HPC Day 4-7 Medium Range 5-Km Grid Methodology

Several steps are taken to obtain a 5-kilometer (km) forecast for Maximum Temperature, Minimum Temperature, 12-hour Probability of Precipitation (PoP), 12-hour Winds and 12-Hour Dew Point Temperatures based off of the HPC medium range point forecasts.

Maximum/Minimum Temperature – HPC medium range forecasters create Maximum Temperature and Minimum Temperature forecasts for days 4-7 at approximately 380 points. To create more detailed 5-km forecast grids from these points, PRISM data obtained from the Spatial Climate Analysis Service, Oregon State University, http://www.ocs.oregonstate.edu/prism/ is mapped to a 5-km grid and applied to the forecasts. The PRISM grids are 30-year monthly climatologies for Maximum Temperature and Minimum Temperature from 1971 to 2000. The ~380 HPC points are taken from the PRISM grid and the difference between the HPC points and the PRISM ~380 points is taken to get HPC-PRISM increment at each point. An objective analysis on the HPC-PRISM increments is performed to get 5-km increment grids. These HPC-PRISM increment grids are added to the appropriate PRISM grids to get a detailed 5-km HPC forecast grid. Over offshore waters, values from the National Digital Forecast Database (NDFD) are used to obtain the Maximum and Minimum Temperatures. On Day 7 which is not included in the NDFD until the 1800Z update, the NDFD Day 6 Forecast is substituted for day 7. For the waters beyond the NDFD area, Sea Surface Temperature is used to obtain the Maximum and Minimum Temperatures over the offshore waters. A climatology of SST-Air Temperature obtained from moored buoys and C-MAN stations for the Atlantic Ocean, Pacific Ocean and the Great Lakes is applied to the sea surface temperature to obtain the Maximum and Minimum Temperature.

12-Hour Probability of Precipitation – Initial background grids for 12-hour PoPs are created from the GFSXMOS with approximately 1500 points. A difference between the HPC PoP forecast at ~380 stations and the GFSXMOS PoP forecast is performed to obtain an HPC-MOS increment at each point. An objective analysis is then performed for each forecast time to obtain 5-km increment grids that are added to the GFSXMOS grids. The results are 5-km HPC forecast grids for 12-hour PoP. No PRISM data is available for PoP, so the grids are left as they are.

Dew Point Temperature – HPC Dew Point Temperature point forecasts are created using the ensemble MOS and GFSXMOS guidance. At each forecast point, the ensemble MOS members and GFSXMOS are compared to the HPC forecast. First, the HPC Minimum Temperature (for 12z) or Maximum Temperature (for 00z) forecasts are compared to the GFSXMOS guidance. If the HPC forecast is the same as the GFSXMOS forecast, the HPC dew point forecast at that point is equal to the GFSXMOS dew point forecast. If the HPC temperature forecast differs from the GFSXMOS, the HPC Probability of Precipitation (PoP) forecast is compared with each member of the ensemble MOS and the GFSXMOS to find the closest match. The Relative Humidity (RH) is computed for the closest matching ensemble MOS member from that member's dew point and temperature forecast. The resulting RH is than used to compute the HPC

dew point forecast. In cases where multiple MOS members are equally as close to the HPC's forecast, the average of those members' RH is used to compute HPC's dew point forecast. A check is than performed on the dew point to make sure it does not exceed the Maximum Temperature at 00z or Minimum Temperature at 12z. If the dew point does exceed those temperature forecasts the dew point is reduced to the Maximum Temperature or Minimum Temperature. A simple linear interpolation between the times is performed to get 6-hour intervals.

To create 5-km HPC dew point forecast grids, initial background 5-km dew point grids are created from the ~1500 points in the GFSXMOS for days 4-7. The difference between the ~380 point HPC dew point forecasts and the GFSXMOS forecasts is taken to create HPC-MOS increments at each point. An objective analysis is performed at each time to create 5-km HPC-MOS increment grids which are the added to the GFSXMOS 5-km grids to obtain first guess HPC dew point 5-km grids. Dew point PRISM grids are than applied to the HPC 5-km first guess grids using the same process as described for the maximum/minimum temperatures to obtain more detailed HPC dew point 5-km grids.

The offshore dew point temperatures are obtained by applying the NDFD forecast values for days 4-6 and the day 6 NDFD values for day 7 similar to Max/Min T. For the offshore waters beyond the NDFD area, a climatology of SST-Dew Point Temperature to the sea surface temperatures. The climatology of SST-Air Temperature was obtained from moored buoys and C-MAN stations for the Atlantic Ocean, Pacific Ocean and the Great Lakes.

Wind Speed and Direction – HPC wind speed and direction forecasts are created by taking the day 4-7 HPC medium range pressure/fronts forecasts and calculating the geostrophic wind from the pressure field. Interpolation is performed between the pressure forecast times to obtain the winds at 6-hour time increments. To ensure a realistic wind speed forecasts, the GFSXMOS 12-hr maximum sustained winds are used to cap the wind speed forecast at each HPC forecast point. If the HPC wind speed forecast exceeds the GFSXMOS 12-hr maximum sustained wind speed, the HPC wind speed is lowered to that speed.

The wind speed and direction are further adjusted to better reflect frictional forces on the geostrophic wind. A consistent high bias was found in the wind speed forecast so a 10% reduction in the HPC wind speed is applied. The wind is also backed by 40 degrees to better represent a wind direction forecast over land. A bias correction of 2.5 knots is applied to any wind greater than 5 knots to correct an observed wind speed bias at the 00Z, 06Z, and 12Z. An objective analysis is then performed on the HPC forecast points to create wind speed 5-km grids and wind direction 5-km grids. Once the wind forecast is on the grid, the winds are adjusted back towards geostrophy over water based on stability. The stability is determined by the differences between the sea surface temperature and the HPC forecast. If the difference is positive, the winds are adjusted closer to geostrophy and for a difference greater that 25 degrees F, the wind will become supergeostrophic.

Cloud Cover – HPC cloud cover forecast are created using the HPC 12-hour PoP and Maximum Temperature. At each forecast point, that day's maximum temperature and the 12-hour PoP is used to give a cloud cover percentage based on the cloud cover categories: clear (0%), few (25%), scattered (40%), partly cloudy (60%), broken (75%),

mostly cloudy (90%), and overcast (100%). The following table depicts the maximum temperature and the 12-hour PoPs range that determines the cloud cover percentage at each point.

Cloud Cover	Max T >=95°F	80°F <= Max T < 95°F	Max T < 80°F
0%	PoP<=10	PoP <= 5	----------
25%	PoP 11-15	PoP 6-15	PoP <= 10
40%	PoP 16-25	PoP 16-20	PoP 11-20
60%	PoP 26-35	PoP 21-30	PoP 21-30
75%	PoP 36-45	PoP 31-40	PoP 31-40
90%	PoP 46-54	PoP 41-54	PoP 41-54
100%	PoP >= 55	PoP >= 55	PoP >= 55

After a cloud cover is assigned to each forecast point, the percentage is than adjusted using the average cloud cover in the GFSXMOS. The GFSXMOS has 3 categories of cloud cover that represents a percentage cloud cover range: Mostly Clear (0-31%), Partly Cloudy (32-68%), and Mostly Cloudy (69-100%). If the assigned percentage matches the GFSXMOS cloud cover range, the cloud cover is left unchanged. If the assigned cloud cover is lower than the GFSXMOS cloud cover range, then the cloud cover is reduced 5-15%. If the assigned cloud cover is greater than the GFSXMOS cloud cover range, than the cloud cover is increased 5-15%. Linear interpolation between the 12-hour times is performed to get 6-hour intervals.

Weather Type – Weather type is created using the HPC Maximum or Minimum Temperature. The Max T (at 00z) or Min T (at 12z) is used to determine the precipitation type. Weather type will be defaulted to rain everywhere on the grid except for the following conditions. If the temperature is less than 40°F, the precipitation type is snow. If the temperature is less than 33°F and the 1000-500mb thickness is greater than 543dm, the precipitation type is freezing rain. To determine possible convection, the GFSXMOS 12-hour probability of thunderstorms is used to determine the coverage of convection using a threshold of 30%.