Development of a next generation regional chemical transport model in Western Australia

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INTRODUCTION

By world standards, Western Australia has very clean air. It is crucial to ensure we have effective, efficient and appropriate means and policies to support a clean air future. This requires an understanding of the complex physical and chemical processes that determine how air pollutants from thousands of sources interact and move around the world and Australia. It is also required to address the increasingly complex environmental problems such as those that:

- involve multiple chemicals
- can build up over time
- can cross state and national borders

The last update of Perth regional model was carried out in 1996. The natural, societal and economic pressures that impact air quality in Western Australia have been changing rapidly since the mining boom. Due to the limitation of computing resource, the previous study adopted an over simplified approach to simulate the meteorology and photochemical degradation. While this approach was fit for purpose at the time, detailed photochemical degradation at smaller grid sizes can produce vastly more accurate simulations due to better resolving key atmospheric processes.

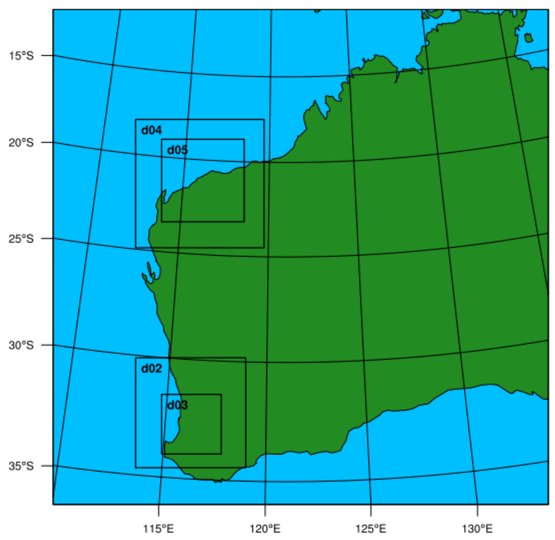
This current study involves the deployment of an comprehensive multiscale air quality model in Western Australia. Besides air quality assessment, this study can form a baseline for other applications, i.e. exposure assessment, major infrastructure assessment, emission loading sensitivity analysis and climate adaptive analysis.

OBJECTIVES

In the priority airsheds, i.e. Perth metropolitan, North West airshed and South West airshed; accurate and timely risk assessments are needed to ensure that public health is protected from dangers like air toxics, smog and smoke from prescribed fires and wildfires. Without a clear and proven understanding of atmospheric processes, efforts to manage air quality will likely be costlier and less effective. Using multiscale air quality model is a reliable and cost-effective way to calculate the potential benefits of air pollution reduction strategies and assess the impact of human and climate influences on the future state of our environment.

The objective of this study is to develop a multiscale air quality model to simulate the changes of pollutant concentrations in the atmosphere in order to characterise the complex physical and chemical processes in the atmosphere in the Western Australia priority airshed. This will become an essential tool to guide analysis of regulatory decisions.

Model Domains



APPLICATIONS

The multiscale air quality model will be used for many purposes including:

- Supporting the Part IV and V of Environmental Protection Act and the development of the National Environmental Protection Measure (NEPM)
- Providing guidance on implementation of the NEPM to other agencies and regional offices, e.g. Collie, North West Shelf and Port Hedland
- Sensitivity analysis of the emission loading in the prioritised airsheds
- Assessing impacts of changing air pollution levels on human health under various scenarios, i.e. population growth, suburban sprawl, infrastructure upgrade and development and climate change.

Future Plan

A highly lumped photochemical mechanism (RACM) has just been implemented in WRF-Chem V4.0.3. We will continue to test the appropriate multiscale air quality model and their respective physics options and photochemical schemes on Pawsey supercomputing infrastructure. Some of the candidates include:

Meteorological models:

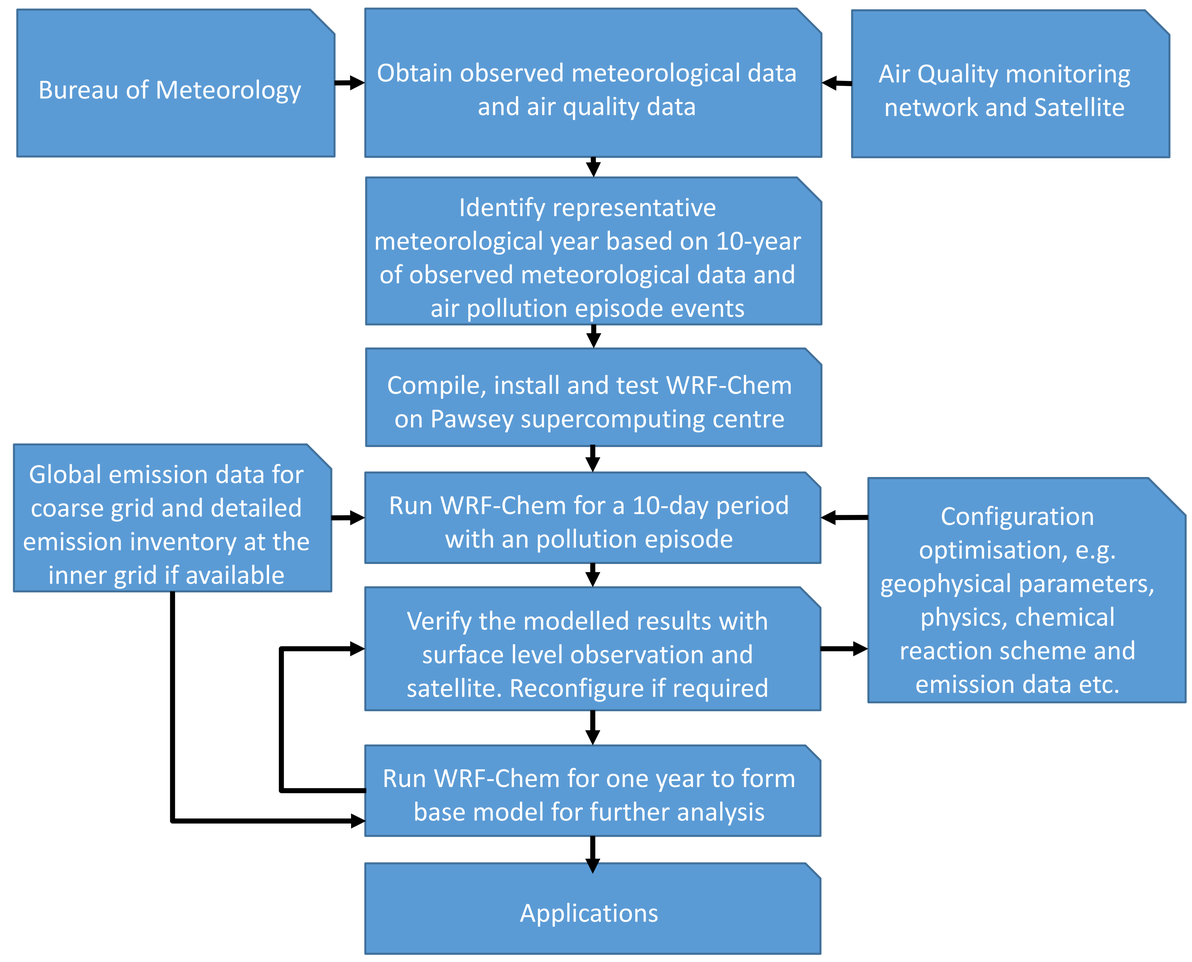
- WRF
- MPAS-A
- CSIRO's CCAM

Multiscale air quality model

- WRF-Chem
- CMAQ
- CTM
- CAMx

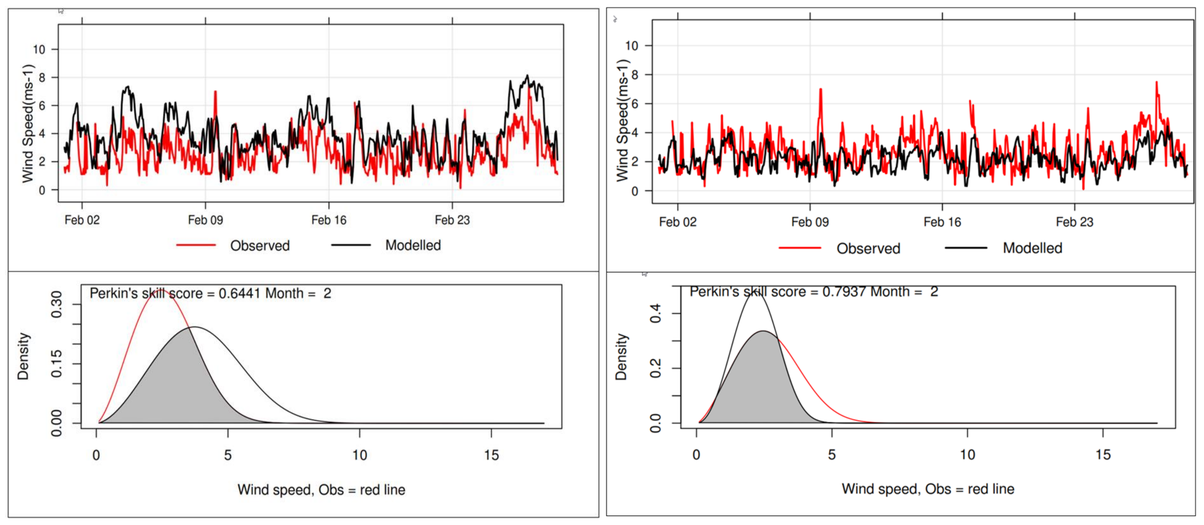
PAWSEY supercomputing centre

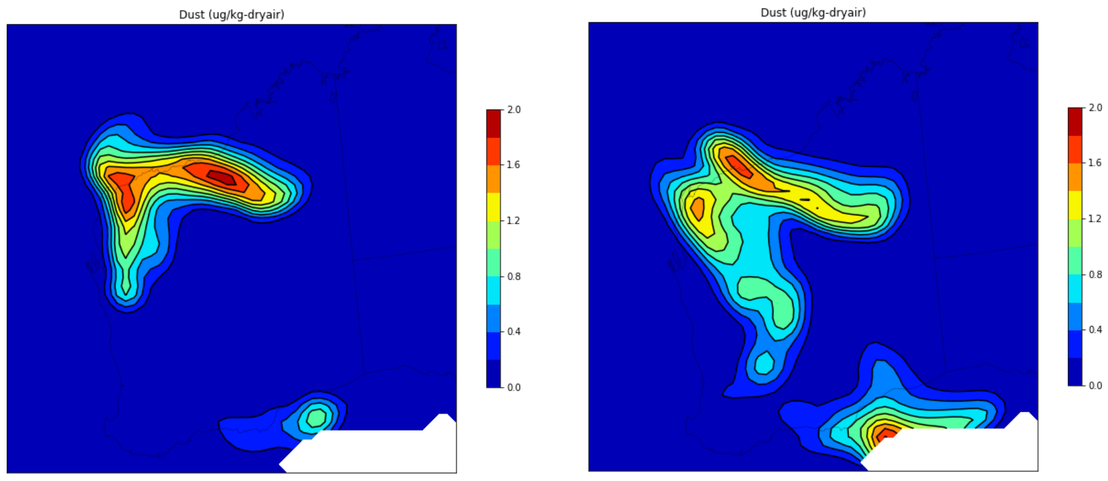
APPROACH



PRELIMINARY RESULTS

- Sensitivity analysis of various boundary layer schemes as well as roughness length parametrisation
- Impact of topographic drag parameterisation
- Fitted Weibull distribution to the observed and modelled wind speeds
- Long range pollutants transport on episode day





ACKNOWLEDGEMENT

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If you have any queries about this work, please do not hesitate to contact Sean Lam via sean.lam@dwer.wa.gov.au

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