

# Package ‘tracheideR’

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**Type** Package

**Title** Standardize Tracheidograms

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**Description** Contains functions to standardize tracheid profiles using the traditional method (Vaganov) and a new method to standardize tracheidograms based on the relative position of tracheids within tree rings.

**Depends** R (>= 3.1.1)

**Imports** tgram (>= 0.2-2)

**License** GPL (>= 2)

**LazyData** TRUE

**RoxygenNote** 5.0.1

**NeedsCompilation** no

**Repository** CRAN

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## R topics documented:

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getTrac                      *Compute tracheidograms*

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### Description

This function computes a tracheidogram from microscope light measurements in gray (0-255).

### Usage

```
getTrac(x, val50 = 120, mw = 5, scale = 1)
```

### Arguments

|       |   |
|-------|---|
| x     | a vector with the light measurements (pixel gray-level values)  |
| val50 | the value giving the "intensity" of the light measurements at which the measurements should be made (for more details please see the help of tgram function). |
| mw    | width of the rolling window to smooth the original data (for more details please see the help of tgram function)  |
| scale | distance per pixel, default = 1   |

### Details

This function uses the tgram function (tgram package) to convert gray pixel values (0-255) into a raw tracheidogram (keeping the original number of cells).

### Value

getTrac returns a list with following elements:

n number of cells

pos pos\$RingWidth gives the tree-ring width and pos\$x gives the "position" of each tracheid.

LD a vector with the lumen diameter (LD).

CWT a vector with the radial cell wall thickness (CWT).

LWratio a vector with the LD/CWT ratio.

### References

DeSoto, L., De la Cruz, M., Fonti, P. (2011). Intra-annual patterns of tracheid size in the Mediterranean tree *Juniperus thurifera* as an indicator of seasonal water stress. *Canadian Journal of Forest Research* 41: 1280-1294. Vaganov, E., 1989. The tracheidogram method in tree-ring analysis and its application, in: Cook, E., Kairiukstis, L. (Eds.), *Methods of Dendrochronology: Applications in the Environmental Sciences*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

### See Also

tgram

**Examples**

```
## Not run:
y2010ray1 <- getTrac(tch$y2010$ray1, scale = 0.169)
y2010 <- getTrac(tch$y2010, scale = 0.169)
TCH <- lapply(tch,getTrac, scale = 0.169)
TCH$y2010$ray1$n #number of tracheids in ray1 in the year 2010
TCH$y2010$ray1$pos$RingWidth #number of tracheids in ray1 in the year 2010
#getTrac(tch$y2010$ray2, scale = 0.169)
#getTrac(data.frame(tch$y2010$ray2), scale=0.169)
## End(Not run)
```

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|          |  |
|----------|--|
| ringPlot | <i>Plot intra-ring variation of tracheid features (with the possibility of plotting a climatic variable)</i> |
|----------|--|

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**Description**

This function plots the intra-ring variation of a tracheid feature (e.g. LD, CWT or LD/CWT) along the growing season and, optionally, the intra-annual variation of a climatic variable can be added to the same plot.

**Usage**

```
ringPlot(traq, varMean = NULL, varYear = NULL, m0 = 3, mt = 6.75,
  m1 = 11, type = c("LD", "CWT", "LWratio"), ylab = match.arg(type),
  main = "", addGS = TRUE, addMonths = addGS, ...,
  varMeanCol = "grey80", varYearCol = "red", varName = "")
```

**Arguments**

|           |   |
|-----------|---|
| traq      | ordered sequence of a tracheid feature (e.g. LD)  |
| varMean   | vector with monthly values of a given environmental variable  |
| varYear   | vector with monthly values of an environmental variable for a specific year                                       |
| m0        | the start of the growing season (in months); the default value is 3 that corresponds to day of the year (doy) 60. |
| mt        | the moment of transition from earlywood to latewood; the default value is 6.75.                                   |
| m1        | the end of the growing season; default value is 11.   |
| type      | a string that defines the tracheid features to be plotted, defaults "LD"  |
| ylab      | the y axis title (for the tracheid feature variable), default value is type                                       |
| main      | an overall title for the plot, if no string is supplied no title is added to the plot                             |
| addGS     | logical; if TRUE add the growing season length to the axis 1, defaults TRUE                                       |
| addMonths | logical; if TRUE add months to the axis 1, defaults TRUE  |
| ...       | graphical parameters for plot may also be passed as arguments to this function                                    |

varMeanCol      the default value, "grey80", gives the color to plot the mean environmental variable

varYearCol      the color to plot monthly environmental values; the default value is "red"

varName          the y axis title (for the environmental variable), default value is ""; if no string is supplied no title is added to environmental axis

### Details

This function returns an invisible data . frame (used to produced the graph)

### Examples

```
## Not run:

# year 2010
y2010raw <- getTrac(tch$y2010, scale = .169)
y2010std <- tracheider(y2010raw)
par(oma = c(2,1,1,0.5))
par(mar = c(2,4,1,4))
y2010LD <- ringPlot(traq = y2010std, varMean = colMeans(sw),
varYear = sw["2010",], main=2010,type = "LD", ylim = c(0,45),
ylab = expression(paste("LD (", mu,"m)")),varName = "Soil moisture")

# year 2013
y2013raw <- getTrac(tch$y2013, scale = .169)
y2013std <- tracheider(y2013raw)
y2013LD <- ringPlot(traq = y2013std, varMean = colMeans(sw),
varYear = sw["2013",], main=2013,type = "LD", ylim = c(0,45),
ylab = expression(paste("LD (", mu,"m)")),varName = "Soil moisture")

# 2010 & 2013 in the same plot
par(mfcol = c(2,1))
par(oma = c(2,1,1,0.5))
par(mar = c(2,4,1,4))

ringPlot(y2010std, varMean = colMeans(sw), varYear = sw["2010",],
type = "LD", ylab = "", main=2010, addGS = FALSE, addMonths = FALSE)

ringPlot(y2013std, varMean = colMeans(sw), varYear = sw["2013",],
type = "LD", ylab=expression(paste("LD (", mu,"m)")),
main = 2013, addGS = TRUE, varName= "Soil moisture")

## End(not run)
```

**Description**

A data frame with monthly soil moisture values for the period 1901-2013.

**Usage**

```
data("sw")
```

**Format**

A data.frame with months in columns and the years as rows (1901-2013). The months are the column names and the years are the row names.

**Details**

...

**Source**

...

**References**

...

**Examples**

```
colMeans(sw)  
plot(colMeans(sw), type="l", xlab="months", ylab="soil water")
```

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tch

*Raw light intensity for two years (2010 and 2013) of Pinus pinaster*

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**Description**

This dataset has 2 years (2010 and 2013) each one with 3 raw profiles (in grayscale).

**Usage**

```
data("tch")
```

**Format**

A list with 2 elements:

**a** y2010 a list with 3 radii

**a** y2013 a list with 3 radii

**Details**

...

**Source**

...

**References**

...

**Examples**

```
names(tch)
names(tch$y2010)
```

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tracheider

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*Compute standardized tracheidograms*


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**Description**

This function computes standardized tracheidograms from raw tracheidograms.

**Usage**

```
tracheider(traq, method = c("nCells", "kCells", "relPos"), k = 20)
```

**Arguments**

|        |   |
|--------|---|
| traq   | a raw tracheidogram (or a list of raw tracheidograms)   |
| method | a string defining the method to be used. Possible values are c("nCells","kCells","relPos"). The default method is "nCells". |
| k      | a integer to determine the number of cells of the standardized tracheidogram when method is "kCells"                        |

**Details**

This function takes as input raw tracheidograms (obtained using the `getTrac` function) and standardizes them using 3 different methods. The first method ("nCells") standardizes rays of a given ring using the mean number of cells, allowing that different rings have different number of cells. The method "kCells" normalizes tracheidograms to a constant number of tracheids (k). The "relPos" method standardizes the tracheidogram based on the relative position of each tracheid inside the tree ring.

**Value**

the function `tracheider` returns a list with the following elements:

LD ordered sequence of lumen diameters.

CWT ordered sequence of radial cell wall thickness.

LWratio ordered sequence of LD/CWT ratio.

**Examples**

```
## Not run:
y2010 <- getTrac(tch$'y2010', scale=0.169)
y2013 <- getTrac(tch$'y2013', scale=0.169)

## nCells
y2010n <- tracheider(y2010, method = "nCells")
y2013n <- tracheider(y2013, method = "nCells")
plot(rowMeans(as.data.frame(y2010n$LD)), type="l", xlim=c(0,86),
      ylim=c(0,60), yaxs="i", xaxs="i", xlab="Number of tracheid",
      ylab=expression(paste("LD (", mu,"m)")), col=2, lwd=2)
lines(rowMeans(as.data.frame(y2013n$LD)), col="blue", lwd=2)
legend("topright",lty=1,lwd=2,col = c(2,4), legend=c("2010 ", "2013 "),
      text.col = c(2,4), box.col = "#00000000", bg="#00000000")

## k = 53
TCH <- lapply(tch, getTrac, scale=0.169)
TCHn53 <- lapply(TCH, tracheider,method = "kCells", k=53)

plot(rowMeans(as.data.frame(TCHn53$'y2010'$LD)), type="l",
      xlab="Number of tracheid", ylab=expression(paste("LD (", mu,"m)")),
      xlim=c(0,54), ylim=c(0,60), col=2, lwd=2, yaxs="i", xaxs="i")
lines(rowMeans(as.data.frame(TCHn53$'y2013'$LD)), col="blue", lwd=2)
legend("topright",lty=1,lwd=2,col = c(2,4),legend=c("2010 ", "2013 "),
      text.col = c(2,4), box.col = "#00000000", bg="#00000000")

## Relative position
TCH <- lapply(tch, getTrac, scale=0.169)
TCHrelPos <- lapply(TCH, tracheider, method = "relPos")
plot(rowMeans(as.data.frame(TCHrelPos$'y2010'$LD)),
      type="l", xlim=c(0,101), ylim=c(0,60), col=2, lwd=2,
      xlab="Number of tracheid", ylab=expression(paste("LD (", mu,"m)")),
      yaxs="i", xaxs="i")
lines(rowMeans(as.data.frame(TCHrelPos$'y2013'$LD)),
      col="blue", lwd=2)
legend("topright",lty=1,lwd=2,col = c(2,4), legend=c("2010 ", "2013 "),
      text.col = c(2,4), box.col = "#00000000", bg="#00000000")
## End(not run)
```

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