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Advanced Integrated Hydrological Modelling (AIHM) for water resource balance, management and control at catchment scale

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The work deals with an advanced integrated hydrological modelling (AIHM) for water resource management at catchment scale based on multisource data sourcing coupled to distributed numerical model. The main rationale refers to the development and implementation of an advanced computing hydrological routing of a regional spatial decision support system (SDSS) addressed to the integrated land and resources management as well as human and natural risks. In particular, among the operative products, the project envisages the structuring and implementation of a hydrological module of an expandable SDSS based on open-data catalogues, able to manage and display both the basic information, including the relative metadata, and the elaboration and processing results with open-source change-detecting codes and hydrological modelling. The SDSS includes the development of integrative methodologies for systematic and continuous catchment monitoring, interfaced in an open source WebGIS environment dialoguing with the Regional Spatial Data Infrastructure (RSDI). The general SDSS as well as the single hydrological routine provides the integration of ground and remotely sensed data with Open Source Information technologies for basic and advanced analyses and web-publishing of geographic data for a simple and intuitive end-user consultation. Geographic data are processed through the interoperability WMS standards defined by the OGC by implementing processing techniques for the production of territorial information, based on PSInSAR and change detection methodologies widely and robustly implemented in the analysis of extended targets like basin and sub-basin areas and/or coastal zones. In such a context, the proposed AIHM provides as first step a detailed historical analysis of the whole of data and measures available from different sources and referred to distributed rainfall, temperature, water discharge and evapotranspiration gauges coupled to a multitemporal change detection analyses of DEM, technical map, land use, soil properties and urban areas. All the analyses refer to 20x20 grid as optimal spatial resolution derived from multisource data, satellite, topographic and Lidar as well. The second step leads to the effective runoff computing based on detailed geological and pedological studies and implementing the Soil Conservation Service method to provide suitable values of CN all over the catchment. The final values of CN adopted in the modelisation correspond to medium-high saturation grounds (CNIII). Furthermore, the processing routine of the catchment hydrological model was developed using the open source HEC-HMS implemented in Q-GIS environment.
The numerical results were validated on observed time series of water discharge data measured on the inlet cross section of Pertusillo reservoir along the Agri River in Basilicata Region (Southern Italy). The routines implemented refer to monthly and yearly water balance as well as event scale analysis robustly supporting the short and medium planning and decision-making phases as pre-operational and operational tools for both fields of water resources management at catchment scale, exploitable to regional and interregional analyses, and civil protection activities working at the event scale.