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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Solar cycle in current reanalyses: (non)linear attribution study" *by* A. Kuchar et al.

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We would like to thank the reviewer for his/her comments.

Author's response and changes in the manuscript are included below. In addition, you can find the revised manuscript as supplement where the particular changes are highlighted together with the comment referring to them.

(1)Similar and comprehensive work has recently made by Mitchell et al.(2014, QJRMS). They examined 9 reanalysis datasets by a multiple regression analysis. Please refer and discuss the accordance and difference between the present study and Mitchell et al (2014). They did not present dynamical analysis such as EP flux. Mitchell, D. M., et al., Signatures of naturally induced variability in the atmosphere us-

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Interactive Discussion

Discussion Paper

ing multiple reanalysis datasets. Q. J. R. Meteorol. Soc. (2014) DOI:10.1002/qj.2492. http://onlinelibrary.wiley.com/doi/10.1002/qj.2492/abstract

The accordance and difference between the present study and Mitchell et al (2014) are discussed in section 1 and also mentioned within the text.

(2) Description of reanalysis product on solar cycle in irradiance and ozone is needed in dataset section. See Table 2 of Mitchell et al (2014).

Since the description of reanalysis product on solar cycle in irradiance and ozone is already included in Mitchell et al (2014) we refer to this table in section 4.1.1 where the upper-stratospheric ozone anomaly is discussed.

(3) QBO3 is needed? I think regression results would not change without QBO3 term. (4) NAO is needed? The NAO is modulated by 11-year solar cycle (Kodera, 2003, GRL) and the tropospheric NAO extends to the stratosphere as AO near solar maximum. So I think the NAO term might not be needed. Without the NAO term in regression equation (1), does the result change? If the results with/without NAO are similar for solar signal, the solar signal in this manuscript is robust.

The paragraph related to the robustness of solar regression coefficient was added in section Methodology. See paragraph and documenting Fig. 1,2,3 and 4.

The robustness of solar regression coefficient has been tested in terms of including or excluding particular regressors in the regression model, e.g. NAO term was removed from the model and resulting solar regression coefficient was compared with the solar regression coefficient from original regression model. The solar regression coefficient seems to be highly robust since either the amplitude or statistical significance was not changed when NAO or QBO3 or all of them were removed. However, cross-correlation analysis reveals that the correlation between NAO and TREND, SOLAR and SAOD regressors is statistically significant.

See correlation matrix in Fig. 5.

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(5) P391 line 20-21 This statistically significant response . . . From the figure, it seems to be insignificant

The upper-stratospheric ozone anomaly in ERA-Interim is definitely statistically significant. Please see the revised figures.

(6) P30897 line 15-25 Sentences and Figure 4d, h, l, indicate stronger BD circulation as summarized in the bottom figure of Figure 6. So, in February, BDC circulation is enhanced at solar maximum opposite to early winter. I think this is new and should be emphasized in the text.

Based on your comment, this was also discussed in section Conclusion. See paragraph below.

Fields of residual circulation and EP flux divergence in February are showing an opposite to what would be expected from the suppressed BDC in the SC max. There is an enhanced downwelling in polar and enhanced upwelling in eq. region under 1 hPa, suggesting the need to diagnose the influence of SC on transport at least on monthly scale because the changes in the underlying dynamics (compare upper and lower diagram in Fig. 7) would make the transport pathways more complicated. Since GCMs have not yet successfully simulated this pattern (e.g. Schmidt et al., 2010; Mitchell et al., 2015) and due to the short (35-year) time series, it is possible that this pattern is not really solar in origin but is instead a consequence of internal climate variability or aliasing from effects of the two major volcanic eruptions aligned to solar maximum periods (Chiodo et al., 2014).

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/14/C12817/2015/acpd-14-C12817-2015-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 30879, 2014.

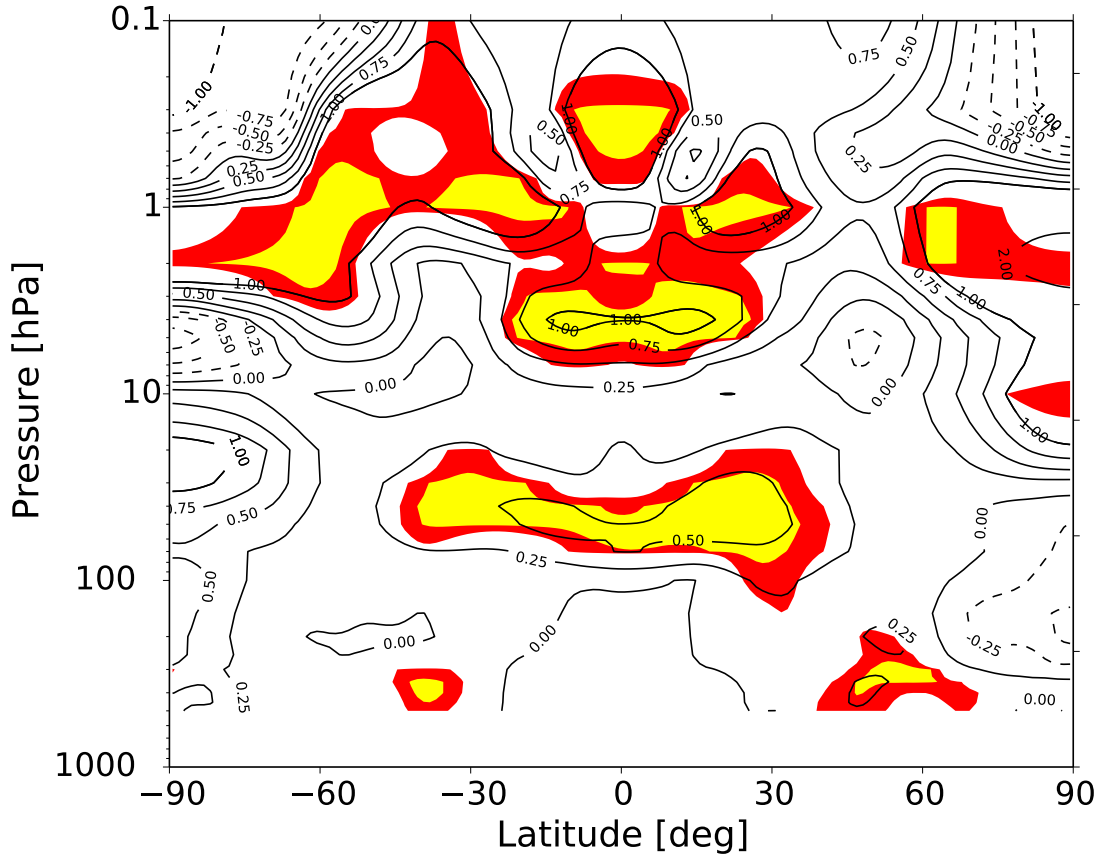

Fig. 1. Temperature response to SC for MERRA. All regressors included.

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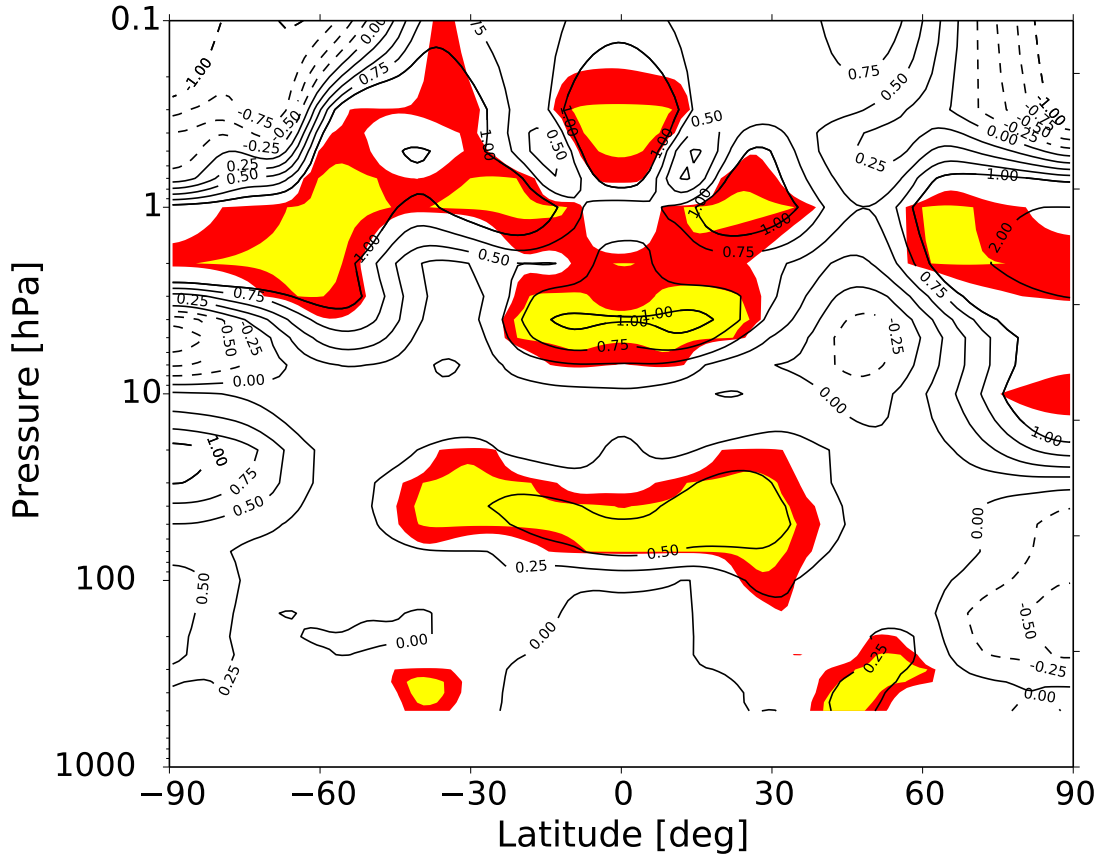

Fig. 2. Temperature response to SC for MERRA. All regressors included except NAO.

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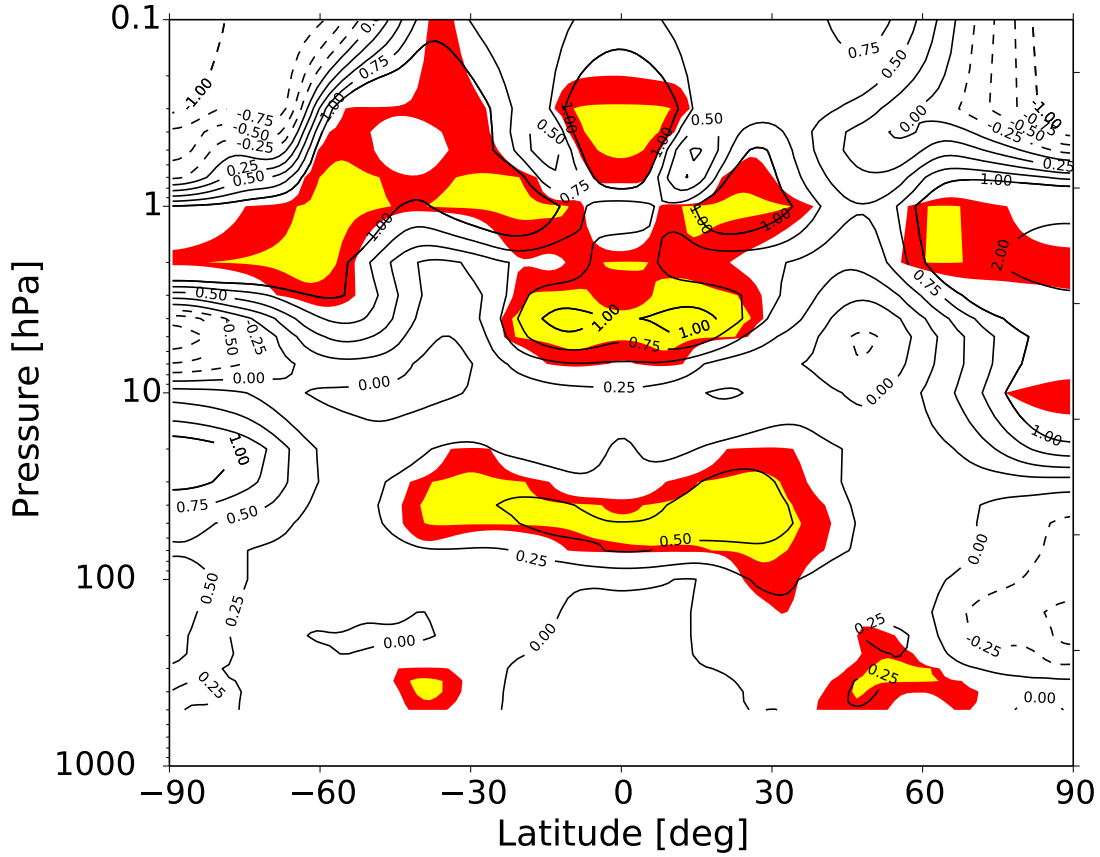

Fig. 3. Temperature response to SC for MERRA. All regressors included except QBO3.

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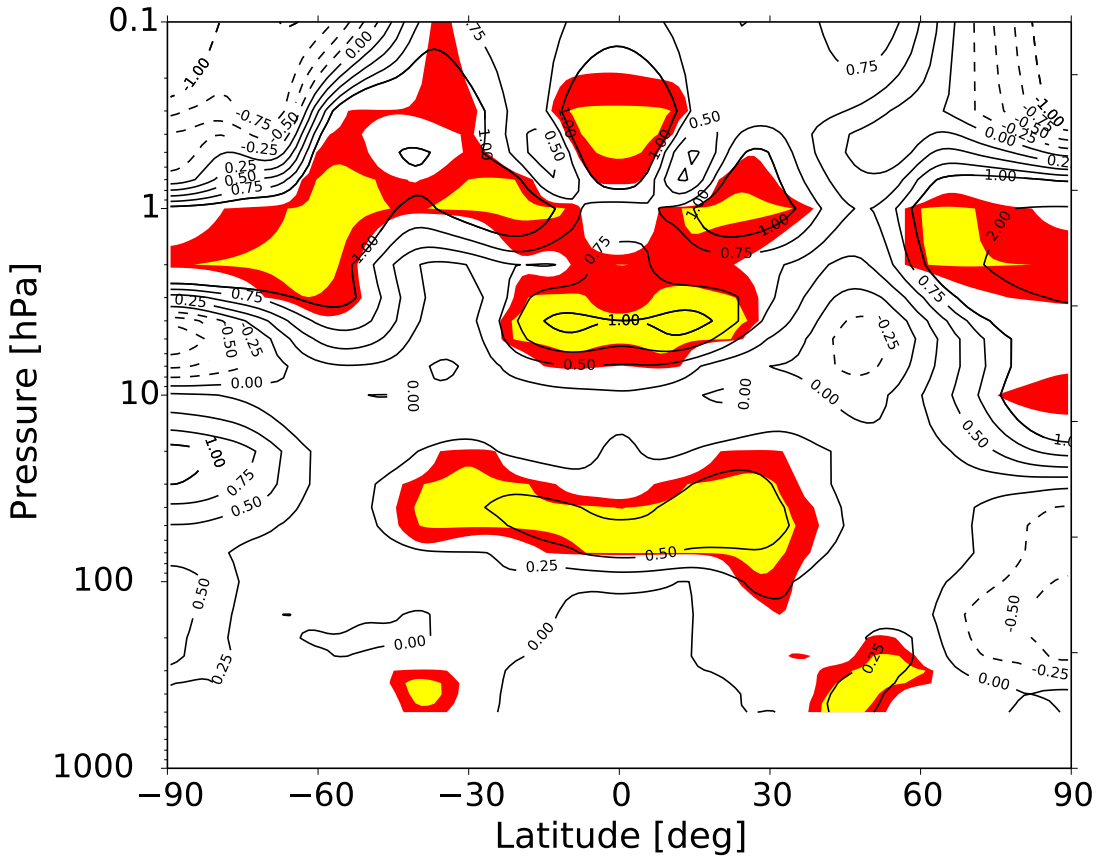

Fig. 4. Temperature response to SC for MERRA. All regressors included except NAO and QBO3.

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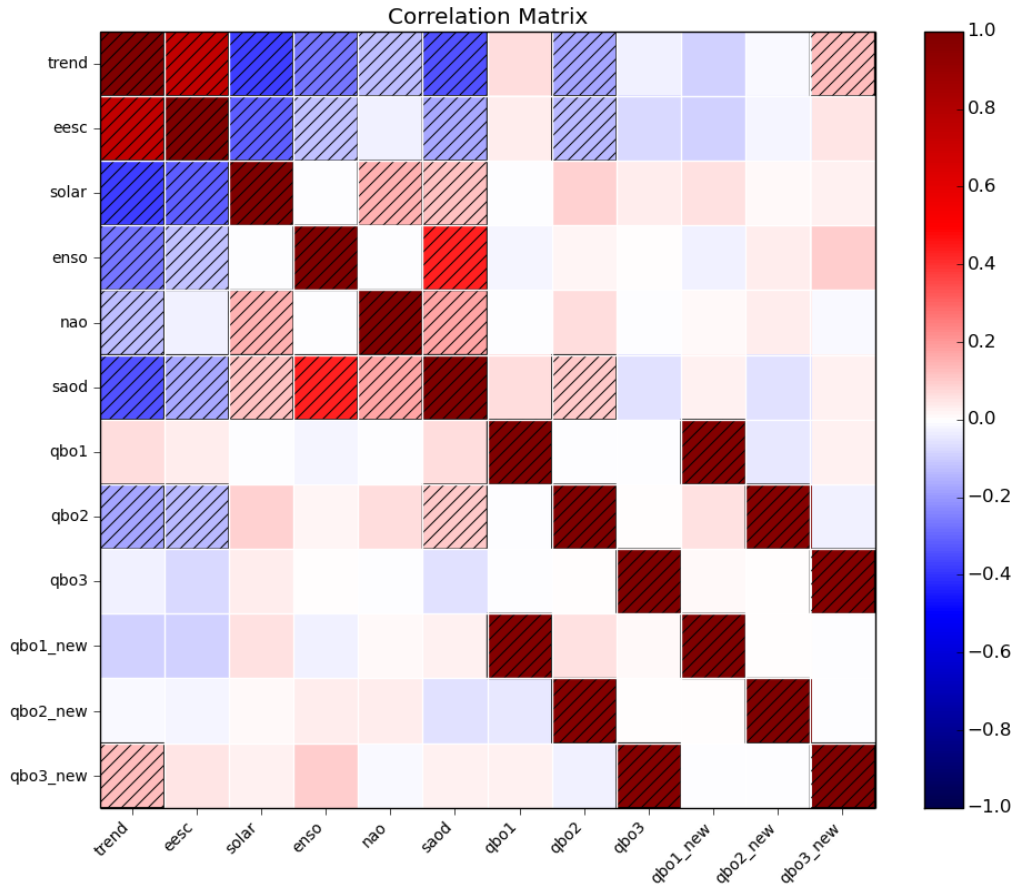

Fig. 5. Cross-correlation matrix of regressors for MERRA. QBO1_new, QBO2_new and QBO3_new were computed from a Principal Component Analysis of equatorial, deasonalized zonal mean zonal wind anomalies only.

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