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Characterization of space-time rainfall patterns over Switzerland based on high-resolution radar images

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Rainfall is generated by diverse and complex processes that produce rain fields with a large variability of patterns. High-resolution measurements of rainfall, provided for instance by networks of terrestrial weather radars, allow observing the spatial variability of rainfall patterns and its temporal evolution. The characterization of these space-time rainfall patterns is important for both the understanding of rain generation processes and the study of environmental impacts of rainfall on hydrology, erosion or plants growth, among others.

Here we propose to study rainfall patterns using image processing methods on high-resolution radar images (1km x 1km x 1min) over Switzerland. The time series of radar images is first segmented in rain events. Then, the spatial structure of each rain event is characterized by computing statistics over several geometrical indices extracted from radar images, by adapting to the context of mid-latitude rainfalls the indices proposed by Aghakouchak, Nasrollahi et al. (2011) and Zick and Matyas (2016) for tropical rainfall characterization. Finally, the dynamics of rainfall patterns is characterized by estimating rain advection through image correlation, and by quantifying the temporal morphing of spatial patterns in a Lagrangian reference frame, where radar images are re-projected to cancel out rain advection.

Two years of data (2015 - 2016) are used to investigate the variability of rainfall patterns over Switzerland. Typical values of the indicators measuring rainfall patterns and their dynamics are extracted for different areas, namely the Jura Mountain, the Swiss Plateau and the Alps. These measures of rainfall variability could be subsequently used to parameterize local weather generators or to investigate the relationships between rainfall patterns and atmospheric synoptic conditions.

References:

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