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Interactive comment on "Climatology and trends in the forcing of the stratospheric zonal-mean flow" by E. Monier and B. C. Weare

Anonymous Referee #2

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Review: 'Climatology and trends in the forcing of the stratospheric zonal-mean flow' E. Monier and B.C. Weare

In this paper the TEM momentum budget of the ECMWF ERA-40 reanalysis was examined. It is concluded that unresolved gravity waves contribute strongly to the forcing of the zonal-mean flow. Trend analysis suggests the polar night jet in both hemispheres persists later in the season and its break down delayed. In the NH this is attributed to changes in transient waves and in the SH to changes in stationary waves. They go on to identify long-term changes in the Brewer-Dobson circulation which they suggest are caused largely by trends in planetary waves during winter and gravity waves at other times. Their study of trends in wave activity and the associated forcing of the mean flow would be of benefit to the community, however I do feel that there is a major

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point for consideration in attributing the residual term as predominantly gravity waves. Therefore I recommend major revisions before it is further considered for publication.

Major Revisions:

(1) In the reanalysis data how reliable is it that the residual term in the TEM budget is predominantly gravity waves and does not include a significant contribution from any Analysis Error? If there is a bias between the model and observations this will result in a forcing in the assimilation and will appear in the residual term.

(2) In the reanalysis when data from a new instrument becomes available and is assimilated this could potentially cause erroneous trends in the data. Has this been considered? See for instance:

(a) 'Erroneous Arctic Temperature Trends in the ERA-40 Reanalysis: A Closer Look', Screen and Simmonds, J. Clim., 2011.

(b) 'Arctic tropospheric warming amplification?', Thorne, Nature, 2008.

Minor Revisions and Typos:

(1) 11650L5-7: 'A trend analysis, from 1980 to 2001...' This sentence could be clarified to specifying later in the season in recent years.

(2) 11651L17: '...stronger westerly winds in the summer-fall season...' Is fall too late?

(3) 11652L23-26: Be consistent with use of section and Sect.

(4) 11653L13-15: 'In addition, Knudsen...' This sentence is a little unwieldy to read with so many sub clauses.

(5) 11654 Equation (1) and (2): These are identical, remove one.

(6) 11654 Equation (2) and throughout manuscript. curl F should be replaced by div F (as in Andrews et al 1987). Mathematically these have difference meanings.

(7) 11654L12: '...the horizontal and vertical components of the residual mean merid-

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ional circulation...' change to '...the meridional and vertical components of the residual mean circulation...'

(8) 11655L16: 'diagnostics' should be 'diagnostic'

(9) 11659L7: 'lower-troposphere drag' should this be 'lower-tropospheric drag'?

(10) 11660L15: 'Finally, and analysis of the seasonal cycle of the tropical residual term (not shown)...' Can this be included as supplementary material?

(11) 11662L7: 'while considerable..., it is unclear why it is not removed from the climatology mean'. Needs clarification as I am unclear as to the meaning of this sentence.

(12) 11662L15: In figure 5 rather than doing overplotted contours of the EP Flux components (bottom row) can you do a vector plot?

(13) 11663L25: 'Also, the Coriolis and advective terms...., reflecting the fact that the wave drag exerted by divF_z is consumed by driving the B-D circulation'. Perhaps I have misunderstood, but you seem to be linking tropospheric correlations with a stratospheric feature in the B-D circulation?

(14) 11664L11-13: 'Furthermore, the uncertainties ....'. I am not sure whether a bias will affect a correlation and how all these correlations fit together. The correlation between du/dt vs Cor+Adv is positive in the summer stratosphere, du/dt vs X is positive but small in the summer stratosphere but Cor+Adv vs X shows a strong negative correlation in summer. i.e. If A is positively correlated with B and A is positively correlated with C can B be negatively correlated with C? Perhaps it is worth considering doing a regression which will give some idea of the importance of the term instead of a correlation.

(15) 11665L3: 'Since the period of the QBO is variable...' I am not sure I follow the reasoning in this sentence.

(16) 11667L25-26: 'Overall, Fig 8 ...., in driving long-term changes in the B-D circulation during seasons when the planetary wave activity is weak.' From Fig 8 it shows that

the residual term mainly balances changes in the cor+adv (or B-D circulation). Looking at when du/dt is non zero this corresponds to when the eddy forcing is non zero. I can't see 'driving' only balancing. If anything looking at du/dt when the eddy forcing is zero it would appear that the B-D circulation is stronger that the balancing residual term.

(17) 11672L24: 'various re-analysis dataset...' should be 'various re-analysis datasets'

(18) 11686 Fig 6: It is slightly confusing that the y axis ranges changes. I would suggest either using a fixed range (-1 to 1) for all plots or alert the reader in the caption that the range changes.

(19) 11688 Fig 8: The legend lines are not clearly indicative of the line styles used in the plots.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 11649, 2011.