HEPEX Seasonal Streamflow Forecast Intercomparison Project

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Outline

- Scope and goals
- Who
- Timelines and progress
- Results from initial experiments
- Next steps

Hydrologic Ensemble Prediction EXperiment

- **Scope**
  - Probabilistic forecasts of flow volumes at lead times up to one year.
  - Standard forecasts are for 1-month, 3-month periods. Other seasonal periods may be defined, e.g., snow melt and monsoonal periods

Goals

- Learn from each other, share and improve techniques and expertise related to seasonal streamflow prediction.

- To test and compare the performance of seasonal hydrological forecasting systems in varied hydro-climatic zones.

- Encourage reproducibility of results and share methods

- To identify unique sources of skill in different forecasting systems

- To make publically available sets of ensemble hydrological re-forecasts for other applications

Hydrologic Ensemble Prediction EXperiment

- First year (2016)
  - Define initial protocol for the experiment
  - Identify initial participants and case studies
  - Set up back-end systems and web presence
  - Trial a few basins and techniques

- Second year (2017)
  - Refine experimental protocol based on initial experiences.
  - Expand the number of participants, techniques and basins.
  - Adopt rigorous benchmarking and verification.

Hydrologic Ensemble Prediction EXperiment

Identified basins

- Australia: Upper Murray River (CSIRO)

- US: Hungry Horse Reservoir Watershed (NCAR)

- Sweden: Umealven River Bain (SMHI)

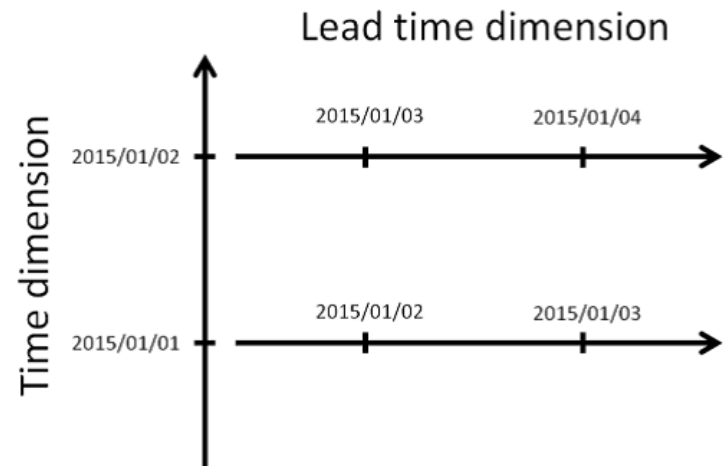- UK: Thames River at Kingston (CEH)

Progress

- NCAR and CSIRO meeting fortnightly since Feb 2016
- Bilaterally establishing systems and processes to ensure the experiment has a solid foundation
- Agreed on data formats / cross-validation strategies etc
- Identified a couple of experiments
- Exchanged data
- Generated forecasts in Aus and US catchments
- Set up a website
- http://www.ral.ucar.edu/staff/wood/ssfip/
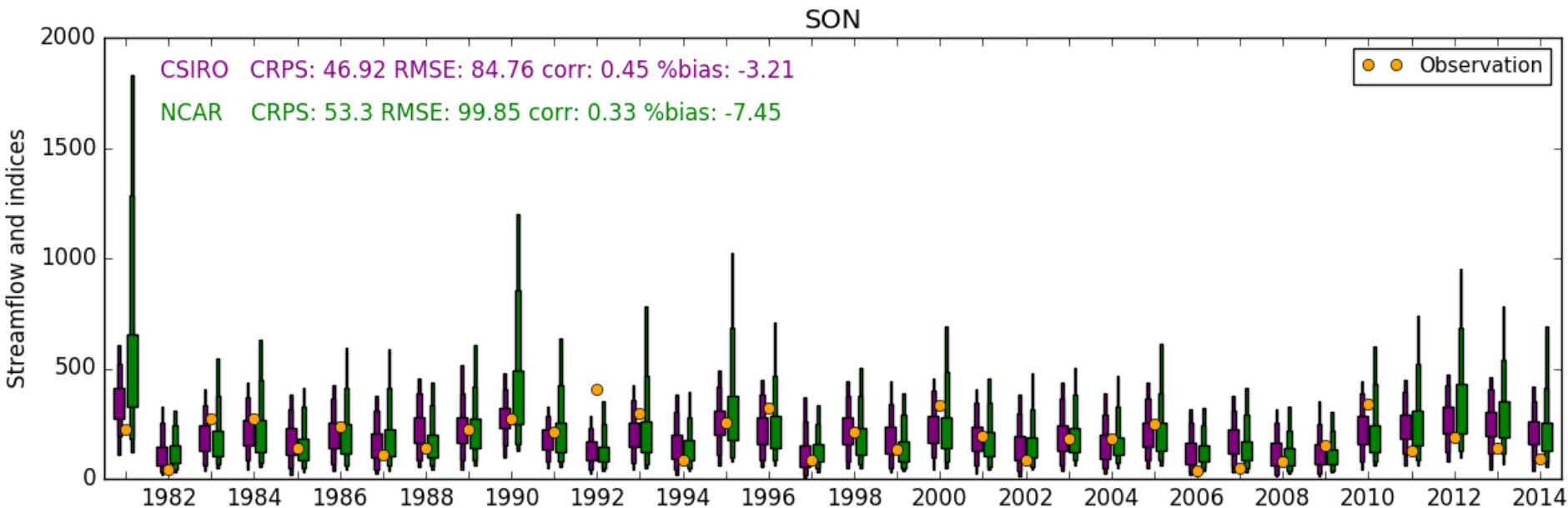
Hydrologic Ensemble Prediction EXperiment

- Leave-three-years-out cross validation
- 500 ensemble members
- Forecasts into netcdf

- Climatology reference
- CRPS, %Bias
- RMSE, correlation (median)
- Reliability (PIT)
- Sharpness (rel. AWCI)

Lead time dimension

http://hepex.irstea.fr/get-your-geek-on-handling-data-for-ensemble-forecasting/

- Example: 0-lead 1-season prediction for Sept-Oct-Nov flow
- CSIRO Approach: BJP using predictors (eg IC moisture, Clim Indices)
- NCAR Approach: Sequential MLR using same predictors

- Intercomparison: *the statistical method*

Hydrologic Ensemble Prediction EXperiment
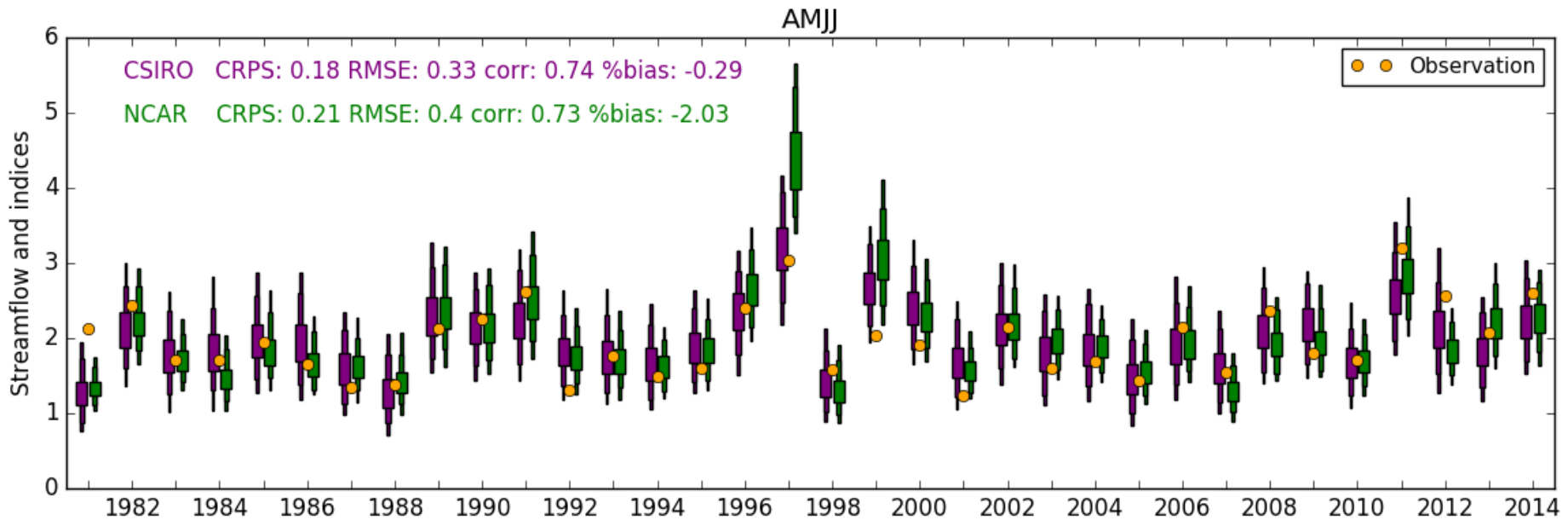
- Example: 0-lead 1-season WSF prediction for Apr-July flow

- Intercomparison: *the statistical method*

Reliability and sharpness
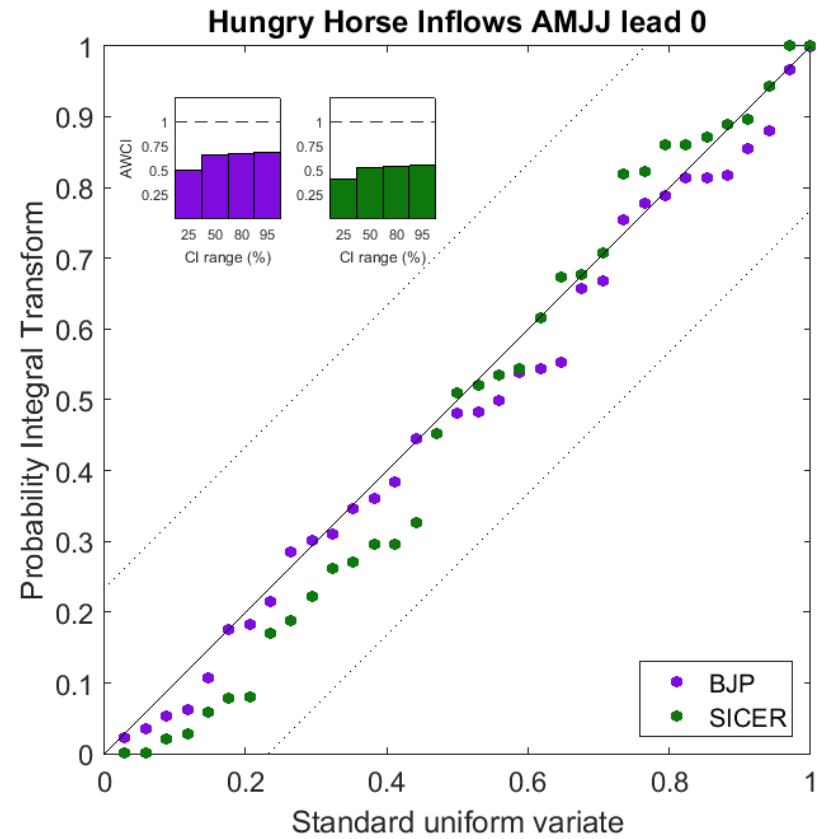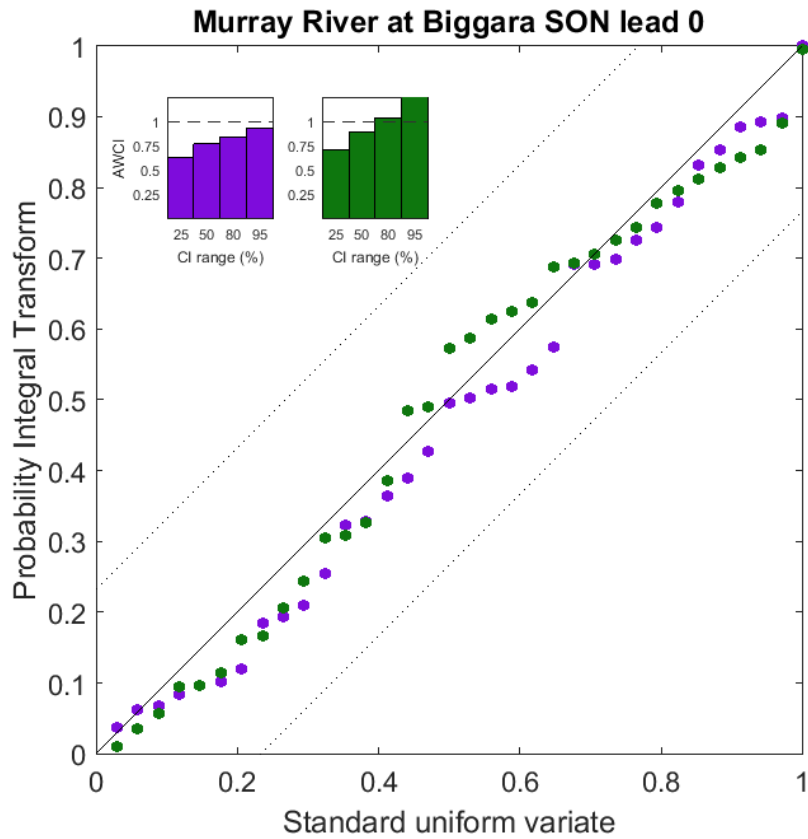
Website

Case Study Watersheds

A small set of watersheds is being implemented for the intercomparison of seasonal streamflow forecasting approaches. The watersheds are relatively unimpaired 'headwater-ish' basins that are important for water resources management. Each watershed (and including associated data and methods) is contributed by a partner in the project.

Click a **Basin Name** in the table below display the seasonal forecasts.

Watershed	Partner
HHWM8 Hungry Horse Reservoir Watershed	NCAR (US)
MRB Murray River Basin	CSIRO (AU)
UMLVN Umealven River Bain	SMHI (Sweden)
KNGST Thames River at Kingston	CEH (UK)
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Basin Description | Forecast Methods | Data | Results | Findings

Hungry Horse Reservoir Watershed (MT, USA)

Host: NCAR (Andy Wood, Pablo Mendoza)

With a largely unimpaired catchment and snowmelt driven runoff seasonality, this basin/reservoir is a key part of the US Federal Columbia River Power System (FCRPS). The multi-objective reservoir releases depend on both short term and seasonal streamflow predictions, and particularly snowmelt runoff season volumes (ie, May-September). Current agency seasonal operational forecasts include both statistical techniques (principal components regression between in situ snow water equivalent and precipitation versus streamflow volume) and the NWS Ensemble Streamflow Prediction (ESP) approach, using simple conceptual watershed models. ESP Forecasts are released daily all year round; and statistical forecasts are released twice monthly between December 15 and July 1. Current operational forecasts do not use future climate information.

More information: Wikipedia

HUNGRY HORSE RESERVOIR (HHWM8)

http://www.ral.ucar.edu/staff/wood/ssfip/

Hydrologic Ensemble Prediction EXperiment
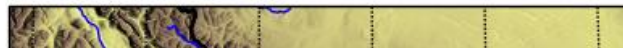
Learning – to date, and in the future?

- This has been a pilot experiment and demonstration to get a sense of what is involved in an SSFIP, nailing down logistics
  - eg, shared data formats
- So far, we have also learned about:
  - considerations other forecasters are taking into account
    - eg different strategies for cross-validation, or for estimating a reference forecast (empirical vs fitted)
  - variations in predictability and strategies for capturing it
    - harnessing IC soil moisture via antecedent precip or via modeling
- To learn more, however, we'll need to dig deeper:
  - *why* does one stat method capture a signal better than another?   More analysis needed, but we have the data for it…

HEPEX

Hydrologic Ensemble Prediction EXperiment

- Set up common verification tools to run on common outputs
- Deliver results to web and standardize what will be shown
- Future comparisons (let's build the list):
  - predictor data (eg climate system analyses & forecasts)
  - watershed models for capturing IHC variability
  - …
- To join the effort:
  - define and contribute data elements of your forecasting approach for your basin
  - be willing to apply your approach to other basins in the testbed (and in return, others will implement their approach in yours)
  - consider what aspect of your approach is most interesting to test
  - visit website to get a sense of what types of data are being shared

Feedback/Contributions Are Welcome