GOES Hail Probability Product

1. Background

The GOES Hail Probability Product combines information from GOES with near storm environment data to provide a 0-3 hour forecast for severe hail across the eastern 2/3 of the Continental U.S. This product is meant to assist SPC forecasters with their hail probability forecasts as part of their Day 1 Convective Outlooks, in addition to Mesoscale Discussions and Watches. A supplement to the product provides the probability of hail greater than or equal to 2" in diameter in order to assist with Significant Hail (SigHail) probability forecasts.

2. Product Details

A new addition to the 2011 version of the GOES Hail Probability Product is the CIMSS/Bedka Overshooting Top Detection (OTT) algorithm, which is used as one of the predictors. This data was available for the 2010 severe weather season but not before, so only 1 season (April-August) was available for the statistical developmental database. In order to build the model, GOES 10.7 µm data, Rapid Update Cycle model (RUC) 0-, 1-, 2-, and 3-hour forecasts and OTT data were collected and placed on a 0.5°x0.5° latitude/longitude grid. Observed severe hail (>= 1" diameter) reports from the SPC were also obtained. Since this product produces a 0-3-hour forecast, each of the RUC forecast fields are searched to find the most unstable value at each grid point. For example, at a given grid point, the Mean Layer Lifted Index (MLLI) having the lowest (most negative) value out of the 0-, 1-, 2- and 3-hour forecasts was placed at that grid point for that time. After all the data was collected, a screen was applied to filter out regions that either aren't able to support convection or are very unlikely to support large hail. The thresholds are:

a) Surface dewpoint > 4 °C (>= 7 °C for SigHail)

b) Mean Layer Lifted Index <= 0.0 °C (<=2.0 °C for SigHail)

c) Mean Layer CAPE >= 100.0 J kg^{-1} (>= 800 J kg^{-1} for SigHail)

d) Mean Layer CIN >= -150 J kg^{-1} (>= -120 J kg^{-1} for SigHail)

Next, the remaining data was sent to a Logistic Regression routine that fits a set of predictors to provide the best probability of having a large hail report at each grid point. The nonlinear equation is

$$p = \frac{1}{1+\exp(-b_0 - b_1x_1 - b_2x_2 - b_3x_3 - b_4x_4 - b_5x_5 - b_6x - b_7x_7 - b_8x_8)},$$

where p is the predicted probability, x_n are the predictors, and b_n are the coefficients that determine the best fit. Below is a description of each predictor.

- x_1: 1 if the coldest 10.7 µm pixel within a grid box is < -30 °C, 0 if it's >= -30 °C

- x_2: 1 if the coldest 10.7 µm pixel within a grid box is < -50 °C, 0 if it's >= -50 °C

- x_3: 1 if an Overshooting Top is detected within the last hour, 0 if not

- x_4: Climatological hail probability at each grid point for that month and hour

- x_5: Surface dewpoint

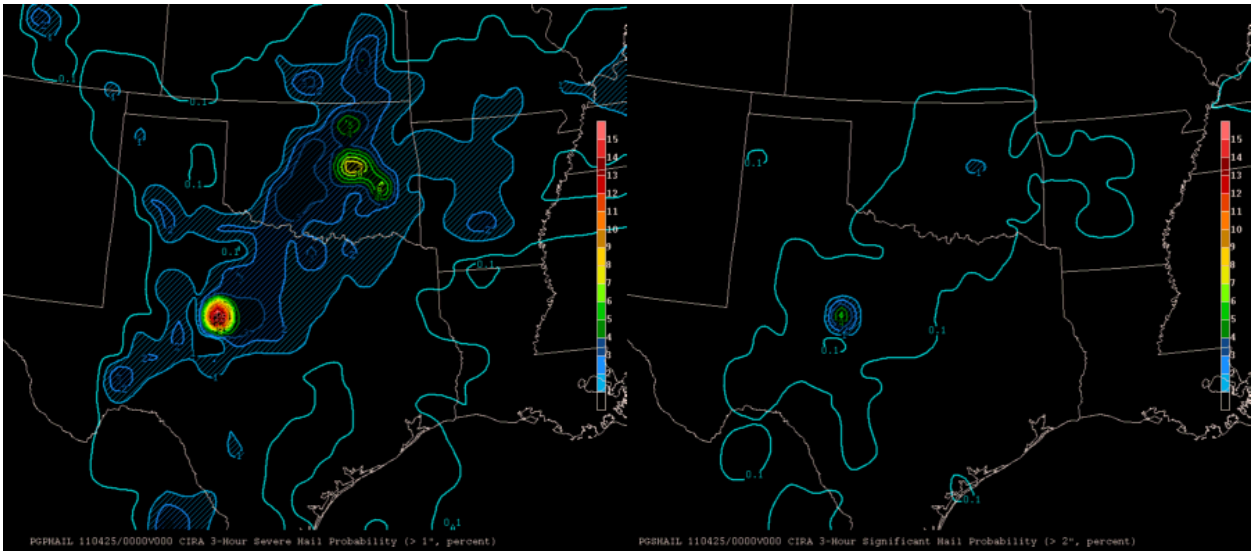
- x_6: 0-6 km shear magnitude

- x_7: Mean Layer Lifted Index

- x_8: Height above ground level of the 0 °C isotherm

The logistic regression routine provided values for each of the b_n coefficients (and the coefficients are different for SigHail, of course). For the real-time forecasts, we also obtain the SPC Surface Mesoanalysis data (SurfaceOA) and use that along with the RUC forecasts in case the SurfaceOA better captures something in the short term. The forecast is updated with every new GOES scan.

The Figure below shows how the GOES Hail Probability Product appears in NAWIPS. The left panel is the probability of >= 1" diameter hail, the right is the probability of >= 2" diameter hail. Probability forecasts are in units of percent chance of hail within ~25 km of a point within the next 3 hours. These forecasts can also be overlaid on a satellite or radar image.



Probability (%) of hail >= 1" in diameter (left) and >= 2" in diameter (right) within ~25 km of a point between 00 and 03 UTC on 25 April 2011.

2. How to load in NMAP2

1. Open new data source under: **GRID/pgphail** (>1”) or **GRID/pgshail** (>2”)
2. Select desired forecast initial time and load