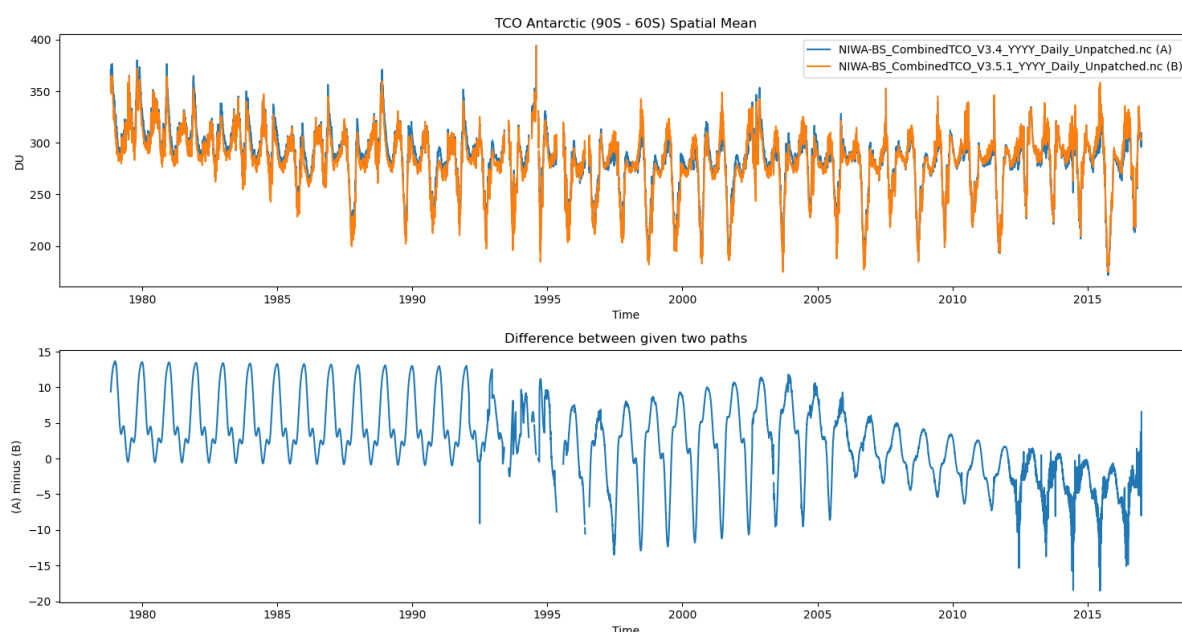


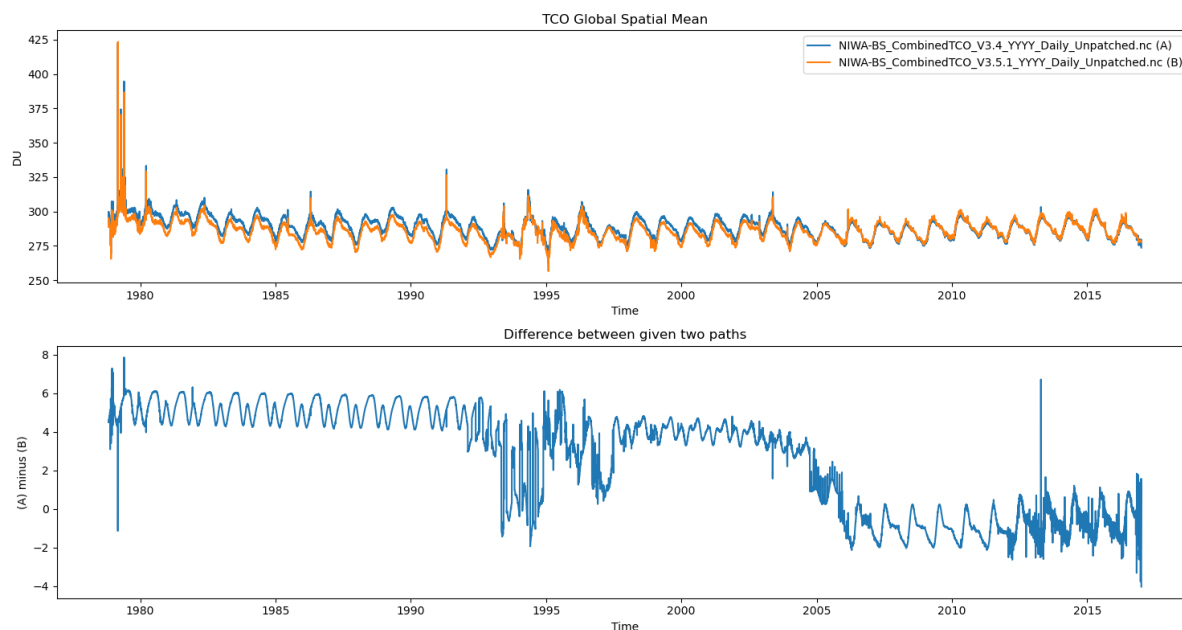
A note on the differences between version 3.4.x and version 3.5.x of the NIWA-BS total column ozone database

Greg Bodeker and Stefanie Kremser
8 June 2022

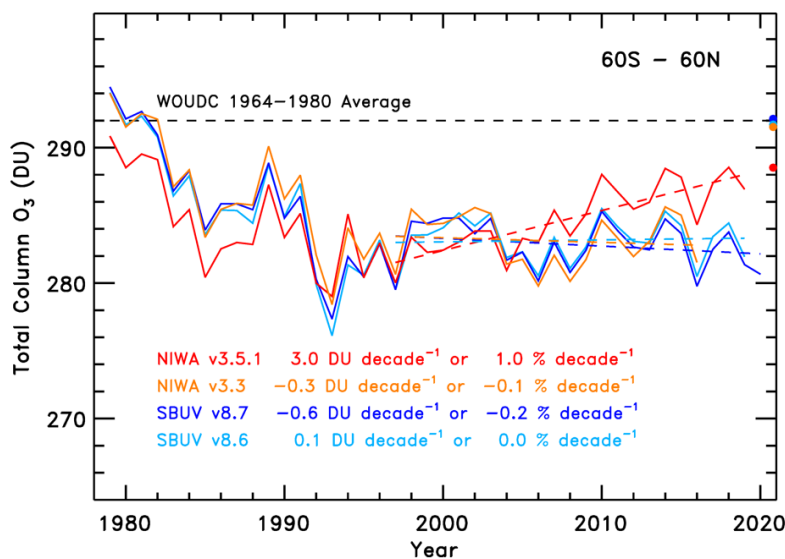
On 16 April 2021 Bodeker Scientific released a new version of the BS Filled combined total column ozone (TCO) database. This version 3.5.1 of the database was published on [Zenodo](#). On 27 April 2021, Kane Stone alerted us to a problem with the filled version of the database where, between 1982 and 1994, around every 5 days, the TCO field had not been correctly filled. This was traced to the filling code falling over whenever the machine-learning-based filling software, using potential vorticity and tropopause height, was prematurely interrupted and resulted in there being a TCO field but not an associated uncertainty field. This code was subsequently fixed and a new version (version 3.5.2), of **only the filled database**, was generated and provided to Kane Stone on 26 May 2021. To ensure traceability of the corrected filling, version 3.5.2 of the filled database was published on [Zenodo](#) on 15 March 2022 with version 3.5.1 being left as the unfilled version of the database (link to [Zenodo](#)).

In August 2021 Olaf Morgenstern at NIWA brought to our attention that there was something strange going on in version 3.5.1 of the database when it came to trend analysis. This becomes clear in comparisons between V3.4 of the database and V3.5.1 as shown below.





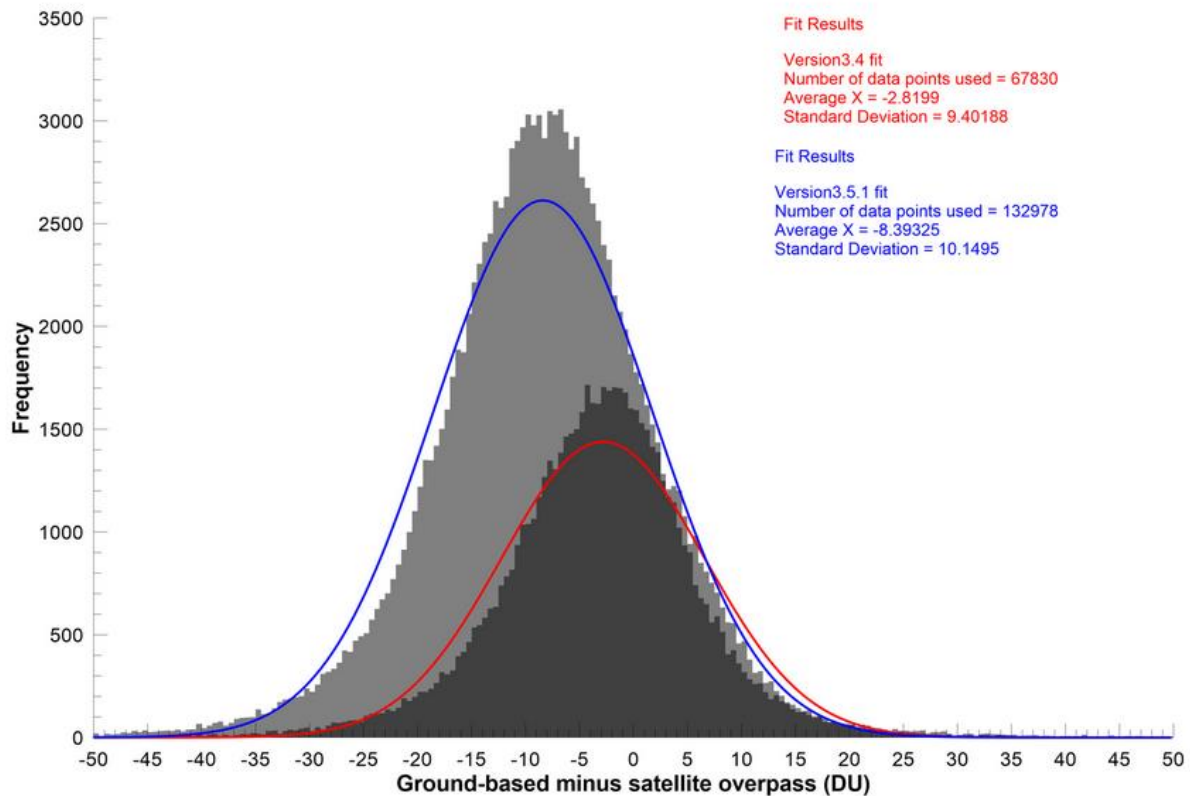
This discrepancy was also highlighted by Laura McBride who emailed us on 20 August 2021 to show that there were some concerning differences between version 3.3 and version 3.5.1 of the NIWA-BS TCO databases:



Recall that to homogenise the several TCO data sets that comprise the NIWA-BS TCO database, five cardinal data sets (the four TOMS instruments and OMI) are compared against the ground-based Dobson and Brewer spectrophotometer network. It is not the gridded data sets that are compared against the ground-based measurements but the overpass data associated with each of these five cardinal data sets. For version 3.5.x of the NIWA-BS TCO database, we sought to use the most up to date overpass data and located new overpass data files for:

- Nimbus-7 TOMS (version 8.6 from)
https://ozonewatch.gsfc.nasa.gov/ozone_maps/ftptoms/nimbus7/data/overpass/
- OMI (version 8.5 from)
https://ozonewatch.gsfc.nasa.gov/ozone_maps/ftptoms/omi/data/overpass/
- Earth Probe TOMS (version 8.6 from)
https://ozonewatch.gsfc.nasa.gov/ozone_maps/ftptoms/eptoms/data/overpass/

At the time we were unaware that there was a systematic bias between these overpass data and earlier versions of the overpass data for these three satellites (see example figures below). When these overpass data were used to compute the bias between the satellite and ground-based observations, this resulted in biased corrections being applied to the Nimbus-7 TOMS and Earth Probe TOMS - less so for the OMI gridded TCO fields where the differences in the version 8 and version 8.5 overpass data are much smaller.



Histograms of overpass/ground-based differences for Nimbus 7 TOMS as used in the creation of version 3.4 (dark grey) and version 3.5.1 (light grey).

Prior to version 3.5.1, we had always downloaded the overpass data from <https://www.earthdata.nasa.gov/> for Nimbus-7 TOMS, Earth Probe TOMS, and Meteor-3 TOMS, and from <https://gs614-avdc1-pz.gsfc.nasa.gov/pub/data/satellite/Aura/OMI/V03/L2OVP/OMTO3/> for OMI overpass data. Adeos TOMS data were downloaded from an ftp server (toms.gsfc.nasa.gov) which is no longer active though.

On 22 March 2022 Stefanie Kremser emailed Paul Newman to alert NASA to the discrepancy between these two sources of overpass data. On 2 June 2022 we received an email from Gordon Labow at NASA telling us that the version 8.5 and version 8.6 overpass data available on the ozonewatch website were never officially publicly released as they were only intended to be an internal working version and should never have been used. Gordon advised that the version 8 overpass data available from the earthdata web site should be used until such time as NASA releases version 9 of the TOMS and OMI data sets.

In conclusion, the version 3.5.x NIWA-BS/BS Filled TCO data sets **should not be used** henceforth for trend analysis and, as such, we have updated the version 3.4 database to the end of 2019 for both the NIWA-BS and BS Filled TCO data sets (now referred to as version 3.4.1 of the database). The

version 3.4.1 of the filled TCO data sets should be seen as a replacement for the version 3.5.2 database which also extends to the end of 2019.

The NIWA-BS/BS Filled version 3.4.1 database are now available on Zenodo:

- [NIWA-BS Total Column Ozone Database V3.4.1](#)
- [BS Filled Total Column Ozone Database V3.4.1](#)