Update on higher resolution air quality modelling work

Benjamin Drummond

Barnaby Sherratt, Lucy Neal, Rachel McInnes, Paul Agnew, Pedro Molina-Jimenez, Matthew Hort

February 2022

Clean Air Programme

Outline

- Motivation for moving toward higher resolution
- National kilometre-scale air quality modelling
 - Summary of results and conclusions
- **Street-resolving** modelling with MAQS-Health
 - Update on current status and upcoming work





Model resolution

Hood et al 2018



- emissions
- meteorology (winds, temperature, turbulence)
- land surface (orography, surface type, buildings)



Schaap et al 2015 NO₂ concentration (µg m⁻³)





Korhonen et al 2019





UK Research

and Innovation



- Current national air quality forecast model: 12 km resolution
- Operational weather forecast models at 1.5 2.2 km resolution
- Emissions data available at 1 km resolution
- Benefits and challenges of moving to the kilometre-scale

Initial analysis:

۲

- Compare 12 km and 2.2 km resolution configurations of NAME dispersion model
- Ozone episode





NOx emissions

JK Research and Innovation

Low Moderate High Very High

Forecast provided by the Met Office

10





Ozone episode June/July 2015

ean Air

ogramme

UK Research and Innovation





m⁻³]

15 🛓

0

Met Office

Ozone episode June/July 2015



	12km	2.2 km
Ozone (O ₃)		
Correlation	0.65	0.68
Bias (µg m ⁻³)	19.73	13.66
Nitrogen Dioxide (NO ₂)		
Correlation	0.52	0.59
Bias (µg m⁻³)	-8.28	-7.57
Daily Air Quality Index (DAQI)		
Hit rate	0.91	0.77
False alarm rate	0.20	0.07
Odds ratio skill score (ORSS)	0.95	0.96



≫ Met Office



Summary

- 2.2 km configuration of NAME model
- Comparison with 12 km model and observations for a single ozone episode
 - Increased detail and more smoothly varying concentrations
 - Slightly improved bias and correlation (O₃ and NO₂)
 - Slightly worse hit rate, but improved false alarm rate and odds ratio skill score (ORSS)
- Results and conclusions written up and delivered as a report

Future work

- Further case studies across range of air quality and meteorological conditions
- Consideration of further model developments, or changes to verification methods
- Ensure impact:









Connect across air quality disciplines



Research to operational forecasting

Street-resolving air quality modelling

*Talk from David (CERC)

- Exploration of street-resolving modelling for national forecasting MAQS-Health modelling system*
- Coupling with Met Office regional models (AQUM and NAME)
- Initial 'basic' configuration is set up and running South West, major roads, no street canyons/urban canopy



Street-resolving air quality modelling

Current and near-term work

- Continue with set up of MAQS-Health configuration
 - Generation of required input data (e.g., street canyon, urban canopy data)
- Set up and/or familiarise with tools for verification of model with measurements
 - Use of CERC verification system and extension of Met Office capabilities
- Define and perform a set of case studies and analyse results
- Write-up of results and conclusions from above due <u>August 2022</u>

Longer-term

- Explore how such a system can augment existing forecast capabilities
- How to include fine-scale data in public forecast
- Extend from South West region to UK



70.00 74.27 78.53 82.80 87.07 91.33 95.60 99.87 104.13108.40 Concentration ug/m3





Update on higher resolution air quality modelling work

Questions or comments?



National kilometre-scale modelling with NAME



Street-resolving modelling with MAQS-Health and Met Office models



