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The Alps - a generator of tornadoes?

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How can the Alps generate tornadoes? Here, we propose the following explanation: PV-banners, originating from the western boundary of the Alps during southwesterly flow, may extend up to some 100 km downwind. The associated channelled flow streamers may produce strong vertical shear in the layers above the ground. That shear favors tornadic supercell storms. It can be expected that tornadic supercell storms preferably develop in the regions of these flow streamers, that is, in a strip extending from the Jura mountains at the boundary of France/Switzerland towards the Black Forest in >Southern Germany. In contrast, non-tornadic supercell storms and ordinary hailstorms may develop in other regions as well.

This explanation is consistent with the climatological distribution of tornadoes and hail in and around Switzerland. The tornado climatology (e.g., discussed by Dotzek et al., this volume) shows a distinct concentration of tornadic events along the Jura and the Black Forest. In contrast, hail frequency is largest in the prealpine regions of Central Switzerland although a secondary maximum exists in the Jura mountains. Central Switzerland is in the wind shadow of the Alps during southwesterly flow. Therefore, vertical wind shear at low layers is not conductive for the formation of tornadoes in that region.

In order to investigate the given explanation furthermore, we show an analysis of the meteorological environment of the 2 June 1999 storm (Walker and Schmid, this volume) on the mesoscale. That storm was supercellular and produced heavy hail damage and a funnel in the Black Forest. Radiosoundings, wind profiler data, ground measurements and simulations with a mesoscale numerical model demonstrate the existence of a channeled flow streamer at low layers (850 hPa) that originated at the western boundary of the Alps and apparently contributed to the specific tornadic potential of that supercell storm.