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Effects of Rainfall Prediction in the Flood Forecasting of the Tiber River in Rome

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In order to protect Rome from extreme floods propagating along the Tiber River, two flood forecasting models were recently proposed by the authors: a conceptual hydrological-hydraulic model (TFF – Tevere Flood Forecasting) and a data driven model based on Artificial Neural Network (ANN). To forecast water levels in Rome, both these models utilize observations of rainfall and discharge in the gauging stations located in the meddle-lower Tiber valley and do not include forecast of rainfall. According to this assumption, the water levels in Rome can be forecasted with a lead time of 12 hours using the TFF model and with a lead time slightly greater (14-16 hours) using the ANN model.

This lead time depend on the dynamics of the formation and the propagation of the flood wave in meddle-lower Tiber valley. The catchment area of the Tiber River in Rome is 16,000 km2, approximately. The catchment upstream of the Corbara dam is approximately 6,000 km2; this reservoir, which is located about 150 km north from Rome, has an active storage capacity of 165 hm3 and disconnect the floods coming from the upper Tiber valley from the floods in the meddle-lower valley. Downstream of Corbara dam, the contributions of the main three tributaries are observed in stream gauging stations; the contribution of 37 small tributaries, located in the lower valley and whose catchment area is about 3000 km2 at all, is unknown and, consequently, must be computed by means of rainfall-runoff procedure in the TFF model. However these ungauged tributaries play a relevant role in the flood propagation. The lower Tiber valley is wide, so that the peak the flood wave released from Corbara dam, with the contribution of the main tributaries, can be reduced by the lamination due to the inundation of the floodplains. On the contrary, if the contribution of the ungauged tributaries is relevant, the peak of the flood wave coming from the meddle Tiber valley does not reduce and relevant discharges may reach Rome. The sum of the concentration time and travel time through the river network to Rome for most of the 37 ungauged tributaries is greater than 10 hours and this influences significantly the lead time. This paper deals with the analysis of the effects of the introduction of rainfall prediction for the 37 ungauged tributaries in both the flood forecasting models on the lead time and on the uncertainties on the forecasted water levels in Rome. More specifically the errors in the prediction of both total rainfall and rainfall time distribution are analyzed and discussed.

Keywords: real-time forecasting, rainfall prediction, lead time