MAR555: Problem Set 3.

1. If the flow is geostrophic, please draw the direction of the current in the following pressure fields (heavy solid line indicates the coastline). Do you expect different magnitudes of the current in these four cases? Why? Note: P1, P2 and P3 indicate the water pressures.



2. The climatology of wind fields over the continental shelf region of the US southeastern coast can be divided into five seasons: winter (November to February), spring (March to May), summer (June to July), fall (August), and mariners' fall (September to October). The entire shelf is characterized by northwesterly or northerly or northeasterly wind in winter and by southeasterly or southwesterly wind in summer. Spring and fall seasons are

in the transition regime with a relatively wind except during the atmospheric frontal passages. In marines' fall, the northeasterly wind prevails over the entire shelf. What is the direction of the Ekman transport over the mid- and outer shelves in each season? Draw the schematics of vectors of the wind stress and Ekman transport (notice that the wind direction is defined as the direction at which the wind comes from. For example, a northwesterly wind is the wind coming from the northwest direction).

3. Describe the physical driving mechanism of the "Ekman spiral". Could the Ekman current form in the inviscous (frictionless) fluid? Why? For a given wind speed of 10 m/s and a vertical eddy viscosity (A_z) of 10^{-2} m²/s, estimate the thickness of the Ekman layer at latitudes of 10° , 30° , and 65° N. Can you explain physically why the thickness of the Ekman layer varies with latitude?