

Package ‘rTephra’

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Title Tephra Transport Modeling

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Description Models and displays tephra transport through custom (windy, turbulent, heterogeneous) atmosphere over custom topography. Includes a Lagrangian (particle-tracking) tephra transport model and a function to save snapshots of model as png files.

Depends R (>= 3.0.0)

Suggests rNOMADS

License GPL

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LazyData true

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 BlastAnim3d

Tephra Transport Snapshots

Description

Generates png files showing map view and cross-section view of tephra motion and final position on ground

Usage

```
BlastAnim3d(L, tframe = 0.1, dir = ".", TOPO = NULL, az = 0,
  xlim = NULL, ylim = NULL, zlim = NULL, units = "m",
  plotMapView = TRUE, plotCrossSection = TRUE)
```

Arguments

L	output of BlastSim3d
tframe	time interval between frames [s]
dir	directory where png files should be saved
TOPO	DEM: list containing vectors x and y and matrix z with dimensions (length(x), length(y))
az	azimuth of section line (degrees clockwise from North)
xlim	easting limits for map view
ylim	northing limits for map view
zlim	elevation limits for section view
units	units of length (string)
plotMapView	logical: should the map view panel be plotted?
plotCrossSection	logical: should the cross-section panel be plotted?

Examples

```
## Not run:
## BlastSim3d(v = 40, th_i = 2* 1:40, th_a = 90, dt = 0.01)
## BlastAnim3d(L, tframe = 0.1, az = 90)
## ImageMagick shell command: animate -delay 10 * # animate with 0.1-s frame rate
```

 BlastSim3d

Explosive Tephra Dispersion Model

Description

Models the transport of particles ejected at the same velocity and different angles using tephra3d.

Usage

```
BlastSim3d(v, th_i = 2 * 1:40, th_a = 0, dt = 0.01, ...)
```

Arguments

v	initial velocity [m/s]
th_i	initial inclination angles to test [degrees]
th_a	initial azimuth angles to test [degrees clockwise from north]
dt	model time interval [s]
...	parameters to pass to Tephra3d

Examples

```
BlastSim3d(v = 10, th_i = 2* 1:40, th_a = 0, dt = 0.01)
```

 meshgridn

N-Dimensional Meshgrid Make a list in which all combinations of inputs occur.

Description

N-Dimensional Meshgrid Make a list in which all combinations of inputs occur.

Usage

```
meshgridn(L)
```

Arguments

L	list containing any number of vectors
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Examples

```
meshgridn(list(1:2, 5:6, 7:9))
```

Tephra3d

*Tephra Lagrangian Transport Model***Description**

This function models the transport of a single particle through a spatially variable, windy, turbulent atmosphere with gravity. It allows 4D-varying atmospheric wind and density. Currently, only Rayleigh drag (low Re) is permitted.

Usage

```
Tephra3d(vx0, vy0, vz0, x0 = 0, y0 = 0, z0 = 0, t0 = 0,
         rho_r = 2000, r = 1, dt = 0.01, Cd = 0.6, verbose = FALSE,
         rho_a = NULL, zt = NULL, wx = 0, wy = 0, wz = 0, mindist = 0,
         TOPO = NULL, Kh = 0, Kz = 0, eddy_timescale = 60, g = 9.80665)
```

Arguments

vx0	initial x component of velocity [m/s]
vy0	initial y component of velocity [m/s]
vz0	initial z component of velocity [m/s]
x0	initial easting [m]
y0	initial northing [m]
z0	initial elevation [m]
t0	initial time [s]
rho_r	density of tephra particle [kg/m ³]
r	rock radius [m]
dt	model time interval [s]
Cd	drag coefficient [unitless]
verbose	logical: print runtime info to screen?
rho_a	scalar or function(x,y,z,t) or function(z) giving atmospheric density [kg/m ³]. If NULL, use a variable-density isothermal atmosphere (T = 0 deg C)
zt	function(x,y) giving topographic height [m]
wx	scalar or function(x,y,z,t) or function(z) giving component of wind to the east [m/s]
wy	scalar or function(x,y,z,t) or function(z) giving component of wind to the north [m/s]
wz	scalar or function(x,y,z,t) or function(z) giving upward component of wind [m/s]
mindist	minimum distance a particle must travel before simulation can stop. This is to prevent early model ends due to spurious collision with crater.
TOPO	DEM: list containing vectors x and y and matrix z with dimensions (length(x), length(y))

Kh	horizontal eddy diffusivity [m ² /s]
Kz	vertical eddy diffusivity (often neglected) [m ² /s]
eddy_timescale	1/e decay time of turbulent eddies [s]
g	gravitational acceleration [m/s ²]

Examples

```
Tephra3d(vx0 = 40, vy0 = 0, vz0 = 40, z0 = 0)
```

TopoInterp *Topography Interpolation*

Description

Interpolates elevation at point (x, y) given Digital Elevation Model (DEM).

Usage

```
TopoInterp(x, y, TOPO = NULL, N = 10)
```

Arguments

x	Easting of point to interpolate [same units as TOPO\$x, TOPO\$y]
y	Northing of point to interpolate [same units as TOPO\$x, TOPO\$y]
TOPO	DEM: list containing vectors x and y and matrix z with dimensions (length(x), length(y))
N	Smoothing parameter, must be positive. Larger N means less smoothing.

Examples

```
data(VILL)
contour(VILL, xlim = c(-500, 500), ylim = c(-500, 500))
TopoInterp(0, 0, VILL) # interpolate elevation at point (0, 0)
```

VILL

Villarrica DEM

Description

Digital Elevation Model (DEM) of Villarrica Volcano, Chile.

Format

List with following elements:

x Easting from vent (m)

y Northing from vent (m)

z Elevation above sea level (m)

lat Latitude (degrees)

lon Longitude (degrees)

Examples

```
data(VILL)
```

```
contour(VILL)
```

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