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Estimation of the drift in the quality of AIRS orbital observations of CH_4 and CO and application of correction methods to long-term series

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The work is dedicated to the validation of the satellite AIRS v6 (IR-AIRS only) data on CH_4 and CO total content for eighteen ground stations of the NDACC monitoring network, for the period from 2003 to 2022. It was found that the linear trend of the difference between satellite and ground-based measurements (AIRS-GR discrepancy trend) of the CH_4 total content (TC) has a negative value for all stations studied. This effect indicates the presence of a drift in the satellite spectrometer parameters. Using synchronized series of AIRS v6 measurements and data from all statistically representative stations, the mean value of the drift of the CH_4 TC discrepancy, equal to $1.69*10^{14}$ molec/cm2 per day, was calculated. A dynamic correction of the satellite data was performed using the obtained mean coefficient. We fulfilled a station-by-station comparison of the correlation parameters of the daily mean CH_4 TC values and the trend estimates based on AIRS and the ground-based NDACC spectrometer data before and after correction. The application of the dynamic correction to the orbital data resulted in a significant improvement in the agreement of both parameters.

A similar analysis was carried out for CO TC. The study has shown that the initial series of ground and satellite measurements of CO TC have a good correlation both for individual stations (R~0.8-0.9) and for the whole dataset (R=0.93). The AIRS-GR difference trend is multidirectional for different measurement sites, which is the result of satellite underestimation of high CO concentrations in the surface layer because of fire emissions and anthropogenic impacts. Therefore, the AIRS v6 CO TC satellite product does not require any additional correction within this method.

The report also provides other examples of detection of drift in satellite instrument parameters, in particular for AIRS v7 (CH_4) and OMI v3 (NO_2).

The methodology developed for comparing and correcting orbital data is universal and can be applied to any long-term satellite data-sets.

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