Geophysical Research Abstracts
Vol. 15, EGU2013-10963-1, 2013
EGU General Assembly 2013

Benefits from using combined dynamical-statistical downscaling approaches in building crop water demand scenarios in a semi-arid Mediterranean region.

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Various downscaling techniques have been developed to bridge the scale gap between global climate models (GCMs) and finer scales required to assess hydrological impacts of climate change. Although statistical downscaling (SD) has been traditionally seen as an alternative to dynamical downscaling (DD), recent works on statistical downscaling have aimed to combine the benefits of these two approaches. The overall objective of this study is to assess whether a DD processing performed before the SD permits to obtain more suitable scenarios of crop water demand. The case study presented here focuses on the north-western part of the Apulia region named Capitanata plain (South East of Italy, surface area about 4000 km2), dominated by agriculture (about 15% of the national production of cereals and olive trees) and mainly depending on surface water. The fifth-generation ECHAM model from the Max-Planck-Institute for Meteorology was adopted as GCM. The DD was carried out with the Protheus system (ENEA), while the SD was performed through a monthly quantile-quantile correction. Finally the crop water demand is estimated through the water mass-balance model G-MAP, considering monthly precipitation, monthly temperature and the major landscape features that determine the soil water balance. The latter introduces a strong non linearity with respect to the meteorological input, due to the non-linear solution of soil infiltration and moisture-dependent evapotranspiration and the threshold-based runoff mechanism, which prevents from forecasting the crop water demand as simple linear combination of the precipitation and temperature scenarios. The crop water demand scenarios resulting from the different downscaling and their combination are then compared in terms of bias, long term non stationarity and spatial variability.