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The crucial representation of deep convection for the cyclogenesis of medicane Ianos

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The paper presents a model intercomparison study to improve the prediction and understanding of Mediterranean cyclone dynamics. It is based on a collective effort with five mesoscale models to look for a robust response among ten numerical frameworks used in the community involved in the networking activity of the EU COST Action "MedCyclones". The obtained multi-model, multi-physics ensemble is applied to the high-impact medicane Ianos of September 2020 with focus on the cyclogenesis phase, which was poorly forecast by numerical weather prediction systems. Models systematically perform better when initialised from operational IFS analysis data compared to the widely used ERA5 reanalysis. Reducing horizontal grid spacing from 10 km with parameterised convection to convection-permitting 2 km further improves the cyclone track and intensity. This highlights the critical role of deep convection during the early development stage. Higher resolution enhances convective activity, which improves the phasing of the cyclone with an upper-level jet and its subsequent intensification and evolution. This upscale impact of convection matches a conceptual model of upscale error growth in the midlatitudes, while it emphasises the crucial interplay between convective and baroclinic processes during medicane cyclogenesis. The ten numerical frameworks show robust agreement but also reveal model specifics that should be taken into consideration, such as the need for a parameterization of deep convection even at 2 km horizontal grid spacing in some models. While they require generalisation to other cases of Mediterranean cyclones, the results provide guidance for the next generation of global convection-permitting models in weather and climate.