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Convection-permitting ICON-LAM simulations as input to evaluate renewable energy potentials over southern Africa

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The largest part of the global population without reliable access to electricity lives in Africa. Here, renewable energy is a sustainable, cost efficient, and climate-friendly solution, especially given the large untapped renewable energy potential existing over the African continent. However, most renewable energy-related studies over Africa typically use input datasets at relatively coarse spatial resolutions (e.g., ERA5 at about 30km). Our objective is to produce a prototypical high-resolution dataset over southern Africa from dedicated atmospheric simulations. The data will be used with renewable energy assessment models, to eventually evaluate the renewables potentials. The hypothesis is that the high-resolution datasets provide more realistic and accurate renewable energy potential estimates. The ICOsahedral Nonhydrostatic (ICON) Numerical Weather Prediction (ICON-NWP) model is run as the operational forecast model at the German Weather Service (DWD); and we employ the same model in its Limited Area Mode (ICON-LAM) in this project. The study domain over southern Africa is chosen due to its high solar and wind energy potential. ICON-LAM dynamically downscales the global deterministic ICON-NWP forecasts dataset from a spatial grid spacing of 13km to a convection-permitting resolution of 3.3km, without convection parameterization. This southern Africa ICON-LAM implementation is novel and has not been run before. Simulations cover the time span from 2017 to 2019 with contrasting meteorological conditions. The high-resolution triangulated grid cells of the 3.3km domain are exactly inscribed in the 13km global grid cells, following the sub-triangle generation rule of the ICON model mesh. To keep the ICON-LAM close to the observed atmospheric state the model atmosphere is reinitialized every 5 days, with one day spinup. The land surface and subsurface are run transient. In a very initial evaluation step, simulated 10m wind speed, global solar radiation, 2m air temperature, and precipitation from the coarser driving model, the ERA5 reanalysis as well as our ICON-LAM setup are validated using satellite data and in situ observations from the two local meteorological networks (SASSCAL and TAHMO). Initial results point to an added value of the convection-permitting simulations.