Impact of Model Structure and Dynamics - version 2

Produced by The COMET® Program

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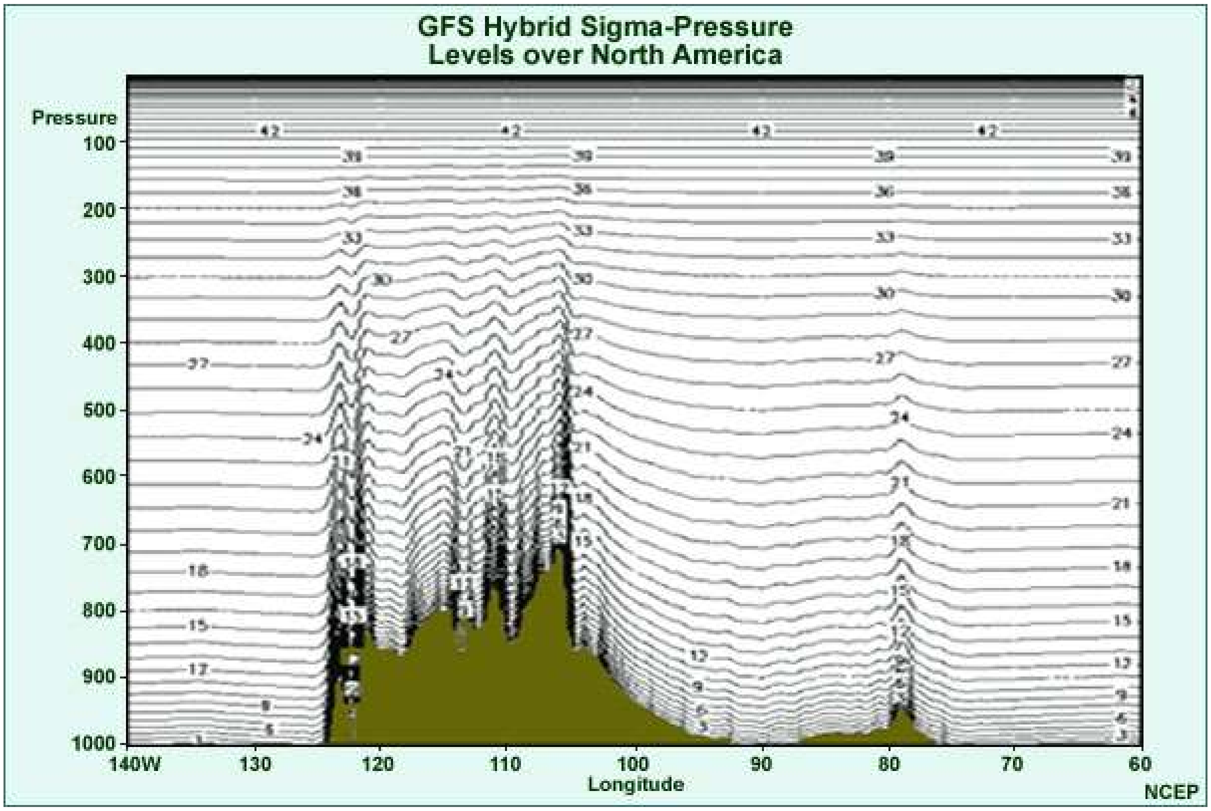
Hybrid Sigma-Pressure Vertical Coordinate System

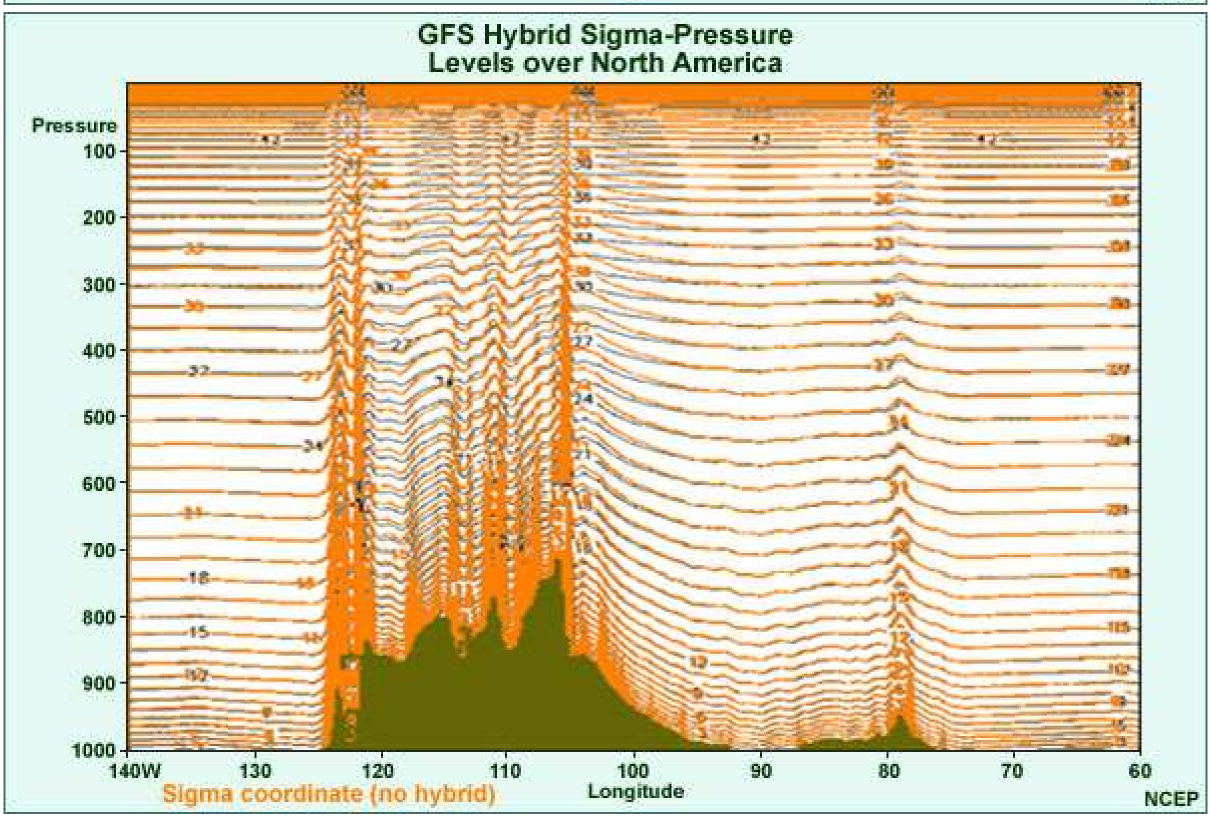
- « Previous
- Next »

Hybrid sigma-pressure coordinate models have a combination of sigma layers at the bottom that shift to isobaric layers above. This takes advantage of the terrain-following sigma in the boundary layer while utilizing flatter coordinates which have better numerical properties aloft and improves the efficiency and accuracy of radiative transfer calculations used in assimilating satellite radiance observations. The upper troposphere and stratosphere are crucial for the assimilation of satellite radiance observations, and these observations now play a dominant role in the data assimilation due to their overwhelming abundance.

Some models, including the NAM in 2009 (though that may change later) have a pure sigma domain at the bottom and a fixed transition pressure, above which all layers are exactly isobaric. However, other models, such as illustrated below for the GFS, have a blend, so that the coordinate gradually transitions from sigma at the bottom to isobaric at the top. The blended method avoids numerical artifacts at the transition level seen in some forecasts using the type which abruptly shifts from sigma to pressure.

Click the images to see larger versions:





The sigma coordinate is depicted in orange while the hybrid is as before in gray. Notice the difference over complex (sloping) terrain of any height, even the low mountains at 80° W – the hybrid is much flatter in the upper troposphere. Over relatively flat areas, the two coordinates nearly coincide.

- [« Previous]
- [Next »]