Sub-kilometre resolution climate model data

Added benefits in the representation of extreme precipitation?

Thomassen, Emma Dybro; Arnbjerg-Nielsen, Karsten; Sørup, Hjalte J. D.; Langen, Peter L.; Olsson, Jonas; Pedsersen, Rasmus A.; Christensen, Ole B.

Link to article, DOI:
10.5194/egusphere-egu23-6866

Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

EGU23-6866, updated on 09 May 2023
https://doi.org/10.5194/egusphere-egu23-6866
EGU General Assembly 2023

Sub-kilometre resolution climate model data: Added benefits in the representation of extreme precipitation?

Emma Dybro Thomassen[1,2,3], Karsten Arnbjerg-Nielsen[2], Hjalte J. D. Sørup[2], Peter L. Langen[4], Jonas Olsson[5], Rasmus A. Pedsersen[1], and Ole B. Christensen[1]

[1]National Centre for Climate Research, Danish Meteorological Institute, Copenhagen, Denmark
[2]Department of Environmental and Resource Engineering, Technical University of Denmark, Kgs. Lyngby Denmark
[3]Flooding and Hydrology, Danish Meteorological Institute, Copenhagen, Denmark
[4]iClimate, Department of Environmental Science, Aarhus University, Roskilde, Denmark
[5]Hydrology Research, Swedish Meteorological and Hydrological Institute, Norrköping, Sweden

Climate change impact on extreme precipitation is of great importance to society. Small-scale, short-term events can have massive social and socioeconomic consequences. The present study analyses a new sub-kilometre (750 m) HARMONIE-Climate[1] model simulation driven by ERA5 reanalysis data. The new sub-kilometre climate model data (750 m) is compared to NorCP data[2] from climate models in 3, 5, and 12 km grid spacing, rain gauge station data and reanalysis data in 31 and 79 km resolution. The study examines a case area covering Denmark for five cloudburst seasons (April – October). The study aims to analyse how convective events are represented in the climate model data across grid resolution, and if an added benefit can be identified moving to sub-kilometre resolution.

Extreme convective events are analysed across datasets with respect to diurnal cycle, intensity levels and spatial structure. This is done at both hourly and sub-hourly scales. The 750 m climate model performs better for most metrics. However, climate models with 3 and 5 km grid spacing also perform well. The added computational and storage cost of the sub-kilometre scale experiments, thus only results in limited added benefit for this specific model set-up. Analysing hourly and sub-hourly temporal scales shows that the model performance varies between different temporal scales. The convection-permitting models, in general, represent hourly extremes much better than sub-hourly extremes. The sub-hourly scale is, therefore, essential to analyse to assess the model performance of convective events.

[1] Belušić D, De Vries H, Dobler A, Landgren O, Lind P, Lindstedt D, Pedersen RA, Carlos Sánchez-Perrino J, Toivonen E, Van Ulft B, et al (2020) HCLIM38: A flexible regional climate model applicable for different climate zones from coarse to convection-permitting scales. Geosci Model Dev 13:1311–1333. https://doi.org/10.5194/gmd-13-1311-2020

[2] Lind P, Lindstedt D, Kjellström E, Jones C (2016) Spatial and Temporal Characteristics of Summer Precipitation over Central Europe in a Suite of High-Resolution Climate Models. J Clim 29:3501–3518. https://doi.org/10.1175/JCLI-D-15-0463.1