Enhancing the vertical resolution of the latest MO GCM to 10 m through the boundary layer

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A major contribution to the uncertainty in climate sensitivity comes from cloud in the subtropical stable boundary layer. There are good physical reasons why our most up-to-date and sophisticated GCMs still produce large but disparate feedbacks here. While tropical deep convection and mid-latitude baroclinic instability are fundamentally linked to, and so constrained by, tropospheric energetics at planetary scales, constraining in turn the cloud associated with them, these boundary layers are only weakly coupled to the rest of the atmosphere. As they are close to the surface with generally clear skies above, at the tropopause the SW radiative effect of the cloud is hardly cancelled by LW effects. Also, the strong positive feedbacks on the presence or absence of cloud (LW cloud-top radiative cooling, and strengthening of the boundary-layer inversion by SW cooling of the surface) create an almost bistable system.

These physical complications interact with an obvious numerical problem in existing GCM simulations: that their layers are too thick to fully resolve the physical processes that control these clouds' formation, dissipation and radiative properties.
This has been addressed using LESs and CRMs, which have helped clarify how different physical mechanisms tend to drive opposite changes, but of course these models require large-scale forcing to be prescribed - and how the large-scale forcing changes under climate change is important for the response. A complementary approach which has not yet been implemented is to run full GCMs at very high vertical resolution.
I am pursuing this with the Met Office's latest benchmark GCM, with 10-m resolution to 2.7 km, and hope to present preliminary results.