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# Numerical simulation of mesospheric gravity waves

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Recently, first three-dimensionally resolved observations of polar mesospheric winter echeos (PMWEs) by a multi-beam experiment of the Middle Atmosphere Alomar Radar system (MAARSY) were published by Rapp et al. (2011). The observed PMWE at about 75 km altitude was tilted in the main flow direction (west to east). The origin of the PMWE was explained by two disparate concepts of gravity wave dynamics. On the one hand, the tilted PMWE was assumed to be aligned with the phase line of a linear gravity wave ($\lambda_z \approx 23$ km, $\lambda_x \approx 460$ km) propagating at an intrinsic phase speed of $-73$ m/s against the westerly wind. On the other hand, turbulence generated by breaking gravity waves was a necessary element to explain the existence of backscattering fluctuations.

In addition to a thorough analysis of the synoptic meteorological conditions, high-resolution numerical simulations are performed with the all-scale geophysical flow solver EULAG (Prusa et al., 2008). The anelastic and pseudo-incompressible approximated equations are solved in a 3D computational domain covers a 1500 km long slice of Scandinavia and spans from the surface to 100 km altitude. Multiple numerical experiments are performed to explore the origin of the observed PMWE. Various hypotheses are tested. The presentation will discuss if the PMWEs were the result of breaking mountain waves excited by the flow over Scandinavia or if dynamical instabilities occuring in the highly sheared mesospheric flow led to the observed turbulence.

Rapp, M., R. Latteck, G. Stober, et al., 2011: First three-dimensional observations of polar mesosphere winter echoes: Resolving space-time ambiguity. J. Geophys. Res., 116, A11307, doi:10.1029/2011JA016858.

Prusa, J.M., P.K. Smolarkiewicz, A.A. Wyszogrodzki, 2008: EULAG, a computational model for multiscale flows, Comput. Fluids 37, 1193-1207.