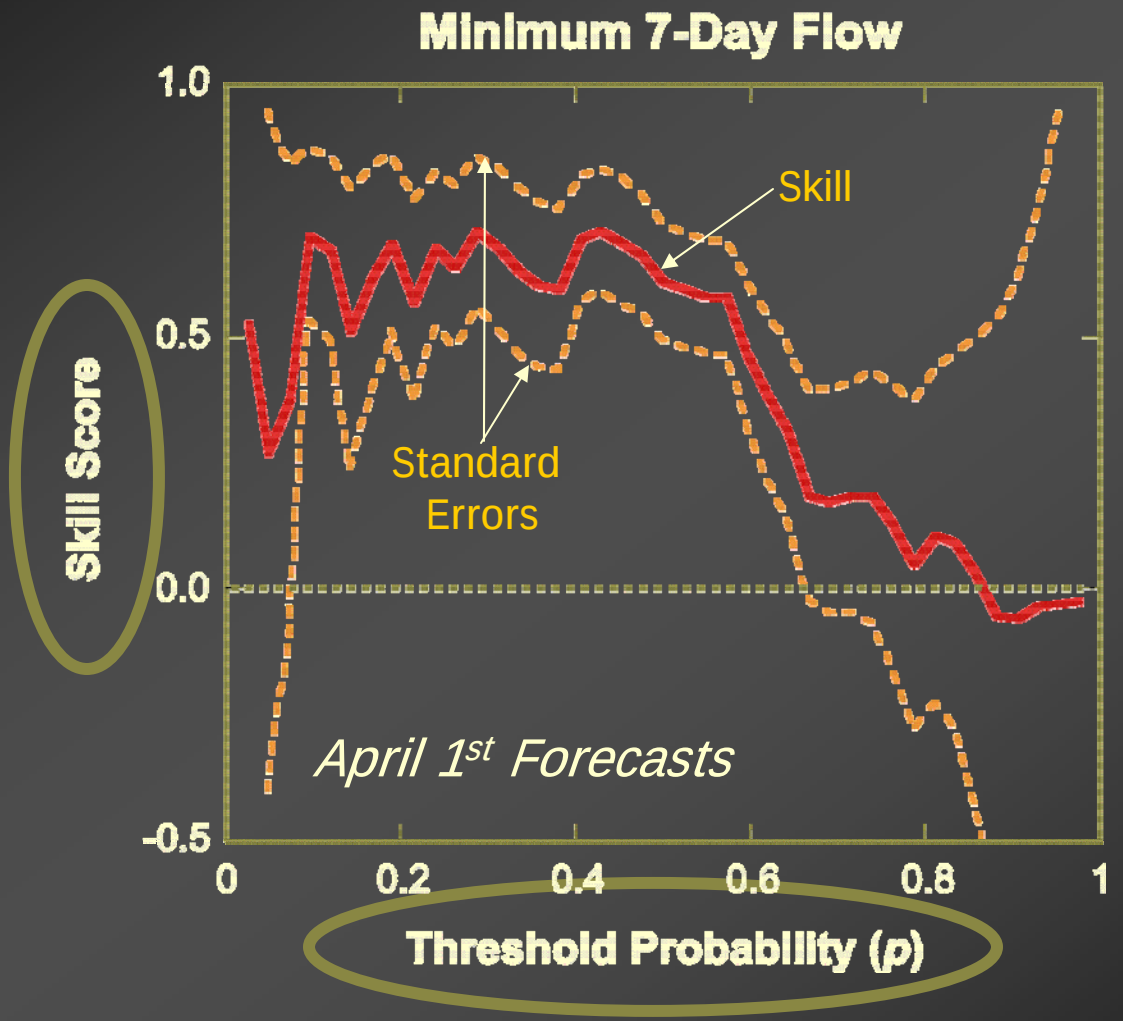
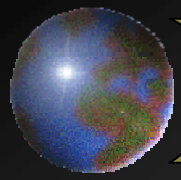
RFC > Forecast Group > Forecast Segment > Options > Images
Des Moines
Please select a forecast segment.
You may select more than one forecast segment.
Mankato
Owatonna
Rochester
Winona
JCKM5
Albert Lea
Austin
Mason City
DAKI4
FODI4
Cedar Falls
Waterloo
STRI4
WBCI4
Segment = Des Moines River near Stratford, IA (STRI4)
Ankeny
REDI4
DESI4
VNMI4
PELI4
AKWI4
TRCI4
BSSI4
OTMI4
Council Bluffs
Bellevue
Selected Forecast Segments
STRI4
Submit
Clear List
Low flow forecasts
Minimum 7-day flow
Issued April 1st
Done

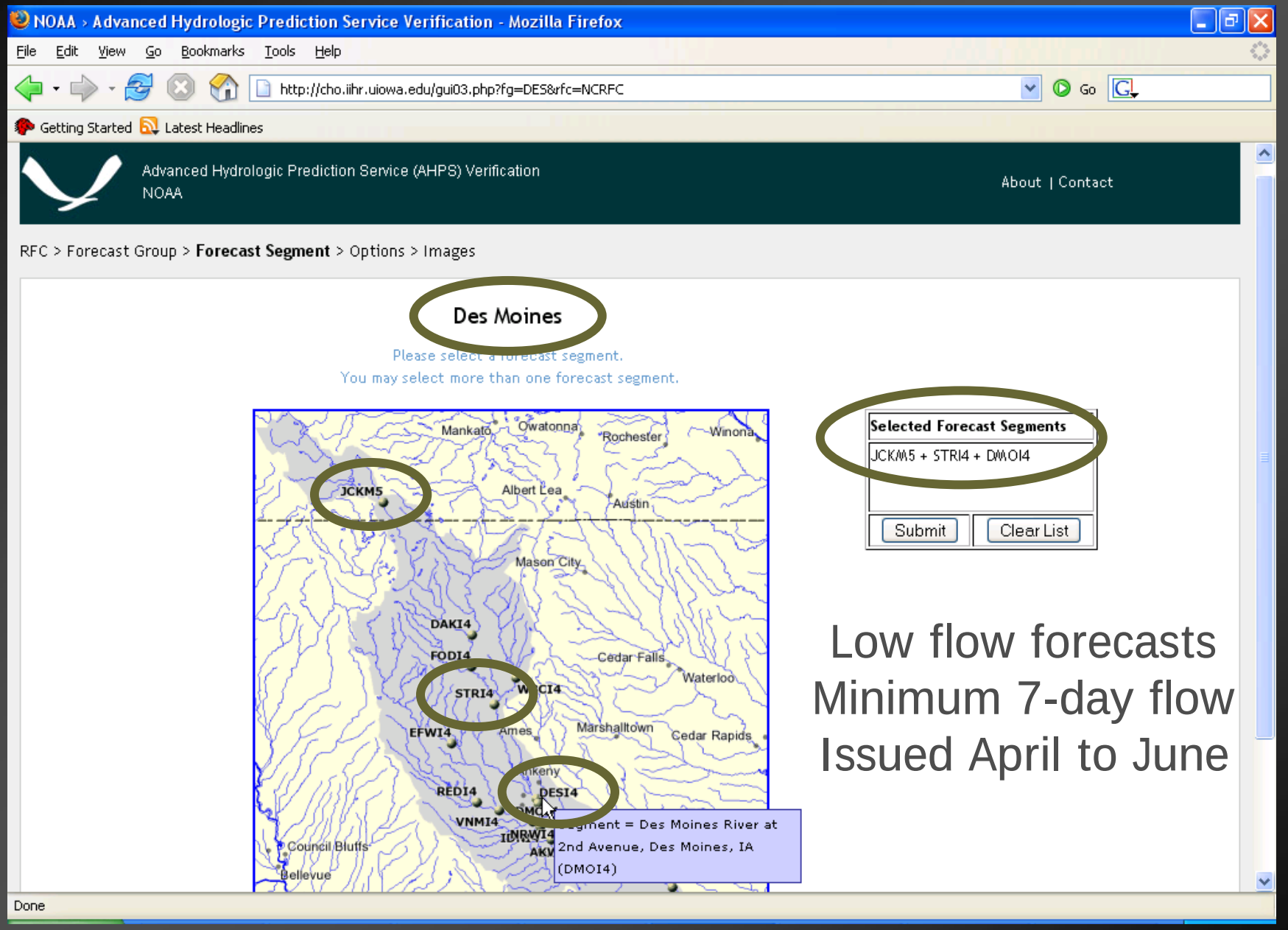
Des Moines River near Stratford



- Skill depends on the threshold
- Uncertainty is greater for extremes



Multiple Forecast Locations/Times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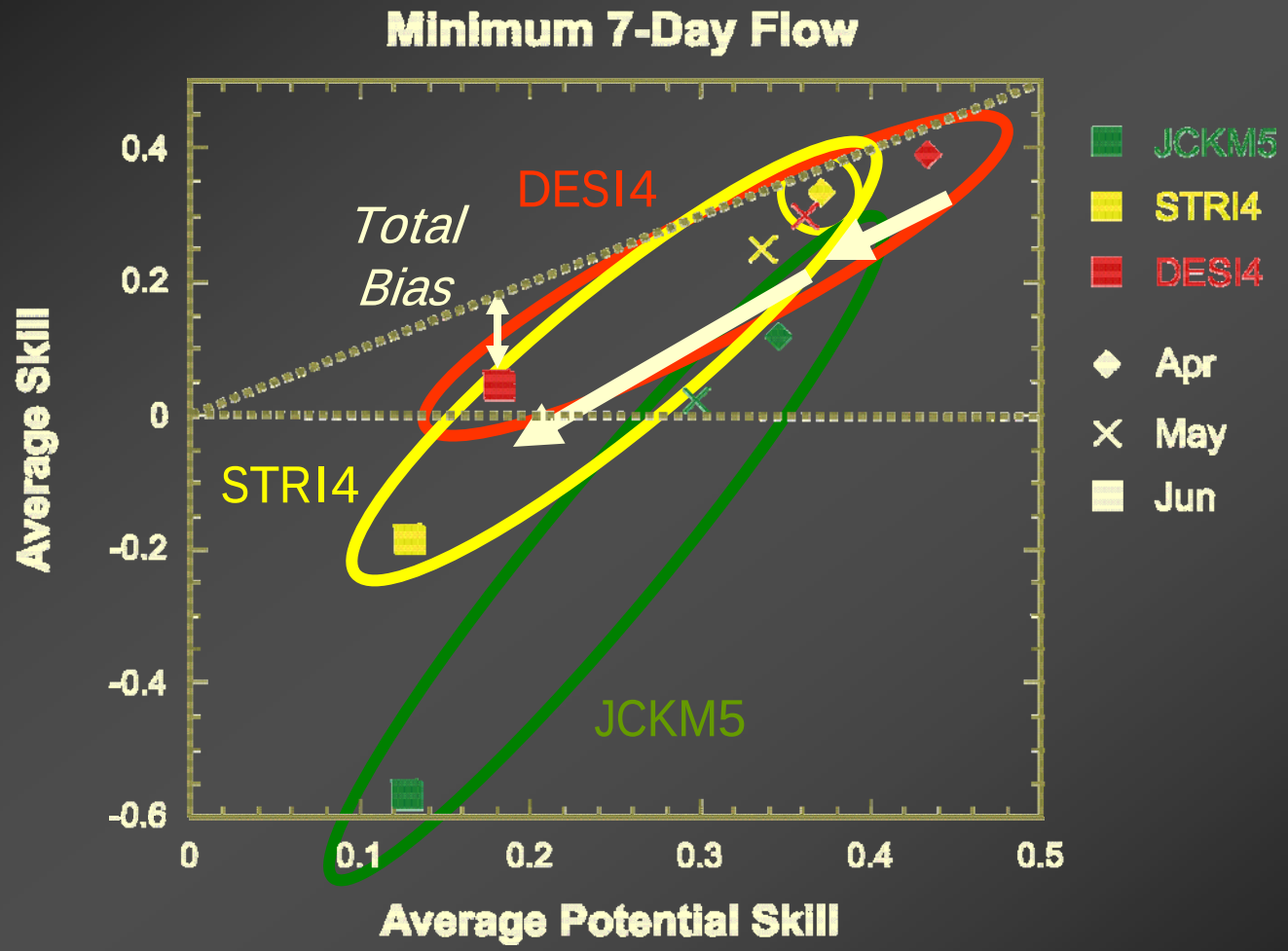
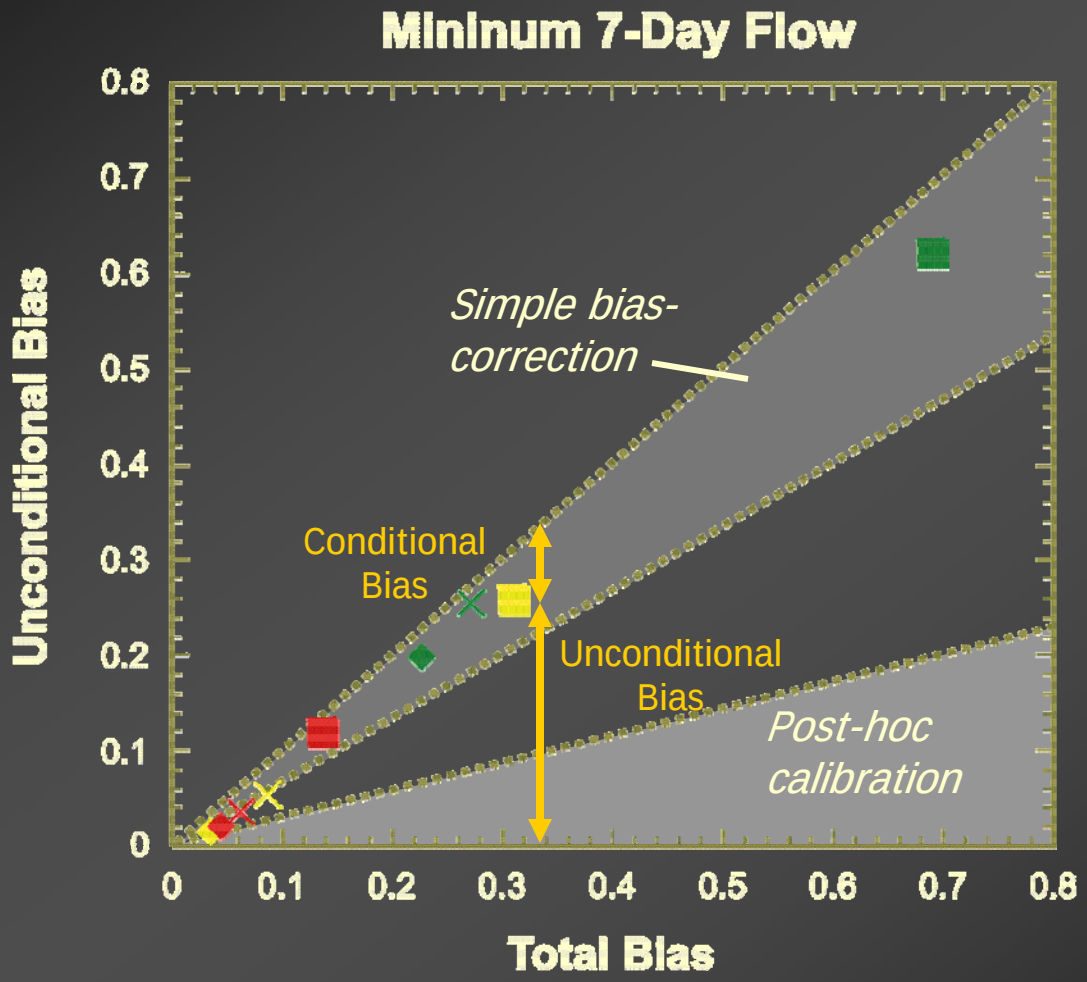
Des Moines
Please select a forecast segment.
You may select more than one forecast segment.
Mankato
Owatonna
Rochester
Winona
JCKM5
Albert Lea
Austin
Mason City
DAKI4
FODI4
Cedar Falls
Waterloo
STRI4
EFWI4
Ames
Marshalltown
Cedar Rapids
DESI4
REDI4
VNMI4
Council Bluffs
Bellevue
2nd Avenue, Des Moines, IA
(DMOI4)
Selected Forecast Segments
JCKM5 + STRI4 + DMOI4
Submit
Clear List
Low flow forecasts
Minimum 7-day flow
Issued April to June
Done

Des Moines Forecast Skill

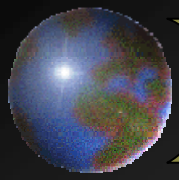


- Skill is higher (lower) downstream (upstream)
- Skill decline from April to June

Des Moines Forecast Biases



- Unconditional bias is dominate
- Simple bias-correction can significantly improve forecasts

Conclusions

- AHPS verification requires:
  - An archive of ensemble forecasts (typically retrospective forecasts for a long historical period)
  - Non-dimensional verification measures that allow comparisons at multiple sites and forecast periods
  - A diagnostic framework to identify opportunities to improve forecasts