Challenges with high-resolution regional earth system modelling on a stretched grid

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This talk describes the global stretched grid Conformal Cubic Atmospheric Model (CCAM) including regional earth system components, as well as some of the challenges encountered when using this approach at convective permitting spatial scales. CCAM is a non-hydrostatic, semi-implicit, semi-Lagrangian climate model, based on a conformal cubic grid. CCAM can focus the cubic grid over a region without imposing lateral boundary conditions (LBCs) by using a Schmidt coordinate transformation. Since there are no LBCs, the model can optionally use spectral nudging to constrain the large wavelength behaviour of selected variables to the host general circulation model. The spectral nudging can also be used selectively for aerosols and the ocean model, avoiding the need for LBCs for Earth system components. However, using the stretched grid also requires physical parameterisations to be scale-aware and be robust over a range of spatial scales. The stretched grid is likely to contain a grey zone region at convective scale resolutions, resulting in the need for a pragmatic approach to parameterisation development (e.g., convection, cloud microphysics, boundary layer & gravity wave drag). In practice, added value is still achievable and simulation speeds of 1-2 simulation years per day are achievable on 24,576 cores (mixed precision). Other challenges include managing the relatively low resolution CMIP emission and land-use change datasets, where a LUCAS approach could provide better outcomes for the Australasia region. Preliminary results from a CCAM 4km national simulation will be briefly discussed.