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Projected changes to Severe Thunderstorm environments as a result of 21st century warming from RegCM CORDEX-CORE simulations

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Dangerous weather related to severe thunderstorms including tornadoes, high-winds, and hail cause significant damage globally to life and property every year. Yet the impact on these storms from a warming climate remains a difficult task due to their transient nature. In this study we investigate changes in the large-scale environments in which severe thunderstorms form during 21st century warming (RCP2.6 and RCP8.5) in a group of RegCM CORDEX-CORE simulations. Severe potential is measured in terms of CAPE (Convective Available Potential Energy) and shear during the severe seasons in three regions which are known to currently be prone to severe hazards: North America, the southeastern coast of South America east of the Andes, and eastern India and Bangladesh. In every region environments supportive for severe thunderstorms are increasing during the warm season months in both RCP2.6 and RCP8.5 during the 21st century. The number of days supportive for severe thunderstorms increases by several days per season over the vast majority of each region by the end of the century. In the case of RCP2.6, where greenhouse gas forcing is relatively weak compared to RCP8.5, there is still a consistent positive trend in the impact on severe days. The simulations using RCP8.5 forcing show large changes to the annual cycle of severe weather as well as the number of days supportive for severe weather per season. In some regions, like for example Northern Argentina along the Andes mountains, the number of days with severe conditions present increases by nearly 100% by the end of the century. Analyzing the CAPE and shear trends during the 21st century we find seasonal and regionally specific changes driving the increased severe potential. 21st century surface warming is clearly driving a robust increase in CAPE in all regions, however poleward displacement of vertical shear in the future leads to the movement of severe environments over North America and South America. The results found here relate that severe impacts in the future cannot be generalized globally, and that regionally specific changes in vertical shear may drive future movement of regions prone to severe weather.