Package ‘soilwater’

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License      GPL (>= 2)
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.
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R topics documented:

  swc ................................................................. 2
  unitResponse ..................................................... 4
  watervolume ..................................................... 5

Index

1
Soil Water Retention Curve 'swc', Hydraulic Conductivity 'khy', Soil Water Capacity 'cap', Soil Water (Hydraulic) Diffusivity 'diffusivity'

Usage

```r
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"), ...)
```

```r
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"), ...)
```

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

```r
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 water 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="Diffusivity 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

# plot diffusivity on log scale
lty <- 1:length(names(D))
plot(psi,Dinv[,1],lty=lty[1],main="1/Diffusivity 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 calculates 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 connected with soil pressure head according with eq. 13 (Cordano and Rigon, 2008);

References


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 = d, m = 500)
val2 <- unitResponse(t, d = d[2], D = 1, H = d, m = 500)
val3 <- unitResponse(t, d = d[3], D = 1, H = d, m = 500)
val4 <- unitResponse(t, d = d[4], D = 1, H = d, 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

```r
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 height (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`
- `...`: parameters 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`
Index

cap (swc), 2

diffusivity (swc), 2

khy (swc), 2

swc, 2, 5

unitResponse, 4

watervolume, 5