Package ‘isocalcR’

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Type Package

Title Isotope Calculations in R

Version 0.0.2

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Description Perform common calculations based on published stable isotope theory, such as calculating carbon isotope discrimination and intrinsic water use efficiency from wood or leaf carbon isotope composition. See Farquhar, O'Leary, and Berry (1982) <doi:10.1071/PP9820121>.

License GPL-3

URL https://github.com/justinmathias/isocalcR

BugReports https://github.com/justinmathias/isocalcR/issues

Depends R (>= 4.0.0)

Imports dplyr (>= 1.0.6)

Encoding UTF-8

Language en-US

LazyData true

Suggests rmarkdown, knitr, testthat (>= 3.0.0)

VignetteBuilder knitr

Config/testthat/edition 3

RoxygenNote 7.1.1

NeedsCompilation no

Repository CRAN

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R topics documented:

`CO2data` *CO2data*

Description

Compiled records of atmospheric CO2 concentrations and stable carbon isotopes to reconstruct climate and derive plant ecophysiological indices from tree rings. Data are from Belmecheri, Lavergne, 2020, Dendrochronologia. Updated based on their methodology beyond C.E. 2019.

Usage

```
data(CO2data)
```

Format

A data frame with 2020 rows and 3 variables:

yr Year of CO2 and d13CO2 measurement

Ca Atmospheric CO2 concentration, in ppm

d13C.atm Atmospheric d13CO2, in per mille, %■

Source

https://www.sciencedirect.com/science/article/abs/pii/S1125786520300874

References

Belmecheri, S. & Lavergne, A. (2020). Compiled records of atmospheric CO2 concentrations and stable carbon isotopes to reconstruct climate and derive plant ecophysiological indices from tree rings. Dendrochronologia, 63, 125748.

Examples

```
data(CO2data)
head(CO2data)
```

d13C.to.Ci *d13C.to.Ci*

Description

Calculates leaf intercellular CO2 concentration given plant tissue d13C signature.

Usage

```
d13C.to.Ci(d13C, year, elevation, temp, frac = 0)
```

Arguments

`d13C`	Measured plant tissue carbon isotope signature, per mille (%■)
`year`	Year to which the sample corresponds
`elevation`	Elevation (m.a.s.l.) of the sample, necessary to account for photorespiration processes
`temp`	Leaf temperature (°C)
`frac`	Post-photosynthetic fractionation factor, defaults to 0 assuming leaf material, user should supply reasonable value if from wood (generally -1.9 - -2.1)

Value

The concentration of leaf intercellular CO2 (Ci) in parts per million (ppm)

References

Badeck, F.-W., Tcherkez, G., Nogués, S., Piel, C. & Ghashghaie, J. (2005). Post-photosynthetic fractionation of stable carbon isotopes between plant organs—a widespread phenomenon. Rapid Commun. Mass Spectrom., 19, 1381–1391.

Belmecheri, S. & Lavergne, A. (2020). Compiled records of atmospheric CO2 concentrations and stable carbon isotopes to reconstruct climate and derive plant ecophysiological indices from tree rings. Dendrochronologia, 63, 125748.

Bernacchi, C.J., Singsaas, E.L., Pimentel, C., Portis Jr, A.R. & Long, S.P. (2001). Improved temperature response functions for models of Rubisco-limited photosynthesis. Plant, Cell Environ., 24, 253–259.

Craig, H. (1953). The geochemistry of the stable carbon isotopes. Geochim. Cosmochim. Acta, 3, 53–92.

Davies, J.A. & Allen, C.D. (1973). Equilibrium, Potential and Actual Evaporation from Cropped Surfaces in Southern Ontario. J. Appl. Meteorol., 12, 649–657.

Farquhar, G., O'Leary, M. & Berry, J. (1982). On the relationship between carbon isotope discrimination and the intercellular carbon dioxide concentration in leaves. Aust. J. Plant Physiol., 9, 121–137.

Frank, D.C., Poulter, B., Saurer, M., Esper, J., Huntingford, C., Helle, G., et al. (2015). Water-use efficiency and transpiration across European forests during the Anthropocene. Nat. Clim. Chang., 5, 579–583.

Tsilingiris, P.T. (2008). Thermophysical and transport properties of humid air at temperature range between 0 and 100°C. Energy Convers. Manag., 49, 1098–1110.

Ubierna, N. & Farquhar, G.D. (2014). Advances in measurements and models of photosynthetic carbon isotope discrimination in C3 plants. Plant. Cell Environ., 37, 1494–1498.

Examples

```
d13C.to.Ci(-27, 2015, 900, 24)
```

d13C.to.CiCa *d13C.to.CiCa*

Description

Calculates the ratio of the concentration of leaf intercellular to atmospheric CO2, unitless.

Usage

```
d13C.to.CiCa(d13C, year, elevation, temp, frac = 0)
```

Arguments

d13C	Measured plant tissue carbon isotope signature, per mille (%■)
year	Year to which the sample corresponds
elevation	Elevation (m.a.s.l.) of the sample, necessary to account for photorespiration processes
temp	Leaf temperature (°C)
frac	Post-photosynthetic fractionation factor, defaults to 0 assuming leaf material, user should supply reasonable value if from wood (generally -1.9 - -2.1)

Value

The ratio of leaf intercellular to atmospheric CO2 (Ci/Ca), unitless

References

Badeck, F.-W., Tcherkez, G., Nogués, S., Piel, C. & Ghashghaie, J. (2005). Post-photosynthetic fractionation of stable carbon isotopes between plant organs—a widespread phenomenon. Rapid Commun. Mass Spectrom., 19, 1381–1391.

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Craig, H. (1953). The geochemistry of the stable carbon isotopes. Geochim. Cosmochim. Acta, 3, 53–92.

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Ubierna, N. & Farquhar, G.D. (2014). Advances in measurements and models of photosynthetic carbon isotope discrimination in C3 plants. Plant. Cell Environ., 37, 1494–1498.

Examples

```
d13C.to.CiCa(-27, 2015, 900, 24)
```

`d13C.to.D13C` *d13C.to.D13C*

Description

Calculates leaf carbon isotope discrimination given plant tissue d13C signature.

Usage

```
d13C.to.D13C(d13C, year, frac = 0)
```

Arguments

d13C	Measured plant tissue carbon isotope signature, per mille (%■)
year	Year to which the sample corresponds
frac	Post-photosynthetic fractionation factor, defaults to 0 assuming leaf material, user should supply reasonable value if from wood (generally -1.9 - -2.1)

Value

Carbon isotope discrimination in units of per mille (%■)

References

Badeck, F.-W., Tcherkez, G., Nogués, S., Piel, C. & Ghashghaie, J. (2005). Post-photosynthetic fractionation of stable carbon isotopes between plant organs—a widespread phenomenon. Rapid Commun. Mass Spectrom., 19, 1381–1391.

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Ubierna, N. & Farquhar, G.D. (2014). Advances in measurements and models of photosynthetic carbon isotope discrimination in C3 plants. Plant. Cell Environ., 37, 1494–1498.

Examples

```
d13C.to.D13C(-27, 2015)
```

---

d13C.to.diffCaCi *d13C.to.diffCaCi*

Description

Calculates the difference between the atmospheric CO2 concentration and the leaf intercellular CO2 concentration in parts per mil (ppm)

Usage

```
d13C.to.diffCaCi(d13C, year, elevation, temp, frac = 0)
```

Arguments

`d13C`	Measured plant tissue carbon isotope signature, per mille (%■)
`year`	Year to which the sample corresponds
`elevation`	Elevation (m.a.s.l.) of the sample, necessary to account for photorespiration processes
`temp`	Leaf temperature (°C)
`frac`	Post-photosynthetic fractionation factor, defaults to 0 assuming leaf material, user should supply reasonable value if from wood (generally -1.9 - -2.1)

Value

The difference between atmospheric and leaf intercellular CO2 concentrations (ppm).

References

Badeck, F.-W., Tcherkez, G., Nogués, S., Piel, C. & Ghashghaie, J. (2005). Post-photosynthetic fractionation of stable carbon isotopes between plant organs—a widespread phenomenon. Rapid Commun. Mass Spectrom., 19, 1381–1391.

Belmecheri, S. & Lavergne, A. (2020). Compiled records of atmospheric CO2 concentrations and stable carbon isotopes to reconstruct climate and derive plant ecophysiological indices from tree rings. Dendrochronologia, 63, 125748.

Bernacchi, C.J., Singsaas, E.L., Pimentel, C., Portis Jr, A.R. & Long, S.P. (2001). Improved temperature response functions for models of Rubisco-limited photosynthesis. Plant, Cell Environ., 24, 253–259.

Craig, H. (1953). The geochemistry of the stable carbon isotopes. Geochim. Cosmochim. Acta, 3, 53–92.

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Ubierna, N. & Farquhar, G.D. (2014). Advances in measurements and models of photosynthetic carbon isotope discrimination in C3 plants. Plant. Cell Environ., 37, 1494–1498.

Examples

```
d13C.to.diffCaCi(-27, 2015, 900, 24)
```

---

d13C.to.iWUE *d13C.to.iWUE*

Description

Calculates leaf intrinsic water use efficiency given plant tissue d13C signature.

Usage

```
d13C.to.iWUE(d13C, year, elevation, temp, frac = 0)
```

Arguments

`d13C`	Measured plant tissue carbon isotope signature, per mille (%■)
`year`	Year to which the sample corresponds
`elevation`	Elevation (m.a.s.l.) of the sample, necessary to account for photorespiration processes
`temp`	Leaf temperature (°C)
`frac`	Post-photosynthetic fractionation factor, defaults to 0 assuming leaf material, user should supply reasonable value if from wood (generally -1.9 - -2.1)

Value

Intrinsic water use efficiency in units of micromol CO2 per mol H2O

References

Badeck, F.-W., Tcherkez, G., Nogués, S., Piel, C. & Ghashghaie, J. (2005). Post-photosynthetic fractionation of stable carbon isotopes between plant organs—a widespread phenomenon. Rapid Commun. Mass Spectrom., 19, 1381–1391.

Belmecheri, S. & Lavergne, A. (2020). Compiled records of atmospheric CO2 concentrations and stable carbon isotopes to reconstruct climate and derive plant ecophysiological indices from tree rings. Dendrochronologia, 63, 125748.

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Examples

```
d13C.to.iWUE(-27, 2015, 900, 24)
```

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