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Convectively-generated gravity waves and mixing along the midlatitude tropopause

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Midlatitude convection generates a spectrum of gravity waves through rapid vertical accelerations and latent heating. The characteristics of the waves depend both on the generating mechanism and the properties of the surrounding environment. Under certain conditions, such as the presence of a wave duct or a critical level, the waves may produce significant local effects. One such possibility is that waves could induce turbulence and mixing at the tropopause.

This study examines the role that convectively-generated gravity waves play in initiating mixing across the midlatitude tropopause. High resolution numerical model simulations of convection using the UK Met Office Unified Model (UM) with a stratospheric tracer demonstrate enhanced mixing and turbulence along the tropopause. This mixing is simulated only in those model runs that have very fine horizontal grid spacing (e.g., 1km) and which do not parameterize convection. Such simulations support very high frequency, vertically propagating waves that are absent from coarser simulations. In order to examine how waves may be influenced by and interact with the midlatitude tropopause, an idealized linear numerical model is applied. The idealized model is used to test the sensitivity of the wave behaviour to the properties of the tropopause and the wave generation mechanism.