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Projections of future climate changes from the cloud-permitting greenhouse warming simulations

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Assessing the future risk of natural disasters, securing sustainable energy and water resources, and developing strategies for adapting to climate change remain challenging due to the large uncertainties in regional-scale climate projections. Recent efforts to address this issue include km-scale coupled climate model simulations that resolve mesoscale processes in the atmosphere and ocean, as well as their interactions with the large-scale environment and small-scale topographic features. Our presentation shows the first results from a series of global 9 km-scale greenhouse warming simulations using the AWI Climate Model Version 3 which is based on the OpenIFS atmosphere model at TCO1279 resolution and 137 vertical levels and the FESOM2 ocean model at 4-15 km resolution. By comparing a set of consecutive 10-year time-slice simulations forced by the CMIP6 SSP585 scenario with a transient simulation at a lower-resolution (31 km in the OpenIFS), we identify key differences in weather and climate-related phenomena, including tropical cyclones, ENSO, and regional climate change features that can be attributed to km-scale dynamics in clouds and atmospheric circulation patterns. The findings from our cloud-permitting climate simulations provide valuable insights into the role of small-scale processes in the sensitivity of the regional and global climate.