Geophysical Research Abstracts
Vol. 15, EGU2013-14004, 2013
EGU General Assembly 2013

Prediction in Ungauged Basins (PUB) for estimating water availability during water scarcity conditions: rainfall-runoff modelling of the ungauged diversion inflows to the Ridracoli water supply reservoir

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The Ridracoli reservoir is the main drinking water supply reservoir serving the whole Romagna region, in Northern Italy. Such water supply system has a crucial role in an area where the different characteristics of the communities to be served, their size, the mass tourism and the presence of food industries highlight strong differences in drinking water needs. Its operation allows high quality drinking water supply to a million resident customers, plus a few millions of tourists during the summer of people and it reduces the need for water pumping from underground sources, and this is particularly important since the coastal area is subject also to subsidence and saline ingression into aquifers.
The system experienced water shortage conditions thrice in the last decade, in 2002, in 2007 and in autumn-winter 2011-2012, when the reservoir water storage fell below the attention and the pre-emergency thresholds, thus prompting the implementation of a set of mitigation measures, including limitations to the population's water consumption.
The reservoir receives water not only from the headwater catchment, closed at the dam, but also from four diversion watersheds, linked to the reservoir through an underground water channel. Such withdrawals are currently undersized, abstracting only a part of the streamflow exceeding the established minimum flows, due to the design of the water intake structures; it is therefore crucial understanding how the reservoir water availability might be increased through a fuller exploitation of the existing diversion catchment area.
Since one of the four diversion catchment is currently ungauged (at least at the fine temporal scale needed for keeping into account the minimum flow requirements downstream of the intakes), the study first presents the set up and parameterisation of a continuous rainfall-runoff model at hourly time-step for the three gauged diversion watersheds and for the headwater catchment: a regional parameterisation approach is then applied for modelling the streamflow originated in the fourth, ungauged, diversion watershed. Finally, the potential reservoir water availability is estimated, hypothesising to take from the diversion catchments all the streamflow exceeding the minimum flow requirements.
The results indicate that modifying the water intake structures might allow a consistent increase in the storage volumes in the reservoir during the water scarcity periods: the water available to the reservoir would in fact – on average - increase of around the 13% of the abstracted annual volume.