9.2 The influence of boundary layer mixing on the evolution of an extratropical cyclone.

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Sub-grid scale turbulence in WRF is typically handled by a planetary boundary layer (PBL) parameterization. These schemes attempt to represent turbulent mixing processes occurring below the resolvable scale of the model grid and act upon temperature, moisture, and momentum within the boundary layer.

This study varies the PBL mixing strength within 4-km WRF simulations of the 27–28 January 2015 snowstorm. The YSU PBL parameterization is used to assess the impact of strong vs. weak mixing. The bulk critical Richardson number for unstable regimes is varied between 0.0–0.5, as a way of directly altering the depth and magnitude of sub-grid scale turbulent mixing. Results suggest differences in boundary layer moisture availability lead to variations in the magnitude of latent heat release above the warm front, resulting in stronger upper-level downstream ridging in the simulation with less PBL mixing. This more amplified flow pattern impedes the eastward propagation of the surface cyclone and results in a westward shift of precipitation. Additionally, trajectory analysis indicates ascending parcels in the less mixing case condense more water vapor and end at a higher potential temperature than ascending parcels in the more mixing case, suggesting stronger latent heat release when PBL mixing is reduced.