



Comment on **essd-2021-143**

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Referee comment on "Advanced NO₂ retrieval technique for the Brewer spectrophotometer applied to the 20-year record in Rome, Italy" by Henri Diémoz et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-143-RC2>, 2021

This is the review of the paper "Advanced NO₂ retrieval technique for the Brewer spectrophotometer applied to the 20-year record in Rome, Italy" submitted by H. Diémoz and coauthors to the ESSD.

The paper provides a very detailed review of the algorithm update to derive the NO₂ column from the Brewer MK IV instrument in Italy. The authors have designed and performed the error propagation analyses that provide information on data uncertainty and stability of the 20-year record.

Validation of the new algorithm retrievals is provided through 1) comparison of the station Brewer observations done during an intensive campaign against another Brewer (#066), which was calibrated independently, and 2) through comparisons against a co-located Pandora spectrometer (#117) in Rome, over a 1-year long period (2016-2017). The second comparison is of the first kind where NO₂ products from Brewer MK IV and Pandora were compared over a year-long time period.

The paper is well constructed, results are summarised in Figures and Tables. The logic of the presentation is easy to follow. The reference to the previous algorithm is provided and the upgrades are well described. I agree with the first reviewer – the equations need to be written out further to explain intermediate steps. If needed, this can be addressed in the Appendix.

The new NO₂ record is of great value (from the accuracy and temporal length points of view) to assess the air quality changes in Italy over a 20-year time period. This record provides information to the policymakers to address the efforts to improve air quality in the region. The record is also of value for satellite verification efforts, including OMI and TROPOMI observations. Another important value of this work is that the method applies to other Brewer MK IV observations. The new method allows historical data reprocessing that minimized instrumental interferences, such as wavelength misalignments and changes in the internal temperature of the instrument. I would be looking forward to seeing it implemented in other long-term records.