

EFFECTS OF THE RECENT CLIMATE CHANGES TO THE WATER BUDGET OF A SEMI-ENCLOSED GULF IN EASTERN MEDITERRANEAN

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Abstract

An analysis of available rainfall data for the period 1955-2008 was performed to assess changes in rainfall frequency and intensity in an Aegean island, Eastern Mediterranean. A statistically significant decrease was observed for the annual rainfall height and the number of wet days, whereas no trend was observed for the occurrence of extreme events. The effects of the changes in precipitation for the functioning of a semi-enclosed gulf were then assessed using a watershed model and a water budget analysis.

Keywords: Aegean Sea, Coastal Systems, Global Change, Eastern Mediterranean

The recent climate changes probably constitute the main environmental concern facing mankind in the twenty first century [1]. The effects of changes in precipitation on the functioning of coastal systems, are probably more pronounced for small Eastern Mediterranean watersheds and the receiving water bodies that undergo rapid hydrological cycles characterized by a rather short rainfall period during winter and a dry summer.

In the present work, a time series of rainfall data (provided by the Hellenic National Meteorological Service, HNMS) were analyzed covering the period from 1955 to 2008 for the island of Lesbos, in the North-eastern Aegean and a large number of climatological indices was calculated [2] to assess local trends in precipitation. The effects of possible changes on the functioning of the Gulf of Kalloni, a semi-enclosed shallow water body surrounded by a watershed of about 413 Km² [3], were then analyzed using a watershed model and applying water budget analysis.

A statistically significant decrease ($R^2=0.1022$, $p=0.018$) was observed for annual rainfall height (Figure 1) and the number of wet days ($R^2=0.1384$, $p=0.006$) from 1955 to 2008, whereas the frequency and intensity of extreme events has shown no trend. Overall a significant trend towards dry conditions was sought for the study site, especially during the winter period.

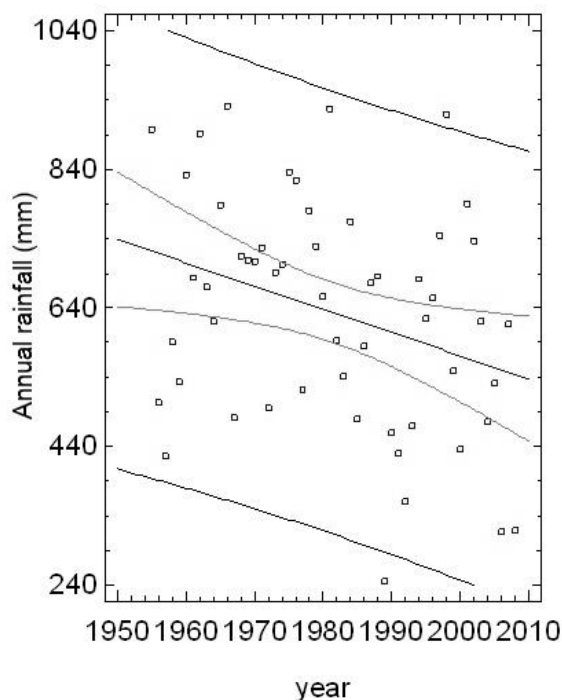


Fig. 1. Trend of annual rainfall height from 1955 to 2008.

Typical years of wet (year 1961) and dry (year 2005) conditions were used as an input to a watershed model calculating the amount of runoff on a daily basis [4]. The model output and available data were then used to analyse the water budget of the receiving reservoir. A threefold decrease in the amount of

runoff was predicted by the model (Figure 2) influencing remarkably the water budget of the gulf, although it is still functions as a dilution (during winter) and concentration (during summer) basin. However the excess of the sum of precipitation and river input over evaporation during winter has almost halved during the last decade since the decade of 1960, resulting to a remarkable decrease in the water renewal time in winter being 86 days for 1961 and 50 days for 2005.

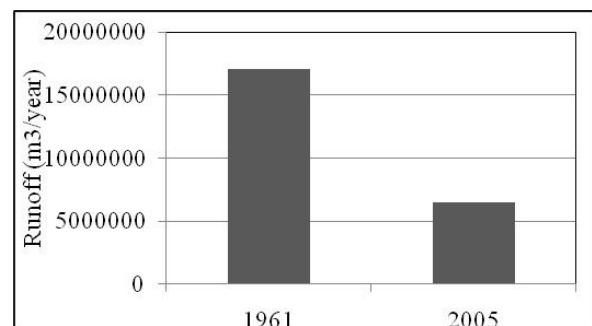


Fig. 2. Annual runoff for a typical wet (1961) and a dry (2005) year.

In conclusion a trend towards dry conditions is observed in the islands of Northern Aegean in Eastern Mediterranean affecting the water budgets of both the river basins and the receiving water bodies. These changes need to be always taken into account by policy makers in the framework of integrated coastal zone management.

References

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