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Atmospheric Chemistry and Physics Discussions

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Interactive Comment

Interactive comment on "An overview of the HIBISCUS campaign" *by* J. P. Pommereau et al.

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Answer to Referee # 1

It is right that the paper was written in a hurry, but even more importantly before knowing the exact results of the analysis of their data by the various groups and ignoring the publications, which will be really available. The paper is now deeply changed, shortened as far as possible with all technical and operational details in appendix, and more oriented toward a synthesizes of the main scientific results, taking into account the comments of all referees. Hope it will be now more acceptable and more interesting.

Major comments

(1) Stage setting (sub-tropics/extratropics vs tropics) A brief description of the meteorology is given by adding an altitude/latitude cross-section and maps of PV contours

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Interactive Discussion

Discussion Paper

showing that the region of Bauru is always corresponding to the definition of tropical climate, north of the tropical jet where the tropopause, defined as the contour of 2 pv unit, is at the 380 K level. Also added is an altitude/time cross-section of the evolution of PV field over Bauru during the campaign showing the latitudinal displacement of the tropical jet. PV at various levels is also indicated in the tables summarizing the meteorological conditions encountered fro each flight. (2) Convective overshoots to 440 K. All information relevant to the subject (diurnal temperature cycle, equivalent vertical diffusivity, chemical tracers and modelling) is synthesised in a specific section (5.1 Local impact of convection on the thermal structure and the composition of the TTL, the paper on the impact on the thermal structure of the TTL will be revised immediately after this one), whereas the information on water vapour including cloud resolving modelling of overshoots and on the impact of overshoot at the global scale are treated in the same manner in separate sections 5.2 and 5.3. (Ref to Hanisco, added in the hydration section).

Minor comments

- Certain ignorance of information on the same subject available in the literature. Âń Presence of VSLS, NOx etc in the UTLS injected there by deep convection largely unknown Âż. The writing was indeed awkward. What is almost ignored is the possible injection of fresh short-lived species in the lower stratosphere, well above the cold point, by convective overshooting over land where there is almost no observations. The description of the transport of such species from the surface to the TTL given in WMO 2006 is limited to the updraft up to the maximum convective outflow, followed by slow lofting by radiative heating (a concept well described by Fueglistaler et al. Rev. Geophys. 2009) although the authors are also noting in their conclusion that “ Perhaps most importantly, the convective detrainment rate profile is still poorly quantified, and the effect of overshooting convection on the heat balance of the TTL is still a major unknown” (ref added in the paper). The objective of HIBISCUS was to get some information on the subject. Hope it is better written now. - Altitude reached

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by overshoots. It is true that the potential energy for a cloud system to reach 440 K would require a heating of some 41°C and a 100% humidity at the surface, but an overshooting tower is due to kinetic energy. It is the consequence of the acceleration in the most active part of the cloud resulting in a vertical velocity of 50 m/s or more at the top. As described in section 5.2, such event is well captured by cloud resolving mesoscale models including a complete cloud microphysics. - Detection of cloud tops by S-band radar Fig. 2 (now Fig. 4) It is right that the details are not published in peer-reviewed literature. The results shown are only available in conference proceedings (Gomes and Held, 2004). The frequencies of echo tops were derived by using IPMet's newly implemented software package TITAN (Thunderstorm Identification, Tracking, Analysis and Nowcasting; Dixon and Wiener, 1993) for the Bauru radar, identifying the height of radar echo tops for cells with the 10 dBZ contour containing storm volumes of ≥50 km3 within the 240 km radar range. Storm volumes of ≥50 km3 are representative of longer-lasting or more severe storms. The minimum life-time of a cell was set at ≥15 min. TITAN uses radar data in MDV format (Meteorological Data Volume; 3-d Cartesian multi-variables) and identifies radar "tracks", which is the term given to describe the following of a convective cell for its lifetime by the software. DIXON, M. and WIENER, G., 1993. TITAN: Thunderstorm Identification, Tracking, Analysis and Nowcasting - A radar-based methodology. J. Atmos. Ocean. Technol., 10, 785-797. Since such details do not seem appropriate for the paper, a short indication on how cloud tops are derived from the radar (10 dBZ threshold reflectivity, storm volume ≥50 km3) has been added in the caption of Fig. 4. - 4.1.1.11 (now in 1.8 appendix 1) Lightweight scattering probe information on particle shape. Modified for "distinguish between spherical liquid droplets and solid crystals". - 4.2.2 SAOZ NIR (now 2.1 in appendix 1) indication of wavelengths suppressed. - 6.1.1 (now in 5.4). Rewritten. Comparison with Borsche included. - 6.2 tropical trajectories. Subject now treated in 5.4. Discussion on trajectories removed. - 6.2.2 (now in 5.1) Large amplitude of the cooling in the afternoon coinciding with the phase of maximum development of diurnal convection. This is a fact (also reported later over West Africa during SCOUT-AMMA, Cairo et al. 2010). The further

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question is indeed to know if it is due to an overshoot of adiabatically cooled air as suggested by Danielsen (1982, 1993), or gravity waves, or even vertical diffusivity. Tracers, water, ice crystals, and more recently cleansing of the lower stratosphere (Vernier et al., 2009) as well as the successful CRM modelling of hydration, strongly support the first hypothesis, whereas the radiosoundings of Bauru do not show gravity waves of enough amplitude (Pommereau and Held, ACPD under revision). - 6.5.3 Comparison of water vapour measurements in the tropics including SAOZ now available in Montoux et al., 2009. Significant influence of scattered light in SAOZ balloon solar occultation observations at twilight limited to altitude below 15 km, demonstrated by color index measurements. - 6.6 Small particles up to 19 km. The information derived by Nielsen et al is that these particles are likely solid of 0.2-1.5 μm radius and that is similar to those observed by Popp et al., but of much far larger number density (0. 03 -1 cm-3 instead of 10-4 cm3) requiring thus another source than nucleation. Ref to Popp et al. added. - 6.7.1 Advection Bry rich air. This is what was observed. But since it's unpublished, the paragraph on Bromine chemistry has been removed. - 6.7.2 Full NOx chemistry required in CTMs. Obviously not very original. But since also not published, paragraph removed. - 6.7.4 Photolyses rate. Section removed for the same reason. - 6.8.2 Universities of Bremen and Heidelberg. Done (now in section 5.5) -7. Summary totally rewritten. All references to unpublished papers removed.

Typos and wrong use of English checked in the new version.

Thanks very much for the many useful comments.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 2389, 2007.

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