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Impact of gravity waves on the distribution of trace constituents at the tropopause during DEEPWAVE

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We present airborne tracer in-situ data obtained during the DEEPWAVE (Deep Propagating Gravity Wave Experiment) project in July 2014 over New Zealand during a period of gravity wave activity. We focus on one flight, which was carried out in the tropopause region over the southern Alps. Measured vertical wind and potential temperature indicated a significant impact of small scale waves. These waves significantly affected the distribution of especially N2O at the tropopause. Since N2O is chemically inert in this region and exhibits a weak vertical gradient at the tropopause its distribution is purely controlled by dynamical processes.
To study a potential irreversible (i.e. non-isentropic) effect of orographic waves on the distribution of N2O and other tracers we analyzed the change of tracer slopes relative to the potential temperature upstream, downstream and above the southern Alpes. We find a significant change of the relationship between N2O and potential temperature perturbations relative to the mountain range indicating irreversible (i.e. cross isentropic) mixing due to the presence of gravity waves. Additional wavelet analyses indicate that the coherence between tracer and potential temperature breaks down for the smallest wave lengths over the mountain range.