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Rainfall index mapping in mountainous regions: links to the physics of orographic rainfall

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In regional frequency analysis the most critical points is mapping the spatial variability of the expectation of the random variable under analysis. When rainfall is of concern, this parameter is referred as “Rainfall Index”. Traditional mapping methods rely mainly on purely geostatistical interpolation. They do not use any information provided by the physics of the processes involved: this is the main weakness of these methods. Recently some attempts to link atmospheric physics and cloud microphysics to the spatial variability of rainfall cumulated over long periods (e.g. month, year) has been made. Starting from these pioneer works a simple, objective methodology for rainfall index mapping is presented. Short duration orographic rainfall is analysed. The spatial variability of the expected value for the annual maxima cumulated on time windows up to 24 hours is related to local orography and climatology of atmospheric disturbances. The relevant parameters describing orography and atmospheric disturbances are singled-out using a simple linear steady-state condensation-advection model for orographic rainfall. Observations taken along the North-western Alps and Apennines are used. It is shown that starting from the physics of orographic rainfall the main parameters affecting rainfall index spatial variability can be singled out in an objective way. With the proposed method up to 80% of the observed spatial variability can be explained.