PHYS.ORG

Extreme rainfall: More accurate predictions in a changing climate

June 3 2021

Credit: Pixabay/CC0 Public Domain

To limit the impacts of climate change it is essential to predict them as accurately as possible. Regional Climate Models are high-resolution models of the Earth's climate that are able to improve simulations of extreme weather events that may be affected by climate change and thus contribute to limiting impacts through timely action.

At their highest resolutions, Regional Climate Models are capable of simulating atmospheric convection, a key process in many extreme weather events which is often the cause of very intense and localized precipitations. Although "convection permitting" models are widely used in weather forecasting, they require large supercomputing resources which limits their use in longer-term climate modeling. However, improved computer power has now made their use in climate prediction more viable.

A study involving research teams from across Europe collaborating on the CORDEX-FPS Flagship Pilot Study on convective phenomena—including scientists of the CMCC Foundation—Euro-Mediterranean Center on Climate Change—presents the first multi-model ensemble of decade-long regional climate models run at kilometer scale. The CORDEX-FPS project on Europe and the Mediterranean region, which focuses on convective precipitation events and their evolution under human-induced climate change, selected the Alpine space as a common target area on which to experiment.

Convection permitting models were used to produce high-resolution simulations that predicted rainfall dynamics from 2000-2009. The simulated rainfall during this period was compared with observed rainfall datasets, assessing how well the models had simulated real events. The configuration developed by the CMCC obtained particularly good results . Moreover, results were compared with lower resolution models, revealing that high resolution models bring a significant improvement in model performance.

Paola Mercogliano, Director of the CMCC Division Regional Models and geo-Hydrological Impacts, and co-author of the study together with

CMCC researchers Marianna Adinolfi and Mario Raffa, explains that: "Although differences still exist between ultra-high-resolution simulations and observations, it is clear that these simulations perform better than simulations with lower resolution in representing precipitation in the current climate, and thus offer a promising prospect for studies on climate and climate change at local and regional scales. The most significant improvements of the high-resolution simulations compared to the lower resolution ones are found especially in summer, when the low-resolution model overestimated the frequency and underestimated the intensity of daily and hourly rainfall."

The benefit of a higher resolution was most pronounced for heavy rainfall events.

On average, the low-resolution models underestimated summer heavy rainfall per hour by ~40%. The high-resolution models only underestimated this rainfall by ~3%. Moreover, the uncertainty ranges in the simulations—namely the variability between the models—were also almost halved at a high resolution for wet hour frequency.

Policymakers rely on accurate climate information to formulate effective measures to adapt to and mitigate the impact of climate change, and this study presents a useful method to improve predictions of extreme rainfall. Improving these predictions helps people and policymakers formulate climate adaptation and mitigation measures with the best available information.

Further studies are currently being developed within the CORDEX-FPS Flagship Pilot Study on convective phenomena to demonstrate the added value of ultra-high resolution configurations.

More information: Nikolina Ban et al, The first multi-model ensemble of regional climate simulations at kilometer-scale resolution,

part I: evaluation of precipitation, *Climate Dynamics* (2021). DOI: 10.1007/s00382-021-05708-w

Provided by CMCC Foundation - Euro-Mediterranean Center on Climate Change