Look-up tables of ground-based UV-vis stratospheric NO_2 column averaging kernels

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1. Introduction

A climatology of stratospheric NO_2 column averaging kernels has been developed with the aim to consolidate and better characterize the time-series of twilight zenith-sky NO_2 measurements produced by UV-vis and SAOZ spectrometers from the NDACC network. Column averaging kernels are needed for satellite nadir NO_2 validation in order to compare the sensitivity of the ground-based and space-borne instruments to the NO_2 vertical profile. Enhancing the usability of the correlative data sets is also the main reason why standard guidelines for data reporting like GEOMS (Global Earth Observation Metadata Standard; see http://avdc.gsfc.nasa.gov/index.php?site=1178067684) recommend to include metadata like averaging kernels in data files. We describe a new multi-entry database of ground-based UV-vis NO_2 column averaging kernels applicable at the global scale. It is complementary to the NO_2 air mass factor (AMF) climatology recently developed in order to homogenize the NDACC UV-vis stratospheric NO_2 column data sets.

2. Description

The proposed database of stratospheric NO_2 column averaging kernels is based on the theoretical work of *Eskes and Boersma (2003)* and has been generated using the UVSPEC/DISORT radiative transfer model (*Hendrick et al., 2006*) and the harmonic climatology of stratospheric NO_2 profile developed by *Lambert et al. (1999, 2000)*. This climatology consists of a Fourier harmonic decomposition of UARS HALOE v19 and SPOT-4 POAM-III v2 NO_2 profile data records. It covers the 20-60 km altitude range for the present application. Between 12 and 17 km, the NO_2 profiles are complemented by a climatology derived from SAOZ balloon observations (*F. Goutail, personal communication*). The NO_2 concentration is set to zero below 12 km altitude. In addition to the NO_2 profile climatology, the parameters considered in building the look-up tables (LUTs) are: wavelength, ground albedo, and SZA. Table 1 summarizes these different parameters and their corresponding values.

Parameter	Values
Lambert et al.'s NO_2 profile climatology	- Latitude: 85°S to 85°N step 10° - Month: 1 (Jan) to 12 (Dec) step 1 - Sunrise and sunset - Altitude range : 20-60 km
SAOZ balloon NO_2 profile climatology	- Latitude: tropics, mid- and high-latitudes - Resolved in seasons (spring, summer, fall, winter) - Altitude range: 12-20 km
Wavelength	350 to 550 nm step 40 nm

Surface albedo	0 and 1
SZA	90° (SZA representative of ground-based UV-vis measurements at twilight)
Aerosols	Aerosol extinction profile corresponding to background conditions and constructed from the aerosol model of *Shettle (1989)* included in UVSPEC/DISORT

Table 1: Parameters of the look-up table and their corresponding values.

The NO_2 column averaging kernels climatology consists of 2 look-up tables (one for sunrise and one for sunset conditions; size: 1 MB each). An interpolation routine has been developed in order to extract appropriately parameterized NO_2 column averaging kernels for the different NDACC stations. This routine is written in FORTRAN 77 and a DOS executable has been created. The source code is also available for compilation on LINUX machines. In addition, a global monthly climatology of the surface albedo at two wavelengths (380 and 494 nm) is coupled to the interpolation routine so that realistic albedo values can be obtained in a transparent way. This albedo climatology is extracted from the GOME surface albedo database developed by *Koelemeijer et al.* (2003). It consists of 24 (12x2) look-up tables, one for each month of the year and each wavelength. Albedo values are given for grid-cells of 1° x 1° (latitude: -89.5° to 89.5°; longitude: -179.5° to 179.5°).

3. How to use the NO_2 column averaging kernel climatology?

The zip file contains 31 files: 2 NO_2 column averaging kernel look-up tables, 24 surface albedo look-up tables (size: 1.1 MB each), a DOS executable (‘no2_avk_interpolation_v1_0_dos’), the source code in FORTRAN 77 (‘no2_avk_interpolation_v1_0.for’), two input files for selecting parameter values, and one output file. All the files should be located in the same directory for a proper use of the climatology. In the file ‘input_file_no2_avk.dat’, the user can enter values for wavelength, latitude, longitude, and surface albedo. Regarding the albedo, the user must give a value to a flag in order to determine whether he wants to use the albedo climatology (flag=1) or not (flag=2). The user has also to define the name of the file (here called ‘DAY_FILE.dat’; maximum number of lines in this file: 500000) containing lines with year, decimal day numbers (decimals being decimal UT time). The resulting NO_2 column averaging kernels are stored in the output file called ‘no2_avk_output.dat’.

4. References

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5. Contact

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