OMTROPNO2CLD README File

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Overview

This document provides a brief description of the **OMTROPNO2CLD** data product. This product contains a global map of free tropospheric NO_2 volume mixing ratio (VMR) at cloudy scenes averaged over three month seasons (i.e., Dec-Jan-Feb, Mar-Apr-May, Jun-Jul-Aug, and Sep-Oct-Nov) during 2005-2007. The spatial resolution of this product is 8^o (longitude) x 6^o (latitude). This product is provided in the netCDF format. Table 1 summarizes the list of variables provided in the product.

Table 1: List of variables provided in the **OMTROPNO2CLD** data product.

Name of Variable	Unit	Description
no2_vmr_climatology	pptv	3-month mean Free tropospheric NO2 VMR at each grid box
pressure_climatology	hPa	Pressure level corresponding to the NO2 VMR
no2_vmr_stderrmean	pptv	Standard error of the NO2 VMR
number_of_omi_orbit	-	Number of VMR measurement used to obtain the NO2 VMR

Algorithm Description

Free-tropospheric NO2 VMR is obtained by applying a cloud-slicing technique to data from the Ozone Monitoring Instrument (OMI) on the Aura satellite. We collect OMI rotational Raman (OMCLDRR) cloud scene pressure and NO2 column (OMNO2) in each grid box of 8^o (longitude) x 6^o (latitude) from a single orbit for the linear fit. In a cloudy scene (cloud radiance fraction > 0.9), the slope of the NO2 column versus the cloud scene pressure is proportional to the NO2 VMR in the grid box. We average the VMR measurements obtained in each grid box during each 3-month season to produce the NO2 VMR climatology. For more detailed algorithm description and data selection criteria, please see Choi et al., 2014.

While the cloud-slicing technique derives the free-tropospheric NO2 VMR without the need for a prescribed stratospheric column, it relies on several assumptions and conditions. The method works well only with a relatively large number of nearby cloudy OMI pixels that have a sufficient variation in cloud pressure. We also note that the derived NO2 VMR information is based on the assumption that NO2 is vertically and horizontally well mixed in the given pressure range and spatial extent of the OMI pixel collections. In addition, we assume that the stratospheric column remains constant during the time period and over the area of the OMI pixel sample. Finally, the absolute magnitude of the derived NO2 VMR is only as accurate as the NO2 column. Errors in the derived cloud scene pressures may contribute additional uncertainty. It should also be noted that the NO2 VMRs are derived in highly cloudy conditions. These conditions may not be representative of the general all-sky atmosphere.

Data Quality Assessment

Grid boxes that fail to pass quality standard are filled with -1E30. Quality standard includes:

- Have NO2 VMR observations equal to or more than 7 times
- The standard error of the NO2 VMR is less than 50 % (polluted area, NO2 VMR > 20 pptv) or 10 pptv (non-polluted area, NO2 VMR < 20 pptv)

Note that some grid boxes have negative values, which implies these grid boxes have NO2 VMRs very close 0 instead of actual negative VMRs.

Notes

- Scattering weights and air mass factors (AMFs) for near-Lambertian clouds used to produce the product are specially calculated for this product and different from ones in the operation OMNO2 product. Such calculations using a radiative transfer model is necessary to product this product. Scattering weight is generally independent of NO2 profile shapes, while AMF is dependent to those.

- Comparison of geometric AMF and near-Lambertian cloudy AMF are provided in Fig.4 of Choi et al. (2014). Cloud slicing measurements are simulated using these two types AMFs and a prescribed NO2 profile. Using near-Lambertian cloudy AMF reproduces the prescribed ‘true’ NO2 VMR slightly better than geometric AMF. Using geometric AMF, however, gives values close the ‘true’ NO2 VMR.

Reference

Choi, S., Joiner, J., Choi, Y., Duncan, B. N., Vasilkov, A., Krotkov, N., and Bucsela, E.: First estimates of global free-tropospheric NO2 abundances derived using a cloud-slicing technique applied to satellite observations from the Aura Ozone Monitoring Instrument (OMI), Atmos. Chem. Phys., 14, 10565-10588, doi:10.5194/acp-14-10565-2014, 2014.

For questions and comments related to this product, please contact Sungyeon Choi (sungyeon.choi@nasa.gov)

http://avdc.gsfc.nasa.gov/pub/tmp/OMTROPNO2CLD/