

## ***Interactive comment on “Equatorial transport as diagnosed from nitrous oxide variability” by P. Ricaud et al.***

**Anonymous Referee #2**

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### General Comments

This paper discusses transport mechanisms in the equatorial region as diagnosed from the occurrence of semi-annual, annual, and quasi-biennial oscillations in the N<sub>2</sub>O field observed by the ODIN. The findings for the SAO and QBO are largely confirmation of previously reported work, but the results presented for the annual oscillation in the UTLS, the main focus of the paper, are new and interesting. The mechanism advanced to explain the observations, convective overshooting coupled with an unobserved variation of tropospheric mixing ratio, is somewhat speculative and not entirely compelling, but serves as a starting point for further thought on the subject. Ideally, it would be nice to see the observations reproduced in a model which, unlike the two used here, incorporates the invoked processes. The arguments in the paper are generally well

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presented, but the text contains a number of minor grammatical errors or unusual phrasings which would benefit from tidying up. Also, some more detail is required throughout the paper on the data, models, and methods used.

### Specific Comments

P.4900, L. 20, '...peaking in May and absent in the models' 'absent in the models' is slightly ambiguous. It's not clear whether or not the models even attempt to simulate overshooting. For the abstract the phrase could probably be omitted altogether.

P.4901, L.7-9, Some more specific information on the N<sub>2</sub>O lifetime in the stratosphere and its variation with height would be helpful. We are told the stratospheric lifetime is 'less than one year', but it is then referred to as a 'long-lived species'

P.4902, L. 7, Reference for the TRMM data?

P.4902, L.9, Definition of TTL, and how it relates to UTLS?

P.4903, L.14, How many measurements are made within each bin? Is the averaging sufficient to effectively remove the measurement noise (precision error)?

P.4904, L.8, Why were the SLIMCAT results zonally averaged instead of being placed into lat-lon bins like the ODIN and MOCAGE data?

P.4904, L.14, State specifically that exactly the same ECMWF files were used for for forcing MOCAGE and SLIMCAT, or explain the difference if there is any.

P.4904, L.24, Could perhaps mention how the surface mixing ratios of N<sub>2</sub>O compare in SLIMCAT and MOCAGE.

P.4904, L.25, The implication from later in the paper is that the Betchold convection scheme does not allow overshooting and transport of material into the stratosphere. This should be stated here.

P.4905, L.6, A sentence indicating how the various oscillation amplitudes were ex-

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tracted from the data (Fourier decomposition?) should be included. What period was used for the QBO?

P.4905, L.9, Clarify if these vertical winds are identical to those used by MOCAGE.

Section 3.1, It would be helpful to give the reader some more indication of which figure is being discussed at various points in the text.

P.4907, L.5, As I understand it, N<sub>2</sub>O from the two models is here being correlated with the vertical winds used by MOCAGE (or at least winds calculated in a similar manner). Thus it is hardly surprising that the correlation is greater in MOCAGE than in SLIMCAT.

P.4907, L.8-11, In addition to the vertical velocities themselves, how the N<sub>2</sub>O field responds to the velocities will depend on the vertical N<sub>2</sub>O gradient, controlled by the chemistry. How do the gradients throughout the stratosphere compare in the observations and the two models? Could this play any role in the differences in amplitude of the oscillations?

P.4908, L.9, Some explanation should be given for why the difference between the Western Pacific and Africa is not shown for SLIMCAT in Figure 5.

P.4908, L.17, Make clear you are referring to Figure 3.

P.4909, L.16, Where does the figure of 600-800 m month<sup>-1</sup> for the ascent rate come from? And how does it relate to the 0.2-0.3 km month<sup>-1</sup> given a few lines earlier?

P.4910,L.27, 'The 2-month chemical lifetime of CO implies that its concentration decreases rapidly with time'. That's not strictly true since in the absence of any change in the sources or sinks a short lived species will be in steady state. This argument should be expressed more clearly.

P.4911.L.12, 'The fourth and last potential contributor' . Are the four factors discussed really the only potential contributors to an AO? I doubt it. Better just to say 'A fourth potential contributor'.

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P.4912,L.1, 'A vertical displacement of 250m...' This sentence is repeated almost verbatim from P.4910,L.20. One or other of the occurrences should be removed.

P.4912,L.7, '...peaking in July' peaking is not the appropriate word for the point where the values are a minimum.

P.4912,L.21, As we are discussing the tropics, what months are meant by 'the winter'? Are the overshooting episodes reported by Ricaud 2007 being advanced as an explanation of the fast increase in CO in November-December mentioned above. If so, this should be made clearer. If not, the fast November-December increase should be attributed to another cause. The likely impact on the CO cycle in the lower stratosphere of the large seasonal variations in tropospheric CO due to biomass burning should also be discussed.

P.4914,L.18, 'The above findings fully confirm the hypothesis of the convective origin...' 'Fully confirm' is a little strong based on the evidence presented. 'Support' is a more appropriate word.

Figure 6, The caption should state the bottom panel is the potential temperature anomaly.

#### Technical Comments

'O3' and 'ozone' are used interchangeably throughout the text. Best stick to one or the other.

P.4900, L.14, '..the variations are shown...' change to '...the OBSERVED variations...'

P.4901, L.11, 'straightforward diagnostic'. Perhaps omit 'straightforward'?

P.4906, L.2, 'diabatic thermal processES'

P.4906, L.21, 'differences with the observations', differences FROM the...

P.4907,L.6, '...is rather poor in SLIMCAT.', rather LOW...

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P.4908,L.9, '...interpolated at 400 ...', interpolated TO

P.4908,L.28, '...such has seen in the HALOE...', such AS

P.4910,L.23, '...a change of 3.5 ppbv only at 17.5 km..', 'a change of only 3.5 ppbv at 17.5 km' is slightly less ambiguous

P.4911,L.4, 'In the case ozone...', In the case OF ozone

P.4914,L.27 'confronting the measurements to', 'COMPARING the measurements WITH'

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 4899, 2009.

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