Upgrade of the New Zealand urban UVB network

Neil Swift[1], Kathryn Nield[1], John Hamlin[1], Graeme Woollett[2], Gregory Bodnar[2], Mike Kotkamp[3], John Sansom[3], Ben Liley[3]

1. Measurement Standards Laboratory, Callaghan Innovation, Lower Hutt, New Zealand
2. Intelligent Machines and Devices Group, Callaghan Innovation, Lower Hutt, New Zealand
3. National Institute of Water & Atmospheric Research (NIWA), Lauder, Central Otago, New Zealand

Abstract. Since 1989 the Measurement Standards Laboratory (MSL) has been calibrating a network of erythemal UV sensors located across New Zealand, primarily at large centres of population. This paper describes a recent upgrade of this network and implementation of data processing algorithms which transfer data to the National Institute of Water and Atmospheric Research (NIWA) climate database.

Introduction

The original UV sensors deployed were purchased from International Light Technologies Inc. and consisted of an SED 240 vacuum photodiode, interference filter and a ground fused silica cosine diffuser. This was mounted in a polycarbonate enclosure which also contained a circuit board with a transimpedance amplifier and 16 bit ADC, the output from which was read by a micro-controller and sent to an attached desktop computer. This PC then provided a VPN connection back to IRL where the data was collated.

More than 20 years of data was collected from these sensors but although this system was reasonably reliable, there were on-going maintenance issues. Hence with consideration also given to known sources of error in our measurements, such as lack of temperature stabilisation of the sensors and a spectral dependence of the angular response, the decision was made to upgrade the network with new sensors and data acquisition systems.

The upgrade

The replacement sensors purchased are Yankee Environmental Systems UVB-1 pyranometers, each with an accompanying UVPS-1 power supply. Each power supply unit has been modified in house with an updated DAQ board and ARM board style computer to meet the networks data logging and VPN connection requirements.

This new system has the following benefits:

- Desktop computer replaced by an embedded device, providing a low power alternative that is tolerant of power supply interruptions.
- Programmable gain amplifier circuit, allowing the gain to be increased for measurement of relative spectral response in the lab.
- Temperature stabilisation of the detector unit.
- More robust sensor unit for deployment outdoors.
- The sensor angular response is less dependent on variations in solar irradiance spectral distribution.

Additionally, data processing algorithms have been developed which transfer data from the sensors to NIWA at the end of each day. In combination with calibration functions forwarded to NIWA annually, daily data is converted to UV Index and uploaded to the NIWA climate database daily.

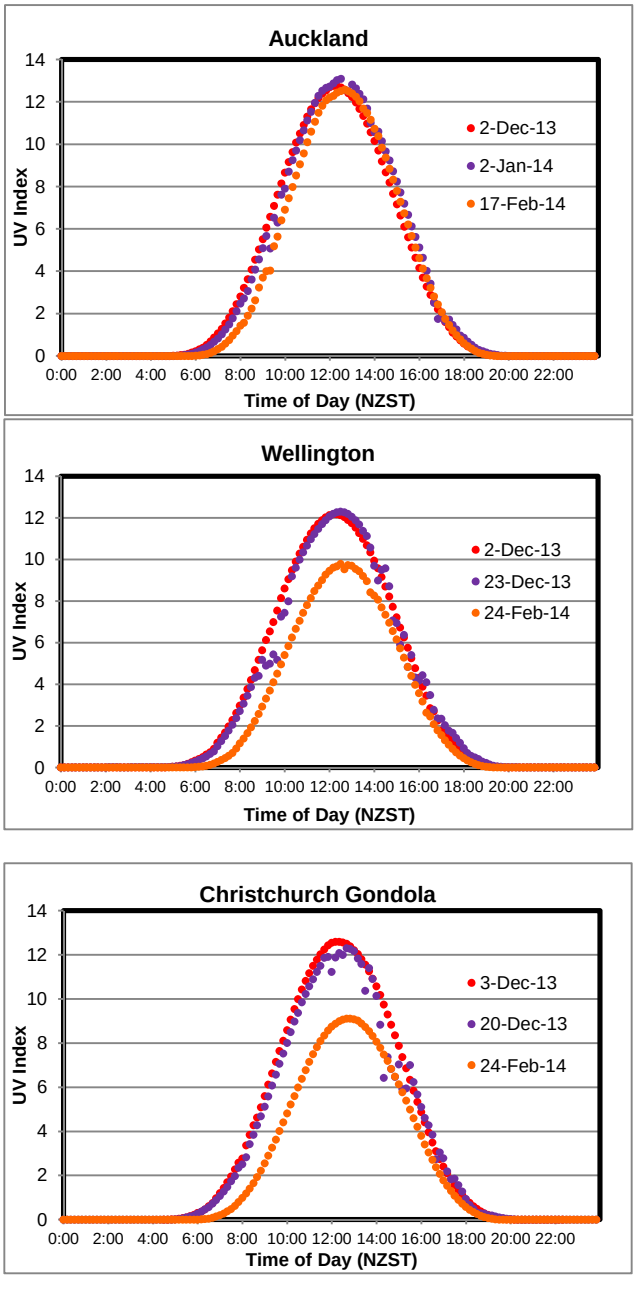

Figure 1. Measurements from New Zealand summer 2013-2014 from our sensors located at Auckland, Wellington and Christchurch Gondola.

Validation

Work is ongoing to validate the data from these new instruments. A comparison was made between MSL and

PMOD/WRC calibration functions for one UVB-1 instrument which highlighted interesting issues (Swift et al. 2012). This is still under investigation but further efforts to validate the data from the new instruments include keeping the old and new instruments co-located in Lower Hutt and comparing measurements with NIWA instruments.

References

Swift, N.S., Huelsen, G, Nield, K.M., Grobner, J., Hamlin, J.D. 2012. Calibration of Erythemally Weighted Broadband Instruments: A Comparison between PMOD/WRC and MSL. Paper at International Radiation Symposium 2012, Berlin, 6-10 August.