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Long-Term Trends and Drivers of Hailstorms in Switzerland

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Climate change affects the severity and frequency of extreme meteorological events, including hailstorms. In this regard, it is imperative to understand the factors driving the intra- and interannual variability of hailstorms. In Switzerland, this remains insufficiently understood. To address this knowledge gap, our study conducts a long-term analysis to identify potential drivers and precursors of Swiss hailstorm variability. Due to the lack of long-term data on Swiss hailstorms, we developed statistical models reconstructing hail days from 1959 to 2022, utilizing radar-based hail observations and environmental data from ERA-5. Our hailday time series shows a statistically significant positive trend in yearly hail days in both southern and northern Switzerland. This trend is mainly attributed to heightened atmospheric instability and moisture content evident in recent decades' ERA-5 data. Noteworthy natural variability is observed in both regions. To delve into the large-scale mechanisms influencing Swiss hail activity, our study uses composites to explore potential drivers and precursors. Those include soil moisture conditions, sea surface temperature anomalies, large-scale variability patterns (Piper and Kunz 2017), central European weather types (e.g., Rohrer et al. 2018), cold fronts (Schemm et al. 2015, 2016), and atmospheric blocks (e.g. Barras et al. 2021).