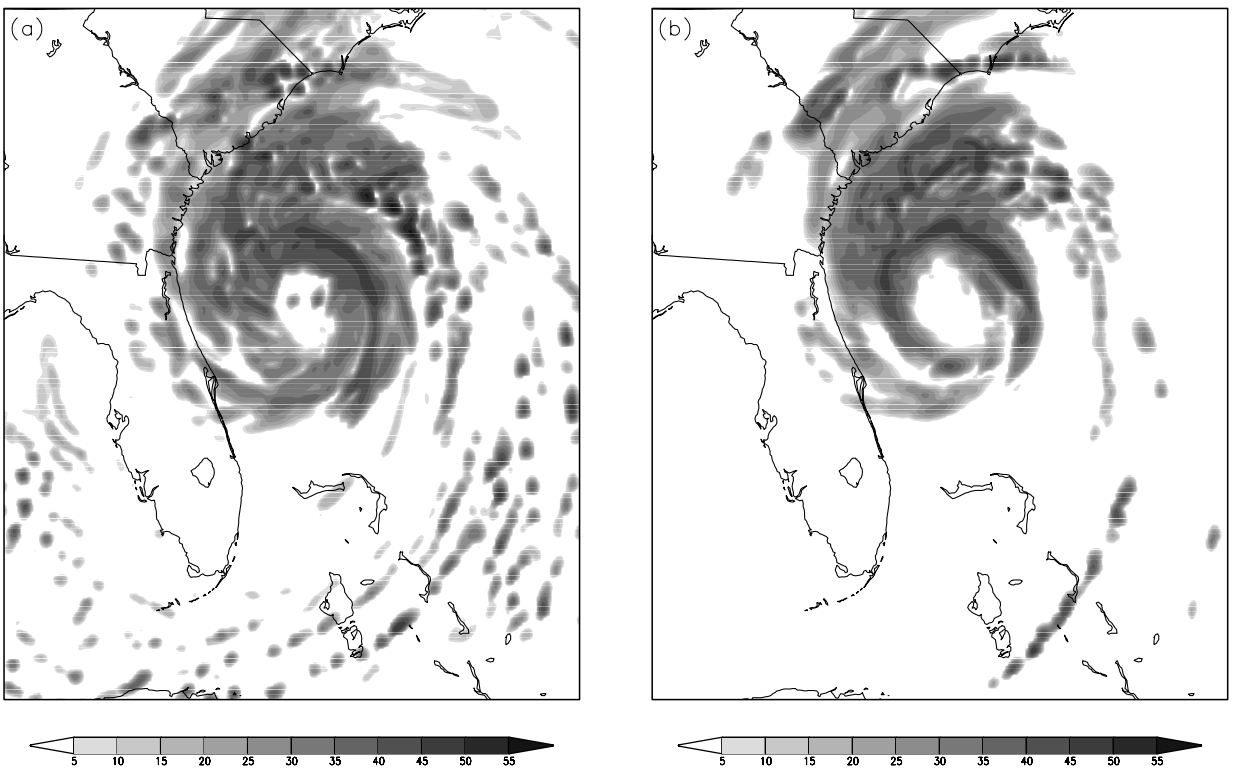

Fig. 4 *Estimated reflectivity (dBZ) 12 hours into simulations of Hurricane Floyd, using (a) the Blackadar PBL code, (b) the TKE-based turbulence closure.*

occurs because the scheme produces more mixing at an early stage of simulation, which inhibits initial thunderstorm growth.

4. SIMULATION OF HURRICANE FLOYD

Figure 4 presents the estimated reflectivity (which is based on rain water mixing ratio at the lowest model level) from two explicit simulations of Hurricane Floyd. The simulations were performed using 6.67 km horizontal grid spacing and 30 vertical levels. The Blackadar PBL code is used for the simulation in Fig. 4a, while the TKE code is used for the simulation in Fig. 4b. The surface flux scheme from the Blackadar PBL was used in both simulations.

The excessively large eyewall in both simulations is a consequence of the coarse data used to initialize the experiments: gridded fields from NCEP's Aviation model with 1° (latitude and longitude) grid spacing were used to define the initial state. Despite the unusually large eyewall, the two simulations are able to reproduce the track of the hurricane very well. Of more interest here, however, is the region outside of the eyewall. In particular, note the numerous cellular thunderstorms in the Gulf of Mexico in the Blackadar PBL simulation. This excessive number of thunderstorms was not observed in this case. We believe that inadequate turbulent mixing (in both vertical and horizontal directions) allows deep thunderstorms to develop with the Blackadar code, whereas non-precipitating shallow cumulus clouds (which were observed) are created with a more appropriate representation of turbulence.

5. CONCLUSIONS

This paper has compared the types of turbulence assumptions that are made in mesoscale models versus cloud-scale models. Results of simulations using the two methodologies were also presented. The neglect of important terms from the complete three-dimensional turbulence equations can have a major impact on results. Since MM5 is now being applied at cloud-scale resolution by many users, a higher-order three-dimensional turbulence scheme should be available for users of the model.

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REFERENCES

Available from author, or at the following web address:
http://www.ems.psu.edu/~bryan/mm5/workshop_c.html