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30 years of regional climate modeling: Where are we and where are we going next?

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The year 2019 marks the thirtieth anniversary of the development of the first Regional Climate Model (RCM) and thus offers an excellent opportunity to reflect on the progress in regional modeling research and on the main challenges lying ahead. RCMs were developed mostly to provide fine scale climate information for application to impact studies, but they have evolved into general and multi-purpose modeling tools. Among the main achievements in RCM research the focus is on: the development of community RCMs portable on different computing architectures and applicable to a wide variety of studies and regional contexts; the increase of model simulation length up to centennial scales, and spatial resolutions up to convection-permitting scales (few km); the development of fully coupled Regional Earth System Models (RESMs); the inception of intercomparison projects culminating in the international Coordinated Regional Climate Downscaling EXperiment (CORDEX); the extensive use of RCM simulations for impact assessments; and the involvement of the scientific community from developing countries in climate modeling research. Among the outstanding issues in need of more attention the focus is on the Added Value of using this downscaling technique and on various technical aspects concerning RCM simulations. Future directions in RCM research are discussed, with highlight on: transition to convection-permitting modeling systems; further development of RESMs including the human component; next phase of the CORDEX project and the use of RCMs in the distillation of actionable information for contribution to climate service activities.