

Department of the Environment and Heritage

Air Quality Forecasting
for Australia's Major Cities
5th and 6th Progress Report

Prepared by Project Management Committee
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The Director
Air Quality Section
Environment Protection Group
Environment Australia
GPO Box 787
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Attention Mr Paul Kesby

Dear Mr Kesby,

**Re: Air Quality Forecasting for Australia's Major Cities — Fifth and Sixth Phases,
Progress Report**

We are pleased to present the progress report for the fifth and sixth phases of the Australian Air Quality Forecasting System. The report is a compilation of progress reports for each of the four collaborating organisations for the project and managed by CSIRO Atmospheric Research.

Introduction

The project team comprises:

Environment Protection Authority (Victoria)
Environment Protection Authority of NSW
Bureau of Meteorology Research Centre
CSIRO Energy Technology and
CSIRO Atmospheric Research

A description of the Project, its management structure and the work schedule are described in Appendix 1, immediately following the Main Reports.

Progress

This Report was to indicate progress to Phase 5. A major objective for Phase 5 was to demonstrate the Pilot System to EPAs in Melbourne and Sydney over the summer period, and to fix problems and refine products ready for the Demonstration System and Demonstration Phase. Recently (see 4th Progress Report) we set as our objective that the

Demonstration Phase should start 7 August. That is, we moved forward from September to August the Phase 6 objective of demonstrating to EPAs in Sydney and Melbourne the full Demonstration System. This proved to be necessary to ensure the System is operating before the Olympic Games.

A consequence of the moving forward of objectives and the compounding of delays in the emissions inventory work and the changeover from SX-4 to SX-5 supercomputers has been that we have had to do a great deal more work in the time than could reasonably be expected. I wish to put on record the extraordinary work done by staff in all participating organisations and to thank them for it.

Thus this Report is over one month late and a month early, since it is a report against both Phase 5 and Phase 6 objectives. I note that much of the work for Phase 5 was actually reported in the last Progress Report. The present Report and following reports will revisit case studies presented in the 4th Progress Report to show refinement of the System.

We have needed to tackle many issues with the Demonstration System Chemical Transport Model (CTM). These issues are not all resolved, but we are now issuing forecasts of meteorology and air quality via the main Web site to the EPAs. We can therefore say that we have met the objective of commencing demonstration to EPAs of the full System, in compliance with Phase 6 objectives.

The CTM is the last in the chain of components of the System. The chain begins with emissions inventory base data, emissions inventory preprocessing of data for the CTM, the global and limited area weather forecasts, the fine scale LAPS meteorology forecast and finally the chemical transport model and its outputs to archive and the Web. Therefore the CTM is subject to all delays earlier in the system and all the cumulative effects of the many contributing components.

While unwelcome, the problems being identified and solved in the various inputs and components to the Demonstration AAQFS are to be expected at this stage of the development of the System. It is only now that the consequences of the cumulative effects in the changes from the Pilot System to the full System are evident to the EPAs and to ourselves. All participants in the Project are working assiduously to isolate problems and resolve the issues. The progress made so far gives me confidence that as long as we continue to cooperate and work to address the problems, we will achieve a major quality result.

As noted in the Component Report from Bureau of Meteorology, over a month of time was lost due to supercomputer operational issues, including the changeover from the NEC SX-4 to SX-5 machines. This was not foreseen. The computers are not binary compatible, meaning that programs had to be recompiled using compilers that were not fully compatible and this led to a lot of time being spent changing code details both in Bureau of Meteorology and in CSIRO.

The meteorological system continues to be improved in response to issues identified, as the System enters the Demonstration Period. In particular, predictions of rainfall and cloud cover have been improved and these will have an immediate beneficial effect on predictions of air

pollution. Winds have also been improved and evidence of this can be found in the Component Report from Bureau of Meteorology. However, an identified bias in near-surface wind speeds has not yet been resolved.

We report for the first time indexes showing improvement in the skill of the meteorological model in terms of surface vector winds and temperature. Our measures of performance in terms of correct forecasts of air pollution day by day can start only now that the Demonstration System is operating. We plan to report on these measures in the next Progress Report.

However we have been reporting on special event days, both correct and false forecast days, for some time. These are our principal measures of progress, since EPAs are really only concerned with high pollution days, not days of low pollution. The present Progress Report continues this focus, and the Component Report on the Meteorology shows good improvement in rainfall prediction on a false forecast day and notes an improvement in cloudiness for that day, which is of vital importance to correct prediction of photochemical smog.

New display products in response to EPA feedback have been produced, both for meteorological parameters displaying winds and mixing height and for air pollution parameters such as air pollution index. The mixing height and winds information are now being supplied directly to the EPAs. The air pollution parameters are now part of the Web display system.

As noted above, the Demonstration System Chemical Transport Model (CTM) has now replaced the Pilot System CTM for the generation of daily air quality forecasts. This is a major milestone. However, as mentioned, the CTM work continues to feel the effects of the earlier delays in the emissions inventory components of the System. We have established that the processing of most components is now correct, but there are ongoing issues about data quality in the emissions and CTM that we are working to resolve.

Other issues

- Dr Kamal Puri and I were guests of World Meteorological Organization Global Atmospheric Watch Urban Research Meteorology and Environment (GURME) for the first GURME Workshop on Air Quality Forecasting Systems 13–17 August 2000 in Kuching, Malaysia. We made presentations on forecasting systems in Australia, particularly the AAQFS. A report of my presentation and of the overall workshop is included in two Appendices to this Report.

It was clear from all the discussions and presentations at that Workshop that the Australian Air Quality Forecasting System is by far the most ambitious air pollution forecasting system. It is only because of the partnership between BOM and CSIRO and the EPAs, facilitated by NHT funds through Environment Australia, that such a comprehensive system has been able to be developed.

A more wide ranging assessment of the AAQFS against other Systems around the world will be reported at a later date.

- The run time for the System for Victoria has proven to be longer than expected. The emissions preprocessor for Victoria takes four times as long as for the (admittedly smaller) domain used for NSW, and the computation time is also considerably longer. We will need to address these issues since the time to produce a forecast is proving to be critical.
- Profiling sounders in western Sydney and in Melbourne, to be used in verification of upper winds and mixing height, have been installed. The Sydney system has just commenced operation.
- Contracts have still not been finalised, although all issues of any significance have been resolved.
- Our external reviewer, Dr Phillip Morgan, (ex) DEP, Western Australia, has again provided a review of work done. He notes the delays that were being indicated in the Stage 3 Report but expresses his satisfaction with progress and the quality of the work being done. His letter, dated 19 April 2000, immediately follows this page.
- We plan to hold a meeting in October among participants to review the Demonstration Phase results and to discuss findings and assess utility of the System. We will make a report to Environment Australia shortly after that meeting.

For and on behalf of
AAQFS Management Committee



(Dr) **Peter Manins** PSM, FTSE, CCM, QEP

COMMENTS ON 5TH PROGRESS REPORT FOR PROJECT AIR QUALITY FORECASTING FOR AUSTRALIAN MAJOR CITIES

In general the project is proceeding well, but there are some difficulties evident in meeting deadlines. However, these difficulties do not appear to be insuperable, or likely to compromise the objectives of the project.

The report on the Emissions Inventory Component appeared to not have been checked for spelling or grammar (cf page 10 line 23, page 11 line 29). It is also clear that this component is now behind schedule. The 4-month delay in accessing the NEC supercomputer is likely to have fairly serious implications for meeting the overall project schedule, and the next report should indicate how the consequent problems have been overcome, if indeed they have been able to be overcome.

The legal issue (Status of Agreement) may have been more appropriately reported in a section on project management rather than with the technical material.

The CSIRO Energy Technology report indicates that good progress has been made with the power based vehicle emission model. There will be some important spin-offs from this work for vehicle emissions management strategies in the future and for evaluating the likelihood of compliance with the 10-year goal of the Air NEPM.

The Bureau of Meteorology report demonstrates that considerable progress has been made with the upgraded meteorological model, and in the validation techniques. While it is recognised that the spikes in the near-surface temperature field resulting from "spin up" errors in the model are not serious, they appear to be significant in the temperature plots (see Figure 7 page 22). It is to be hoped that a technique to minimise or eliminate them will be quickly developed and applied. Otherwise this aspect of the project appears to be proceeding very well.

The CSIRO Atmospheric Research report also indicates that good progress continues with the photochemical modelling work. It would seem (Figure 2 page 37) that the GRS chemistry performs reasonably well for days when maximum 1-hour ozone is 60 ppb or less, ie for non-episode days, but the LCC chemistry provides a better fit to the peak value on episode days. Presumably meteorological screening can be applied to determine those cases where LCC should be used, as it clearly performs better for episode days.

The time series plots for the 11-13 December 1998 episode are very encouraging. With the expected improvements in the meteorological modelling, the quantitative forecasts of photochemical smog seem likely to have a high level of accuracy.

In summary, then, Progress Report No 3 indicates that the project is proceeding well, aside from some slippage in meeting the deadline for completing emissions inventory work.

Phil Morgan
19 April 2000

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