WEATHERGEEK'S GUIDE TO NUMERICAL MODELS V 2.3

GETTING THE MOST OUT OF YOUR WEATHERGEEK PRO APP

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INTRODUCTION

We don't mean to geek out on you, but if you are using WeatherGeek Pro, we thought it would be helpful if we explained a bit about the datasets it accesses. So read on as we try to unleash a bit of your inner WeatherGeek!

NUMERICAL WEATHER PREDICTION

Numerical Weather Prediction is a method of weather forecasting using current weather conditions (taken from various sources including weather balloons, satellites, aircraft and surface weather stations) which are entered into computer program to obtain future weather conditions at various levels and points in the atmosphere. These computer programs use mathematical models of the atmosphere which are created using the complicated equations which estimate the physical dynamics of the atmosphere. Because the atmosphere is so complex, the numerical models must process huge amounts of data and execute a large number of difficult calculations in order to produce forecasts with enough resolution and timeliness to make them useful. Not even the smartest human WeatherGeek is capable of such feats! This requires numerical models to use some of the most powerful supercomputers in the world to process these vast datasets and crunch the complex equations needed. So you can kind of say numerical weather models are the ultimate WeatherGeek!

WEATHER GEEK MODELS

WeatherGeek Pro provides interfaces to many different numerical models including the GFS, NAM, WRF, SREF, RAP and HRRR as well as MOS output. We plan to offer interfaces to even more models and imagery in the near future.

TYPES OF NUMERICAL MODELS

Numerical models fall into one of two categories. The model is either global, meaning it covers weather conditions for the entire Earth, or regional, meaning it covers weather conditions for a specific part of the Earth.

Global Models

The advantage of a global model is it tends to have a better handle on weather patterns across the entire Earth. This not only allows them to forecast for anyplace on the globe, but also allows them to be more useful in producing forecasts further out in time with less error. Because global models cover such a vast area, their resolution is typically limited in comparison to regional models.

Regional Models

On the other hand, regional models, while only covering weather conditions for a limited area, typically do so in a much higher resolution and finer detail. While this can make them more accurate and precise in forecasting shorter-term weather conditions, it also opens them up to larger errors in medium range predictions.

Ensemble Models

The atmosphere is incredibly complex. Because of this, even the smartest WeatherGeek can frequently face difficulties in trying to predict what it will do. Also, the complex series of equations which help us to predict what future weather is coming our way are what we call “nonlinear” equations. Put simply, nonlinear equations are equations which are impossible to solve exactly. Couple this with the fact our network of weather observations have extremely limited resolution (especially over oceans), numerical weather models only provide *approximate solutions* of the future state of the atmosphere. To account for some of this uncertainty (in particular the uncertainty to the initial state of the atmosphere), Ensemble Forecasts have become increasingly popular and are often referred to as the “future of numerical modeling”. An Ensemble Forecast is a forecast taken from multiple numerical models using slightly different initial conditions. The resulting data output is typically the “mean” of all the ensemble members. The ensemble “spread” is also considered, which represents the degree of agreement among the various models being used in the ensemble forecast. With the advent of faster and faster supercomputers, ensemble forecasting is now more practical than ever and can give us a good indication of the certainty or uncertainty of any forecast. In many cases ensemble forecasts can also help to “smooth” errors more common in traditional forms of numerical modeling. Even though this is the case, ensemble models can also have a tendency of missing extreme events since many of the extremes are smoothed out in the ensemble process.

MODELS FOR THE WEATHERGEEK

WeatherGeek Pro provides an interface to view output of various numerical models on your mobile device. For WeatherGeek Version 2.x, we have expanded our global model interface to access model data from around the world. Most of the models provided are developed and maintained by the National Centers for Environmental Prediction (NCEP), which is a division of the US Department of

Commerce's NOAA (National Oceanic and Atmospheric Administration). The images in WeatherGeek Pro are derived from the gridded (or raw) numerical output of each model.

Global Models

GFS – GLOBAL FORECAST SYSTEM

It doesn't take a WeatherGeek to realize by the name alone that the GFS Model or "Global Forecast System" is NCEP's global model. This model is run four times per day (00Z, 06Z, 12Z, 18Z) and produces forecasts out to 16 days in advance. The seven day forecasts by the GFS are run at a higher horizontal resolution than those of days 8-16 (35 kilometer grid squares vs. 70 kilometer grid squares). The GFS model also splits the atmosphere vertically into 64 layers in the vertical.

GFS Products on WeatherGeek Pro

Surface Products

If you're a true WeatherGeek and follow closely weather reports on TV, you may see meteorologists show depictions of the following surface weather maps now and into the future (the ones with the highs, lows, precipitation, and sometimes even isobars). In fact, the following products are some of the most-used in TV weather reports.

10m-Wnd 06hr Pcpn – This product shows sea level pressure (and associated highs and lows) ,winds at 10 meters above the surface as well as 2 meter temperatures (near surface) in Celsius and 6 hour total precipitation. This product is useful in depicting future surface weather systems out to 7 days, along with areas of precipitation, winds, and near-surface temperatures.

850mb Temp, MSLP, 6hr Pcpn - This product also shows sea level pressure and 6 hour precipitation, but instead of near-surface temperatures, it shows temperatures at the 850 millibar (mb) pressure level instead (in Celsius). The 0 degree 850 mb temperature line can sometimes be used as a crude rain/snow line. As a result, this particular product is useful in showing the movement of surface weather systems, resulting precipitation and even precipitation type estimates.

Tot Pcpn 03, 06, 12, 24, 36, 48, 60 hrs and Tot Pcpn of Period: These products show precipitation estimates for the periods and times indicated.

Upper Air Products

Real WeatherGeeks know the weather just doesn't happen on the ground where we live, but takes place in three dimensions. That's why it's so important to not only know what's going on at the surface, but also aloft. The following products available on WeatherGeek Pro really allow you to dive into the complexities of the air above our heads and thus improve your forecasts. Instead of measuring the height above ground in actual distance, meteorologists measure the height above the ground by using various pressure surfaces measured in millibars. The higher the pressure, the lower the surface. The lower the pressure, the higher the surface. From the ground up, we would measure pressure surfaces of 1000, 850, 700, 500 (about halfway up through the troposphere), 300, 250 and 200 millibars (the highest point). The actual distance from the ground of each pressure surface is measured in meters and plotted on maps. This is known as a "height". Knowing the heights of various pressure surfaces can tell us WeatherGeeks a lot about what the atmosphere is doing.

MSLP 1000 - 500mb – Again, this product shows surface weather systems and six hour total precipitation, but adds the important field of 1000-500 millibar thickness. This field is useful for helping to roughly determine precipitation type. For a rough approximation of the rain/snow line, look for the blue dashed line marked “540.” This is the line which represents a thickness (or distance) of 5400 meters in-between the 1000mb to 500mb pressure surface. The lower the thickness or distance between pressure surfaces, the colder and denser the atmosphere is. Thus, we can approximate the atmosphere would produce frozen precipitation or even snow when the distance between the 1000mb and 500mb pressure surfaces is 5400 meters or less thickness in determining the approximate rain/snow line. Looked for the dashed blue line labeled “132” which is 1320 meters.

MSLP 850 - 700mb- This map shows six hour total precipitation and 850-700 mb thickness, yet another useful thickness in determining the approximate rain/snow line. Looked for the dashed blue line labeled “152” which is 1520 meters.

200mb Wind, Ht- This map represents the highest pressure surface. The solid lines represent the height of the 200mb pressure surface in meters. Winds are both plotted with wind barbs and the highest wind speeds are shaded. This map is a good approximation of jet stream winds and is excellent for showing areas of diffluence and rising air motions.

250mb Wind, Ht- This map represents one of the highest pressure surfaces. The solid lines represent the height of the 250mb pressure surface in meters. Winds are both plotted with wind barbs and the highest wind speeds are shaded. This map is also a good approximation of jet stream winds and is excellent for showing areas of diffluence and rising air motions.

300mb Wind, Ht- This map also represents one of the highest pressure surfaces. The solid lines represent the height of the 300mb pressure surface in meters. Winds are both plotted with wind barbs and the highest wind speeds are shaded. This map is also a good approximation of jet stream winds and is excellent for showing areas of diffluence and rising air motions.

500mb Vort, Ht- This map represents the approximate halfway point up in the troposphere. The solid lines represent the height of the 500mb pressure surface in meters. Winds are plotted with wind barbs. Areas of vorticity are shaded and maximum areas of vorticity or denoted by an ‘X’. Vorticity is an important thing for WeatherGeeks. In its simplest form, vorticity is the tendency for the atmosphere to spin or the amount of rotation or circulation in the atmosphere. Since vorticity leads to upward vertical motion in the atmosphere and leads to precipitation, it is one of the most sought-after fields to plot on numerical weather maps. On this map, look for areas of vorticity and the direction in which they are moving. Now look at forecast model precipitation and see if you can find a relationship.

700mb RH, Ht- This map represents the 700mb pressure surface. The solid lines are the height of the 700mb pressure surface in meters. Winds are plotted with wind barbs. The relative humidity of the 700mb surface is shaded in green. Relative humidities of 70% or greater at 700mb are a good indication of where clouds may exist. 700mb “omega” is also contoured here. Areas of negative omega (contoured in red) indicate upward vertical atmospheric motion and probable areas of precipitation while areas of positive omega (contoured in blue) indicate downward vertical atmospheric motion and areas which usually do not have precipitation.

850mb Temp, Ht- This map shows the height (in meters) of the 850mb pressure surface along with winds at 850mb (plotted with wind barbs) and also temperatures at 850mb. Again, temperatures at 850mb can help determine the position of the rain/snow line and can also help in forecasts of surface temperatures and even aid in the forecasting of lake effect snow.

850mb Vort- This map shows the height (in meters) of the 850mb pressure surface along with winds at 850mb (plotted with wind barbs) and also vorticity at 850mb. Like 500mb vorticity, 850mb vortcity can be instrumental in determining areas of rising vertical motion and precipitation.

ECMWF (EURO) – EUROPEAN CENTER FOR MEDIUM RANGE WEATHER FORECASTING MODEL

This model is often considered the "holy grail" for medium range weather models for WeatherGeeks everywhere. This global model has consistently performed better than other global models in accuracy scores. This model is produced by the European Center for Medium Range Weather Forecasting which is an independent intergovernmental organization supported by 34 nations. Unlike data from NOAA, this model data is not available in the public domain and is only sold by this organization at a fairly steep price. Because of this, the data available is fairly limited. Images displayed in WeatherGeek Pro are from 00 hours to 240 hours in 24 hour increments.

ECMWF Products on WeatherGeek Pro

850 Winds/MSLP - Pressure reduced to mean sea level (black contours labeled in hPa) and wind speed on the 850-hPa isobaric surface, which is around 1.5km above sea level (yellow/green shading labeled in m/s).

500 Heights/850 Temps - Height of the 500-hPa isobaric surface, which is around 5.5km above sea level (blue contours labeled in dm), and temperature on the 850hPa isobaric surface, which is around 1.5km above sea level (color shading, 4C bands).

WW3 – WAVE WATCH 3

When WeatherGeeks need to know what's going on in the oceans, they turn to the Wave Watch 3 (WW3). WeatherGeeks who are also surfers love this model because it helps them to figure out when conditions will be optimal to catch that big wave. The WW3 is a third generation wave model developed at NCEP. WW3 forecasts are produced every six hours at 00, 06, 12 and 18 UTC. The WW3 graphics are based model fields of 1.0^0 x 1.25^0 to 5^0 x 5^0 and are available at six hour increments out to 87 hours.

POLAR – POLAR ICE DRIFT

WeatherGeeks enjoy forecasting the weather. It's their life's passion. But sometimes they think about a career that would bring them closer to the conditions they forecast. And we're not talking about storm chasing. Oh no, we're talking something even more extreme. You know, out on the ocean on a fishing vessel, maybe catching crab just like those guys you see on TV! But WeatherGeeks can sometimes be wimpy. Some of them wouldn't last a day on one of those boats. But even so, what they can do is help the captains of those boats make decisions as they set gear ahead of the advancing ice in the Bering Sea. Thankfully the captains don't just have to guess when ice may advance on their location and trap

their boats and gear within a solid sheet of ice. They have a model. And WeatherGeek Pro offers an interface to it. It's called the POLAR model. The Polar and Great Lakes Ice group works on sea ice analysis from satellite, sea ice modeling, and ice-atmosphere-ocean coupling. Automated analyses have been used by the NWS global atmospheric models for their sea ice conditions since February 1998. POLAR forecasts are produced once daily at 00 UTC. The POLAR graphics are available at 24 hour increments out to 384 hours. The analysis provides a daily, 0.5 degree resolution in latitude and longitude, condition for the models.

Regional Models

NAM – NORTH AMERICAN MESOSCALE

The NAM or North American Mesoscale Model is a limited area or regional model ran by NCEP and is preferred by WeatherGeeks all over inside of 48 hours. The model is run four times per day (00Z, 06Z, 12Z, 18Z) and has a finer horizontal resolution than the GFS – currently at 12 km, thus providing finer detail. Unlike the GFS, the NAM is only run out to 84 hours or 3 ½ days.

NAM Products

Available products from the NAM on WeatherGeek Pro are almost exactly the same as products offered for the GFS with one notable exception: this model has the added product of "SimRadar" which is Simulated Radar Reflectivity. This field does what it says: It allows the model to simulate what a radar picture may look like out to 84 hours in the future. Now that's something cool any WeatherGeek would love!

HRW – HIGH RESOLUTION WINDOW (WRF)

The WRF (Weather Research and Forecasting) Model (pronounced "worf") is one of the latest and greatest models to be used by WeatherGeeks. There are two distinct versions of the WRF model: The NNM version or "Nonhydrostatic Mesoscale Model" is designed for forecasting operations and is used at National Weather Service offices across the US where WeatherGeeks are busy forecasting on a daily basis. The ARW version or "Advanced Research WRF" is designed primarily for WeatherGeeks who do weather research for a living and is utilized by NCAR (National Centers for Atmospheric Research). For V 2.x, WeatherGeek Pro allows access to both the ARW and NNM version of the WRF which run at a horizontal resolution of approximately 5 km. Typically, the WRF is run four times per day, but unlike the GFS and NAM models, each run is of a much more limited spatial domain. The 00Z run of the WRF is run for the eastern US, while the 06Z WRF is run for the western US. The 12Z WRF is again run for the eastern US while the 18Z is run for Alaska. The model produces forecasts out to 48 hours or two days. Also of note: runs of the WRF model can be cancelled if an NCEP Hurricane Model is being run. See the "Model Status" page during hurricane season to see if the WRF is being produced on any given day.

WRF Products

Products for the WRF are again similar to the products for both the GFS and the NAM. And like the NAM, WeatherGeek's favorite SimRadar, or Simulated Radar Reflectivity is also included.

RAP – RAPID UPDATE

The RAP or Rapid Refresh Model is a model WeatherGeeks use when they need information fast. This is a limited area or regional model, but unlike the others, this model has the most frequent run times out

of any NCEP model. It is run every hour and is based on the WRF. It produces forecasts out to 18 hours. This model was developed to provide timely forecasts for weather-sensitive industries such as aviation and to help better predict severe weather in the short term. It replaced the older RUC model on May 1, 2012.

RUC Products

Again, many of the products available with the GFS, NAM and WRF are available for the RUC. In addition, the following products are available:

Helicity- Helicity is the transfer of vorticity (or rotation) from the environment to an air parcel in convective motion. Areas which have a higher amount of helicity along with a high amount of instability would have a higher chance of seeing rotating thunderstorms (supercells) and even possibly tornadoes due to the inherent "turning of winds with height" which help to produce rotating storms. Whenever the atmosphere looks to be unstable, WeatherGeeks always check out helicity to see if there will be a risk of tornadoes.

CAPE/CIN– CAPE stands for Convective Available Potential Energy and is the amount of energy a parcel of air would have if lifted a certain distance vertically through the atmosphere. The higher the amount of CAPE, the more likely it is the atmosphere will produce convection or thunderstorms because the higher its instability. Because of this, CAPE is an excellent predictor of severe weather and it is one of the first variables WeatherGeeks look at to determine the risk for severe storms. CIN or Convective Inhibition is represented in numerical form and indicates the amount of energy which will prevent an air parcel from rising to the Level of Free Convection. You will sometimes hear this referred to as a "cap" or "capping inversion." When high levels of CIN are present, the atmosphere will have a much more difficult time in producing convection and you'll see lots of WeatherGeeks sitting on the side of the road waiting for storms to erupt which will never materialize.

HRRR – HIGH RESOLUTION RAPID REFRESH

The HRRR is the hottest model going now for WeatherGeeks around the U.S. and is a favorite of storm chasers. It is arguably the most advanced model offered in WeatherGeek Pro. The HRRR (High Resolution Rapid Refresh) is an experimental 3-km hourly updated nest inside of the 13km Rapid Refresh (using the 13km RAP as parent model). The HRRR is *fully dependent* on the hourly-updating RAP running at ESRL (Earth Systems Research Laboratory), being initialized from RAP-ESRL analyses. Since this model is experimental, its output frequently is unavailable. **Purchase of this option in WeatherGeek Pro does not guarantee the data will be available, but only provides an interface to view the data when it is available.**

Ensemble Models

SREF – SHORT RANGE ENSEMBLE FORECAST

The SREF or Short Range Ensemble Forecast Model consists of 21 model members and runs four times per day at 03Z, 09Z, 15Z and 21Z. Output is available every 3 hours out to 87 hours. The cool thing WeatherGeeks love about the SREF model (and all other ensemble models) is that it shows the spread between the various models (usually the shaded colors) of whatever variable you are looking at. If there is less of a spread in solutions between members of the SREF, you usually can infer a higher confidence in the forecast. More of a spread typically indicates less certainty about a given forecast.

SREF Products

Products of the SREF are similar to that of the other models listed above with one notable exception: For most every variable, there is a color shading on the map which indicated the spread in solutions for that particular variable. Thus, the lower the spread, the higher confidence in the model forecast (and the higher the confidence in WeatherGeeks' forecasts). The higher the spread, the lower the confidence in the model forecast and you'll hear WeatherGeeks talking out of both sides of their mouths. Values displayed for each variable are mean values among the 21 members of the ensemble.

Lifted Index (LI)- One product available with the SREF and not the other models is LI or Lifted Index. The LI is a stability parameter. It is calculated by taking the temperature difference between an air parcel lifted adiabatically and the temperature of the environment at a given pressure height in the atmosphere. When the value is positive, the atmosphere is stable and when the value is negative, the atmosphere is unstable. An unstable atmosphere is more prone to producing convection with a stable atmosphere less conducive to producing convection. WeatherGeeks all over place a great deal of value on LI values, much like CAPE values.

GEFS – GLOBAL ENSEMBLE FORECAST SYSTEM

The Global Ensemble Forecast System (GEFS) is another model WeatherGeek's turn to when they want to see how much confidence they should have in their forecast. The GEFS is a GFS-based modeling system run with 20 ensemble members per cycle plus one control at T126. GEFS forecasts are produced up to 28 levels every six hours at 00Z, 06Z, 12Z, and 18Z. All runs are shown out to 384 hrs at 6-hour intervals. Data is interpolated to 1°x1° resolution from 0 to 384 forecast hours. Two versions of the GEFS are available in WeatherGeek Pro: GEFS-MNSPRD which offers a visualized mean spread between the ensemble members in color shading for given parameters. The bigger the spread, the higher the uncertainty in a given forecast and the more nervous WeatherGeeks will be. GEFS-SPAG offers various parameters plotted in "spaghetti" fashion. The closer the lines are together, the higher the certainty and you'll find WeatherGeeks all over standing up tall. The more spread apart the lines are (and the more they look like a plate of WeatherGeek's Mom's Famous Spaghetti), the more uncertainty there is in a given forecast and the more likely you'll see your favorite WeatherGeek enjoying an entire bottle of wine with that spaghetti.

NAEFS – NORTH AMERICAN ENSEMBLE FORECAST SYSTEM

It's always nice when counties come together for common good, especially for the common good of the WeatherGeek. That's why peace-loving WeatherGeeks all over enjoy the North American Ensemble Forecast System. The NAEFS is a global weather modeling system run jointly by the Meteorological Service of Canada (MSC) and the U.S. National Weather Service (NWS) to provide numerical weather prediction (NWP) probabilistic products to weather forecasters in both countries (and around the world) for a forecast period that runs out 16 days. The NAEFS combines the Canadian global forecast model ensemble and the NWS Global Ensemble Forecast System (GEFS). NAEFS forecasts are produced every six hours at 00, 06, 12 and 18 UTC. (Note: For 06 and 18 UTC graphical products are produced by NWS GEFS input only). The NAEFS graphics are based on 70 km grid (T190) bias-corrected and are available at six hour increments out to 384 hours. Oh, and the entire world benefits from this partnership. Unlike the name suggests, output for this model is available globally and not just for North America.

MOS – MODEL OUTPUT STATISTICS

MOS tables are another dataset WeatherGeek Pro can access. MOS stands for Model Output Statistics. This method of predicting the weather combines statistical weather prediction techniques with numerical models to produce local forecasts of everything from temperature and precipitation chances to cloud cover and wind direction and speed. MOS tables are the main backbone in the way most meteorologists forecast air temperature (although many other considerations and techniques are often taken into account). The MOS tables show times every 3 hours along with variables such as temperature (low and high temperatures are listed on a separate line), dew point, cloud cover, wind direction, wind speed and POPs (probability of precipitation) for 6 and 12 hour periods. Precipitation amounts, type and visibility are also included in some MOS tables. WeatherGeek Pro will allow you to look at MOS tables from both the NAM and GFS models.

Decoding MOS tables

Every WeatherGeek sometimes needs a reminder about how to decode those MOS tables. If you need a reminder, or you're a new WeatherGeek and need to learn, check out this excellent primer from the National Weather Service's Meteorological Development Lab:

Sample Message

```
KDEN   GFS MOS GUIDANCE    3/04/2010  1200 UTC
DT /MAR   4/MAR   5                /MAR   6                /MAR   7
HR   18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 06 12
N/X                     27          53          28          51    24
TMP  48 52 51 40 35 32 30 35 47 50 48 40 38 35 32 36 45 48 45 31 27
DPT  25 25 27 29 29 27 25 25 21 17 18 20 21 21 20 21 21 22 22 23 21
CLD  BK SC SC SC SC OV OV OV BK BK BK SC BK SC SC SC SC SC SC SC SC
WDR  19 14 13 16 20 20 25 25 28 28 28 22 23 23 22 21 12 10 10 17 21
WSP  05 12 11 08 08 07 07 07 08 10 11 08 08 07 07 07 07 10 10 08 07
P06         1     6    14    20    14    25     8     4     2  3  2
P12                     15          27          26          4     3
Q06         0     0     0     0     0     0     0     0     0  0  0
Q12                     0          0           0           0     0
T06      5/11  1/ 2  0/ 1  1/ 2  8/ 3  1/ 1  0/ 0  0/ 0  2/ 8  0/ 0
T12           7/11        1/ 2        8/ 4        0/ 1     2/ 8
POZ   1  1  3  2  2  7  8  3  4  2  3  0  3  3  4  6  3  1  2  0  3
POS  27 16 18 24 28 65 74 72 31 20 37 57 94 87 95 65 41 18 28 50 91
TYP   R  R  R  R  R  S  S  S  R  R  R  S  S  S  S  S  R  R  R  R  S
SNW                     0                          0                0
CIG   8  8  8  8  8  8  8  7  8  8  7  8  8  8  8  8  8  8  8  8  8
VIS   7  7  7  7  7  7  7  1  7  7  7  7  7  7  7  7  7  7  7  7  7
OBV   N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N  N
```

- **DT** = The day of the month, denoted by the standard three or four letter abbreviation
- **HR** = Hour of the day in UTC time. This is the hour at which the forecast is valid, or if the forecast is valid for a period, the end of the forecast period.
- **N/X** = nighttime minimum/daytime maximum surface temperatures.
- **TMP** = surface temperature valid at that hour.
- **DPT** = surface dew point valid at that hour.

- **CLD** = forecast categories of total sky cover valid at that hour.
- **WDR** = forecasts of the 10-meter wind direction at the hour, given in tens of degrees.
- **WSP** = forecasts of the 10-meter wind speed at the hour, given in knots.
- **P06** = probability of precipitation (PoP) during a 6-h period ending at that time.
- **P12** = PoP during a 12-h period ending at that time.
- **Q06** = quantitative precipitation forecast (QPF) category for liquid equivalent precipitation amount during a 6-h period ending at that time.
- **Q12** = QPF category for liquid equivalent precipitation amount during a 12-h period ending at the indicated time.
- **SNW** = snowfall categorical forecasts during a 24-h period ending at the indicated time.
- **T06** = probability of thunderstorms/conditional probability of severe thunderstorms during the 6-hr period ending at the indicated time.
- **T12** = probability of thunderstorms/conditional probability of severe thunderstorms during the 12-hr period ending at the indicated time.
- **POZ** = conditional probability of freezing precipitation occurring at the hour.
- **POS** = conditional probability of snow occurring at the hour.
- **TYP** = conditional precipitation type at the hour.
- **CIG** = ceiling height categorical forecasts at the hour.
- **VIS** = visibility categorical forecasts at the hour.
- **OBV** = obstruction to vision categorical forecasts at the hour.

Definitions of Categorical Elements

MAV Ceiling Height Categories	
1	< 200 feet
2	200 - 400 feet
3	500 - 900 feet
4	1000 - 1900 feet
5	2000 - 3000 feet
6	3100 – 6500 ft
7	6600 - 12,000 feet
8	> 12,000 feet or unlimited ceiling

MAV Cloud (CLD) Categories	
CL	clear
FW	few > 0 to 2 octas
SC	scattered > 2 to 4 octas
BK	broken > 4 to < 8 octas
OV	overcast

MAV Visibility (VIS)	**MAV Obstruction to Vision (OBV) Categories**

Categories	
1	< 1/2 miles
2	1/2 - < 1 miles
3	1 - < 2 miles
4	2 - < 3 miles
5	3 - 5 miles
6	6 miles
7	> 6 miles

MAV QPF Categories	
0	no precipitation
1	0.01 to 0.09 inches
2	0.10 to 0.24 inches
3	0.25 to 0.49 inches
4	0.50 to 0.99 inches
5	1.00 to 1.99 inches
6	2.00 inches or greater

N	none of the following
HZ	haze, smoke, dust
BR	mist (fog with visibility >= 5/8 mile)
FG	fog or ground fog (visibility < 5/8 mile)
BL	blowing dust, sand, snow

MAV Snow Fall Amount Categories	
0	no snow or a trace expected
1	> a trace to < 2 inches
2	2 to < 4 inches
4	4 to < 6 inches
6	6 to < 8 inches
8	>= 8 inches

	MAV Precipitation Type (TYP) Categories	
	S	pure snow or snow grains
	Z	freezing rain/drizzle, ice pellets, or anything mixed with freezing precip
	R	pure rain/drizzle or rain mixed with snow

CONCLUSION

Numerical weather prediction continues to evolve and get more and more advanced all the time. WeatherGeek Pro offers you a mobile interface to access many of these advanced models which are the backbone to modern day weather forecasting. Even if you are a beginner forecaster, you can easily learn how to interpret the data provided by numerical weather models. The longer you study them, the more you begin to learn their strengths and weaknesses. However, keep in mind even the best numerical model is often an approximation of how the actual weather may behave. That is why it is important to analyze data yourself and compare model predictions to what is actually occurring in the atmosphere. Even though we have come a long way in the science of numerical weather prediction, there is still much work to be done. We hope this guide offered you a little insight into how the models function and the types of data produced by them. If you have any questions about WeatherGeek Pro or about numerical modeling, feel free to contact the WeatherGeeks at Hurricane Baby.