Geophysical Research Abstracts
Vol. 21, EGU2019-16852, 2019
EGU General Assembly 2019

Weather Extremes in a Hierarchy of Climate Model Resolutions

Joakim Kjellsson (1), Wonsun Park (1), Mojib Latif (1), and Glenn Carver (2)

(1) GEOMAR Helmholtz Zentrum für Ozeanforschung Kiel, Kiel, Germany (joakimkjellsson@gmail.com), (2) European Centre for Medium-Range Weather Forecasts, Reading, UK

We examine weather extremes, specifically heavy precipitation events, in climate models of varying horizontal resolutions to understand how the lack of resolution can impact our prediction of future extremes. Low-resolution models and reanalyses show that precipitation as well as the intensity of high percentiles have increased in the last century due to surface warming. The increase in precipitation is higher at higher percentiles. As an example, for the northern hemisphere midlatitudes the ERA-20C reanalysis shows $\sim 2\%$ increase in the mean precipitation from 1900 to 2010, while the increase is $\sim 12\%$ for the 99th percentile. Hence, precipitation extremes have increased at a faster rate than the mean. However, precipitation extremes are often relatively small scale and short-lived, and thus not well represented in climate models of ~ 100 km horizontal resolution. We find that low-resolution models often fail to capture the most extreme precipitation events due to insufficient horizontal resolution and excessive diffusion, making predictions of future precipitation extremes somewhat unreliable. We therefore investigate how the resolution of the model impacts both the intensity of extremes but also the distribution of events. We simulate the recent change in precipitation extremes in models of varying horizontal resolution, ranging from $\Delta x \sim 100$ km to $\Delta x \sim 16$ km, to estimate how our predictions of future precipitation extremes are impacted by the horizontal resolution and output frequency of current climate models and reanalysis products.

We use both atmosphere-only and coupled climate models and explore situations where the mesoscale is either resolved, unresolved or partially resolved. We use both ERA-20C renanalysis, which is based on an atmospheric model of $\Delta x \sim 125$ km, and the new ERA-5 reanalysis which is based on a model of $\Delta x \sim 31$ km, as well atmosphere-only simulations with the OpenIFS model at similar resolutions. We also use coupled model simulations with $\Delta x \sim 100$ km or $\Delta x \sim 39$ km resolution in the atmosphere and $\Delta x \sim 50$ km in the ocean.