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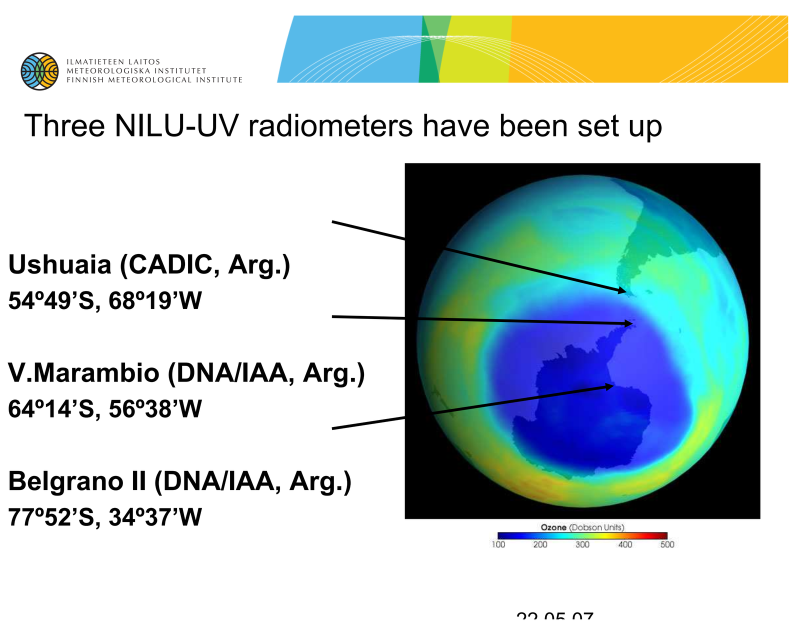
Observations from the NILU-UV Antarctic network since 2000

K. Lakkala[1], E. Asmi[2], O. Meinander[2], B. Hamari[1], A. Redondas[3], F. Almansa[3], V. Carreno[3], H. Ochoa[4], G. Deferrari[5]

(1) Finnish Meteorological Institute, Rovaniemi, Finland
(2) Finnish Meteorological Institute, Helsinki, Finland
(3) Spanish Agencia Estatal de Meteorología, Tenerife, Spain
(4) Dirección Nacional del Antártico-Instituto Antártico Argentino, Buenos Aires, Argentina
(5) Centro Austral de Investigaciones Cientificas, Ushuaia, Argentina
⋆ kaisa.lakkala@fmi.fi

Abstract

Total ozone and UV measurements have been performed with the NILU-UV radiometer at the station of Ushuaia (54°S), Marambio (64°S) and Belgrano II (77°S) since 2000. The network was established in 1999/2000 by the Spanish Agencia Estatal de Meteorología (AEMET) in collaboration with the Finnish Meteorological Institute (FMI), the Argentinian Dirección Nacional del Antártico-Instituto Antártico (DNA-IAA) and Centro Austral de Investigaciones Cientificas (CADIC). The location of the network was chosen in order to monitor total ozone and UV radiation at different sides of the polar vortex: Belgrano II is mostly located inside the vortex, Marambio at various times inside, on the edge of, or outside the vortex, while Ushuaia is mostly outside the vortex.



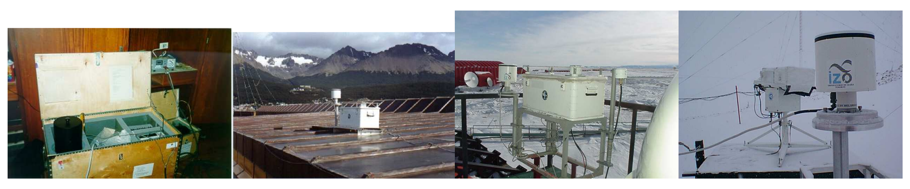
General gole

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

- UV data published on a web page (http://www.polarvortex.aemet.es/) and in the WMO Antarctic Ozone Bulletin

Role of FMI

- **Quality Assurance (QA) of the UV data**
- Maintenance of the irradiance scale
- Irradiance scale of the travelling reference: Regular calibration at NILU
- National and international solar comparison with spectroradiometers
- Solar comparisons with other filter radiometers
- **Traveling refence NILU-UV**
- Lamp tests
- Solar comparisons in Ushuaia and Marambio



NILU-UV radiometer

- 5 UV channels, with central wavelengths around 305, 312, 320, 340 and 380 nm
- Bandwidths of around 10 nm at FWHM
- Sixth channel measures PAR in the 400–700 nm wavelength region
- Flat Teflon diffusor, interference filters, silicon detectors
- Temperature stabilized at 40°C
- Records data in a built-in data logger at a 1-min time resolution(capacity to store 3 weeks of 1 minutes averages
- Data with a 1-s time resolution can also be recorded
- Weatherproof and designed to operate in harsh environments

Quality assurance of the UV time series

- **Travelling refence** (NILU-UV no. 008, FMI) visits three times Ushuaia and twice Marambio during spring-summer-autumn season.
- NILU-UV at Belgrano is replaced regularly by other calibrated at Observatory Atmospheric Izaña.
- **Quality Control preformed at each station**
- Two lamps (100 W) are measured every two week. A third lamp is measured every three calibration.

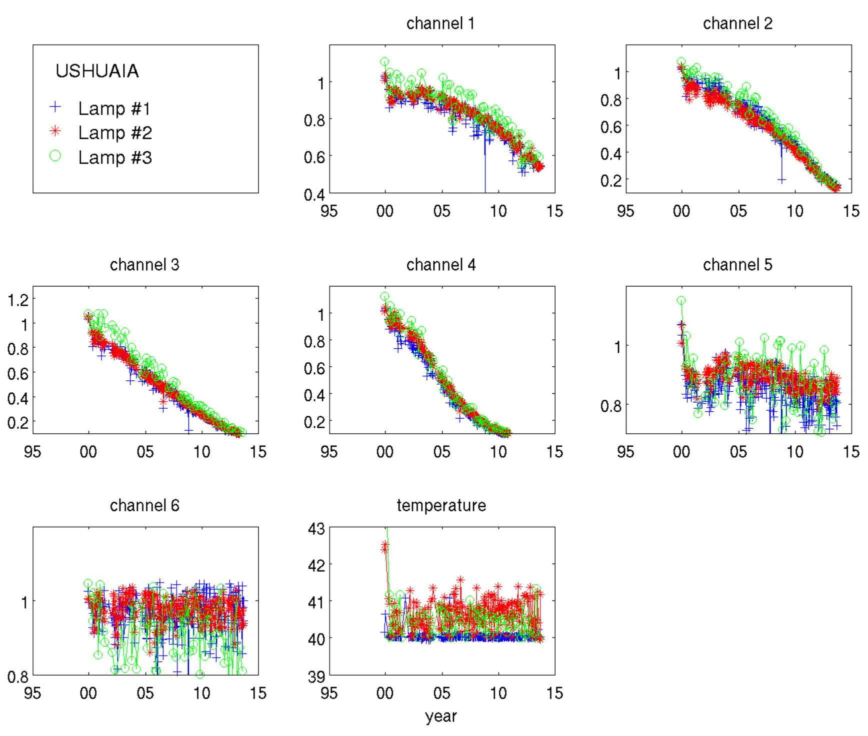


FIG. 1 Time series of lamp measurements at Ushuaia during 2000-2013. The results are scaled to the first three measurements.

Transfer of the irradiance scale

Following Dahlback 1996, the UV dose rate (E_{eff}) can be determined by a linear combination of the irradiances, represented by these voltages V_i, measured by the M channels:

$$E_{eff} = \sum_{i=1}^{M} a_i V_i. \qquad (1)$$

The transfer of the irradiance scale is based on raw data comparison of the travelling reference and the site instrument. Measurements are compared channel by channel, and a scaling factor is applied to the station's reading in order to make it match the travelling reference. Thus the erythemally-weighted UV dose rate of the site NILU-UV, $E_{eff(site)}$, can be calculated as

$$E_{eff(site)} = \sum_{i=1}^{5} a_i c_i V_{i,site}, \qquad (2)$$

where a_i is the coefficient of the linear combination of eq. 1 for channel i of the reference NILU-UV. c_i is the scaling factor between the raw data of the site NILU-UV and the reference NILU-UV for channel i and $V_{i,site}$ is the site NILU-UV raw signal voltage for channel i. Thus each channel of the site instrument is scaled to the corresponding channel of the reference instrument. More details about the calculation of the scaling factor can be found in Lakkala et al.2005.

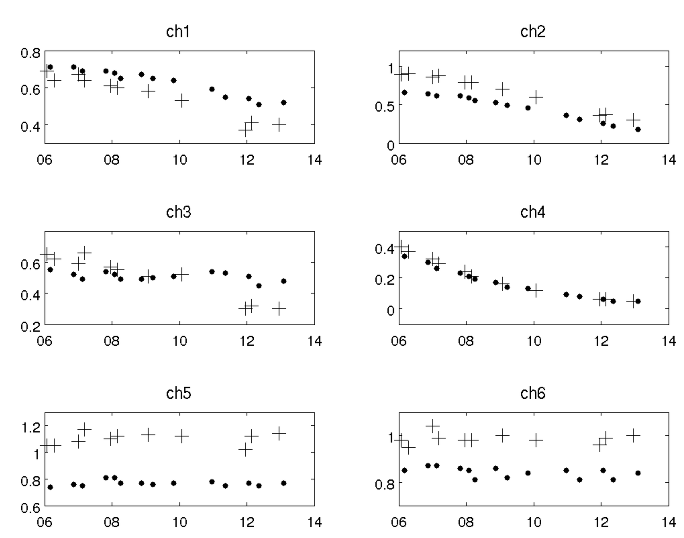


FIG. 2 Time series of scaling factors for different channels (ch1-ch6) at Ushuaia and Marambio during 2007–2013.

Results

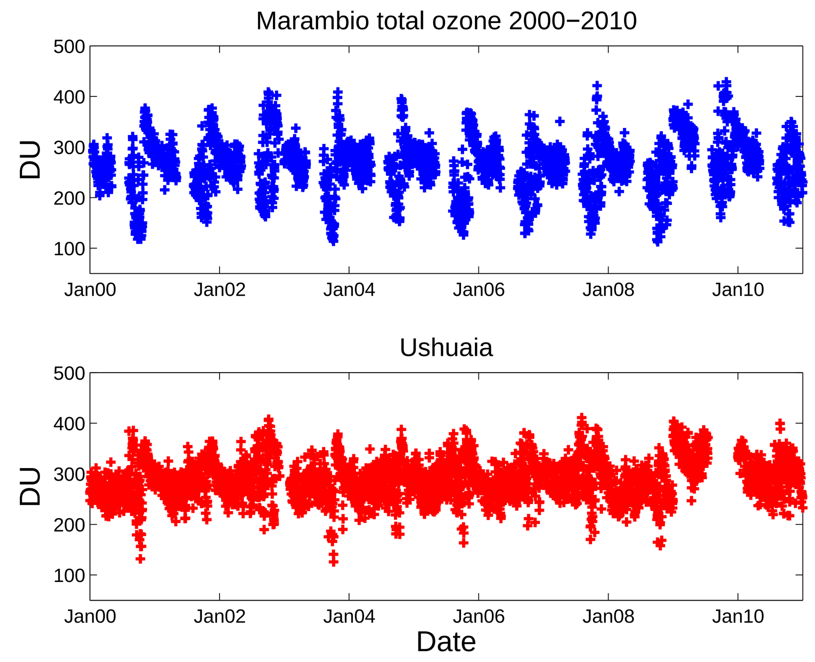


FIG 3. Total ozone at Ushuaia and Marambio during 2000-2010.

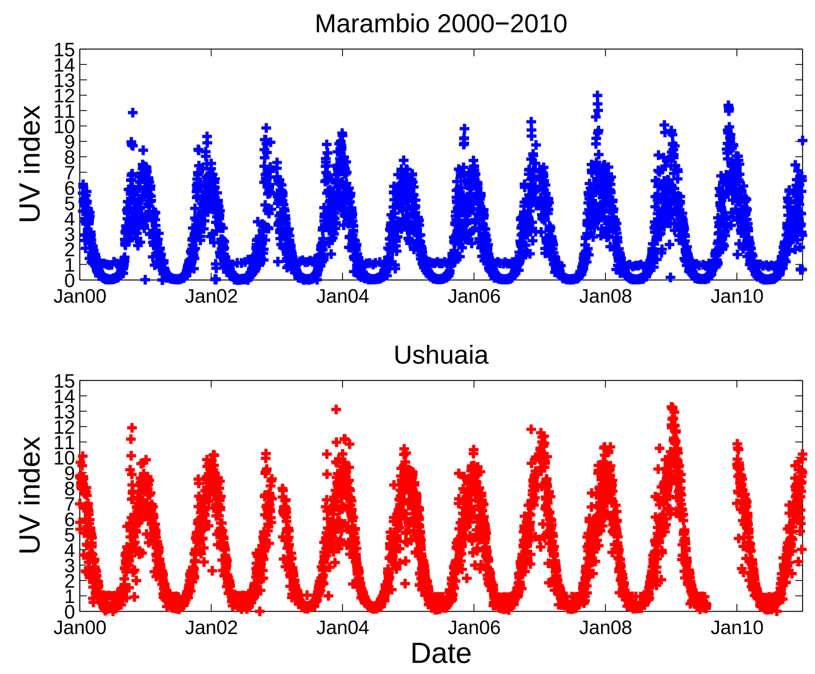


FIG 4. Daily maximum UV index at Ushuaia and Marambio during 2000-2010.

Drift in the sensitivity of the channels

- Severe drift in sensitivity of the channels was seen after a couple of years of measurements.
- Time series were possible to be corrected until 2010.
- Future: Instruments need to be upgraded.

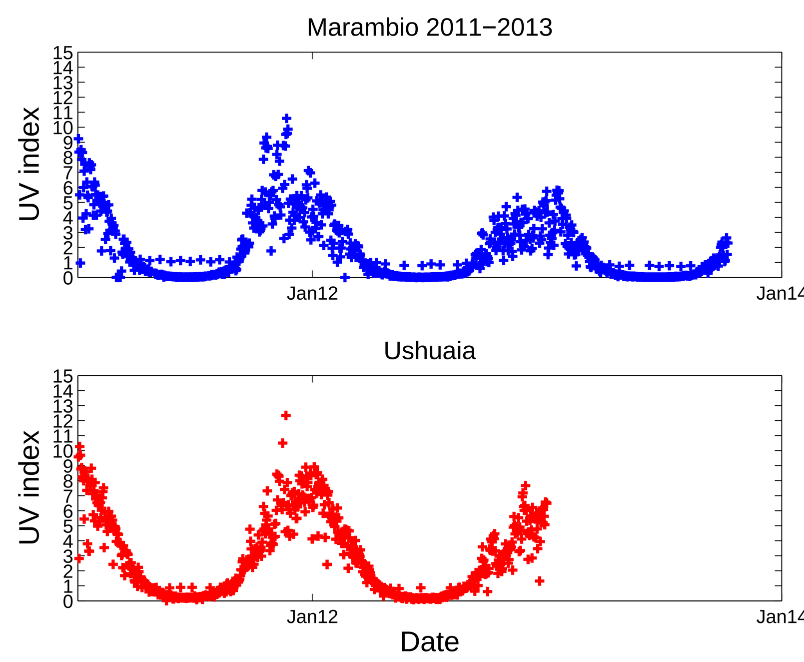


FIG 5. Daily maximum UV index at Ushuaia and Marambio during 2011-2013, the effect of drifts in the sensitivity of the channels is seen as downward drift of irradiances. The effect is so strong that data need further post processing.

References

Dahlback 1996, Measurements of biologically effective UV doses, total ozone abundances, and cloud effects with multichannel, moderate bandwidth filter instruments, Appl. Optics, **35**, 6514-6521.**Lakkala et al. 2005**, Quality assurance of the solar UV network in the Antarctic, J. Geophys. Res., **110**, D15101. **Meinander et al. 2004** , Antarctic-NILU-UV network linked to QASUME and NSF irradiance scales, In Proc. of Quadrennial Ozone Symposium QOS 2004, 1-8 June 2004, Kos, Greece, 1128-1129. **Redondas et al. 2008** , Antarctic network of lamp-calibrated multichannel radiometers for continuous ozone and UV radiation data, Atmos. Chem. Phys. Discuss., **8**, 3383-3404.

Acknowledgments

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