Hailstorm distribution in the Alpine area: a long-term, radar-based analysis over complex orography

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Intense hailstorms regularly affect the Alpine area, causing substantial damage to agriculture, forest, buildings, cars and infrastructure. In Switzerland severe summer storms belong to the costliest high-impact weather events. A deeper knowledge of the dynamics and the physics of these phenomena as well as of their interaction with the complex orography is required. Even if the employment of weather radars over complex orography is challenging, they represent the best solution for investigating high impact events like hailstorm with satisfying temporal and spatial resolutions. For this purpose, two radar-based hail detection products, namely the Probability Of Hail (POH) and the Maximal Expected Severe Hail Size (MESHS), have been reprocessed for the extended convective season (April-September) between 2002 and 2013. The hail products computation is based on high resolution data provided by the Swiss weather radar network as well as on the Swiss regional numerical model COSMO-7. The result is a comprehensive hail distribution map, which highlights regional and macro-regional differences considering different temporal scales. Seasonal and monthly variability of hail occurrence as well as the diurnal cycle are analyzed. The main meteorological conditions leading to hailstorms over different regions are investigated using the weather-type classification based on wind directions (surface and 500 hPa) as well as on mean sea level pressure and 500 hPa geopotential. Furthermore, a rich hailstorm database constituted by more than 100’000 cells has been created by merging a radar tracking algorithm and the two considered hail products. The aim is to investigate a possible dependence between hailstorm development and the synoptic triggering (fronts). The results are discussed considering the challenges of using radar-based hail products over complex terrain. Furthermore, in order to assess the quality of the hail products, a global validation based on an independent data set of insurance losses is presented.