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# Impacts of increasing the aerosol complexity in the Met Office global NWP model

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Inclusion of the direct and indirect radiative effects of aerosols in high resolution global numerical weather prediction (NWP) models is being increasingly recognised as important for the improved accuracy of short-range weather forecasts. In this study the impacts of increasing the aerosol complexity in the global NWP configuration of the Met Office Unified Model (MetUM) are investigated. A hierarchy of aerosol representations are evaluated including three dimensional monthly mean speciated aerosol climatologies, fully prognostic aerosols modelled using the CLASSIC aerosol scheme and finally, initialised aerosols using assimilated aerosol fields from the GEMS project. The prognostic aerosol schemes are better able to predict the temporal and spatial variation of atmospheric aerosol optical depth, which is particularly important in cases of large sporadic aerosol events such as large dust storms or forest fires. Including the direct effect of aerosols improves model biases in outgoing longwave radiation over West Africa due to a better representation of dust. Inclusion of the indirect aerosol effects has significant impacts on the SW radiation particularly at high latitudes due to lower cloud amounts in high latitude clean air regions. This leads to improved surface radiation biases at the North Slope of Alaska ARM site. Verification of temperature and height forecasts is also improved in this region. Impacts on the global mean model precipitation and large-scale circulation fields were found to be generally small in the short range forecasts. However, the indirect aerosol effect leads to a strengthening of the low level monsoon flow over the Arabian Sea and Bay of Bengal and an increase in precipitation over Southeast Asia. This study highlights the importance of including a more realistic treatment of aerosol-cloud interactions in global NWP models and the potential for improved global environmental prediction systems through the incorporation of more complex aerosol schemes.