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## Restoring the top-of-atmosphere reflectance during solar eclipses: a proof of concept with the UV Absorbing Aerosol Index measured by TROPOMI

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Solar eclipses reduce the measured top-of-atmosphere (TOA) reflectances as derived by Earth observation satellites, because the solar irradiance that is used to compute these reflectances is commonly measured before the start of the eclipse. Consequently, air quality products that are derived from these spectra, such as the ultraviolet (UV) Absorbing Aerosol Index (AAI), are distorted. Sometimes, such eclipse anomalies propagate into anomalies in temporal average maps without raising an eclipse flag, potentially resulting in false conclusions about the mean aerosol effect in that time period. The availability of air quality satellite data in the penumbral and antumbral shadow during solar eclipses, however, is of particular interest to users studying the atmospheric response to solar eclipses.

Given the time and location of a point on the Earth's surface, we explain how to compute the eclipse obscuration fraction taking into account wavelength dependent solar limb darkening. With the calculated obscuration fractions, we restore the TOA reflectances and the AAI in the penumbral shadow during the annular solar eclipses on 26 December 2019 and 21 June 2020 measured by the TROPOMI/S5P instrument.

We find that the Moon shadow anomaly in the uncorrected AAI is caused by a reduction of the measured reflectance at 380 nm, rather than a color change of the measured light. We restore common AAI features such as the sunglint and desert dust, and we confirm the restored AAI feature on 21 June 2020 at the Taklamakan desert by measurements of the GOME-2C satellite instrument on the same day but outside the Moon shadow.

We conclude that our correction method can be used to detect real AAI rising phenomena and has the potential to restore any other product that is derived from TOA reflectance spectra. This would resolve the solar eclipse anomalies in satellite air quality measurements in the penumbra and antumbra, and would allow for studying the effect of the eclipse obscuration on the local atmosphere from space.