Geophysical Research Abstracts,
Vol. 11, EGU2009-11311, 2009
EGU General Assembly 2009

Flash flood warning in ungauged basins by use of the Flash Flood Guidance and model-based runoff thresholds

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We investigate here the use of the Flash Flood Guidance (FFG) method and a method of model-based threshold runoff computation to improve the accuracy of flash flood forecasts at ungauged locations. The methodology proposed in this paper requires running a lumped hydrological model to derive flood frequencies at the outlet of the ungauged basin under consideration, and then to derive the threshold runoff from these model-based discharges. The study examines the potential of this method to account for the hydrologic model uncertainty and for biases originated by lack of model calibration, which is the typical condition in ungauged basins.
Experiments to validate this approach involve the implementation of a semi-distributed continuous rainfall-runoff model and the operation of the FFG method over four basins located in the central-eastern Italian Alps and ranging in size from 75.2 km2 to 213.7 km2 . The model is calibrated on two larger basins and the model parameters are transposed to the other two basins to simulate operations in ungauged basins. The FFG method is applied by using the 2-yr discharge as the threshold runoff. The threshold runoff is derived both by using local discharge statistics and the model-based approach advocated here. Examination of the results obtained by this comparison shows that the use of model-based threshold leads to improvements in both gauged and ungauged situations. Overall, the Critical Success Index (CSI) increases by 12% for gauged basins and by 31% for ungauged basins by using the model-based threshold with respect to use of local data. As expected, the increase of CSI is more remarkable for ungauged basins, due to lack of local model calibration and the greater likelihood of occurrence of a simulation bias in model application over these basins. This shows that the method of threshold runoff computation provides an inherent bias correction to reduce systematic errors in model applications to ungauged (and gauged) basins.