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Where will arid areas enlarge or reduce in a global warming future?

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In the last decades, rising temperatures and increased frequency of extreme meteorological events have caused a progressive shift from temperate and sub-humid areas to dry or even arid area in particular over North-Eastern Brazil, Mediterranean Region, Africa, and China. However, few sparse areas experienced the inverse process, in particular over bordering regions between dry, sub-humid, and humid regions in the tropical belt. We investigate which regions are likely to see an enlargement (or reduction) of arid areas, thus facing an increased (or decreased) risk of land degradation or desertification processes. To do that, we selected three climate indicators frequently used to classify climate zones: the FAO-UNEP Aridity Index, the Köppen-Geiger climate classification, and the Holdridge Life Zones classification. The three indicators are complementary and define climate areas depending on a peculiar scheme that makes use of precipitation, temperature, and potential evapo-transpiration (PET) monthly and annual values. We focused on the macro-class labelled as "arid climate", present in all the three indicators, and we estimated the potential risk of desertification depending on how many indicators project the advance or retreat of arid areas from recent past (1981-2010) to far future (2071-2100), under two climate scenarios (RCP4.5 and RCP8.5). The input meteorological variables derive from 110 CORDEX (COordinated Downscaling Regional Experiment) simulations – spatial resolution is 0.44° – representing the combinations between more than 15 General Circulation Models (GCMs) and 15 Regional Circulation Models (RCMs). The widest increase of arid areas through the 21st century is projected over Central United States, Patagonia, Southern Europe, Africa (Sahel, Angola, Zambia, and Botswana), Central Asia, and Australia. In Europe, two regions are likely to face a relevant desertification risk: Mediterranean region and Danube Delta.