Review of “Machine learning for improvement of upper tropospheric relative humidity in ERA5 weather model data”, by Wang and coauthors, EGUSphere-2024-2012.

The goal of this study is to improve the estimations of the relative humidity with respect to ice in the upper troposphere/lower stratosphere from ERA5 fields using machine learning. To achieve this goal, the authors develop an artificial neural network model to correct relative humidity from ERA5, using thermodynamic conditions and dynamical quantities from ERA5, together with water vapor data from IAGOS commercial aircraft measurements. The model RHi is trained using these data. Overall, this is an excellent article, and, although I spent a lot of time thinking about different aspects of the model, I have relatively few comments.

Line 64. You may want to mention that calibration of RH instruments at temperatures below 0^0C are difficult, with increasing difficulty at decreasing temperatures.

145. A brief mention of how ciwc is derived from ERA5, as it is so important a variable to differentiate cloudy and cloud-free regions, would be helpful.

168. “accounts for” rather than “copes”.

189. At temperatures below -40^0C, RH_i should not exceed 100%, even though it may be above that value for a short period of time.

202. contrail formation threshold. A sentence is needed here-how is the threshold met? The Schmidt-Appleman criteria?

217-218. What is the spatial resolution of the radiometer?

Section 4. Model evaluation and results

An additional evaluation could be made by using collocated CALIPSO lidar data.

Figure 5. You get cloudy skies from ERA5 when IWC is indicated? How accurate is this?

Figures 4, 5, 6. Could you possibly partition by 5^0C increments in supplemental information to see if RHi>100% at temperatures below -40C, because it shouldn't.

408. You may want to mention that ECLIF3 was an experiment involving synthetic aviation fuel. The DLR Falcon jet research aircraft participated in the project, making some measurements simultaneously with the A350 aircraft. Could you use the ANN model in these situations as a test of the model?