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Effect of raingage density, position and interpolation on rainfall-discharge modelling

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Precipitation traditionally observed using raingages or weather stations, is one of the main parameters that have direct impact on runoff production. Precipitation data require a preliminary spatial interpolation prior to hydrological modeling. The accuracy of modelling result depends on the accuracy of the interpolated spatial rainfall which differs according to different interpolation methods. The accuracy of the interpolated spatial rainfall is usually determined by cross-validation method. The objective of this study is to assess the different interpolation methods of daily rainfall at the watershed scale through hydrological modelling and to explore the best methods that provide a good long term simulation.

Four versions of geostatistics: Ordinary Kriging (ORK), Universal Kriging (UNK), Kriging with External Dridft (KED) and Ordinary Cokriging (OCK) and two types of deterministic methods: Thiessen polygon (THI) and Inverse Distance Weighting (IDW) are used to produce 30-year daily rainfall inputs for a distributed physically-based hydrological model (EPIC-GRID). This work is conducted in the Ourthe and Ambleve nested catchments, located in the Ardennes hilly landscape in the Walloon region, Belgium. The total catchment area is 2908 km^2, lies between 67 and 693 m in elevation. The multivariate geostatistics (KED and OCK) are also used by incorporating elevation as external data to improve the rainfall prediction. This work also aims at analysing the effect of different raingage densities and position used for interpolation, on the stream flow modelled to get insight in terms of the capability and limitation of the geostatistical methods. The number of raingage varies from 70, 60, 50, 40, 30, 20, 8 to 4 stations located in and surrounding the catchment area. In the latter case, we try to use different positions: around the catchment and only a part of the catchment. The result shows that the simple method like THI fails to capture the rainfall and to produce good flow simulation when using 4 raingages. The KED and UNK are comparable to other methods for a raingage case in which stations are located around the catchment area, especially in the high elevation catchment but the worst methods for other raingage position cases where the rainfall stations are located only at a part and mostly outside of the catchment area. However, three methods (IDW, ORK and OCK) can overcome this problem since they are more robust and can provide good performance of simulation in all raingage densities.

When using 70, 60, 50, 40, 30, 20, 8 raingages in the catchment area (2908 km^2), no substantial differences in model performance are observed.