

# Package ‘humidity’

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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<sup>3</sup>), 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)

**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  $\rho_w$  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  $\rho_w$  ( $\text{kg}/\text{m}^3$ )

### 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(T0, 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**

$e_s(T_0) = 6.11hPa$  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 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  $L = 2.5 \times 10^6 \text{ J/kg}$

**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  $\omega$  based on specific humidity  $q$

**Usage**

MR( $q$ )

**Arguments**

$q$  specific humidity  $q$  ( $kg/kg$ )

**Value**

numeric mixing ratio  $\omega$  ( $kg/kg$ )

**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	<i>Molecular weight of water vapor</i>
----	--

---

**Description**

**Molecular weight** of water vapor  $M_w = 18.01528\text{g/mol}$

**Usage**

Mw

**Format**

An object of class `numeric` of length 1.

**See Also**

[Md](#)

---

RH	<i>calculate relative humidity</i>
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---

**Description**

calculate relative humidity  $\psi$  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](#)



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SH	<i>calculate specific humidity</i>
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---

**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  $\psi$  at temperature  $t$  and under atmospheric pressure  $p$ .

**Usage**

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

**Arguments**

<code>q</code>	specific humidity $q$ ( $kg/kg$ )
<code>t</code>	temperature in Kelvin (K) or in degree Celsius ( $^{\circ}C$ )
<code>p</code>	atmospheric pressure in Pascal (Pa). The default is standard atmospheric pressure of 101325Pa.
<code>isK</code>	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	<i>calculate saturation vapor pressure</i>
-----	--

---

**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	<i>calculate saturation vapor pressure using the Clausius-Clapeyron equation</i>
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---

**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)
```

---

$T_0$	<i>Absolute zero</i>
-------	----------------------

---

**Description**

**Absolute zero** in Kelvin  $T_0$  (K)

**Usage**

$T_0$

**Format**

An object of class `numeric` of length 1.

---

WVP1	<i>calculate partial water vapor pressure given dew point</i>
------	---

---

**Description**

calculate partial water vapor pressure  $e$  based on dew point  $T_d$

**Usage**

WVP1( $T_d$ , `isK` = TRUE)

**Arguments**

$T_d$	dew point in Kelvin (K) or in degree Celsius ( $^{\circ}\text{C}$ )
<code>isK</code>	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	<i>calculate partial water vapor pressure given relative humidity and saturation water vapor pressure</i>
------	---

---

**Description**

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

**Usage**

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

**Arguments**

psi	relative humidity $\psi$ in percentage (%)
Es	saturation vapor pressure $e_s$ (hPa) at temperature $t$ , which can be calculated by calling <a href="#">SVP</a> 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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