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# ***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 #3**

Received and published: 2 April 2014

Using monthly layer mean temperatures from geopotential height thicknesses between specific pressure levels from the lower troposphere up to the lower stratosphere of the Northern Hemisphere the authors calculated long-term temperature changes since 1958. It is a comprehensive analysis using different analysis tools including the NCEP/NCAR I reanalysis, the Free University of Berlin and the RICH radiosonde data sets and CESM1-WACCM global modeling. General findings include that non-significant trends or slight cooling is observed in the lower troposphere from 1958–1979, whereas afterwards significant warming trends are seen. Above the tropopause persistent cooling is observed throughout the entire study period. The statistical signif-

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icance of the results show some variation in terms of latitude and season, but still show the general pattern. The authors showed evidence for an early greenhouse cooling signal in the stratosphere before 1980, i.e. before the overall greenhouse warming in the troposphere became evident. The authors argue that the stratosphere would be more suitable than the troposphere to identify greenhouse warming signals. Overall, this paper is well written and shows convincing material and associated discussion. After addressing some (mainly minor) issues lined out below I would be happy to recommend the publication of this manuscript in ACP.

Page 1075, line 12: the authors mention the time period 1958-2011 here, but the Figs. 1-7 all refer to some different time periods ending either 2001, 2005, or 2010. Would be nice to have some clarification.

Page 1080, line 29: Please add some points why mean temperature from thickness would be expected to improve homogeneity in both space and time.

Page 1081, line 7: Please mention explicitly what variables you are referring to when using the term "data", e.g. temperature, pressure etc.?

Page 1084, equation 1: Please explain what "t" and "T" stands for?

Page 1084, equation 2: Please doublecheck, whether it is the variable "Nt" or if "t" is an index (same for "et")? Please explain variable  $\varphi$ .

Page 1085, line 17 and associated figures: The text refers to the layer mean temperature, but the figures do not have any units associated with either the temperature or the layer thickness.

Page 1089, lines 4-7: I think what is shown in the figures is a decrease in the cooling trend, but not a shift from a negative trend in winter to a positive trend in early spring as the values are still negative.

Figures: Apart from figure 5 all other figures are pretty tiny and very hard to read. What are the units for the y-scales in figures 1 and 2?

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

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14, C1041–C1043, 2014

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