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Improvements to the boundary layer scheme of the linear model in the Met Office's NWP Data Assimilation System

William Grey
Met Office, FitzRoy Road, Exeter, Devon, EX1 3PB, UK.

In the current Met Office operational NWP 4D-Var data assimilation system observations are not being correctly assimilated for many temperature inversions and stratocumulus cloud cases in the boundary layer. This issue have principally been attributed to inappropriate background error covariances in the vertical that have a tendency to spread the background information too much. However, we explore the role of the physical parameterisations in the linear model in spreading the information from observations in a more realistic manner. In particular we examine the improvements that can be obtained from the newly developed boundary layer diffusion scheme in the linear model.

The boundary layer scheme is composed of two sub-steps: a Buizza type approach that takes account of vertical diffusion and surface drag for momentum, and a second that parameterises the vertical diffusion using an empirical approach that seeks to minimise the difference between the non-linear and linear model increments. The statistics are obtained by running the linear and the nonlinear unified model over a training dataset. The vertical diffusion scheme uses diagnostics from the nonlinear model to discriminate between different boundary layer situations.

Trials of this scheme in the Met Office global model show improvement in the NWP scores over ocean of 0.4%. We also implement the scheme in the Met Office 70 level 12 km mesoscale model that covers the North Atlantic and European (NAE) domain. Trials are performed over a 1 month period in order to verify the improvements in NWP scores especially for forecasts of the boundary layer variables (e.g. screen temperature). In addition, the scheme is implemented in the high resolution 1.5 km UKV (UK variable) model. Our aim is to incorporate the new boundary layer diffusion scheme into the operational Met Office Global, NAE and UKV models.