Sub-kilometre numerical weather prediction of fog events and the sensitivity to soil thermal conductivity.

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Despite its impact on human activity fog still remains a challenge for numerical weather prediction models to simulate accurately. To help overcome this challenge sub-kilometre scale models have been developed. Here, the performance of the Met Office Unified Model (MetUM) at three resolutions, 1.5km, 333m and 100m, is compared against observations from the recent Local and Non-Local Fog experiment (LANFEX). The LANFEX data provide the opportunity to assess the models' ability to form dew and deposit fog water, the vertical extent of the fog and the spatial variation of fog over the different valleys in two contrasting orographic regions, one a complex valley system and the other a more homogenous area. The results show that increasing the horizontal resolution reduces the depth of fogs but this does not necessarily compare well with the observations. The horizontal variation of the fog at the shallow and wide valley site is not improved by the increased resolution but the sub-kilometre scale models are more accurate in terms of the spatial variation of fog in the complex valley region. A comparison of soil temperature indicates the model transfers heat too readily to the surface erroneously preventing fog from forming. Sensitivity tests show the specification of soil thermal conductivity can lead to as much as a 5 hour delay in the formation of fog. These results highlight the potential sub-kilometre models have to forecast fog but continued work on the development and implementation of parametrizations such as soil conductivity and dew deposition at these resolutions is needed.