Spatial variation of occurrence of cloudburst events from a high-density historical rainfall observation network

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Rates of cloudbursts and their spatial variations across Denmark are studied using daily precipitation sums from a historical rainfall observation network with 161 stations covering the period 1914-2010. To estimate cloudburst occurrence from the daily sums, we use another network of stations of hourly rainfall sums, where each station has data from the mid-1980's onwards. By choosing a realistic cloudburst threshold of e.g., 11.5 mm on the hourly sum, we consider each day a cloudburst/no-cloudburst day according to whether the threshold was exceeded at any hour during that day or not. The binary variable cloudburst/no-cloudburst is then related to the daily sum by logistic regression giving the probability of cloudburst occurrence depending on the daily total. The logistic model is validated using leave-one-out cross-validation and other approaches.

The logistic relation is applied to the daily sums from the historical network giving an estimate of the number of cloudbursts per year for each station in the network. We find significant regional differences in climatological cloudburst occurrence across Denmark. The significance of these differences is further quantified using Moran's I and other tests.

We suggest that the present approach, which has shown skillful for Denmark, could be applied to other regions of the World also.