Convective-scale modelling opportunities for the Bureau

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Regional convective-scale numerical weather prediction (NWP) models have been operational at the Bureau since 2017. These models have demonstrated enhanced predictive capabilities for forecasting precipitation and high-impact weather, and provide valuable information on local weather. Over the past few years, the Bureau's convective-scale models have undergone significant development and expanded to include national km-scale models and ensembles for weather and climate prediction. Additionally, urban-scale models (100-300m grid length) have been developed to assess the current science and benefits of these very-high resolution models.

While the Bureau's new national km-scale models provide users with unprecedented weather and climate information for the entire country, they have limitations and require improvements. It's important to note that these models also serve to provide the training data for Machine Learning activities. Priority development areas that will be discussed include:

- Realistic aerosols: Current ACCESS weather models use a climatological aerosol field. This approach does not account for real-time events like bushfire smoke or the diurnal cycle of urban anthropogenic emissions, affecting near-surface temperatures and cloud-aerosol interactions important for fog, cloud lifetime, and precipitation.
- Physical processes: Higher resolution models require better representation of small-scale processes, such as convection, cloud microphysics, and turbulence. Improving these can reduce systematic errors and enhance storm track and convective initiation predictions.
- Coupling to ocean and waves: High-resolution models can capture small-scale ocean processes, such as mesoscale eddies that have a direct impact on the weather predicted by km-scale atmospheric models. Improved representation of interactions between the atmosphere, ocean and waves can lead to more reliable forecasts, especially for extreme weather events like tropical cyclones.
- Integrating machine learning: Utilising physics-informed approaches for improved efficiency and accuracy of convective scale weather and climate models, and blending nowcasting with short-range forecasting.