GOME measurements of NO_2 and HCHO compared to results from a global CTM

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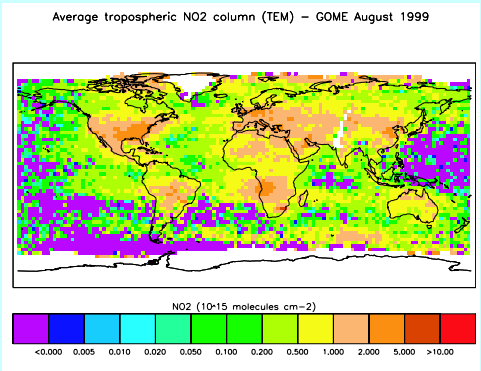
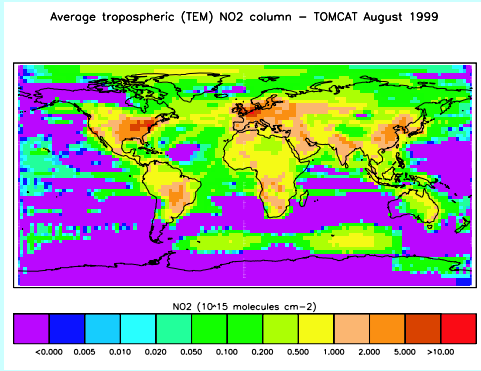
INTRODUCTION

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.

TOMCAT: Global CTM, T42 horizontal resolution ~2.8 x 2.8 degrees, 31 levels and 48 chemical species. Concentrations of NO_2 and formaldehyde were output where the local time was 10:30 +/− 15 minutes. To obtain columns of NO_2 a similar subtraction as for the GOME data was applied. For HCHO the total column to the WMO tropopause was found. A set of NO_2 data from an average of 4 output files made at 6 hour intervals and a data set up to the WMO tropopause were also calculated

RESULTS



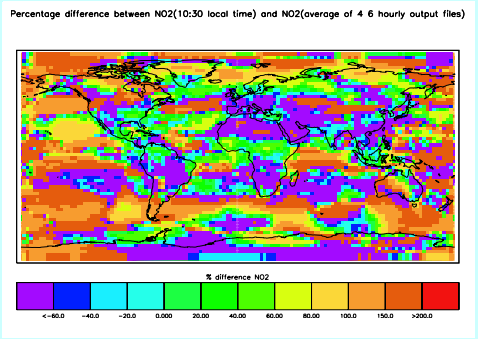


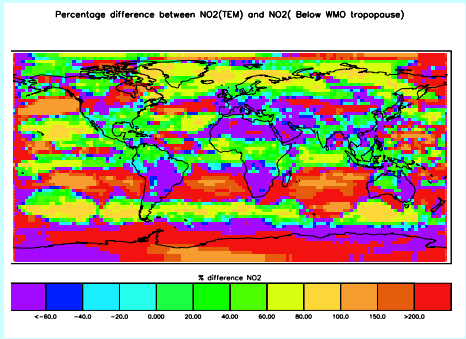
The TOMCAT NO_2 results compare well to GOME. The highest concentrations of NO_2 are seen in the same places and are of the same order of magnitude. Total columns over the Eastern USA and Western Europe appear to be slightly higher in the model. Concentrations in the more southerly latitudes are lower than those observed by GOME. Insufficient boundary layer mixing or too weak convection in the model may in part explain the larger model columns over N.H. industrialised areas. Alternatively, the GOME data may be too low in some regions as a result of residual clouds that shield part of the troposphere from view.

TOMCAT appears to have lower concentrations over the oceans. Possible reasons for this include a lifetime for NO_2 which is too short, secondary sources of NO_x which are missing from the model or insufficient mixing of air from polluted to unpolluted regions.

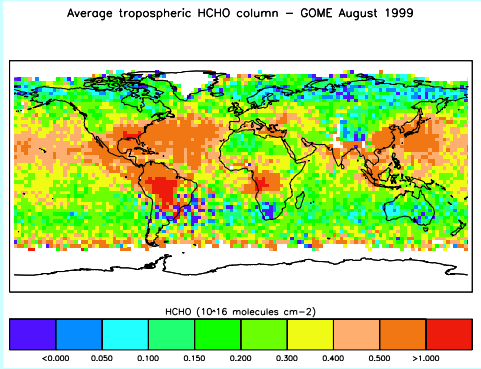
The percentage change in the columns calculated by the model using different techniques are seen here to be very significant. In both sets of difference plots large areas where the difference is greater than +200% or less than −60% are seen.

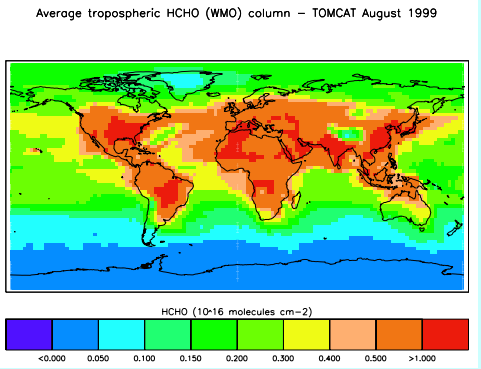
The diurnal averages seem to be consistently overestimating the column in regions where there are high concentrations in the original model results This emphasises the importance of taking the overpass time of the satellite into consideration.





The model columns below the WMO tropopause also seem to show an overestimate over high concentration regions but also some large regions of both underestimation and overestimation of the column over the oceans. These need to be considered in more detail and for a longer time series with reference to such factors as the modelled tropopause height and zonal variation in the model's stratospheric column.





In the GOME measurements similar regions of high concentrations can be seen as for the NO_2 data. However here it appears that the areas where there is biomass burning are more important than for NO_2. The comparison between the model and the measurements is not as good as it was for NO_2 but large columns of HCHO are seen in the same areas in the two data sets with generally higher concentrations being seen in the TOMCAT results especially over polluted regions.

CONCLUSIONS

1) some good comparisons are found for NO_2; not so good for formaldehyde
2) it is important to do comparisons of models with satellite data in the correct manner