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Global and continental changes of arid areas using the FAO Aridity Index over the periods 1951-1980 and 1981-2010

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An increase in arid areas and progressing land degradation are two of the main consequences of global climate change. In the 2nd edition of the World Atlas of Desertification (WAD), published by the United Nation Environment Program (UNEP) in 1997, a global aridity map was presented. This map was based on the Food and Agriculture Organization (FAO) Aridity Index (AI) that takes into account the annual ratio between precipitation (RR) and Potential Evapo-Transpiration (PET). According to the long-term mean value of this ratio, climate is therefore classified in hyper-arid (<0.05), arid (0.05-0.2), semi-arid (0.2-0.5), dry sub-humid (0.5-0.65), and humid (>0.65); a special case are cold climates, which occur if the mean annual PET is below 400 mm.
In the framework of the 3rd edition of the WAD, we computed new global aridity maps to improve and update the old version that was based on a single dataset (CRU dataset, Climate Research Unit of University of East Anglia) related to the 1951-80 period only. We computed the AI on two different time intervals (1951-80 and 1981-2010) in order to account for shifts in classes between the two periods and we used two different datasets: PET from CRU (version 3.2), and precipitation from the global 0.5˚x0.5˚ gridded monthly precipitation of the Global Precipitation Climatology Center (GPCC) of the Deutscher Wetterdienst (DWD). We used the GPCC Full Data Reanalysis Version 6.0, which showed a high reliability during many quality checks and is based on more stations than the CRU's precipitation counterpart.
The results show that the "arid areas" (i.e. AI <0.5) globally increased from 28.4% to 29.6% and in Northern Hemisphere the cold climate areas decreased from 26.6% to 25.4%. Comparing the aridity maps of the two periods, the areas which most remarkably moved to lower AI values ("more arid" conditions) are: Canada, Brazil, the Mediterranean Region, Eastern Europe, almost all of Africa, the Middle East, Eastern China, Borneo, and Australia. At regional or country level, a shift of one class towards a "more arid" class can be found in Alaska (U.S.), Alberta (Canada), Patagonia (Argentina), Pernambuco (Brazil), Western Peru, Spain, the Southern Sahara and North-Eastern Kalahari deserts, Rajasthan and Madhya Pradesh (India), Mongolia, the Yang-Tze Basin (China), and the North-Eastern and South-Western Australian coasts. On the other hand, Central U.S., Paraguay and Northern Argentina, Scandinavia, Northern Australia, and Western China moved to a wetter climate in the last period. Due to the low data availability, we assumed that no changes took place in Antarctica, which is meant to be under a permanent ice cap, excluding the northernmost Graham Land.