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Forecasting the transport of pollution using a numerical weather prediction model

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The concentration and variability of pollutants in the atmosphere are strongly influenced by the advection and mixing processes they are subject to. These meteorological processes act on a wide range of spatial and temporal scales, all of which need to be represented in models to produce accurate forecasts of pollutant concentrations. Currently forecasts of pollutant concentrations in the UK are performed by chemistry transport models with fixed meteorological coupling intervals (typically every 3 hours for 40km resolution). Thus changes in the meteorology that occur on short time and spatial scales are not well represented in these models. Recent increases in computing power now allow pollutant transport to be integrated into numerical weather prediction (NWP) models with meteorological fields available at high resolution every timestep (approx. 5 mins for 12km resolution). The aim of this work is to determine whether a more accurate representation of the meteorology improves the forecast of pollution concentrations using an NWP model.

In this study observations from the second ETEX (European Tracer EXperiment) tracer release have been used to assess the performance of the UK Met Office's NWP model in predicting the regional-continental scale transport of pollution. Results show that the dominant process responsible for transporting pollution for this case study is a warm conveyor belt which transports tracer out of the boundary layer into the free troposphere. Tracer is also transported to higher levels, on short-timescales, by convection. It is found that high resolution meteorology is needed to capture the rapid change in wind speed and direction associated with a cold front and hence to accurately predict the horizontal dispersion of tracer. Although the spatial distribution of tracer compares well with the observations the NWP model over-predicts surface concentrations.