The Atmospheric River Retrospective Forecasting Experiment

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Experiment Overview:

The Hydrometeorological Testbed (HMT) at the Hydrometeorological Prediction Center (HPC) will partner with the HMT at the Earth System Research Laboratory, Physical Sciences Division (ESRL/PSD) to conduct the Atmospheric River Retrospective Forecasting Experiment (ARRFE) in September, 2012.

The ARRFE aims to evaluate numerical model performance for West Coast Atmospheric River (AR)-induced heavy precipitation events by:

- Exploring the viability of probability of QPF (PQPF) guidance at various lead times
- Determining the predictability of QPF and PQPF using operational deterministic and ensemble guidance at various lead times
- Examining the utility of the experimental HMT-West ensemble system for QPF and PQPF at short to medium range lead times
- Analyzing the utility of reforecast datasets and techniques for PQPF at various lead times.
- Investigating the predictability of the timing and duration of AR-induced precipitation

Experiment Operations:

The HMT-HPC ARRFE study will be a two week-long retrospective analysis of 8 AR events (Table 1) that impacted the U.S. West Coast during the 2009-2012 cool seasons, focusing on three topics:

(1) AR timing (i.e., start and end times at specific locations)

(2) 72-h cumulative QPFs

(3) Day 7, 5 and 3 PQPFs.

IOP	Dates of Event	24 hr PQPF	72 hr QPF	Initialization #1	Initialization #2	Initialization #3	Initialization #4
1	13-14 Oct 2009	13-14	13-16	12Z 10/06	12Z 10/08	12Z 10/10	12Z 10/12
2	17-23 Jan 2010	19-20	17-20	12Z 01/12	12Z 01/14	12Z 01/16	NA
3	23-25 Oct 2010	25-26	23-26	12Z 10/18	12Z 10/20	12Z 10/22	NA
4	10-14 Dec 2010	12-13	10-13	12Z 12/05	12Z 12/07	12Z 12/09	NA
5	16-23 Dec 2010	19-20	17-20	12Z 12/12	12Z 12/14	12Z 12/16	NA
6	15-19 Jan 2011	16-17	16-19	12Z 1/09	12Z 1/11	12Z 1/13	12Z 1/15
7	18-26 Mar 2011	19-20	19-22	12Z 3/12	12Z 3/14	12Z 3/16	12Z 3/18
8	14-20 Jan 2012	21-22	19-22	12Z 1/14	12Z 1/16	12Z 1/18	NA

Table 1) *The eight preliminary intensive operation periods (IOP) to be examined. Columns 2 shows the date of the event, columns 3 and 4 show the periods that will be used in specific forecast tasks, and columns 5-8 shows the model initialization times that will be used for the forecasts.*

- The forecast team will verify their forecasts using Stage IV and Atmospheric River Observatory (ARO) observational data from specific sites
- A survey of questions will also be asked, in order to gain information on model biases and trends in QPF timing, amount and location
- The experimental setting will mirror the environment of an HPC forecaster; forecasts will be made in real time

Model	Resolution	Forecast
GFS	0.5 deg	216 h
ECMWF	0.5 deg	240 h
ECMWF Hi Res	0.25 deg	240 h
UKMET	75 km	144 h
NAM	12 km	84 h
GEFS	70 km	180 h
ECMWF-Ensemble	70 km	180 h
CMC-Ensemble	100 km	384 h
HMT-Ensemble	9 km	114 h
ESRL Reforecast	5 km	216 h

Table 2) *Numerical model guidance that will provided to forecasters, when available.*

Daily Schedule:

8:30-10:00 am – Create 24-h PQPFs for 7,5,and 3 day lead time
10:15-11:30 am – Create 72-hour QPF; answer survey questions.
11:30-12:30 pm – Lunch
12:30-1:45 pm – Create and verify precipitation duration forecast for specific location
2:00-3:00 pm – Verify 24-h PQPFs
3:15-4:15 pm – Verify 72-hour QPF
4:15-4:30 pm – Group discussion and/or exit questions

Task #1: *Create 24-h PQPFs (00Z to 00Z) for 7 day, 5 day, and 3 day lead times*

- Forecast team will be given various NWP guidance from 7, 5 and 3 days prior to the event, in order to create PQPF for >2 inches using greater than 10%, 30% and 50% thresholds (refer to Figure 1)
- Subjective verification will focus on how well the probability forecast areas are collocated with the observed 24-hr precipitation amounts from Stage IV data, as well as how models perform at various lead times

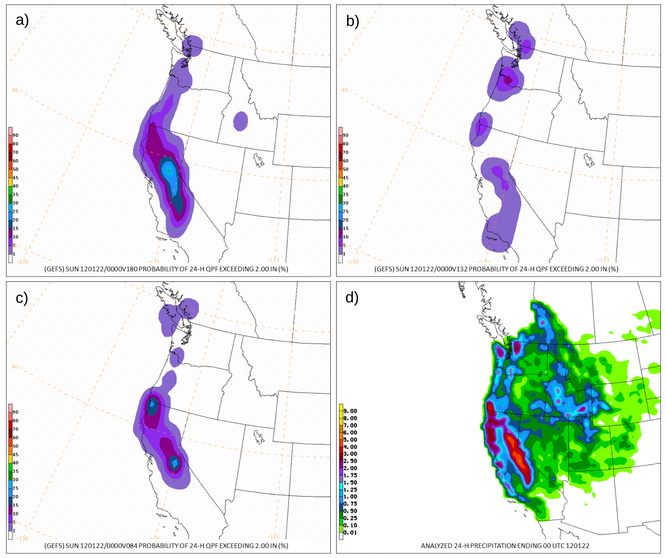


Figure 1) *The 12Z GEFS forecast probability of 24 h precipitation accumulation exceeding 2 inches ,valid 00Z January 22, 2012 (encompassing 24 h period from 00Z January 21 to 00Z January 22), at (a) 7 day, (b) 5 day and (c) 3 day lead-times. The 24 h Stage IV observed precipitation, valid 00Z January 22 , is shown in (d).*

Task #2: *Create a 72-hour QPF for the domain of interest*

- Forecast team will be given various NWP guidance, including the HMT-Ensemble, to forecast 72 h total precipitation (refer to Figure 2) by drawing isohyets for 4", 8", 12", >16"
- Subjective verification will focus on how well the forecast identified the location and amounts of the heaviest precipitation, as well as trends/biases from individual models

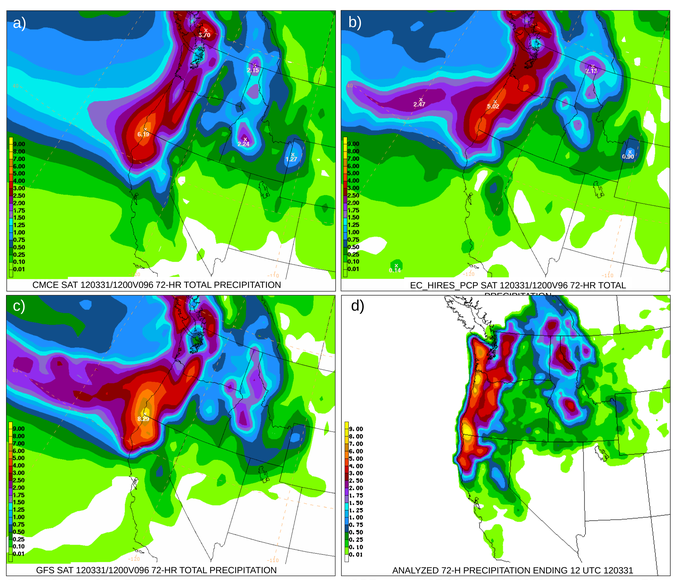


Figure 2) *The 96h, 72h quantitative precipitation forecast (QPF) ,valid 12Z March 31, 2012 (encompassing 72 h period from 12Z March 28 to 12Z March 31), at for the CMCE (a), ECMWF Hi Res (b) and GFS (c). The 72 h Stage IV observed precipitation, valid 12Z March 31 , is shown in (d).*

Task #3: *Predict precipitation duration at a specific location*

- Forecast team will be given various NWP guidance to determine precipitation onset and ending time at a specified inland location, using 6-hour windows (00-06Z, 06-12Z, 12-18Z, and 18-24Z)
- Verification will compare forecasted start/stop times of each event to times seen in available observations (including ARO data, when available)
- Forecasters will have the opportunity to be trained on the ARO product and its usefulness in short-term AR forecasting

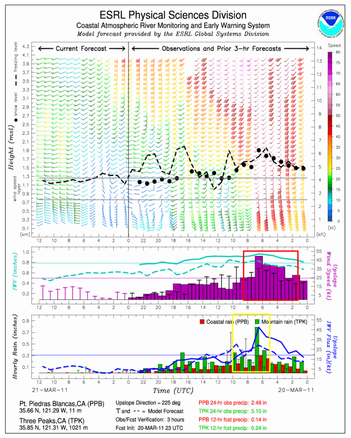


Figure 3) *An example of the ESRL ARO product from March 20-21, 2012. Red box denotes time period when AR conditions were met, and yellow box denotes time period of heaviest rainfall at the corresponding inland location (TPK).*

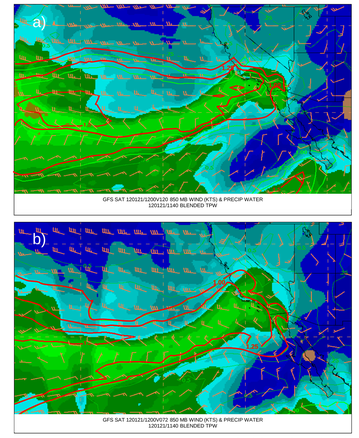
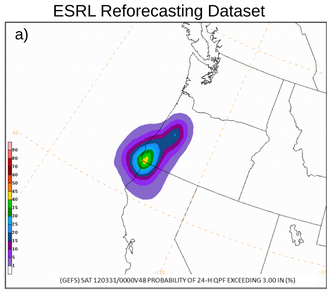


Figure 4) *The GFS 1200 UTC 120 h (a) and 72 h (b) forecasts of precipitable water (red), valid 12Z January 21, 2012, overlaid with the GOES Blended Total Precipitable Water (TPW) image from 1140Z January 21, 2012 .*

Experimental Guidance:

ESRL Reforecasting Dataset



Standardized Anomalies

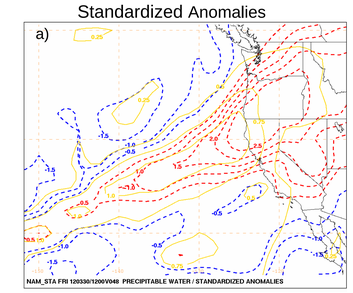


Figure 5) *The 00Z 48 h forecast probability of 24 h precipitation accumulation exceeding 3 inches, valid 00Z March 31, 2012 (encompassing 24 h period from 00Z March 30 to 00Z March 31), from the GEFS (a) and GEFS Analog reforecasting dataset (b).*

Figure 6) *The (a) NAM and (b) GFS 1200 UTC 48 h forecast of precipitable water (yellow) and associated standardized anomalies (red/blue), valid 12Z March 30, 2012.*

Expected Outcomes:

- Educate HPC forecasters on experimental datasets and tools
- Identify forecasting issues and difficulties associated with predicting West Coast heavy precipitation (e.g. model trends and biases in precipitation amounts, timing, and location)
- Provide useful feedback to PSD researchers on experimental tools and datasets
- Enhance collaboration between HPC and PSD