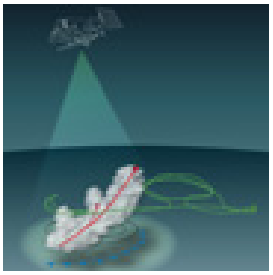

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Impact of model upgrades on diabatic processes in extratropical cyclones and downstream forecast evolution

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Models are continuously developed at numerical weather prediction (NWP) centres to improve forecast skill, with new operational model configurations adopted every few years. The parameterisations of diabatic processes are probably the most frequently updated part of NWP models as they are crucial for accurate weather predictions and contain uncertainties in their formulation. The impact of model developments is assessed here in forecasts from the Met Office's weather forecast model initialised throughout the North Atlantic Waveguide and Downstream Impact Experiment field campaign period in autumn 2016. Planned model parameterisation developments are considered, together with an 'inexpensive coupled'forecast with daily updating of the sea surface temperature and sea-ice fraction.

Forecasts produced from the coupled system have, on average, indistinguishable skill from the control forecasts, suggesting the benefits of coupled atmosphere-ocean NWP systems can be small. In contrast, a reduction in forecast error (˜4%) is identified in forecasts produced using an upgraded convection scheme. Periods of low forecast skill during the study period are shown to be associated with the onset and decay of blocking events and increased diabatic heating of air masses reaching the upper troposphere. In forecasts of a specific block development case that was not accurately predicted in any of the experiments or in the operational ensemble forecast from the Met Office, the representation of diabatic heating in the warm conveyor belt of an upstream cyclone is shown to moderate the subsequent block development: forecasts in which the heating is stronger generally have a more-amplified blocking ridge and amplified heating contributions from all parameterisations as diagnosed using diabatic tracers. Hence, we demonstrate that plausible changes to the representation of several different diabatic processes in models can impact forecast block development via changes within upstream cyclones.

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