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A CORDEX-based study on the links between droughts and climatological risk of desertification

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The Coordinated Regional Climate Downscaling Experiment (CORDEX) datasets include a large number of simulations driven by the combination of Global and Regional Climate Models (GCMs and RCMs) over fourteen macro-regions. To perform this study, we selected 161 simulations based on 23 GCMs and 33 RCMs at 0.44° spatial resolution, and we focused on two climate scenarios, i.e. the RCP4.5 and the RCP8.5. For each simulation, we used monthly precipitation, minimum and maximum temperature from 1981 to 2100 to compute a set of indicators: to investigate drought, we selected the Standardized Precipitation-Evapotranspiration Indicator (SPEI, at 12-month accumulation scale), whilst to investigate the climatological risk of desertification we combined the FAO-UNEP Aridity Index (AI), the Köppen-Geiger climate classification (KG), and the Holdridge Life Zones (HdG). In particular, we analyzed the changes in drought frequency and severity, as well as the shifts from not-arid to arid climate, from the reference period (1981-2010) to four different warming levels (WLs), i.e. the increase of 1.5 °C, 2 °C, 3 °C, and 4 °C from pre-industrial period. We present global and continental maps and statistics about the percentage of areas projected to face an increase in both frequency and severity of meteorological drought events, as well as maps and statistics about the areas that are likely to face a climatological risk of desertification in the 21st century. We detected a few hotspots where the increasing droughts could be linked to progressive land degradation until an eventual desertification: central U.S., southern Europe, Kazakhstan and Mongolia, southern Africa, and inland Australia.