

## **Issues, Recommendations and Actions from the Second RFC Verification Workshop Salt Lake City, November 18-20, 2008**

The NWS Hydrology Forecast Verification Team held a three-day verification workshop in November 2008 to present the progress made on verification activities at the RFCs, WFOs, and OHD, as well as in academia. All the workshop material is available online at [http://www.nws.noaa.gov/oh/rfcdev/projects/rfcHVT\\_workshop2\\_agenda\\_presentations.html](http://www.nws.noaa.gov/oh/rfcdev/projects/rfcHVT_workshop2_agenda_presentations.html)

Here are the key verification issues discussed during this workshop, including the team recommendations and proposed actions for future work.

### **1. Users of forecast and verification products**

The team discussed the need to identify a few groups of customers of forecast products (including customers within NWS, such as hydrology managers) to define what kind of verification standard products would be meaningful for each group.

To do so, the team proposed that all the Service Coordination Hydrologists from the RFCs work with the RFC Verification Focal Point(s) to define these main groups of customers and propose a few verification metrics/graphics for each group. The verification team will have a meeting to discuss the proposed user groups and standards. Recommendations on verification standards for specific user groups will be given in the final verification team report.

This effort should also be coordinated with the verification efforts from the meteorological community to present consistent verification information for weather forecasts, climate forecasts and hydrological forecasts.

### ***Service Coordination Hydrologists with RFC Verification Focal Points NWS Hydrology Forecast Verification Team***

### **2. Verification strategies to effectively communicate verification information**

The team agreed that the NWS should provide at least three levels of sophistication in the verification information, from detailed statistics useful to forecasters, modelers and sophisticated users (e.g., with decision support tool that could directly ingest some verification results), to summary scores (e.g., green/red lights for various quality aspects) for the general public, along with explanations of such verification products.

Also the NWS should convey the forecast uncertainty information to customers, even with deterministic forecasts. One could have graphics with deterministic forecasts issued at different times to show how the forecast values are changing with lead time and get the user understand how difficult the situation is to predict. Also it would be useful to plot the probability forecast for a particular threshold (e.g. action stage) alongside the single-valued forecast; this plot will have a single line giving the probability of exceeding the selected threshold. In case a bias correction

technique is available, a second line could be plotted for the bias-corrected probability. This approach will help users become familiar with probabilistic forecasts.

The team recognized the need to use normalized metrics to have meaningful inter-comparison results among basins and RFCs. For example, instead of using an absolute flow threshold value, the threshold value could be defined as one of the percentiles in the climatological record.

### ***NWS Hydrology Forecast Verification Team***

#### **3. Raw model applications**

Raw model forecasts, which are generated by the forecasting system with no/minimal human interactions at the time of the forecast issuance, are one of the meaningful references for verifying the operational forecasts for some specific users. These users include the forecasters, who want to evaluate how much value they add to the forecasts in various forecast situations, and the Hydrology Program managers, who evaluate what should be done to improve the forecasts. Depending on the users, the definition of raw model forecasts may vary. For inter-comparison purpose, it seems necessary to develop a unique national definition of raw model forecasts; each RFC could also define other raw model flavors to meet their own needs.

It was proposed that, at each RFC, the RFC Verification Focal Point(s) work with the Service Coordination Hydrologist to define how the raw model forecasts will be used and send their use cases and raw model definitions to the verification team. The verification team will have a meeting to discuss the different raw model definitions and use cases and will make a recommendation for the HICs.

### ***RFC Verification Focal Points with Service Coordination Hydrologists*** ***NWS Hydrology Forecast Verification Team***

#### **4. Future verification case studies for the RFCs**

In several RFC presentations, forecasters mentioned their office choice concerning how many lead times of QPF is used to generate hydrologic forecasts. In some offices, a policy is in place to restrict the QPF lead times to very short lead time (e.g., 12 hours). This decision should be based on verification results to help evaluate in which situations more QPF values could be used to improve flow/stage forecasts. Therefore the verification team proposed to define a new verification study to be done at each RFC to inter-compare the quality of flow/stage forecasts based on different QPF lead times (0 QPF, 6 hours of QPF, 12 hours of QPF, 18 hours of QPF, ... 10 days of QPF). Basically, this study requires producing in parallel and archiving various forecast runs, each one using a different QPF lead time, and evaluating in IVP the different sets of forecasts. For each forecast set, the verification metrics should be computed for each individual lead time for the whole time period, as well as sub-periods relative to specific weather or hydrologic conditions. Even if users may have different needs for these forecasts and thus accept to use forecasts with various quality levels, each RFC should be able to determine the

optimal QPF lead times to meet the needs of their main users using such systematic verification case study.

Also the RFCs recognize the need to work on verification case studies using EVS to become more familiar with probabilistic verification. The EVS exercise that the team worked on in June and July 08 was a good introduction to EVS but each RFC needs to work with its own data. For example, EVS could be used to evaluate the long-term ESP forecasts (generated from climatological forcing inputs). Regarding the support on EVS, the RFCs should send all their questions to the verif-hydro list server to get some help from all the EVS moderators and users. Andrew Philpott at MARFC is now one of the moderators for EVS support.

### ***RFC Verification Focal Points NWS Hydrology Forecast Verification Team***

#### **5. Decomposition of flow error into timing error, peak value error, and hydrograph shape error**

As one of the activities in the FY09 verification work plan presented during the workshop, HEP will work on decomposing the flow error into timing error, peak value error and hydrograph shape error. The difficulty is to define an observed event and a forecast event to be paired together (in the current verification process, pairing is based on forecast and observed valid time). Once the event pairing is done, standard statistics can be used (or if necessary, new metrics can be developed) to characterize the timing, peak value, and hydrograph shape error. Several techniques will be investigated, such as curve registration and object-based methods. The participants suggested starting with a simple manual pairing process and eventually including both an automated process and a manual process for the event pairing. The manual pairing process (similar to the STAT-Q tool used in calibration) should lead to an easier implementation of such functionality. This functionality will also be very beneficial to evaluating the quality of tide forecasts, for which the error decomposition would be very meaningful to users.

### ***HEP Group at OHD***

#### **6. Verification training and communication**

The team proposed that training on IVP and EVS, such as the software demonstration offered to the verification team, should be recorded as webinar to be offered at any time.

GoToMeetings should also be held regularly to answer specific questions on software or interpretation of verification graphics.

Also the verification team will help COMET develop new verification modules. One module will present one verification case study with IVP and another one with EVS. These case studies will be defined once the verification team interim report has been developed.

The workshop participants recommended conducting another verification workshop in two years or so, with the verification team members and a few extra RFC participants, to share verification experiences and show progress being made in the NWS and in academia.

The verif-hydro list server is a good tool to support the RFCs by sharing questions and solutions. A few rules need to be accepted to get efficient support:

- whenever someone wants to submit a question to the verification team, he/she should submit it to the list server, with in the title one of the four following categories: IVP and database issues; EVS; verification science; workshops and training;
- if you are one of the list server moderators, see if you can answer the question, or see if the question gets answered; if not, add the question to the list of unanswered questions, which will be revisited by the verification team at a future meeting.

***HEP Group and HSEB at OHD  
RFC Verification Focal Points  
NWS Hydrology Forecast Verification Team***

#### 7. Define requirements for FY10 verification branch work

The current verification statistics compiled by the NWS Performance Branch aggregate forecasts over time to compute basic error statistics for individual forecast points. These statistics are then averaged over various response times and geographical extents. Because there is no information to place these statistics in context or information to distinguish individual events, this verification system has been of little value.

As proposed in the FY09 verification work plan, the team should develop requirements to improve the routine hydrology verification statistics computed and archived by the NWS Performance Branch. These requirements should be developed by the verification team based on results from the case studies completed and ongoing. These requirements should be presented to the RFC and OHD management. The NWS Performance Branch should be engaged late in FY09 so that these requirements can become part of their FY10 workload.

***NWS Hydrology Forecast Verification Team  
NWS Performance Branch  
RFC and OHD management***