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USING MODEL LIFTED INDICES

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Introduction

Forecast lifted indexes (LI) available from the Eta and NGM models are often observed to differ from actual values computed on upper-air soundings (as well as from each other). Does this mean the forecast values are wrong? Answering this question requires an understanding of the differences between a model "lifted index" and a sounding "lifted index".

Both the sounding and model LIs take a "parcel" of air from the lower atmosphere, lift it dry adiabatically to saturation, then wet adiabatically until 500 mb is reached, and finally compare the computed temperature to the ambient temperature. One difference between the two LIs is associated with the parcel used. The LI computed from the sounding uses a parcel encompassing the lowest 100 mb layer, or about 3,000 feet at sea level.

Model Lifted Indices

The models attempt to provide a more refined LI by using a smaller parcel size and comparing LIs for various parcels taken above the surface. Most of the model LIs available in the field are termed a "best" LI. This index is determined by computing values for each of the four lowest NGM layers, or six lowest Eta layers, then choosing the lowest LI value. One advantage of this, as stated by Technical Procedures Bulletin #350, is that the models "would recognize instability existing in warm air located over a shallow cold layer, such as in warm front over-running". These values will typically be lower than the sounding LI; sometimes much lower. Note also that the depth of the layers varies between models. The NGM used the four lowest sigma layers, including a thin boundary layer, while the Eta uses six layers each 30 mb thick. The total depth of the NGM 4-layers is equivalent to the total depth of the 6-layers used by the Eta.

Not all of the model LIs are of the "best" type. The 00-hour Eta LI available through AFOS uses a surface-based parcel. The "best" value available in the AFOS file xxxFRHxxx should be a better forecast tool, although there may be little difference on summer afternoons. PCGRIDS data contains a "best" LI for the NGM and the Eta, as described in the previous paragraph (Dennis Keyser, NMC, Development Division, personal communication).

Using Model LIs as a Forecast Tool in Washington State

LIs (and Showalter Indices) computed from Spokane soundings have not been good predictors of thundershowers at that location. A study was initiated in 1993 to compare 12- and 24-hour model LIs valid at 0000 UTC with the frequency of observed thunder or lightning in a six-hour window between 2100 UTC and 0300 UTC.

Preliminary results from spring and summer 1993 data showed that both the Eta and NGM LIs related well to observed thunder and lightning in the range of -2 and -3, much better than the 0000 UTC sounding LIs. The highest frequency came when both the 12-hour NGM and Eta LIs were -2 or -3. However, only one thunderstorm was observed out of eleven dates with a model LI of -4 or lower. Thus, one cannot assume that the frequency (or severity) of thunderstorms at Spokane will increase as the model LI decreases.

Conclusion

Model LIs that differ from observed sounding values are not wrong; they are simply different. Hopefully, they will provide better guidance to the development of convection than the sounding LIs. Local studies should be conducted to assess the performance of each model in the local climate.

Remember also that LIs are just one factor in forecasting convection. Others include available moisture, upper-level forcing such as in deformation zones, and air mass changes during the forecast period.

It is also worth noting that all the LIs are limited to 500 mb. Many Western Region thunderstorms extend much higher in the atmosphere, especially those generated by subtropical moisture. It would be interesting to have a forecast 700 mb to 400 mb LI available.

References

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