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Rainfall-runoff modelling of volcanic islands for future risk assessment (and beyond)

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Volcanic islands are often densely populated and attract large numbers of tourists each year. Climate change may alter weather related risks like floods on these islands. They have often complex orography that influences the precipitation patterns. For impact assessments therefore, this complexity calls for detailed modelling. As part as part of the H2020 European Climate Prediction System project (https://www.eucp-project.eu/) we aim investigating the usage of the new generation convection-permitting regional climate models (Ban et al., accepted for publication 2021) for future flood risk and water security assessments.

Here we focus on the Lesser Antilles and La Reunion that are part of EU's outermost regions. We have setup distributed hydrological wflow_sbm models at ~1km2 resolution for each island following the approaches of Imhoff et al (2020) and Eilander et al. (2021). Validation of these models is difficult because of the poor quality of available precipitation data sources and limited discharge observations records if available at all. Still, for La Reunion, we show that wflow_sbm performs well once driven with high resolution gridded rainfall (provided by MeteoFrance). CHIRPS rainfall (Funk et al., 2014) shows potential in some seasons but leads to significant underestimation of flow for other seasons. Similar behavior is obtained for rivers on Guadeloupe and Martinique islands in the Lesser Antilles (where high-quality gridded rainfall data is lacking). To further validate the approach/models for the Lesser Antilles, we also setup a wflow_sbm model for the whole of the Dominican Republic (including Haiti) and compared the wflow_sbm model against available discharge observations using both ERA5, CHIRPS and MSWEP2.0 as rainfall sources.

Next step in the project will be to force the wflow_sbm model for La Reunion with future climate projections obtained with AROME. For the Lesser Antilles, we will force the wflow_sbm models using pseudo global warming scenarios.

Besides the intended use for flood risk (incl. operational forecasting) and water resources management, these high-resolution hydrological models and climate scenarios may be helpful in exploring future changes to river water salinization, inflows of sediment and nutrient/pollutants to nearby coastal waters and coral reefs.

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