



The Australian Air Quality Forecasting System (AAQFS)

P.C. Manins¹, M.E.Cope^{1,2},
G.D Hess³, K.J. Tory³,
Sunhee Lee¹, K.Puri³, M.Young⁴



¹CSIRO Atmospheric Research, ²CSIRO Energy Technology, ³Bureau of Meteorology
Research Centre ⁴Environment Protection Authority of NSW

GENERAL PROJECT OBJECTIVES

- Develop and implement a numerical air quality forecasting system in Melbourne and Sydney – Australia
- Demonstrate the System in Sydney during the Olympics and Para-Olympics (2000)

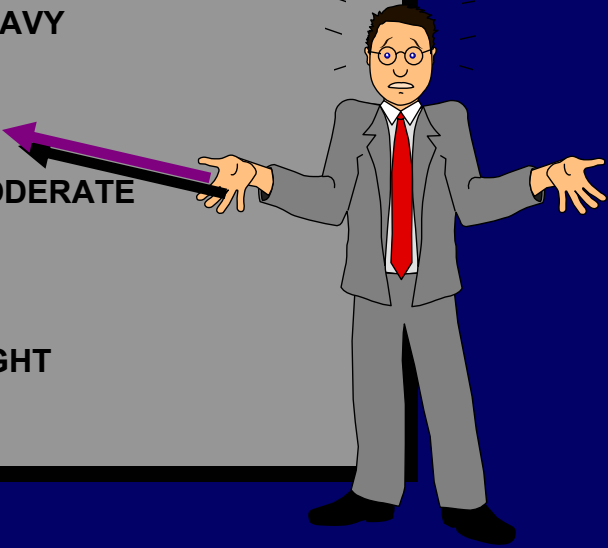
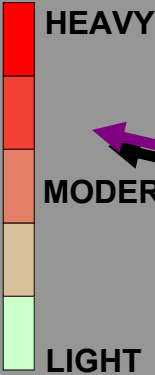
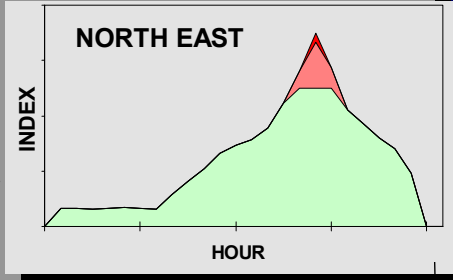
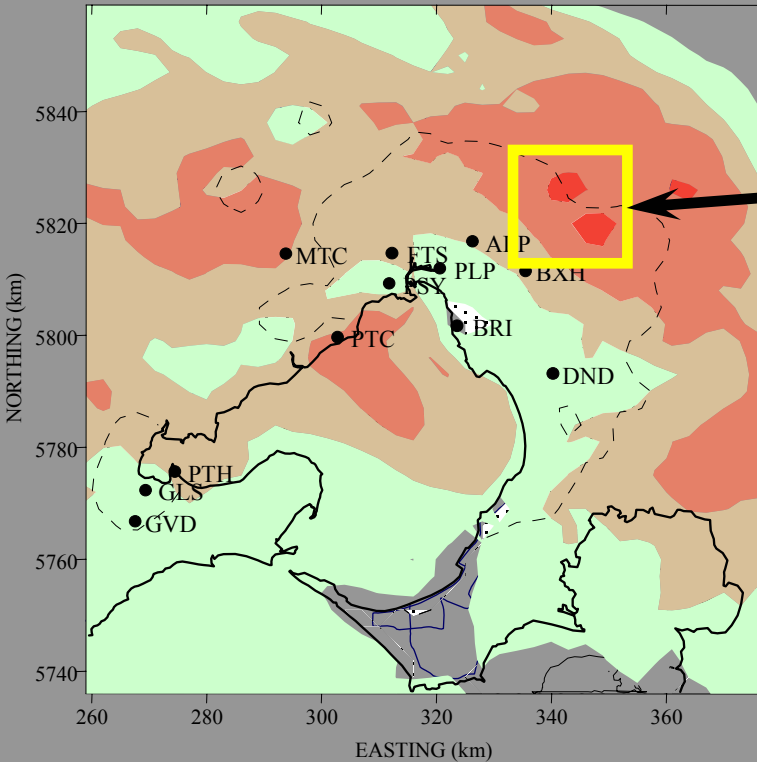


A project supported by Environment Australia through the Natural Heritage Trust.



Tomorrow will be fine and sunny
-with moderate to heavy air pollution

AIR QUALITY FORECAST- MELBOURNE





Is a prognostic air pollution forecasting system worth the considerable effort?

Why not use a statistical forecasting system? [More...](#)

- Are spatial and temporal information needed from the forecast?
(e.g. hour-by-hour, suburb-by-suburb)
- Support air quality management & policy development? (e.g. VOC controls)
- Are monitoring data limited?
(no extensive network)?





Levels of Complexity [More...](#)

1. Embedded in a operational National Weather Forecasting System – AAQFS
2. Extension of Numerical Weather Forecasting Capability – *e.g.*, Beijing, China
3. NMHS seeking to develop both a national numerical weather and pollution forecast – Malaysia?
4. NMHS focussed on forecasting air pollution for a limited region – others?





AAQFS DESIGN FEATURES

- Generate air quality forecasts twice per day for a period of 24–36 hours: (*3 pm and 9 am*).
- Consider a range of air pollutants:
NO_x, ROC, SO₂, O₃, aerosol, air toxics.
- Resolve air quality at regional and suburb level (5 km, 1 km).
- Generate a ‘business as usual’ forecast and a ‘greener emissions’ forecast.



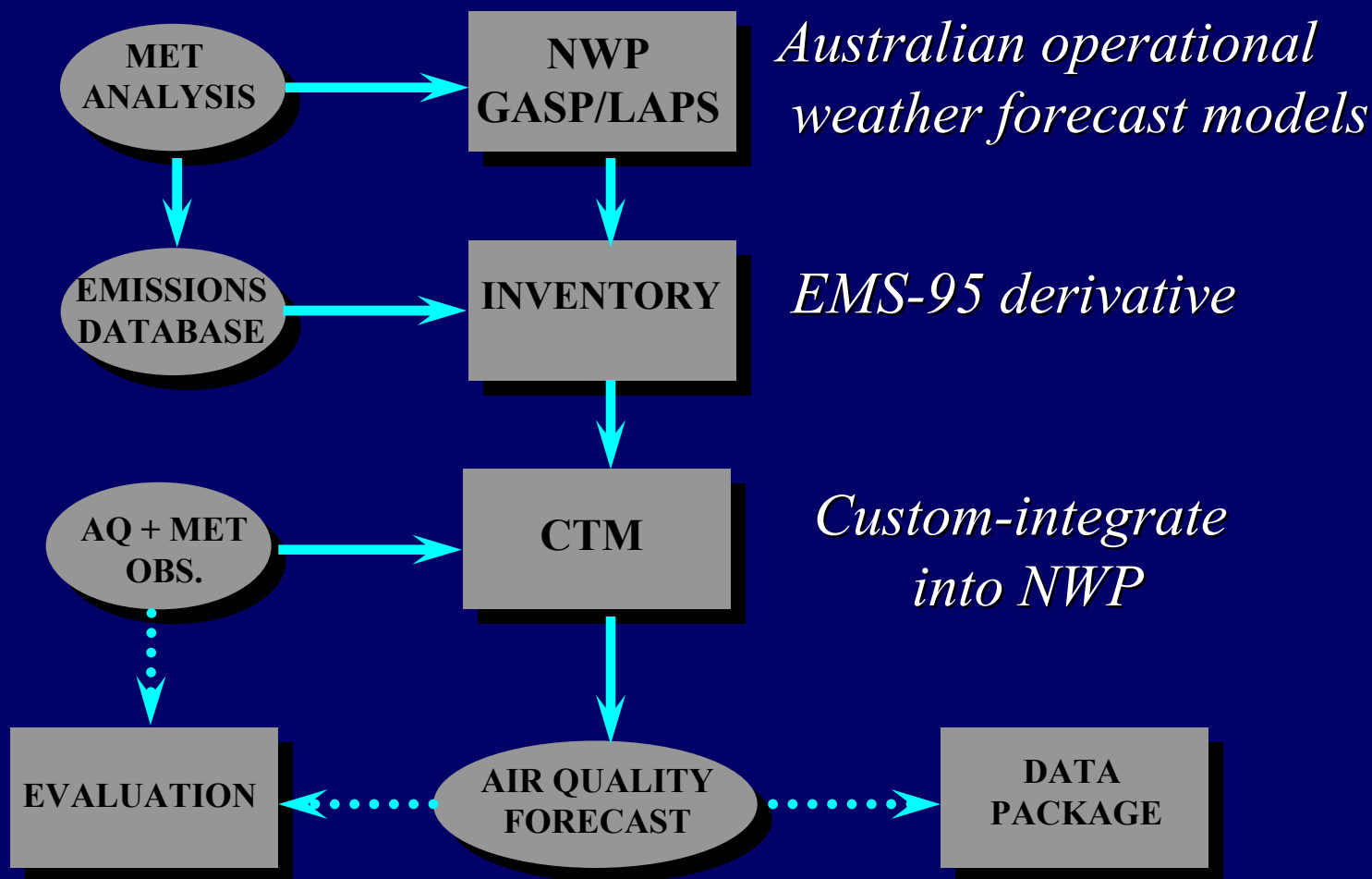


The Need for High Resolution [More...](#)

- Leads to improved weather forecasts
 - Changes in space and time important
- Necessary to resolve regional flows
 - For air pollution, wind *trajectory* vital
- Boundary layer must be resolved
 - For air pollution levels, *mixing height* vital

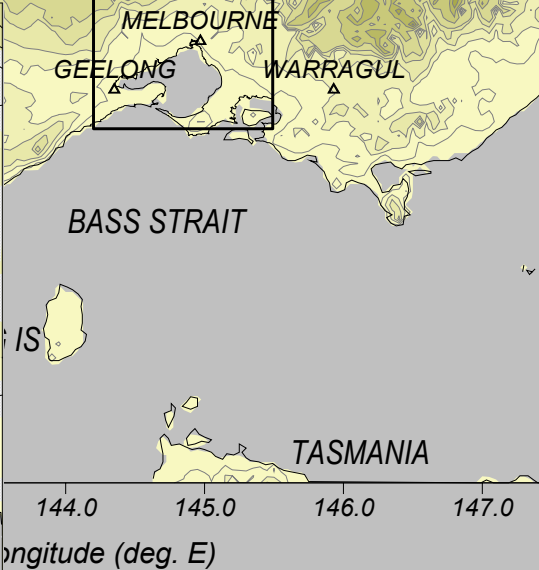
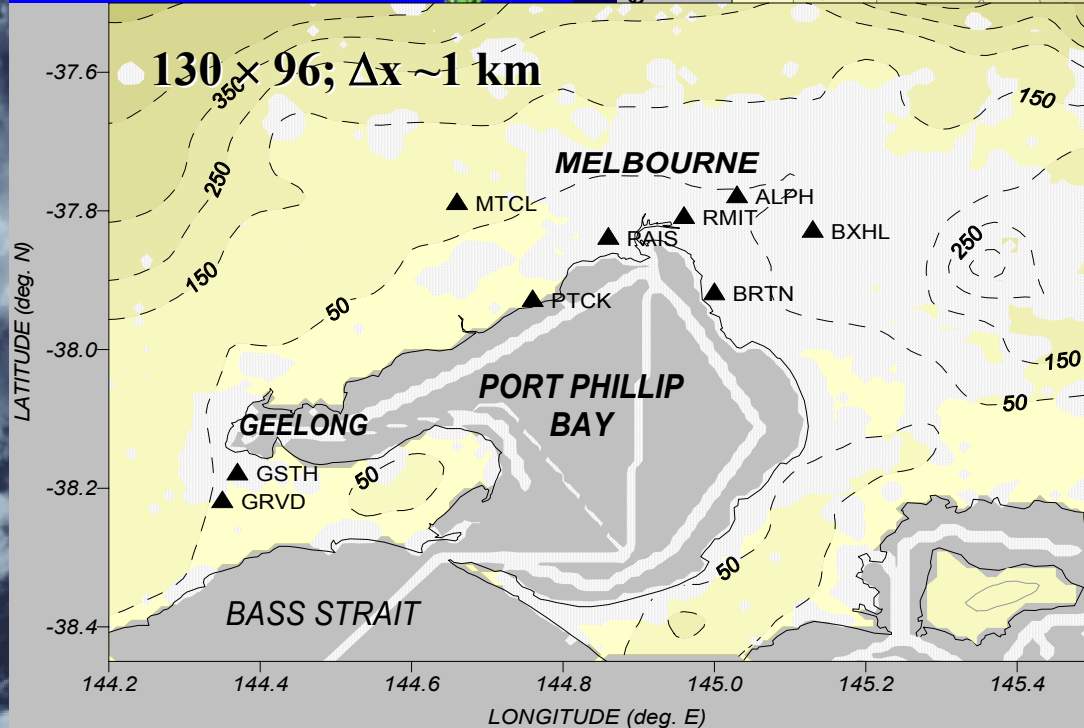
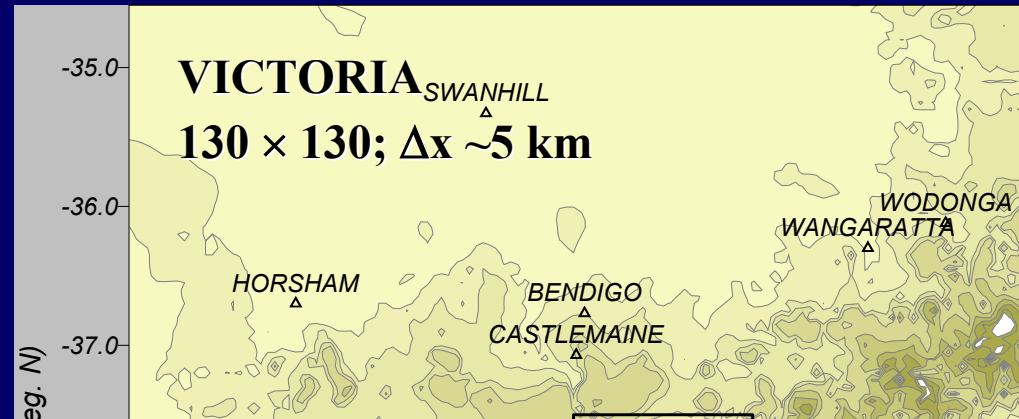
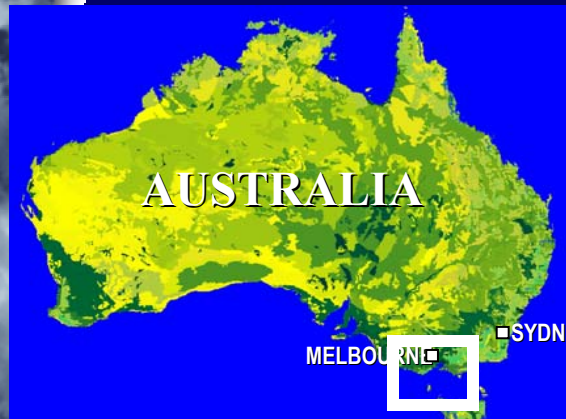


SYSTEM- FEATURES



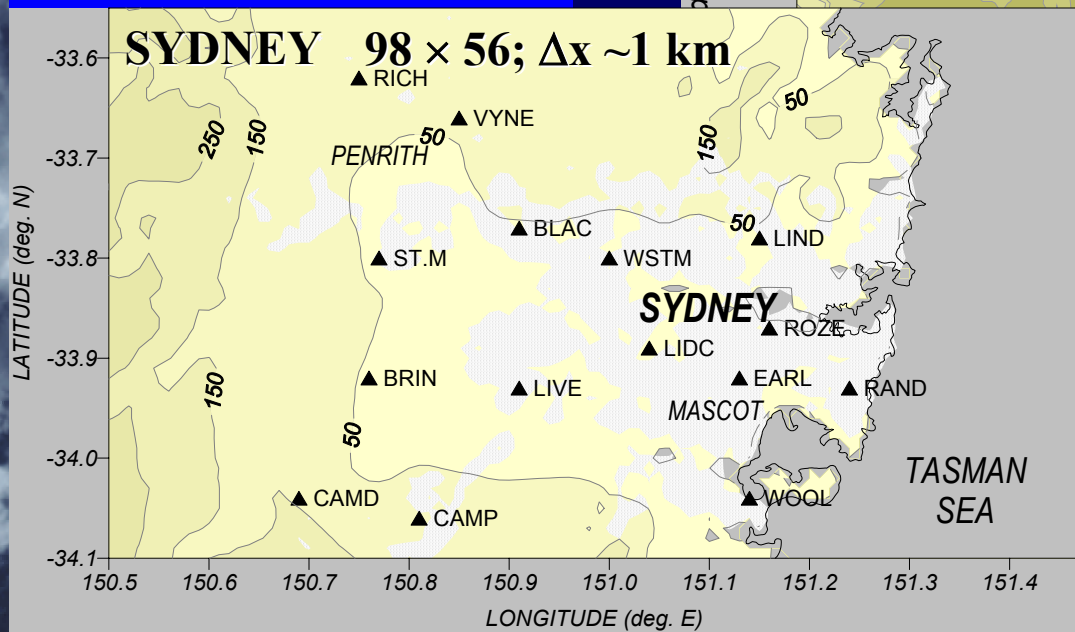
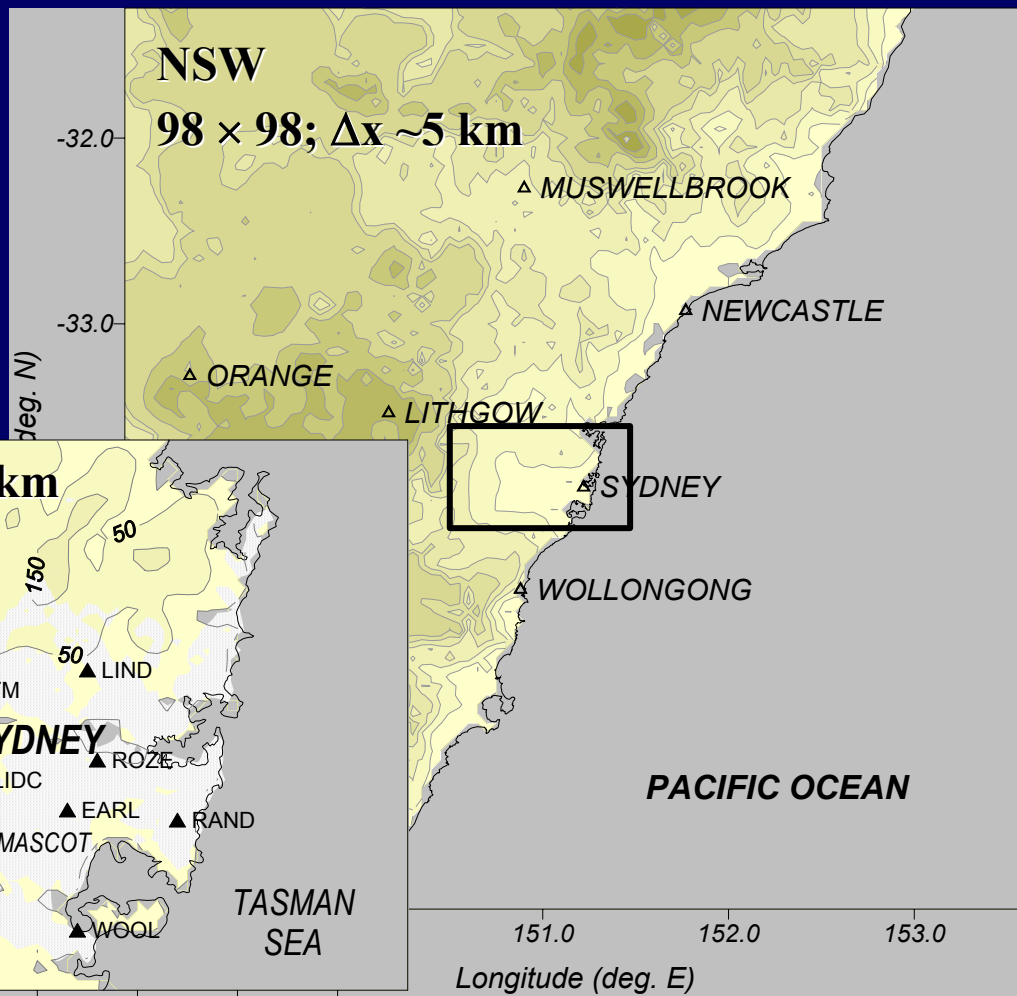


STUDY REGIONS Victoria-Melbourne

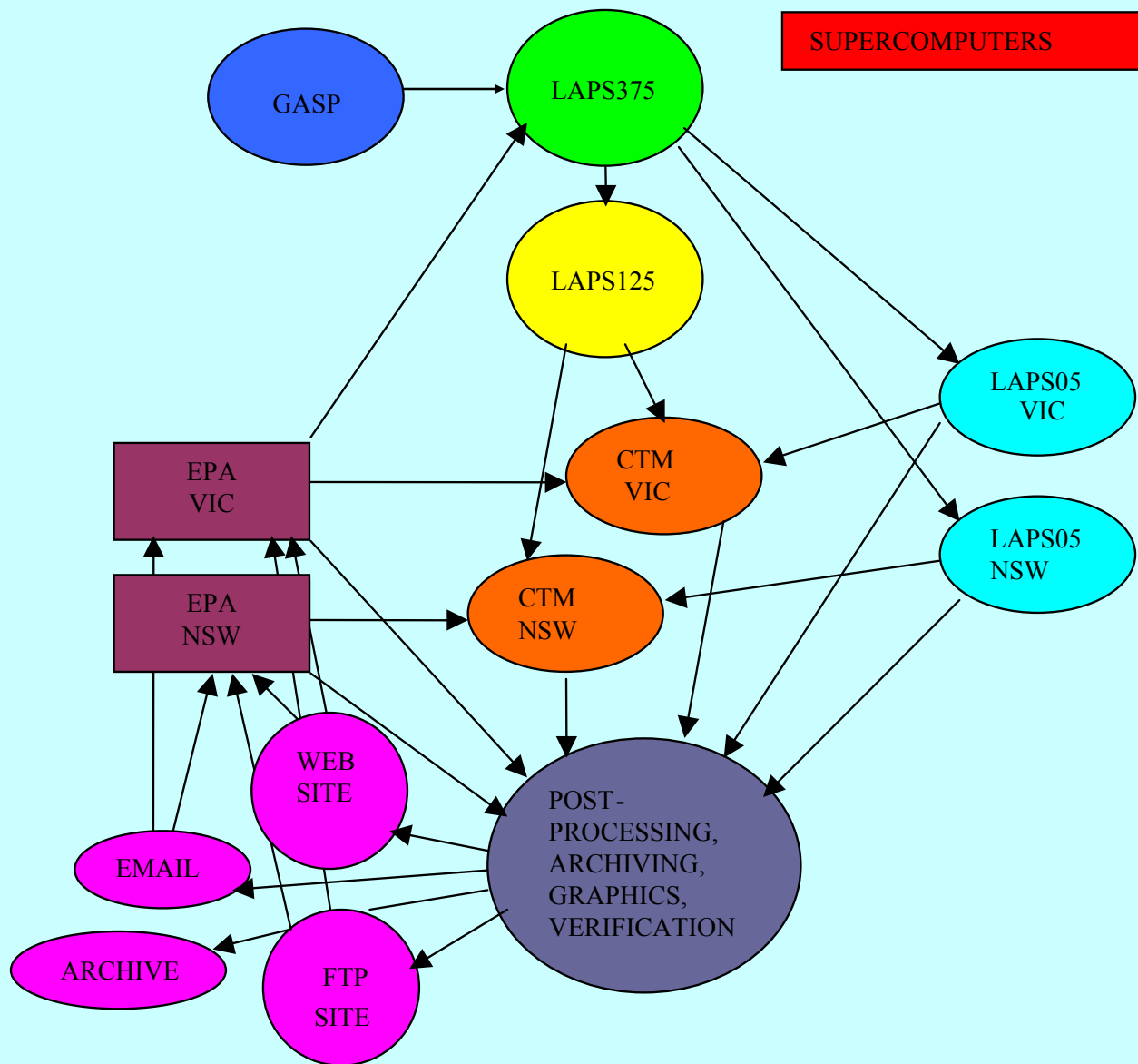


STUDY REGIONS

New South Wales-Sydney



Data Flows for AAQFS





EPA-Victoria AAQFS Web Page

AAQFS_vic_forecast - Microsoft Internet Explorer - [Working Offline]

File Edit View Favorites Tools Help

<http://www.epa.vic.gov.au/air/AAQFS>

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Australian Air Quality Forecasting System

AAQFS Pages

- [AAQFS Home](#)
- [AAQFS Victorian Forecast](#)
- [AAQFS Melbourne Forecast](#)
- [AAQFS Technical Information](#)
- [AAQFS User Guide](#)
- [AAQFS Acknowledgements](#)

Related Pages

- [Today's Forecast](#)
- [Current Air Quality](#)

Today's forecast-Melbourne

Maximum average concentration of PM_{10} ($\mu g/m^3$) at ground level
Date= 27/ 9/2001
Air Quality Standard (24-hour average) for PM_{10} : $50 \mu g/m^3$

Northing

Easting

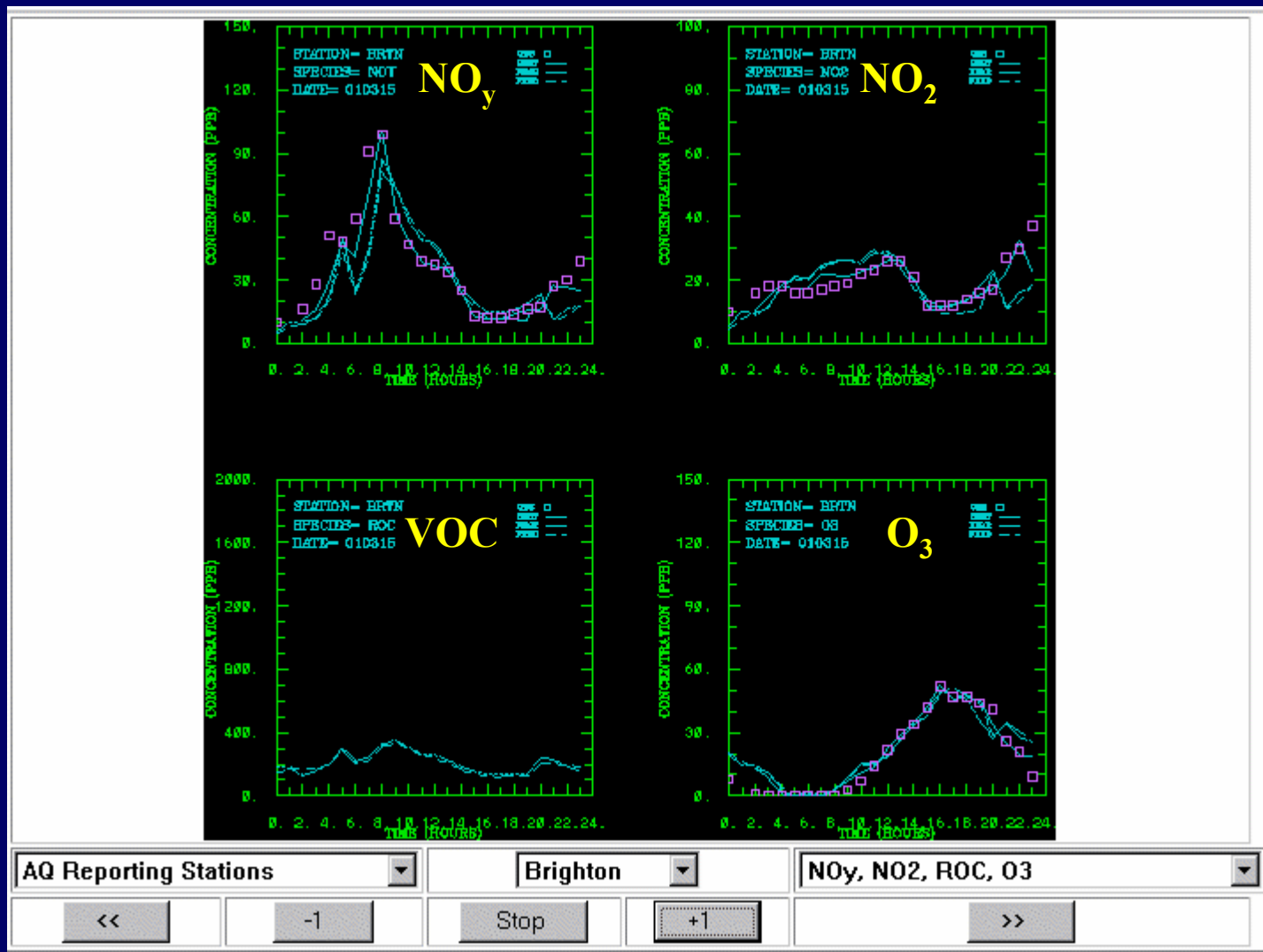
Air Quality: Particle Matter < 10 Micron Image No: Max

<< -1 Stop +1 >>

http://www.dar.csiro.au/aaqfs_vic/g2_pm10_max.gif Internet



Daily Validation



15 March 2001



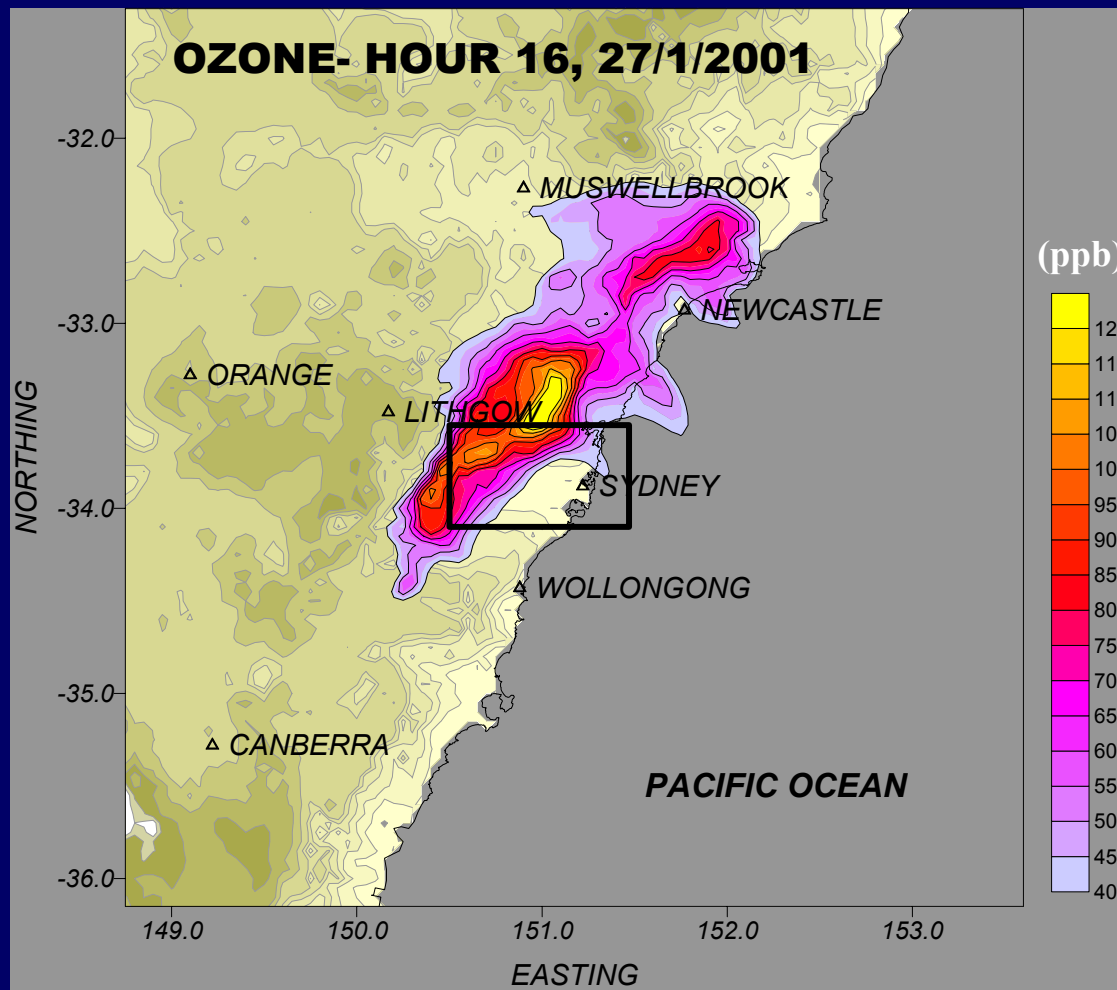
PERFORMANCE REVIEW

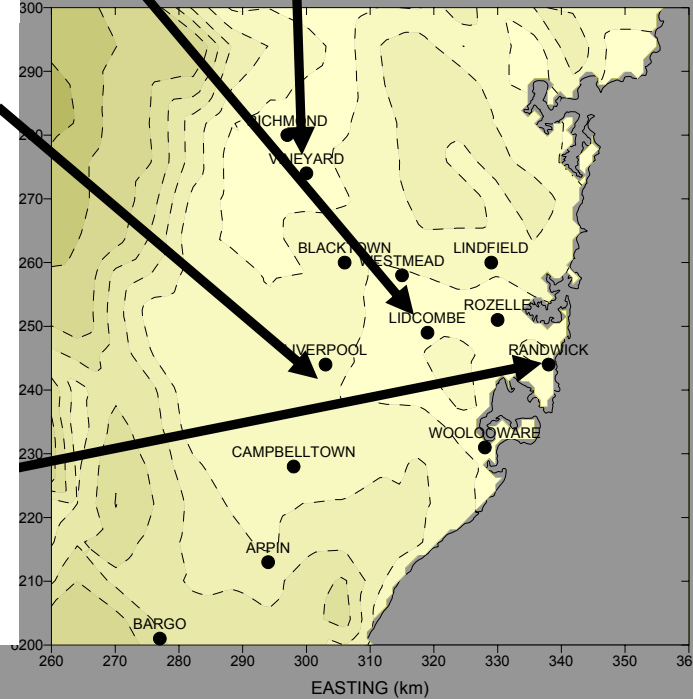
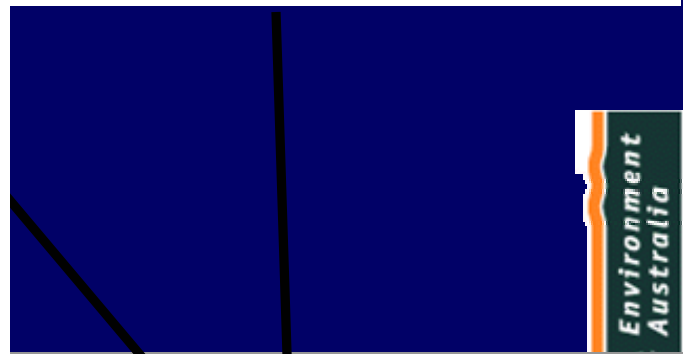
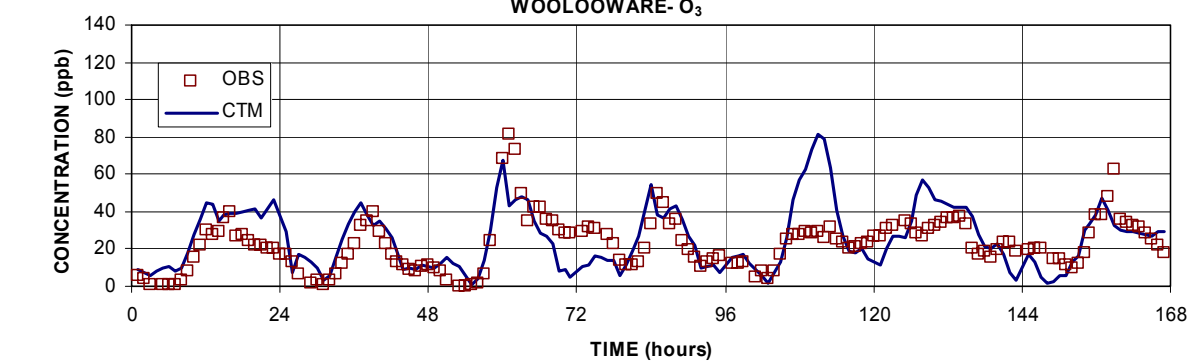
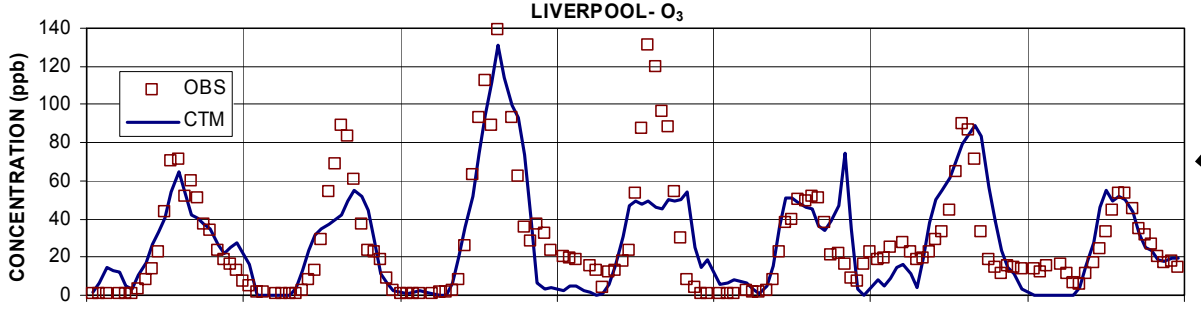
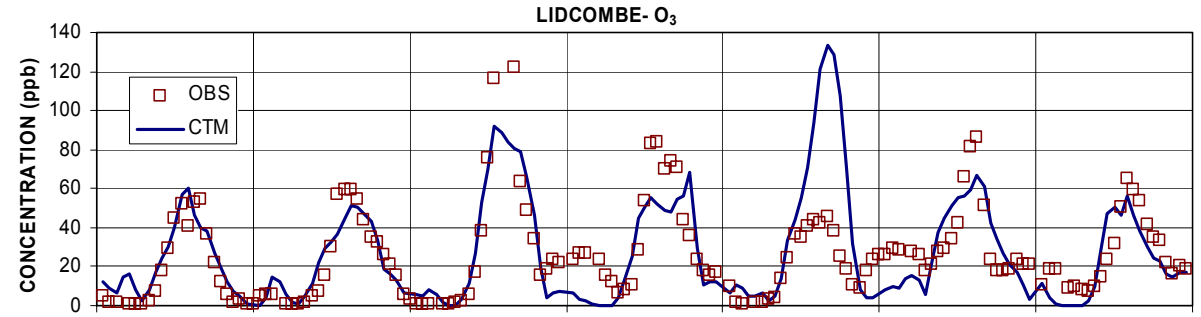
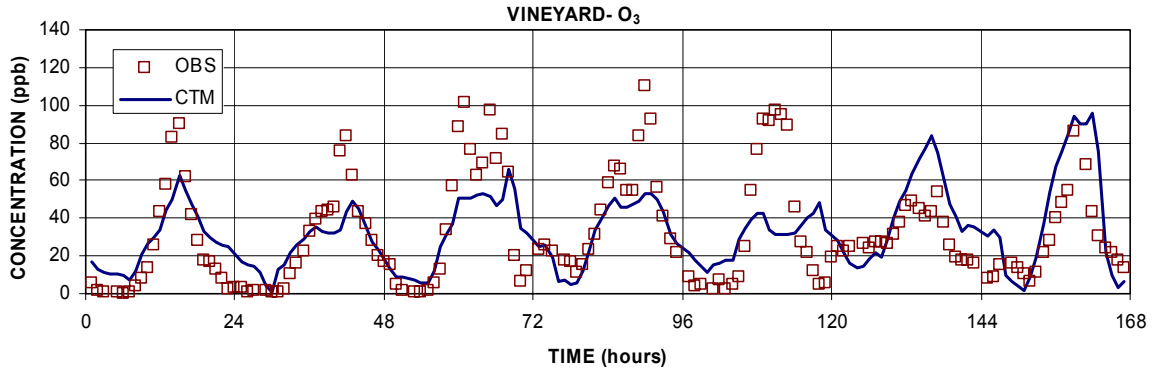
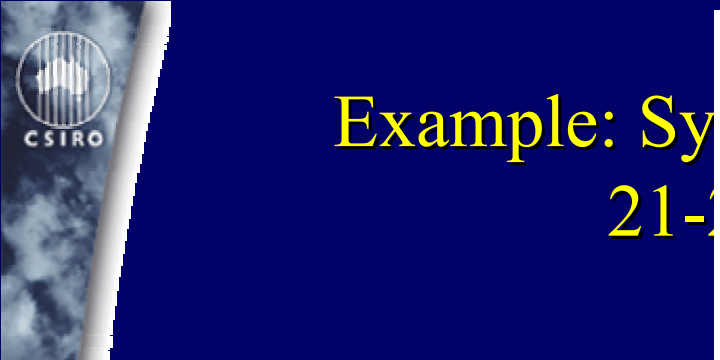
- Consider forecasts for some of 2000/2001 and all of 2001/2002 photochemical smog seasons
- 5 km forecasting domains
- Assess the limit of predictability for forecasts of peak daily 1-hour ozone concentration



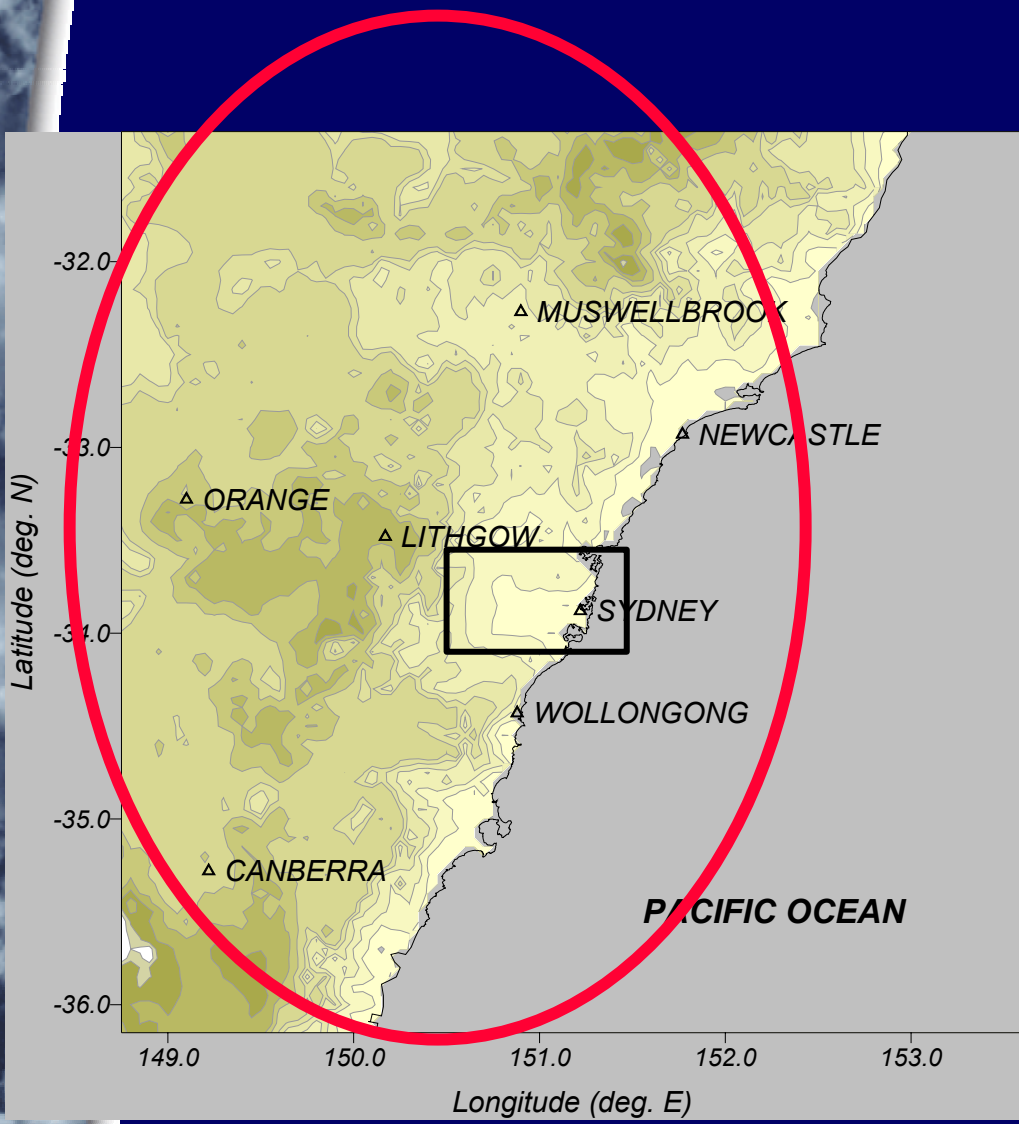
Verification- Air Quality modelling

Example: Sydney 7-day ozone episode 21-27 January 2001

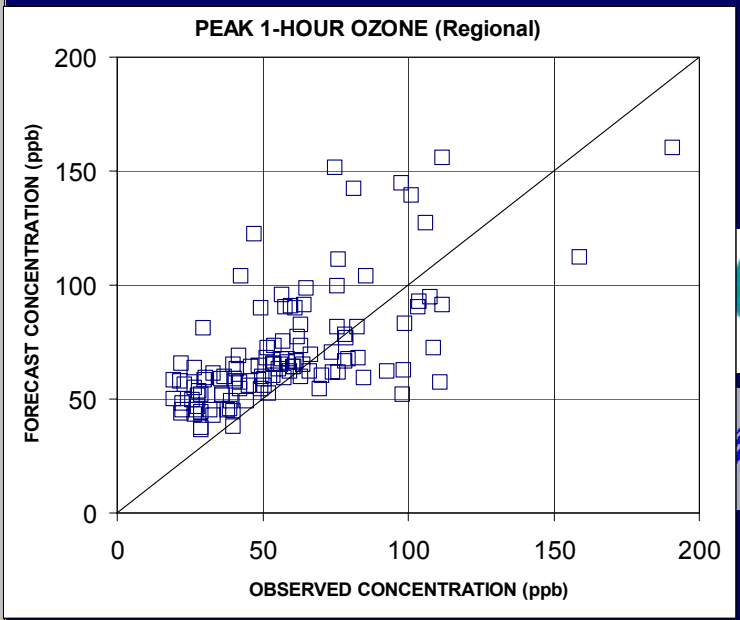




PERFORMANCE REVIEW

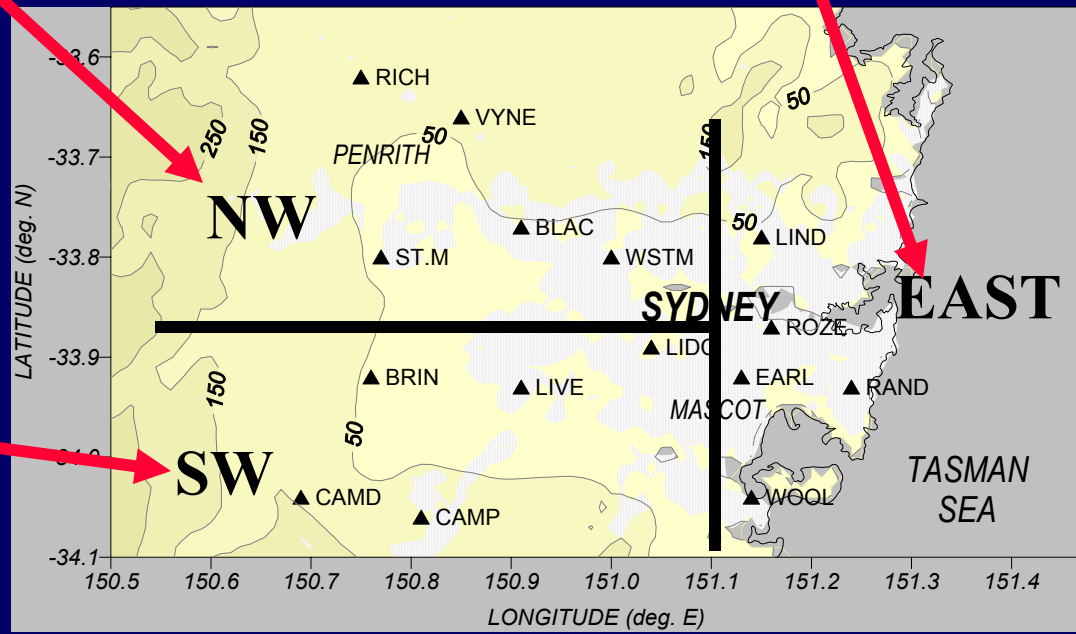
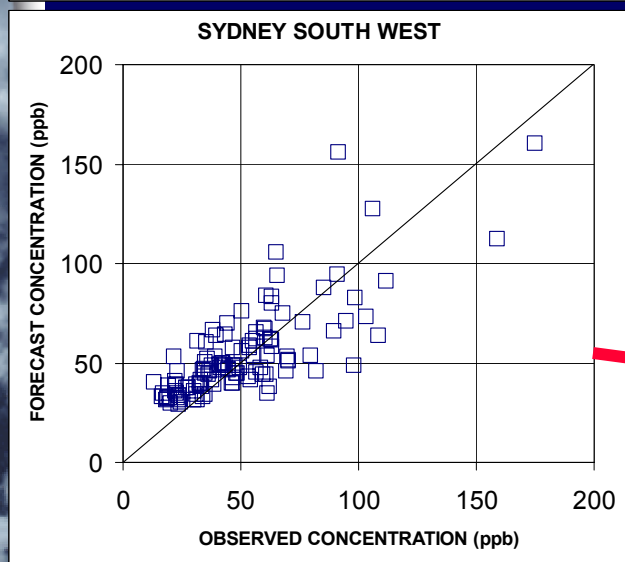
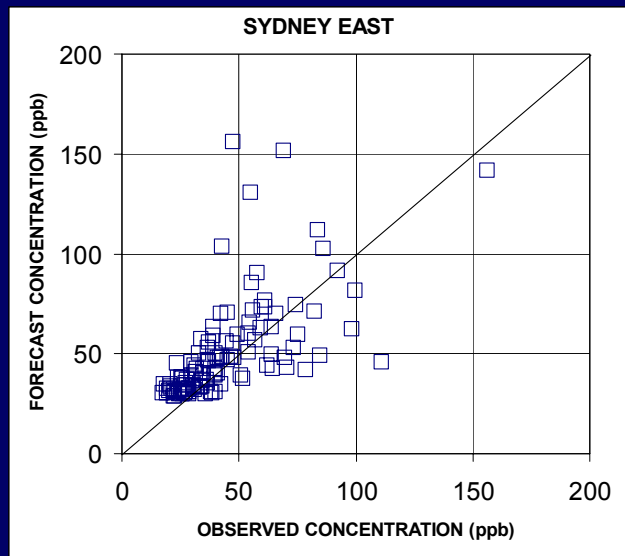
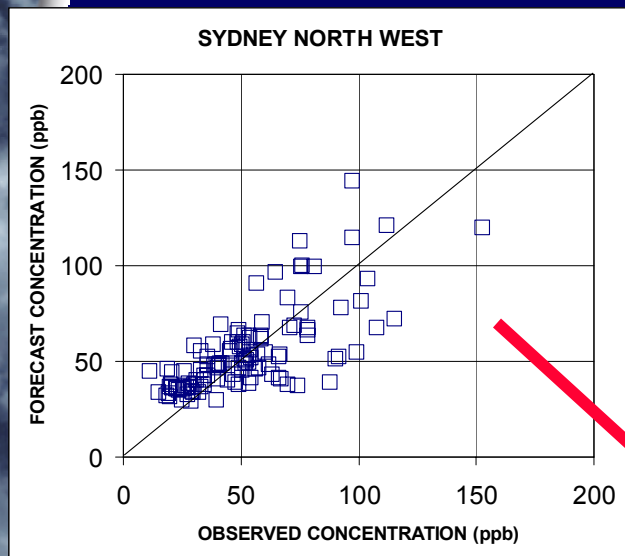


REGIONAL FORECASTING



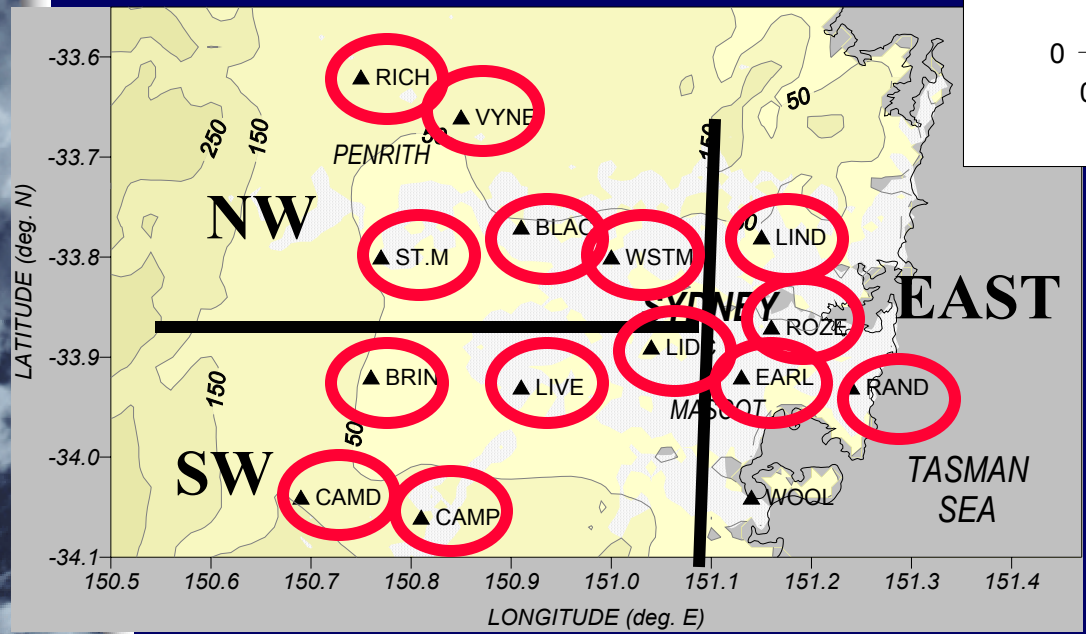
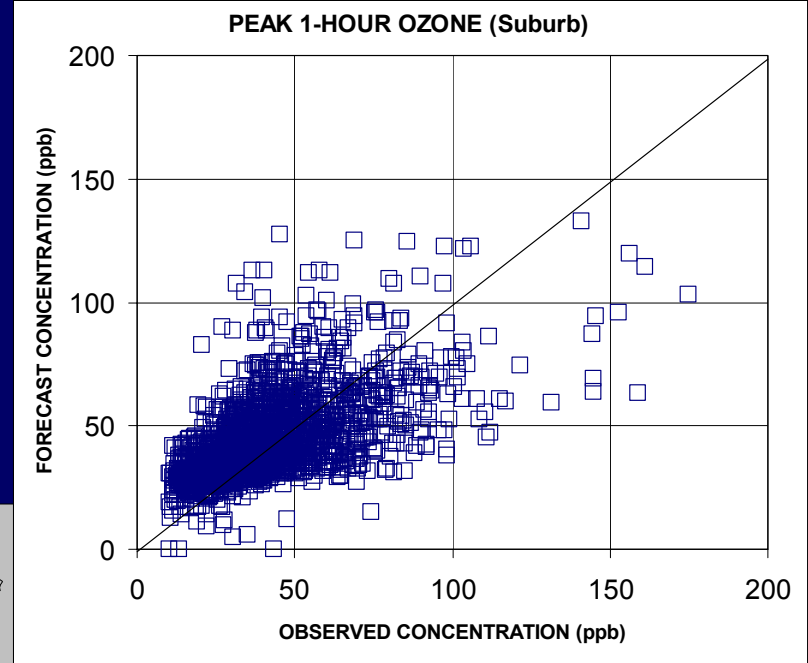
SYDNEY- Daily 1-hour O₃ max

SUB-REGIONAL FORECASTING



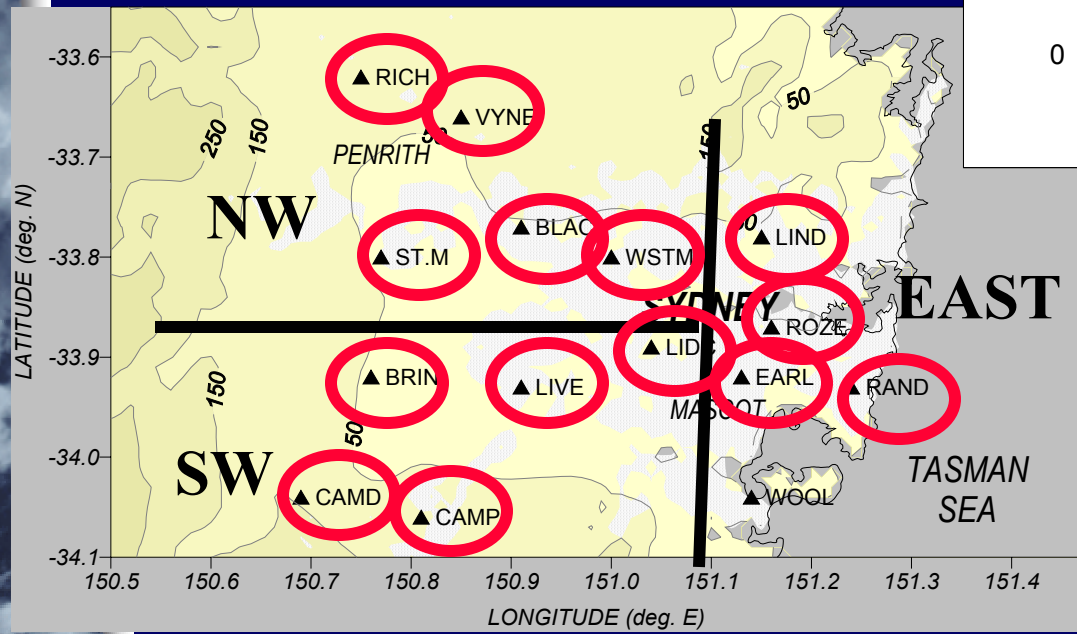
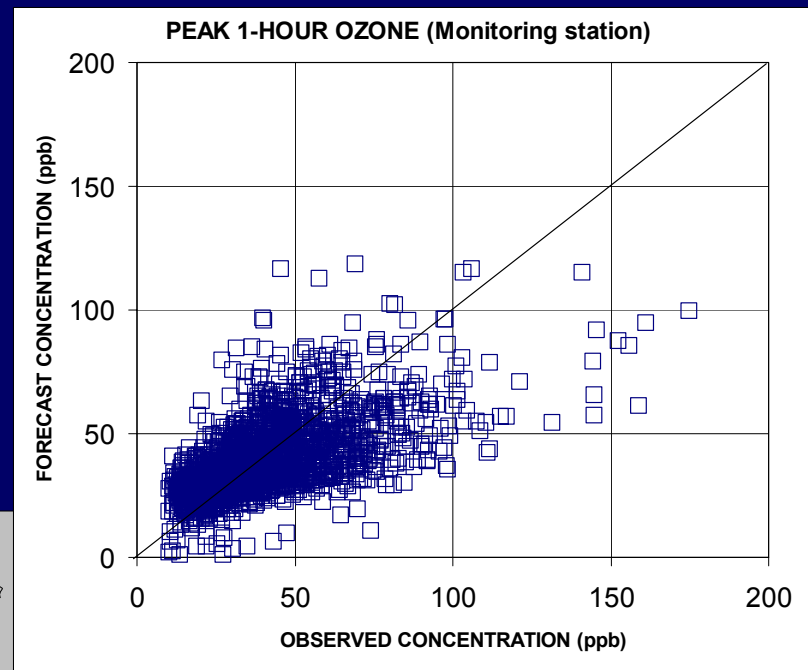
SYDNEY- Daily 1-hour O₃ max

SUBURB-LEVEL FORECASTING



SYDNEY- Daily 1-hour O₃ max

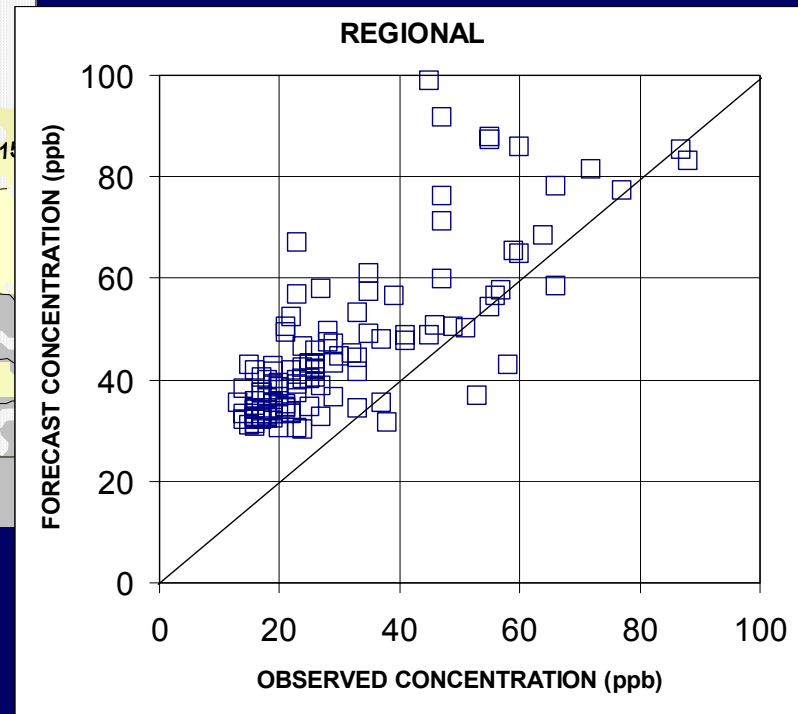
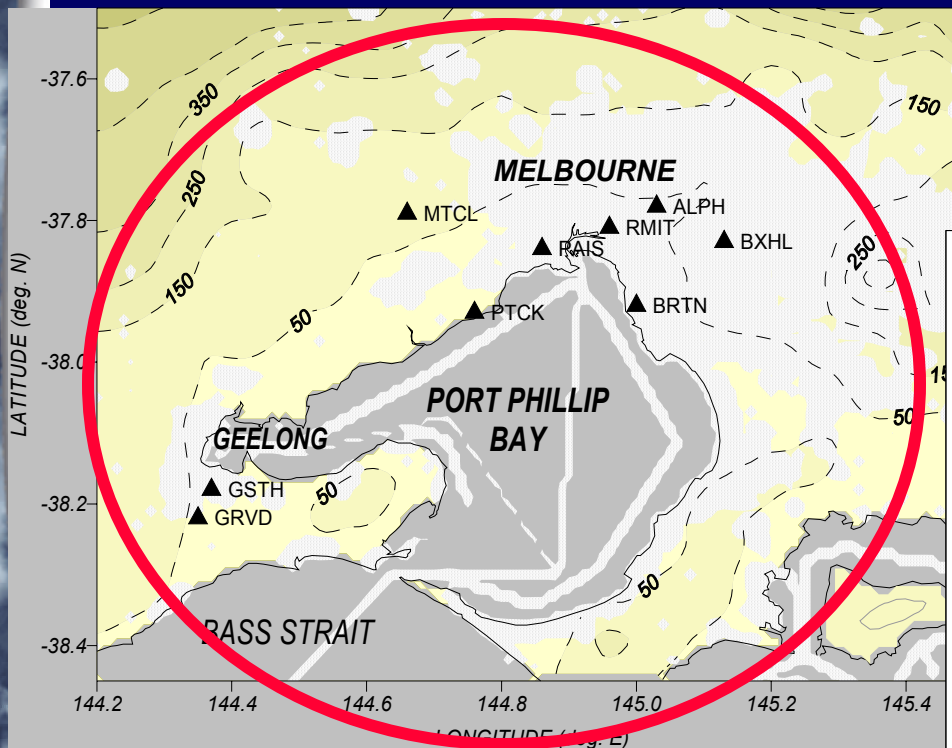
STATION-LEVEL FORECASTING





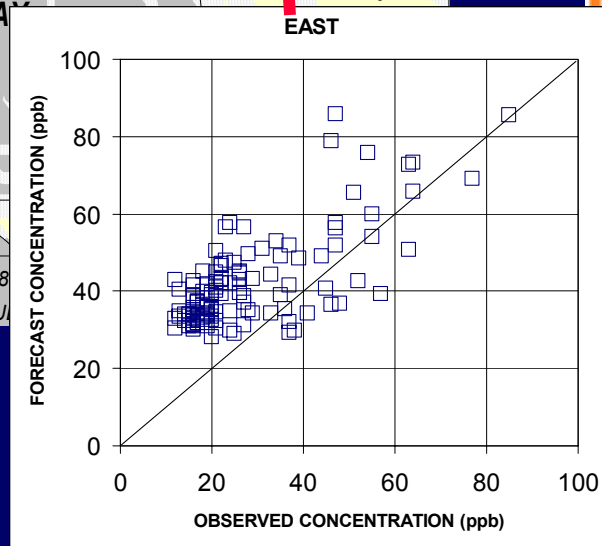
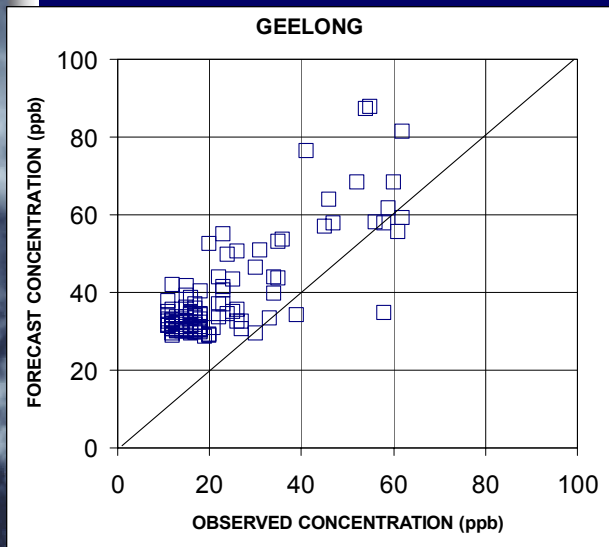
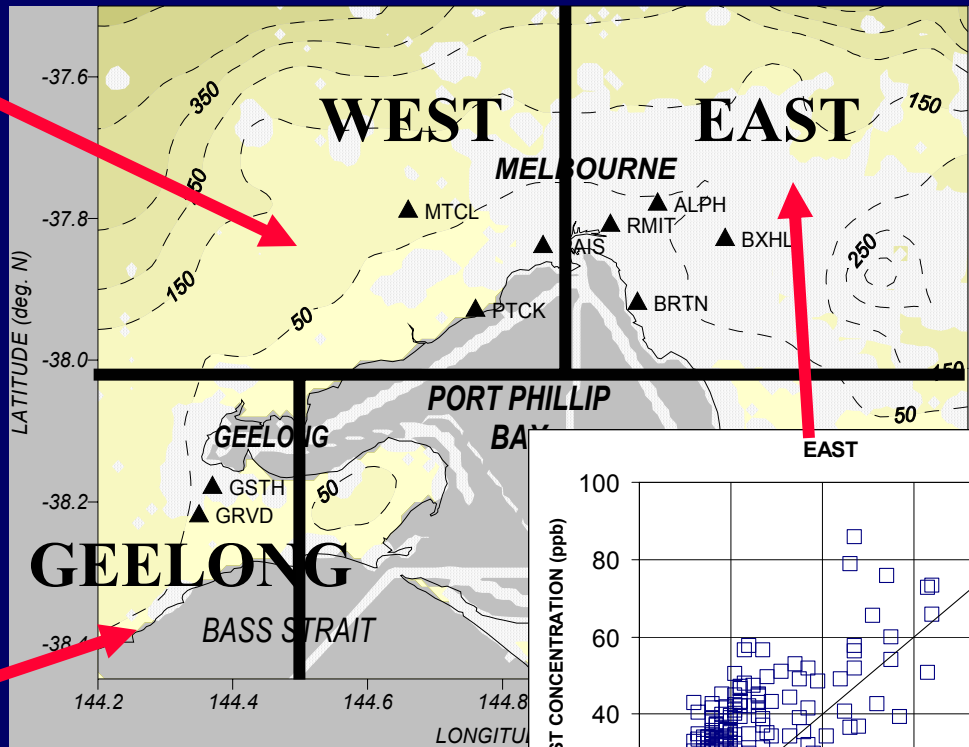
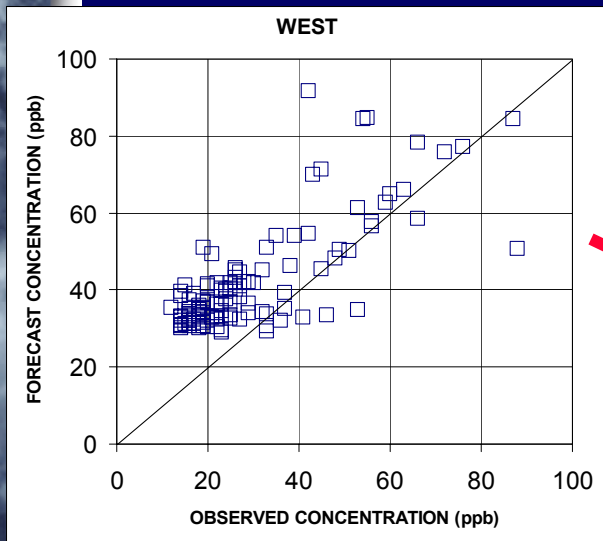
MELBOURNE- Daily 1-hour O₃ max

REGIONAL FORECASTING



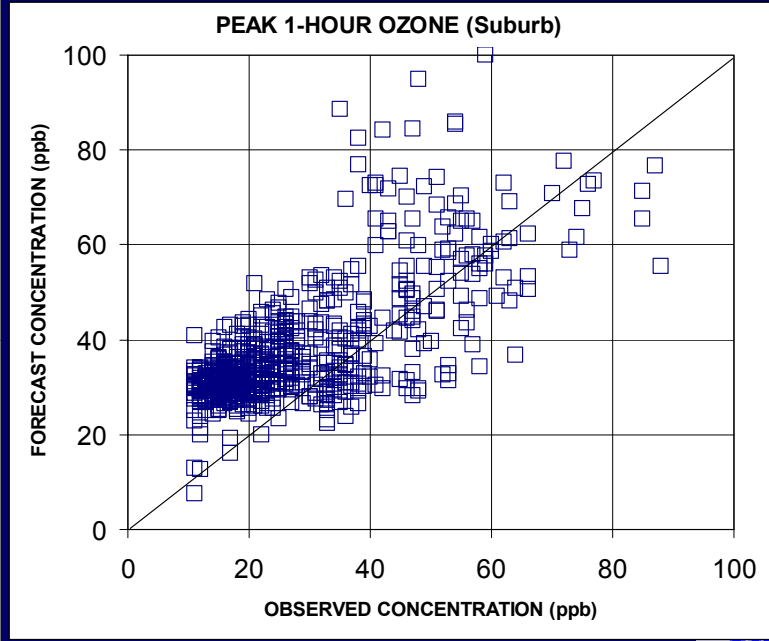
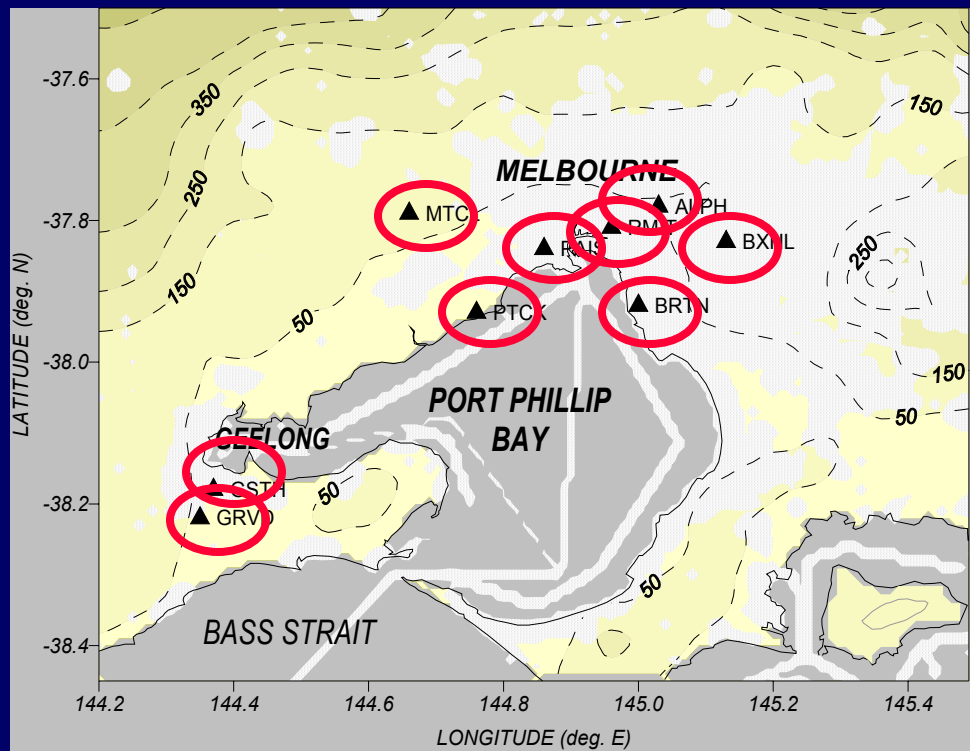
MELBOURNE- Daily 1-hour O₃ max

SUB-REGIONAL FORECASTING



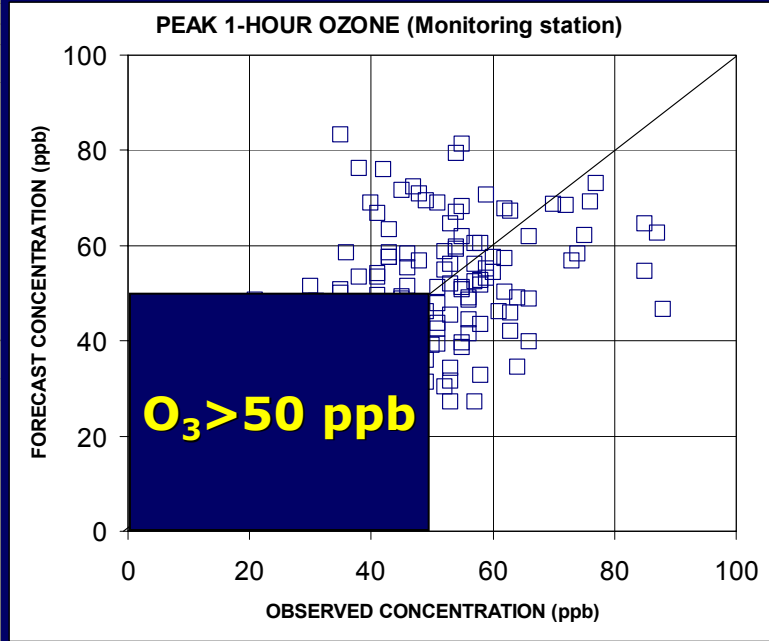
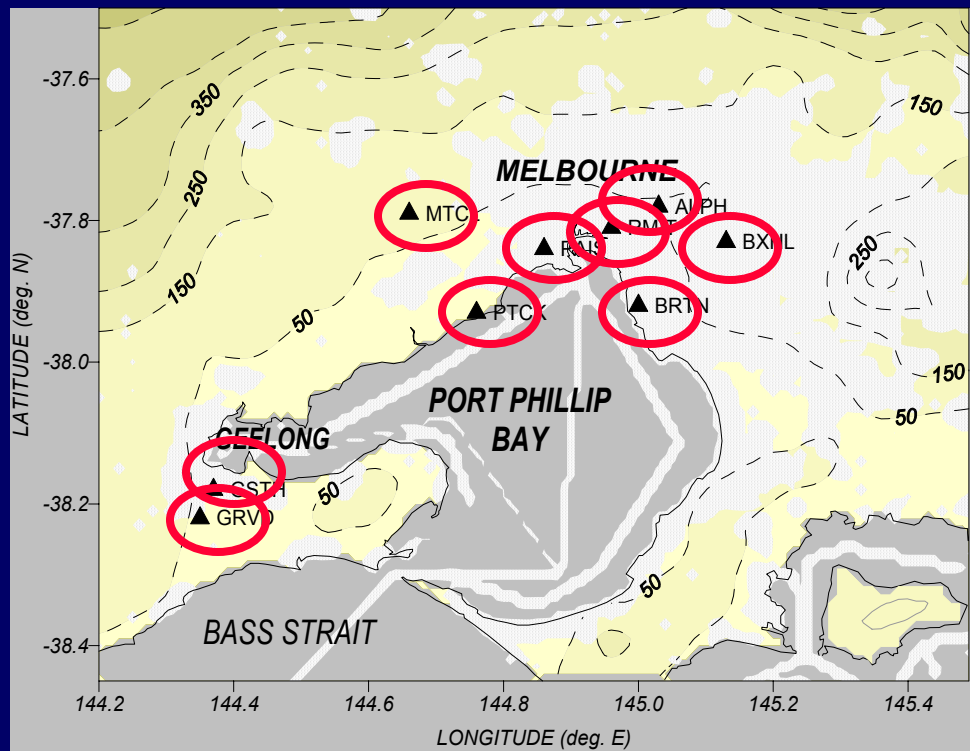
MELBOURNE- Daily 1-hour O₃ max

SUBURB-LEVEL FORECASTING

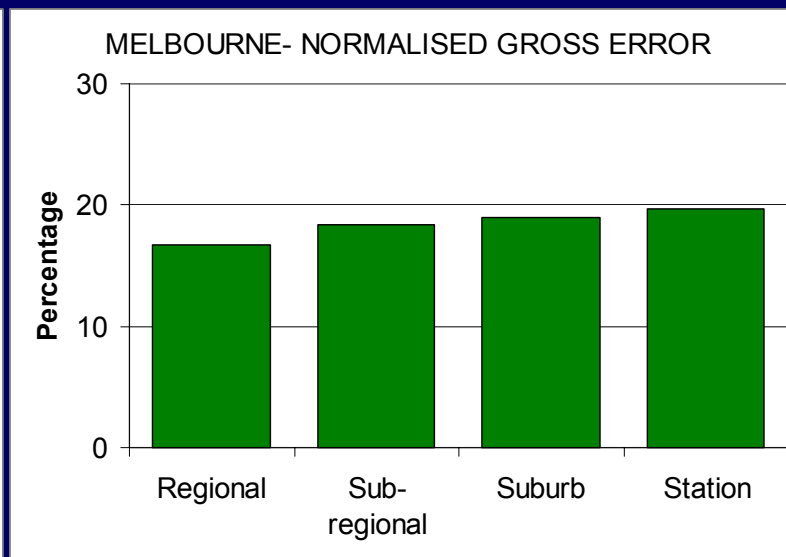
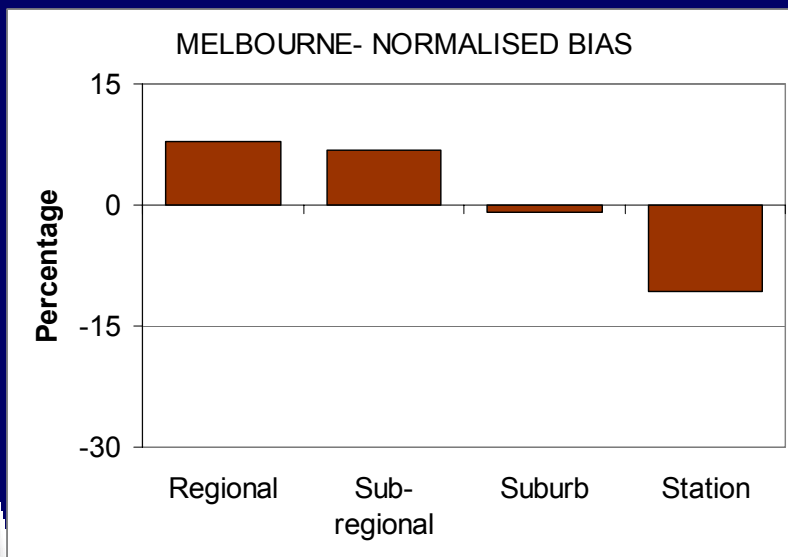
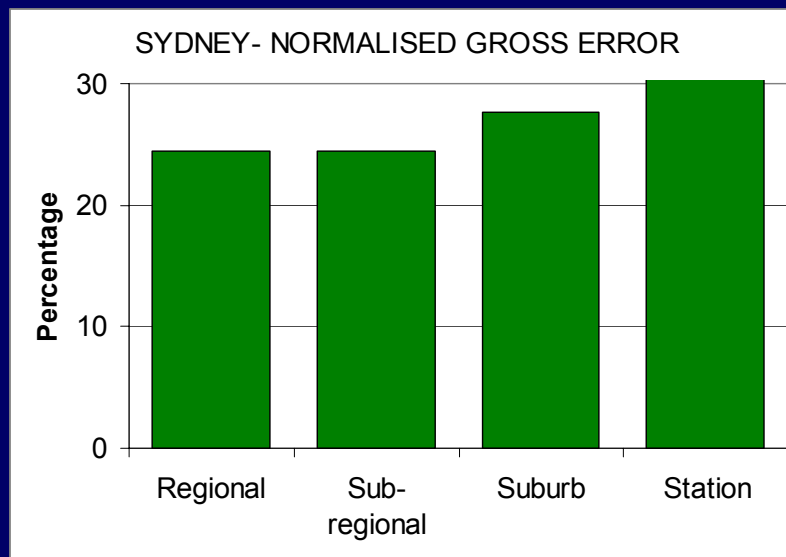
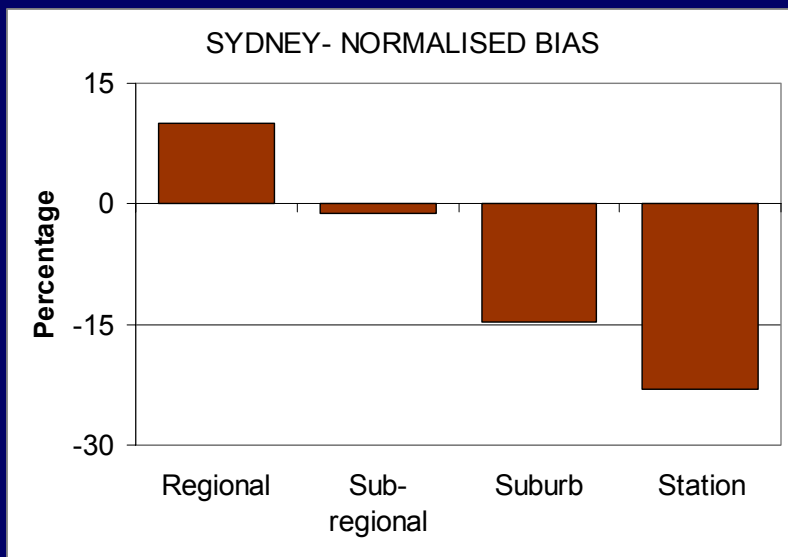


MELBOURNE- Daily 1-hour O₃ max

STATION-LEVEL FORECASTING



PERFORMANCE INDICES ($O_3 > 50$ ppb)



AAQFS- PERFORMANCE

Contingency Table

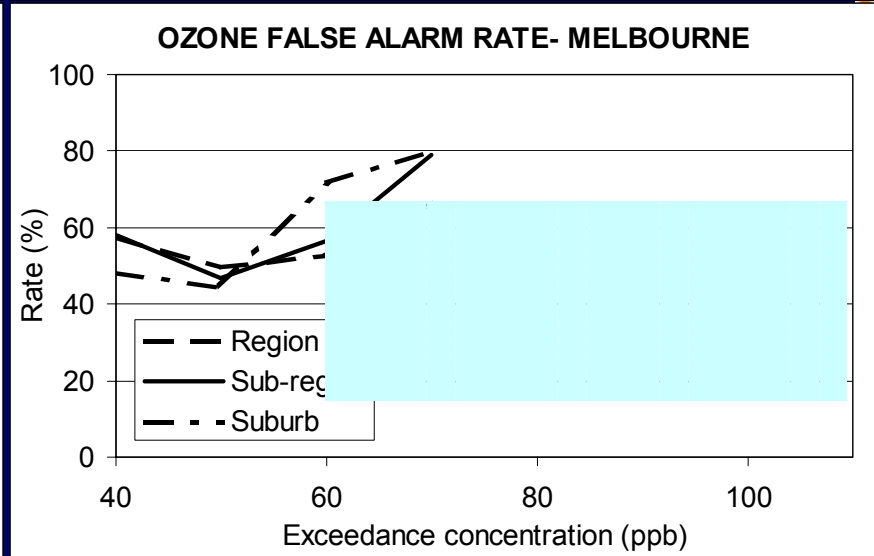
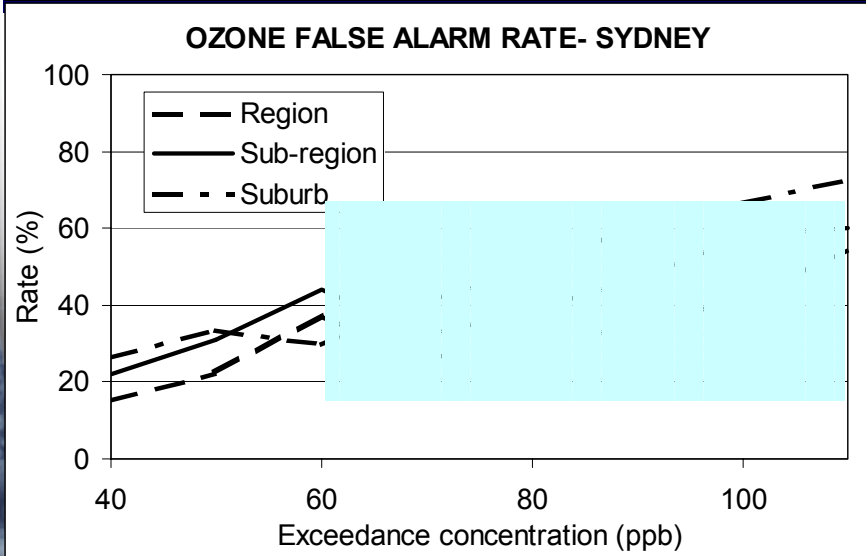
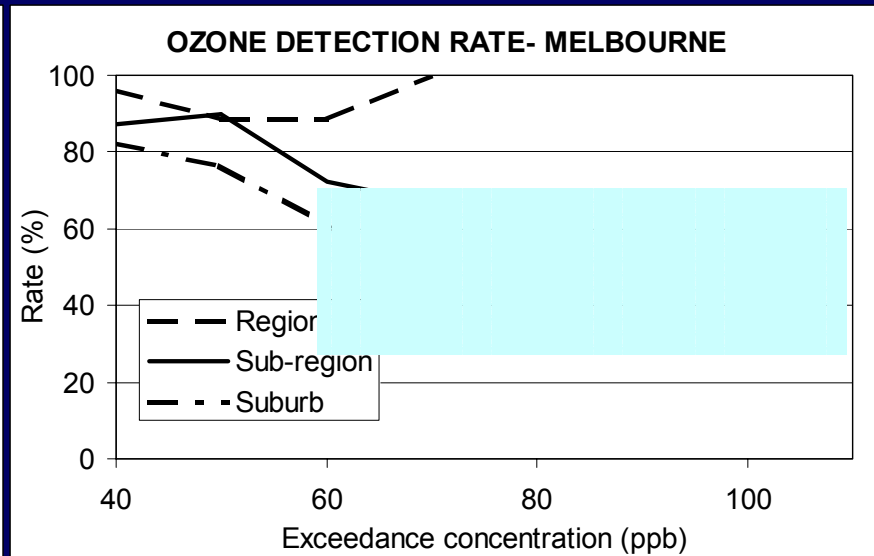
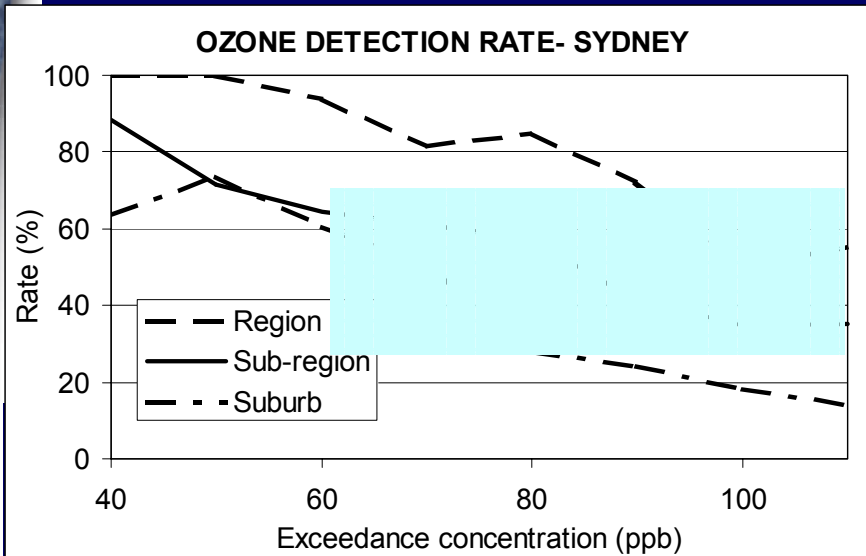
$M \geq O$	Observed		
Model	Yes	No	Total
Yes	d	f	f+d
No	m	b	m+b
Total	d+m	f+b	

Detected = $d/(d+m)$ — correct forecasts

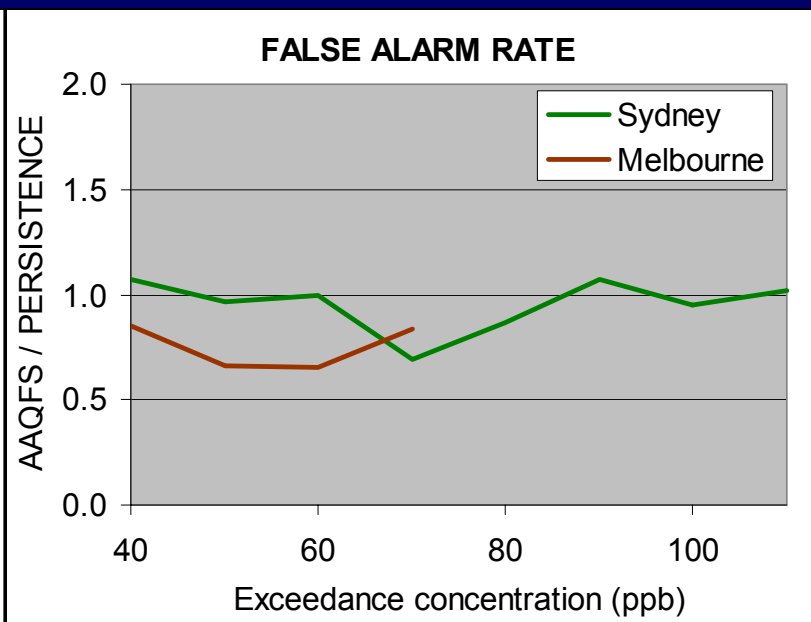
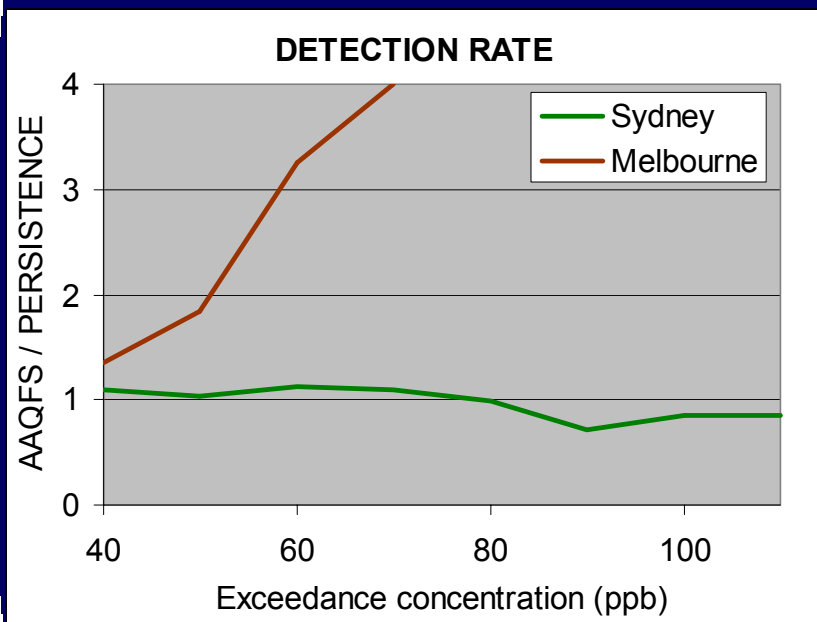
False alarm = $f/(f+d)$ — missed events

SYDNEY

MELBOURNE

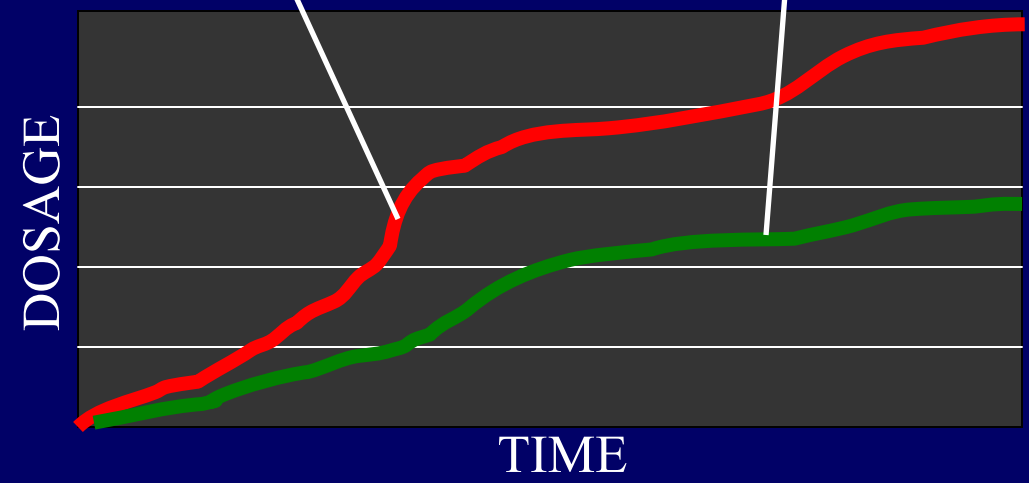
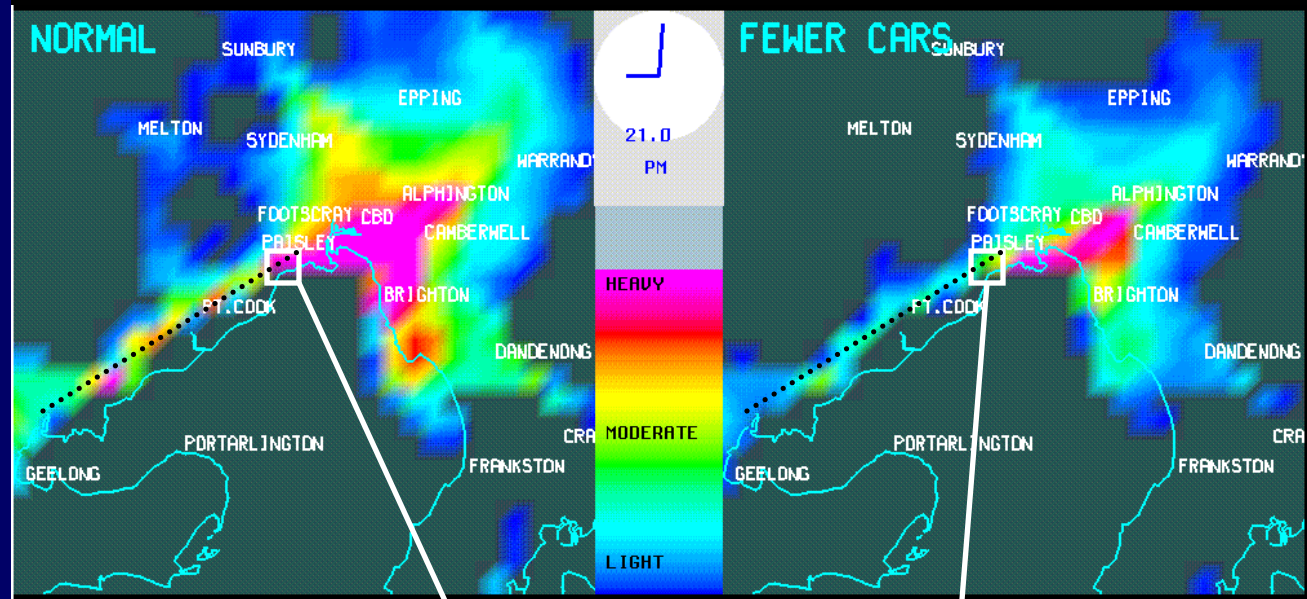


AAQFS vs. PERSISTENCE (Sub-regional)





TWO-SCENARIO FORECAST



Why is AAQFS special?


- ▣ Provides twice-daily forecasts of AQI and 18 pollutants for EPAs
- ▣ Shows the daily development of pollution (highly instructive/other applications)
- ▣ Because prognostic, unusual events handled
- ▣ Can explore results with off-line tools
- ▣ Alternative scenarios, special locations

Why is AAQFS unique?

- Resolution: 5 km Met, 1 km AQ
- Integral verification of yesterday's forecast
- Proven operational within a NMHS
- Responsive to daily changes in EPA-supplied emissions data
- Minimal demand on resources by EPAs
- 'Green' scenarios can be run on special days

Experience with Generating Emissions Inventories [More...](#)

- Population-based emissions can produce quite acceptable results (no industry)
- Industry must be treated explicitly
- Simple biogenics scheme works well
- Pollution inflows may be much more important in other national settings
- Seasonal, diurnal and weather-related emissions changes should be done in-line for simplicity and speed.



Prognostic Model + Emissions Inventory → Applications [More...](#)

■ Stand-alone applications useful (TAPM)

- Air quality management planning/scenarios
- Monitoring network designing
- Industrial complex emissions management
- Surveillance of urban pollution emissions
- Urban design applications
- Assessments of transport options/technologies
- Airshed emissions taxes/trading
- Wind-Power prospecting!



AAQFS Experiences [More...](#)

- Emissions Inventories – our biggest problem
- Wind-blown dust, other particle sources, difficult – effort by Met. Service of Canada commendable
- Timeliness and quality of air pollution monitoring data is vital for warm starts (assimilation)
- GRS chemistry adequacy
- Routine verification of forecasts
- Backgrounds/domain-size issue
- Cooperation between Agencies is important
- Uptake by others is slow – patience!