Review of “Distribution and morphology of non-persistent and persistent contrail formation areas in ERA5”, by Wolf, Bellouin and Boucher, egusphere-2023-3086

This is a most impressive, comprehensive article, characterizing the potential persistent contrail (PC) formation conditions as a function of time of year, temperature, relative humidity, pressure, and wind speed. The region considered is from the North Atlantic flight corridor from the East coast of North America to central Europe and between 30°N and 70°N, using data from 2015 to 2021. The modified Schmidt-Appleman criteria are used to identify the PC regions, using a combination of In-service Aircraft for a Global Observing System (IAGOS) data and ERA5 re-analysis products. Most interestingly, the dimensions of individual PC formation regions was determined by applying the python image processing tool scikit-image Python.

Some takeaways that I got from the article. Most commercial aircraft are currently flying at altitudes that are most prone to PC formation, thus, shifting to probably lower altitudes would decrease PC formation, but this is not practical. Also, that the position of highest wind speed might be used as a proxy for potential PC occurrence. It’s interesting, using the angle between the elongated PC regions and latitude that lateral flight diversion would reduce the time spent inside the PC zone with limited additional fuel consumption.

Some quality controls were used in the analysis. A 2023 study noted by Wolf et al. evaluated the IAGOS observations, with directly measured temperature and relative humidity with a Vaisala sensor from commercial aircraft, to evaluate ERA5 performance. They found a dry bias and applied a correction to those data.

My comments appear below. I recommend publication of the article subject to minor revision.

Main Comments

The Vaisala Humicap sensor is used for the relative humidity measurements for IAGOS. I assume the sensor is similar to a Vaisala RS80H (Humicap) sensor. A study by Verver et al. (2006) found a significant wet bias in RH from +2% to +5% in the RS80H profiles in the upper troposphere when compared with a very advanced humidity sensor. Please comment on this as it may have effected the dry bias found in the ERA5 data.

Verver, G., M. Fujiwara, P. Dolmans, C. Becker, P. Fortuin, and L. Miloshevich, 2006: Performance of the Vaisala RS80A/H and RS90 Humicap Sensors and the Meteolabor “Snow White” Chilled-Mirror Hygrometer in Paramaribo, Suriname. *J. Atmos. Oceanic Technol.*, **23**, 1506–1518

Line 143. How are the time-averages calculated? Is it from the current point to 19.4 seconds ahead of the aIrcraft?

Do NPC satisfy the SAc criteria but not rh>rhi? I assume that’s the case but I suggest stating it.

A schematic showing the different path lengths for IAGOS and EROS would be helpful, and showing the distances for time-averaged values.

Figure 6. This is a most interesting and important figure.

Years ago, there was a program called GHOST (Global HOrizontal Sounding Technique), which used constant pressure balloons to measure ambient temperature and relative humidity. Also, more recently, the CNES new super-pressure balloon system deployed for Strateole-2 program. Would such systems potentially aid in evaluating the ERA5 data in the future?

Minor Comments

138. "fixed grid resolution" is repeated in this line

167. allows us

249: could you define "all grid boxes"

250. for pressure
362. Further more>Furthermore