We analyse formaldehyde (HCHO) column data retrieved from GOME over the European continent. Formaldehyde is an important intermediate in the oxidation of VOsCs of anthropogenic and biogenic origin. We compare GOME HCHO column with model simulations focusing on the European continent. Our results suggest that the formaldehyde column over Europe is generally overestimated by the state-of-the-art chemistry and transport model GEOS-CHEM with respect to GOME column (Figure 1), possibly indicating biases in model VOC emissions.

We apply the method described by Palmer et al. [1] to constrain isoprene (a major biogenic VOC) emissions over Europe and to compare with the inversion for isoprene emissions first in a region where the biogenic influence is demonstrated to be predominant. We check for regions under biogenic control looking at the HCHO/NOx ratio and biogenic emissions from GOME HCHO column. We found one such region in the Eastern part of Europe as seen by GOME. A clear cycle with a peak in summer is over much of the European territory, indicating biogenic emissions as a main driver of the HCHO column, a result that is consistent with the GEOS-CHEM model (right) for July (top) and August (bottom) 1997. The correlation coefficients between observation and simulation are shown inset. The red dots on the plot show results from a run where the isoprene emissions are increased by a factor of 5 [3] so as to match the main features of biogenic emissions, as deduced from GOME HCHO column for July 1997. The correlation coefficients between observation and simulation and are averages between 10-12am local time (GOME overlap hours). Cloud scenes with cloud fraction >40% are excluded. Slope, background values of the corresponding equation (3) and correlation coefficient are shown inset. The red dots on the plot show results from a run with null isoprene emissions. From the comparison with the standard run it is clear how the HCHO column in the model is largely controlled by biogenic emissions in this region. In the two plots on the right we compare the isoprene emission distribution in GEIA inventory and as deduced from GOME HCHO observations. GOME results suggest a reduction of isoprene emissions in the upper and right part of the selected domain. The overall budget of isoprene emissions for the selected month (July 97) over the whole area is halved with respect to GEIA. This is also consistent with the recently released biogenic emission inventory MEGAN [2] that revises low the isoprene emission in this region (not shown in this poster).

Future work will extend the method also to other European countries after a careful estimation of the anthropogenic contribution to HCHO column. The resulting updated isoprene emission inventory will be implemented into the model and will be evaluated against independent measurements of HCHO.

References

For further information on the GEOS-CHEM model please check on the Harvard group's web site: http://www-as.harvard.edu/chemistry/trp/

Figure 1

Figure 2: Monthly mean formaldehyde columns over Europe from GOME for the years 1996-97.

Figure 3: (a) Rural and forested region where we apply the inversion. (b) local linear regression vote between isoprene emissions and HCHO columns from the model in region (a) (blue equation 1) and (c) GEIA isoprene emissions implemented into the GEOS-CHEM model in region (a) (red equation 2) and (d) updated isoprene emissions derived from GOME HCHO column for July 1997.