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Enhancing responsiveness of the MYJ turbulence closure scheme to strong instability

Zavisa Janjic
NOAA/NWS/NCEP, Environmental Modeling Center, College Park, United States

The Mellor-Yamada Level 2.5 turbulence closure scheme is currently widely used in atmospheric models. However, with this closure model, growth of the turbulent kinetic energy (TKE) can be sluggish, particularly in case of strong static instability. This may become a problem, e.g., when excessive latent heat is released in models running at convection allowing resolutions without parameterized moist convection.

Here, an attempt is made to enhance the responsiveness of the MYJ turbulence closure scheme (Janjic, 2001) to TKE production in case of strong instability, including strong free convection. Unlike in the 1D turbulence model, in reality the vanishing horizontal wind speed, and consequently the free convection, cannot be sustained. Therefore, similarly as in Beljaars (1994), an assumption is made that a residual vertical wind shear measure cannot be smaller than a certain small value, and normally should take on a fraction of the value of the instability measure. In this way, the development of turbulence can be accelerated, and the maximum value of the TKE can be increased 2-3 times. Testing has commenced in order to determine the range of enhanced shear needed to sufficiently accelerate the turbulence development and the TKE enhancement in case of strong instability and free convection. Examples illustrating the impact of the shear modifications will be shown.

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