

EGU21-15973, updated on 20 Oct 2021

<https://doi.org/10.5194/egusphere-egu21-15973>

EGU General Assembly 2021

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An assessment of the impact of initial soil conditions on drought and precipitation extremes by using a high-resolution regional climate model

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Soil moisture (SM) is one of the fields with a relevant role in processes involving land-atmosphere interactions, especially in regions such as the Mediterranean Europe, where coupling between those components of the climate system is very strong. The aim of this study is to address the impact of initial soil conditions on drought and precipitation extremes over the Iberian Peninsula (IP). For this purpose, a dynamical downscaling experiment has been conducted by using the Weather Research and Forecasting model (WRF) along the period 1990-2000. Two one-way nested domains has been considered: a finer domain spanning the IP, with spatial resolution around 10 km, nested within a coarser domain covering the Euro-CORDEX region at 50 km of spatial resolution.

WRF simulations have been driven with ERA-Interim reanalysis data for all fields except for SM. Initial SM conditions can be divided into three different types: wet, dry and very dry. Values corresponding to initial SM states have been calculated by combining the WRF soil texture map along with the Soil Moisture Index (SMI). For wet conditions, SMI = 1 has been assigned; for dry conditions, SMI = -0.5; and for very dry conditions, SMI = -1. For a grid point with a given texture class, field capacity, wilting point and SMI are used to obtain initial SM. Two different initial dates have been taken into account to also consider the effect of initializing at different moments in the year: 1990-01-01 00:00:00 UTC and 1990-07-01 00:00:00 UTC. Therefore, 6 experimental runs have been carried out (2 initial dates x 3 initial SM). Additionally, a control run full-driven with ERA-Interim has been conducted from 1982 to 2000 to be used as reference. In this context, the impact of initial conditions on different extreme precipitation indices (R5xDay, SDII and R10mm) and on the Standardized Precipitation Index (SPI) for drought has been addressed.

Results could help to better understand the relevance of land-atmosphere processes in climate modeling, particularly in assessing WRF sensitivity to variations in SM and its skill to detect drought and precipitation extremes. This information could be notably useful in those applications in which initial conditions are especially relevant, such as the seasonal-to-decadal climate prediction.

Keywords: soil moisture, initial conditions, precipitation extremes, drought, regional climate, Weather Research and Forecasting model

ACKNOWLEDGEMENTS: JJRC acknowledges the Spanish Ministry of Science, Innovation and Universities for the predoctoral fellowship (grant code: PRE2018-083921). This research has been carried out in the framework of the projects CGL2017-89836-R, funded by the Spanish Ministry of Economy and Competitiveness with additional FEDER funds, and B-RNM-336-UGR18, funded by FEDER / Junta de Andalucía - Ministry of Economy and Knowledge.