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Single-profile forcing (SPF) of a high resolution NWP model for fog and low level cloud forecasting

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Fog and low level cloud forecasting is crucial for aviation, both commercial and military. Current NWP models can give a broad indication of fog formation and dissipation on scales of a few tens of km, but can provide little detail especially in areas of complex terrain. One-dimensional models for specific locations taking into account the impact of the surrounding orography on the flow have been developed as a cheap solution, but they are unable to treat complex three dimensional flows. A full NWP model running at a horizontal resolution of around 1km (or better) may eventually be required to address the three-dimensional fog forecasting problem in full. But, enhancement of the model resolution to such a scale is presently restrained by available computing power and will not be feasible for many years. However, in the weakly forced situations leading to fog formation, the use of small, local area (e.g. 50 km x 50 km), high resolution NWP model may be a viable alternative.

In this study, we explore the local area NWP model approach, initialising and forcing the model with a time series of single forcing profiles from either a low resolution NWP model, or from a local radiosonde profile. This method of homogeneous single-profile forcing (SPF) allows the model to be run locally with a small volume of input data. The UK Met Office Unified Model (UM) is set up for a 50km by 50km horizontal domain, with real orography and a grid spacing of 1km and 76 vertical levels. The model is initialised and forced with temperature, humidity and wind profiles from a 12km coarse resolution model. In addition, aspects of the current model physics, such as the radiation scheme and microphysics, which have a critical impact on fog formation have also been assessed and optimised. We will show some typical results from a single-profile forcing (SPF) model run, compared with the output from a full NWP model with 1km resolution and observational data.