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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Isentropic advection and convective lifting of water vapor in the UT– LS as observed over Brazil (22° S) in February 2004 by in situ high-resolution measurements of H_2O, CH_4, O_3 and temperature" *by* G. Durry et al.

Anonymous Referee #4

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This paper describes profiles of ozone, H2O and methane made by a balloon-borne diode laser spectrometer above tropical Brazil. The profiles reveal layering in the upper troposphere and lower stratosphere attributed to convective activity and advection of mid-latitude stratospheric air into the tropics. My overall assessment of this paper is that in its current form it provides marginally new information to warrant publication in ACP. But much work is needed to clarify the context of these intrusions, and more support is needed for the analyses of the air mass origins.

Many studies over the past 15-20 years (just a few of which are referenced in this paper)

have already described the advection of mid-latitude stratospheric air into the tropical lower stratosphere and upper troposphere (see the intrusion climatology by James et al, 2003 (reference listed below)). Based on these earlier works, the observation of such intrusions over Brazil is not surprising. However high quality measurements over Brazil are still useful, and the fact that the observations occur in austral summer when such intrusions are less common is interesting. The authors need to do a better job of referencing previous studies and placing these intrusions in the context of what is already known.

The authors also need to clearly state the purpose of this paper. I could not find a specific scientific question that the authors were trying to answer, or even what the purpose of the HIBISCUS experiment was to be. In its current form the message seems to be: measurements were made in the UT-LS above Brazil and air masses of various origins were observed. But this is to be expected. What is significant about these measurements?

I suggest that the authors shift the focus of the paper to a less-explored topic and come up with a specific scientific question that they are trying to address. One aspect of the paper that could provide new and valuable information is the hypothesis that the cold point tropopause above the continents is warmer than above the oceans. The limited data presented in this paper can not be used to effectively explore this hypothesis. However, if no one has already conducted such an analysis, the authors should be able to easily obtain from WMO routine radiosonde profiles above maritime and continental sites in the tropics. They can then easily calculate the cold point tropopause temperatures at the various sites and test the hypothesis. If there really is a difference then this places their measurements of enhanced stratospheric water vapor above Brazil in a new light. A problem I see with the current hypothesis is that, if convection is deeper over the continents, wouldn't one expect a lower coldpoint over land? Also, the authors could explore the origin of the warmer air in the lower stratosphere above Brazil. Although it appears that this analysis is being conducted by Huret et al., 2006.

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Specific comments On page 12476 the authors state that SF4 was under the influence of convection, but then seem to contradict this statement on page 12481 when they say that the ozone profiles appear to indicate a lack of local convective influence.

The SF4 ozone intrusion reaches a maximum at 335 K but the authors only show PV plots at 340 K and above. PV needs to be shown for 335 K.

Regarding the PC contour advection technique: Are PV values initialized at a particular time and then advected with conserved PV values? Also what are the vertical, horizontal and temporal resolutions of the ECMWF data? MIMOSA does not account for possible vertical transport of air masses, so why is it surprising that the PV contours remain coherent features in regions of convective activity, when MIMOSA does not handle such transport processes?

I found the text in most of the figures to be far too small and difficult to read. Also, the PV plots need a color bar because the contour labels are not legible.

Papers to add to the reference list:

A recent manuscript that is relevant to this study is:

Cooper, O. R., et al. (2005), Direct transport of midlatitude stratospheric ozone into the lower troposphere and marine boundary layer of the tropical Pacific Ocean, J. Geophys. Res., 110, D23310, doi:10.1029/2005JD005783.

This paper presents the most detailed aircraft-based measurements of mid-latitude stratospheric intrusions that have advected into the tropics. One case study shows a large intrusion above Hawaii that enhances ozone throughout the tropospheric column. This intrusion also destabilized the atmosphere allowing convection to occur beneath the intrusion and in situ measurements show that the convective clouds mixed stratospheric ozone into the troposphere. The Introduction contains an extensive literature review of intrusions in the tropics

Another relevant paper is: Baray, J. L., S. Baldy, R. D. Diab, and J. P. Cammas (2003),

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Dynamical study of a tropical cut-off low over South Africa, and its impact on tropospheric ozone, Atmos. Environ., 37, 1475-1488.

This paper documents ozone from a mid-latitude cut-off low that influences the southern hemisphere tropical upper troposphere above Africa.

Also, the following paper: James, P., A. Stohl, C. Forster, S. Eckhardt, P. Seibert, and A. Frank (2003), A 15-year climatology of stratosphere-troposphere exchange with a Lagrangian particle dispersion model: 2.Mean climate and seasonal variability, J. Geophys. Res., 108(D12), 8522, doi:10.1029/2002JD002639.

is useful for placing the Brazil measurements in a global and seasonal context.

And this paper discusses the advection of polar stratospherec ozone into the tropical lower stratosphere, and uses MIMOSA. Tripathi O. P., T. Leblanc, I. S. McDermid, F. Lefèvre, M. Marchand, A. Hauchecorne (2006), Forecast, measurement, and modeling of an unprecedented polar ozone filament event over Mauna Loa Observatory, Hawaii, J. Geophys. Res., 111, D20308, doi:10.1029/2006JD007177.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 12469, 2006.