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.
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Soil Water Retention Curve and Unsaturated Hydraulic Conductivity

Description

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)
soiltypes <- c("sand","silty-sand","loam","clay")
theta_sats <- c(0.44,0.39,0.51,0.48)
theta_res <- c(0.02,0.155,0.04,0.10)
alphas <- c(13.8,6.88,9.0,2.7) # 1/meters
n <- c(2.09,1.881,1.42,1.29)
m <- 1/n
v <- array(0.5,length(soiltypes))
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(soiltypes))))
names(D) <- soiltypes
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))
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 = 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

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 height (over bedrock)
nstep    number of vertical spatial cells. Default is 100
Gamma    linear 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
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