Package: humidity (via r-universe)

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Type Package

Title Calculate Water Vapor Measures from Temperature and Dew Point

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Description Vapor pressure, relative humidity, 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), relative humidity (%), absolute humidity (kg/m^3), specific humidity (kg/kg), and mixing ratio (kg/kg) from temperature (K) and dew point (K). Conversion functions between humidity measures are also provided.

Depends R (>= 2.10)

Suggests dplyr, knitr

License GPL-3

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

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

Encoding UTF-8

LazyData true

RoxygenNote 6.1.1

VignetteBuilder knitr

Repository https://caijun.r-universe.dev

RemoteUrl https://github.com/caijun/humidity

RemoteRef HEAD

RemoteSha 243cf0fbd8d1bb08a00f2877f4c6c61276214291

Contents

`AH` *calculate absolute humidity*

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 (°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 Department of Earth System Science, Tsinghua University

See Also

WVP1, WVP2, RH, SH.

Examples

```
t <- 273.15
Es <- SVP(t)
e <- WVP2(70, Es)
AH(e, t)
```

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 Department of Earth System Science, Tsinghua University

See Also

K2C.

Examples

```
T0 # absolute zero in Kelvin (K)
C2K(T0)
```

Es.T0 *Saturation vapor pressure at absolute zero (hPa)*

Description

$e_s(T_0) = 6.11 hPa$ 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)
- PV: 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.

ivt — *Aerosol transmission efficiency of influenza A virus from guinea pigs to guinea pigs*

Description

A dataset containing aerosol transmission efficiency of influenza A virus from four infected guinea pigs to four exposed guinea pigs under conditions of controlled temperature and relative humidity.

Usage

```
ivt
```

Format

A data frame with 24 rows and 4 variables:

- T: temperature in degree Celsius (5–30)
- RH: relative humidity in percentage (20–80)
- PT: transmission efficiency in percentage (0–100)
- source: data source

Source

Lowen, A. C., Mubareka, S., Steel, J., & Palese, P. (2007). *Influenza virus transmission is dependent on relative humidity and temperature*. PLoS pathogens, 3(10), e151.

Lowen, A. C., Steel, J., Mubareka, S., & Palese, P. (2008). *High temperature (30°C) blocks aerosol but not contact transmission of influenza virus*. Journal of virology, 82(11), 5650-5652.

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 Department of Earth System Science, Tsinghua University

See Also

C2K.

Examples

```
K2C(0)
```

L *Latent heat of water vapor*

Description

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

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 Department of Earth System Science, Tsinghua University

See Also

SH.

Examples

```
t <- 273.15
Es <- SVP(t)
e <- WVP2(70, Es)
q <- SH(e, p = 101325)
MR(q)
```

Mw *Molecular weight of water vapor*

Description

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

Usage

```
Mw
```

Format

An object of class `numeric` of length 1.

See Also

`Md`

`RH` *calculate relative humidity*

Description

calculate relative humidity ψ based on temperature t and dew point T_d

Usage

```
RH(t, Td, isK = TRUE)
```

Arguments

`t`	temperature in Kelvin (K) or in degree Celsius (°C)
`Td`	dew point in Kelvin (K) or in degree Celsius (°C)
`isK`	logical indicator whether temperature is in Kelvin (K). The default value is TRUE.

Value

numeric relative humidity in

Author(s)

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

See Also

`AH`, `SH`.

Examples

```
RH(30, 15, isK = FALSE)
```

Rw *Specific gas constant of water vapor*

Description

Specific gas constant of water vapor $R_w = \frac{1000R}{M_w} = 461.52 J/(kgK)$, where $R = 8.3144621 J/(molK)$ is the molar gas constant and $M_w = 18.01528 g/mol$ 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 Department of Earth System Science, Tsinghua University

See Also

WVP2, WVP2, AH, RH, MR.

Examples

```
t <- 273.15
Es <- SVP(t)
e <- WVP2(70, Es)
SH(e, p = 101325)
```

SH2RH *convert specific humidity into relative humidity*

Description

Climate models usually provide specific humidity only; however, relative humidity is used to compute heat index that is really useful for health impacts studies. This function converts specific humidity q into relative humidity ψ at temperature t and under atmospheric pressure q.

Usage

```
SH2RH(q, t, p = 101325, isK = TRUE)
```

Arguments

q	specific humidity q (kg/kg)
t	temperature in Kelvin (K) or in degree Celsius (°C)
p	atmospheric pressure in Pascal (Pa). The default is standard atmospheric pressure of 101325Pa.
isK	logical indicator whether temperature is in Kelvin (K). The default value is TRUE.

Value

numeric relative humidity in

Author(s)

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

See Also

AH, SH.

Examples

```
SH2RH(0.005867353, 22.25, p = 101325, isK = FALSE)
```

SVP — *calculate saturation vapor pressure*

Description

calculate saturation vapor pressure E_s 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 Department of Earth System Science, Tsinghua University

See Also

`SVP.ClaCla`, `SVP.Murray`.

Examples

```
SVP(273.15)
```

SVP.ClaCla *calculate saturation vapor pressure using the Clausius-Clapeyron equation*

Description

calculate saturation vapor pressure E_s 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 Department of 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

```
T0 # absolute zero in Kelvin (K)
SVP.ClaCla(T0)
```

SVP.Murray *calculate saturation vapor pressure using the Murray equation*

Description

calculate saturation vapor pressure E_s 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 Department of 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

```
T0 # absolute zero in Kelvin (K)
SVP.Murray(T0)
```

T0 — *Absolute zero*

Description

Absolute zero in Kelvin T_0 (K)

Usage

```
T0
```

Format

An object of class `numeric` of length 1.

WVP1 — *calculate partial water vapor pressure given dew point*

Description

calculate partial water vapor pressure e based on dew point T_d

Usage

```
WVP1(Td, isK = TRUE)
```

Arguments

`Td`	dew point in Kelvin (K) or in degree Celsius (°C)
`isK`	logical indicator whether temperature is in Kelvin (K). The default value is TRUE.

Value

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

Author(s)

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

See Also

`SVP`, `SVP.ClaCla`.

Examples

```
T0 # absolute zero in Kelvin (K)
WVP1(T0)
```

`WVP2` *calculate partial water vapor pressure given relative humidity and saturation water vapor pressure*

Description

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

Usage

```
WVP2(psi, Es)
```

Arguments

`psi`	relative humidity ψ in percentage ($\%$)
`Es`	saturation vapor pressure e_s(hPa) at temperature t, which can be calculated by callling `SVP` function.

Value

numeric partial water vapor pressure in Pascal (Pa)

Author(s)

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

See Also

`SVP`, `SVP.ClaCla`, `SVP.Murray`.

Examples

```
Es <- SVP(273.15)
WVP2(70, Es)
```

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