

EGU21-3855

<https://doi.org/10.5194/egusphere-egu21-3855>

EGU General Assembly 2021

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Realised added value in dynamical downscaling of Australian climate change

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Coarse resolution global climate models (GCM) cannot resolve fine-scale drivers of regional climate, which is the scale where climate adaptation decisions are made. Regional climate models (RCMs) generate high-resolution projections by dynamically downscaling GCM outputs. However, evidence of where and when downscaling provides new information about both the current climate (added value, AV) and projected climate change signals, relative to driving data, is lacking. Seasons and locations where CORDEX-Australasia ERA-Interim and GCM-driven RCMs show AV for mean and extreme precipitation and temperature are identified. A new concept is introduced, 'realised added value', that identifies where and when RCMs simultaneously add value in the present climate and project a different climate change signal, thus suggesting plausible improvements in future climate projections by RCMs. ERA-Interim-driven RCMs add value to the simulation of summer-time mean precipitation, especially over northern and eastern Australia. GCM-driven RCMs show AV for precipitation over complex orography in south-eastern Australia during winter and widespread AV for mean and extreme minimum temperature during both seasons, especially over coastal and high-altitude areas. RCM projections of decreased winter rainfall over the Australian Alps and decreased summer rainfall over northern Australia are collocated with notable realised added value. Realised added value averaged across models, variables, seasons and statistics is evident across the majority of Australia and shows where plausible improvements in future climate projections are conferred by RCMs. This assessment of varying RCM capabilities to provide realised added value to GCM projections can be applied globally to inform climate adaptation and model development.