

Interactive comment on “Interannual variation patterns of total ozone and temperature in observations and model simulations” by W. Steinbrecht et al.

Anonymous Referee #2

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In general, this paper provides a very useful overview of the geographical dependence of major modes of variability of total ozone and temperature in the lower stratosphere and upper troposphere. Useful comparisons are made between observed variations and model calculations which attempt to simulate the observed record.

The TOMS/SBUV merged ozone record that is adopted for total ozone variability is relatively free of instrument-related artifacts although it is available only since 1979. The NCEP record, especially for the lower stratosphere, is available since 1958 but is unfortunately not so reliable for long-term variability, even after 1979 when global

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satellite measurements were incorporated. This is because of intercalibration offsets and differences between observing systems that were incompletely removed by the re-analysis and assimilation procedure. (Note that other reanalysis data sets besides the NCEP data also have similar problems.) Therefore, some of the 50 hPa temperature results relating to decadal and longer-term variability should be treated with caution. In particular, the authors have chosen to calculate the solar regression coefficient for 50 hPa temperature using the entire NCEP data base (1958 to 2000). One suspects that the pattern would change if only data after 1979 had been considered.

Although valuable for assessing the geographical dependence of major modes of variability, it should be stressed that the comparisons presented in the paper tell us very little about the dependence on vertical coordinate of these modes. Thus, although there may appear to be good agreement between models and observations for total ozone, such may not be the case if the vertical profile of the variations for a given mode is examined. Again using the solar cycle mode as an example, most models predict that the ozone column change from solar minimum to maximum occurs at low latitudes mainly in the middle stratosphere. However, observations suggest that most of this column change occurs in the lower stratosphere. The apparent existence of a solar cycle variation of NCEP 50 hPa temperature in Figure 5 also suggests that much of the ozone solar cycle change is occurring in the lower stratosphere. The comparisons of Figure 5 do not allow one to judge whether the MAECHAM4 and E39/c models also predict that most of the solar cycle ozone change occurs in the lower stratosphere. However, it is interesting to note that a solar cycle variation of 50 hPa temperature in the subtropics is also predicted by the models. What is the physical cause of this 50 hPa temperature solar cycle variation in the models? What does that tell us about the origin of the total ozone solar cycle variation?

Finally, it should be pointed out that a multiple regression model containing only a linear trend term may no longer be appropriate for either the column ozone or the reanalysis temperature data sets. Some evidence for a significant change in slope of the ozone

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trend beginning in about 1994 has been obtained in recent statistical analyses (Reinsel et al., *J. Geophys. Res.*, 2005; Krzyscin et al., *Annales Geophysicae*, 2005). For this reason, a piecewise trend model with two components may yield a somewhat better fit to the data as measured, for example, by the R-squared parameter of Figure 2. Probably most of the modes of variability will be largely unaffected by this refinement. Nevertheless, future analyses of this type should consider a piecewise trend model. Such a model should at least be discussed in the text.

Again, this is a valuable overview of lower stratospheric and upper tropospheric variability as reflected in column ozone and reanalysis temperature data sets. The authors are to be commended for producing a valuable summary that will be an important resource for years to come.

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