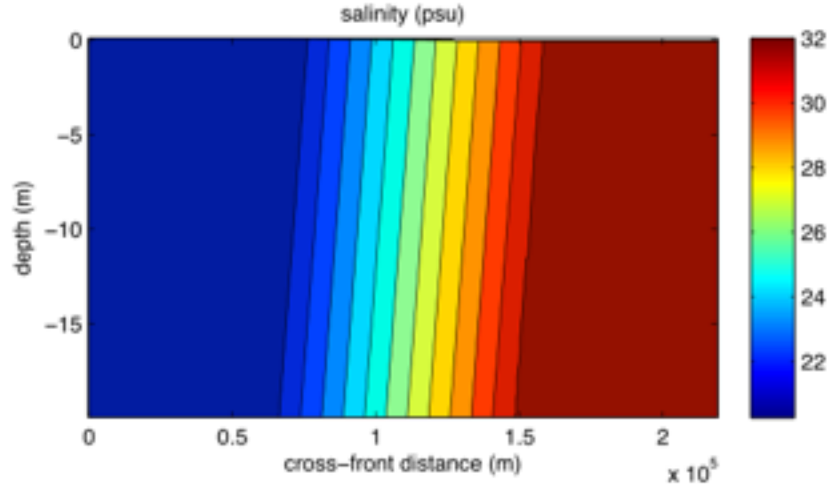
HW3

The top figure on the right shows a wide salinity front that has constant salinity gradients in both y (north-south) and z direction in the central domain (i.e. constant sloping salinity surface; stably stratified with fresher water on the southern side). The bottom figure is a schematic of the grid-layout The black dots (in total 30 x 422 dots) are where temperature, salinity and velocity are located (run course_data_mat.m to see the distribution of temperature, salinity, and u). Note that this is sigma coordinate in the vertical, meaning that two grid points next to each other may not be at the same height z. For example, d2_zr(end,150) is NOT equal to d2_zr(end,151) because the model uses 30 layers and the water column at j=150 is thicker than at j = 151. Therefore, when you compute dρ/dy, you need to make sure that they are on the same z-level to be accurate.

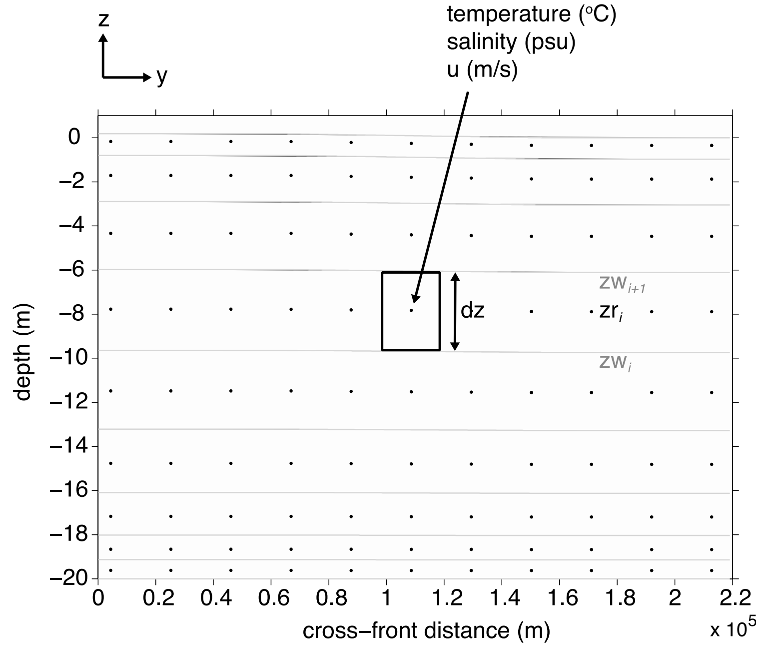


Now apply what you have learned in the class and complete the following tasks

(1) Use the linear equation of state (see course_data_mat.m) to compute the density and plot the density distribution.

(2) Use thermal wind relation to infer geostrophic flow ug.
(hint: you need to compute dρ/dy. You also have to choose a reference level to do the integration. For example, you can use ug = 0 or ug = u (model) at the bottom)

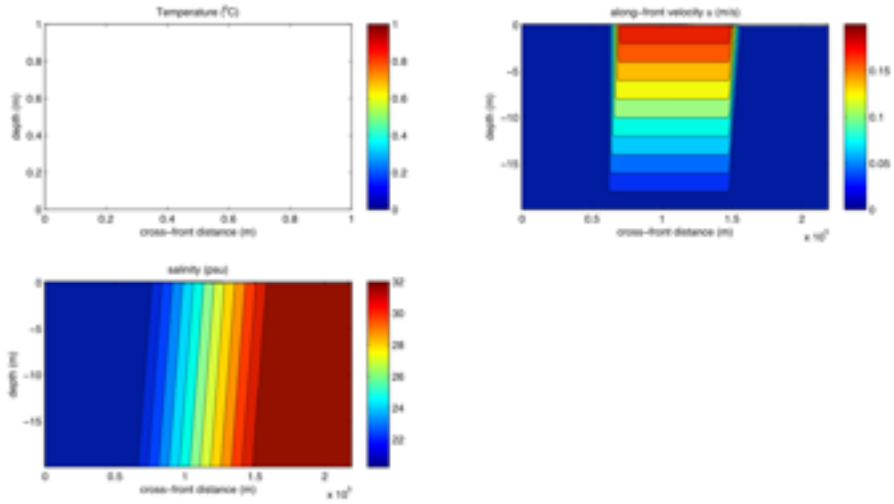
(3) Is the model state in geostrophic balance? (You can compare your estimated ug and d2_u)



course_data_mat.m

kestrel : /home/CJ/0_COURSE/201904_THERMALWIND/

data generated by PreprocessAnaCC_ini_Eady.m



```
% d2_yr   [nz,ny]     y(m)
% d2_zr   [nz,ny]     depth(m) of black dots in figure
% d2_zw   [nz+1, ny]  depth(m) of gray lines in figure
% d2_T    [nz,ny]     temperature(C)
% d2_salt [nz,ny]     salinuty(psu)
% d2_u    [nz,ny]     along-front velocity u(m/s)
% fconst  [#]         Coriolis parameter(1/s)
% g       [#]         gravitational constant(m/s2)
% rho0    [#]         background density(kg/m3)
%-----------------------------------------------------------
% linear equation of state
%   R0 = 1027;
%   T0 = 10;
%   S0 = 32;
%   TCOEF = 1.7d-4
%   SCOEF = 7.6d-4
% DENSITY = R0 +rho0*( SCOEF*(S-S0) -TCOEF*(T-T0) );
%-----------------------------------------------------------
close all;
clear all;

load('./AnaCoastalCurrent_ini_Eady.mat');
```

```
figure; set(gcf,'Position',get(gcf,'Position').*[0.6 0.6 2.25 1.5]);

subplot(221);
 contourf(d2_yr,d2_zr,d2_T); colorbar;
 xlabel('cross-front distance (m)');
 ylabel('depth (m)');
 title('Temperature (^oC)');

subplot(223);
 contourf(d2_yr,d2_zr,d2_salt); colorbar;
 xlabel('cross-front distance (m)');
 ylabel('depth (m)');
 title('salinity (psu)');

subplot(222);
 contourf(d2_yr,d2_zr,d2_u); colorbar;
 xlabel('cross-front distance (m)');
 ylabel('depth (m)');
 title('along-front velocity u (m/s)');
```