Impacts of climate change on the water resources of coastal Mediterranean rivers in southern France

FRANCK LESPINAS*, WOLFGANG LUDWIG and SERGE HEUSSNER

CEFREM - Centre de Formation et de Recherche sur l'Environnement Marin (UMR5110-CNRS/Université de Perpignan), Université de Perpignan, 52, avenue Paul Alduy, 66860 Perpignan, Cedex, France.

* Corresponding author:
Tel: +33-46866-1746.
Fax: +33-46866-2096.
E-mail address: franck.lespinas@univ-perp.fr

Congress sub-theme:

Session 3.2. Linking climatology, hydrology and water resources management.

Introduction

Recent climate monitoring and modelling studies revealed a general trend toward drier and warmer conditions in the Mediterranean area, both for the last and forthcoming centuries. Such a climatic evolution would lead to a decrease of water resources likely affecting ecosystems, socio-economic activities and populations. In this study, we aimed to analyse recent and future climate change and its consequences on the water resources of 6 coastal Mediterranean rivers located in southern France (Figure 1).

Objectives

1. Examine the major climatic conditions changes for the period 1965-2004 and its consequences on the water resources in the considered watersheds.

2. Build scenarios on the evolution of the water resources in the 6 considered rivers for the end of the 21st century.

Methods

Firstly, we collected a comprehensive dataset of hydrometeorological data from climatic and hydrologic stations for the period 1965-2004. A digital elevation model was used to delineate the 15 watersheds according to the geographical position of the considered hydrologic stations. Climatic parameters were spatialised and averaged for each watershed. All reconstituted hydroclimatic data time-series were submitted to trend analyses in order to detect significant trends over the study period and the consequences of the changing climatic conditions on the hydrologic variables were examined through correlation analysis and hydrological modelling.

Secondly, the climatic scenarios for the period 2070-2099 produced by the PRUDENCE project were coupled with the GR2M hydrologic model calibrated for the present conditions.

This allowed us to provide a first estimation of the possible changes in the water resources of the studied river basins at the end of the 21st century.

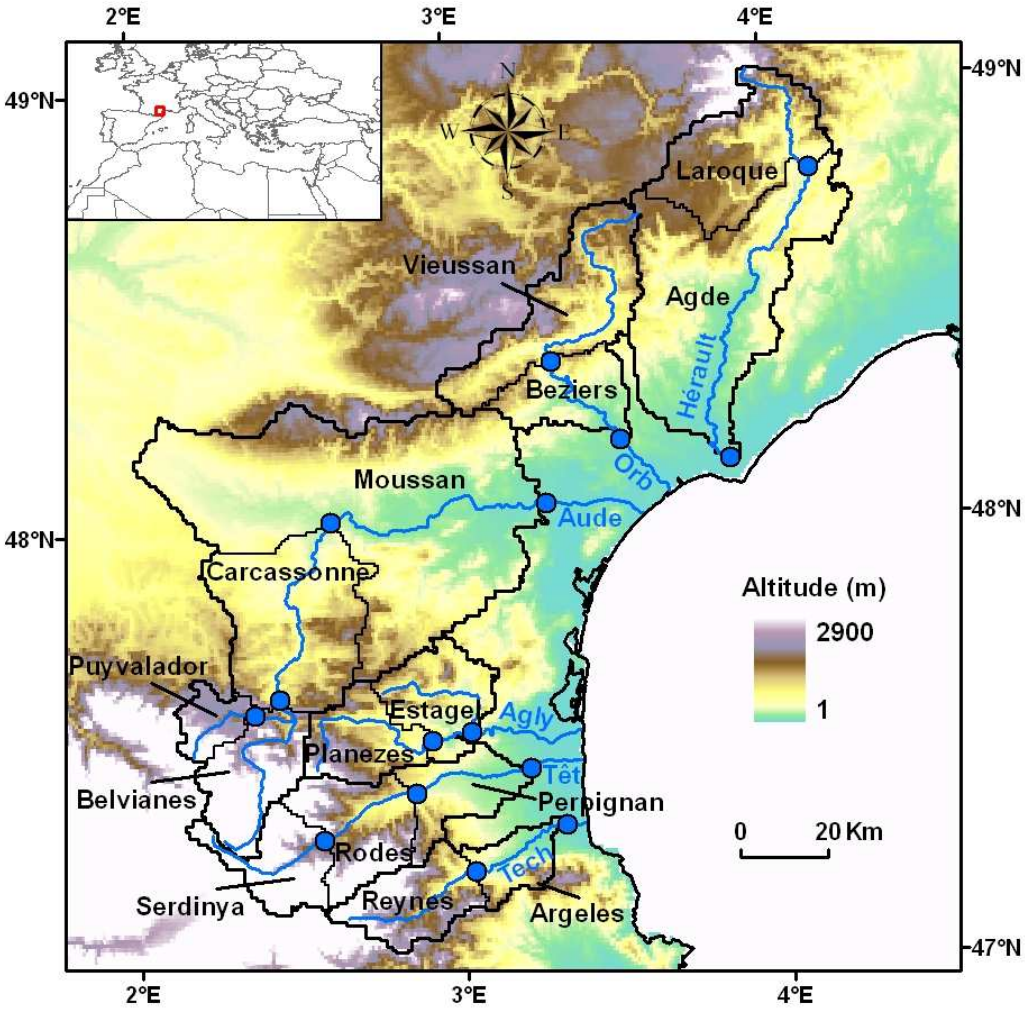

Figure 1: Location of the hydrologic stations retained in this study (blue points) and corresponding subcatchments (black lines).

Results

1965-2004 was characterised by a temperature increase of about 1.5°C, mainly because of a strong warming during spring and summer. Rainfall did not follow significant changes, except a small decrease in winter in the northernmost watersheds (Figure 2). Water discharge significantly decreased in one third of the watersheds, accounting for an overall decrease of the water resources in this area of about 20% (Figure 3). Increasing losses by evaporation processes due to the temperature increase are likely to be responsible for this, notably in the most elevated subcatchments where a major shift from solid (snow) to liquid (rain) rainfall occurred.

First results of the coupling of climatic and hydrologic models revealed a decrease of the water resources between 20 and 70% for the end of the 21st century, depending both on the considered rivers and the scenarios and climatic models we used.

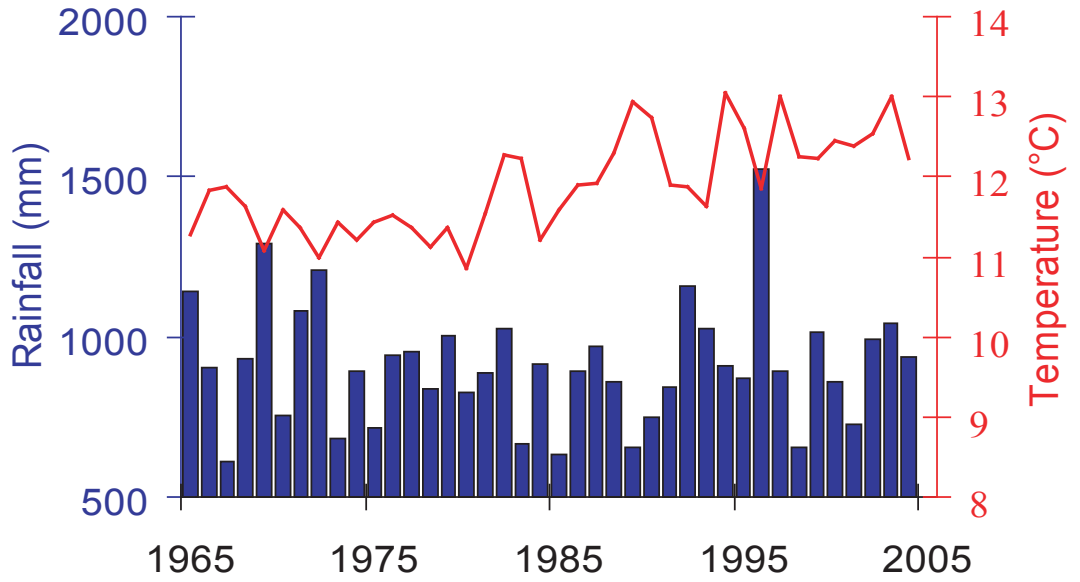

Figure 2: Evolution of total rainfall (blue charts) and temperature (red line) in the entire study area for the period 1965-2004.

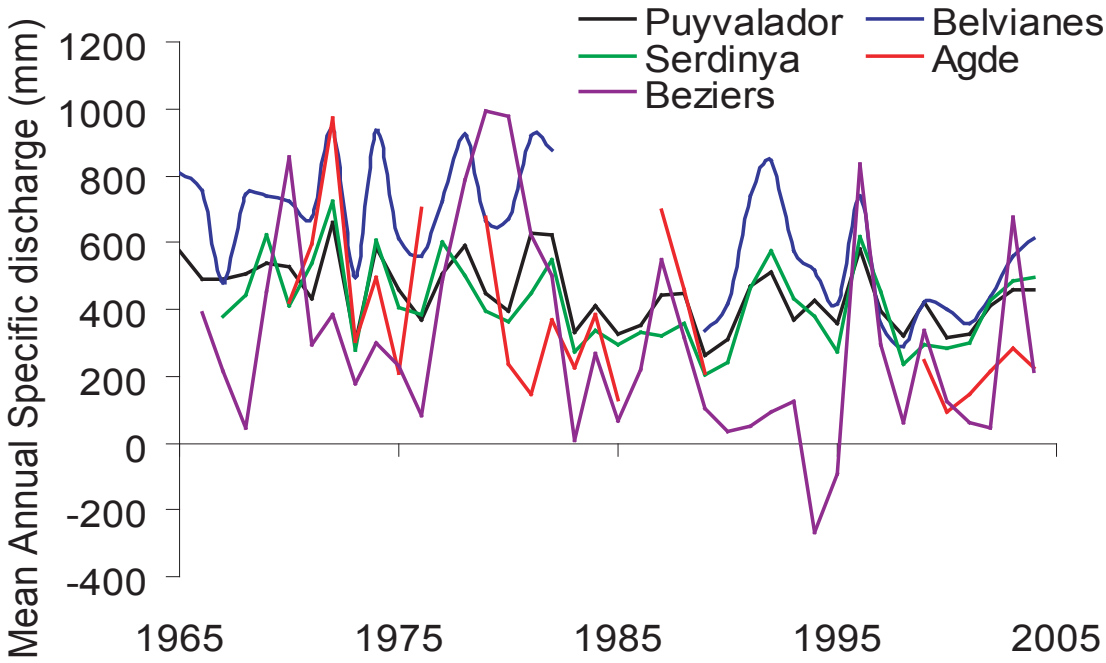

Figure 3: Evolution of the mean annual specific discharge shown only for stations for which decreasing trends are significant (p-value<0.1 according to the Mann-Kendall test).

Conclusion

Although rainfall in the studied watersheds did not change markedly during 1965-2004, our results already revealed a significant decrease in the water resources, likely related to the strong temperature increase. According to model scenarios, future climate evolution in this region will also be accompanied by decreasing rainfall and hence still extend the decline of the water resources.