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Using a frozen turbulence hypothesis to extrapolate catchment-sized precipitation distributions from highly localized data.

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Measuring the precipitation in a catchment area can often be difficult, as there may be a lack of data. Radar data can provide data for most locations on the planet, but are limited in their resolution and accuracy. Weather station data may provide very accurate and highly resolved data, at the cost of being highly localized.

In this project we apply a "frozen turbulence" hypothesis to precipitation patterns. Under this hypothesis the spatial arrangement of a precipitating cloud is considered as not changing in time. By using this assumption, we intend to use the data from a weather station to extrapolate the distribution of precipitation over an area. This would then enable a single weather station to provide meaningful spatial data on the precipitation in a drainage basin.

By averaging the same set of radar data across different temporal and spatial resolutions, we will have multiple datasets containing the same events, but recorded at differing resolutions. The best resolution dataset then becomes a proxy for a weather station measurement. Precipitation distributions made from these datasets were then made and compared to each other, and found to have a high degree of similarity. Specifically, a distribution of precipitation made from low temporal, high spatial resolution data was found to have a high degree of similarity with a distribution made from high temporal, low spatial resolution data. This matches previous results (Haerter et al. 2015), with some differences due to seasonal variations.

To further explore the method and its limitations a statistical simulation is deemed necessary. By using a Monte-Carlo style simulation where clouds are initialized outside a simulated recording area and then moved through the importance of different features can be analyzed. These are features like cloud size or advection velocity. Developing the idea further, we intend to move beyond using radar data as a proxy, and apply the method to weather station data from, for example, the wegenernet in Austria.

References: Jan O. Haerter, Bastian Eggert, Christopher Moseley, Claudio Piani, and Peter Berg (2015). Statistical precipitation bias correction of gridded model data using point measurements. Geophysical Research Letters, 42, 1919-1929, doi:10.1002/2015GL063188