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Data Set Description

PI:	Monica Navarro Comas / Margarita Yela Gonzalez
Instrument:	UV-Visible Spectrometer RASAS
Site:	IZANA 28.308º N, 16.493º W
Measurement Quantities:	O3, NO2

Contact Information:

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N/A

Data License:

Reference Articles:

García, O. E., Schneider, M., Sepúlveda, E., Hase, F., Blumenstock, T., Cuevas, E., Ramos, R., Gross, J., Barthlott, S., Röhling, A. N., Sanromá, E., González, Y., Gómez-Peláez, Á. J., Navarro-Comas, M., Puentedura, O., Yela, M., Redondas, A., Carreño, V., León-Luis, S. F., Reyes, E., García, R. D., Rivas, P. P., Romero-Campos, P. M., Torres, C., Prats, N., Hernández, M., and López, C.: Twenty years of ground-based NDACC FTIR spectrometry at Izaña Observatory – overview and long-term comparison to other techniques, Atmos. Chem. Phys., 21, 15519–15554, https://doi.org/10.5194/acp-21-15519-2021, 2021.

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Robles-Gonzalez, C., Navarro-Comas, M., Puentedura, O., Schneider, M., Hase, F., Garcia, O., Blumenstock, T., and Gil-Ojeda, M., Intercomparison of stratospheric nitrogen dioxide columns retrieved from ground-based DOAS and FTIR and satellite DOAS instruments over the subtropical Izana station, Atmos. Meas. Tech., 9, 4471-4485, https://doi.org/10.5194/amt-9-4471-2016, 2016.
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Puentedura, O., Gil, M., Saiz-Lopez, A., Hay, T., Navarro-Comas, M., Gómez-Pelaez, A., Cuevas, E., Iglesias, J., and Gomez, L., Iodine monoxide in the north subtropical free troposphere, Atmos. Chem. Phys., 12, 4909-4921, doi:10.5194/acp-12-4909-2012, 2012.
Roscoe, H.K., et al., Intercomparison of slant column measurements of NO2 and O4 by MAX-D0AS and zenith-sky UV and visible spectrometers, Atmos. Meas. Tech., 3, 1629-1646, 2010.
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<u>Instrument description:</u>
Name: RASAS_02
Location: Indoor
Spectrometer type: Shamrok SR-163i spectrograph
Grating: Holographic 1200 grooves/mm blazed a 300nm
Detector: 1024×255 pixels DU420A-BU Andor Idus CCD
Input optic: 10m Quartz fiber optic pointing at IEA: 90º, 70º, 30º, 10º, 5º, 3º, 2º, 1º, 0º, -1º
Detector Temperature: -30ºC (Peltier + circulating cooler)
Housing temperature: +18º ? 0.2º C
Wavelength region: 410-525 nm
Field of view: 1º
Spectral resolution: 0.6 nm
Sampling ratio: 5 samples/FWHM
Linear dispersion: 0.11 nn/pixel
Instrument automatic control: Home made

Name: RASAS_01

Location: Indoor
Spectrometer type: Jarrell Ash Monospec 18
Grating: 600 g/mm ruled
Input optic: 5m Quartz fiber optic pointing the sky
Detector: EG&G 1453ª with a 1024 Reticon PDA
Detector controller: EG&G 1461
Detector Temperature: -40ºC (Peltier + circulating cooler)
Housing temperature: +18º ? 0.2º C
Wavelength region: 350-590 nm
Field of view: 10º
Spectral resolution: 1.2 nm
Pixel size: 0.257 nm
Sampling ratio: 5 samples/FWHM
ADC: 14 bits
Instrument automatic control: Home made

Name: EVA_01
Spectrometer type: Jobin-Yvon H20
Location: Outdoor
Grating: 1200 g/mm holographic
Input optic: Mirror 45º
Detector: PMT in current mode
Detector controller: Home made
Detector Temperature: Room
Housing temperature: Room
Wavelength region: 430-450 nm
Field of view: 10º
Spectral resolution: 1 nm
Samples: 10/nm
Sampling ratio: 10 samples/FWHM
ADC: 16 bits
Instrument automatic control: Home made

Algorithm description:
NO2 and ozone vertical and/or slant column densities are retrieved by the method of differential optical absorption spectroscopy, using the spectral analysis software suite (LANA) developed at INTA. The DOAS settings for the NO2 column retrieval follows the NDACC UV/Vis Working Group recommendations whenever possible.
Optical depths calculated as the log of the ratio of a reference high sun spectrum with the measured spectrum are fitted to laboratory cross-sections using a least square method. Stretching and shifting are taken into account for the fit. Cross-sections of NO2, O3, O4, H2O, and Rayleigh are included in the analysis. Ring is corrected by including a pseudo-cross section in the fitting process. Dark current is calculated from the integration time accounting by interpixel variability. Raman scattering cross section was generated by the Win-DOAS package calculated from Raman theory. Finally, the inverse of the

reference spectrum was included as a pseudo cross section to account for stray light inside the spectrograph and the residual dark current of the detector. Spectral ranges used for standard analysis are: RASAS_01: 450-530 nm for NO2 and O3; RASAS_02: 430-520 nm for NO2 and O3; EVA_01: 430-450 nm for NO2.
The air mass factor (AMF) used for the conversion of the NO2 slant columns to vertical columns is the NDACC NO2 standard AMF, available on the NDACC UV-Vis web page (http://ndacc-uvvis-wg.aeronomie.be/) and based on the Lambert et al., 1999 and 2000 climatology of the NO2 profiles. For ozone columns, look-up tables of AMFs based on the TOMS V8 O3 profile climatology are used. The amount in the reference spectra are estimated by Langley plots (O3) and iterative approximation using twilight am and pm (NO2). Mean twilight vertical columns are obtained by averaging individual measurements between 89 and 91º SZA.

Expected precision/Accuracy of Instrument:
The error budget to each measured value, discriminate random and systematic error sources.
Random error is dominated by the uncertainties related to the slant column spectral fit (due to detector noise, instrumental imperfections, as well as errors or unknowns in the signal modeling)and the calculations of the Air Mass factors (errors related to the choice of the radiative transfer model settings, i.e. the O3 and NO2 vertical profiles, the aerosol extinction profile, the cloud conditions, and in case of NO2, the inclusion or not of the rapid twilight photochemistry).
The systematic error budget is dominated by the uncertainties of the O3 and NO2 cross sections used in the spectral fit and the uncertainty on the determination of the residual amount of O3 and NO2 in the reference spectra by using the Langley-plot technique.
The estimated overall errors in the individual measurements are, on average, approximately:
for NO2: 1 % fit analysis; 5 % AMF; 2 % cross-sections; 2 % residual column.
for O3: 0.5 % fit analysis; 3.6 % AMF; 3 % cross-sections; 2 % residual column.
Total random and systematic uncertainty for each measured value are given in the data.

Instrument History:
EVA_01 and RASAS_01 instruments have been operating together since 1999 to 2010 and EVA_01 and RASAS_02 since 2010 for overlapping purposes.
Data submitted to the database are:

2010-present	RASAS_02: NO2 O3
1999-2010	RASAS_01: NO2 O3
1993-1999	EVA_01: NO2

RASAS_02 had been tested in the Cabauw Intercomparison of Nitrogen Dioxide measuring Instruments (CINDI) campaign in 2009 in Cabauw, the Netherlands.
RASAS_01 meet the certification criterium for type 2 instruments in the blind NDSC intercomparison of 1996 (OHP).
EVA_01 NO2 has been compared with RASAS_01/RASAS_02. The agreement between instruments is within 5% (1 sigma).