A UK Air Quality Reanalysis

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The Clean Air (W1) programme is led by NERC and the Met Office, with Innovate UK, EPSRC, ESRC, MRC, NPL & Defra as delivery partners.
## Overview

**A reanalysis of atmospheric composition over the UK**

<table>
<thead>
<tr>
<th>What</th>
<th>When</th>
<th>Why</th>
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<tr>
<td>A simulation of the past which uses observational data (from the past) to constrain the model</td>
<td>For a ~15 year period initially, starting from 2003</td>
<td>Air quality model and measurement data is often temporally or spatially limited (or both) or inconsistent over long time periods, which limits long term assessments of air quality and health impacts</td>
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<td>This gives an improved recreation of past reality across the model domain</td>
<td>More years will be added to the dataset as a rolling archive</td>
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The reanalysis simulations use Air Quality in the Unified Model (AQM) in a similar set up to the operational forecasts.

- 0.11° (~12 km) horizontal resolution
- 63 model levels (from the surface up to ~40 km)
- UKCA Regional Air Quality chemical scheme
- CLASSIC aerosol scheme
- Simulation start time 00Z, forecasts run for 24 hours

Savage et al. 2013, https://doi.org/10.5194/gmd-6-353-2013
Measurements of air pollution at **background** sites across the UK will be used to bias correct the surface level model data using the same statistical post processing method applied to the operational forecasts.

The bias correction will be applied to ...

Neal et al. 2014, [https://doi.org/10.1016/j.atmosenv.2014.09.004](https://doi.org/10.1016/j.atmosenv.2014.09.004)
Things that will be included in the data files ...

- **Ozone (O₃)**
- **Nitric Oxide (NO)**
- **Nitrogen Dioxide (NO₂)**
- **Sulphur Dioxide (SO₂)**
- **Carbon Monoxide (CO)**
- **Ammonia (NH₃)**
- **Methane (CH₄)**
- **Non-Methane Volatile Organic Compounds (NMVOCs)**
- **PM_{2.5}** *(Total Concentration and contributions from Organic Carbon, Black Carbon, Biomass Burning, Sulphate, Nitrate, Dust and Secondary Organic Aerosol)*
- **PM_{10}**
- Bias corrected concentrations of O₃, NO, NO₂, SO₂, CO, PM_{2.5} and PM_{10} *(surface level only)*
- **Surface Temperature**
- **Surface Pressure**
- **1.5 metre Temperature**
- **1.5 metre Relative Humidity**
- **10 metre U and V Wind Components**
- **Surface Sensible Heat Flux**
- **Total Precipitation**
- **Very Low, Low, Medium and High Cloud Amount**
- **Temperature**
- **Pressure**
- **Boundary Layer Depth**
- **U, V and W Wind Components**

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The dataset will cover the UK with data for 63 vertical levels from the surface up to ~40 km. The dataset will be extended forward as a rolling ~20 year archive. Data will be available at hourly time resolution. The data will be available to download and/or interact with on the Clean Air Framework.

Simulations are run on a rotated pole grid but the data will be unrotated before being shared.

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**Possible Uses**

- Provide boundary condition information for running local scale models.
- Look at long term trends in concentrations of different pollutants on different scales (e.g. national, regional, individual).
- Investigate how pollutant concentrations compare to limits or targets over extended time periods and examine whether changes in policy might have impacted concentrations.
- Combine with population information to estimate exposures for health impact studies.
- Make comparisons with observational data from different platforms.

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Progress

Model Setup
modify the operational forecast model setup to make it suitable for the reanalysis simulations

Emissions
select, retrieve and process emission inventory data

Observations
retrieve observational data for all available AURN sites for 2003 - 2019

Boundary Conditions
select and retrieve meteorology and chemical composition data for boundary condition generation

Model Output
select the variables to be output and included in the reanalysis dataset

Model Testing
test the reanalysis model under a range of pollutant conditions and using a range of emission inventories

Production Simulations
run the production simulations for 2003 – 2019 to generate the raw model output data

Post Processing
bias correct the surface level model data using the observational data

Data Formatting
convert the data files to NetCDF format on a regular latitude-longitude grid

Data Available
make the data available on the Clean Air Framework

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