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Cross-tropopause transport by deep convection in high resolution mesoscale model simulations

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Deep convection in the midlatitudes often extends to the elevation of the tropopause. The motions associated with these penetrating convective systems may transport of mass across the tropopause. Direct observations of this transport are difficult, so numerical model calculation must be relied upon to elucidate the precise mechanism involved as well as the magnitude and structure of the resulting transport The purpose of this investigation is to examine the characteristics of transport across 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. It is shown that a small amount of mixing of stratospheric into the mid troposphere takes place which is largely independent of model resolution (although the spatial structure is strongly dependent on model configuration). Additionally, some shallow mixing takes place within a few kilometres of the tropopause in the high resolution simulations that resolve high frequency gravity waves.