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The importance of high resolution for simulating observed lee-wave rotor turbulence

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On 18 November 2008 a commercial aircraft encountered severe turbulence while flying in westerly flow along the southeastern coast of Iceland and descending from 2.500∼m down to the ground.

The situation is reproduced with the WRF-model at horizontal resolutions up to 1 km. The simulations show a train of amplified lee waves and a Type 1 rotor below the first lee wave, which is in agreement with the vertical profile of wind and temperature. Very strong shear-turbulence is reproduced at the interface of the lee wave and the rotor, as well as inside the rotor and along the lee-side slope of Mt. Öræfajökull. The lee waves and the turbulence patterns are not stationary and as the upstream vertical wind shear increases, the lee wave becomes less steep, but the turbulence increases. At the surface, an observed severe downslope windstorm is generated by the gravity wave activity.

From a forecasting perspective, this event could have been foreseen quite accurately, but not with the NWP tools that are currently in use for aviation forecasts. Their resolution is typically of 9 to 27 km and even coarser, and that is simply not adequate. This event underlines the urgency of delivering products from fine-scale simulations over complex terrain to pilots. Such products need to be developed taking into account the transient nature of the flows and the hazards. Interpolation from coarse resolution simulations may lead to large errors in the forecast of similar events, even if the mountains are to some extent represented at these resolutions.