It is well-known that the soil state plays an essential role in the climate conditions at regional scale, especially in those regions with strong land-atmosphere coupling. In this study, the impact of different soil moisture (SM) initial conditions is explored by using a dynamical downscaling experiment. To this end, the Weather Research and Forecasting (WRF) model v3.9.1 was used to generate high-resolution climate simulations driven by the ERA-Interim reanalysis over the Iberian Peninsula (IP). The sensitivity experiment consisted of comparing a control run (CTRL) completed using the ERA-Interim soil moisture (SM) as initial conditions with a set of simulations performed under different SM initializations (very dry, dry, and wet). In this framework, the study focused on exploring the impact of the winter (DJF) soil state on the summer (JJAS) extreme temperatures using two extreme indices: the warm spell index (WSI), an index related to heat-waves, and the daily temperature range (DTR), which is strongly affected by the soil state. These results provide valuable information about the impact of the SM initial conditions on temperature extremes, and how long these affect the regional climate in this region. Additionally, these results may provide a source of knowledge about the mechanisms involved in the occurrence of extreme events such as heatwaves, which are expected to increase in frequency, duration, and magnitude under the context of climate change.

Main Model Setup

- Period of study: 10 years (1990-1999) starting on 01/01/1990.
- CTRL simulation: 18 years (1982-1999) using the ERA SM.
- Experiments: dry, wet, and very dry soil conditions.

How have initial conditions for SM been calculated?

Using the WRF soil texture map (Fig. 2), we defined the different soil initial states as:

- **very dry**: $SMI = -5$ as $\theta_{initial}$
- **dry**: $SMI = -2.5$ as $\theta_{initial}$
- **wet**: $SMI = 5$ as $\theta_{initial}$

$\theta$: soil moisture; $\theta_w$: wilting point; $\theta_f$: field capacity

Table 1: Relative differences (%) between the very dry, dry, and wet simulations and the CTRL one in terms of precipitation (pr) and actual evapotranspiration (E). In columns, the values for spring (MAM) and summer (JJA) are shown for each region.

<table>
<thead>
<tr>
<th>Region</th>
<th>MAM pr (%)</th>
<th>JJA pr (%)</th>
<th>MAM E (%)</th>
<th>JJA E (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Dry</td>
<td>32.1</td>
<td>3.7</td>
<td>18.8</td>
<td>45.1</td>
</tr>
<tr>
<td>Dry</td>
<td>35.1</td>
<td>6.7</td>
<td>22.4</td>
<td>52.3</td>
</tr>
<tr>
<td>Wet</td>
<td>23.1</td>
<td>3.3</td>
<td>16.8</td>
<td>37.2</td>
</tr>
</tbody>
</table>

WRF represents quite well the spatial patterns of the DTR, but shows more difficulties to adequately capture the WSDI behavior. The model tends to overestimate WSDI, especially for the Plateau region.

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