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Reliable rain rates from optical satellite sensors - a random forests-based approach for the hourly retrieval of rainfall rates from Meteosat SEVIRI

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Many ecological and biodiversity-oriented projects require area-wide precipitation information and satellite-based rainfall retrievals are often the only option. Using optical and microphysical cloud property retrievals, area-wide information about the distribution of precipitating clouds can generally be provided from optical sensors aboard geostationary (GEO) weather satellites. However, the retrieval of spatio-temporal high resolution rainfall amounts from such sensors bears large uncertainties.

In existing optical retrievals, the rainfall rate is generally retrieved as a function of the cloud-top temperature which leads to sufficient results for deep-convective systems but such a concept is inappropriate for any kind of advective/stratiform precipitation formation processes. To overcome this drawback, several authors suggest to use optical and microphysical cloud parameters not only for the rain-area delineation but also for the rain rate retrieval.

In the present study, a method has been developed to estimate hourly rainfall rates using cloud physical properties retrieved from MSG SEVIRI data. The rainfall rate assignment is realized by using an ensemble classification and regression technique, called random forests. This method is already widely established in other disciplines, but has not yet been utilized extensively by climatologists. Random forests is used to assign rainfall rates to already identified rain areas in a two-step approach. First, the rain area is separated into areas of precipitation processes. Next, rainfall rates are assigned to these areas.

For the development and validation of the new technique, radar-based precipitation data of the German Weather Service is used. The so-called RADOLAN RW product provide gauge-adjusted hourly precipitation amounts at a temporal resolution of one hour.

Germany is chosen as the study area of the new technique. The region can be regarded as sufficiently representative for mid-latitudes precipitation formation processes since it is dominated by frontally induced precipitation processes in connection with extra-tropical cyclones.