THE AUSTRALIAN AIR QUALITY FORECASTING SYSTEM

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The Australian Air Quality Forecasting System (AAQFS) is a joint project between the Bureau of Meteorology (BoM), CSIRO Atmospheric Research (CAR), CSIRO Energy Technology (CET), the Environment Protection Authority of Victoria (EPA Victoria) and the New South Wales Environment Protection Authority (NSW EPA) to develop a high-resolution air quality forecasting system. The initial development of AAQFS was funded by the Air Pollution in Major Cities Program (sponsored by Environment Australia).

The project has a number of specific goals: to provide the ability to generate 24/36-hour air quality forecasts twice per day (available 9 am and 3 pm); provide forecasts for a range of air pollutants including oxides of nitrogen (NO_x), ozone (O_3), sulfur dioxide (SO_2), carbon monoxide (CO), benzene (C_6H_6), formaldehyde (CH_2O) and particulate matter (PM10 and PM2.5); provide forecasts at a resolution sufficient to consider suburban variations in air quality; and to provide the ability to generate simultaneous forecasts for a 'business-as-usual' emissions scenario and a 'green emissions' forecast. The latter scenario may correspond to minimal motor vehicle-usage, for example, and which could be used to indicate the reduction in population exposure that could result from a concerted public response to a forecast of poor air quality for the next day.

The AAQFS consists of five major components: a numerical weather prediction (NWP) system, an emissions inventory module (EIM), a chemical transport module (CTM) for air quality modelling, an evaluation module, and a data archiving and display module.

The BoM's operational Limited Area Prediction System (LAPS) system has been adapted for the AAQFS NWP component. Comprehensive numerics and physics packages are included and recent work has paid special attention to the resolution and treatment of surface processes. The model has 29 vertical levels and a horizontal resolution of 0.05° (covering the State of Victoria and most of New South Wales). This model is nested in LAPS at 0.375^o resolution, which in turn is nested in the BoM global model, GASP.

EPA Victoria and CSIRO, with support from NSW EPA, have developed the emissions inventory. The inventory component includes estimates of size-fractionated and speciated particle emissions, 0.01° gridded area sources over the densely populated regions and meteorologically-dependent emissions that are generated based on LAPS predictions.

The CTM has been custom-built for the project using state-of-the-art methodologies. A notable inclusion to the CTM is the Generic Reaction Set photochemical mechanism, a highly condensed (7 species and 7 reactions) photochemical transformation mechanism featuring minimal computational overhead. Parallel tests of a more comprehensive photochemistry, Carbon Bond IV, are now being conducted. Particle transformation is modelled by a sectionally-based particle scheme. The transport fields are updated every 60 minutes. The CTM has 17 vertical levels, and simulations use a 0.05° outer grid, with nested 0.01° inner grids for major urban areas.

While the focus of the AAQFS to date has been the forecasting of urban air quality, other applications are being considered. Australia is currently suffering from a prolonged drought, which has given rise to frequent dust storms. The feasibility of forecasting these dust storms is being investigated (Fig. 1). Another current activity is verifying long-range transport of the Melbourne urban plume (Fig.2).

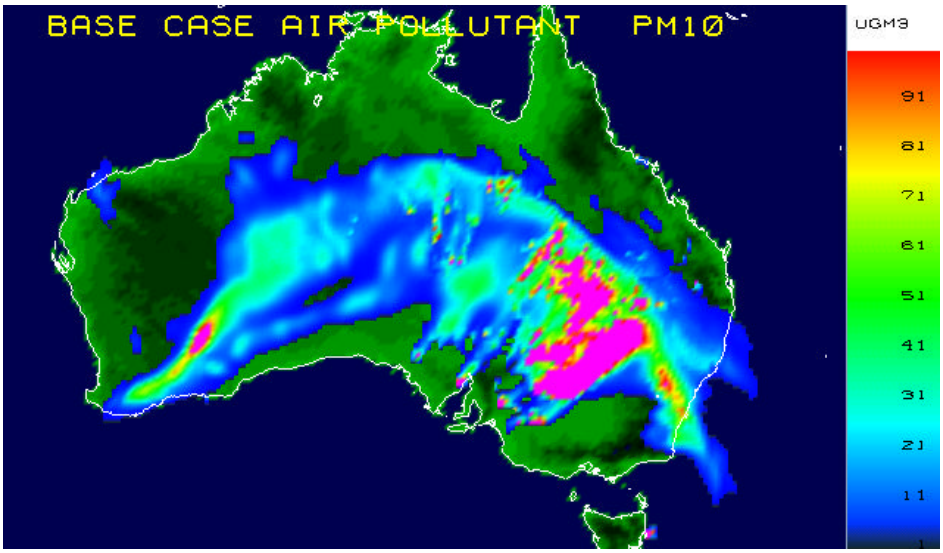

Figure 1. Simulation of a major dust storm at 1200 Australian Eastern Standard Time, 23 October 2002, which engulfed eastern cities from northern Victoria to Queensland in a deep cloud of dust. The concentrations indicate 1-hour average PM10 values.

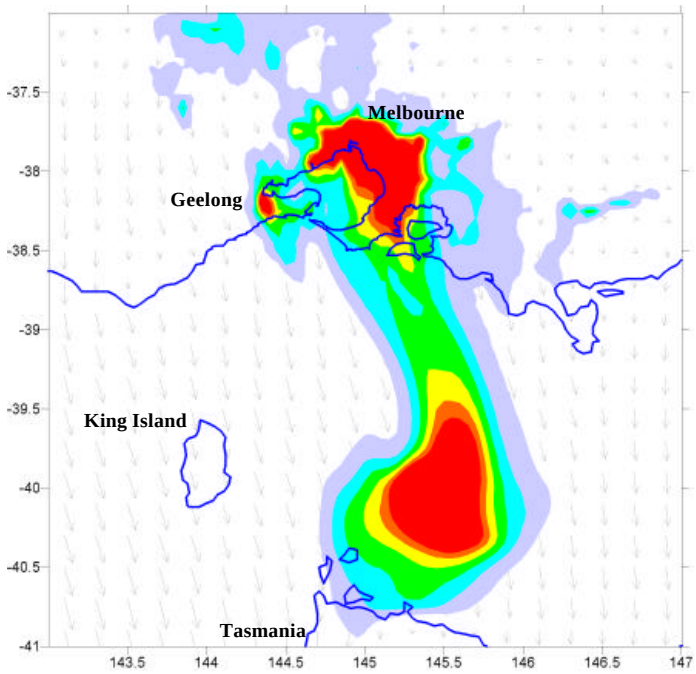

Figure 2. Simulation of the long-range transport of the carbon monoxide urban plume from the Melbourne-Geelong region to northern Tasmania at 0600 Australian Eastern Standard Time, 19 September 2001. The shaded region indicates concentrations ranging from 80–140+ ppb.