

MAST 467/667: Introduction to Polar Oceanography (Fall 2021)
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Workshop/Homework-7: Sea water properties

Data: Ocean Melts Greenland (OMG) at <https://omg.jpl.nasa.gov/portal/>

Introduction. We are ready for scientific work. The first step is to convert in-situ temperatures to potential temperature. This removes the pressure effects that in-situ temperature measurements include by removing the temperature variation introduced by pressure effects. The potential temperature thus is the temperature that a parcel of water at depth z would have, if it were brought to the surface without any addition or subtractions of heat (adiabatic process).

Goal. Become aware of oceanographic standards and precise definitions variables temperature, salinity, and pressure and derived state variables described in the current, internationally adopted TEOS-10 standard (Thermodynamic-Equation-Of-State-2010) as described at <http://teos-10.org/> and links provided there.

Assignment. Calculate potential temperature, density, and deviations from the freezing point from measurements of in-situ temperature, conductivity, and pressure using the TEOS-10 standard. Research functions listed at

https://rdr.io/cran/gsw/man/gsw_pt_from_t.html

1_Install and load the package “gsw” (RStudio users) or similar tool-box (MatLab user) or source code (Fortran or C users):

```
install.package("gsw")  
library(gsw)
```

2_For one vertical profile only, use the following routines to convert your in-situ temperature “ t ” and salinity “ s ” and depth “ z ” to pressure, absolute salinity SA, potential temperature pt :

```
p = gsw_p_from_z(z)           # pressure  
SA = gsw_SA_from_SP(s,p,lat,lon) # absolute salinity  
pt = gsw_pt_from_t(SA,t,p,0)   # potential temperature
```

3_For the same profile, use the following routines to estimate potential density at both zero and 1000-dbar pressure as well as the freezing point:

```
CT = gsw_CT_from_t(SA,t,p)     # conservative temperature  
r0 = gsw_sigma0(SA,CT)         # potential density to zero pressure
```

```
r1 = gsw_sigma1(SA,CT)      # potential density to 1000-m pressure
tf = gsw_CT_freeze_poly(SA,p,1) # freezing point
```

4_Plot the profile to compare in-situ with potential temperature;

5_Plot the profile of absolute salinity and potential density;

6_Estimate and plot a first metric on the heat-content within the water profile as the positive difference of the potential temperature and the freezing point temperature.