Geophysical Research Abstracts
Vol. 20, EGU2018-3319, 2018
EGU General Assembly 2018


# Entropy production due to subgrid-scale thermal fluxes with application to breaking gravity waves

Almut Gaßmann
IAP, Kühlungsborn, Germany (gassmann@iap-kborn.de)

Numerical formulations of turbulent heat fluxes must lead to positive energy dissipation of energy contained in the resolved scales and positive internal entropy production. Current parameterization approaches only deliver positive dissipation rates for free convection, not for forced convection. This contribution explains how positive dissipation rates are achieved by a new formulation of subgrid-scale terms in the case of stable stratification. This is of importance for the numerical realization of the breakdown of gravity waves.

A turbulent atmosphere tends to an isentropic stratification, because in addition to turbulent heat diffusion, pressure work leads to expansion when air is rising and contraction when air is sinking. This pressure work remains completely subgrid-scale when the atmosphere is unstably stratified. When the atmosphere is stably stratified, this pressure work has to be done by the outer environment. Therefore, a turbulent pressure gradient term is introduced in the vertical momentum equation and the equations account for the irreversible energy conversion from resolved kinetic energy into the model's internal energy.

Numerical experiments for breaking gravity waves in the mesosphere highlight the different behavior of new and conventional approaches. The conventional approach leads to a deepening of the wave amplitudes, whereas the new approach supports wave overturning. The observed foliate structure of very sharp inversion layers is indeed simulated with the new approach for stable stratification. In contrast to the traditional setting the new scheme does not evolve into persistent non-physical wave structures on long timescales.