Mesoscale modelling at the Bureau

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Mesoscale modelling requirements for the BoM present a number of challenges. The domain of interest is very large, stretching from Antartica all the way to the tropics. Thus, the modelling systems must be able to capture the strongly topographically-driven flow of the former, as well as deal with the complexities of tropical convection.

Not only is the domain large, but the forecast accuracy required varies significantly across it - forecasts for the Sydney region provide significantly greater impact than for many parts of outback Australia for example.

In response to these requirements, the BoM has developed a suite of mesoscale modelling systems. Tropical modelling is detailed in another paper at this workshop. Antartic modelling has evolved from the initial, rather limited, "Antartic LAPS" model, to a system based on rotated-pole coordinates, "polarLAPS". For the critical mid-latitude forecasts, a cascading sequence of models is used. To capture the large-scale flow, a full assimilation/forecast system is run over the Australian region at a resolution of 37.5km: "LAPS" (Limited-Area Prediction System). The LAPS forecasts are then used to provide initial/boundary conditions for two sets of higher-resolution models. These "MESO_LAPS" systems include a 12.5km resolution system run over an Australian-wide domain (though smaller than that of LAPS), and then dedicated 5.0km systems covering the major cities: Perth, Adelaide, Sydney, SouthEast Queensland, and a combined Victoria/Tasmania domain.

The introduction of ACCESS in general, and the UKMO UM (Unified Model) in particular provides impetus for re-examining our mesoscale modelling strategy. The computational benefits of having high-resolution systems only where required, must be balanced against the support cost of maintaining a large number of systems (even if those systems are built around single-executable models). Relative to the current systems, assimilation costs will be increased enormously, with the introduction of 4D variational assimilation, and assimilation at much higher resolutions. Ensembles are expected to play a more prominent role, placing further stress on computational requirements.

Whilst the migration to ACCESS-based NWP systems is of the highest priority, there will be a short window in which we will have both the old and ACCESS-based systems running in parallel. This provides a unique opportunity for comparison of particular competing aspects of NWP models. For example, the BoM and UKMO UM dynamical cores have been built around very different numerical approaches, and we will present some (very preliminary) timing results which may provide some broad-brush measure of the relative computational efficiency of the two approaches.