MAST 467/667: Introduction to Polar Oceanography (Fall 2021)

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Workshop/Homework-8: Bin Averages and Metrics

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

Introduction. We are ready for scientific work. The second step will bin average the profile data so that we derive metrics systematically on equally-spaced data in 1-m vertical bins.

Goal. Using loops and conditional data assignments within R or MatLab

Assignment:

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

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

2_The above package contains a bin-averaging routine binMeans to average a vector Salt into a bin-averaged vector binSalt using binDepth as the bin depths:

2a_ Extract a set of casts from your data frame omg where "Cast" is the label for the last column that gives you the cast number (filter is a routine in package "dplyr")

```
for (i in 1:2)
  { data <- filter(omg, Cast == i)
    print(i)
  }
```

2b_Extract the measurements depths into a vector "Depth"

```
Depth <-   as.numeric(data[,3])
Temp <-   as.numeric(data[,4])
Salt    <-   as.numeric(data[,5])
```

2c_Find the last depth via the tail command

```
maxDepth  <-   as.integer(tail (Depth,1))
print(maxDepth)
if (maxDepth >= Dmax)
   { Dmax = maxDepth
   }
```

2d_Create the sequence of depth bins that you want to average temperature and salinity

```
binDepth <- seq(2,maxDepth,1)
```

3_Perform the bin average for temperature and salinity

```
binSalt  <-  binMeans(Salt,x=Depth,bx=binDepth,na.rm=TRUE)
binTemp  <-  binMeans(Temp,x=Depth,bx=binDepth,na.rm=TRUE)
```

4_Plot the original profile with the bin averaged profile;

6_Estimate as a first metric the fresh water component (in vertical meters) by evaluating the integral (1) below taken from Spall (2013) as the sum over all depths.

Another measure of the amount of freshwater in the upper ocean is the freshwater content, defined as the vertical integral of the salinity relative to $S_r = 34.8$ down to the depth where $S = S_r$ or the bottom, whichever is less:

$$F = \int_0^H (S_r - S)/S_r \, dz . \qquad (1)$$

Spall, M.A.: On the Atlantic circulation in the Arctic Ocean, J. Phys. Oceanogr., 43(11), 2352-2371, 2013.