



MINISTERIO
DE MEDIO AMBIENTE

INM

INSTITUTO
NACIONAL
DE METEOROLOGÍA

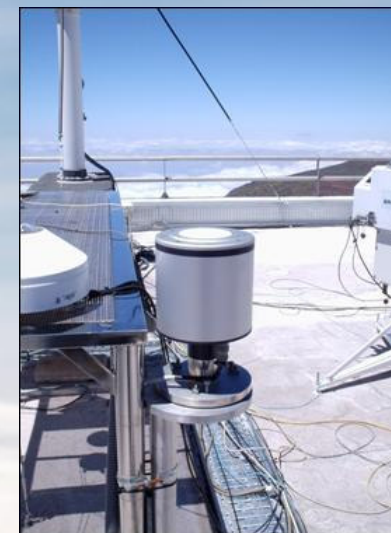
INM ozone measurements in the Antarctic region

C. Torres, A. Redondas
Izaña Atmospheric Observatory, INM

SAUNA Workshop, 10 November
2006

INM Ozone measurements

- Brewer
- Dobson
- DOAS
- SAOZ
- LIDAR
- ...



“Multichannel moderate-bandwidth filter instrument”

NILU-UV

INM Ozone measurements

- 1) INM Antarctic UV Network
- 2) Characteristics of radiometer NILU-UV
- 3) Determination of ozone total column with NILU-UV
- 4) NILU-UV calibrations
- 5) Preliminary results at Ushuaia and Marambio
- 6) Conclusion

Antarctic UV Network

- Institutions
 - Instituto Nacional de Meteorología (INM), Spain
 - Finnish Meteorological Institute (FMI), Finland
 - Dirección Nacional del Antártico-Instituto Antártico Argentino (DNA/IAA), Argentina
 - Centro Austral de Investigaciones Científicas (CADIC), Argentina

- General goal

To promote observations and research of stratospheric ozone, UV radiation and related physical parameters in the Antarctic region.

Antarctic UV Network

Ushuaia (CADIC, Arg.)

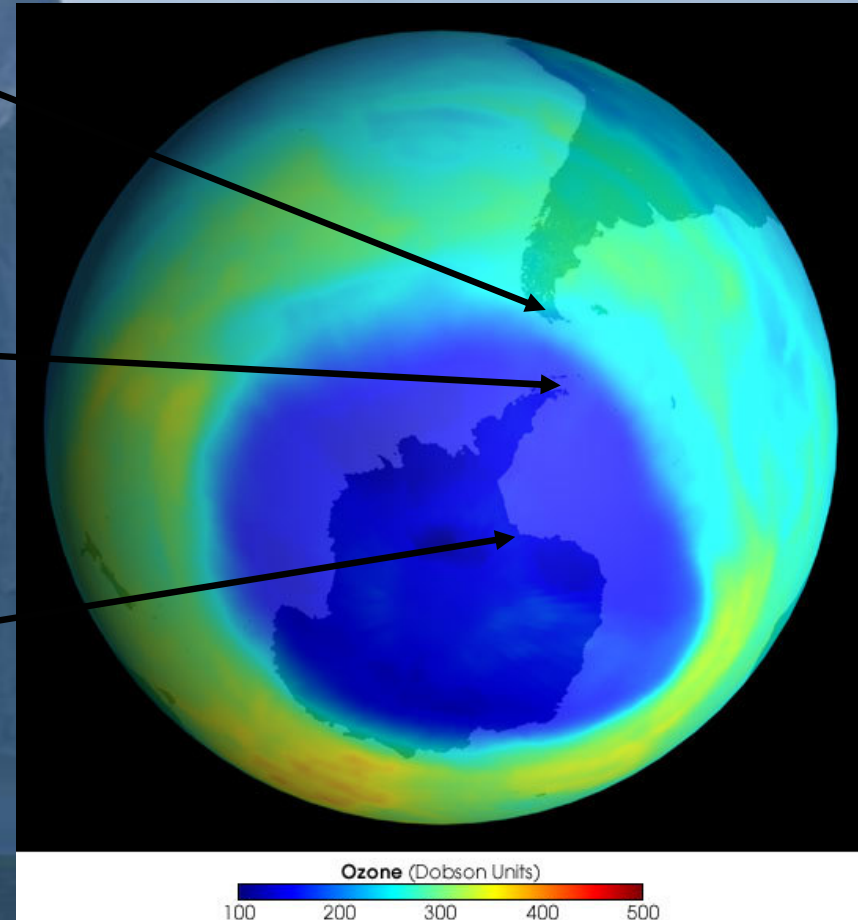
54°49'S, 68°19'W

V.Marambio (DNA/IAA, Arg.)

64°14'S, 56°38'W

Belgrano II (DNA/IAA, Arg.)

77°52'S, 34°37'W



Antarctic UV Network

Ushuaia: NILU-UV #012



Marambio: NILU-UV #011



Belgrano: NILU-UV #023

NILU-UV Instrument

- Characteristics
 - Multichannel moderate-bandwidth filter instrument
 - Measures global irradiance (direct +diffuse)
 - Five channels in the UV spectrum
 - 305, 312, 320, 350 and 380 nm
 - Around 10 nm at FWHM
 - Photosynthetic active radiation (PAR, 400-700nm)

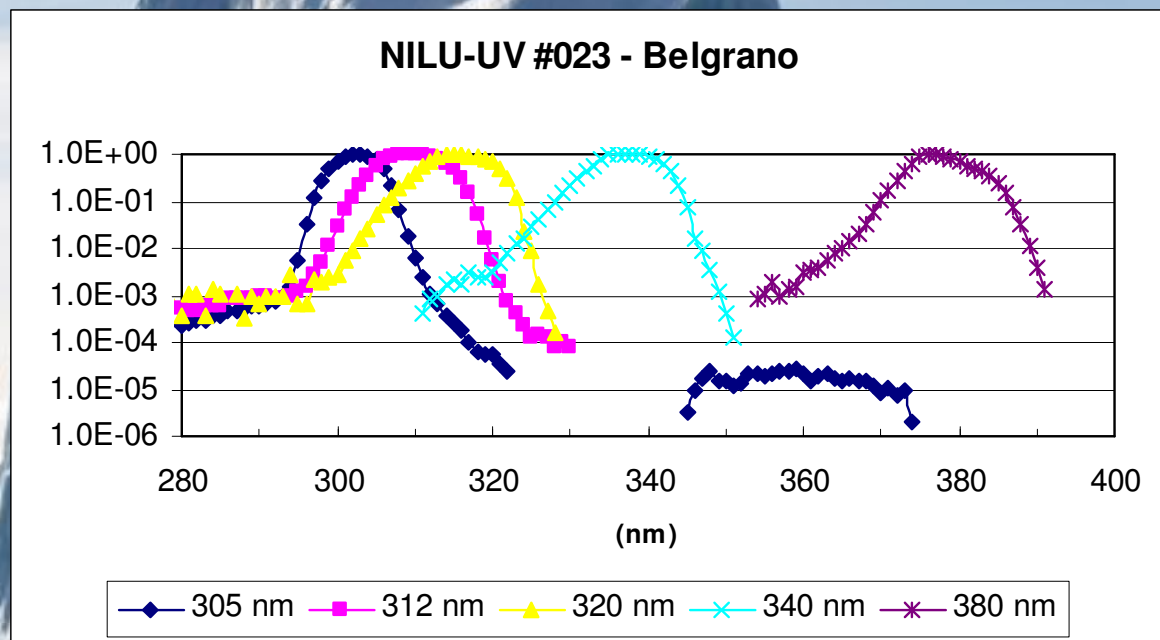


NILU-UV Instrument

- Characteristics
 - Teflon diffuser
 - Silicon detector and high-quality bandpass filters
 - Temperature stabilized at 40°C
 - Measures every second, and stores one-minute averages in a builtin data logger (capacity to store 3 weeks of 1 minutes averages).
 - Weatherproof and designed to operate in harsh environments.

NILU-UV Instrument

- Spectral Response



Relative spectral response of the five UV channels of the NILU-UV.

NILU-UV Instrument

- Measurements
 - The different channels may be used to monitor the UV radiation level.
 - By combining several channels:
 - Ozone total column
 - Cloud transmission
 - CIE weighted UV dose rates

Ozone Total Column

- Methodology described by *A. Dahlback, 1996*.

$$N(z, \Omega) = \frac{V_i(z, \Omega)}{V_j(z, \Omega)}$$

The ozone total column (Ω) is determined by comparing a calculated irradiance ratio (N), with a corresponding measured ratio. V_i (320nm) and V_j (312nm) are two channels with different sensitivity to ozone absorption, and z is the SZA.

A radiative-transfer model is used to determine a lookup table of N as function of z and Ω .

NILU-UV Calibration

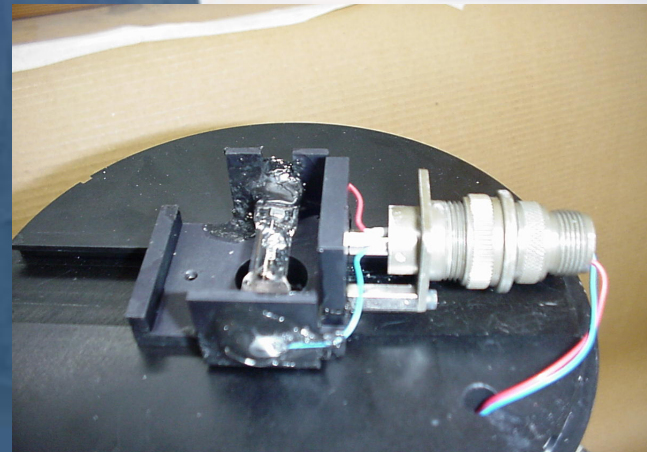
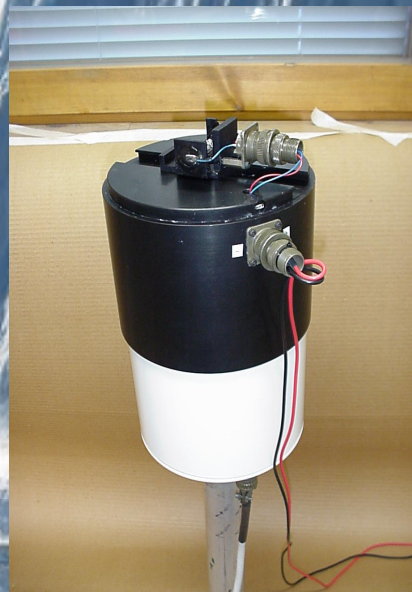
- Calibration: Quality Assurance

Travelling reference (NILU-UV #008, FMI) visits three times Ushuaia and twice Marambio during spring-summer-autumn season.

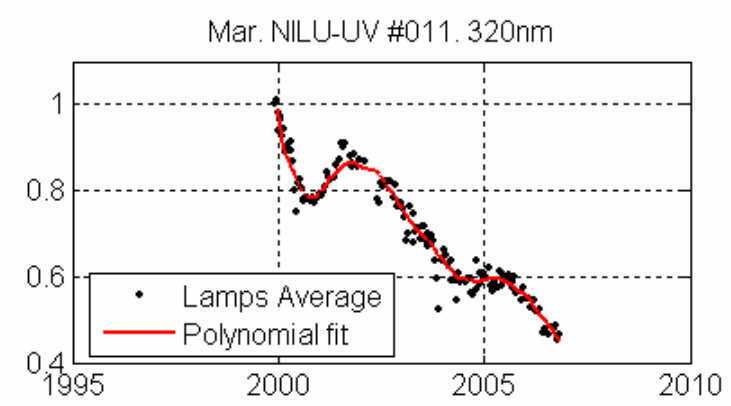
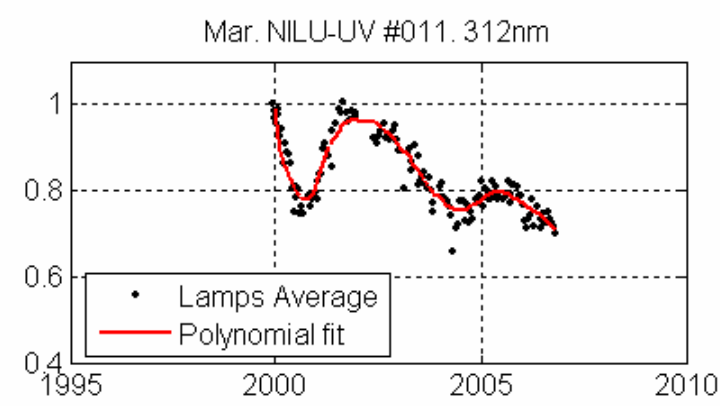
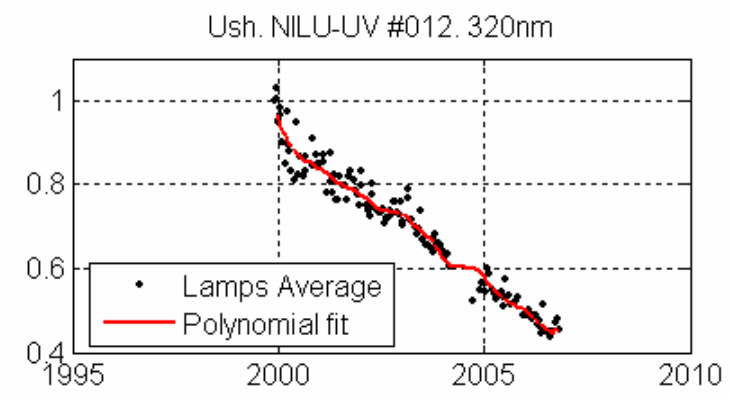
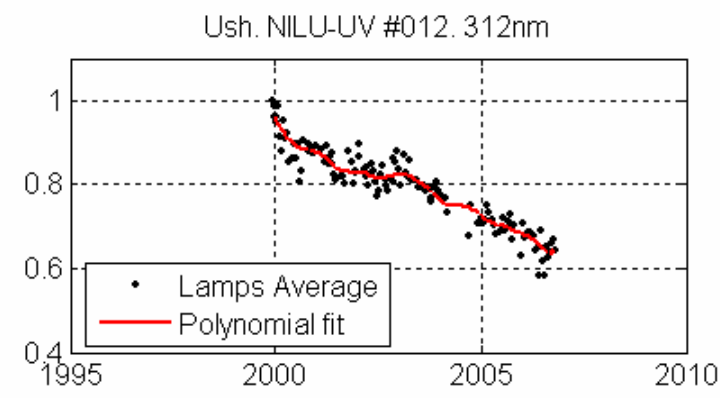
NILU-UV at Belgrano is replaced each year by other well calibrated at Observatory Atmospheric Izaña.

NILU-UV Calibration

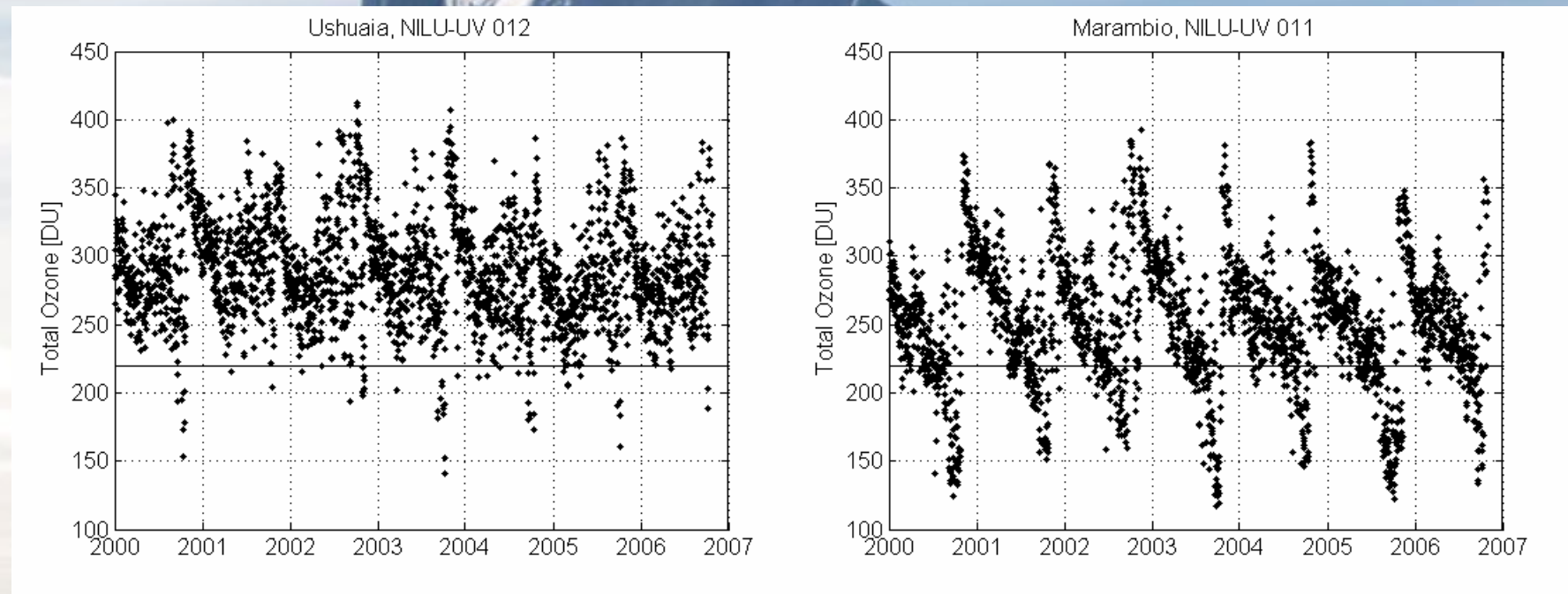
- Calibration: Quality Control
 - Two lamps (100 W) are measured every two week. A third lamp of control is made every three calibration.



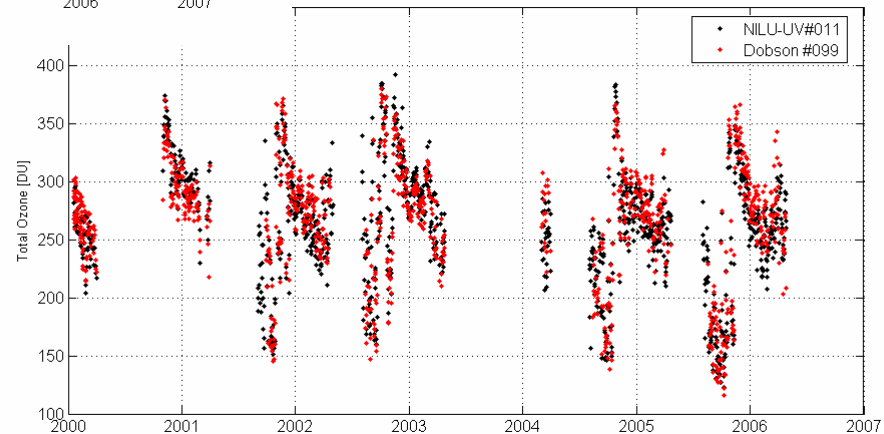
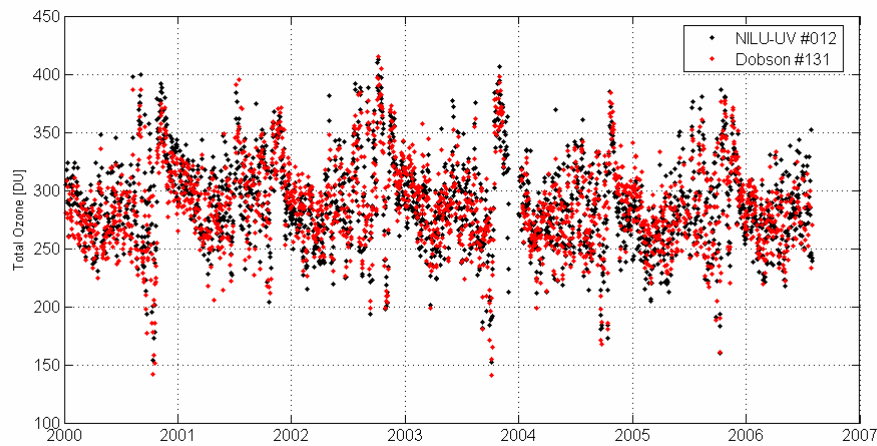
NILU-UV Calibration



Preliminary Result



Preliminary Result

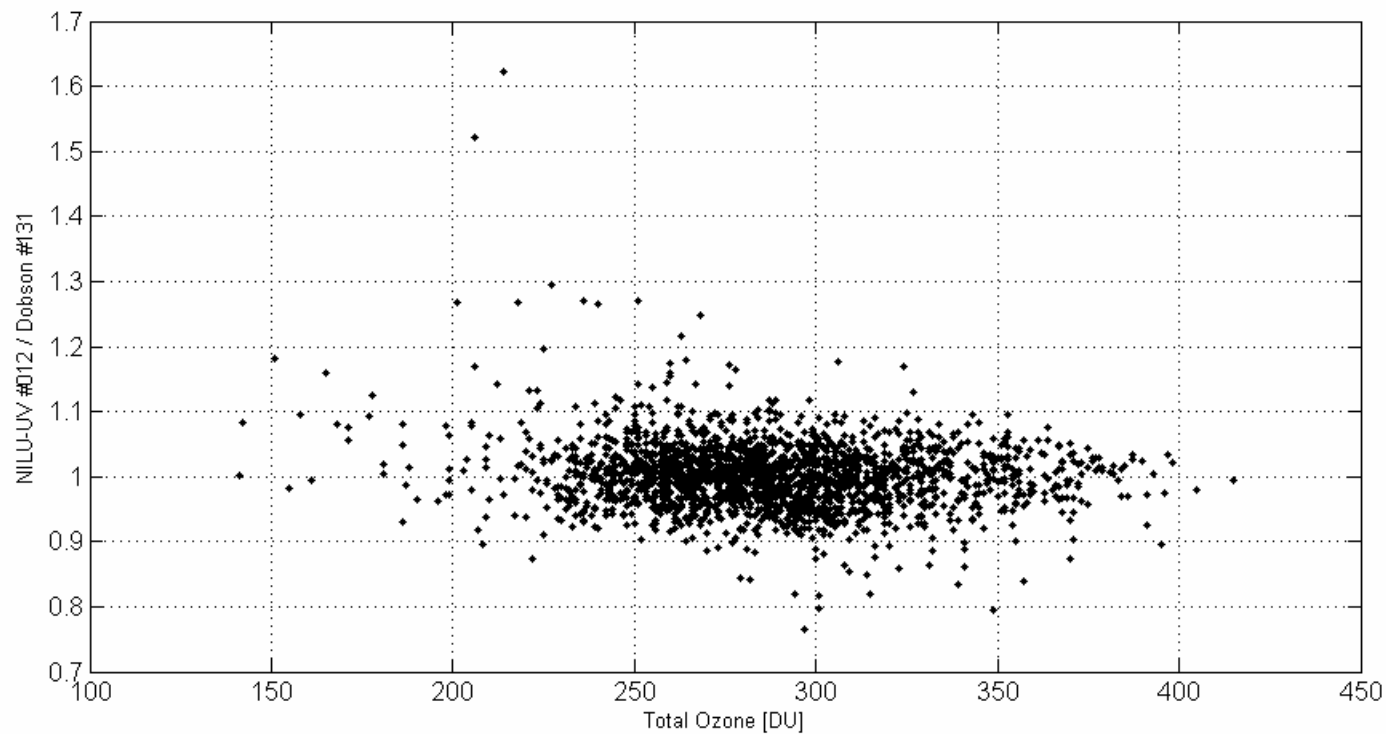


Comparison between NILU-UV & Dobson (WOUDC Data) at Ushuaia and Marambio.

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Preliminary Result

Ushuaia

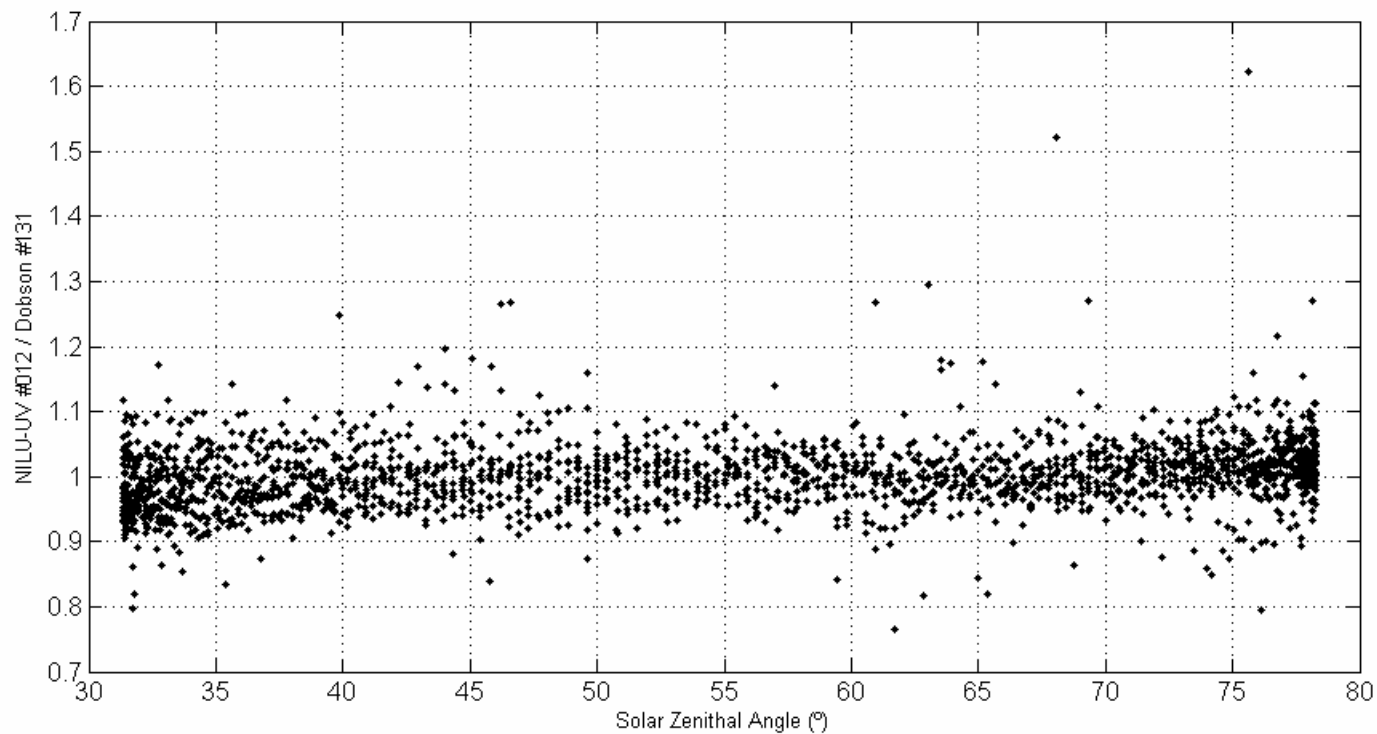


Comparison NILU-UV & Dobson: Ratio vs Total ozone

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Preliminary Result

Ushuaia

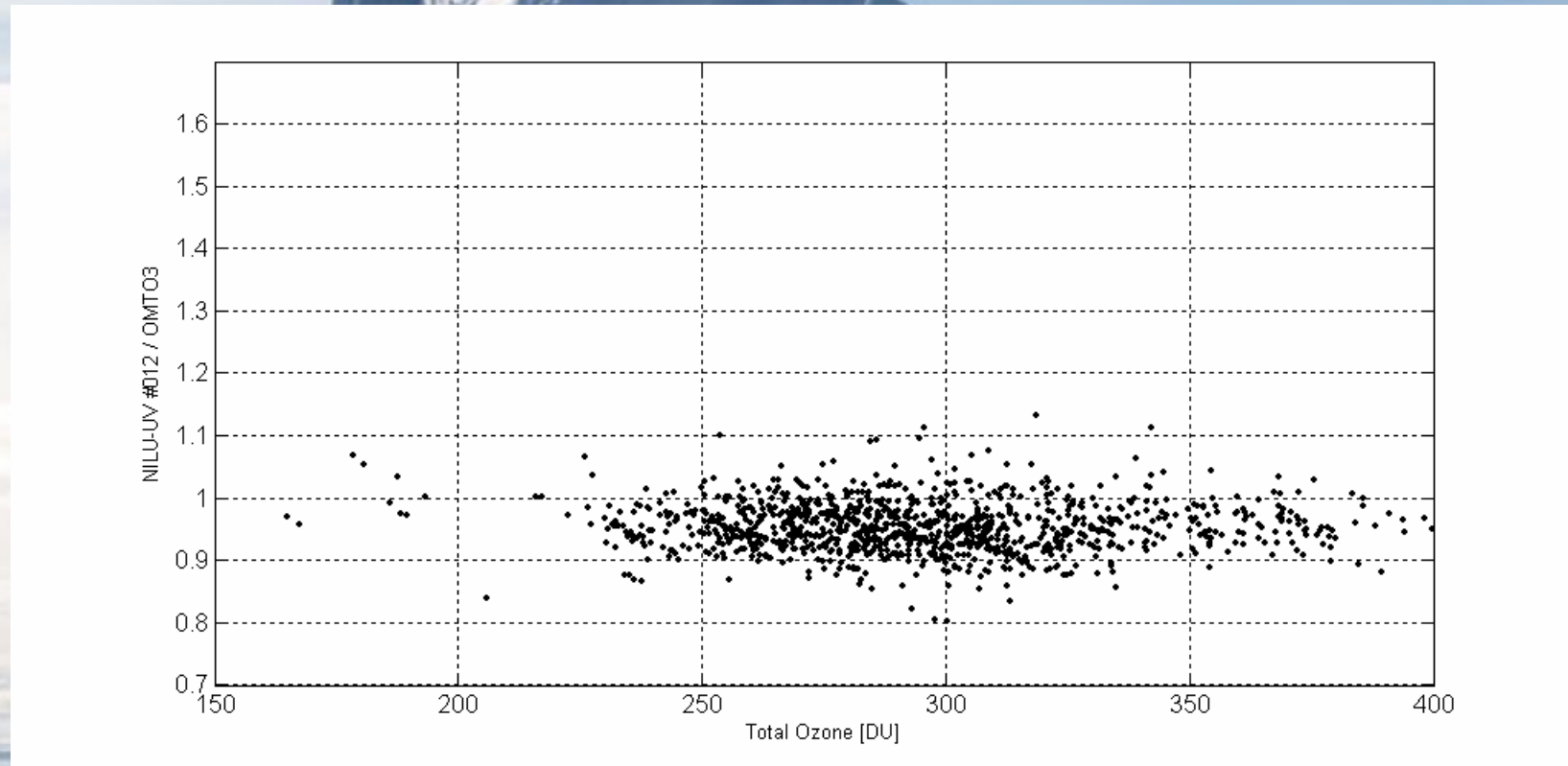


Comparison NILU-UV & Dobson: Ratio vs SZA

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Preliminary Result

Ushuaia

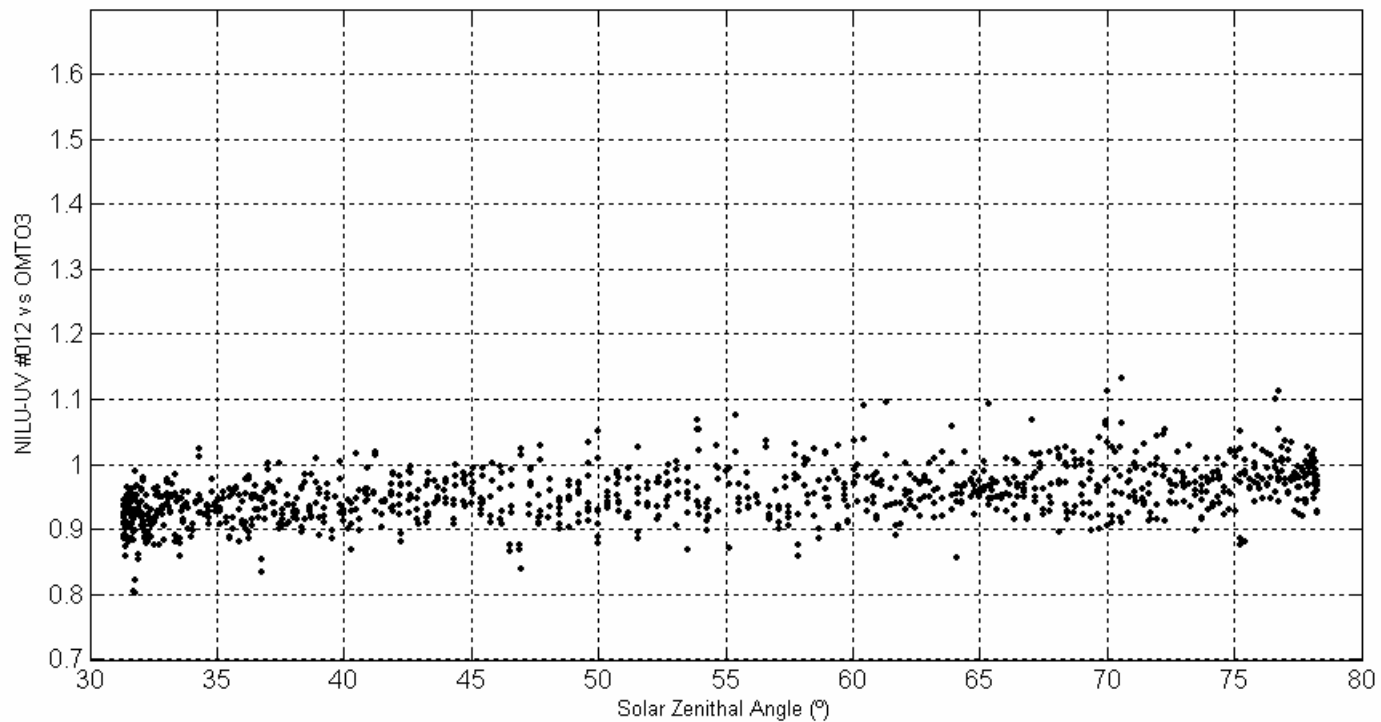


Comparison NILU-UV & OMITO3: Ratio vs Total Ozone

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Preliminary Result

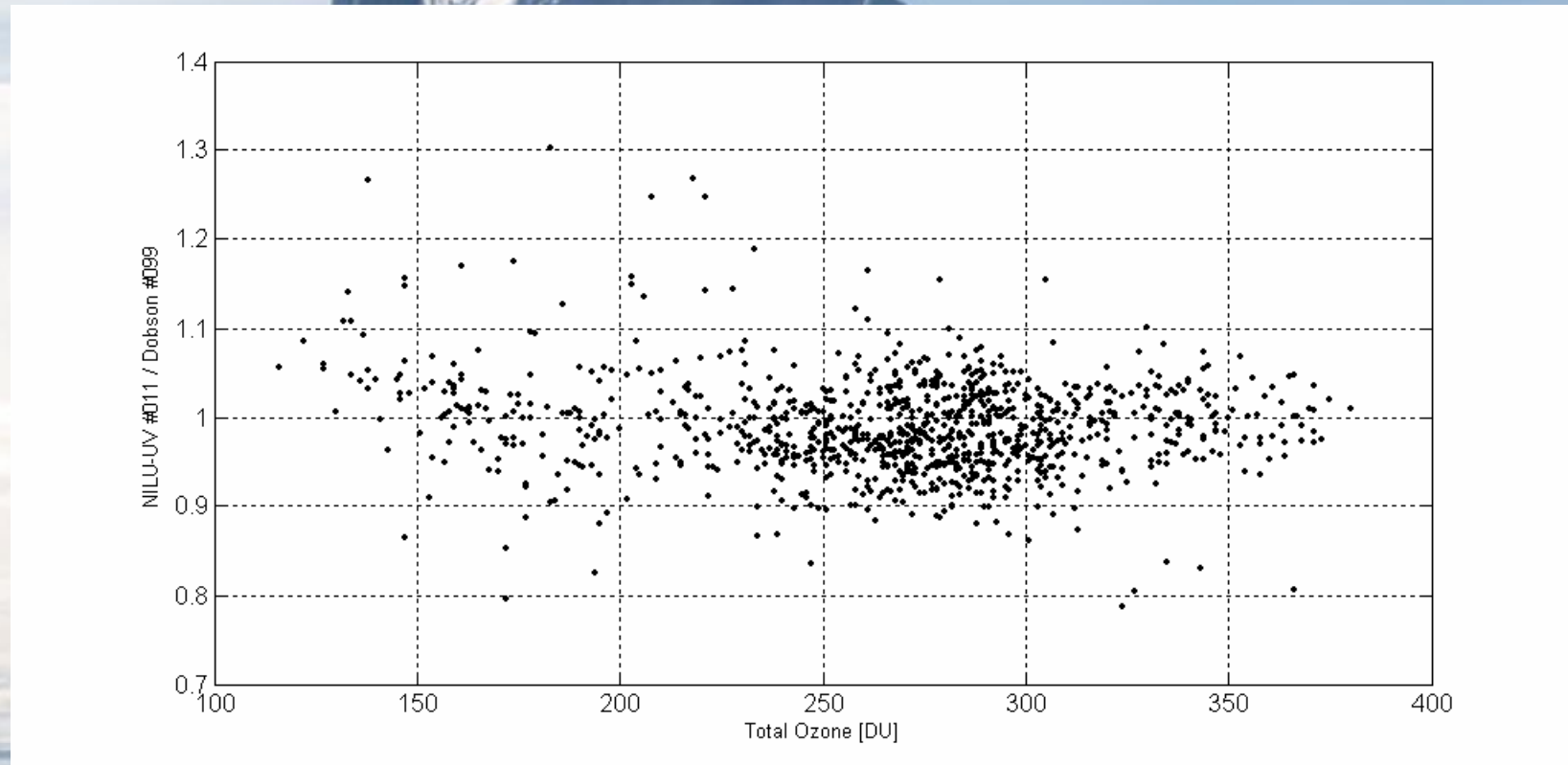
Ushuaia



Comparison NILU-UV & OMITO3: Ratio vs SZA

Preliminary Result

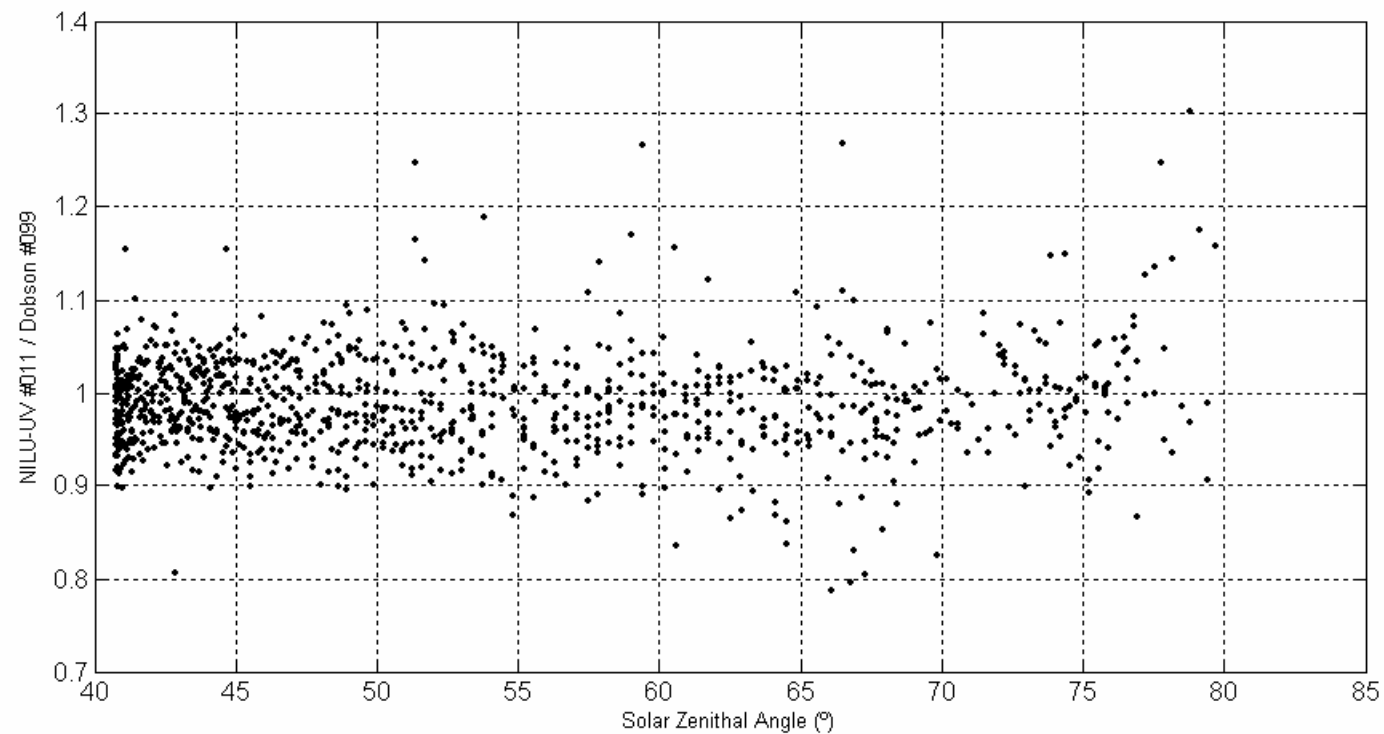
Marambio



Comparison NILU-UV & Dobson: Ratio vs Total Ozone

Preliminary Result

Marambio

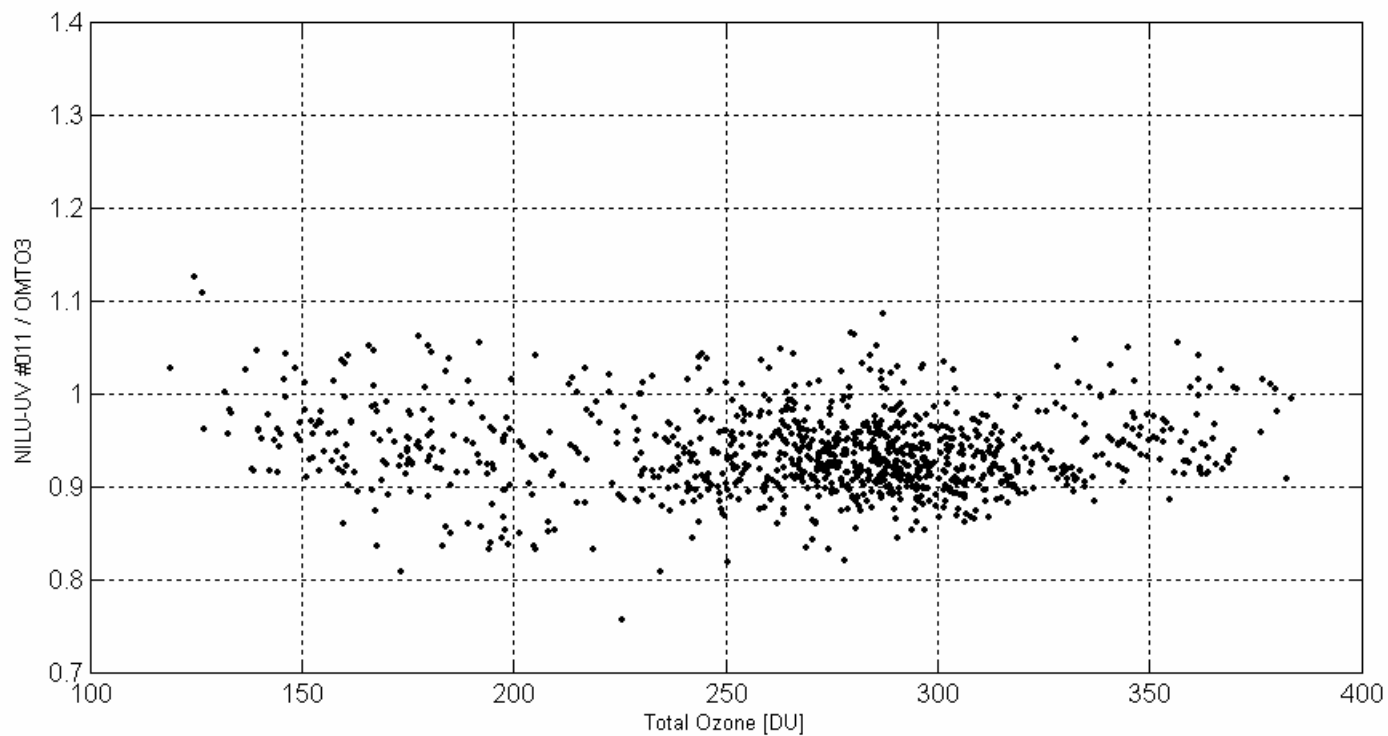


Comparison NILU-UV & Dobson: Ratio vs SZA

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Preliminary Result

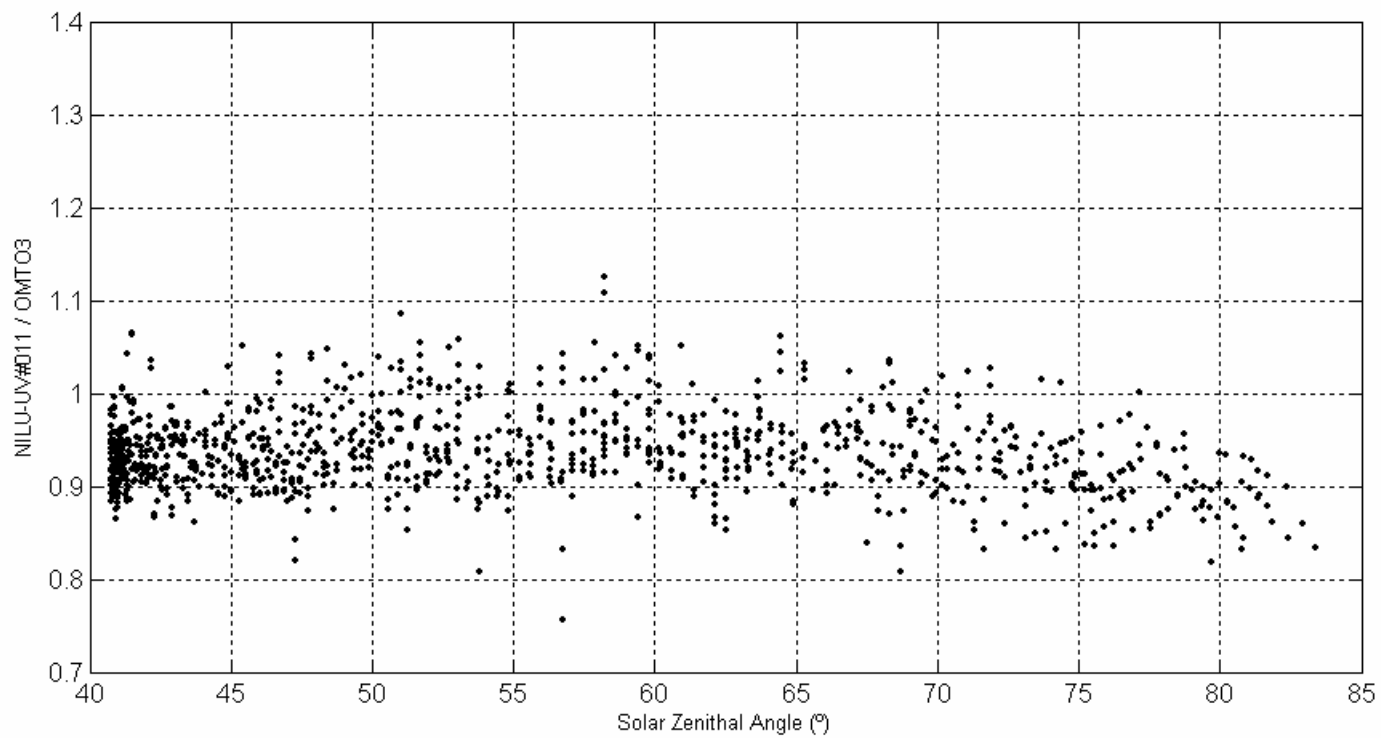
Marambio



Comparison NILU-UV & OMITO3: Ratio vs Total Ozone

Preliminary Result

Marambio



Comparison NILU-UV & OMITO3: Ratio vs SZA


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Preliminary Result

	Ushuaia NILU-UV #012 vs			Marambio NILU-UV #011 vs		
Diff. (%) & σ (%)	Dobson # 131	EOS-Aura OMI OMTO3	Dobson vs OMI	Dobson #099	EOS-Aura OMI OMTO3	Dobson vs OMI
2000	-4.52 / 4.73	---	---	0.72 / 3.93	---	---
2001	-0.77 / 7.70	---	---	-1.50 / 4.08	---	---
2002	1.27 / 3.20	---	---	0.40 / 5.56	---	---
2003	0.85 / 4.03	---	---	-1.90 / 2.86	---	---
2004	4.15 / 3.32	-7.55 / 3.25	-3.41 / 3.58	-0.41 / 5.20	-3.57 / 4.32	-3.98 / 5.49
2005	1.11 / 4.45	-4.70 / 4.10	-3.59 / 3.91	3.47 / 4.87	-7.01 / 4.42	-3.53 / 6.47
2006	0.77 / 3.88	-4.10 / 3.59	-3.33 / 4.33	4.96 / 6.04	-7.98 / 3.24	-3.03 / 6.23

Conclusion

- NILU-UV radiometer is a good instrument to operate in harsh environments.
- The use of relative lamp tests are essential to monitor the drift in the sensitivity of the channels.
- NILU-UV data agree with Dobson data in the Antarctic region. Both instruments exhibit no clear dependence on total ozone or SZA.
- Data NILU-UV measurements are on average lower than OMT03 measurements and between both instruments exist dependence with SZA.



Thank you for your attention