Intermittency of gravity waves modelled by a transient gravity-wave parametrization coupled with convective sources

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The intermittency of gravity waves (GWs) is investigated using Multi-Scale Gravity Wave Model (MS-GWaM) implemented in the upper-atmosphere extension of ICON model. The intermittency of GWs is originated from that of wave sources but altered during propagation of the waves. Conventional GW parametrization (GWP), which diagnoses vertical profiles of GW properties under the steady-state assumption, can take into account the source intermittency if the GWP employs flow-dependent sources, while it cannot present the change of intermittency by transient evolutions of GWs. MS-GWaM is a prognostic model that explicitly solves the evolution of positions of waves (as well as their wavenumbers and amplitudes) in time and thus capable of describing the intermittency change. In order to include the source intermittency and variability, we couple the convective source, as diagnosed by subgrid-scale cumulus parametrization in ICON, to MS-GWaM, based on an analytic formulation of GW response to this source. In addition to this, a spatio-temporally uniform, persistent source is prescribed in the extratropics to take into account other non-orographic sources. Orographic sources are currently not used. The GW intermittency is measured by the Gini index, and is found to be quite high in the tropics, compared to that in the extratropics. In both regions, the index has similar values to those obtained from superpressure balloon observations reported in previous studies. A control experiment is performed using GWP based on the steady-state assumption, but coupled to the same wave sources, to assess the effects of transient modelling using MS-GWaM on the simulated intermittency. From comparison to the control experiment, the intermittency is found to increase largely for GWs from the uniform source but to decrease for convective GWs by the transient modelling.