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Combining hydrological modeling and satellite observation to estimate the hydrological regime of non-perennial rivers

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Accurate mapping and classification of non-perennial rivers (NPRs) is currently not available. However, in EU Member states, the implementation of the Water Framework Directive (WFD, 2000) requires continuous measurements or modeling of the natural flow rate in all water bodies. Recent studies have shown that the use of multispectral satellite imagery can effectively provide observations of flow or non-flow conditions with temporal resolution of about 5 days and limited to sections sufficiently wide (greater than around 30 m) and without vegetation cover. In addition, areas and periods with high cloud cover can lead to limitations on the availability of satellite imagery. On the other hand, the hydrological models require a large amount of data for the simulation of the water cycle in basins. The lack of gauging stations – typical condition for NPRs - for calibrating the models, and the fact that most of the models are constructed with reference to perennial rivers, make them unsuitable for simulating the hydrological regime of temporary waterbodies. Within the framework of the RIVERTEMP project [Erasmus+ 2022-1-IT02-KA220-HED-000086223], a methodology was created for combining hydrological modeling and satellite monitoring for determining the hydrological status of NPRs, using Keritis river basin (Chania, Greece) as a case study in the period 2019-2021. The analysis of the satellite images showed that in 69.5% of the observations the status of Keritis is “flowing” while in 30.5% is “ponding”. We used hydrological modeling to simulate river flows, then we calibrated the model by comparison with satellite observations and successively filled the date gaps of satellites. The comparison between satellite classification and modeled daily flowrate allowed the extraction of significant flow rate values, then used as threshold values to foresee the hydrological condition. This analysis showed that 59.6% of the results characterize the status of Keritis as “flowing”, 37% as “ponding” and 3.4% as "dry". The research results show that classified satellite data can be used to validate the prediction of hydrological models and, in turn, the results of hydrological model simulations can be used for the estimation of the hydrological conditions of NPRs when and where satellite images are not available.