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Weather type and frontal activity related evaluation of multi-year convection-permitting simulations in the greater Alpine region

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Over the last decade, regional climate models have been successfully applied in big modelling efforts, like PRUDENCE, ENSEMBLES, NARCAP, and more recent the Coordinated Downscaling Experiment (CORDEX). Pan-continental climate projections for the 21st century have been created with various spatial resolutions on the hydrostatic scale (50 km, 25 km, 12.5 km grid spacing). More recently, first long-term simulations on convection-permitting scales (grid spacing < 4 km) appeared. These simulations do have the advantage of capturing deep convection in a more satisfying way and hence, they are supposed to improve modelled precipitation. However, due to their high spatial and temporal resolution, model evaluation becomes challenging - even if high quality observational data on these scales is available: (1) there are spatial and/or temporal shifts between modelled and observed phenomena (known as the double penalty problem) that do not allow a meaningful application of traditional error statistics; (2) in a typical climate modelling setup (large model domain without nudging) the model partly decouples from its driving data and introduces meso and synoptic scale incomparability with observations even if the model's lateral boundary conditions were generated from re-analysis data.

The present study summarises major difficulties in evaluating convection-permitting multi-year simulations in complex terrain (the European Alpine region) and discusses the strengths and weaknesses of a phenomena based evaluation technique that combines weather types and frontal activity in order to circumvent meso and synoptic scale decoupling effects in error measurements for precipitation.

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