Review comments for "An extensive database of airborne trace gas and meteorological observations from the Alpha Jet Atmospheric eXperiment (AJAX)" by Emma L. Yates et al.

This manuscript presents a multi-year dataset from the AJAX airborne observations of tropospheric ozone, CO_2, CH_4, and HCHO, together with meteorological parameters over an extended area of California. These data provide valuable information for a broad range of research, as demonstrated by cited publications, making this work highly relevant for publishing in the journal ESSD. Overall, the manuscript is well-organized and well-written. However, there are a few gaps and issues that need to be addressed. Please see my suggestions below.

1) Inception of the project and the design of the project scope

The introduction briefly mentions that AJAX is a project of a government-run laboratory partnered with a private company and is considered a project of "opportunity." In my experience, this is an unusual model for an airborne atmospheric experiment. As a project and data overview, it would be important for the readers to see a brief description of the project formation and the concept of the payload design, which must be related to intended scientific applications. Currently, the manuscript focuses on the number of flights and instruments that produced the multi-year, multi-objective dataset without explaining the motivations and scientific scope at the project's inception. Providing a brief conceptual and design introduction would help the multi-objective flights and data description take on an active voice, giving the reader a better context of the data.

2) Information flow

There are several information flow issues that created repetitions. An outstanding example is the paragraph starting at line 225 that overlaps with section 5 data availability.

Try to introduce the platform (range and ceiling) and the payload (variable measured) before sampling strategy. It may work better.

3) Issues with Section 4 "dataset overview"

This is a problematic section. It is possible to integrate the first paragraph (line 225) with section 5 and called it "Dataset overview and availability".

The remaining contents of section 4 do not provide an overview, but rather showcase the dataset's application through three examples. Although these examples effectively highlight the rich information contained in the dataset, the style of the discussions in this section needs improvement. The main issue is that it is unclear whether these examples are written as mini data analysis papers, each leading to conclusions, or merely as a conceptual demonstration of possible applications in these problems. Assuming that your intention is the latter, it is acceptable to use a hand-waving style of writing. However, you should (a) clearly state this

intention and (b) provide references to any concepts or methods used but not sufficiently introduced in the text.

Specific examples:

- In Section 4.1, the data application in trend analysis is showcased through figures that clearly display the available information in the dataset. However, the statement "The increase in the mean annual CO2 reported by AJAX was ~3.0 ppm/yr between 2011 and 2018" is not supported by a reference or a detailed explanation of how the result was derived.

- Section 4.3 would benefit from some simplifications and more referencing. Although the method described is well-established, it is problematic without a couple of references here for the concept behind eq (1). Since this section overlaps the topic of 2.1, I wonder if you already have a publication for this work, where eq (1) is better introduced. Otherwise, it is appropriate to cite a paper that introduced the method, possibly go back to Rogers & Connor (2003). Additionally, XCO2 should be defined to ensure clarity for readers who may be unfamiliar with the term.

4) Some editorial comments, primarily on figure clarity

Most of the issues are related to the color choices in the figures, as they are not suitable for printing. I would recommend printing a copy and reviewing it to identify areas where the color choice needs to be changed.

- Line 26: "modified for ~~for~~ …"
- Fig. 1 (left): reduce the background sky color to a much lighter blue, so the plane is visible in print.
- Fig. 3: change color table for the track to use lighter and brighter colors to avoid blue on blue.
- Fig. 9 (right): This map is not readable in print – change track color and increase the fonts of labels. Yes, you can do that in Google Earth.
- Fig. 10 (left) the dotted lines are too faint.