

Package ‘humidity’

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Type Package

Title An R Package for Calculating Water Vapor Measures from Temperature and Relative Humidity

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Description

Vapor pressure, absolute humidity, specific humidity, and mixing ratio are commonly used water vapor measures in meteorology. This R package provides functions for calculating saturation vapor pressure (hPa), partial water vapor pressure (Pa), absolute humidity (kg/m³), specific humidity (kg/kg), and mixing ratio (kg/kg) from temperature (K) and relative humidity (%).

Depends R (>= 2.10)

License GPL-3

URL <https://github.com/caijun/humidity>

BugReports <https://github.com/caijun/humidity/issues>

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AH	<i>calculate absolute humidity</i>
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Description

calculate absolute humidity ρ_w based on partial water vapor pressure e at temperature t

Usage

AH(e , t , isK = TRUE)

Arguments

e	partial water vapor pressure in Pascal (Pa)
t	temperature in Kelvin (K) or in degree Celsius ($^{\circ}\text{C}$)
isK	logical indicator whether temperature is in Kelvin (K). The default value is TRUE.

Value

numeric absolute humidity ρ_w (kg/m^3)

Author(s)

Jun Cai (<cai-j12@mails.tsinghua.edu.cn>), PhD candidate from Center for Earth System Science, Tsinghua University

See Also

[WVP](#), [SH](#).

Examples

```
## Not run:  
t <- 273.15  
Es <- SVP(t)  
e <- WVP(70, Es)  
AH(e, t)  
  
## End(Not run)
```

C2K

Celsius to Kelvin conversion

Description

convert temperature in degree Celsius (°C) into Kelvin (K)

Usage

```
C2K(C)
```

Arguments

C temperature in degree Celsius (°C)

Value

numeric temperature in Kelvin (K)

Author(s)

Jun Cai (<cai-j12@mails.tsinghua.edu.cn>), PhD candidate from Center for Earth System Science, Tsinghua University

See Also

[K2C](#).

Examples

```
## Not run:  
T0 # absolute zero in Kelvin (K)  
C2K(T0)  
  
## End(Not run)
```

 Es.T0

Saturation vapor pressure at absolute zero (hPa)

Description

$e_s(T_0) = 6.11hPa$ is the saturation vapor pressure at the absolute zero $T_0 = 273.15K$.

Usage

Es.T0

Format

An object of class `numeric` of length 1.

See Also

[T0](#)

 ivs

Viability of influenza A virus for 1 hour after spraying

Description

A dataset containing airborne virus particles of influenza A for viable survival in the dark at controlled temperature and relative humidity for 1 hour after spraying.

Usage

ivs

Format

A data frame with 11 rows and 3 variables:

- T: temperature in degree Celsius (7.5–32.0)
- RH: relative humidity in percentage (20–82)
- PVV: percentage of viable virus (6.6–78.0)

Source

Harper, G. J. (1961). *Airborne micro-organisms: survival tests with four viruses*. *Journal of Hygiene*, 59(04), 479-486.

K2C *Kelvin to Celsius conversion*

Description

convert temperature in Kelvin (K) into degree Celsius (°C)

Usage

K2C(K)

Arguments

K temperature in Kelvin (K)

Value

numeric temperature in degree Celsius (°C)

Author(s)

Jun Cai (<cai-j12@mails.tsinghua.edu.cn>), PhD candidate from Center for Earth System Science, Tsinghua University

See Also

[C2K](#).

Examples

```
## Not run:  
K2C(0)  
  
## End(Not run)
```

L *Latent heat of water vapor*

Description

Latent heat of water vapor $L = 2.5 \times 10^6 \text{ J/kg}$

Usage

L

Format

An object of class `numeric` of length 1.

Md *Molecular weight of dry air*

Description

Molecular weight of dry air $M_d = 28.9634g/mol$

Usage

Md

Format

An object of class numeric of length 1.

See Also

[Mw](#)

MR *calculate mixing ratio*

Description

calculate mixing ratio ω based on specific humidity q

Usage

MR(q)

Arguments

q specific humidity q (kg/kg)

Value

numeric mixing ratio ω (kg/kg)

Author(s)

Jun Cai (<cai-j12@mails.tsinghua.edu.cn>), PhD candidate from Center for Earth System Science, Tsinghua University

See Also

[SH](#).

Examples

```
## Not run:
t <- 273.15
Es <- SVP(t)
e <- WVP(70, Es)
q <- SH(e, p = 101325)
MR(q)

## End(Not run)
```

Mw *Molecular weight of water vapor*

Description

Molecular weight of water vapor $M_w = 18.01528g/mol$

Usage

Mw

Format

An object of class numeric of length 1.

See Also

[Md](#)

Rw *Specific gas constant of water vapor*

Description

Specific gas constant of water vapor $R_w = \frac{1000R}{M_w} = 461.52J/(kgK)$, where $R = 8.3144621J/(molK)$ is the molar **gas constant** and $M_w = 18.01528g/mol$ is the molecular weight of water vapor.

Usage

Rw

Format

An object of class numeric of length 1.

See Also

[Mw](#)

SH *calculate specific humidity*

Description

calculate specific humidity q based on partial water vapor pressure e under given atmospheric pressure p

Usage

```
SH(e, p = 101325)
```

Arguments

e partial water vapor pressure in Pascal (Pa)
 p atmospheric pressure in Pascal (Pa). The default is standard atmospheric pressure of 101325Pa.

Value

numeric specific humidity q (kg/kg)

Author(s)

Jun Cai (<cai-j12@mails.tsinghua.edu.cn>), PhD candidate from Center for Earth System Science, Tsinghua University

See Also

[WVP](#), [AH](#), [MR](#).

Examples

```
## Not run:  
t <- 273.15  
Es <- SVP(t)  
e <- WVP(70, Es)  
SH(e, p = 101325)  
  
## End(Not run)
```

SVP *calculate saturation vapor pressure*

Description

calculate saturation vapor pressure at temperature t , using the Clausius-Clapeyron equation or the Murray equation.

Usage

```
SVP(t, isK = TRUE, formula = c("Clausius-Clapeyron", "Murray"))
```

Arguments

t	temperature in Kelvin (K) or in degree Celsius (°C)
isK	logical indicator whether temperature is in Kelvin (K). The default value is TRUE.
formula	the formula is used for calculating saturation vapor pressure. By default the Clausius-Clapeyron equation is used.

Value

numeric saturation vapor pressure in hectopascal (hPa) or millibar (mb)

Author(s)

Jun Cai (<cai-j12@mails.tsinghua.edu.cn>), PhD candidate from Center for Earth System Science, Tsinghua University

See Also

[SVP.ClaCla](#), [SVP.Murray](#).

Examples

```
## Not run:  
SVP(273.15)  
  
## End(Not run)
```

SVP.ClaCla	<i>calculate saturation vapor pressure using the Clausius-Clapeyron equation</i>
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Description

calculate saturation vapor pressure at temperature t , using the Clausius-Clapeyron equation.

Usage

SVP.ClaCla(t)

Arguments

t temperature in Kelvin (K)

Value

numeric saturation vapor pressure in hectopascal (hPa) or millibar (mb)

Author(s)

Jun Cai (<cai-j12@mails.tsinghua.edu.cn>), PhD candidate from Center for Earth System Science, Tsinghua University

References

Shaman, J., & Kohn, M. (2009). *Absolute humidity modulates influenza survival, transmission, and seasonality*. Proceedings of the National Academy of Sciences, 106(9), 3243-3248.

Wallace, J. M., & Hobbs, P. V. (2006). *Atmospheric science: an introductory survey* (Vol. 92). Academic press.

See Also

[SVP.Murray](#), [SVP](#).

Examples

```
## Not run:  
T0 # absolute zero in Kelvin (K)  
SVP.ClaCla(T0)  
  
## End(Not run)
```

SVP.Murray

calculate saturation vapor pressure using the Murray equation

Description

calculate saturation vapor pressure at temperature t , per the equation proposed by Murray (1967).

Usage

SVP.Murray(t)

Arguments

t temperature in Kelvin (K)

Value

numeric saturation vapor pressure in hectopascal (hPa) or millibar (mb)

Author(s)

Jun Cai (<cai-j12@mails.tsinghua.edu.cn>), PhD candidate from Center for Earth System Science, Tsinghua University

References

Murray, F. W. (1967). *On the Computation of Saturation Vapor Pressure*. Journal of Applied Meteorology, 6(1), 203-204.

See Also

[SVP.ClaCla](#), [SVP](#).

Examples

```
## Not run:  
T0 # absolute zero in Kelvin (K)  
SVP.Murray(T0)  
  
## End(Not run)
```

<code>T0</code>	<i>Absolute zero</i>
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Description

Absolute zero in Kelvin T_0 (K)

Usage

`T0`

Format

An object of class `numeric` of length 1.

<code>WVP</code>	<i>calculate partial water vapor pressure</i>
------------------	---

Description

calculate partial water vapor pressure e based on relative humidity and saturation water vapor pressure at temperature t

Usage

`WVP(psi, Es)`

Arguments

<code>psi</code>	relative humidity ψ in percentage (%)
<code>Es</code>	saturation vapor pressure e_s (hPa) at temperature t , which can be calculated by calling SVP function.

Value

numeric partial water vapor pressure in Pascal (Pa)

Author(s)

Jun Cai (<cai-j12@mails.tsinghua.edu.cn>), PhD candidate from Center for Earth System Science, Tsinghua University

See Also

[SVP](#), [SVP.ClaCla](#), [SVP.Murray](#).

Examples

```
## Not run:  
Es <- SVP(273.15)  
WVP(70, Es)  
  
## End(Not run)
```

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