

Interactive comment on “Interannual variability of tropospheric composition: the influence of changes in emissions, meteorology and clouds” by A. Voulgarakis et al.

Anonymous Referee #2

Received and published: 10 August 2009

Interannual variability of tropospheric composition is a complex and not well understood problem. A newly updated global CTM is used in this study to investigate this problem. Meteorological conditions are found to be the main factor. The effect of cloud is highlighted in particular for Europe and Indonesia. My assessment of this paper is that it is not ready for publication at ACP. There are many areas where more analysis is needed.

While GOME NO₂ and surface observations of ozone at Zugspitze are used to evaluate the model simulations, the paper is mainly a study of model sensitivity simulations. Before a complex problem like interannual variability can be analyzed using a model,

C3724

it is pivotal to demonstrate through comparisons with the observations that the model is indeed capable of simulating observed interannual variability of tropospheric composition. Without such evaluations, any conclusions from simply investigating model sensitivities may represent merely the specific configuration or assumptions used in a model.

This paper has not demonstrated that the model can simulate the observed interannual variations of tropospheric ozone, NO₂, or CO. The comparison with GOME NO₂ measurements (the columns in Figure 1 are incorrectly labeled) shows that the model cannot simulate the large interannual variations of tropical biomass burning emissions. I suspect that the model cannot simulate the interannual variations in tropical CO because of this problem. Without proper simulations of biomass burning emissions, model analysis of chemicals over Indonesia will not be realistic. Previous model studies show that large biomass burning emissions during El Niño years are the main reason for pollutant increases in the region.

GOME NO₂ measurements have been used by many studies to show the large increase of Asian emissions (some cited in the paper). The standard deviation of GOME NO₂ shown in Figure 1 over China seems to be too low. The processing of GOME NO₂ data may be problematic.

The model simulation of ozone at Zugspitze compares well with the observations, which is encouraging. However, there are more measurements of ozone and other pollutants over Europe than ozone at Zugspitze. They should be used in this paper.

Regions other than Europe and Indonesia must also have large interannual variations. With a global CTM, there is no reason to ignore the other regions. For these regions as well as Europe and Indonesia, yearly emission variations (like in Table 1) should be given.

Isoprene and lightning NO_x emissions vary with meteorological conditions. It appears that lightning NO_x emissions vary each year in this model, but no detail of the emission

C3725

variation is given. Annual isoprene emissions are assumed to be constant in this paper. This assumption is inappropriate for modeling interannual variations of tropospheric composition.

The discussion of ozone budget and cloud effects has some overlap with another ACPD paper by the lead author (Voulgarakis et al., 2009b). I wonder if it would be more appropriate to move the relevant discussion from this paper to that paper because how cloud processes affect ozone is analyzed more carefully there. Since no direct observations are used to evaluate model simulated effects, there is no good reason to write two papers on the simulated effects of clouds.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 14023, 2009.