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A Modeling Case Study of an Alpine Supercell

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In this study, we present the convective storm of 2 August 2007, which was identified to be a supercell storm with an unusually long lifetime of over eight hours. Its track led it over several Alpine peaks and ridges with heights of more than 2000 m MSL. Along its path it caused over € 600,000 in damage, injured several hikers with hailstones and caused hail to accumulate up to 25 cm locally.

We present simulations using the Weather Research and Forecasting Model (WRF) to help understanding the conditions of 2 August which led to the development of the storm. The simulation is able to capture the event well and produces a supercell with a lifetime of over 6 hours. While the exact location and timing of the triggering is hard to capture the subsequent development is well simulated. The observed and simulated paths are almost parallel and intersect over the Austrian state of Salzburg where the storm went through its most intense phase. This allows to study the simulated storm in detail. We show that the combination of an approaching cold front, alpine pumping, residual cold pools and an approaching trough led to the intense development of 2 August.

Two sensitivity tests are presented. The first test consists of two simulations with smoothed and flattened Alps respectively. The simulations are designed to test if the fine scale features of the terrain had a large impact on the development of the supercell and to test the effect of the Alpine ridge as a whole. The smooth simulation produces a supercell with a shorter life cycle of about 90 minutes which developed further south close to high terrain and the flat simulation does not produce any supercells. Instead, it simulates a squall line parallel to and ahead of the cold front.

The second test is run without surface sensible heat flux to explore the role of thermally driven circulations. They redistributed moisture from the surface in the valleys over the ridges and peaks and also caused deeper mixing of the boundary layer, allowing more energy to accumulate. However, even with higher CAPE values this sensitivity test shows a weaker and less organized convective storm.