By taking into account several suggestions made by the referees on the previous version, the quality of the revised manuscript now seems significantly improved. I therefore support publication of the manuscript in its present form.

I need to note that I do maintain my doubts concerning the argument raised by the authors in reply of my previous comment concerning the use of ground pressure for constructing the airmass reference. The authors state “However, we disagree with the approach of using the surface pressure and water vapor columns to calculate the VMRs … we [would] introduce [site-to-site] biases from the pressure measurement.”

It should not pose any difficulty to measure ground pressure within 0.5 mbar (in my understanding, the collection of a reliable ground pressure record at each site within this accuracy range is a prerequisite for operating the TCCON). So the reference airmass constructed via ground pressure is reliable on the ~0.5/1000 = 0.05% level. There is in addition a higher-order error via the spectroscopic determination of the water column, but TCCON should be capable of measuring this variable ~2% contribution to the total atmospheric column with an accuracy of ~ 2%. This gives rise to an additional uncertainty contribution to the ground-pressure approach of 2% * 2% = 0.04%, so the resulting uncertainty budget of this approach becomes ~0.1%.

If this level of consistency is compared with the XAIR time series from the individual stations included in this work, then it is found that while the retrieved GGG2020 XAIR for Darwin is near unity, it ranges slightly lower for Tsukuba and Ny Alesund ~0.98 … 0.99 and still lower for Ascension ~ 0.97. This is a scatter in the order of 1%, so an order of magnitude higher site-to-site bias than the estimated uncertainty for the route via ground pressure. I understand that errors in the target gas column and the oxygen column (their ratio being used for constructing Xgas) are expected to be significantly correlated, but the correlation needs to be very tight in order to be en par with the ground-pressure approach. For this reason, the discussion of the ground pressure approach would be appropriate in a spectroscopic study (1) for assessing the absolute band intensities and (2) for separating out airmass dependent disturbances introduced via the oxygen retrieval.