Western Region Technical Attachment
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INTERPRETING NGM FOUS OUTPUT

Now that several new sites in the Western Region have NGM numerical guidance available to them (FOUS bulletins - cccFRHT## products on AFOS), we thought it would be a good time to remind everyone how to interpret this guidance. It can be particularly confusing if you are used to the LFM numerical guidance (cccFRH## products on AFOS). The most significant differences between the two guidance bulletins are the relative humidity (RH) and temperature levels reported. This Technical Attachment focuses on how to interpret the RH and temperature numerical output from the NGM, and how this output is different from the LFM FOUS bulletins. Information on how to interpret other parameters not discussed in this Technical Attachment can be found in Technical Procedures Bulletins (TPB) #294 and #351 for LFM FOUS and NGM FOUS, respectively.

The RH and temperature reported in the NGM FOUS bulletins are average values representing model sigma layers. Sigma is the vertical coordinate used by the model to take terrain effects into account. By definition, sigma is equal to one at the surface and zero at the "top" of the atmosphere (where the pressure goes to zero). At a given pressure level, sigma then is equal to that pressure divided by the surface pressure. Figure 1 should help you to visualize how sigma surfaces are related to pressure surfaces and the terrain.

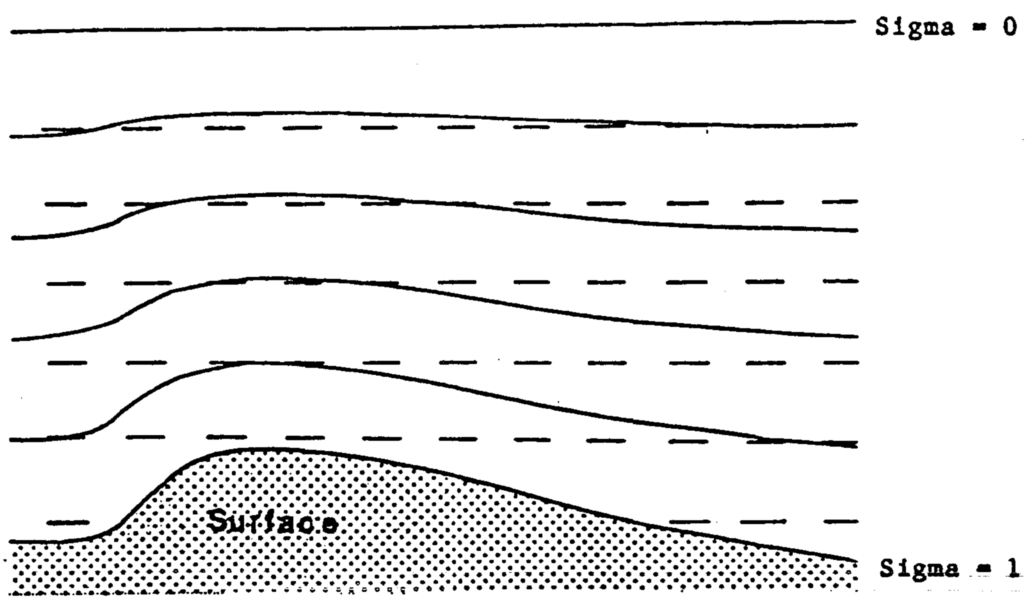

FIG. 1. A comparison on constant sigma surfaces (solid lines) and constant pressure surfaces (dashed lines). Notice that sigma-surfaces follow the terrain, while pressure surfaces do not.

Layer average values of RH are reported for three layers in the NGM FOUS bulletins. The boundaries of these layers are the following sigma levels:

R1 = surface to sigma 0.965 (model layer 1)
R2 = sigma 0.965 to sigma 0.473 (model layers 2-9)
R3 = sigma 0.473 to sigma 0.181 (model layers 10-13)

In contrast, the LFM FOUS bulletins report mean RH values for each of the three <u>lowest</u> model layers (also sigma coordinates) as well as the combined mean RH from all three of those layers.

There are also three layers for which the average layer temperatures are reported (°C) in the NGM FOUS bulletins. The boundaries of these layers are as follows:

T1 = surface to sigma 0.965 (model layer 1)
T3 = sigma 0.922 to sigma 0.872 (model layer 3)
T5 = sigma 0.816 to sigma 0.755 (model layer 5)

The LFM FOUS bulletin only provides the mean potential temperature of the 50mb-thick boundary layer (in °K).

Table 1 is a worksheet which can be used to convert the RH and temperature layers from sigma coordinates to pressure coordinates for any station. Since the FOUS output is valid for model sigma layers, you need to plug in the station pressure that the <u>model</u> is using, which may not be exactly the actual station pressure. A list of FOUS stations in North America and their model terrain height and model station pressure can be found in TPB #351. This list is currently being updated to add the new NGM FOUS locations. To use the worksheet, simply plug in the standard station pressure the model uses (from the list in TPB 351) into the starred blanks on the worksheet. This will give you typical pressure boundaries for the RH and temperature layers for the station of interest.

Station ________ **Standard Station Pressure** ________* **mb**

R1 = ______mb to ______mb (1.0 X ______*, 0.965 X ______*)
R2 = ______mb to ______mb (0.965 X ______*, 0.473 X ______*)
R3 = ______mb to ______mb (0.473 X ______*, 0.181 X ______*)
T1 = ______mb to ______mb (1.0 X ______*, 0.965 ______*)
T3 = ______mb to ______mb (0.922 X ______*, 0.872 X ______*)
T5 = ______mb to ______mb (0.816 X ______*, 0.755 X ______*)

Table 1

Let's use Salt Lake City (SLC) as an example. The standard station pressure the NGM uses for SLC is 811.91mb. Since the model thinks SLC is about 600m higher than it actually is, a more realistic standard station pressure would be about 870mb. However, since were are looking at model output, we need to use the model's standard surface pressure for SLC. Plugging in 811.91mb, we get:

R1 = 812mb to 783mb	T1 = 812mb to 783mb
R2 = 783mb to 384mb	T3 = 749mb to 708mb
R3 = 384mb to 147mb	T5 = 663mb to 613mb

A station near sea-level (1000mb for simplicity) would be significantly different:

R1 = 1000mb to 965mb	T1 = 1000mb to 965mb
R2 = 965mb to 473mb	T3 = 922mb to 872mb
R3 = 473mb to 173mb	T5 = 816mb to 755mb

In contrast, the LFM FOUS RH layers for a station near sea-level would be:

R1 = 1000mb to 950mb (LFM's boundary layer)
R2 = 950mb to 720mb
R3 = 720mb to 490mb

You can see that R1 for both the NGM and LFM is the mean RH of the boundary layer, whereas R2 and R3 for the NGM represent middle and upper layers of the model and R2 and R3 for the LFM represent the two lower tropospheric layers of the model. The three NGM FOUS temperature layers were selected to define temperatures in the lowest two kilometers of the model; the thinking was that these layers would be valuable for precipitation type decisions.

It is also worth mentioning something about how the Lifted Index (LI) values in the NGM FOUS bulletins are calculated, since it is not the same method used for calculating the LFM FOUS LI values or the way one might do it operationally. Instead of lifting a parcel from the lowest 50mb model layer (LFM method), or from lifting a 100mb-deep mixed layer just above the ground (common practice operationally), the NGM method calculates <u>four</u> lifted indices using the mean temperature and dew point for each of the lowest four sigma layers in the model and lifting them. These layers are:

Layer 1........surface to sigma = 0.965
Layer 2........sigma = 0.965 to sigma = 0.922
Layer 3........sigma = 0.922 to sigma = 0.872
Layer 4........sigma = 0.872 to sigma = 0.816

The lowest LI value (most unstable) of the four is then reported in the NGM FOUS bulletin.

As most of you are aware, the LFM is scheduled to be discontinued operationally sometime in 1992. The NGM will then be moved into the LFM's production slot at NMC. By this time, there may be some changes to the format of the NGM FOUS bulletin. The possible changes may include reporting different RH and temperature layers, perhaps additional layers. If and when changes in the format occur, updated TPBs will be issued to detail the changes.

References

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