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## A Budget-Based Turbulence Length Scale Diagnostic

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The most frequently used boundary-layer turbulence parameterization in numerical weather prediction (NWP) models are turbulence kinetic energy (TKE) based schemes. However, these parameterizations suffer from a potential weakness, namely the strong dependence on an ad-hoc quantity, the so-called turbulence length scale. The physical interpretation of the turbulence length scale is difficult and hence it cannot be directly related to measurements or large eddy simulation (LES) data. Consequently, formulations for the turbulence length scale in basically all TKE schemes are based on simplified assumptions and are model-dependent. A good reference for the independent evaluation of the turbulence length scale expression for NWP modeling is missing. We propose a new turbulence length scale diagnostic which can be used in the gray zone of turbulence without modifying the underlying TKE turbulence scheme. The new diagnostic is based on the TKE budget: The core idea is to encapsulate the sum of the molecular dissipation and the cross-scale TKE transfer into an effective dissipation, and associate it with the new turbulence length scale. This effective dissipation can then be calculated as a residuum in the TKE budget equation (for horizontal sub-domains of different sizes) using LES data. Estimation of the scale dependence of the diagnosed turbulence length scale using this novel method is presented for several idealized cases.