A Comparison of TOMCAT Global CTM to Nine Months of GOME NO_2 Data

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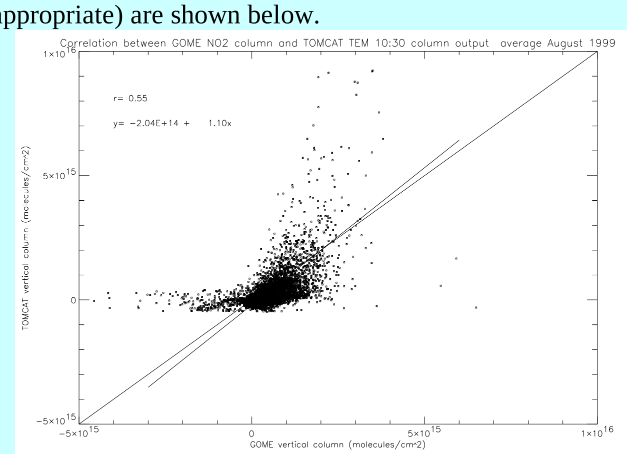
ABSTRACT: A set of comparisons between satellite measurements of NO_2 and model results for April to August 1999 have been made. Reasonably good correlations are found especially over polluted regions. However the model has a tendency to overpredict concentrations over source areas and to have too small values in remote regions.

GOME: UV/visible spectrometer, passes over the equator at 10:30 local time. NO_2 and HCHO columns evaluated for cloud free pixels, gridded at T42 resolution. The tropospheric column of NO_2 was calculated by subtracting a zonal mean of the vertical column over a clean area. (Tropospheric Excess Method or TEM)
TOMCAT: Global CTM, T42 horizontal resolution ~2.8 x 2.8 degrees, 31 levels and 48 chemical species. Model data from April to December of 1999 were used to compare to GOME

Model Data Processing 3 different model datasets were used to obtain tropospheric model columns to compare to GOME
a) Concentrations of NO_2 were output where the local time was 10:30 +/− 15 minutes. A similar subtraction as for the GOME data (TEM) was applied.
b) A set of NO_2 data from an average of 4 output files made at 6 hour intervals and then applying the TEM
c) a data set calculated using the 10:30 data but with the total column up to the WMO tropopause.

In order to investigate the effect of these different methods of processing the model output scatterplots of TOMCAT versus GOME were done for all months for each method. Linear regressions were calculated using the Ordinary Least Squares Bisector and the linear Pearson correlation coefficient found. The results for August using the first method (considered the most appropriate) are shown below.

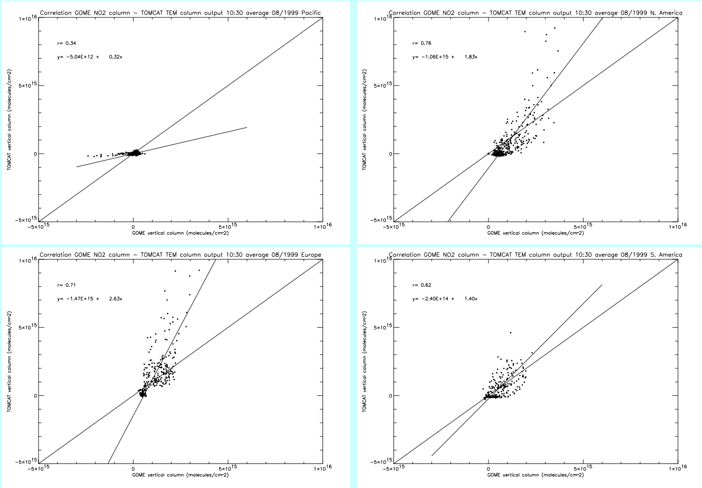


The mean correlation, intercept and gradient for all months is shown in the table below.

	Correlation	Intercept	Gradient
TEM,10:30	0.50	1.6×10^{13}	1.08
TEM,diurnal	0.50	-7.8×10^{12}	1.34
WMO 10:30	0.45	1.6×10^{14}	1.08

Using the diurnal average gives a similar correlation coefficient but that total column amounts are increased by 25% on average. Using the WMO tropopause height gives a similar gradient and intercept but a lower correlation coefficient.

A series of correlations for various regions of the globe were also performed. An example of the results of this from the Pacific, North America, Europe and South America are shown:



The following table shows the average results of the linear regression by region.

	Correlation	Intercept	Gradient
N. America	0.78	-2.5×10^{14}	1.7
Europe	0.64	4.2×10^{14}	1.89
Asia	0.61	-3.4×10^{13}	1.15
Africa	0.69	-2.9×10^{14}	0.93
S. America	0.51	-1.5×10^{13}	1.02
N. Atlantic	0.3	4.5×10^{13}	0.79
S. Atlantic	0.29	-8.2×10^{13}	0.28
Pacific	0.25	-2.0×10^{13}	0.66

The best correlations are observed in polluted regions − this is probably just a result of the fact that the major source regions are well determined. Over Europe and North America also show a large overprediction by the model of the NO_2 column. Two possible reasons for this are insufficient model convection at mid−latitudes and insufficient PAN formation. Both increased PAN formation and extra convection in the model would reduce the concentrations of NO_2 close to sources and enable it to be transported more rapidly to remote regions.Over the oceans very low correlation coefficients and gradients are seen which is probably due to both insufficient NO_x being transported from the polluted regions and a lack of strong variation in the concentrations over these regions. To investigate these features further it will be useful to combine these data with aircraft information on modelled profiles of NO_2 and make use of GOME formaldehyde and ozone concentrations.

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