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Deep convection and cross tropopause transport in a high resolution mesoscale model

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Deep convection often extends to the height of the tropopause. Vertical transport can take place across the otherwise stable interface when convective updrafts come in contact with the tropopause. Some of this transport can be accomplished within the overshooting convective plumes, and some can be accomplished by high frequency gravity waves and the turbulent motions they induce. The purpose of this investigation is to examine the characteristics of mixing along the tropopause above mesoscale convective systems. Several case studies in which deep convection occurred over the UK are simulated using the Met Office Unified Model (UM) at very high resolution (1 km horizontal grid spacing). A passive stratospheric tracer is integrated in the simulations in order to identify episodes of cross tropopause transport and to quantify their depth and magnitude. The evolution of the tracer field is then correlated to properties of the gravity wave field. It is shown that a small amount of mixing of stratospheric into the mid troposphere takes place which is largely independent of model resolution. Additionally, some shallow mixing takes place within a few kilometres of the tropopause in the high resolution simulations that resolve high frequency gravity waves.