

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2021-302

Anonymous Referee #1

Referee comment on "Time evolution of temperature profiles retrieved from 13 years of infrared atmospheric sounding interferometer (IASI) data using an artificial neural network" by Marie Bouillon et al., Atmos. Meas. Tech. Discuss.,
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This paper presents analysis of 13 years of temperature data from homogenized IASI measurements, based on a neural network retrieval. Results include comparisons with several other temperature data sets (ERA5, radiosondes and independent EUMETSAT retrievals), and calculation of temperature trends over 2008-2020. The new IASI retrievals show reasonable agreement with the other data sets, and trends from the short data record show the expected structure of tropospheric warming and stratospheric cooling, although with interesting detailed structure. Overall the IASI neural network retrieval seems reasonable and can provide accurate information on tropospheric and stratospheric temperatures. The paper is a useful contribution regarding the details of the data and retrieval, and it is appropriate for AMT. I have a number of comments for the authors to consider in revision.

- The comparisons with ERA5 in Fig. 3 show systematic patterns in the tropics over levels 100-7 hPa that are suggestive of the quasi-biennial oscillation (QBO), and not tropospheric cloud cover as suggested near line 188. I would guess that IASI data have relatively low vertical resolution and underestimate some of the QBO temperature signal in ERA5. A simple comparison of IASI vs. ERA5 in height-time cross sections at the equator would clarify this behavior (showing deseasonalized temperature anomalies in both data sets, along with their differences). This may also explain the large equatorial rms differences seen in Fig. 4.
- I think the comparisons with radiosondes (ARSA data) should be limited to pressures 750-30 hPa, where the radiosonde measurements occur. Higher levels are simply other data sets. I don't find the complicated/noisy differences in Fig. 6 to be quantitatively very useful. Additional or complementary calculations could show the mean and rms differences for each region as a function of pressure (750-30 hPa), and perhaps include correlations to quantify the agreement between IASI and radiosondes.
- Several comments on the trend results in Fig. 8:

1) Results are shown for simple linear trends, but it would be good to test the sensitivity to including additional terms in the regression that explain known variations in tropospheric and stratospheric temperatures, including the QBO and ENSO. This is standard practice in calculation of long-term trends, e.g. Steiner et al 2020 (DOI:10.1175/JCLI-D-19-0998.1). The tropical stratospheric trends look to me to have structure possibly aliased from the QBO in this short record.

2) The calculated tropospheric temperature trends are reasonably close to results shown in Steiner et al 2020 based on radiosonde and GPS RO data sets for the period 2007-2018 (their Fig. 11). However, these trends are much larger than corresponding results for longer time series, and are certainly influenced by the short data record and large warm ENSO event occurring in 2016, near the end of the time series. This detail should be clarified, as trends in excess of 0.7 K/decade are not representative of long-term tropospheric trends. In addition to Fig. 8, it could be helpful to include time series at several specific locations (tropical upper troposphere, Arctic troposphere, SH lower stratosphere – see below) to show the actual behavior and provide perspective to the trends calculated from this short record.

3) The large warming trend in the SH lower stratosphere (50 S, 100 hPa) is probably a result of transient warming in early 2000 tied to the Australian New Year fires (Yu et al, 2021, doi: 10.1029/2021GL092609). This could easily be confirmed by examining the associated time series.

4) I suggest adding a line in Fig. 8 indicating the time average tropopause.