

Interactive comment on “Response of tropical stratospheric O₃, NO₂ and NO₃ to the equatorial Quasi-Biennial Oscillation and to temperature as seen from GOMOS/ENVISAT” by A. Hauchecorne et al.

Anonymous Referee #1

Received and published: 1 June 2010

This is a potentially interesting paper. Given the value of the observations and the appreciable retrieval effort, it is a work that should eventually be published. However, I find the status of the data analysis and its presentation in need of clarifications. Based on my concern on the methodology reported below, my recommendation is for major revision.

My major concern is on the methodology:

At page 9158 (bottom) it is written that a multi-parameter fit is performed to extract,

C3434

among other signals, also the 30 hPa and the 10 hPa QBO signals in the three constituents. But it is not clear if thereafter the results from this signal extraction are actually used to calculate the correlation shown in Figures 3 and 5 as well as the timeseries in Figure 2 and 4. Why are the results shown in terms of either values normalized by their seasonal mean evolution or deviation from their mean seasonal cycle, instead than in terms of the extracted signals from the multi-parameter fit? What is the role of the multi-parameter fit?

Therefore my concern is that, by showing deviations from the mean seasonal cycle in the tropics, the QBO signal is not singled out, because of the influence of other interannual variability, most notably ENSO. This is especially true in the tropical lower stratosphere (unknown in the upper stratosphere and lower mesosphere). Hence, although the reported correlations are of interest, their interpretation is not warranted, given the results shown.

In addition to the above, I am wondering what is the meaning of interpreting the correlations above 30 km (pressures below 10 hPa) with the status of the QBO at 10 and 30 hPa. Here, the structure of the QBO induced residual circulation should be better discussed. This is implicitly mentioned at page 9163, but no evidence is given that at 45–50 km there should be ascending motion associated with the QBO, by the way which QBO phase and where?

I also have problems with using the QBO winds to compute the correlations. Given that the QBO induced residual circulation (and consequently the QBO signal in temperature and tracers) is in phase with the QBO wind shear and not the QBO wind itself, I am wondering if more revealing results can be obtained by examining correlations with the QBO-wind shear.

Specific comments

There is no information on which equatorial wind data are used.

C3435

I find Figure 2 not very revealing, because from U at 10 hPa it is not straightforward to visualize the O3-QBO wind relationship. Because, as mentioned above, the QBO induced residual circulation (and consequently the QBO signal in temperature and tracers) is in phase with the QBO wind shear and not the QBO wind itself. Basically, the reader has to visualize in his/her head the QBO in the region of interest, from the QBO at 10 hPa (not straightforward, to know what is going on at 45 km from the QBO at 10 hPa).

A suggestion for improving Figures 2 and 4, and possibly make them much more revealing, is to show the pressure-altitude evolution of the zero wind contour of the equatorial winds for all the vertical domain shown. The zero wind line is of interest because an indication of where the wind shear is located. If then in another panel the winds themselves would be shown, it would be ideal. Indeed, given that the QBO is the central topic, I think that to show its evolution in zonal wind for the time of interest is mandatory.

Figure 5: I do not understand why below 30 km, O3 is positively correlated with both U at 10 hPa and at 30 hPa. If the time series of U at these elevation are almost orthogonal (stated at page 9158), should not the ozone be correlated with U at 30 hPa and anti-correlated with U at 10 hPa?

I would suggest to revise the manuscript proceeding in the following steps:

1. Show the QBO in Equatorial winds for the period in question. Take care of explaining how the QBO signal is extracted, and show results that are consistent with the described methodology.
2. Establish the temperature - zonal wind (vertical shear) relationship for the QBO signal: Are these as expected from what we know from the QBO theory? Is there anything new illustrated here, especially in the region above 30 km?
3. Once the status of the QBO for the time period and atmospheric region of interest is presented, focus on the correlation between temperature and the three constituents,

C3436

given that among these quantities we can expect either in phase or out of phase relationships (depending on transport, chemistry and background distributions)

4. Revise interpretation.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 9153, 2010.

C3437