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AFRICAP - The impact of climate change on agriculture in Tanzania, Malawi, Zambia and South Africa

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Sub-Saharan Africa is one of the most food insecure regions in the world and is highly vulnerable to climate change. We use a comprehensive set of bias-corrected global (CMIP5) and regional (CORDEX-Africa) models and a new convection-permitting pan-Africa simulation (and its parameterized counterpart) to examine changes in rainfall and temperature and the impact on agricultural suitability of maize, cassava and soy in sub-Saharan Africa by 2100 (RCP8.5). This is the first time a convection-permitting projection has been used to examine agricultural suitability in Africa. Increasing temperatures and declining rainfall led to large parts of sub-Saharan Africa becoming unsuitable for multiple staple crops, which may necessitate a transition to more heat and drought resistant crops to ensure food and nutrition security. Soy was resilient to temperature increases, however maize and cassava were not, leading to declines in crop suitability. Inclusion of sensitivity to extreme temperatures led to larger declines in maize suitability than when this was excluded. The variation in rainfall projections within the multi-model ensemble was examined in detail for Tanzania, Malawi, Zambia and South Africa. In each country the range of projections included wetting and drying, but the majority of models projected rainfall declines, except in Tanzania, leading to declines in crop suitability. Overall, the CORDEX and CMIP5 models gave similar results for agricultural suitability. Explicit-convection led to more temperature extremes, but had little systematic impact on temperature and rainfall, and the resulting suitability analysis. Global model uncertainty, rather than convection parameterizations, still makes up the largest part of the uncertainty in future climate. Explicit-convection may have more impact if suitability included a more comprehensive treatment of extremes. This work highlights the key uncertainty from global climate projections for crop suitability projections, and the need for improved information on sensitivities of African crops to extremes, in order to give better predictions and make better use of the new generation of explicit-convection models.