Package 'photobiologyPlants'

June 15, 2019

Type Package

Title Plant Photobiology Related Functions and Data

Version 0.4.2

Date 2019-06-09

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Description Provides functions for quantifying visible (VIS) and ultraviolet (UV) radiation in relation to the photoreceptors Phytochromes, Cryptochromes, and UVR8 which are present in plants. It also includes data sets on the optical properties of plants. Part of the 'r4photobiology' suite, Aphalo P. J. (2015) <doi:10.19232/uv4pb.2015.1.14>.

License GPL (>= 2)

VignetteBuilder knitr

Depends R (>= 3.5.0), photobiology (>= 0.9.28), photobiologyWavebands (>= 0.4.3)

Suggests knitr (>= 1.23), rmarkdown (>= 1.13), ggplot2 (>= 3.1.1), ggspectra (>= 0.3.2)

LazyLoad yes

LazyData yes

ByteCompile true

Encoding UTF-8

URL https://www.r4photobiology.info/
https://bitbucket.org/aphalo/photobiologyplants

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

RoxygenNote 6.1.1

NeedsCompilation no

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Repository CRAN

Date/Publication 2019-06-14 22:13:25 UTC

R topics documented:

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photobiologyPlants-package

photobiologyPlants: Plant Photobiology Related Functions and Data

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Description

Provides functions for quantifying visible (VIS) and ultraviolet (UV) radiation in relation to the photoreceptors Phytochromes, Cryptochromes, and UVR8 which are present in plants. It also includes data sets on the optical properties of plants. Part of the 'r4photobiology' suite, Aphalo P. J. (2015) <doi:10.19232/uv4pb.2015.1.14>.

Details

Package 'photobiologyPlants' is part of a suite of packages for analysis and plotting of data relevant to photobiology (described at http://www.r4photobiology.info/). The current component package provides functions and data related to plant photoreceptors, light dependent reponses and optical properties of plants.

Acknowledgements

Author(s)

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References

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

Aphalo, P. J., Albert, A., Bjoern, L. O., McLeod, A. R., Robson, T. M., Rosenqvist, E. (Eds.). (2012). Beyond the Visible: A handbook of best practice in plant UV photobiology (1st ed., p. xxx + 174). Helsinki: University of Helsinki, Department of Biosciences, Division of Plant Biology. ISBN 978-952-10-8363-1 (PDF), 978-952-10-8362-4 (paperback). Open access PDF download available at http://hdl.handle.net/10138/37558

Mancinelli, A.L. (1994) The physiology of phytochrome action. In Photomorphogenesis in plants, 2nd edition. R.E. Kendrick and G.H.M. Kronenberg, eds. Kluwer Academic Publishers, Dordrecht, pp. 211-269. ISBN 978-0-7923-2551-2 (print), 978-94-011-1884-2 (on-line). https://doi.org/10.1007/978-94-011-1884-2_10.

Banerjee, R., Schleicher, E., Meier, S., Viana, R. M., Pokorny, R., Ahmad, M., ... Batschauer, A. (2007). The signaling state of Arabidopsis cryptochrome 2 contains flavin semiquinone. J Biol Chem, 282(20), 14916-14922. https://doi.org/10.1074/jbc.M700616200.

See Also

Package photobiology-package

Betula_ermanii.mspct   *Spectral data for 'Betula ermanii' leaves*

Description

A dataset containing for wavelengths at a 1 nm interval in the range 350 to 1000 nm, tabulated values for total reflectance and total transmittance, for the upper and lower epidermis of leaves of different ages from 'Betula ermanii' trees growing in the forest in Japan.

The variables in each spectrum are as follows:

- w.length (nm)
- Rfr
- Tfr

Usage

```
Betula_ermanii.mspct
```

Format

object_mspct collection object with six object_spct member objects, each with 651 rows and 3
variables

Note

We thank H. M. Noda for allowing us to include these data in our package. We have included here
only data for two leaves from one species (Betula ermanii) and for wavelengths shorter than 1000
nm, from the much larger original data set. The whole data set is publicly available and the data easy
to read into R. The data included here where measured with a Li-Cor LI-1800 spectroradiometer
equipped with a LI-1800-12 (Li-Cor) integrating sphere, and consequently are for total reflectance
and total transmittance. Further details on methods are available through the JaLTER web site. If
you use these data in a publication, please cite the original source as given under references and
contact the original author.

References

Noda H. 'Reflectance and transmittance spectra of leaves and shoots of 22 vascular plant species
and reflectance spectra of trunks and branches of 12 tree species in Japan' ERDP-2013-02.1.1
(http://db.cger.nies.go.jp/JaLTER/metacat/metacat/ERDP-2013-02.1.1/jalter-en)
JaLTER, Japan Long Term Ecological Research Network, http://www.jalter.org/

B_G   *Calculate B:G photon ratio from spectral irradiance.*

Description

This function returns the blue:green photon ratio of a light source spectrum.

Usage

```
B_G(spct, std = "Sellaro", use.cached.mult = FALSE,
  use.hinges = TRUE)
```

Arguments

spct	an object of class "source.spct"
std	select which definition of blue and green should be used, defaults to "Sellaro"
use.cached.mult	
	logical indicating whether multiplier values should be cached between calls
use.hinges	logical indicating whether to use hinges to reduce interpolation errors

Value

a single numeric nondimensional value giving the B:G photon ratio, with name attribute set to the name of the wavebands, with "(q:q)" appended.

Examples

```
B_G(sun.spct)
```

---

carotenoids.mspct   *Absorbance spectra for carotenoids.*

Description

A dataset containing the wavelengths at an arbitrary nm interval. Tabulated values for the in vitro absorbance spectrum of beta-carotene, lutein, lycopene, 3-4,di-hydro-lycopene, phytoene, phytofluene, violaxanthin and zeaxanthin. Data were digitized from plots downloaded from Lipid-Base (<http://lipidbank.jp/>), The official database of Japanese Conference on the Biochemistry of Lipids (JCBL). Data contributed to LipinBank by Takaichi Sinichi.

Format

A `filter_mspct` with eight member `filter_spct` objects each with 300 rows and 2 numeric variables, `w.length` and `A`

Details

The variables of the member spectra are as follows:

- w.length (nm)
- A (spectral absorbance)

Note

If you use these data in a publication, please cite also the original source as given under references.

References

Watanabe K., Yasugi E. and Oshima M. "How to search the glycolipid data in LIPIDBANK for Web: the newly developed lipid database" Japan Trend Glycosci. and Glycotechnol. 12, 175-184, 2000.

Examples

```
names(carotenoids.mspct)
getWhatMeasured(carotenoids.mspct[[1]])
```

| chlorophylls.mspct | *Absorbance spectra for chlorophylls.* |

Description

Optical absorption spectra of chlorophyll a in methanol and chlorophylls a and by in diethyl ether containing the wavelengths at 1 nm interval.

Format

A `filter_mspct` with three member `filter_spct` objects each with variable number of rows and 2 numeric variables, `w.length` and `A`

Details

The variables of the member spectra are as follows:

- w.length (nm)

- A (spectral absorbance)

Data from PhotochemCAD 2.1a has been munged on 2 June 2017 by Scott Prahl (https://omlc.org/) to make the information available to non-Windows users. Although he has tried to be as careful as possible, he may have introduced some error; the cautious user is advised to compare these results with the original sources at https://www.photochemcad.com/ (Du et al., 1998; Dixon et al., 2005).

The spectral absorption measurements of chlorophyll a in methanol, chlorophyll a and chlorophyll b in diethyl ether were made by J. Li on 12-11-1997 using a Cary 3. The absorption values were collected using a spectral bandwidth of 1.0 nm, a signal averaging time of 0.133 sec, a data interval of 0.25 nm, and a scan rate of 112.5 nm/min.

Chlorophyll a measurements were scaled to make the molar extinction coefficient match the value of 111700 cm-1/M at 417.8 nm. These values were then interpolated to report extinction coefficients at regular 1nm intervals. The reported molar extinction coefficient is from Strain et al. (1963).

Chlorophyll b measurements were scaled to make the molar extinction coefficient match the value of 159100 cm-1/M at 453.0 nm. These values were then interpolated to report extinction coefficients at regular 1nm intervals. The reported molar extinction coefficient is from Vernon and Seely (1966).

Note

If you use these data in a publication, please cite also the original sources as given under references. For more information please visit https://omlc.org/.

References

J. M. Dixon, M. Taniguchi and J. S. Lindsey "PhotochemCAD 2. A refined program with accompanying spectral databases for photochemical calculations", Photochem. Photobiol., 81, 212-213, 2005.

H. Du, R. A. Fuh, J. Li, A. Corkan, J. S. Lindsey, "PhotochemCAD: A computer-aided design and research tool in photochemistry," Photochem. Photobiol., 68, 141-142, 1998.

Strain, H. H., M. R. Thomas and J. J. Katz (1963) Spectral absorption properties of ordinary and fully deuteriated chlorophylls a and b. Biochim. Biophys. Acta 75, 306-311.

Vernon, L. P. and G. R. Seely (1966) The chlorophylls. Academic Press, NY.

Examples

```
names(chlorophylls.mspct)
getWhatMeasured(chlorophylls.mspct[[1]])
```

---

chlorophylls_fluorescence.mspct

Fluorescence emission spectra for chlorophylls.

Description

Optical absorption spectra of chlorophyll a in methanol and chlorophylls a and by in diethyl ether containing the wavelengths at 1 nm interval.

Format

A `filter_mspct` with three member `filter_spct` objects each with variable number of rows and 2 numeric variables, `w.length` and `A`

Details

The variables of the member spectra are as follows:

- w.length (nm)
- A (spectral absorbance)

Data from PhotochemCAD 2.1a has been munged on 2 June 2017 by Scott Prahl (https://omlc.org/) to make the information available to non-Windows users. Although he has tried to be as careful as possible, he may have introduced some error; the cautious user is advised to compare these results with the original sources at https://www.photochemcad.com/ (Du et al., 1998; Dixon et al., 2005).

Fluorescence emission was measured using a Spex FluoroMax. The excitation and emission monochromators were set at 1 mm, giving a spectral bandwidth of 4.25 nm. The data interval was 0.5 nm and the integration time was 2.0 sec. Samples were prepared in 1cm pathlength quartz cells with absorbance less than 0.1 at the excitation and all emission wavelengths to uniformly illuminate across the sample, and to avoid the inner-filter effect. The dark counts were subtracted and the spectra were corrected for wavelength-dependent instrument sensitivity.

Note

If you use these data in a publication, please cite also the original sources as given under references. For more information please visit https://omlc.org/.

References

J. M. Dixon, M. Taniguchi and J. S. Lindsey "PhotochemCAD 2. A refined program with accompanying spectral databases for photochemical calculations", Photochem. Photobiol., 81, 212-213, 2005.

H. Du, R. A. Fuh, J. Li, A. Corkan, J. S. Lindsey, "PhotochemCAD: A computer-aided design and research tool in photochemistry," Photochem. Photobiol., 68, 141-142, 1998.

Examples

```
names(chlorophylls_fluorescence.mspct)
getWhatMeasured(chlorophylls_fluorescence.mspct[[1]])
```

CRYs.mspct   *CRY1, CRY2 and CRY3 absorbance spectra.*

Description

A dataset containing the wavelengths at an arbitrary nm interval. Tabulated values for the in vitro absorbance spectrum of CRY1, CRY2, CRY3 for Arabidopsis. CRY1 data were digitized from figure 1, curve "dark" and curve "30 min illumination" in Zeugnwer et al. (2005). The CRY2 data were digitized from Figure 1.B, curve "dark adapted sample", and curve "irradiated with blue light (450 nm, 50 umol m-2 s-1) during 30 min" in Banerjee et al. (2007). CRY3 data were digitized from figure 2a, curve "cry3" in Song et al. (2006).

Format

A `filter_mspct` with five member `filter_spct` objects each with 300 rows and 2 numeric variables, `w.length` and `A`

Details

The variables of the member spectra are as follows:

- w.length (nm)
- A (spectral absorbance)

Note

If you use these data in a publication, please cite also the original source as given under references.

References

Banerjee, R., Schleicher, E., Meier, S., Viana, R. M., Pokorny, R., Ahmad, M., ... Batschauer, A. (2007) The signaling state of Arabidopsis cryptochrome 2 contains flavin semiquinone. J Biol Chem, 282(20), 14916-14922. doi:10.1074/jbc.M700616200

SONG, S.-H., B. DICK, , A. PENZKOFER, , R. POKORNY, , A. BATSCHAUER, L.-O. ESSEN (2006) Absorption and fluorescence spectroscopic characterization of cryptochrome 3 from Arabidopsis thaliana. Journal of Photochemistry and Photobiology B: Biology. 85(1):1-16.

ZEUGNER, A., MARTIN BYRDIN, JEAN-PIERRE BOULY, NADIA BAKRIM, BALDISSERA GIOVANI, KLAUS BRETTEL, MARGARET AHMAD (2005) Light-induced Electron Transfer in Arabidopsis Cryptochrome-1 Correlates with in Vivo Function. Journal of Biological Chemistry. 280(20):19437-19440.

McCree_photosynthesis.mspct

McCree's action spectra for whole-leaf photosynthesis.

Description

The 'classical' action spectra of K. J. McCree (1972) for Amaranthus edulis Speg. var. UCD 1966 and Avena sativa L. var. Coronado are included in this data set. Response is net CO2 uptake measured of leaf sections. Light source was a xenon-arc lamp fitted with a monochromator. Irradiance was in the range 10 to 15 W m^{-2}.

Format

A response_mspct object with two member response_spct objects each with 300 rows and 2 numeric variables, w.length and s.e.response.

Note

Digitised from bitmap of from the original publicatiom.

If you use these data in a publication, please cite also the original source as given under references.

References

McCree, K. J. (1972) Significance of Enhancement for Calculations Based on the Action Spectrum for Photosynthesis. Plant Physiology, 49, 704-706. Fig. 1, AMARANTH

| Pfr_Ptot | *Calculate phytochrome photoequilibrium* |

Description

A method implemented for objects of different classes.

Usage

```
Pfr_Ptot(x, ...)

## Default S3 method:
Pfr_Ptot(x, ...)

## S3 method for class 'numeric'
Pfr_Ptot(x, spct.out = length(x) > 20, ...)

## S3 method for class 'source_spct'
Pfr_Ptot(x, ...)
```

Arguments

x	an R object
...	not used
spct.out	logical Flag indicating if the returned object should be of class `response_spct` instead of `numeric`.

Value

If x is numeric, giving wavelengths (nm), a vector of numeric values giving the unitless photon ratio at each wavelength or a `generic_spct` object with the wavelength values sorted in ascending order and the corresponding Pfr_Ptot values in column s.q.response.

If x is a `source_spct` object, a single numeric value giving the unitless photon ratio

Methods (by class)

- `default`: Default for generic function
- `numeric`: Specialization for numeric
- `source_spct`: Specialization for source_spct
  Calculate phytochrome photoequilibrium from spectral (photon) irradiance

Note

If you use these data in a publication, please cite also the original source as given under references.

References

Mancinelli, A.L. (1994) The physiology of phytochrome action. In Photomorphogenesis in plants, 2nd edition. R.E. Kendrick and G.H.M. Kronenberg, eds. Kluwer Academic Publishers, Dordrecht, pp. 211-269. ISBN 978-0-7923-2551-2 (print), 978-94-011-1884-2 (on-line). DOI 10.1007/978-94-011-1884-2_10

Pfr_Ptot_R_FR	*Pr:Ptot ratio (photoequilibrium) from R:FR photon ratio.*

Description

Calculation of Pfr:Ptot ratio for Type I Phytochrome from red:far-red photon ratio. "Exact" only for dichromatic irradiation, only approximate for R:FR ratio calculated from a broadband light source.

Usage

```
Pfr_Ptot_R_FR(R.FR)
```

Arguments

R.FR   R:FR a single value or a vector of photon ratio (unitless) values

Value

a single value or a vector of numeric values giving the Pr:Ptot unitless ratio

References

Mancinelli, A.L. (1994) The physiology of phytochrome action. In Photomorphogenesis in plants, 2nd edition. R.E. Kendrick and G.H.M. Kronenberg, eds. Kluwer Academic Publishers, Dordrecht, pp. 211-269. ISBN 978-0-7923-2551-2 (print), 978-94-011-1884-2 (on-line). DOI 10.1007/978-94-011-1884-2_10

See Also

q_ratio

Examples

```
Pfr_Ptot_R_FR(1.15)
Pfr_Ptot_R_FR(0.10)
Pfr_Ptot_R_FR(c(0.1,1.15,5.0,20.0))
```

PHOTs.mspct   *PHOT1 and PHOT2 absorbance spectra.*

Description

A dataset containing the wavelengths at an arbitrary nm interval. Tabulated values for the in vitro absorbance spectrum of PHOT1 LOV2 domain for fluorescence yield of PHOT1 and PHOT2 from Arabidopsis measured in vitro. PHOT1 fluorescenve yield data were digitized from figure 1a curve "LOV1 + LOV2 (WT) and PHOT2 fluorescenve yield data were digitized from figure 7a curve "LOV1 + LOV2 (WT) in Christie et al. (2002). PHOT1 LOV2, dark adapted, spectral absorbance data were digitized from figure 3, black curve and PHOT1 LOV2, blue-light adapted spectral absorbance data were digitized from figure 3, blue curve in Christie et al. (2015).

Format

A `filter_mspct` with five member `filter_spct` objects each with 300 rows and 2 numeric variables, `w.length` and `A`

Details

The variables of the member spectra are as follows:

- w.length (nm)
- A (spectral absorbance)

Note

If you use these data in a publication, please cite also the original source as given under references.

References

CHRISTIE, John M., SWARTZ, Trevor E., BOGOMOLNI, Roberto A., BRIGGS, Winslow R. (2002) Phototropin LOV domains exhibit distinct roles in regulating photoreceptor function. The Plant Journal 32(2):205-219.

CHRISTIE, J. M., BLACKWOOD, L., PETERSEN, J., SULLIVAN, S. (2015) Plant Flavoprotein Photoreceptors. Plant and Cell Physiology. 56(3):401-413.

PHYs.mspct *Tabulated data for Phytochrome Sigma*

Description

A dataset containing the wavelengths at a 1 nm interval. Tabulated values for Sigma R and Sigma FR for Type I Phytochrome as compiled by Mancinelli (1994).

The variables are as follows:

- wavelength (nm)
- Sigma.R (quantum effectiveness)
- Sigma.FR (quantum effectiveness)

Format

A `generic_mspct` with one member `generic_spct` object with 49 rows and 3 numeric variables, `w.length`, `Sigma.R` and `Sigma.FR`.

Note

If you use these data in a publication, please cite also the original source as given under references.

References

Mancinelli, A.L. (1994) The physiology of phytochrome action. In Photomorphogenesis in plants, 2nd edition. R.E. Kendrick and G.H.M. Kronenberg, eds. Kluwer Academic Publishers, Dordrecht, pp. 211-269. ISBN 978-0-7923-2551-2 (print), 978-94-011-1884-2 (on-line). DOI 10.1007/978-94-011-1884-2_10

Phy_reaction_rates *Phytochrome reaction rates*

Description

Rate constants k1 Pr -> Pfr; k2 Pfr -> Pr; photoconversion rate nu = k1 + k2 for Type I Phytochrome.

Usage

```
Phy_reaction_rates(w.length, s.irrad, unit.in = "energy",
  check.spectrum = TRUE, use.cached.mult = FALSE)
```

Arguments

`w.length`	numeric array of wavelength (nm)
`s.irrad`	numeric array of spectral (energy) irradiances (W m-2 nm-1) or (mol s-1 m-2)
`unit.in`	character string with allowed values "energy", and "photon", or its alias "quantum"
`check.spectrum`	logical indicating whether to sanity check input data, default is TRUE
`use.cached.mult`	
	logical indicating whether multiplier values should be cached between calls

Value

a list of three numeric values giving the photoconversion rate (nu) and reaction rates (k1, k2).

References

Hayward, P. M. (1984) Determination of phytochrome parameters from radiation measurements. In Techniques in Photomorphogenesis, H. Smith and M. G. Holmes (eds). Academic Press, London, pp. 159-173. ISBN 0-12-652990-6.

Mancinelli, A.L. (1994) The physiology of phytochrome action. In Photomorphogenesis in plants, 2nd edition. R.E. Kendrick and G.H.M. Kronenberg, eds. Kluwer Academic Publishers, Dordrecht, pp. 211-269. ISBN 978-0-7923-2551-2 (print), 978-94-011-1884-2 (on-line). DOI 10.1007/978-94-011-1884-2_10

See Also

photon_ratio and energy_ratio

Examples

```
library(photobiology)
trimmed.sun.spct <- trim_wl(sun.spct, range = c(300, 770))
with(trimmed.sun.spct, Phy_reaction_rates(w.length, s.e.irrad))
```

Phy_Sigma	*Phytochrome Sigma as a function of wavelength*

Description

Phytochrome Sigma as a function of wavelength, calculated by interpolatio from data for Type I Phytochrome as compiled by Mancinelli (1994).

Usage

```
Phy_Sigma(w.length)
```

Arguments

w.length   numeric array of wavelength (nm)

Value

a numeric array with values for Sigma

References

Mancinelli, A.L. (1994) The physiology of phytochrome action. In Photomorphogenesis in plants, 2nd edition. R.E. Kendrick and G.H.M. Kronenberg, eds. Kluwer Academic Publishers, Dordrecht, pp. 211-269. ISBN 978-0-7923-2551-2 (print), 978-94-011-1884-2 (on-line). DOI 10.1007/978-94-011-1884-2_10

See Also

`Pfr_Ptot` and `Pfr_Ptot_R_FR`

Examples

```
with(sun.data, Phy_Sigma(w.length))
```

Phy_Sigma_FR   *Pfr Sigma as a function of wavelength*

Description

Pfr Sigma as a function of wavelength, calculated by interpolatio from data for Type I Phytochrome as compiled by Mancinelli (xxxx).

Usage

```
Phy_Sigma_FR(w.length, use.cached.mult = FALSE)
```

Arguments

w.length   numeric array of wavelength (nm)

use.cached.mult

                logical ignored

Value

a numeric array with values for Sigma

References

Mancinelli, A.L. (1994) The physiology of phytochrome action. In Photomorphogenesis in plants, 2nd edition. R.E. Kendrick and G.H.M. Kronenberg, eds. Kluwer Academic Publishers, Dordrecht, pp. 211-269. ISBN 978-0-7923-2551-2 (print), 978-94-011-1884-2 (on-line). DOI 10.1007/978-94-011-1884-2_10

See Also

Phy_Sigma, Pfr_Ptot and Pfr_Ptot_R_FR

Examples

```
with(sun.spct, Phy_Sigma_FR(w.length))
with(sun.spct, Phy_Sigma_FR(w.length, TRUE))
```

Phy_Sigma_R   *Pr Sigma as a function of wavelength*

Description

Pr Sigma as a function of wavelength, calculated by interpolatio from data for Type I Phytochrome as compiled by Mancinelli (1994).

Usage

```
Phy_Sigma_R(w.length, use.cached.mult = FALSE)
```

Arguments

w.length   numeric array of wavelength (nm)

use.cached.mult

                  logical ignored

Value

a numeric array with values for Sigma

References

Mancinelli, A.L. (1994) The physiology of phytochrome action. In Photomorphogenesis in plants, 2nd edition. R.E. Kendrick and G.H.M. Kronenberg, eds. Kluwer Academic Publishers, Dordrecht, pp. 211-269. ISBN 978-0-7923-2551-2 (print), 978-94-011-1884-2 (on-line). DOI 10.1007/978-94-011-1884-2_10

See Also

Phy_Sigma, Pfr_Ptot and Pfr_Ptot_R_FR

Examples

```
with(sun.data, Phy_Sigma_R(w.length))
with(sun.data, Phy_Sigma_R(w.length, TRUE))
```

R_FR   *Calculate R:FR photon ratio from spectral irradiance.*

Description

This function returns the red:far-red photon ratio of a light source spectrum.

Usage

```
R_FR(spct, std = "Smith10", use.cached.mult = FALSE,
  use.hinges = TRUE)
```

Arguments

spct   an object of class "source.spct"

std   select which definition of red and far-red should be used, defaults to "Smith"

use.cached.mult
                    logical indicating whether multiplier values should be cached between calls

use.hinges   logical indicating whether to use hinges to reduce interpolation errors

Value

a single numeric nondimensional value giving the R:FR photon ratio, with name attribute set to the name of the wavebands, with "(q:q)" appended.

Examples

```
R_FR(sun.spct)
```

Solidago_altissima.mspct

Spectral optical data for 'Solidago altissima' leaves

Description

A dataset containing for wavelengths at a 1 nm interval in the range 350 to 1000 nm, tabulated values for total reflectance and total transmittance, for the upper and lower epidermis of one leaf from the upper part of a shoot and another one from the lower part.

The variables in each spectrum are as follows:

- w.length (nm)
- Rfr
- Tfr

Usage

Solidago_altissima.mspct

Format

`object_mspct` collection object with four `object_spct` member objects, each with 651 rows and 3 variables

Note

We thank H. M. Noda for allowing us to include these data in our package. We have included here only data for two leaves from one species (Solidago altissima) and for wavelengths shorter than 1000 nm, from the much larger original data set. The whole data set is publicly available and the data easy to read into R. The data included here where measured with a Li-Cor LI-1800 spectroradiometer equipped with a LI-1800-12 (Li-Cor) integrating sphere, and consequently are for total reflectance and total transmittance. Further details on methods are available through the JaLTER web site. If you use these data in a publication, please cite the original source as given under references and contact the original author.

References

Noda H. 'Reflectance and transmittance spectra of leaves and shoots of 22 vascular plant species and reflectance spectra of trunks and branches of 12 tree species in Japan' ERDP-2013-02.1.1 (http://db.cger.nies.go.jp/JaLTER/metacat/metacat/ERDP-2013-02.1.1/jalter-en)
JaLTER, Japan Long Term Ecological Research Network, http://www.jalter.org/

UVA_PAR *Calculate UVA:PAR photon ratio from spectral irradiance.*

Description

This function returns the UVA:PAR photon ratio of a light source spectrum.

Usage

```
UVA_PAR(spct, std = "ISO", use.cached.mult = FALSE,
  use.hinges = TRUE)
```

Arguments

spct	an object of class "source.spct"
std	select which definition of UVA should be used, defaults to "ISO"
use.cached.mult	
	logical indicating whether multiplier values should be cached between calls
use.hinges	logical indicating whether to use hinges to reduce interpolation errors

Value

a single numeric nondimensional value giving the UVA:PAR photon ratio, with name attribute set to the name of the wavebands, with "(q:q)" appended.

Examples

```
UVA_PAR(sun.spct)
```

UVA_UV *Calculate UVA:UV photon ratio from spectral irradiance.*

Description

This function returns the UVA:UV photon ratio of a light source spectrum.

Usage

```
UVA_UV(spct, std = "ISO", use.cached.mult = FALSE, use.hinges = TRUE)
```

Arguments

`spct`	an object of class "source.spct"
`std`	select which definition of UVB and UV should be used, defaults to "ISO"
`use.cached.mult`	
	logical indicating whether multiplier values should be cached between calls
`use.hinges`	logical indicating whether to use hinges to reduce interpolation errors

Value

a single numeric nondimensional value giving the UVA:UV photon ratio, with name attribute set to the name of the wavebands, with "(q:q)" appended.

Examples

```
UVA_UV(sun.spct)
```

`UVB_PAR`   *Calculate UVB:PAR photon ratio from spectral irradiance.*

Description

This function returns the UVB:PAR photon ratio of a light source spectrum.

Usage

```
UVB_PAR(spct, std = "ISO", use.cached.mult = FALSE,
  use.hinges = TRUE)
```

Arguments

`spct`	an object of class "source.spct"
`std`	select which definition of UVB should be used, defaults to "ISO"
`use.cached.mult`	
	logical indicating whether multiplier values should be cached between calls
`use.hinges`	logical indicating whether to use hinges to reduce interpolation errors

Value

a single numeric nondimensional value giving the UVB:UV photon ratio, with name attribute set to the name of the wavebands, with "(q:q)" appended.

Examples

```
UVB_PAR(sun.spct)
```

UVB_UV   *Calculate UVB:UV photon ratio from spectral irradiance.*

Description

This function returns the UVB:UV photon ratio of a light source spectrum.

Usage

```
UVB_UV(spct, std = "ISO", use.cached.mult = FALSE, use.hinges = TRUE)
```

Arguments

spct   an object of class "source.spct"

std   select which definition of UVB and UV should be used, defaults to "ISO"

use.cached.mult
                  logical indicating whether multiplier values should be cached between calls

use.hinges   logical indicating whether to use hinges to reduce interpolation errors

Value

a single numeric nondimensional value giving the UVB:UV photon ratio, with name attribute set to
the name of the wavebands, with "(q:q)" appended.

Examples

```
UVB_UV(sun.spct)
```

UVR8s.mspct   *UVR8 absorbance spectrum*

Description

A dataset containing the wavelengths at an arbitrary nm interval. Tabulated values for the in vitro
absorbance spectrum of UVR8.

Format

A `filter_mspct` object with one member `filter_spct` objects with 300 rows and 2 numeric
variables, `w.length` and `A`

Details

The variables are as follows:

- w.length (nm)
- A (spectral absorbance)

Note

If you use these data in a publication, please cite also the original source as given under references.

References

Christie, J. M., A. S. Arvai, K. J. Baxter, M. Heilmann, A. J. Pratt, A. O'Hara, S. M. Kelly, M. Hothorn, B. O. Smith, K. Hitomi, et al. (2012). Plant UVR8 photoreceptor senses UV-B by tryptophan-mediated disruption of cross-dimer salt bridges. In: Science (New York, N.Y.) 335.6075, pp. 1492-1496. DOI: 10.1126/science.1218091. (Figure S3)

Examples

```
names(UVR8s.mspct)
getWhatMeasured(UVR8s.mspct[[1]])
```

UV_PAR   *Calculate UV:PAR photon ratio from spectral irradiance.*

Description

This function returns the UV:PAR photon ratio of a light source spectrum.

Usage

```
UV_PAR(spct, std = "ISO", use.cached.mult = FALSE, use.hinges = TRUE)
```

Arguments

spct	an object of class "source.spct"
std	select which definition of UV should be used, defaults to "ISO"
use.cached.mult	
	logical indicating whether multiplier values should be cached between calls
use.hinges	logical indicating whether to use hinges to reduce interpolation errors

Value

a single numeric nondimensional value giving the UV:PAR photon ratio, with name attribute set to the name of the wavebands, with "(q:q)" appended.

Examples

```
UV_PAR(sun.spct)
```

ZTLs.mspct	*ZTL absorbance spectra.*

Description

A dataset containing the wavelengths at an arbitrary nm interval. Tabulated values for the in vitro absorbance spectrum of ZTL LOV2 domain from Arabidopsis measured in vitro. Data were digitized from figure 2B in Zoltowski and Imaizumi (2014).

Format

A `filter_mspct` with five member `filter_spct` objects each with 300 rows and 2 numeric variables, `w.length` and `A`

Details

The variables of the member spectra are as follows:

- w.length (nm)
- A (spectral absorbance)

Note

If you use these data in a publication, please cite also the original source as given under references.

References

Zoltowski, B. D., Imaizumi, T. (2014). Structure and Function of the ZTL/FKF1/LKP2 Group Proteins in Arabidopsis. Enzymes, 35, 213-39.

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