Notes on the GSW function gsw_SP_from_SA

This function, **gsw_SP_from_SA** is the inverse function of **gsw_SA_from_SP**. The **gsw_SP_from_SA**(SA, p, long, lat) function first interpolates the global Absolute Salinity Anomaly Ratio (R^{δ}) data set to the (p, long, lat) location using the internal GSW library function **gsw_SAAR** and then uses this interpolated value to calculate Practical Salinity according to (so long as the longitude and latitude of the observation do not place it in the Baltic Sea)

$$S_{\mathrm{P}} = \frac{35}{35.165\,04\ \mathrm{g\,kg^{-1}}}\ \frac{S_{\mathrm{A}}}{\left(1+R^{\delta}\right)}. \qquad \textit{Non-Baltic} \qquad (1)$$

This follows from Eqn. (A.5.10) of IOC *et al*. (2010).

If the observation is detected to be from the Baltic Sea, Practical Salinity is calculated using the relationship $S_{\mathrm{A}} - S_{\mathrm{R}} = 0.087\,\mathrm{g\,kg^{-1}} \times \left(1 - S_{\mathrm{P}}/35\right)$ (from Eqn. (A.5.16) of IOC *et al*. (2010), following Feistel *et al*. (2010)), so that

$$S_{\mathrm{P}} = \frac{35}{\left(35.165\,04\ -\ 0.087\right)\mathrm{g\,kg^{-1}}}\left(S_{\mathrm{A}}\ -\ 0.087\ \mathrm{g\,kg^{-1}}\right). \qquad \textit{Baltic Sea} \qquad (2)$$

In summary, the **gsw_SP_from_SA** function returns either Eqn. (1) or Eqn. (2) depending on whether the longitude and latitude of the sample put the observation outside or inside the Baltic Sea.

If the latitude and longitude are such as to place the observation well away from the ocean, a flag 'in_ocean' is set to zero as a warning, otherwise it is 1. This flag is only set when the observation is well and truly on dry land; often the warning flag is not set until one is several hundred kilometers inland from the coast. When the function detects that the observation is not from the ocean, R^{δ} is set equal to zero and **gsw_SP_from_SA** returns $S_{\mathrm{P}} = \left(35/35.165\,04\ \mathrm{g\,kg^{-1}}\right) S_{\mathrm{A}}$ in accordance with Eqn. (1).

References

IOC, SCOR and IAPSO, 2010: *The international thermodynamic equation of seawater – 2010: Calculation and use of thermodynamic properties*. Intergovernmental Oceanographic Commission, Manuals and Guides No. 56, UNESCO (English), 196 pp. Available from http://www.TEOS-10.org

Feistel, R., S. Weinreben, H. Wolf, S. Seitz, P. Spitzer, B. Adel, G. Nausch, B. Schneider and D. G. Wright, 2010: Density and Absolute Salinity of the Baltic Sea 2006–2009. *Ocean Science*, **6**, 3–24. http://www.ocean-sci.net/6/3/2010/os-6-3-2010.pdf