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A distributed hydrologic model for the estimation of the design flood and for the hydraulic safety of existing dams in Sardinia (Italy)

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The recent floods observed in 2004 and 2008 in Sardinia (Italy) showed a significant flood increase in magnitude and frequency and put the attention on the problem of the hydraulic safety of existing dams. Thirty dams built for both electric production and water supply for irrigation and civil uses during the 1920-1960 are present in Sardinia (Italy).
The distributed hydrologic model is an event model (FEST) which assesses runoff through a simplified approach based on Soil Conservation Service equations and runoff propagation through the Muskingum-Cunge approach. The FEST needs the calibration of different parameters: 1) the critical support area that defines the minimum drainage area required to initiate a channel, 2) the ratio between cross-section width and flood flow depth for hillslope, 3) the hillslope values of the Gaulckler-Stickler roughness coefficient, and 4) the Curve Number obtained/extracted from the landscape characteristics of each basin.
The data collection of numerous historical flood observations of the Sardinian basins allow for the first time to accurately calibrate an hydrologic model for the Sardinian basins, characterized by hortonian runoff mechanisms typically, steep hillslopes and thin soils. Areas of the catchments are between 4 and 3147 Km2 and the basins are characterized by an high variability of the landscape characteristics such as geology, topography, soil, land use and vegetation.
Using the calibrated hydrologic model and the synthetic design hyetograph the design floods of the dams are estimated. The comparison between peak flows of the generated design floods and those estimated using typical regionalized statistical methods (based for Sardinian studies on two components extreme value (TCEV) and logarithmic probabilistic distributions) shows contradiction and interesting results. For large scale basin (> 200 km2) the two contrasting methods agree, while for small basins the proposed method underestimates the peak respect to the values estimated by the regionalized statistical methods, suggesting a strong revision of the regionalized statistical methods now available over Sardinia.