SURVEY

This survey is being used to assist in devising procedures for verification of hydrologic forecasts, in ways that can assist forecasters as they are generating forecasts.

Because you are a forecaster within a River Forecast Center, you are being asked to answer several questions about your practices, preferences, and perspectives regarding hydrologic forecasts and their verification. This survey is to be completed by ***each person*** within your River Forecast Center with responsibilities for generating hydrologic forecasts. Because some of these questions ask about your personal practices as a forecaster, or about your opinions related to forecasting and verification, ***please do not collaborate*** with any other forecasters in completing this survey. ***Your*** answers are important. You can expect to spend about 1-2 hours completing this survey.

This survey is completely confidential. When Dr. Hartmann receives your survey, before any responses are examined, she will remove all identifying information, including the email address from which it was received and any document editing identification. No other personnel, either within the NWS or connected with this project, will have access to the individual survey responses. They will have access *only to summaries* of the survey responses.

Finally, please note that this survey is not a test of your intelligence or knowledge about forecasting or verification. In some cases, it asks for your perspective about tools or approaches that have not yet been implemented. Your responses are important because you are among the few professional active in operational forecasting in the U.S. Your responses will be important in devising procedures and tools for verifying hydrologic forecasts in ways that can assist forecasters *as they are generating* forecasts.

There are no known risks from your participation and no direct benefit from your participation is expected. There is no cost to you except for your time and you will do the survey as part of your workday. You can obtain further information from Dr. Holly C. Hartmann at 541-607-6722 or hollyoregon@juno.com or from Dr. Bisher Imam at 949-824-8830 bimam@uci.edu. However, when returning the survey, please return it only to Dr. Hartmann without copying any other person.

This survey has a total of 28 questions. It should take between 60 and 90 minutes to complete. It could be completed in sections. But we would like to have all responses within 20 days.

Section I. General Information

In this section, we ask some general questions that allow us to classify the survey results based on forecasting duties, forecaster background, and years of service.

1. Which statement best describes your hydrologic forecasting duties?
   Please check only one statement.

   ☐ I am a full time hydrologic forecaster. I perform hydrologic forecasts on daily basis
   ☐ I am a full time hydrometeorology forecaster (HAS) forecaster
   ☐ I supervise a group of forecasters
   ☐ Other, Please specify: _____

2. Which statement best describes your formal educational training?
   Please check only one statement.

   ☐ Hydrologist
   ☐ Meteorologist
   ☐ Environmental Scientist/Engineer
   ☐ Agricultural engineer
   ☐ Civil Engineer
   ☐ Other, Please specify: _____

3. Please indicate the number of years you have been performing hydrologic forecasting duties.
   Please check one statement only.

   ☐ Less than one year
   ☐ 2 to 5 years
   ☐ 5 to 10 years
   ☐ More than 10 years

4. After you perform stream flow forecast, your stream flow forecasts are then:
   Please check all that apply.

   ☐ Delivered directly to WFOs
   ☐ Quality controlled at the RFC and then delivered directly to WFOs
   ☐ Used by other forecasters for downstream forecasting
   ☐ Published directly on the web
   ☐ Used to write flood warning statements by WFO personnel

Section II. Deterministic Streamflow forecasts

In this section we attempt to identify current forecasting practices and to gauge your opinion about the forecasting tools. Please answer all questions with respect to deterministic Streamflow forecasts only.

5. Do you perform hydrologic forecasting?
   Please check only one statement.

   ☐ Yes, go to question 6
   ☐ No. Thank you for participation. Please return the survey.

6. Please indicate the frequency with which you perform hydrologic forecasting.
   Please check only one statement.

   ☐ More than once a week
   ☐ About once a week
   ☐ About once a month

☐ Rarely (several times a year)

7. Do you perform forecasts for:
   Please check all that apply.

   ☐ Complete forecast groups
   ☐ Selected basins from different forecast groups
   ☐ Both complete forecast groups and selected basins from different forecast groups
   ☐ My forecast points change based on needs

8. When conducting realtime forecasting, do you perform modifications (MODS)?
   Please check only one statement.

   ☐ Yes, go to question 9
   ☐ No, go to question 14

9. Which types of MODS do you usually perform?
   Please check all that apply.

   ☐ MAP
   ☐ Q
   ☐ MAT
   ☐ UH
   ☐ Baseflow
   ☐ Soil Reservoir Capacities
   ☐ Initial model states (carry-over) of the hydrologic model used by your RFC
   ☐ SWE
   ☐ Snow model melt factor
   ☐ Others, Please specify _____

10. Whether you perform MODS or not, for each of the following types of modification, please indicate your likely action if observation and model output are not close enough. Please check only one choice for each Modification.

Modification	Most Likely	Will perform only if other MODS were not satisfactory	Never
MAP	☐	☐	☐
Q	☐	☐	☐
MAT	☐	☐	☐
UH	☐	☐	☐
Baseflow	☐	☐	☐
Soil Reservoir Capacities	☐	☐	☐
Model States (Carryover)	☐	☐	☐
SWE	☐	☐	☐
Snow Model Melt Factor	☐	☐	☐
Others (specified above)	☐	☐	☐

11. Please rank on scale from 1 to 3, the three most important factors affecting your decision to perform MODS. (Rank only three)

    ____ Recent model performance (Observed vs. Predicted)
    ____ Information from observers in the field
    ____ Long term model performance for the given basin/forecast point
    ____ Performance of past modifications during similar meteorological events
    ____ My personal knowledge and familiarity with the basin
    ____ My personal knowledge and familiarity with observation network
    ____ The magnitude of observations (possibility of flood)
    ____ Mass conservation (Water Balance)
    ____ Other (Please describe) _____

12. What do you think is an acceptable number of iterations for MODS when performing realtime forecast during flood hazard for an individual segment?
    Please check only one statement.

    ☐ 1-3 Iterations
    ☐ 4-6 Iterations
    ☐ More than 6 iterations

13. What do you think is an acceptable number of iterations for MODS when performing realtime forecast during non-hazard periods?
    Please check only one statement.

    ☐ 1-3 Iterations
    ☐ 4-6 Iterations
    ☐ More than 6 iterations

Section III. Uncertainty in Deterministic Forecasts

In this section, we would like to identify, based on your experience, the main sources of uncertainties and errors in deterministic forecasts.

14. Please rate, based on your experience, the importance of matching observations and predictions for each of the following hydrograph elements.
    For each hydrograph characteristic, check only one choice. If you select "Important' for a characteristic, please also note the conditions when it is important.

Hydrograph characteristic	**Important**	**Not Important**	**If you marked 'Important', Please note the conditions when it is important**
Baseflow	☐	☐	
Shape of rising limb	☐	☐	
Peakflow discharge	☐	☐	
Shape of recession limb	☐	☐	
Total volume	☐	☐	
Individual ordinates of hydrograph	☐	☐	
Low flow	☐	☐	
Time to peak	☐	☐	

15. Please rank, based on your experience, the degree each of the following may contribute to forecast error and uncertainties. As in operational cases, assume all models to have been pre-calibrated. Please check only one choice for each NWSRFS Element.

NWSRFS Element	Very Important	Moderately Important	Somehow Important	Not Important	Not sure
Hydrology model (SAC-SMA,API) parameters	☐	☐	☐	☐	☐
Hydrology model (e.g. SAC-SMA,API) structure	☐	☐	☐	☐	☐
Initial conditions (Carryover)	☐	☐	☐	☐	☐
Snow model (SNOW-17) parameters	☐	☐	☐	☐	☐
Snow model (SNOW-17) structure	☐	☐	☐	☐	☐
Unit Hydrograph	☐	☐	☐	☐	☐
Precipitation input (Observations)	☐	☐	☐	☐	☐
Precipitation input (Forecast)	☐	☐	☐	☐	☐
Temperature input (Observations)	☐	☐	☐	☐	☐
Temperature input (Forecasts)	☐	☐	☐	☐	☐
Upstream inflow (forecasts)	☐	☐	☐	☐	☐
Upstream inflow (observations)	☐	☐	☐	☐	☐
Reservoir release/level projections	☐	☐	☐	☐	☐
Rating curves	☐	☐	☐	☐	☐
Routing procedures	☐	☐	☐	☐	☐
Recent modifications/carry-over	☐	☐	☐	☐	☐
Freezing level	☐	☐	☐	☐	☐
SWE	☐	☐	☐	☐	☐

Section IV. General Verification

16. Many forecasters informally monitor the skills of forecasts they issue. This is meant to monitor their own skills and/or the skills of the forecast system and its ability to provide accurate and reliable forecasts for different conditions. Please check only the one statement that best describes the type of forecast skill monitoring activities you perform.

☐ I monitor forecast skills only for selected basins
☐ I monitor forecast skills for all forecast points I am responsible for
☐ I conduct random sampling of forecast skills
☐ In my RFC, monitoring forecast skill is performed by management and /or senior forecasters only
☐ In my RFC, there is anecdotal or event based monitoring of skill, but no systematic monitoring of skill
☐ In my RFC, there is no monitoring of forecast skill
☐ In my RFC, there is monitoring of forecast skill, but I am not a participant

17. In general, forecast verification involves calculation of several performance scores that provide information on the differences between forecast and observations. There are many possible measures that can provide some information about such differences and the list below includes some of these measures. Please indicate whether or not you are familiar with these terms.
Please check only one column for each Skill Measure.

Skill Measure	Used it	Very Familiar	Familiar	Not Familiar	Not Applicable to Duties
Root Mean Square Error	☐	☐	☐	☐	☐
Nash-Sutcliffe Index	☐	☐	☐	☐	☐
Visual inspection of hydrographs	☐	☐	☐	☐	☐
Scatter plots	☐	☐	☐	☐	☐
Correlation coefficient	☐	☐	☐	☐	☐
Critical Success Index	☐	☐	☐	☐	☐
Mean Absolute Error	☐	☐	☐	☐	☐
Gerrity Score	☐	☐	☐	☐	☐
Linear error in probability score	☐	☐	☐	☐	☐
Discrimination Diagram	☐	☐	☐	☐	☐
Probability of detection	☐	☐	☐	☐	☐
Brier Score	☐	☐	☐	☐	☐
Ranked Probability Score	☐	☐	☐	☐	☐
Forecast Resolution	☐	☐	☐	☐	☐
Forecast Reliability	☐	☐	☐	☐	☐
Forecast Sharpness	☐	☐	☐	☐	☐
Reliability Diagram	☐	☐	☐	☐	☐
Relative Operating Characteristic	☐	☐	☐	☐	☐
Correspondence Ratio	☐	☐	☐	☐	☐
False Alarm Ratio	☐	☐	☐	☐	☐
Ranked Histogram	☐	☐	☐	☐	☐
Visual inspection of probability distributions	☐	☐	☐	☐	☐

18. Forecast skill is typically expressed in terms relative to the next best alternative forecast. For the forecasts you make, please indicate what would you consider to be the next best alternative forecast. Please select only one.
    - ☐ Persistence
    - ☐ Long term mean of observations (climatology)
    - ☐ Trended persistence
    - ☐ A Raw Model (model without any forecaster interference)

Section V. Retrospective Analyses

In this section, a retrospective analysis study is defined as a study that aims to further understand and improve the performance of forecast system. This may include: (a) re-calibration of forecast models, (b) assessment of forecast skills at specific points, and (c) diagnostic assessments of system-wide. In the following series of question, we attempt to gauge forecaster's involvement as well as their assessment of the benefit and needed improvement of such studies.

19. Please check the type in-house of post event analysis studies *you* have performed or participated in performing.
    Please check all that apply.

    - ☐ Calibration for new forecast points/basins
    - ☐ Model re-calibration
    - ☐ Deterministic forecast verification (Forecast skill assessment)
    - ☐ Probabilistic forecast verification
    - ☐ Re-forecasts (Hindcasts) for assessing forecast skill
    - ☐ None, I personally have not done or participated in post event analysis studies
    - ☐ My office performs post event analysis studies

Section VI. Ensemble Streamflow Predictions

The NWSRFS includes several tools for generating ESP forecasts. As the NWS attempts to improve ESP generation and verification capabilities, we are trying to determine what tools may be useful to extend, and what type of verification statistics might be included in future verification tools.

20. Do you perform ESP forecasting?
    Please check only one statement.

    - ☐ Yes, please continue with the question 21
    - ☐ No . Thank you for your participation. Please return the survey.

21. Relative to the number of points for which you issue deterministic forecasts, what is the proportion of points for which you also issue probabilistic forecasts?
    Please write in the proportion.

    Proportion: _____

22. When generating ESP forecasts, do you:
    Please check only one statement.

    - ☐ Use ESPADP/ESPINIT Manager
    - ☐ ETSGEN Interface
    - ☐ Direct scripting (ens tools)

23. To create ESP Products, do you:
Please check only one statement.

☐ Use ESPADP graphical user interface
☐ ESPADP scripts (ens tools)

24. In general, when generating the Exceedance plots, do you use:
Please check only one statement.

☐ Empirical distribution
☐ Others from those available in ESPADP

25. Have you attended formal training on ESP tools in the NWSRFS?
Please check only one statement.

☐ Yes
☐ No

26. As mentioned above, NWSRFS includes several tools that improve the issuance and management of probabilistic forecasts, please indicate your level of familiarity with the following tools.
Please check only one column for each Tool.

TOOL	**Use it**	**Had training on using**	**Familiar with**	**Never Used**	**Not Applicable to Duties**
ENS_PRE	☐	☐	☐	☐	☐
ENS_POST	☐	☐	☐	☐	☐
ENS_PRE_CP	☐	☐	☐	☐	☐
ENS_POST_CP	☐	☐	☐	☐	☐
ETSGEN	☐	☐	☐	☐	☐
ESPVS	☐	☐	☐	☐	☐
TSTool	☐	☐	☐	☐	☐
ESPADP	☐	☐	☐	☐	☐

27. Originally, ESP was developed for long-term forecasts (30 days or longer). Please indicate your agreement/disagreement level with each of the following statements regarding the utility of ESP for shorter terms probabilistic forecasts.
Please check only one column for each Statement.

Statement	**Strongly Agree**	**Somehow agree**	**Somehow disagree**	**Strongly disagree**	**Not sure**
ESP forecasts are only useful for long term forecasts 1-3 month	☐	☐	☐	☐	☐
Short term ESPs (1-3 days) from the current system are appropriate for use	☐	☐	☐	☐	☐
Short term ESPs can be issued only if traces are weighed using other information	☐	☐	☐	☐	☐
Short term ESPs can only be issued if uncertainty in initial condition is included in the generation process	☐	☐	☐	☐	☐
Probabilistic forecasts will replace deterministic forecasts for both short and long term predictions	☐	☐	☐	☐	☐
Future implementations of ESP should incorporate other sources of uncertainty in addition to uncertainty in future precipitation and temperature	☐	☐	☐	☐	☐
Incorporating other sources of uncertainty in probabilistic forecasts will significantly complicate the operational procedure use to produce ESP	☐	☐	☐	☐	☐
Including other sources of uncertainty will adversely affect the users' ability to interpret ESP products	☐	☐	☐	☐	☐
Incorporating other sources of uncertainty will enhance the usage of ESP products	☐	☐	☐	☐	☐

Section VII. Verification of Probabilistic Forecasts

As mentioned in the introduction to this survey, the ultimate goal of this survey is to assist the NWS in determining the most appropriate means to allow forecasters to use various measures of the skill of probabilistic forecasts in realtime modeling. In the next series of questions, we attempt to identify, with the help of forecasters, a set of guidelines for such means.

28. A robust verification of probabilistic forecasts requires information about past forecasts. From your own perspective, please indicate the level of importance you would assign to each of the information listed below.
    Please check only one column for each NWSRFS Element.

NWSRFS Element	Very Important	Moderately Important	Somehow Important	Not Important	Not sure
Complete retrospective performance of ESP for all possible forecasts (Full Hindcast)	☐	☐	☐	☐	☐
Skill of forecasts for the current forecast window, from previous years.	☐	☐	☐	☐	☐
Skill of recent forecasts leading up to the current forecast window.	☐	☐	☐	☐	☐
Evaluation of forecasts for periods having similar climatic and hydrologic conditions	☐	☐	☐	☐	☐

Thank you for completing this Survey