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Investigation of orography impact on extreme dry spells over Greece

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Precipitation regime over Greece is controlled by the atmospheric circulation, orography sea surface temperature distribution and land/sea interaction. Previous studies have shown that the precipitation amounts are increased in Western Greece, which is located in the upstream side of the largest mountain range of the central mainland. Furthermore, the longest dry spells were identified in south eastern part of Greece during summer and in northern Greek area during winter.

The objective of this study is to investigate the impact of topography on prolonged dry periods over Greece, using the third generation hydrostatic Regional Climate Model RegCM3, which shows a noticeable improvement in the representation of the surface hydrological cycle in mountainous regions. More specifically, an attempt is made to study the distribution of prolonged dry spells during two seasons, summer of 1993 and winter of 1989, over the Greek area, under two different simulation scenarios: the first employs the real orography of the Greek area while in the second one the orography is eliminated, by transforming the models terrain code. Both simulation experiments were conducted with the high spatial resolution of 10 Km, while the MIT-Emanuel Convective Precipitation Scheme was selected for the computation of convective precipitation, as it offers more physical representation of convection compared to the other oldest schemes of RegCM.

The model was firstly validated through comparisons of the model outputs with observed precipitation amount data, employing 20 stations over Greece for the two selected seasons. The validation demonstrated that the model can simulate precipitation amount quite well over the Greek area, except for the south Dodecanese Islands, where precipitation is underestimated, and the eastern continental Greece, where the daily precipitation is overestimated.

For the identification of the extreme dry spells, the climatic index CDD (Maximum number of consecutive dry days) was employed selected, as it does not require the meaningful employment of fixed threshold values, which are not applicable for all grid points.The index was calculated both for the observational and the model data for the two seasons and further validation of the model output has been performed by calculating the differences and the standard deviation ratios of the two datasets. It was found that RegCM3 is able to simulate the distribution of dry spells with maximum duration, especially during summer.

Preliminary results of the two simulations (with and without orography) have shown that the local topography exerts a strong influence on the distribution and maximum duration of dry spells over Greece. More specifically, by the elimination of orography, duration of extreme dry spells is increased over the land for both seasons, in agreement with the precipitation decrease. On the contrary, a significant reduction of the maximum dry spells duration is depicted over central Aegean and south Ionian Sea during summer of 1993, as well as over Ionian Sea for winter of 1985. However, the uncertainties of model to depict the precipitation regime and its variability are still remaining, implying that these results should be handled with caution and further work must be carried out.

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