Package 'photobiologySensors'

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Type Package

Title Spectral Response Data for Light Sensors

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Description Spectral response data for broadband ultraviolet and visible radiation sensors. Different data sources were used: author-supplied data from scientific research papers, sensor-manufacturer supplied data, and published sensor specifications. Part of the 'r4photobiology' suite Aphalo P. J. (2015) <doi:10.19232/uv4pb.2015.1.14>.

License GPL (>= 2)

VignetteBuilder knitr

Depends R (>= 3.6.0), photobiology (>= 0.10.5)

Suggests knitr (>= 1.29), rmarkdown (>= 2.4), photobiologyWavebands (>= 0.4.4), ggspectra (>= 0.3.6), ggplot2 (>= 3.3.2)

LazyLoad yes

LazyData yes

ByteCompile true

Encoding UTF-8

URL https://www.r4photobiology.info, https://bitbucket.org/aphalo/photobiologysensors

BugReports https://bitbucket.org/aphalo/photobiologysensors/issues

RoxygenNote 7.1.1

NeedsCompilation no

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`photobiologySensors-package`

photobiologySensors: Spectral Response Data for Light Sensors

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Description

Spectral response data for broadband ultraviolet and visible radiation sensors. Different data sources were used: author-supplied data from scientific research papers, sensor-manufacturer supplied data, and published sensor specifications. Part of the 'r4photobiology' suite Aphalo P. J. (2015) <doi:10.19232/uv4pb.2015.1.14>.

Details

Data for response spectra for different types of broadband sensors. The package contains one collection of spectra for different broadband sensors.

In addition to the spectra the package provides character vectors of names to be used as indexes to subset groups of spectra. In many cases spectral data are normalized to spectral energy responsiveness equal to one at the wavelength of maximum spectral energy response (peak sensitivity).

A list of data frames contains angular response data for some of the same broadband sensors and some cosine diffusers used with spectrometers.

The data in this package are not original. Some have been provided by authors of scientific publications and manufacturers. However, most of the spectra have been digitized from manufacturer's brochures and manuals available on web sites.

Warning!

The spectral data included in this package are not all based on supplier's specifications and are only for information. The exact response spectrum depends to some extent on testing conditions, but more importantly varies among individual sensor units. Spectral specifications are usually given as typical values. All the sensors for which data are presented here need periodic calibration. In other words, the data provided here are not a substitute for actual calibration under measuring conditions for each individual sensor unit. For less demanding situations like roughly assessing the suitability of sensors or the need or not of a transfer calibration, the data are good enough. They can be especially useful in teaching.

Author(s)

Maintainer: Pedro J. Aphalo <pedro.aphalo@helsinki.fi> (ORCID)

References

Aphalo, Pedro J. (2015) The r4photobiology suite. UV4Plants Bulletin, 2015:1, 21-29. https://doi.org/10.19232/uv4pb.2015.1.14.

See Also

Useful links:

- https://www.r4photobiology.info
- https://bitbucket.org/aphalo/photobiologysensors
- Report bugs at https://bitbucket.org/aphalo/photobiologysensors/issues

Examples

```
library(photobiology)
library(photobiologyWavebands)
library(ggspectra)

names(sensors.mspct)

licor_sensors
par_sensors
intersect(par_sensors, licor_sensors)

photon_as_default()

response(sensors.mspct$LICOR_LI_190, w.band = PAR(), quantity = "contribution.pc")

plot(sensors.mspct$LICOR_LI_190, w.band = PAR(), label.qty = "contribution.pc")
```

berger_sensors *'Berger' UV-Biometer*

Description

A vector of indeces for stracting subsets of spectra from the `sensors.mspct` object.

Usage

```
berger_sensors
```

Format

A character vector of members of the collection of spctra.

Note

'Berger' UV-Biometer (Fig. 1 in Berger, 1994). Digitized with 'enguage' from manufacturers brochures. These are approximate data, both because of the digitizing process, and because they are either typical values or for a particular sensor unit. Individual sensor units are expected to differ to some degree in spectral response.

References

Berger, Daniel (n.d., ca. 1994) A comparison of Spectroradiometers to Radiometers for UV Radiation Measurements. Solar Light Co., Inc., Philadelphia.

Examples

```
berger_sensors
```

deltat_sensors *Delta-T sensors*

Description

A vector of indeces for stracting subsets of spectra from the `sensors.mspct` object.

Usage

```
deltat_sensors
```

Format

A character vector of members of the collection of spctra.

Note

Spectral data digitized from figure in manufacturer's manual. These are typical measured data, and for specific sensor units the calibration data supplied with the sensor must be used as individual units may differ in their spectral response. Furthermore, the digigitizing process from figures with a linear scale is prone to errors, which are specially noticeable in regions of low responsivity.

Manufacturer: Delta-T Devices Ltd, CAMBRIDGE CB25 0EJ, UK https://www.delta-t.co.uk/

References

Manufacturer's User Manual Version: 1.0 dated Nov 2010

Examples

```
deltat_sensors
```

---

diffusers.lst *Angular response of sensors*

Description

A collection of angular response data for selected broadband sensors used for measuring ultraviolet and visible radiation and of cosine diffusers used with spectrometers. Each data frame in the collection contains three variables, angle.deg (degrees) at either regular or irregular intervals, response relative to the maximum (as a fraction of one) and response relative to a perfect cosine response(as a fraction of one). Data are either from manufacturer specifications or independent measurements reported in the scientific literature.

Usage

```
diffusers.lst
```

Format

A `response_mspct` object containing a `response_spct` objects as *named* members.

Each member spectrum contains three variables:

- angle.deg (degrees)
- response (/1)
- response.over.cosine (/1)

Note

Values are only good as reference, as individual sensors and diffuser deviate to a smaller or lager extent from typical or mean responses.

Examples

```
names(diffusers.lst)
```

`ideal_sensors` *Idealized sensors*

Description

A vector of indexes for extracting subsets of spectra from the `sensors.mspct` object.

Usage

```
ideal_sensors
```

Format

A character vector of members of the collection of spectra.

Note

Flat response to spectral energy irradiance and to spectral photon irradiance.

Examples

```
ideal_sensors
```

`kipp_sensors` *Kipp Radiometers.*

Description

A vector of indeces for stracting subsets of spectra from the `sensors.mspct` object.

Usage

```
kipp_sensors
```

Format

A character vector of members of the collection of spctra.

Details

Kipp CUV 5 Broadband UV Radiometer: Detection system includes optical filters and a photodiode.

Kipp PQS 1 PAR Quantum Sensor: Detection system includes optical filters and a photodiode.

UVS-A-T Radiometer, UVS-B-T Radiometer, Kipp UVS-E-T Erythemal Radiometer: The detection system includes optical filters and a phosphor that determine the spectral response. The phosphor is very sensitive to low levels of ultraviolet radiation and is stimulated by the UV to emit green light, which is detected by a photodiode. The system is temperature stabilised at +25 °C to prevent changes in spectral response and sensitivity with variations in the ambient conditions.

Manufacturer: Kipp & Zonen B.V., Delftechpark 36, 2628 XH Delft, Nederlands. https://www.kippzonen.com/

Note

Digitized with 'enguage' from manufacturers brochures. These are approximate data, both because of the digitizing process, and because they are either typical values or for a particular sensor unit. Individual sensor units are expected to differ to some degree in spectral response.

References

Brochure 'Broadband UV Radiometers', Brochure 'PQS 1 PAR Quantum Sensor', Brochure 'Broadband UV Radiometers'.

Examples

```
kipp_sensors
```

`licor_sensors` *LI-COR sensors*

Description

A vector of indeces for extracting subsets of spectra from the `sensors.mspct` object.

Usage

```
licor_sensors
```

Format

A character vector of members of the collection of spctra.

Details

In the LI-190 PAR quantum sensor (PAR = photosynthetically active radiation) colored glass filters are used to tailor the silicon photodiode response to the desired quantum response.

The LI-200SA features a silicon photovoltaic detector. This is not a true 'pyranometer' and should be used only in sunlight, and calibrated in sunlight.

The LI-210SA Photometric Sensor utilizes a filtered silicon photodiode to provide a spectral response that matches the CIE curve within ± 5

Note

Digitized with 'engauge' from manufacturers brochures. These are approximate data, both because of the digitizing process, and because they are either typical values or for a particular sensor unit. Individual sensor units are expected to differ to some degree in spectral response.

Manufacturer: LI-COR Inc., Lincoln, Nebraska https://www.licor.com/

References

Brochure from manufacturer.

Examples

```
licor_sensors
```

---

sensors.mspct *Spectral response of sensors*

Description

A collection of response spectra for various broadband sensors used for measuring ultraviolet and visible radiation. Each spectrun in the collection contains two variables, wavelengths (nm) at either regular or irregular intervals and spectral responsiveness (in energy units). Spectral data are in most cases normalized to one at the wavelength of maximum energy responsivity. Absolute calibration values are given only for data from a publication which reports on mulstiple units of the same type.

Usage

```
sensors.mspct
```

Format

A `response_mspct` object containing a `response_spct` objects as *named* members.

Each member spectrum contains two variables, with responsivity in most cases in relative energy units:

- w.length (nm)
- s.e.response (r.u.)

Note

In addition to this object containing the spectral data, this package provides character vectors useful for subsetting spectra by supplier, type, color, etc.

See Also

source_spct and generic_mspct

Examples

```
names(sensors.mspct)
```

---

sglux_sensors *sglux broadband sensors*

Description

A vector of indexes for extracting subsets of spectra from the sensors.mspct object.

Usage

```
sglux_sensors
```

Format

A character vector of members of the collection of spectra.

Details

sglux SG01D-A UV-A broadband sensor (filtered SiC sensor).

sglux SG01D-B UV-B broadband sensor (filtered SiC sensor, VIS-blind).

sglux SG01D-C UV-C broadband sensor (filtered SiC sensor, "solar-blind").

sglux SG01L SiC broadband sensor (SiC sensor not filtered).

sglux TOCON blue 4 blue light broadband sensor (pre-amplified GaP detector).

TOCON preamplified sensors with similar spectral response as the diodes are also available from sglux. The blue light sensor is only available as preamplified TOCON. Sensors are available in different configurations with different sensitivity and with different angular responses, and encased to resist different environmental conditions.

Manufacturer: sglux GmbH, Richard-Willstätter-Str. 8, 12489 Berlin, Germany. https://sglux.de/en/

Note

Original data supplied by the manufacturer as a computer readable file. These are typical measured data. Individual sensor units are expected to differ to a small degree in spectral response.

References

personal communication from Dr.\ Stefan Langer.

Examples

```
sglux_sensors
```

`skye_sensors` *Skye-Instruments Sensors*

Description

A vector of indexes for extracting subsets of spectra from the `sensors.mspct` object.

Usage

```
skye_sensors
```

Format

A character vector of members of the collection of spectra.

Details

Skye PAR quantum Sensor SKP215, Skye PAR energy sensor SKE510, Skye Lux sensor SKL310, Skye PAR 'Special' Sensor SKP210, Skye PAR quantum Sensor SKP215, Skye 660/730 Sensor (Red/Far Red) Sensor SKR110 (red and far-red channels), Skye Pyranometer Sensor SKS1110, Skye UV-A Sensor Sensor SKU421, Skye UV-A Sensor Sensor SKU421 V. 3, Skye UV-B Sensor Sensor SKU430 V. 3, Skye UVI Sensor Sensor SKU440 V. 3.

Manufacturer: Skye Instruments, Llandrindod Wells, Powys, UK https://www.skyeinstruments.com/

Note

Spectral data digitized from figures in manufacturer's manuals. These are typical measured data, and for specific sensor units the calibration data supplied with the sensor must be used as individual may differ in their spectral response. Furthermore, the digigitizing process from figures with a linear scale is prone to errors, which are specially noticeable in regions of low responsivity.

References

Manufacturer's brochure for 'SKP215' dated 2007-10-03. Manufacturer's brochure for 'SKP510' dated 2007-10-02. Manufacturer's brochure for 'SKL310' dated 2007-10-09 Manufacturer's brochure for 'SKP210' dated 2007-10-03 Manufacturer's brochure for 'Skye 660/730 Sensor (Red/Far Red) Sensor SKR110' dated 2007-10-09 Manufacturer's brochure 'Skye Pyranometer Sensor SKS1110' dated 2009-08-19 Manufacturer's 'UV-A, UV-B & UV-I Sensors' Manual, Iss. 1.1 Manufacturer's 'SKU 421 UVA Sensor' V. 3 brochure, not dated, dowloaded on 2015-01-24 Manufacturer's 'SKU 430 UVB Sensor' V. 3 brochure, not dated, dowloaded on 2015-01-24 Manufacturer's 'SKU 440 UV Index Sensor' V. 3 brochure, not dated, dowloaded on 2015-01-24

KJ McCree. The action spectrum, absorbance and quantum yield of photosynthesis in crop plants. Agricultural Meteorology. 1971/72 Vol 9, pp 191-216

Examples

```
skye_sensors
```

`solarlight_sensors` *Solar Light sensors*

Description

A vector of indexes for extracting subsets of spectra from the `sensors.mspct` object.

Usage

```
solarlight_sensors
```

Format

A character vector of members of the collection of spectra.

Details

Solar Light UVB biometer model 501 (units with high and low UV-A sensitivity, and a typical unit). Data from an intercomparison.

Manufacturer: Solar Light Company, Glenside, PA, U.S.A.

Source

Data kindly made available by Lasse Ylianttila. These are the responses from a unit with higher and lower response to UVA radiation than typical units, as well as the response for a typical unit as observed in an instrument intercomparison.

References

Leszczynski K, Jokela K, Ylianttila L, Visuri R, Blumthaler M. 1997. Report of the WMO/STUK Intercomparison of erythemally-weighted solar UV radiometers (Spring/Summer 1995, Helsinki, Finland). WMO-GAW Report No. 112, 90 pages.

Leszczynski K, Jokela K, Ylianttila L, Visuri R, Blumthaler M. 1998. Erythemally weighted radiometers in solar UV monitoring: results from the WMO/STUK Intercomparison. Photochem. Photobiol. 67(2):212-221.

https://solarlight.com/product/uvb-biometer-model-501-radiometer/

Examples

```
solarlight_sensors
```

`solarmeter_sensors` *Solarmeter devices*

Description

A vector of indexes for extracting subsets of spectra from the `sensors.mspct` object.

Usage

```
solarmeter_sensors
```

Format

A character vector of members of the collection of spectra.

Details

SOLARMETER MODEL 6.0 UV METER: Silicon Carbide (SIC) Photodiode packaged in hermetically sealed UV glass window cap. Interference filter coating (Metal Oxide) blocks most UVA.

Manufacturer: Solartech, Inc., 26101 Harbour Pointe Dr N., Harrison Twp, MI 48045

Note

Digitized with 'enguage' from manufacturers brochures. These are approximate data, both because of the digitizing process, and because they are either typical values or for a particular sensor unit. Individual sensor units are expected to differ to some degree in spectral response.

References

digitized from SM60graph.gif obtained from https://www.solarmeter.com/ on 20 December 2013.

Examples

```
solarmeter_sensors
```

`thiesclima_sensors` *Thies Clima sensors*

Description

A vector of indexes for extracting subsets of spectra from the `sensors.mspct` object.

Usage

```
thiesclima_sensors
```

Format

A character vector of members of the collection of spectra.

Details

Thies Clima E1.c broadband UVB sensor

Manufacturer: Thies Clima, Göttingen, DE https://www.thiesclima.com/

Source

Digitized with 'DigitizeIt' from manufacturers manual. These are approximate data, both because of the digitizing process, and because they are either typical values or for a particular sensor unit. Individual sensor units are expected to differ to some degree in spectral response.

Examples

```
thiesclima_sensors
```

uv_sensors *Sensors responsive to different wavebands*

Description

Names of datasets containing the wavelengths and tabulated values spectral responsivity for broadband sensors from various suppliers.

Usage

```
uv_sensors

uvc_sensors

uvb_sensors

erythemal_sensors

uva_sensors

par_sensors

vis_sensors

photometric_sensors

shortwave_sensors

pyranometer_sensors

red_sensors

far_red_sensors

blue_sensors

multichannel_sensors
```

Format

A vector of character strings.

An object of class `character` of length 1.

An object of class `character` of length 4.

An object of class `character` of length 8.

An object of class `character` of length 4.

An object of class `character` of length 6.

An object of class `character` of length 2.

An object of class `character` of length 2.

An object of class `character` of length 2.

An object of class `character` of length 2.

An object of class `character` of length 1.

An object of class `character` of length 1.

An object of class `character` of length 1.

An object of class `character` of length 2.

See Also

`sensors.mspct`

Examples

```
uv_sensors
uvc_sensors
uvb_sensors
uva_sensors
par_sensors
vis_sensors
shortwave_sensors
red_sensors
far_red_sensors
blue_sensors
multichannel_sensors

# select PAR sensors
sensors.mspct[par_sensors]
```

---

vitaltech_sensors *Vital Technologies sensors*

Description

A vector of indexes for extracting subsets of spectra from the `sensors.mspct` object.

Usage

```
vitaltech_sensors
```

Format

A character vector of members of the collection of spectra.

Details

Vital "Blue Wave" BW-20 UV-B "erythemal" radiometer. Data for a specific unit included in a sensor intercomparison event.

Manufacturer: Vital Technologies, Canada. Company no longer in business.

Source

Data kindly made available by Lasse Ylianttila.

References

Leszczynski K, Jokela K, Ylianttila L, Visuri R, Blumthaler M. 1997. Report of the WMO/STUK Intercomparison of erythemally-weighted solar UV radiometers (Spring/Summer 1995, Helsinki, Finland). WMO-GAW Report No. 112, 90 pages.

Leszczynski K, Jokela K, Ylianttila L, Visuri R, Blumthaler M. 1998. Erythemally weighted radiometers in solar UV monitoring: results from the WMO/STUK Intercomparison. Photochem. Photobiol. 67(2):212-221.

Examples

```
vitaltech_sensors
```

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