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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evidence for an earlier greenhouse cooling effect in the stratosphere before the 1980s over the Northern Hemisphere" *by* C. S. Zerefos et al.

Anonymous Referee #2

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This paper presents a comprehensive analysis of the long-term temperature evolution in atmospheric layers located in the troposphere and lower stratosphere, based on meteorological analyses and long-term homogenized radiosonde datasets, over the 1958-2011 period. The quantification of long-term temperature trends is based on multivariate regression analysis using classical parameters such as the solar cycle, the QBO and stratospheric aerosols optical depth. Results, which are compared to trends deduced from chemistry-climate model simulations, show a cooling of the stratosphere from the beginning of the record. Based on the fact that the stratosphere is less perturbed by anthropogenic aerosols and clouds, the authors then argue that the lower

stratosphere is better suited than the troposphere for the detection of an early signal of human influence on climate. The article is well written and it addresses an important issue. I thus recommend publication in ACP, provided that important comments are taken into account.

Main comments and suggestions

1. The results are based on the evaluation of temperature values that are computed from the thickness of atmospheric layers. It is argued that this method provide better temperature values than the temperatures themselves but little evidence is given to support this statement. A comparison of the presented temperatures with the initial temperatures of the used data sets should thus be provided. Also it would be interesting to have an idea of how the presented temperature anomalies compare to those of satellite data in the lower stratosphere (e.g. MSU channel 4 and SSU channel 1) in the 1980-2011 period. Indeed ,these datasets are widely used for the evaluation of recent temperature trends in the lower stratosphere.

2. Considering the parameters used (QBO, stratospheric aerosol optical depth), the regression model seems to be best suited for the evaluation of temperature trends in the stratosphere. Although it is quite clear that the study focuses on stratospheric temperature trends, results are also presented for the troposphere. Can the authors comment on the validity of the temperature trends in the troposphere?

3. Some more information should be provided on the multiple regression analysis. Since trends are calculated for two time periods, what is the sensitivity of the temperature to the other parameters (QBO, solar cycles) in both these periods? How the model reproduce this sensitivity?

4. The trends are computed in specific latitude bands (e.g. 5-30°N, 30-60°N and 60-90°N). Considering the position of the tropical barrier in the stratosphere, the former latitude band mixes tropical air with mid-latitude air. Can the authors comment on this point? Also, how representative are temperature trends in winter and spring in

the 60-90°N latitude band, considering the presence of the polar vortex during these seasons? Could the formation of the vortex influence the large cooling trends found in February, especially during the earlier period in the polar regions?

5. More information should be given on the validity of the FU-Berlin record, which seems to be quite noisy in the early period. Results from this data set also show significant positive values in some months in the early period, in contrast to results based on the other data sets. A more detailed discussion of the various monthly trend results is thus recommended.

Minor comments

Significance of trends and correlation coefficients should be indicated in the contour figures.

In section 3.3 the significance of correlation coefficients is not provided.

P1078, l16: what is meant by “low frequency variability of the BD circulation”?

P1080, l7: Do the derived quantities correspond to age of air? The text should be more specific.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 1073, 2014.