Supplemental Description of Experimental Product Probabilistic Precipitation Forecasts

Product Information

Experimental guidance derived from the National Centers for Environmental Prediction (NCEP) Short-Range Ensemble Forecast (SREF) system is being automatically produced to help increase awareness of potential heavy precipitation events. This guidance is distributed in the Keyhole Markup Language (KML) format. To view these data, software such as Google Earth, NASA World Wind, or ArcGIS Explorer is required.

The guidance displays a threat level indicating the potential for heavy precipitation at locations in the western United States based on calibrated SREF Probabilistic Quantitative Precipitation Forecasts (PQPF) by an Artificial Neural Network (ANN). The ANN calibrated PQPFs are presented in the form of probability of exceedance (POE) forecasts. The probabilities to exceed .01, .25, .50, and 1.0 inch are provided for each 3 hour period for the 87 hours of the forecast cycle. Experimental probability thresholds are used to color code 4 threat categories of None, Low, Moderate, and High. These threat categories represent the potential for heavy precipitation at any time in the forecast period. This format is intended to provide the user with a quick look at the potential threat for heavy precipitation during the next 87 hours at over 4,000 locations. These locations are spaced every ¼ of a degree latitude and ½ of a degree longitude. POE values at these latitude and longitude points are from the nearest SREF 40km grid cell. Figure 1 shows the KML product in Google Earth.

The guidance allows the user to examine the POE forecasts from the uncalibrated (or raw) SREF, ANN calibrated SREF, and the SREF mean QPF fitted to an exponential distribution. This forecast information is presented in the form of a table as shown in figure 2. A description of the labeling in the table is as follows:

Model Cycle -YYYYMMDD_HHMM
For example: 20100830_2100 => 21Z SREF solution on August 30, 2010
DAY - Is the numeric day of the month that starts at 2400(0000) UTC
UTC – Is the valid time of the POE forecast in intervals of 3 hours
ANN QPF- Is the POE values from the Artificial Neural Network (ANN)
SREF QPF – Is the POE values from the NCEP's SREF
EXPO QPF – Is the NCEP's SREF mean QPF fitted to an exponential distribution.

Technical Information

The method used to produce calibrated PQPF from the SREF utilizes an ANN technique. A separate ANN is developed for each of the 4 SREF model cycles (03Z, 09Z, 15Z, and 21Z), and for both cool (October 1st to March 31st) and warm (April 1st to September 30th) seasons. Observed precipitation from the Real-Time Mesoscale Analysis (RTMA) and fields from the SREF are used to train the ANN. The main fields from the SREF are the

QPF and CAPE POEs and the ensemble mean precipitable water. The ANN is trained with 2 seasons of SREF and RTMA data. Output from the ANN is gridded on the same SREF 40km AWIPS Grid212 using input from the SREF at each grid point. Figures 3 and 4 show the ANN and raw SREF POE grids for hurricane Alex, respectively. These figures illustrate how the ANN was able to generate probabilities for the higher POEs of .50 and 1.0 inch, especially in the northeast quadrant of the hurricane where raw SREF values were very low or zero.

It is important to understand that POE values presented as latitude and longitude points in the KML product represent grid-box averages. This understanding is central to interpreting the POE forecasts from the ANN as well as the SREF properly. For example, the probability of precipitation exceeding one inch in a 3 hour period and averaged over a 40km grid-box at Yuma, Arizona would be near zero for any time of year. Therefore, a PQPF of 2 percent for the exceedance of one inch at a grid point in southwest Arizona is noteworthy.

The following experimental rules for the western United States are used to determine the threat levels based on the output from the ANN. Ideally, these rules should be derived from observed frequencies using some type of gridded precipitation analysis climatology. Future enhancements of this guidance will use and display monthly 3 hourly precipitation frequencies for each POE using the NCEP North American Regional Reanalysis (NARR).

Threat Level	**Criteria**
None	QPF > 0.25 is less than 30% in any time period
Low	QPF > 0.25 is greater than 30% in 2 to 3 time periods or QPF > 0.50 is greater than 15% in any time period.
Moderate	QPF > 0.25 is greater than 30% in 4 to 6 time periods or QPF > 0.50 is greater than 15% in 2 to 4 time periods or QPF > 1.0 is greater than 5% in 1 to 2 time periods
High	QPF > 0.25 is greater than 30% in more than 6 time periods or QPF > 0.50 is greater than 15% in more than 4 time periods or QPF > 1.0 is greater than 5% in 3 or more time periods
No Precip	QPF > 0.01 is less than 10% in any time period

Similar ANN calibration techniques have been developed and applied to both medium and short range NWP ensembles in a research environment. The development of this guidance is an initial step toward implementing an ANN method in an operational setting. For details on a similar technique used in a research environment, see:
http://ams.confex.com/ams/pdfpapers/85291.pdf
A full description of the exponential distribution fitting technique and its operational use at the Tulsa WFO can be found at:
http://ams.confex.com/ams/Annual2006/techprogram/paper_100354.htm

For more information on the NCEP's SREF, please refer to their website:
http://www.emc.ncep.noaa.gov/mmb/SREF/SREF.html

Figures

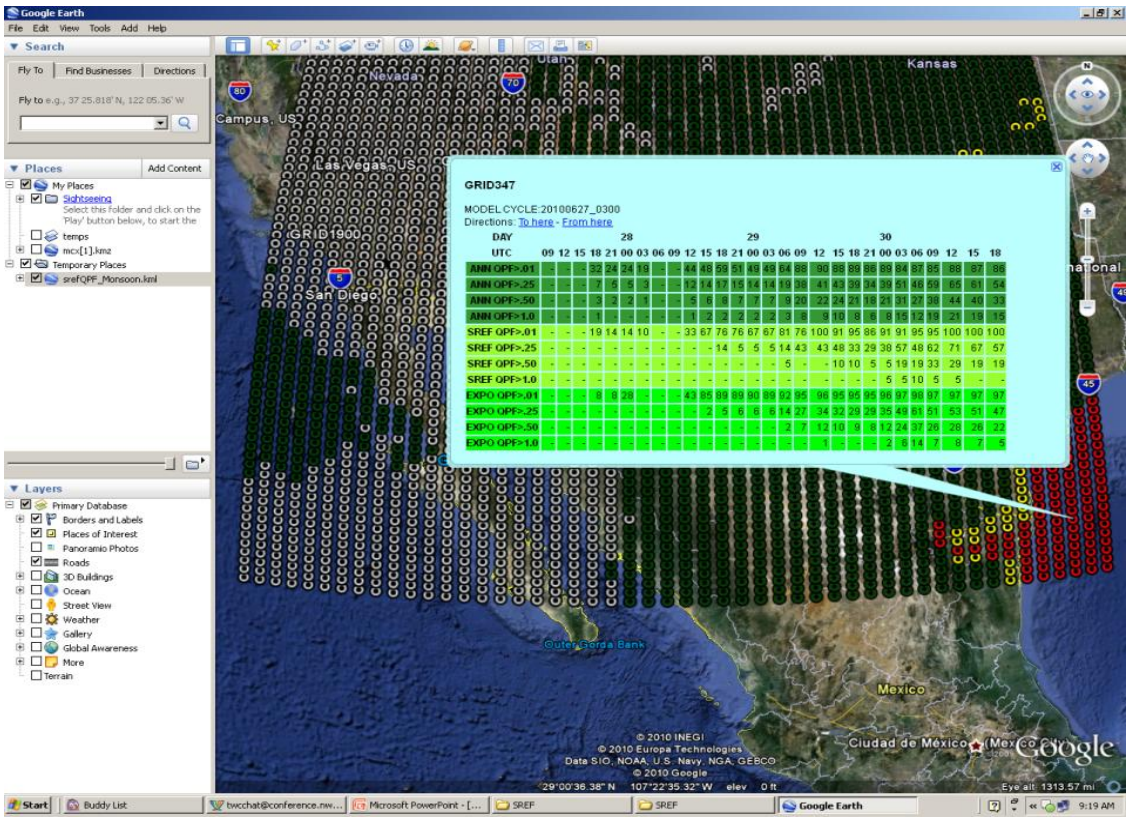

Figure 1. Screen shot of the KML guidance displayed in Google Earth

LatLonPt260

MODEL CYCLE: 20100901_1500
ANN - Artificial Neural Network
SREF- SREF Relative Frequency
EXPO- SREF mean fitted CDF
See Product Description for more details
Directions: To here - From here

DAY	02									03									04									05			
UTC	21	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21	00	03	06		
ANN OPF>.01	45	89	48	30	6	-	-	-	34	47	45	-	-	-	-	-	17	43	11	6	-	-	-	7	39	46	30	6		
ANN OPF>.25	12	38	13	7	1	-	-	-	8	13	12	-	-	-	-	-	2	11	1	1	-	-	-	1	10	12	7	1		
ANN OPF>.50	5	16	6	3	-	-	-	-	3	5	5	-	-	-	-	-	1	5	1	-	-	-	-	-	4	5	3	-		
ANN OPF>1.0	1	4	1	1	-	-	-	-	1	1	1	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	1	-		
SREF OPF>.01	62	86	71	29	5	-	-	-	33	81	62	-	-	-	-	-	38	48	29	5	-	-	-	14	38	71	29	5		
SREF OPF>.25	-	38	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
SREF OPF>.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
SREF OPF>1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
EXPO OPF>.01	82	94	85	28	-	-	-	-	28	90	84	-	-	-	-	-	65	79	60	8	-	-	-	8	73	84	53	-		
EXPO OPF>.25	-	21	2	-	-	-	-	-	-	8	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-		
EXPO OPF>.50	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
EXPO OPF>1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

Figure 2. Enlarged KML guidance table

ANN Calibrated SREF PQPF
Hurricane ALEX
SREF June 27th 03Z cycle: Fcst Valid June 29th 06Z

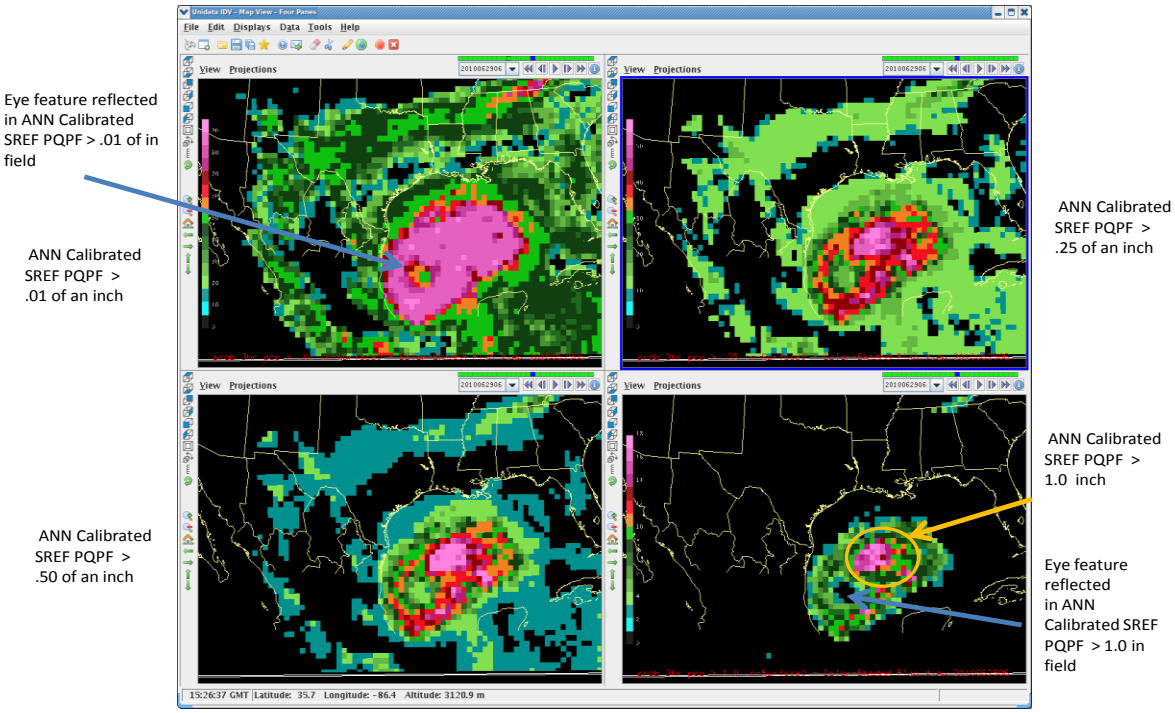

Figure 3. Example of ANN gridded output

RAW SREF PQPF
Hurricane ALEX
SREF June 27th 03Z cycle: Fcst Valid June 29th 06Z

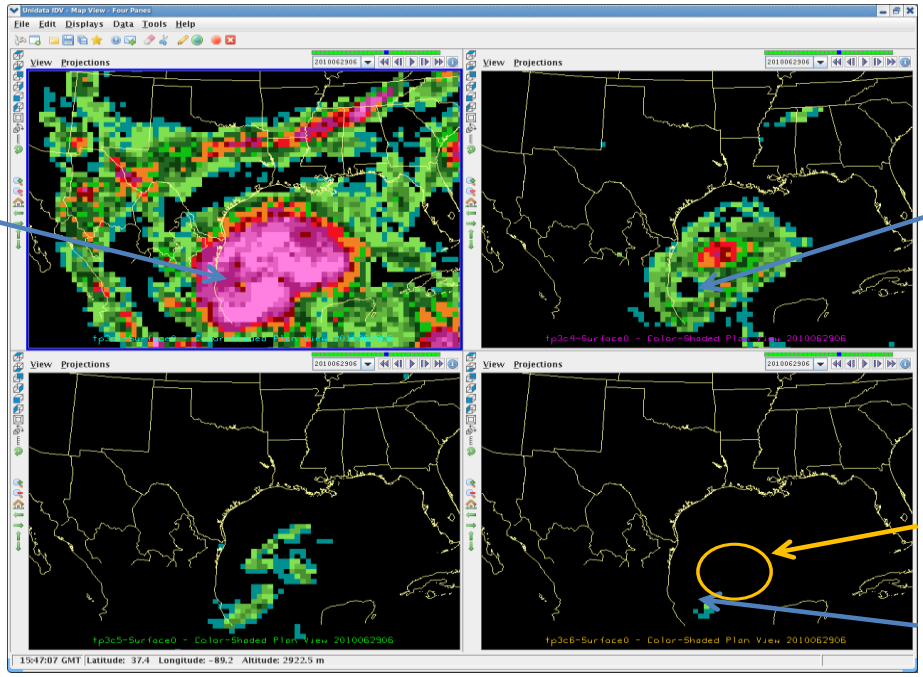

Figure 4. Example of SREF gridded output