Evaluation of Wintertime Precipitation Forecasts over the Snowy Mountains in a Regional Forecast Model using High-density Ground-based Observations

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This study evaluates the quantitative precipitation forecast skill of a limited-area version of the Australian Community Climate and Earth-System Simulator (ACCESS) Numerical Weather Prediction (NWP) system across the Snowy Mountains in Australia for the cool seasons during 2014 and 2015, using a newly developed high-density precipitation gauge network.

Metrics based on seasonally accumulated and daily precipitation in the analysis region show that, while the model is able to reproduce the observed domain-mean accumulated precipitation reasonably well (with a slight overestimation), this is, in part, due to a compensation of different errors: both the frequency and intensity of the heavy precipitation days (domain-mean daily precipitation > 5 mm day^{-1}) are overrepresented, particularly over the complex terrain and high-elevation areas, whereas the frequency of the very light precipitation days (domain-mean daily precipitation < 1 mm day^{-1}) is underestimated, primarily over lower-elevation areas on both the upwind and downwind sides of the mountains.

The model also demonstrates appreciable skill in reproducing the observed synoptic regimes diagnosed from the upwind soundings. The proportion of the precipitation amount for each cluster is well reproduced, although the orographic enhancement over the western slopes of the mountains is much more pronounced in the forecasts across all the clusters, particularly for the wetter clusters. A further examination on the effect of the lower-atmosphere stability (the effect of blocking by mountains) suggests that the vast majority of precipitation (~ 50-70% over the high elevations) is produced under the “unblocked” condition which is diagnosed 31% of the time, with the rest being produced under the “blocked” condition.

The results of this study suggest that the misrepresentation of the fine-scale dynamics over the complex terrain and microphysical processes in the large-scale precipitation parameterization may be the key to explaining the main model deficiencies.

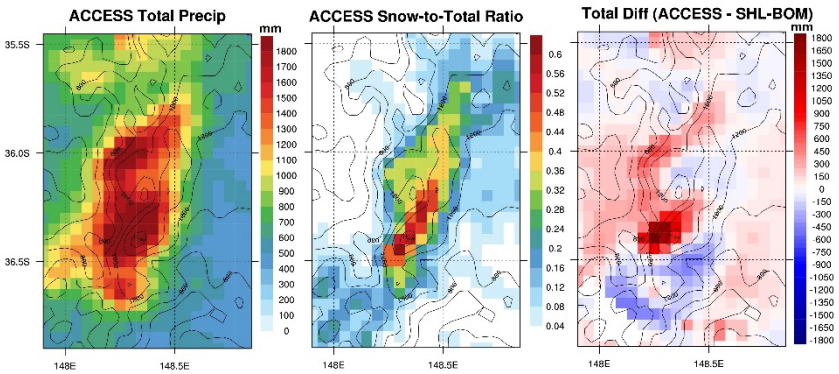

Figure 2. Left panel: Accumulated precipitation for 2014-2015 May-Sept from the operational ACCESS-VT (Victoria-Tasmania domain) forecasts. Centre panel: Snow to total precipitation amount ratio from the ACCESS-VT forecasts for the same period. Difference between the observed and ACCESS-VT forecasts precipitation. Black contours are the elevations of the mountains.