Dear Editor,

Please find hereafter our response to your comment (changes to the manuscript are shown in red). The line numbers where those changes appear in the revised paper are also given at that point.

Editor's comment:

The reviewer #2 was questioning the novelty of this study. In the response, you have listed three points of the new contributions. I'd suggest you to consider including these discussions also in the manuscript, and revise your manuscript. Because of the nature of the reviewer's comments and revisions required, we may send the revised manuscript for further review.

Response to Comment:
Thank you for the suggestion. We considered adding all three arguments, detailed in the response to reviewers, in one paragraph, but we believed it did not really fit the flow of the paper. Instead, we chose to add the three points describing our new contribution throughout the manuscript, in places where we thought they best bolstered our arguments, as detailed below:

- The first point addressed the critical need for an evaluation of airborne in situ measurements by comparison with spatially collocated observations from well-established long-term monitoring networks. ATom and HIPPO missions, due to their extensive spatial and temporal coverage, allow for the first time (to the best of our knowledge) for such an exercise at various locations around the globe.
  We have highlighted this contribution first in the introduction:

  l.120-126: "Evaluating the representativeness of in situ observations from airborne campaigns by comparing them to longer-term observational records is a critical exercise never before done at such a global scale. We show that ATom and HIPPO measurements capture the spatial and, in some cases, temporal dependence of O_3 in the remote atmosphere, thus highlighting the usefulness of airborne observations to fill in the gaps of established but limited O_3 climatologies and other similarly long-lived species."

  And again, in the conclusion:
  l.574-575: "This representativeness evaluation on global scales highlights the usefulness of airborne observations to fill in the gaps of established but limited O_3 climatologies."

- The second point dealt with the novelty of having in situ measurements with global coverage to depict O_3 distribution rather than relying on useful, but imperfect satellite and modeling studies. Substantial discussion to this effect had already been added to the manuscript after responding to the reviewers' comments, but we emphasized even more on this aspect in the introduction, l.83-89:

  "Most studies reporting global O_3 distribution use satellite observations (Edwards et al., 2003; Fishman et al., 1990, 1991; Thompson et al., 2017; Wespes et al., 2017; Ziemke et al., 2005, 2006, 2017), modeling analyses (Hu et al., 2017), or observations spatially expanded using back trajectory calculations (e.g., Liu et al., 2013; Tarasick et al., 2010). While useful, these studies come with somewhat large uncertainties, as recently noted by reports from the Tropospheric Ozone Assessment Report (TOAR), and thus require additional in situ observations to be used as a validation bench-mark (Tarasick et al., 2019b; Young et al., 2018)."

- The third point focused on several features described in our manuscript that we believe significantly confirm and extend our understanding of O_3 distribution and climatology, and the legacy influence of continental outflow on O_3 enhancements. One of these features is the similar tropospheric O_3 distribution observed year-round between the Atlantic and Pacific in the extra-tropics. This result has been highlighted in past and very recent studies in the mid-latitudes of the northern hemisphere, but disputed by other works. Discussion to this effect had already been added to the manuscript after responding to the reviewers' comments, but we emphasized even more on this aspect, l.494-496:

  "However, the similarity of the O_3 distribution in the extra-tropical free troposphere above the Atlantic and Pacific is not always evident in satellite-, modelling-, or ozonesonde-derived maps (Gaudel et al., 2018; Hu et al., 2017; Ziemke et al., 2017)."

  Another of these features is the wide-spread, year-round influence of continental outflow on O_3 in the remote troposphere in both oceans, and at almost all latitudes. This finding expands on a large body of literature have highlighted episodic and regional events of long-range transport of pollution plumes above the Atlantic and Pacific Oceans. Discussion to this effect had already been added to the manuscript after responding to the reviewers' comments, but we emphasized even more on this aspect, l.551-554:

  "Our results expand on previous observation-based, but more spatially and temporally limited, studies that highlighted collocated enhancements of O_3 and CO at remote locations to show in situ evidence of frequent, large-scale influence of continental outflow on O_3 in the remote troposphere in both oceans, and at almost all latitudes."

  And again, in the conclusion, l.604-608:

  "In addition, ATom and HIPPO in situ measurements help to establish the quantitative legacy of global pollution transport and chemistry through the evaluation of key, covarying species – in this case O_3 and CO, and reveal the year-round pervasive influence of continental outflow on O_3 enhancements in the remote troposphere."

Sincerely,

Ilann Bourgeois, on behalf of the authors.