

Modelling Precursors of Tropospheric Ozone over Australasia

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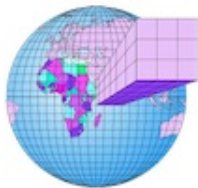
February 15, 2011



A Comparison Study

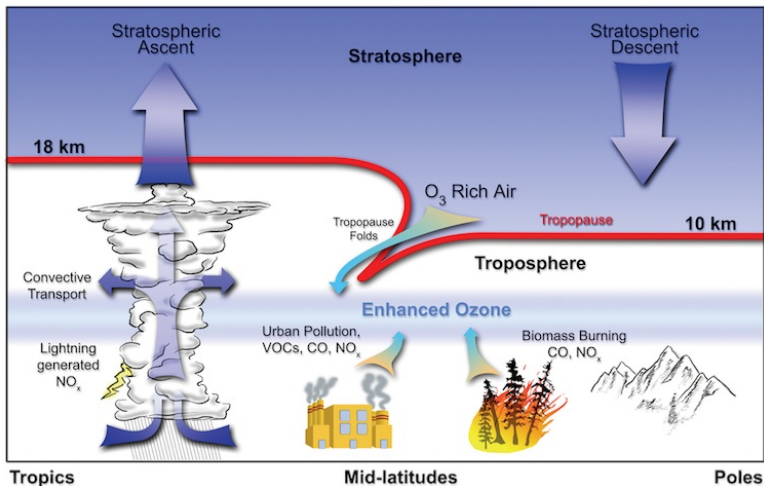
Model simulations and measurements for CO at Wollongong.
Investigating:

- ▶ timeseries 2004-2009
- ▶ seasonal cycles
- ▶ CTM validity



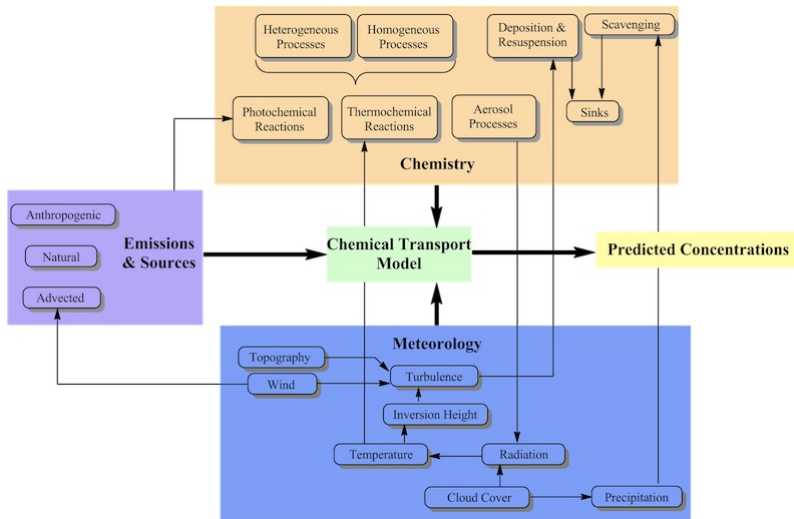
www.tc.umn.edu/~pksnyder/models.html, CAC, jpl.nasa.gov

Emissions/ Sources of gases important in the Troposphere



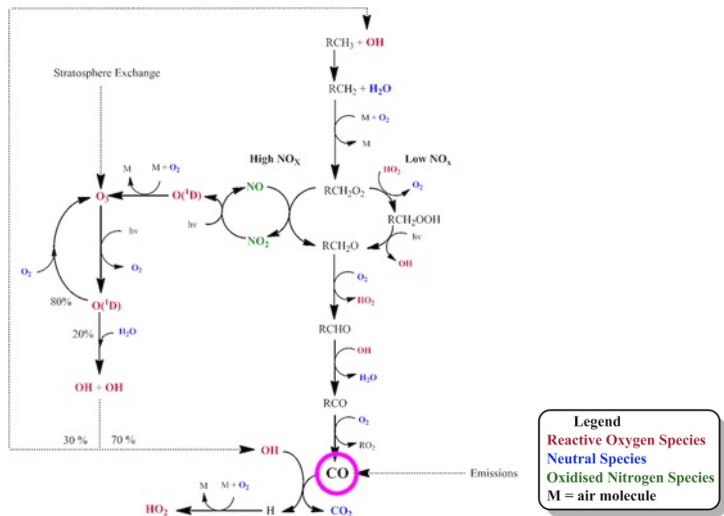
http://earthobservatory.nasa.gov/Features/Aura/Aura_3.php

Modelling: Components of a Chemical Transport Model



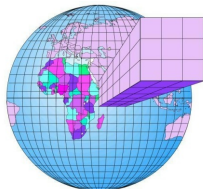
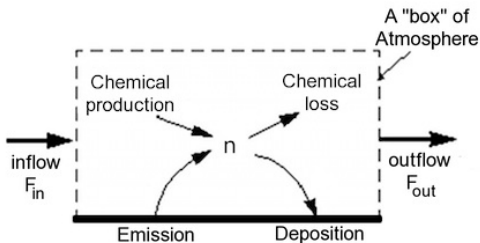
adapted from pg 1093: Seinfeld, G: Atmospheric Chemistry and Physics, 2006.

Tropospheric Pollution: Some Chemistry



Tropospheric Hydrocarbon- O_x - NO_x Main Pathways

Modelling: Continuity equation/ Mass Balance



$$\frac{\partial n}{\partial t} = F_{in} - F_{out} + P - L$$

P = sources: emissions and chemical production

L = sinks: chemical loss and deposition

diagram adapted from: Jacob, D., Introduction to Atmospheric Chemistry, 1999

The Chemical Transport Model GEOS-Chem

<http://www.geos-chem.org/>

Resolution:

48 vertical levels

$4^{\circ} \times 5^{\circ}$ horizontal

NASA GEOS5 meteorology

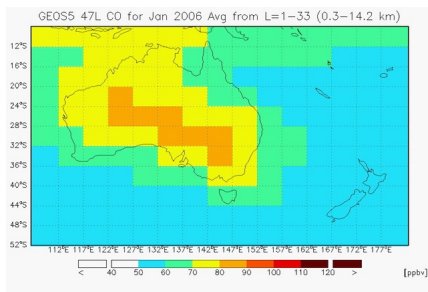
Tropospheric chemistry:

80 chemical tracer species

150 reactions

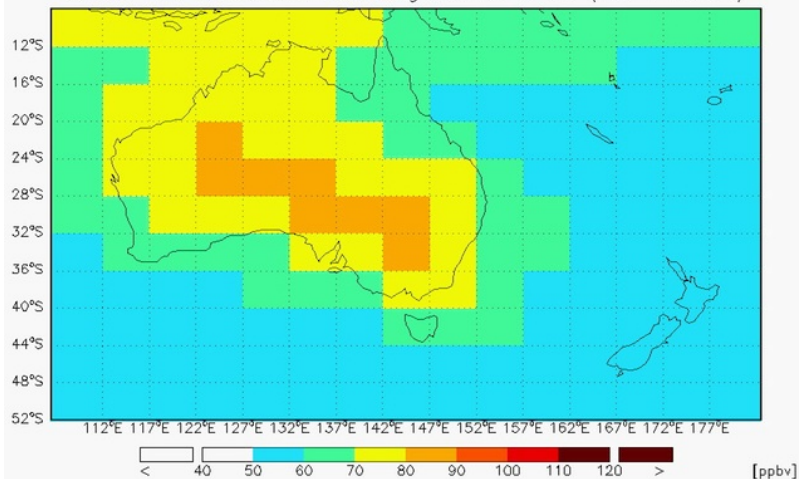
~ 60 minute timesteps

Simulated CO field - January 2006



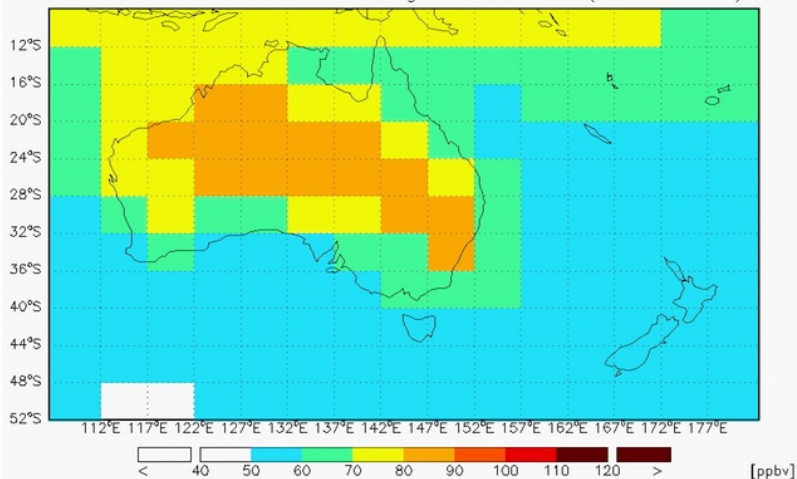
Australasia CO

GEOS5 47L CO for Jan 2006 Avg from L=1-33 (0.3-14.2 km)



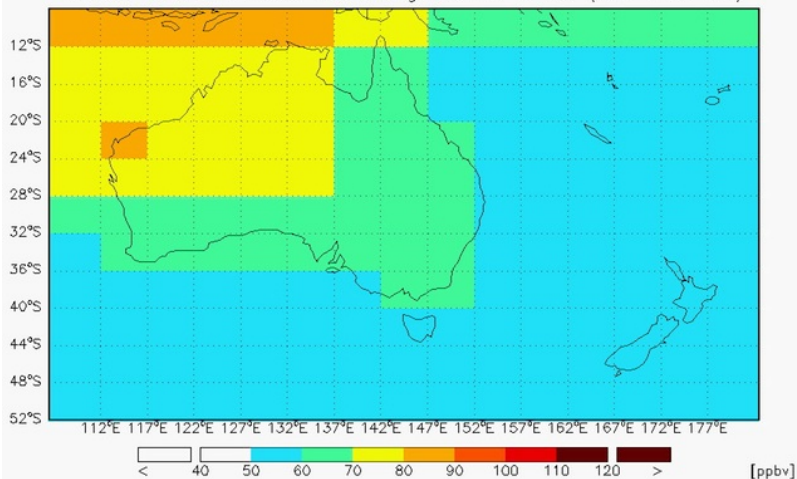
Australasia CO

GEOS5 47L CO for Feb 2006 Avg from L=1-33 (0.3-14.2 km)



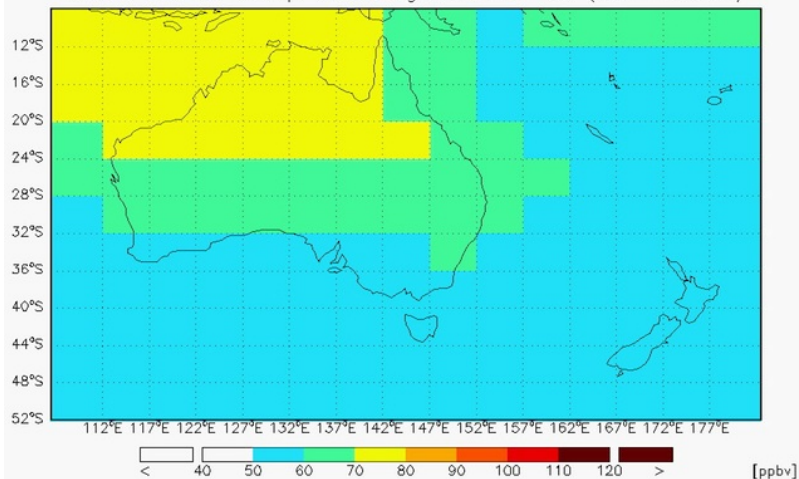
Australasia CO

GEOS5 47L CO for Mar 2006 Avg from L=1-33 (0.3-14.2 km)



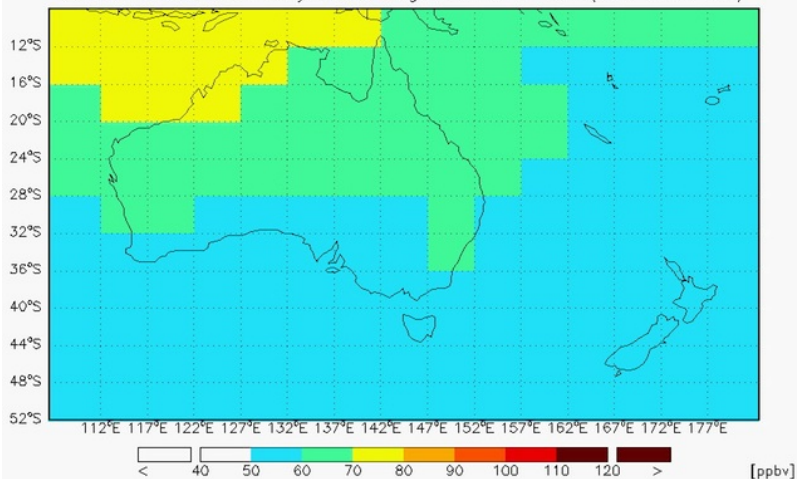
Australasia CO

GEOS5 47L CO for Apr 2006 Avg from L=1-33 (0.3-14.2 km)



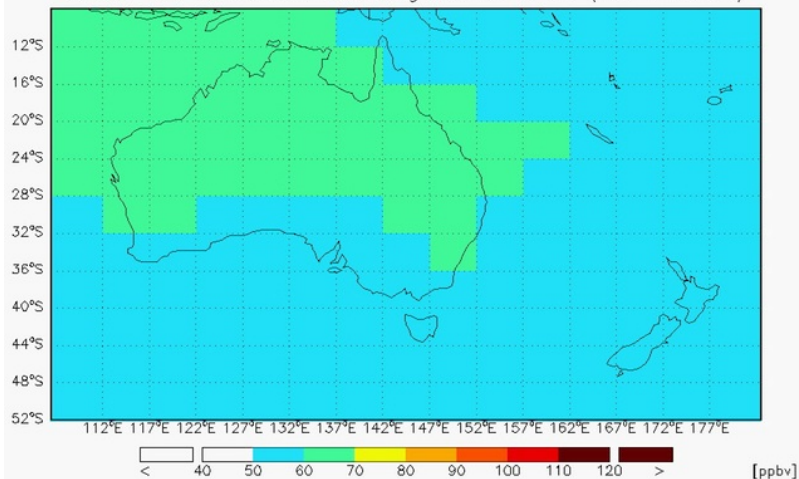
Australasia CO

GEOS5 47L CO for May 2006 Avg from L=1-33 (0.3-14.2 km)



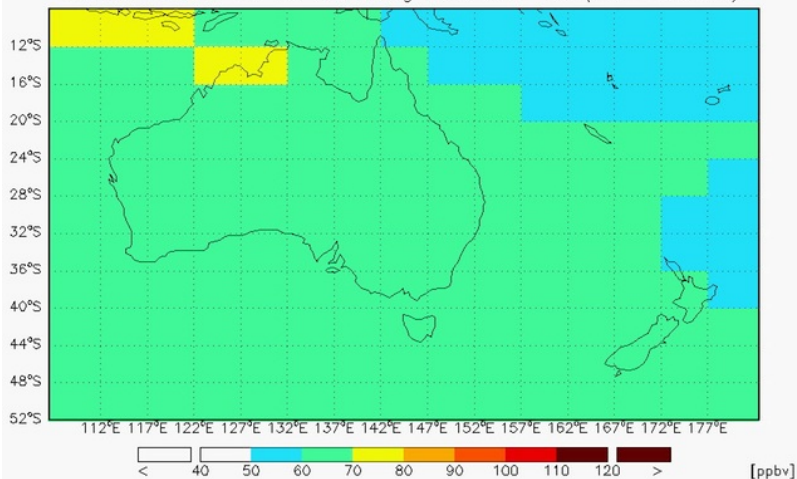
Australasia CO

GEOS5 47L CO for Jun 2006 Avg from L=1-33 (0.3-14.2 km)



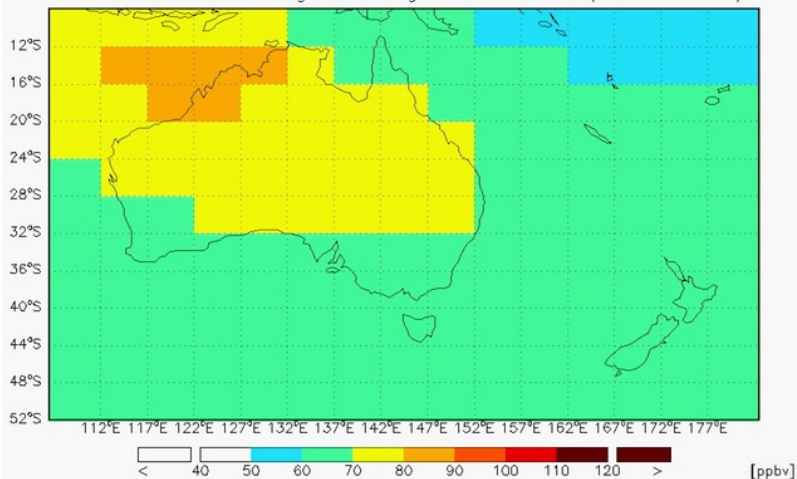
Australasia CO

GEOS5 47L CO for Jul 2006 Avg from L=1-33 (0.3-14.2 km)



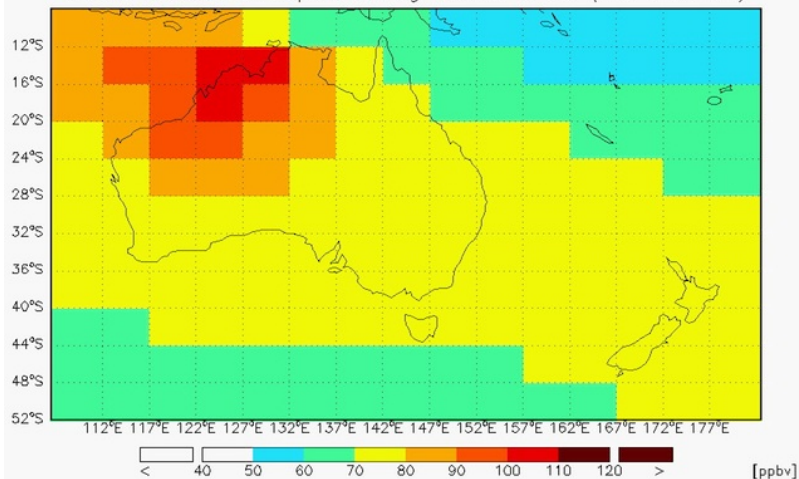
Australasia CO

GEOS5 47L CO for Aug 2006 Avg from L=1-33 (0.3-14.2 km)



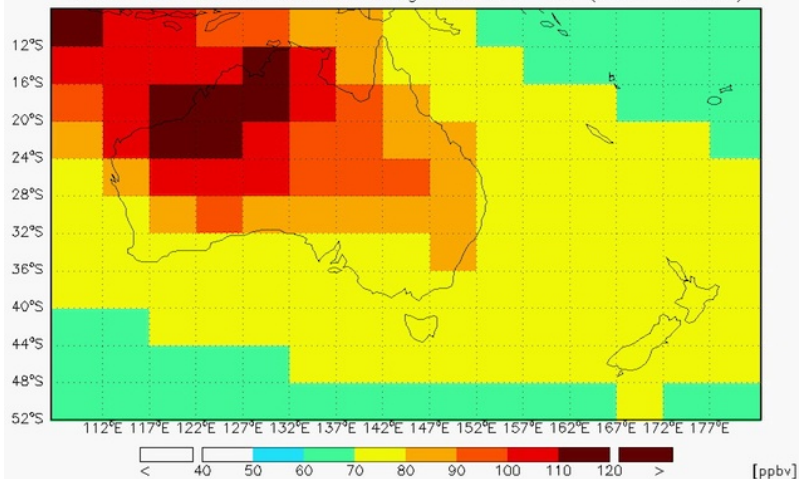
Australasia CO

GEOS5 47L CO for Sep 2006 Avg from L=1-33 (0.3-14.2 km)



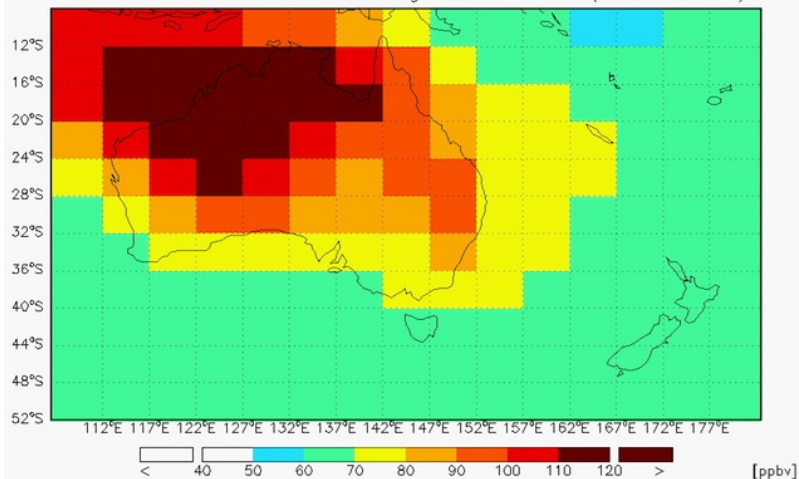
Australasia CO

GEOS5 47L CO for Oct 2006 Avg from L=1-33 (0.3-14.2 km)



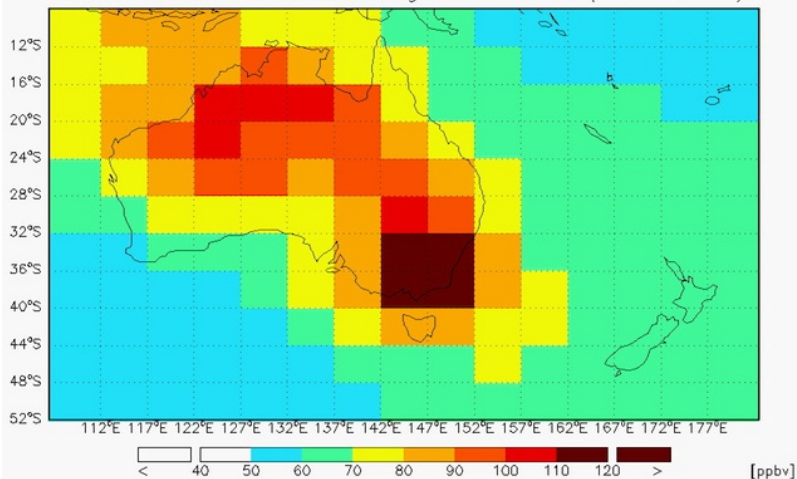
Australasia CO

GEOS5 47L CO for Nov 2006 Avg from L=1-33 (0.3-14.2 km)



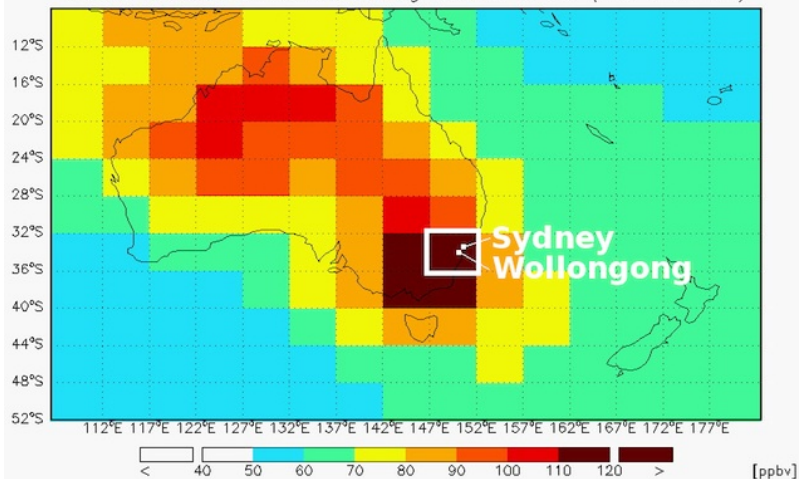
Australasia CO

GEOS5 47L CO for Dec 2006 Avg from L=1-33 (0.3-14.2 km)

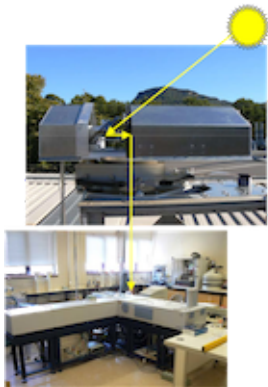


Spatial Representativity

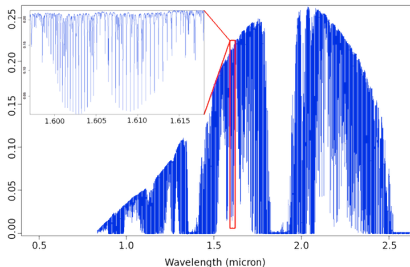
GEOS5 47L CO for Dec 2006 Avg from L=1-33 (0.3-14.2 km)



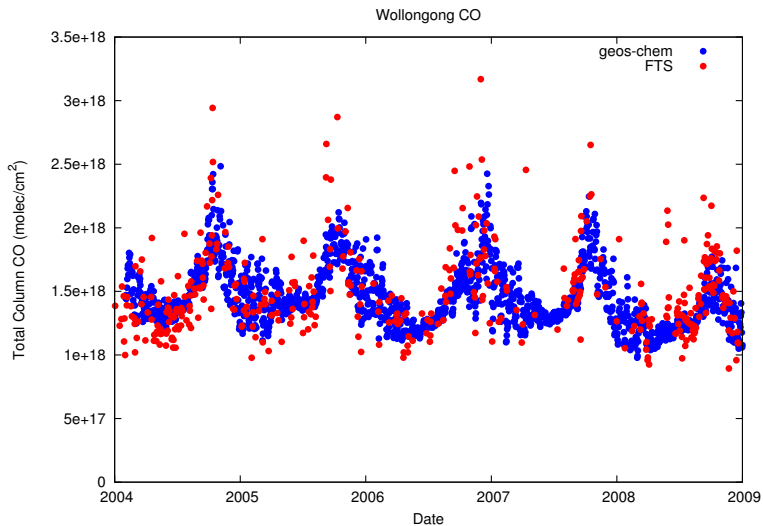
Fourier Transform Infrared Spectrophotometer



Atmospheric trace gases absorb solar radiation in the infrared

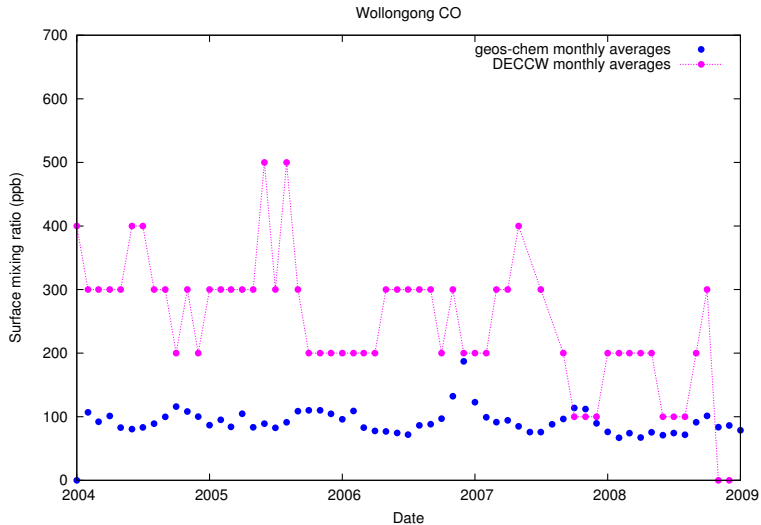


Wollongong CO - model versus FTS measurements



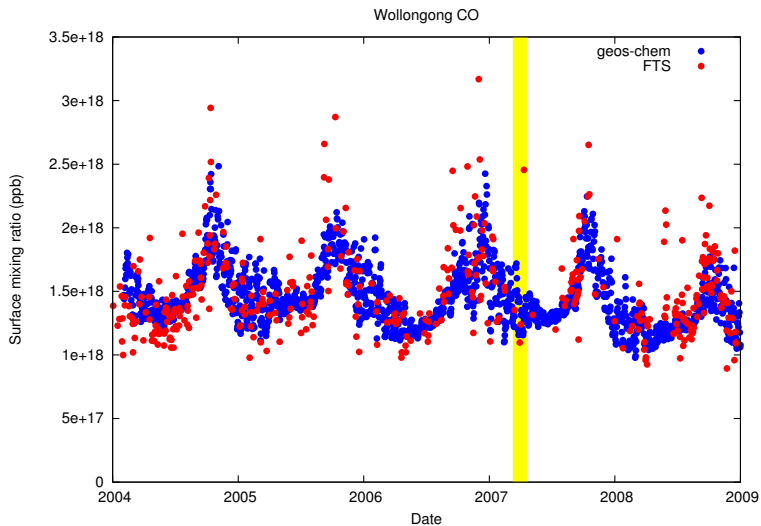
SFIT retrieval of FTS data by Dr. Nicholas Jones

Wollongong CO - model versus ground based measurements

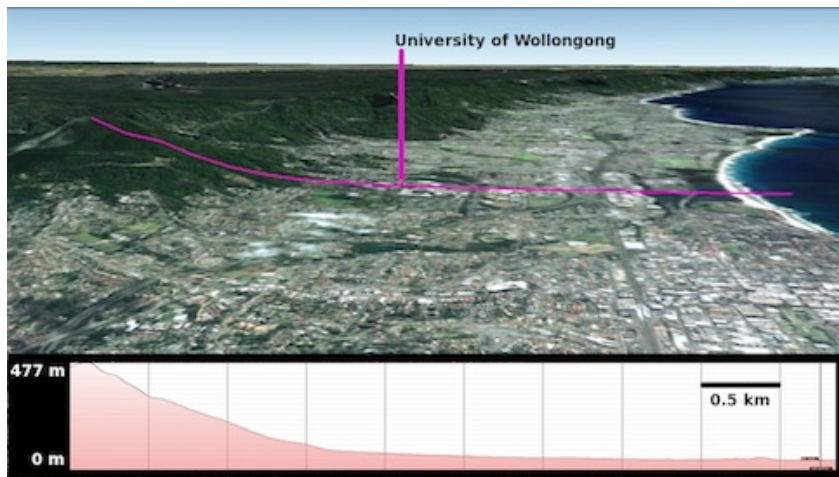


DECCW data from: www.environment.nsw.gov.au/AQMS/search.htm

Wollongong CO - enhancement



Wollongong Topography



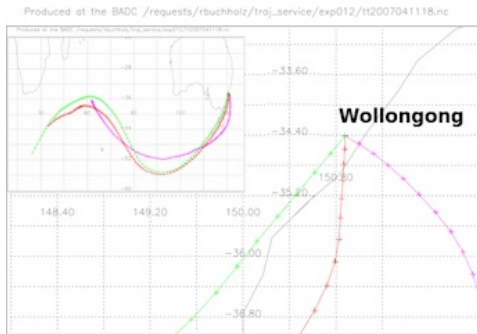
googleearth

Enhancement analysis 11/04/2007: White Haze

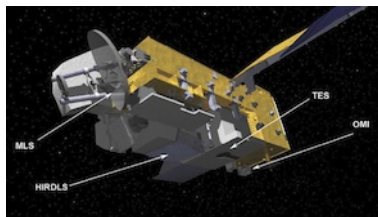
BOM Wind Data and Port Kembla Wind Wedge



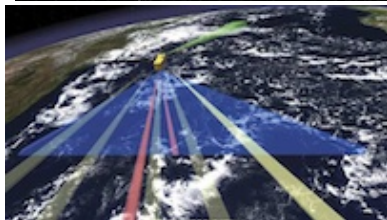
BADC 5-day back trajectory



Tropospheric Emission Spectrophotometer (TES)



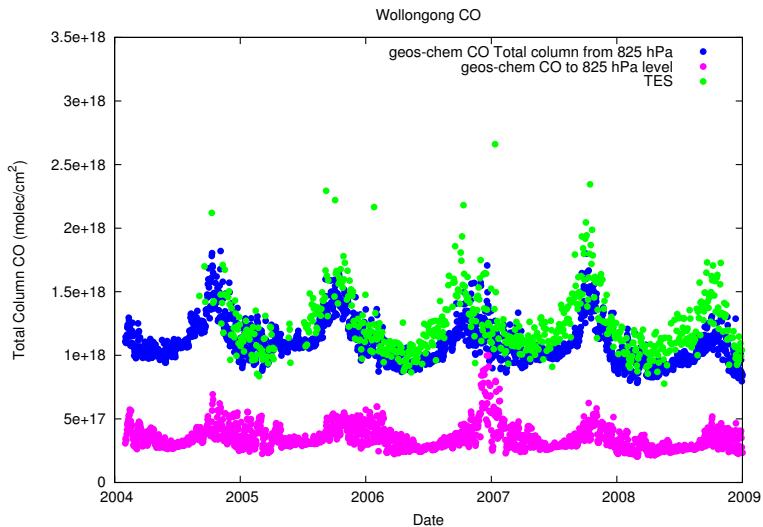
Aboard Aura Satellite
Launched July 15, 2004



Wollongong overpass 13:00 - 14:00
Altitude limit ~ 825 hPa

IEEE Transactions on Geoscience and Remote Sensing, 44 (5), 1066-1074, 2006

Wollongong CO - model versus satellite measurements



TES analyses used were produced with the Giovanni online data system, developed and maintained by the NASA
GES DISC: disc.sci.gsfc.nasa.gov/giovanni

Summary

An aerial photograph of Wollongong, Australia, showing the city, coastline, and a lighthouse on a cliff. The image is slightly faded to serve as a background for the text.

The GEOS-Chem model generally simulates a good representation of the atmosphere over Wollongong, but doesn't pick up local events.

Combination of measurements and modelling is necessary to properly understand tropospheric composition and processes.

Acknowledgements



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