Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02626, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02626
EGU General Assembly 2008

A conceptual and neural network model for real time flood forecasting of Tiber river in Rome

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Rome is subjected to a non negligible risk of inundation when extreme floods (characterized by a return period of about 200 years) propagate along the Tiber River. The authors proposed in the past the mathematical model TFF (*TEVERE* FLOOD FORECASTING) for real time forecasting of hourly discharge at *Ripetta* gauging station in Rome. This is a conceptual model constituted by a semi-distributed rainfall-runoff model applied on 37 ungauged sub-basins covering about 30% of the catchment area of the Tiber River in Rome, and a flood routing model. The parameters of the flood routing model were calibrated offline and held constant during the forecasting computations. The parameters of the rainfall-runoff model are calibrated during the event at any time step via an adaptive procedure.

The original version of the semi-distributed rainfall-runoff model (*TEVERE BASIN*) requires 13 parameters, that are estimated by means of a regional analysis. Four of them, referring to surface runoff, are related to morphological characteristics of the sub-basins (area, time of concentration) via linear correlations; the remaining 9, referring to infiltration and subsurface flow, are related to the SCS-CN Curve Number of the storm via linear correlations. All the linear correlations were calibrated offline. Consequently, the model requires, for each of the 37 ungauged sub-basins, only one parameter: the ratio $r = CN_s / CN_{II}$ between the value of the CN_s of the storm and CN_{II}, the value in normal antecedent moisture conditions deduced from soil type and land use maps. In previous work we identified 3 homogeneous zones (each of them

included several sub-basins) where the value of r can be considered constant; as a consequence the number of TFF model parameters to be calibrated during the event at any time step is 3.

The aim of present work is to investigate the possibility of simplifying the structure of the *TEVERE BASIN* model and to reduce the number of the TFF model parameters to be calibrated online. The first goal was achieved by simplifying the schematisation of the subsurface flow component: in this way the number of the model parameters decreased from 13 to 10. The performance of this new simplified model, evaluated in terms of reproduction of volume, peak discharge, peak time and duration, are not statistically different from the performance of the original model. The performance of the two models is compared by reproducing more than 70 floods observed on 12 gauged sub-basins. New linear correlation equations are determined. The second goal was achieved by considering r constant for all sub-basins and introducing a second parameter, assumed constant for all the ungauged sub-basins, r_2= k_s/k_a ratio between the values of the k parameter of the Gamma IUH for the surface runoff; k_s is the value of the event and k_a is the average value deduced from the linear correlation with the time of concentration. The performance of the new version of the TFF model is evaluated by simulating some of the more relevant recent floods. A neural network model has also been developed simultaneously and the performance will be compared to the conceptual model on these same flood events.