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Response of climate extremes over Southern African Monsoon Region to limiting global warming to 1.5[U+2103] instead of 2[U+2103]

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Abstract

Already vulnerable monsoon regions like those in populous Africa are expected to be hard-hit by the effects of anthropogenic global warming. Therefore, such regions could benefit from low global warming levels. Using the Community Earth System Model low-warming simulations, we study the avoided impacts over the southern Africa monsoon region (SAMR) from limiting warming to 1.5[U+2103] instead of 2[U+2103]. There is a tendency of a dryer and significant warmer conditions being projected over SAMR at the 1.5[U+2103] warming world and is amplified at the 2[U+2103] warming world with warming exceeding the mean global warming rates. Specifically, a change of 0.63[U+2103] (0.59-0.67[U+2103]) in surface temperature is projected from 1.5[U+2103] to 2[U+2103] warmer world. Consequently, extreme climate events in the SAMR are also estimated to respond to this warming albeit precipitation based extremes showing higher uncertainty levels than temperature extremes. In particular, there is a projected increase in the severity of heatwaves and the number of cumulative dry days accompanied by an increasing rainfall intensity events from 1.5 to 2[U+2103] warming in SAMR. This may have severe implications for run-off characteristics in the region especially when half of the land area here is being projected to have a 20% increase in extreme precipitation. We also estimate an increase in cumulative dry days in the SAMR where a decrease in rainfall is also estimated with warming. This may exacerbate drought occurrence in the region under a 2[U+2103] warmer climate than under a 1.5[U+2103] one. Restricting warming to 0.5[U+2103] lower than 2[U+2103] is projected to result in 5 to 10 mm/day reductions in the intensity of rainfall extremes across the SAMR. This restriction on warming is also projected to lead to 29% (27-31%) to 42% (39-48%) reduction in severity and frequency of high-temperature extreme events. Once-in-10/20-year heat extremes may also be reduced by as much as 28% (25-34%) to 37% (34-40%) from limiting warming to half a degree lower than 2[U+2103] in the region. Moreover, the probability of occurrence of the record-breaking extreme drought experienced in summer of 1991/1992 in southern Africa is projected to be reduced by about 20% (16-24%) from limiting warning to 1.5[U+2103] instead of 2[U+2103]. This probability is heavily linked to changes in temperature associated with that drought. Therefore, restricting warming to low levels may indeed translate to substantial benefits in the Southern Africa Monsoon region.