File Revision Date:
October 9, 2014

Data Set Description:

PI: R. L. McKenzie NIWA, NZ
Instrument: UV Spectrometer (UVL JYDH10, UVM Bentham DM300, UV4 Acton 270, UV9 Bentham DTM300)
Site(s): Lauder, New Zealand (45.04S, 169.68E, 370m) Dec 1989.. (UVL, UVM, UV4, UV9)

PI: R. L. McKenzie NIWA, NZ and Patrick Disterhoft NOAA, USA
Instrument: UV Spectrometer (UVL JYDH10 system, UV3 Bentham DTM300, UV4 Acton 270, UV5 Bentham DTM300)
Site(s): Mauna Loa Obs, Hawaii (19.53N, 155.57W, 3400m) Jul 1995.. (UVL, UV3)
Boulder, Co, USA (40.13N, 105.24W, 1650m) Aug 1999.. (UVL, UV4, UV5)

PI: R. L. McKenzie NIWA, NZ and Stephen Rhodes BoM, Australia
Instrument: UV Spectrometer (UV6 and UV7 Bentham DTM300)
Site(s): Melbourne Australia (37.69S, 144.94E, 110m) Jan 2001-Apr 2003 (UV6), Mar 2001-Jun 2003(UV7), May 2009 ... (UV6)
Alice Springs, Aust (23.80S, 133.89E, 547m) Apr 2003-Oct 2005 (UV6), Jun 2006 (UV7)
Darwin, Aust (12.42S, 130.89E, 32m) Jun 2003-Dec 2005 (UV7)

PI: R. L. McKenzie NIWA, NZ and Yutaka Kondo University of Tokyo, Japan
Instrument: UV Spectrometer (UV8 Bentham DTM300, with actinic head)
Site(s): Tokyo, Japan (35.65N, 135.67E, 20m) Nov 2003-Nov 2008(UV8)
+ irradiances: Jun 2004-June 2005 (UV4)

Measurement Quantities:

Spectral irradiance on a horizontal surface (cosine weighted)
of UV 285-450 nm at 0.6 to 1 nm resolution. In routine operation,
scans are taken at intervals of 5 degrees in solar zenith angle
and at midday. On cloudless days "sky only" measurements can be made
at midday using a shadow band to obscure the direct sun. Since 1993
scans have been from sunrise to sunset (sza=95), and in addition,
scans are taken at midnight.

The data summaries on the NDSC database include the following:

1. 285-450 nm integral (290-450 nm for uvl and uvm instruments)
2. UVA, 315-400 nm (Wm-2)
3. UVB, 290-315 nm (Wm-2)
4. Erythemal UV (Wm-2)
5. DNA-damaging UV (Wm-2)
6. VitD weighted UV (or Generalised plant-damaging) (Wm-2)
7. Cosine correction applied to UVA (CosUVA)

8. Calculated UVA transmission	(TrUVA)
9. Instrument EHT range	(EHTmin and EHTmax)
10. Statistics of intensity changes during the scan	(Diode_mean & Stdev)
11. Instrument Temperature	(C)
12. Wavelength shift applied	(nm)
13. Derived ozone (from ratio:305/340)	(DU)

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Instrument Description:

[UVB: Include list of instrument spec's that are or are not met. See UVB instrument validation appendix for list of instrument specs.]

UVL JYDH10. Bandpass too broad for NDSC (1200 g/mm 1.15 nm fwhm)
and detection threshold of 0.001 uW cm-2 nm-1
Not NDSC quality - cosine response inadequately characterised for MLO
- detection threshold too high

- mismatch for data at MLO between UVL and UV3 at MLO
  (especially for large sza in morning data)
- bandpass too broad

UVM Bentham DM300 Bandpass NDSC standard (2400 g/mm, 0.9 nm fwhm) but detection threshold of 0.0001 uW cm-2 nm-1 requires several scans.

Later instrument (UVn, n>2) all meet NDSC specs, but direct sun obs require manual intervention

UV3 Based on Bentham DTM300. NDSC standard (2400 g/mm, 0.8 nm fwhm) NOAA
UV4 Based on Acton 270. NDSC standard (2400 g/mm, 0.8 nm fwhm) NIWA.
UV5 Based on Bentham DTM300. NDSC standard (2400 g/mm, 0.8 nm fwhm) NOAA
UV6 Based on Bentham DTM300. NDSC standard (3600 g/mm, 0.6 nm fwhm) BoM
UV7 Based on Bentham DTM300. NDSC standard (3600 g/mm, 0.6 nm fwhm) BoM
UV8 Based on Bentham DTM300. NDSC standard (3600 g/mm, 0.6 nm fwhm) Univ Tokyo
UV9 Based on Bentham DTM300. NDSC standard (3600 g/mm, 0.6 nm fwhm) NIWA

Instruments UVL and UVM: Fixed speed scan in the forward direction only
Data stored as integers
12-bit a/d converters
Dynamic range achieved by changing EHT to pmt during scans

Instruments UVn (n>=3) : Variable speed scans in both directions
Data stored as floating point numbers
20-bit, or 24-bit a/d converters
No EHT gain switching during scans

All instruments operate in additive dispersion.

<u>Algorithm Description:</u>
Programme written in MS Visual Basic. Current version UVP3.6.EXE
Reads file of instrument-dependent parameters
Selection of cal file depends on date as specified in above file
(ref McKenzie et al., 1992)
Intensity calibration:
Uses calibrations made with 1000W FEL lamps to form files of
calibration factors at each wavelength.
For NDSC instruments, can tranfer cal to internal 45W lamp used in
weekly stability calibrations.
A facility exists for removing emission line features from k-files
generated from lamps with contaminant gases (e.g., Al near 390 nm)
Wavelength calibration:

Correlation alignment against Solar Fraunhofer lines
non-linear wavelength errors deduced from Hg lamp scans.

Expected Precision/Accuracy of Instrument:
+/- 5% see McKenzie et al., 1992.

Irradiances are derived from FEL lamps for which calibrations traceable to NIST are provided by standrards laboratories at 10 nm intervals. For the older FEL lamps it was safe to interpolate between the set wavelengths

to determine the lamp output at intermediate points.However, most of the more recent FEL lamps contain emission lines from impurities, which introduce rrors at the ~1% level at the specific wavelengths that correspond to these emission features. The FEL lamps used at Boulder and Mauna Loa have the largest emissions. However, for the weighted irradiances reported here, any erros traceable to these emissions is less than 0.1%. For spectrally-resolved data, it is possible in principal (though time consuming in practise) to apply corrections to remove these feature.

In 2005, ambient temperatures have been logged, and an algorithm has been added to the processing to apply corrections for the temperature dependence of the PTFE diffusers (see McKenzie, Badosa, et al., 2005).

Instrument History:
Dates and description of significant changes in instrument or algorithm

Dec 1989.	UVL Lauder	(JY DH10) Observations began at Lauder
Feb 1990.	UVL Lauder	Instrument rotated 180 degrees (azimuth 23)
Oct 1990.	UVL Lauder	First observations with on-site calibration
Jan 1992.	UVL Lauder	Cross calibration at Lauder (Seckmeyer)
Feb 1993.	UVL Lauder	Cross calibration at Lauder (Seckmeyer, Roy)
Jan 1993.	UVM Lauder	Bentham DM300 -with integrating sphere Obs began at Lauder
Dec 1993.	UVM Lauder	Reliable measurements began at Lauder
Jul 1994.	UVL Garmisch	Cross calibration in Garmisch-P, Germany
Oct 1994.	UVM Lauder	Wavelength drive replaced.
Feb 1995.	UVL Lauder	Albedo measurements. Last routine UVL obs at Lauder
Jul 1995.	UVL Hawaii	Mounted in weatherproof box. Installed at MLO (NOAA).
Aug 1996.	UVL Hawaii	Testing sensitivity to rotation
Jun 1997.	UVL Hawaii	Instrument damaged by lightning and removed
Aug 1997.	UV3.Greece	SUSPEN intercomparison Nea Michionia (see Bais et al)
Nov 1997.	UV3 Hawaii	NOAA Collab Bentham DTM300 observations started at MLO
Sep 1998.	UVL Boulder	Modified version with new diffuser/fibre optic installed at Boulder
Sep 1998.	UVM Lauder	Integrating sphere replaced with diffuser/fibre optic
Mar 1999.	UVL Boulder	Moved to new lab in Skaggs building

May 1999.	UVL Boulder	Fibre optic broken. Replaced day 168
Sep 1999.	UV4 Boulder	Instrument installed day 251
Nov 1999.	UVL Boulder	Instrument decommissioned. Returned to Lauder
Nov 2000.	UV6 AliceSpr.	Australian BoM collaboration
May 2001.	UV4 Boulder	Moved to Table Mt for campaign, installed day 143
Jul 2001.	UV5 Boulder	NOAA Collab. Instrument, installed day 214
Oct 2001.	UV4 Boulder	Instrument decommissioned. Returned to Lauder
Nov 2001.	UV7 Darwin	Australian BoM collaboration
Jun 2003.	UV5 Boulder	USDA campaign at Boulder
Nov 2003.	UV8 Tokyo	Actinic flux measurements
Jun 2004.	UV4 Tokyo	University of Tokyo. Returned to Lauder July 2005
Jun 2005.	UV9 Thule	NDACC-cerify UV spectrometer of Danish Met Instr
Sep 2005.	UV9 Lauder	returned from Thule
Oct 2005.	UV6 AliceSpr.	Instrument damaged, returned to Melbourne & Lauder for repair
Jun 2006.	UV7 AliceSpr.	Australian BoM collaboration
Aug 2006.	UV4 Lauder	Diffuser replaced by temperature-controlled Schreder Head
Nov 2006.	UV9 Arr.Hgts.	NDACC-certify Biopsherical's NSF UV spectrometer
Feb 2007.	UV9 Lauder	returned from Arr.Hgts.
May 2007.	UV7 AliceSpr.	Temperature Control of instrument failed, instrument turned off until repaired in March 2008
Mar 2008.	UV7 AliceSpr.	Good data resumed
Mar 2008.	UV5 Boulder	Noisey data produced by new logging PC, will be reprocess at later data
Mar 2008.	UVM Lauder	Logging PC failed & replaced
Jun 2008.	UV5 Boulder	Logging PC replaced good data resumed
May 2009.	UV6 Melbourne	Australian BoM collaboration, good data resumed
Aug 2009.	UV5 Boulder	Temperature Control of instrument failed, instrument turned off until repaired in Sept 2009
Oct 2009.	UV5 Boulder	Temperature Control of instrument restored 26 Oct
Jun 2011.	UV4 Lauder	Instrument off line during work to building. Substituted UVM data for Mar-Jul 2011
May 2012.	UV5 Boulder	Level left on top of entrance optic for 8 days 8-16 May 2013

The data processing algorithm has undergone many revisions, which will continue.

June 2000.	Processing version : uvp25.exe (ms Quick Basic)
July 2005.	Current processing version : uvp3.6.exe (ms Visual Basic)