Package 'kwb.hantush'

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Title Calculation of Groundwater Mounding Beneath an Infiltration Basin

Version 0.3.0

Description Calculation groundwater mounding beneath an infiltration basin based on the Hantush (1967) equation (<doi:10.1029/WR003i001p00227>). The correct implementation is shown with a verification example based on a USGS report (page 25, <https://pubs.usgs.gov/sir/2010/5102/support/sir2010-5102.pdf#page=35>).

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URL https://kwb-r.github.io/kwb.hantush, https://github.com/KWB-R/kwb.hantush

BugReports https://github.com/KWB-R/kwb.hantush/issues

Depends R (>= 3.0), lattice

Imports hydroGOF

Suggests testthat, knitr, rmarkdown

VignetteBuilder knitr

Encoding UTF-8

Language en-US

LazyLoad yes

RoxygenNote 6.1.1

NeedsCompilation no

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Repository CRAN

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R topics documented:

`baseProperties` *Hantush equation base properties*

Description

Hantush equation base properties

Usage

```
baseProperties(time = 10, basinWidth = 10, basinLength = 10,
  infiltrationRate = 0.5, horizConductivity = 10, iniHead = 10,
  specificYield = 0.2, numberTimeSteps = 150)
```

Arguments

`time`	time elapsed since recharge began (T), (Default: 1.5 days)
`basinWidth`	half width of the recharge basin (L), (Default: 10 m)
`basinLength`	half length of the recharge basin (L), (Default: 10 m)
`infiltrationRate`	recharge (infiltration) rate (L/T), (Default: 0.5 m/d)
`horizConductivity`	horizontal hydraulic conductivity (L/T), (Default: 10 m/d)
`iniHead`	initial head (height of the water table above the base of the aquifer);(L), (Default: 10)
`specificYield`	specific yield (Default: 0.2)
`numberTimeSteps`	number of time steps to be used for average aquifer thickness calculation (Default: 150)

Value

Base properties for Hantush equation

References

p.22, https://pubs.usgs.gov/sir/2010/5102/support/sir2010-5102.pdf

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`baseProps_ex1` *USGS verification example: base parameterisation*

Description

USGS verification example

Usage

```
baseProps_ex1()
```

References

p.23, https://pubs.usgs.gov/sir/2010/5102/support/sir2010-5102.pdf

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`compareModelResults` *USGS verification example: compare R results for water level increase with other models and calculate statistical goodness of fit values (e.g. RMSE, PBIAS, NSE)*

Description

USGS verification example: compare R results for water level increase with other models and calculate statistical goodness of fit values (e.g. RMSE, PBIAS, NSE)

Usage

```
compareModelResults(conf = example1())
```

Arguments

`conf`	list as retrieved by example1()

Value

data.frame with R results and other model including all goodness of fit criteria calculated with gof() of package hydrogof

References

Table 5, p.25, https://pubs.usgs.gov/sir/2010/5102/support/sir2010-5102.pdf

See Also

example1 for the USGS example parameterisation with distances

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`erf` *Error function*

Description

Error function

Usage

```
erf(x)
```

Arguments

x	x

Value

Error function result

References

https://stat.ethz.ch/R-manual/R-devel/library/stats/html/Normal.html

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`example1` *USGS verification example: model parameterisation (multiple distances)*

Description

USGS verification example: model parameterisation (multiple distances)

Usage

```
example1(x = c(0, 0.3, 3.3, 6.6, 10, 20, 25, 30, 40, 50, 75, 100, 150,
  200), baseProps = baseProps_ex1(), dbg = FALSE)
```

Arguments

x	distance from the center of the recharge basin in the x direction (L)
baseProps	basic model properties as retrieved by baseProps_ex1()
dbg	If True additional messages on debug messages

References

p.23, https://pubs.usgs.gov/sir/2010/5102/support/sir2010-5102.pdf

Examples

```
res <- example1()
if (FALSE) {
  #### Head for each time step (defined with parameter "numberTimeSteps)
  xyplot(head ~ x | as.factor(sprintf("%f days", timeSteps)),
    data = res$timeSteps,
    type = "b",
    las = 1,
    as.table = TRUE
  )
  #### Head at end of simulation
  plot(head ~ x,
    data = res$simTime,
    type = "b",
    las = 1
  )
}
#### Water level increase at end of simulation & compare to alternative models
modelComparison <- compareModelResults(conf = res)
plotModelComparison(modelComparison = modelComparison)
```

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getModelComparisonTable

USGS verification example: get model comparison table

Description

USGS verification example: get model comparison table

Usage

```
getModelComparisonTable()
```

Value

data.frame with water level increase of different model approaches

References

Table 5, p.25, https://pubs.usgs.gov/sir/2010/5102/support/sir2010-5102.pdf

Examples

```
modelComparison <- getModelComparisonTable()
```

`hantush` *Hantush equation*

Description

Hantush equation

Usage

```
hantush(x = 0, y = 0, baseProps = baseProperties(), dbg = TRUE)
```

Arguments

x	distance from the center of the recharge basin in the x direction (L)
y	distance from the center of the recharge basin in the y direction (L)
baseProps	basic model properties as retrieved by baseProperties()
dbg	If True additional messages on integration quality of function hantushSstar are printed on screen

Value

Head at a given time after recharge begins

References

p.22, https://pubs.usgs.gov/sir/2010/5102/support/sir2010-5102.pdf

See Also

`baseProperties` for basic model properties

hantushDistances *Hantush distance: for multiple coordinates*

Description

Hantush distance: for multiple coordinates

Usage

```
hantushDistances(x = 0:10, y = rep(0, length(x)),
  baseProps = baseProperties(), dbg = TRUE)
```

Arguments

x	vector with distances from the center of the recharge basin in the x direction (L), (Default: each meter between 0-100m)
y	vector with distances from the center of the recharge basin in the y direction (L), (Default: 0 times length of x)
baseProps	basic model properties as retrieved by baseProperties()
dbg	If True additional debug messages are printed on screen

Value

Head at a given time after recharge begins

See Also

hantush for parameterizing the Hantush equation

hantushDistancesBaseProps *Hantush distances & base properties: allows input of vector of x,y coordinates and also a vector for one of the base properties*

Description

Hantush distances & base properties: allows input of vector of x,y coordinates and also a vector for one of the base properties

Usage

```
hantushDistancesBaseProps(x = seq(0, 200, 5), y = rep(0, length(x)),
  baseProps = baseProperties(time = 2^(0:6), infiltrationRate = 1,
  basinWidth = 10, basinLength = 50, horizConductivity = 10, iniHead = 10,
  specificYield = 0.2), dbg = FALSE)
```

Arguments

x	vector with distances from the center of the recharge basin in the x direction (L), (Default: every 5 meter between 0-200m)
y	vector with distances from the center of the recharge basin in the y direction (L), (Default: 0 times length of x)
baseProps	as retrieved by baseProperties(), but one property is allowed to be a vector (e.g. infiltrationRate = c(1,2,4))
dbg	If True additional debug messages are printed on screen

Value

List with sublists "dat" (x,y,head & WLincrease), "changedBaseProp.Name" (name of base property with multiple values) and "baseProps" (complete base parameterisation)

See Also

baseProperties for basic model properties

Examples

```
baseProps <- baseProperties(
  time = 2^(0:6),
  infiltrationRate = 1,
  basinWidth = 10,
  basinLength = 50,
  horizConductivity = 10,
  iniHead = 10,
  specificYield = 0.2,
  numberTimeSteps = 10
)
res <- hantushDistancesBaseProps(baseProps = baseProps)
cols <- length(unique(res$dat[[res$changedBaseProp.Name]]))
mainTxt <- sprintf("Changed baseProperty: %s", res$changedBaseProp.Name)
xyplot(WLincrease ~ x,
  groups = res$dat[[res$changedBaseProp.Name]],
  data = res$dat,
  type = "b",
  auto.key = list(columns = cols),
  main = mainTxt
)
```

---

hantushS *Helper function hantushS*

Description

Helper function hantushS

Usage

```
hantushS(x, alpha, beta)
```

Arguments

x	distance between 0 and half length of recharge basin
alpha	alpha
beta	beta

Value

Hantush star

References

p.22, https://pubs.usgs.gov/sir/2010/5102/support/sir2010-5102.pdf

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hantushSstar *Hantush function Sstar*

Description

Hantush function Sstar

Usage

```
hantushSstar(alpha, beta, dbg)
```

Arguments

alpha	alpha
beta	beta
dbg	If True additional messages on integration quality of function hantushSstar are printed on screen

Value

Hantush Sstar result

References

p.22, https://pubs.usgs.gov/sir/2010/5102/support/sir2010-5102.pdf

`plotModelComparison` *USGS verification example: plot model comparison results*

Description

USGS verification example: plot model comparison results

Usage

```
plotModelComparison(modelComparison = compareModelResults(),
  title = "", ...)
```

Arguments

`modelComparison`	data.frame as retrieved by compareModelResults(), Default: (compareModelResults())
`title`	to be used as title above plot (Default: "")
`...`	further arguments passed to function xyplot()

Value

model comparison goodness of fit plots

See Also

`compareModelResults` for comparison with USGS benchmark models

Examples

```
### Plot model comparison with title "Model comparison" and one plot for
### each page
plotModelComparison(
  title = "Model comparison",
  layout = c(1, 1)
)
```

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