Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-1053-SC2, 2021

Atmospheric Chemistry and Physics Discussions
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Interactive comment

Interactive comment on "3-D tomographic observations of Rossby wave breaking over the Northern Atlantic during the WISE aircraft campaign in 2017" *by* Lukas Krasauskas et al.

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Received and published: 8 February 2021

Thank you for the helpful comments and interest in the manuscript. We will try to address your overall comments in the next revision. The answers to the more specific questions and comments are given below. The questions themselves are quoted in italic.

Describe the FISH and FAIRO instruments. Where is PV data from? We assumed it was from the ECMWF operational analysis.

The PV data is indeed from the ECMWF operational analysis.

The measurement principle used by the Fast In-Situ Stratospheric Hygrometer (FISH) is based on photofragment fluorescence: water molecules are split into an excited OH molecule and a single H atom by Lyman-α radiation (121.6 nm). The excited OH molecules emit radiation in the 285–330 nm range when relaxing to the ground state. This emitted radiation is detected by a photomultiplier tube. The number of detected fluorescence photons is proportional to the water vapor mixing ratio with a calibration factor. This calibration factor is determined prior to each experiment in the laboratory, using the commercial frost-point hygrometer DP30. FISH data with 1 Hz sampling was available for the WISE campaign. The instrument is described in detail in Meyer et al. (2015), as cited in the manuscript.

The Fast Airborne Ozone instrument (FAIRO) is based on the chemiluminescence of ozone (at λ = 450-500 nm) on the surface of an organic dye (Coumarin 47) adsorbed on silica gel powder deposited on an aluminum disk. The chemiluminescence light is detected by a small channel photomultiplier. The instrument is calibrated using UV photometry. The measurement frequency when flying aboard the HALO aircraft is 12.5 Hz, which results in a high spatial resolution of 20-25 m at cruising altitude. The instrument is described in detail in Zahn et al. (2012), as cited in the manuscript.

Figure 1: What do the yellow dots with black outlines along the limb view represent? Colours for the chemistry and dynamics mode could be more distinct. The yellow looks pale green.

Colours will be updated in the next version of the manuscript. The yellow dots with black outlines represent the tangent points in each profile that are closest to the altitude shown in the plot (11 km for Figure 1a, 10 km for Figure 1b). This will be included in the figure description. The remaining tangent points are shown in green.

Line 168: “O3 and HNO3 are more abundant in the stratosphere, where they are generated by photolysis” Is HNO3 generated in this way? I thought it was photolysed into NO2.

Thank you for pointing this out, the statement you mentioned is indeed imprecise. It was meant to state that "O3 and HNO3 are more abundant in the stratosphere, where their VMRs are controlled by photolysis".

Figure 4: The colour scale makes the air masses hard to interpret. Perhaps a different one would work better. We found the features being referred to such as the double mixing lines unclear. Annotations would be helpful too. Would it be possible to give a rough number of observations plotted in the caption for all such figures?

The figures were updated with a new colour scale which has better contrast between points (see Figures 1-3 in this document, replacing Figures 4a, 4b and 5, respectively, of the manuscript). The double mixing lines in the comparison of Figures 4a and 5, admittedly, should have been explained better. They refer to the two clusters of air parcels in the 10-30 ppmv H_2O range, now highlighted by black lines in Figure 1, and seen in Figure 3 as well. All these changes will also be implemented in the new manuscript. The number of GLORIA observations for Figure 4a, 4b and 5 are 12706, 25359 and 5032, respectively, with majority of these points located in purely tropospheric and purely stratospheric regions of the tracer-tracer space.

Figure 6 was hard to visualise. Would a rotated perspective work better? It would be good to also have latitudes and longitudes along the horizontal axes and to indicate the cross-sections from Figure 7 here.

Figure 6 will be replaced by an improved version, given in this document as Figure 4. Black line there represents the flight path, blue line – the horizontal projection of flight path.

Figure 8, label 165 W. We were also confused about how the calculation was done. Were the regions in Figure 7 (c) and (d) selected prior to doing the back trajectories or were they found after Figure 8 (a) showed that there were two groups of particles – red and black?

The regions corresponding to the red and black groups of particles are shown in Figure 7 (e) and (f). I am assuming you meant to ask about these, since Figure 7 (c) and (d) do not highlight any regions. These regions were defined after the analysis on which Figure 8 (a) is based showed that the particles were divided into two groups until shortly before the measurements.

Figure 9 (c) was not referred to in the text. Please describe what this figure shows.

Figure 9 (c) was referred to in the text. Here is an excerpt of the manuscript describing the figure: "Figure 9 gives some insight into the vertical transport of observed air parcels. Panel c) shows the distribution of the observed air parcels according to the potential temperature at which they entered stratosphere (maximum potential vorticity gradient tropopause was used to determine the entry point). It shows the two distinct pathways of air into the stratosphere around the polar jet: from low potential temperature levels ($\approx$ 340 K or less) upwards across the tropopause, or isentropically from lower latitudes at high potential temperature (horizontal transport). The latter pathway plays a major role, as expected for this region (Holton et al., 1995; Pan et al., 2009)."

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1053, 2020.

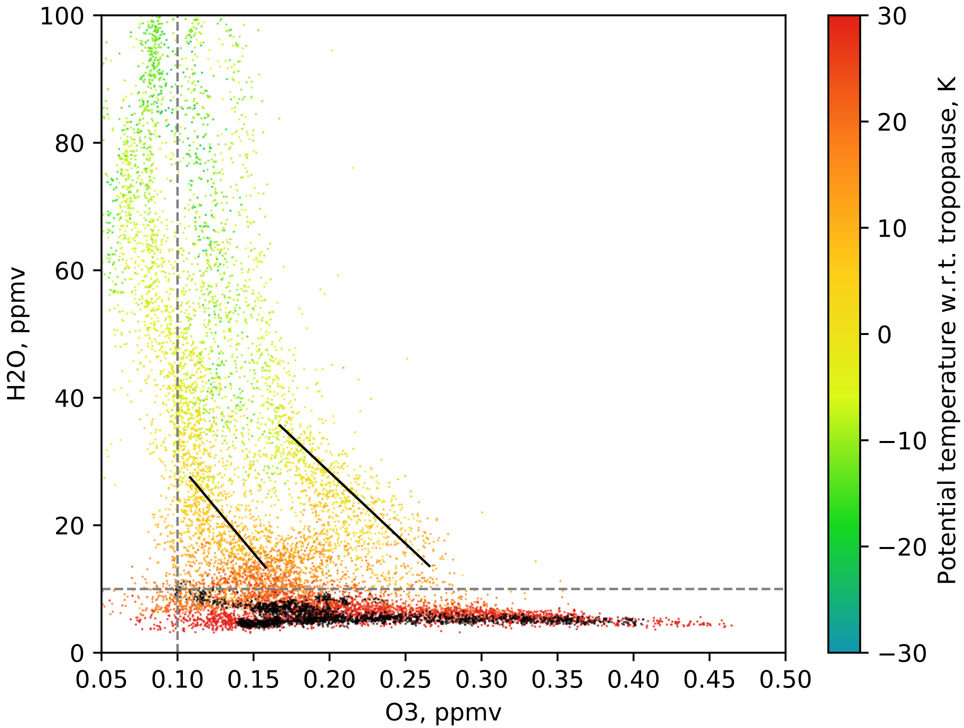

Fig. 1. Ozone – water vapour tracer-tracer correlations from western part of 7 October flight. Black dots represent in situ measurements at flight altitude, black lines - mixing lines referred to in the text.

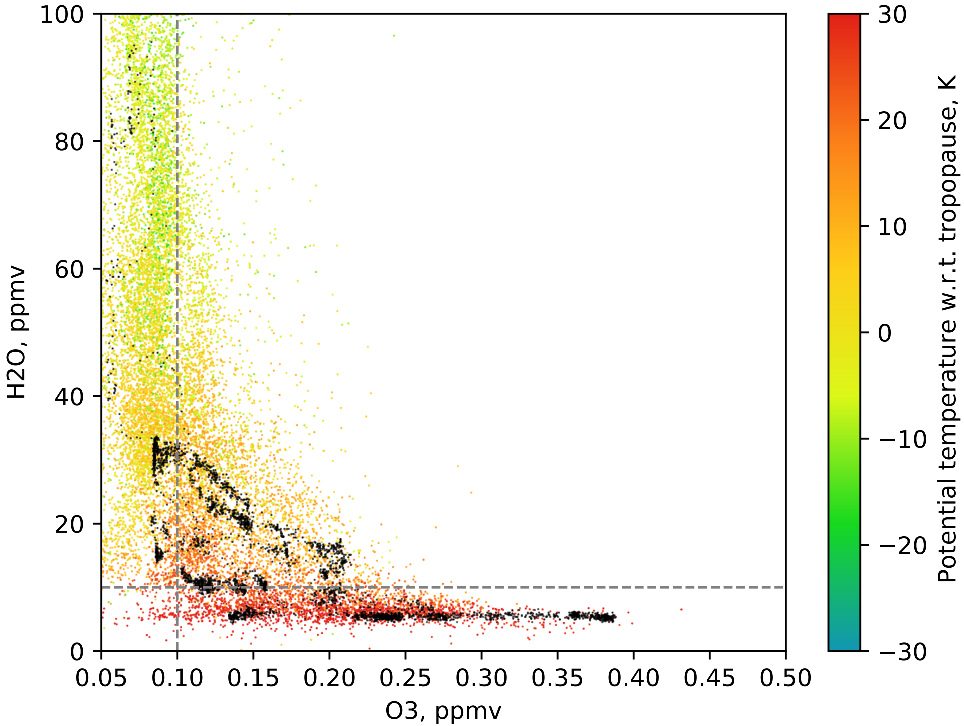

Fig. 2. Ozone – water vapour tracer-tracer correlations from eastern part of 7 October flight. Black dots represent in situ measurements at flight altitude.

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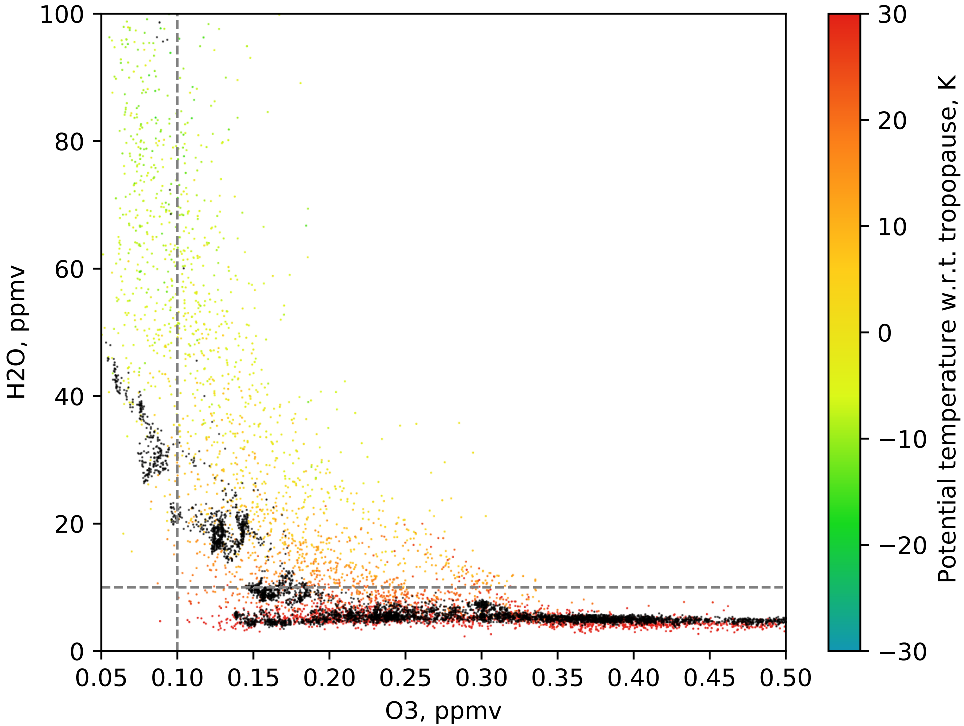

Fig. 3. Ozone – water vapour tracer-tracer correlations from 9 October flight. Black dots represent in situ measurements at flight altitude.

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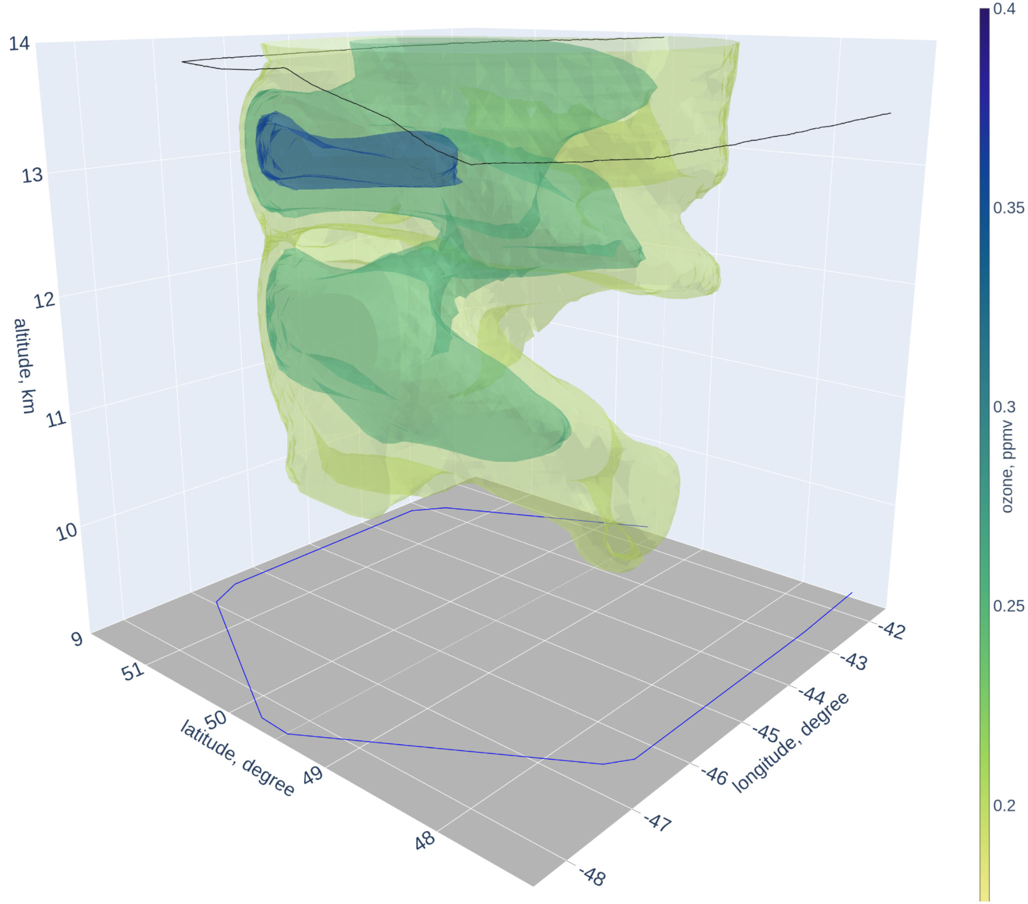

Fig. 4. 3-D plot of tomographic retrieval of ozone VMR. Flight track represented by thin black line, a horizontal projection of slight track – by thin blue line.