Symbols

The next few pages list some symbols used in oceanography. The R commands used here require the `oce` package to have been loaded, with

```
library(oce)
```

which may be done in a startup file (see page 10). It is also common to use this startup file to specify a default seawater formulation. In this book, most examples use the Gibbs SeaWater (GSW) formulation (McDougall and Barker 2011), as established with

```
options(oceEOS="gsw")
```

in the author's startup file. The older UNESCO system, denoted `"unesco"`, is also available throughout `oce`. See Sect. 5.2.1 and Appendix D for more discussion of these systems, and note that a choice of equation of state can also be made in function calls, as illustrated below.

ρ in situ seawater density in kg/m^3. For example, at practical salinity 35 PSU, in situ temperature 10°C and pressure 100 dbar, the UNESCO and TEOS-10 formulations of seawater density are[1]

```
swRho(salinity=35, temperature=10, pressure=100,
      eos="unesco")
[1] 1027.404
swRho(salinity=35, temperature=10, pressure=100,
      longitude=300, latitude=30, eos="gsw")
[1] 1027.406
```

(Note that the GSW formulation requires longitude and latitude, and it is a geographical variation of seawater "salt" ion ratios that yields the small density difference seen above.) The names of the arguments could be omitted, e.g.

```
swRho(35, 10, 100, 300, 30, "gsw")
```

works as above. In R, argument names are optional, provided that they are given in the correct order, and without gaps. R also permits abbreviation of argument names, e.g. `t=10` could be written instead of `temperature=10`, as explained in Sect. 2.3.11.2.

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[1] In a convention employed throughout `oce`, this function starts with "`sw`" to indicate that it applies to seawater. Analogously, air density may be calculated with `airRho()`.

σ Density anomaly, $\rho - 1000\,\mathrm{kg/m^3}$, calculated with `swSigma()`.

σ_θ Potential density anomaly, referenced to surface pressure;

```
swSigmaTheta(35, 10, 100, eos="unesco")
[1] 26.95398
```

is equivalent to

```
th <- swTheta(35, 10, 100, eos="unesco")
swSigma(35, th, 0, eos="unesco")
[1] 26.95398
```

σ_t Crude form of potential density anomaly, defined as $\rho - 1000\,\mathrm{kg/m^3}$, with ρ based on in situ temperature and zero pressure.

```
swSigmaT(35, 10, 100, eos="unesco")
[1] 26.952
```

$\sigma_0, \ldots, \sigma_4$ Potential density with reference pressure 0 dbar, 1000 dbar, 2000 dbar, 3000 dbar and 4000 dbar.

θ Potential temperature, i.e. the temperature of a water parcel moved adiabatically from one pressure to another, e.g.

```
swTheta(35, 10, 100, eos="unesco")
[1] 9.988453
```

for movement to the surface, or

```
swTheta(35, 10, 100, 1000, eos="unesco")
[1] 10.10996
```

for movement to 1000 dbar. (These two calculations illustrate the use of default values for function arguments; see Sect. 2.3.11.2.)

Θ Conservative temperature, as defined in GSW.

`CT` Conservative temperature argument name in GSW functions.

f Coriolis parameter, e.g. at 45°N

```
coriolis(45)
[1] 0.0001031261
```

g Acceleration due to gravity, e.g. at 45°N

```
gravity(45)
[1] 9.80619
```

N^2 Square of buoyancy frequency defined by $N^2 = -g\,\rho_0^{-1}\partial\rho/\partial z$ where ρ_0 is a reference density. N^2 may be calculated with `swN2()`.

p Sea pressure, i.e. in situ pressure minus atmospheric pressure. Given hydrostatic balance $dp/dz = -\rho g$,

```
gravity() * swRho(35, 10, 1, eos="unesco") / 1e4
[1] 1.007053
```

illustrates the near equivalence of sea pressure in dbars and depth in m, since 1 dbar is 10^4 Pa.

S Seawater practical salinity, in the UNESCO system.

S_A Seawater absolute salinity, as defined in GSW (Sect. 5.2.1 and Appendix D.)

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`SA`	Absolute salinity argument name in GSW functions.
`SP`	Practical salinity argument name in GSW functions.
t	Time, for most of the oceanographic literature. (In some thermodynamic treatments, e.g. the GSW literature, t stands for in situ temperature, in °C.)
`t`	In situ temperature argument name in GSW functions.
T	In situ temperature in Celsius, for most of the oceanographic literature, although in Kelvin for some thermodynamic analyses, e.g. in the GSW literature.
u, v, w	Components of velocity in the x, y and z directions.
x, y, z	Horizontal and vertical Cartesian coordinates. Typically z is measured in metres above the mean sea surface. Since instruments measure pressure instead of vertical coordinate, conversion with `swZ()` or `swDepth()` can be useful.

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