NWS Hydrologic Forecast Verification Team: 20th Meeting

02/25/2010 – 12 pm EST

Outline

- Real-time verification survey
  - Goal and next tasks
  - Feedback from 13 RFCs
- Next team activities
- Next meeting

Real Time Verification: purpose and status

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Overview of problem

Ensembles will always be imperfect

- **Sources of uncertainty ignored etc. etc.**

We can consult past to minimize risk….

- **Manual modifications (MODs)**
- **Automated bias-correction (post-processor)**
- **Data assimilator (bias-correct w/ recent past)**
- **Diagnostic verification (test fcst. system)**
- **Real-time verification….**

Real-time verification

Real-time verification (RTV)

- Analogs: examples of forecast error in past…
- …under conditions akin to real-time forecast
- Could use many sources of info (see survey)

What can it offer over other techniques?

- Bias-corrections are lumped (large sample)
- Diagnostic verification is lumped
- DA good, but can we learn from distant past?

Potential applications

Many potential applications

- MODs could benefit from analogs
- What MODs were applied in the past?
- Can we trust our best forecast for this specific event (e.g. post-processed)?
- To communicate uncertainty in a simple way: nothing fancy, just past cases or “raw data”
- To show what happened for rare events (“raw data” may provide best insight here)

The tricky part

How to identify analogs?

- **Hence the survey…..**

Tasks for FY10

"Develop capabilities for real-time verification of ensemble forecasts."

Subtask	**Lead**
a) Develop analog prototype	James B.
b) Develop prototype displays	Julie D.

Tasks for FY10

A) Develop analog prototype

- **Develop survey for RFCs: 1) conditions under which analogs would be most useful; and 2) criteria for selection**
- **Develop analog selection prototype, probably in R environment, with examples of pre-defined queries (informed by survey results)**

Tasks for FY10

B) Develop prototype displays

- **Develop new displays for analog forecasts (probably in R), together with steps necessary to implement displays in CHPS Graphics Generator**
- **Develop new map displays for EVS verification metrics in CHPS ("context information")**

Real-time verification: survey results

- 2 types of information:
  - Analogs
  - Summary statistics from diagnostic verification

- Feedback:
  - Analogs to show forecast uncertainty
  - Wide range of applications
  - Lots of auxiliary data to be used for conditioning
  - Using both analogs and summary stats

- Will requires:
  - lots of flexibility in software (e.g. adding query on new variable)
  - robust archiving system

Analog query/display: survey results

1. Useful for which conditions:
   - high (Action, Minor, Mod., Major, Record), low, average flow/stage
   - season specific, event type specific (snowmelt peak, ice impact, dry/wet, tidal event), impact specific (navigation, recreation, agric.)

2. Queries on which variables:
   - Precip, Temp, SWE, Flow, Stage + combinations
   - Freezing level, snow depth, AFDD, dew point, winds, soil moisture, climate/weather indices (ENSO, PDO, MJO), drought criteria
   - Reservoir releases, lake volumes

3. Queries on which stats or temporal parameters:
   - Season, time to peak flow/stage, time to rise above FS
   - Single-value: obs/fcst at given time
   - Ensemble: mean, median, spread, prob. for < or > threshold

Analog query/display: survey results

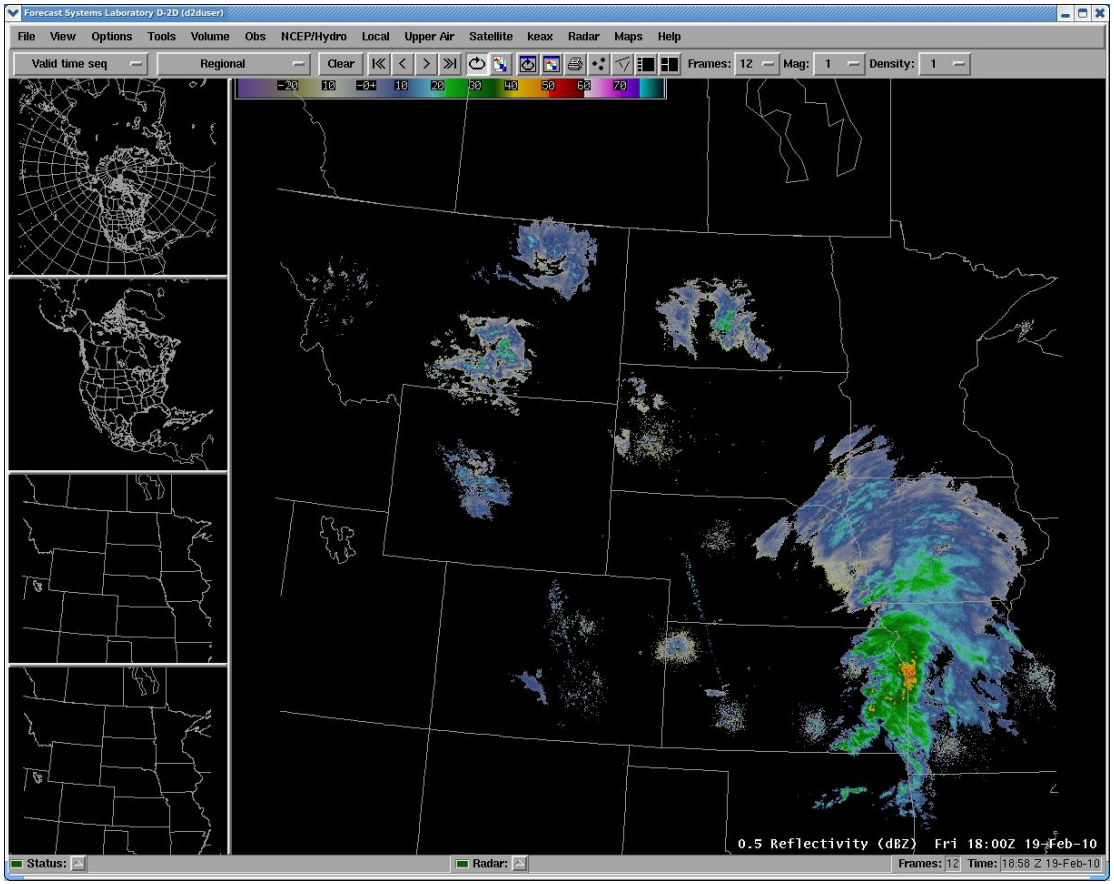
4. Queries on which spatial parameters:
   - Upstream basins mostly
   - Downstream basins, same forecast group, similar basins
   - Interior gage locations, county, state

5. Useful auxiliary information: a lot!!!
   - Forcing inputs: climate indices (ENSO, PDO, NAO), weather patterns (MJO, synoptic/tropical/frontal), storm track/direction, hurricane strength/speed, wind, precipitation (intensity, duration), precipitable water, temperature, snowpack, snow cover, freezing level, AFDD, ice conditions, drought condition
   - Topographic: slope facing, elevation…
   - Storm surge

Analog query/display: survey results

6. Parameters for analog display: lots of flexibility for user!
   - Undockable window from IFD
   - Toggle on/off analog display

Example: D2D window



Analog query/display: survey results

7. How analog info will be used
   - Provide analog displays to forecasters
   - Assess if forecast reasonable
   - Help decision about forecast uncertainty, forecast skill, forecast reliability…
   - Define new MODs
   - Provide forecast context, forecast history, contingency forecasts
   - Represent forecast uncertainty for end users
     (e.g. extreme events)
   - Test and archive analog queries

Analog query/display: survey results

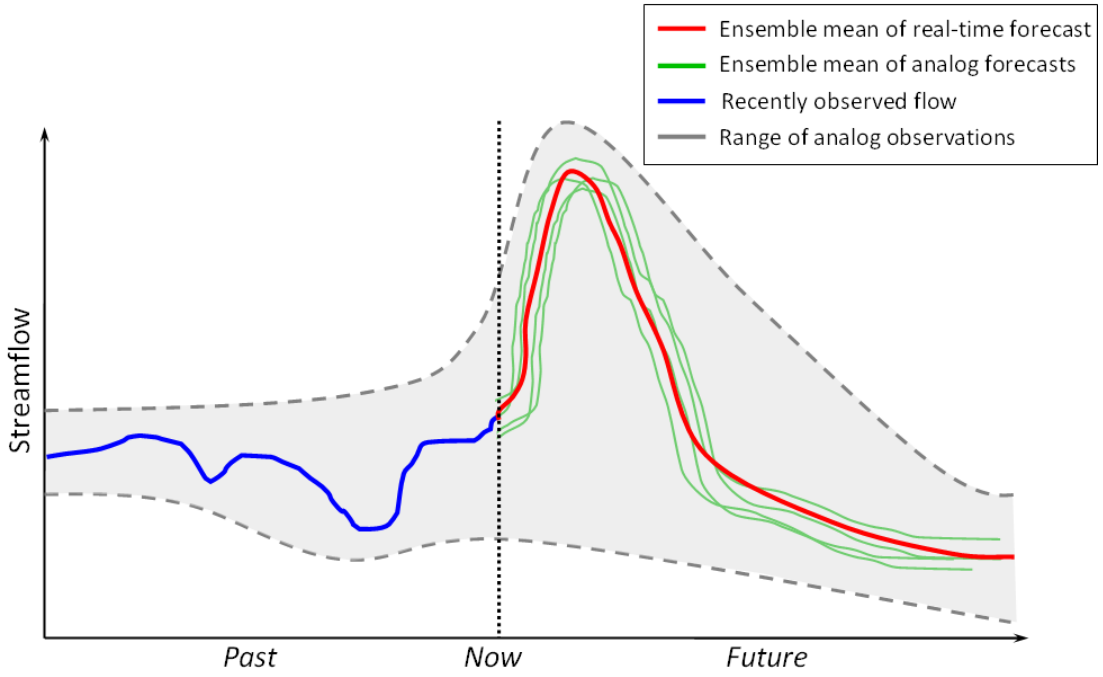
8. Critical analog queries: from simple queries ("predefined") to complex queries -> SQL query for any data archived in database
   - Specific range, specific time, multiple variables
   - From upstream and/or downstream locations
   - From other locations (e.g. lake)
   - Query on rising/falling limb of hydrograph
   - Query on specific mods (e.g. ice affect)

   Examples of complex queries:
   - Give me past stage forecasts where high tide exceeded 6.9 feet, strong winds 20-30 mph, and 180-270 degree wind direction at location X
   - Give me past stage forecasts for location X where SWE at Lake Y was greater than 11.0 in, snow levels were above 10,000 ft, and precip within a 2 day period was greater than 2 in
   - Give me past forecast volumes in KAF for location X where April-July volume was less than 60% of average three years in a row

Analog query/display: survey results

9. Examples of analog displays: maximum flexibility!

- Clarified terminology, user-defined display elements, toggle on/off
- Display query, multiple windows for other variables (e.g. precip)
- Display forecast and obs. (curves, shaded-band), error envelop



10. Other comment:

- Differentiate forecasts before RTV mods and forecasts after RTV mods

Summary verification: survey results

1. Useful for which conditions:
   - high (Action, Minor, Mod., Major, Record), low, average flow/stage
   - season specific, event type specific (snowmelt peak, ice impact)

2. Computed for which time periods:
   - Month, quarters, multiple seasons (warm/cold, navigation, snow), water years, date-range
   - Specific events (flood season, x weeks after peak snowmelt, tropical system)

3. Computed for which conditions:
   - Precipitation, Temperature, SWE, Flow, Stage + combinations
   - Freezing level, snow depth, AFDD, soil moisture…
   - Absolute thresholds, percentiles, impact thresholds (FS), hurricane categories

Summary verification: survey results

4. Useful statistics for forecasters:
   - MAE, RMSE, MSE, MaxAE, MCRPS, Rel. Bias, ME, skill scores w/ various references (clim., pers., zero QPF, user specified)
   - Talagrand, Reliability diagrams; FAR; POD, POFD

5. Useful statistics for forecast users:
   - MAE, RMSE, MSE, MCRPS, Rel. Bias, ME, skill scores w/ various references (clim, pers., user specified)
   - Reliability diagrams

6. Useful verification spatial maps:
   - Static for given response time, for specific levels (Min. Stage…)
   - Animated by season, by forecast issuance time

7. Spatial maps for which locations:
   - Whole RFC, Forecast group, Multiple RFCs (scalable by user)
   - Any parameter (headwater/routed, regulation, response time…)

Summary verification: survey results

8. Other summary verification info

- Verif statistic vs. lead time, month, season, year, threshold, moving time window, date-range
- Verif stat by groups of basin size, of locations, of response time
- Plots + tables

9. Parameters for verification displays

- Number of plots: user specified
- Predefined conditions to select from: varies a lot -> menu

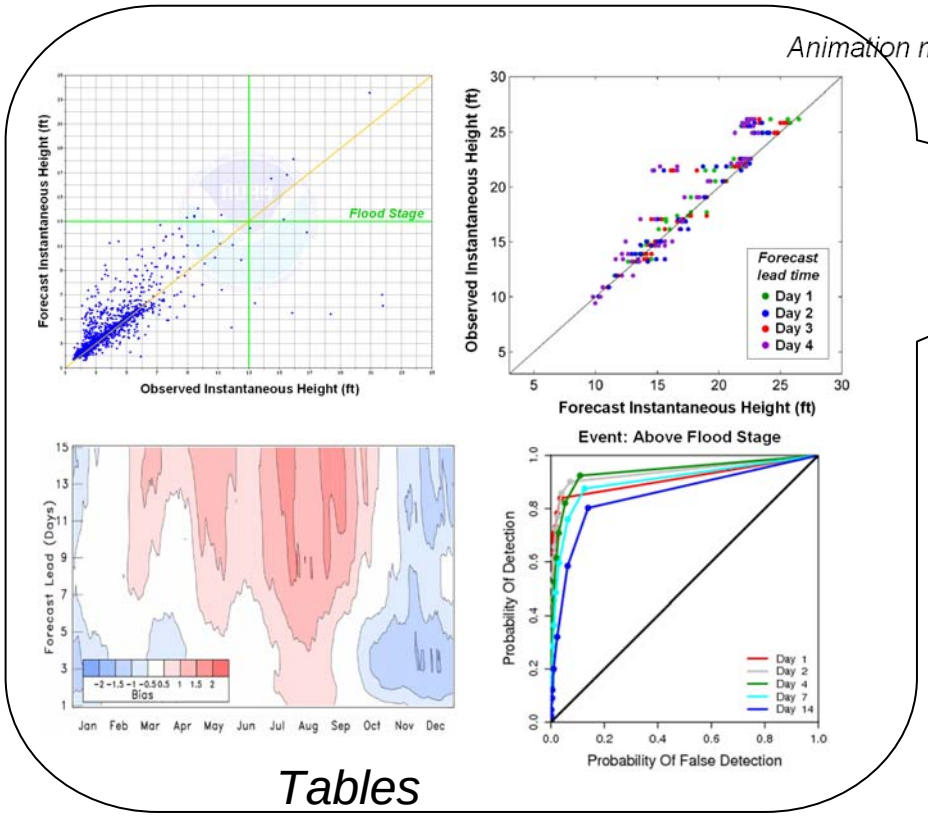
10. How summary verification info will be used

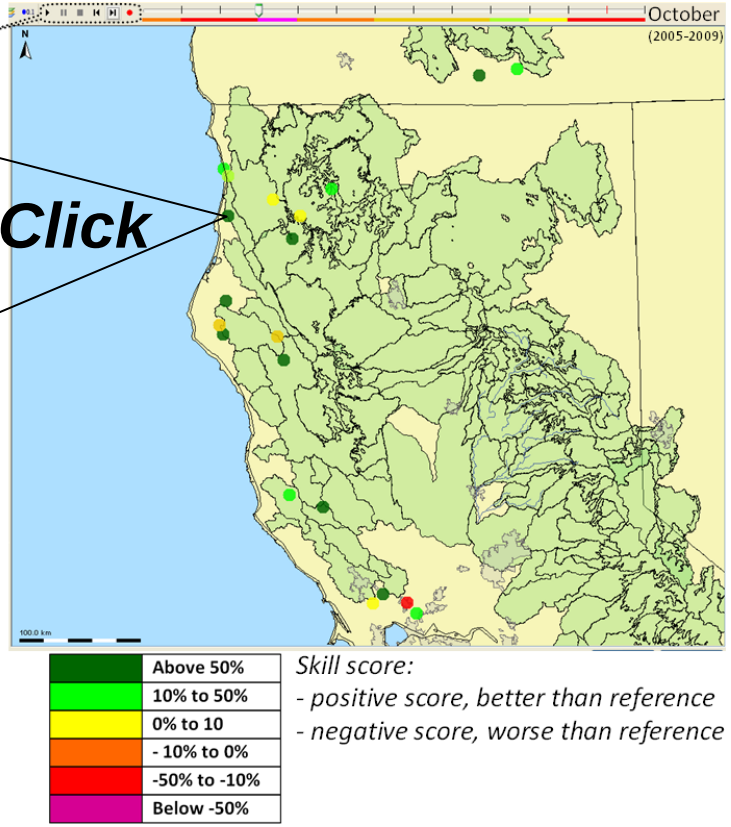
- 1st level of verification info for forecasters
- As a complement to analog displays
- Summary info to users (e.g. WFOs)

Summary verification: survey results

11. Example of summary verification map

- Menu to select additional statistics, real-time forecast, flood status
- Ranked list of basins based on skill
- Ability to group by forecast group, elevation, area

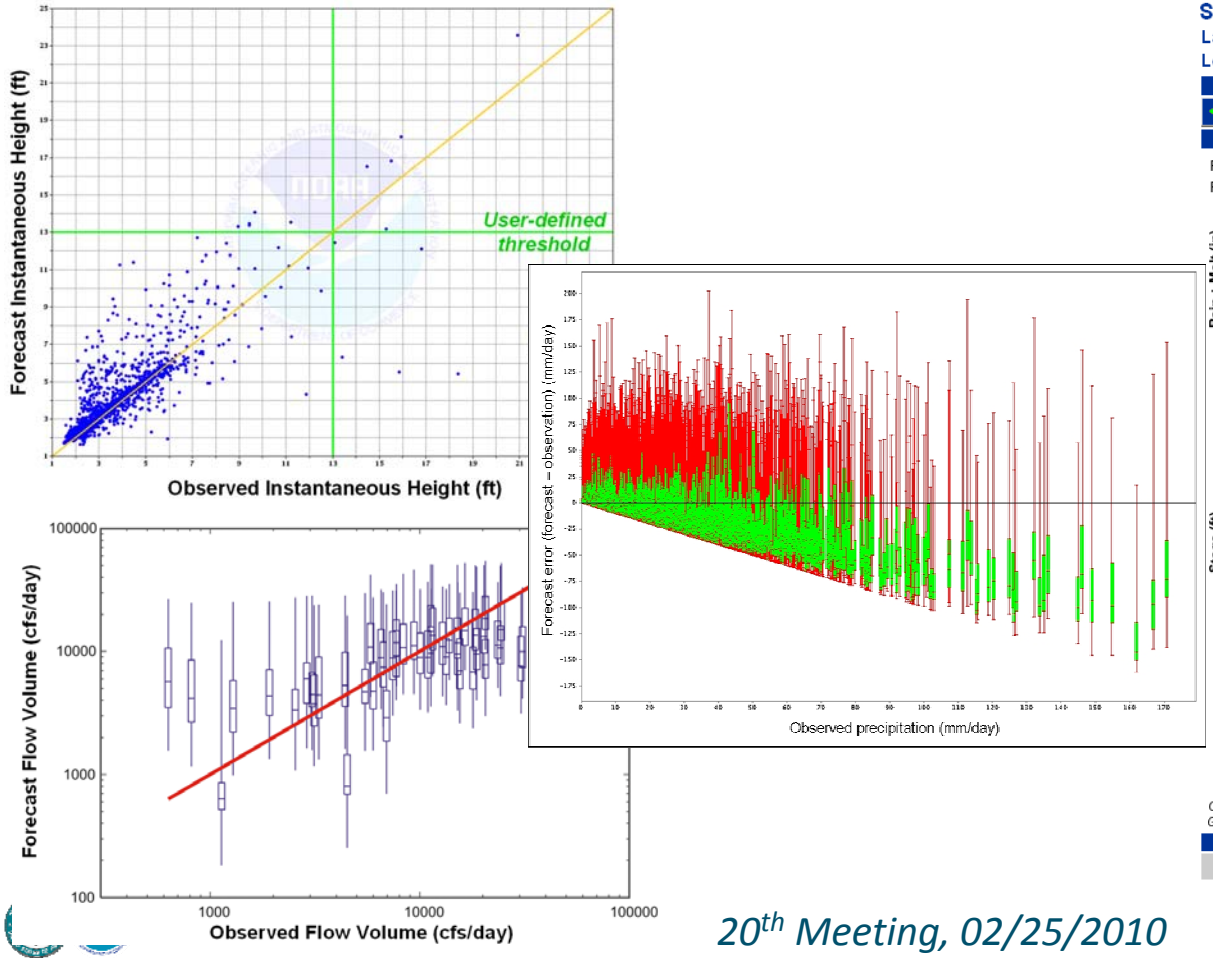


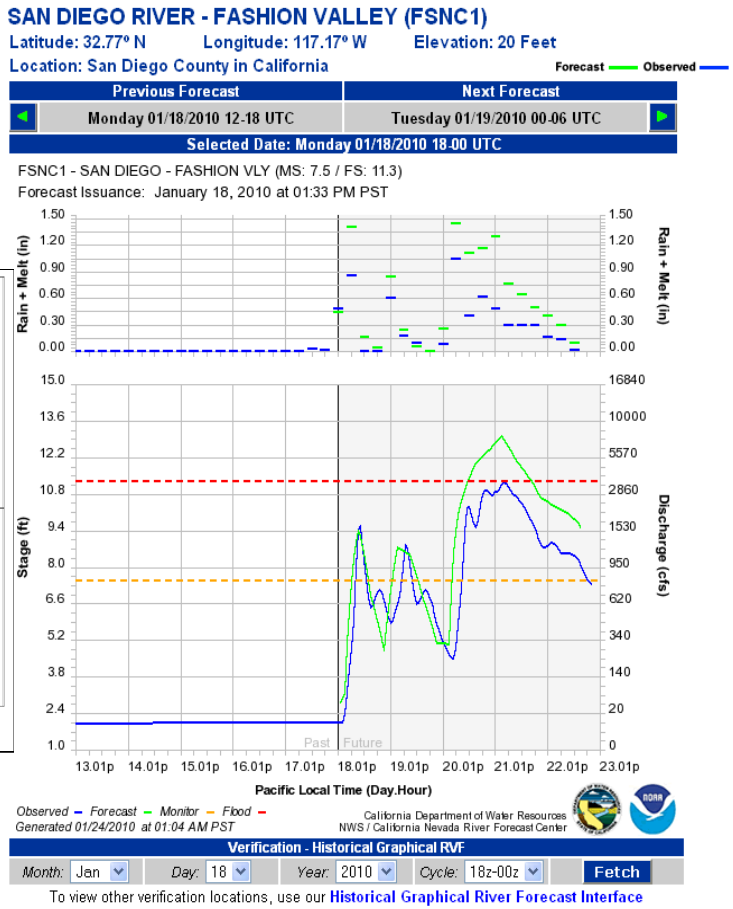


Summary verification: survey results

12. Other comments:

- Tool for data exploration
- Tables of verification stats along other products





Next team activities

- Discussion with HICs right after this meeting
- Get feedback on verification products
  - New survey to be filled out by each team member and by each SCH w/ input from external users
  - Survey finalized and sent out in March
- Work on verification case studies to produce and evaluate standard verification products proposed in Sep. 09 report

Next meeting

- 21st meeting: April-May
  - Verification case studies (HEP, RFCs?)
  - Discussion on user analysis of standard verification products

Thank you!

Questions?