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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "The influence of typhoons on atmospheric composition deduced from IAGOS measurements over Taipei" *by* Frank Roux et al.

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Anonymous Referee #1 Comments on the manuscript

(...) the manuscript needs moderate revision before publications. My specific comments are following under :

(1) The authors have shown a significant increase in ozone concentration in the proxy of dry air and low CO concentration which occurs in the middle and upper troposphere. I do agree with the authors that the enhanced ozone is primarily associated with the passage of typhoon. But my main concern, even the authors themselves have stated

that lightning associated with a typhoon may cause enhancement of ozone. Then how sure we are that the observed enhanced ozone in the middle and upper troposphere is of stratospheric origin. I suggest doing a back-trajectory analysis.

-> Retrotrajectory analyses have been added for typhoons Nepartak, Nida and Megi. FLEXPART Lagrangian dispersion model(Stohl et al. 2005) has been used in order to determine the origin of ozone-rich layers identified with IAGOS pseudo-vertical soundings. As discussed in the revised version, the backward plumes of particles initiated within these layers reveal a probable stratospheric origin 2.5 to 4 days before IAGOS observations. Associated Figs. 8 (for Nepartak), 11 (for Nida) and 14 (for Megi) have been added in the revised version.

(2) Potential vorticity (PV): PV is a dynamical tracer for stratosphere-troposphere exchange (STE) processes but in the absence of diabatic heating and frictional forces. During a typhoon, the convective tower will have a high value of PV, which is generated due to latent heating associated with it. A detailed study on the evolution of PV structures associated with a typhoon has been carried out by Grad et al. (2011). Thus one needs to take caution during a typhoon while linking high PV value as the air of stratospheric origin. However, Leclair De Bellevue et al. (2007) have mentioned that latent heat can be negligible outside the convection core in the upper troposphere. In this aspect, a detailed discussion is required in the manuscript.

-> A sentence has been added at the end of 2.3. The use of potential vorticityÂă: In the upper troposphere outflow layer, at large distances ($\geq$500 km) from the cyclone core, where diabatic heating and friction are small, PV must be nearly conserved following air parcels and may be a good indicator of large-scale horizontal and vertical motions (e.g. Molinari et al., 1998 ; Leclair de Bellevue et al., 2007).

(3) There may be a thermal sensor in the aircraft. Thus it will be good to show the thermal structure (maybe temperature inversion).

-> We have compared the vertical profiles of relative humidity, ozone and carbon monoxide contents (previous Figs. 5, 8 and 11), with the vertical profiles of pressure, temperature T and potential temperature θ (see the attached Profiles_RHO3CO+PTTH_Nep+Nid+Meg.pdf). No systematic association could objectively be found between the base and the top of the dry and ozone-rich layers (orange dashed lines), and the vertical gradients of T or θ. Nevertheless, small changes in dT/dz and dθ/dz can be seen for profiles NEP-1 at 2.2 km altitude, NEP-2 at 3 km, NEP-6 at 5.4 and 7.2 km, NID-5 at 3.2 km, MEG-2 at 9 km, MEG-4 at 6.4 and 8,4 km, MEG-5 at 4.5 km. Considering this meager evidence, this discussion was not included in the revised version.

(4) Near Taipei, there is an ozonesonde launching station at Banqiao (25 degree N, 121.3 degree E) or elsewhere. It will be quite supportive of the IAGOS observations if one can show the ozonesonde profiles during any of the typhoon cases (till 3-4 days after typhoon landfall). This will also validate IAGOS data in the convective situation.

-> Unfortunately, the Central Weather Bureau did not conduct ozonesonde measurements in June-October 2016.

(5) The tropopause structure has a key role in STE and also during a typhoon. Thus, I suggest authors take nearby radiosonde data (twice a day) to show the thermal structure and also the wind information.

-> Indeed, these radiosounding data reveal that the "cold point tropopause" decreased substantially when the dry zone arrived over Taiwan (Typhoon NepartakÂă: from 18.2 km on 5 July 00 UTC to 16.2 km on 6 July 00 UTC, Typhoon Megi Âă: from 17.3 km on 25 September 00 UTC to 16.1 kmon 26 September 00 UTC, no significant change was found for Tropical Storm Nida). These remarks have been included in the revised version.

(6) Ratnam et al. (2016) have shown a significant increase in upper tropospheric ozone associated with north Indian Ocean tropical cyclones. It is shown that a particular sector of the cyclone has high ozone and low humidity. I also suggest the authors look

into this possibility in the existing data set and discuss the results.

-> A reference to Venkam Ratman et al. (2016) has been added in the revised version.

(7) Figs.4, 7 and 10 can be combined.

-> Figs. 4, 7 and 10 have been combined into Fig. 5 in the revised version.

We thank Referee #1 for the constructive comments which helped to clarify the submitted version.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2019-622/acp-2019-622-AC1-supplement.pdf

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