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Response: Commentary: Energetic particle forcing of the Northern Hemisphere winter stratosphere: comparison to solar irradiance forcing

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A commentary on

Commentary: Energetic particle forcing of the Northern Hemisphere winter stratosphere: comparison to solar irradiance forcing
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We would like to thank the authors of the commentary [1] for pointing out the error in the analysis of the early winter months (Oct–Dec) in our article. We find that this is indeed correct, and wish to apologize for such an error in our analysis. After correcting the error we have been able to reproduce **Figure 1** from the commentary. We wish to point out that we have checked that this issue has not affected our previous papers using re-analysis [e.g., 2]. The second issue raised concerning the inclusion of stratospheric sudden warmings (SSW) in the climatology when calculating anomalies was previously brought to our attention and discussed in the recent Conference on Sun-Climate Connections, organized in Kiel on the 16–19 March, 2015. To address this potentially significant effect in the results, we have re-analyzed the composite differences for the cases considered in our article, taking into account both the issues of SSWs and the correction for the month order.

Figure 1 presents the composite differences for "Solar Maximum–Solar Minimum" and "high Energetic Particle Forcing (EPF)–Solar Maximum." The years are as in Seppälä and Clilverd [3], but now assuring that all months are consecutive (i.e., 10, 11, 12, 1, 2). These composite differences indicate that, relative to Solar maximum conditions, high EPF is able to influence the stratospheric polar night jet from early winter (Nov) onwards, with a stronger/polewards shifted polar night jet persisting throughout the winter, at first present in the upper stratosphere and later extending across the whole polar stratosphere. These latest results support the conclusions of our original article.

As before, we want to emphasize the potential effects on these signals from other factors such as the quasi-biennial oscillation, which we are not able to fully exclude due to the length of the dataset. Therefore, as soon as a full description of EPF becomes available, these potential dynamical signals should be investigated with the means of whole atmosphere chemistry-climate modeling.

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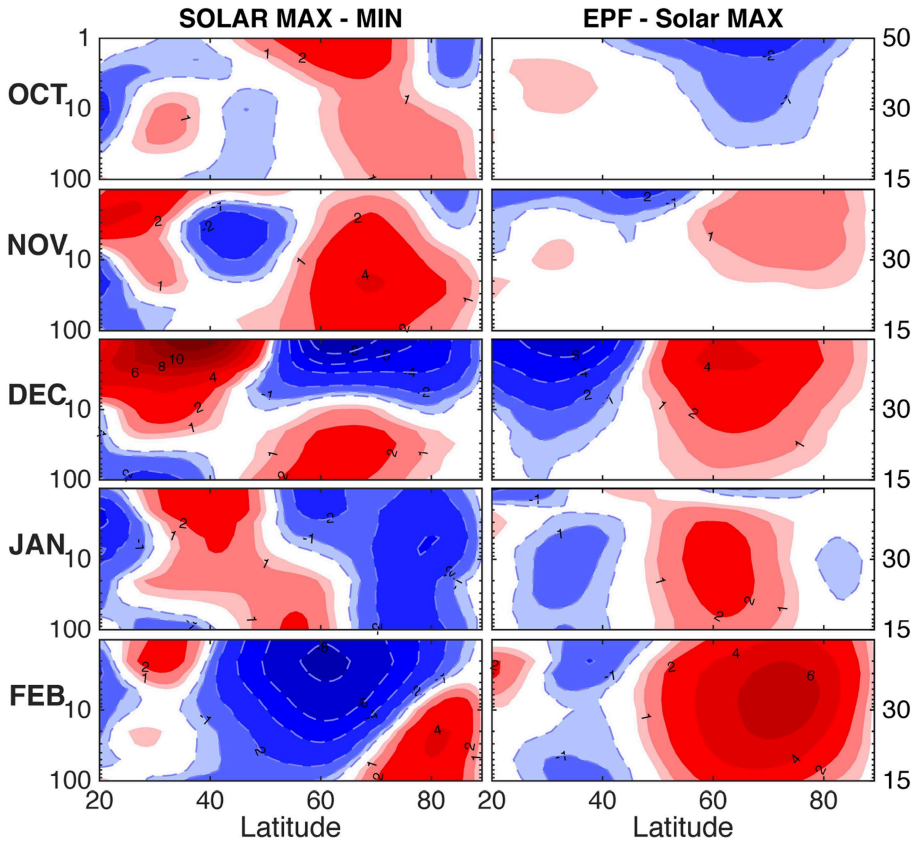

FIGURE 1 | Monthly mean zonal mean zonal wind composite differences. Left: Solar maximum–Solar minimum. **Right:** Energetic Particle Forcing (EPF)–Solar maximum. Contour lines are shown for ±0.5, ±1, ±2, ±4, ±6, ±8, ±10, and ±12 m/s. Negative values are shown in blue and indicated with additional dashing. The vertical axis on the lefthand side is pressure [hPa], the approximate altitude in [km] is given on the righthand side.

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