Package 'soilwater'

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Title Implementation of Parametric Formulas for Soil Water Retention or Conductivity Curve

Type Package

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Description It implements parametric formulas of soil water retention or conductivity curve. At the moment, only Van Genuchten (for soil water retention curve) and Mualem (for hydraulic conductivity) were implemented.
See reference (<http://en.wikipedia.org/wiki/Water_retention_curve>).

Suggests raster

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URL https://github.com/ecor/soilwater

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NeedsCompilation no

Repository CRAN

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Contents

swc *Soil water Retantion Curve and Unsaturated Hydraulic Conductivity*

Description

Soil Water Retention Curve 'swc', Hydraulic Conductivity 'khy' , Soil Water Capacity 'cap' , Soil Water (Hydraulic) Diffusivity 'diffusivity'

Usage

```
swc(psi = 0.5, alpha = 1, n = 1.5, m = 1 - 1/n, theta_sat = 0.4,
  theta_res = 0.05, psi_s = -1/alpha, lambda = m * n,
  saturation_index = FALSE, type_swc = c("VanGenuchten", "BrooksAndCorey"),
  ...)

khy(psi = 0.5, v = 0.5, ksat = 0.01, alpha = 1, n = 1.5, m = 1 -
  1/n, theta_sat = 0.4, theta_res = 0.05, psi_s = -1/alpha, lambda = m *
  n, b = NA, type_swc = "VanGenuchten", type_khy = c("Mualem",
  "BrooksAndCorey"), ...)

cap(psi = 0.5, alpha = 1, n = 1.5, m = 1 - 1/n, theta_sat = 0.4,
  theta_res = 0.05, type_swc = "VanGenuchten", ...)

diffusivity(psi = 0.5, v = 0.5, ksat = 0.01, alpha = 1, n = 1.5,
  m = 1 - 1/n, theta_sat = 0.4, theta_res = 0.05, ...)
```

Arguments

psi	soil wwater pressure head
alpha	inverse of a length - scale parameters in Van Genuchten Formula
n	shape parameter in Van Genuchten Formula
m	shape parameter in Van Genuchten Formula. Default is 1-1/n
theta_sat	saturated water content
theta_res	residual water content
psi_s	psi_s value (capillary fringe) in Brook and Corey formula. It is used in case type_swc and/or type_khy are equal to BrooksAndCorey.
lambda, b	lambda and b exponents in Brook and Corey formula. It is used in case type_swc and/or type_khy are equal to BrooksAndCorey.
saturation_index	logical index, If TRUE (Default) the function swc() returns soil water content, otherwise a saturation index between 0 and 1.
type_swc	type of Soil Water Retention Curve. Default is "VanGenuchten" and actually the only implemented type
...	further arguments which are passed to swc() and khy()

v	exponent in Mualem Formula for Hydraulic Conductivity
ksat	saturated hydraulic conductivity
type_khy	type of Soil Hydraulic Conductivity Curve. Default is "Mualem" and actually the only implemented type

Examples

```
library(soilwater)
soiltype <- c("sand","silty-sand","loam","clay")
theta_sat <- c(0.44,0.39,0.51,0.48)
theta_res <- c(0.02,0.155,0.04,0.10)
alpha <- c(13.8,6.88,9.0,2.7) # 1/meters
n <- c(2.09,1.881,1.42,1.29)
m <- 1-1/n
v <- array(0.5,length(soiltype))
ks <- c(1.5e-1,1e-4*3600,3.3e-2,4.1e-4)/3600   # meters/seconds

psi <- -(1:2000)/1000

D <- as.data.frame(array(0.1,c(length(psi),length(soiltype))))
names(D) <- soiltype
for (it in names(D)) {

  i=which(names(D)==it)
  D[,i] <- diffusivity(psi=psi,
            v=v[i],ksat=ks[i],alpha=alpha[i],
            n=n[i],m=m[i],theta_sat=theta_sat[i],
            theta_res=theta_res[i])

}
# plot diffusivity on log scale
lty <- 1:length(names(D) )

plot(psi,D[,1],lty=lty[1],main="Diffusvity vs psi",xlab="psi [m]",
ylab="D [m^2/s]",type="l",ylim=range(D),ylog=TRUE)
for (i in 2:ncol(D)) {
  lines(psi,D[,i],lty=lty[i])
}
legend("topleft",lty=lty,legend=names(D))
Dinv <- 1/D

# pot diffusivity on log scale
lty <- 1:length(names(D) )

plot(psi,Dinv[,1],lty=lty[1],main="1/Diffusvity vs psi",
xlab="psi [m]",ylab="1/D [s/m^2]",type="l",ylim=range(Dinv),ylog=TRUE)
for (i in 2:ncol(Dinv)) {
  lines(psi,Dinv[,i],lty=lty[i])
}
legend("topright",lty=lty,legend=names(D))
```

`unitResponse` *The water table recharge: the response unit*

Description

The water table recharge: the response unit

Usage

```
unitResponse(t, d = 1, D = 1, H = d, m = 100)
```

Arguments

`t`	time coordinate
`d`	depth of unsaturated zone along the slope-normal direction
`D`	soil water diffusivity
`H`	soil depth
`m`	maximum limit of summary truncation. Default is 100.

Note

This function calcletes the water-table recharge rate in a hillslope assuming:

1. Richards' Equation is linearized and reduced to the form of heat equation;

2. The diffusion water-table rate is connectedwith soil pressure head according with eq. 13 (Cordano and Rigon, 2008);

References

Cordano, E., and R. Rigon (2008), A perturbative view on the subsurface water pressure response at hillslope scale, Water Resour. Res., 44, W05407, doi:10.1029/2006WR005740. http://onlinelibrary.wiley.com/doi/10.1029/2006WR005740/pdf

Examples

```
library(soilwater)


t <- seq(0,2,by=0.001)
d <- c(1,0.75,0.5,0.25)
val1 <- unitResponse(t, d = d[1], D = 1, H = 1, m = 500)

val2 <- unitResponse(t, d = d[2], D = 1, H = 1, m = 500)

val3 <- unitResponse(t, d = d[3], D = 1, H = 1, m = 500)

val4 <- unitResponse(t, d = d[4], D = 1, H = 1, m = 500)
```

`watervolume` *Water volume in function of water-table depth or height 'swc', Hydraulic Conductivity 'khy' , Soil Water Capacity 'cap' , Soil Water (Hydraulic) Diffusivity 'diffusivity'*

Description

Water volume in function of water-table depth or height 'swc', Hydraulic Conductivity 'khy' , Soil Water Capacity 'cap' , Soil Water (Hydraulic) Diffusivity 'diffusivity'

Usage

```
watervolume(d = H - h, H = 1, h = NA, nstep = 100, Gamma = 1,
  soilwaterretentioncurve = swc, ...)
```

Arguments

`d`	water-table depth (under surface)
`H`	soil thickness
`h`	water-table heigth (over bedrock)
`nstep`	number of vertical spatial cells. Default is 100
`Gamma`	liner coefficient for hydrostatic profile (Default is 1)
`soilwaterretentioncurve`	function describing the soil water retention curve. Default is `swc`
`...`	parametes for `soil.water.retention.curve`

Note

The water volume per topographical area unit obtained by vertical integration off soil water content profile

See Also

`swc`

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