ECSS2023-56, updated on 31 Oct 2023
https://doi.org/10.5194/ecss2023-56
11th European Conference on Severe Storms

Hail time series from radar proxies for decadal variability of hail in Switzerland

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In Switzerland hail regularly causes substantial damage to agriculture, cars, and infrastructure. However, addressing hail damage is challenging, as hail is related to severe thunderstorms, one of the most complex atmospheric phenomena due to its small spatial scale, vigorous development, and intricate physical interactions. In a changing climate, hail frequency and its patterns of occurrence may change, with potentially negative ramifications, e.g. when considering agricultural losses. According to the new Swiss hail climatologies (Madonna et al. 2018; Nisi et al. 2016; Nisi et al. 2020) there is a significant difference between the interannual hail variability on the north and south sides of the Alps. Understanding the drivers of this variability is essential for possible adaptation strategies. In contrast to North America, where important drivers of interannual variability of severe convection are well studied (see Tippett et al. 2015 and Allen et al. 2020), a comprehensive analysis of the year-to-year variability of hail in Switzerland has only been done for the last 20 years (in preparation by Katharina Schröer[2]). A long-term analysis, however, is still missing.

Therefore, this study presents a daily hail time series for Northern and Southern Switzerland from 1950 to today. The time series is produced from radar hail proxies and ERA-5 reanalysis data. Daily POH (Probability of Hail) data from MeteoSwiss is used to identify haildays in the region north and south of the Alps (plus 140km radar buffer) from 2002 to 2021 for the hail months April - September. The decision hailday yes/no is based on surpassing a POH ≥ 80 for a certain minimum footprint area of the domains. Then, a logistic regression model is constructed for each domain to predict the occurrence of a hailday depending on various environmental variables and indices. 70 different variables were tested. The predictors were chosen based on model performance, collinearity, and expert judgement. With the two best models, haildays are reconstructed back to 1950 for each region. The time series is then used to study the local and remote drivers of interannual variability, e.g. central European weather types, large-scale variability patterns, etc., as well as to investigate past changes or shifts in hailstorm seasonality. With this knowledge, we could improve our understanding of the meteorological-climatological variability, and, with the help of climate scenarios, infer about possible changes in the future.