Math 483 – Homework 10

When doing the homework please keep in mind the material learned in the laboratory.
Remember to clear when moving on to a new figure.

1)Use the seabreeze.gs script to display the vertical and horizontal perturbation velocities as done in the lab. Display the results for for the three latitudes (0, 30, 60 degrees) but at sunrise, sunset and at midnight. Discuss the results by:

a)comparing the output for different latitudes at the same time
b)comparing the output for the same latitude at different times

Please note in which cases do you get a land breeze (flow from land to sea).
Please note if there is penetration of the sea breeze into the land.

2)Plotting the Rotunno heat function.

a)As a function of time

```
> open seabreeze.rotunno.30deg
> set t 1 289
> set z 1
> set x 100
> set xaxis 0 24 3
> d sb_hsrc
> draw xlab hour
> draw ylab heating function at surface
> draw title heating function vs. time
```

b)As a function of x for several vertical levels

```
set mproj off
set t 72
set gxout contour
set lev 0 4
set x 80 120
set clab forced
d sb_hsrc*100000
draw title heating function sb_hsrc*100000
```

Notes: The function has been multiplied by 100000 because the values are so small.
The command 'set clab forced' forces labels to be placed in all contours

When in doubt about a command use the help in the 'Index' page in the GrADS documentation

3) On the same graph draw the circulation for 0, 30, 60 and 90 degrees.

>> Make sure to evaluate the circulation at the ground level by stating

>set z 1

Discuss if it fits the theoretical results presented in the Rotunno paper which are in the power point and which are summarized below. Keep in mind the effects of friction .

Please also comment on the expected results for the onshore flow. You can use the graphs we did in the laboratory.

Note: to plot on the same graph include the command 'vrange -4000 4000' so that there is a common axis. You may want to explore what happens if you do not do this.

From Rotunno:

If f > w (poleward of 30˚) equation is elliptic

- sea-breeze circulation spatially confined
- circulation in phase with heating
- circulation, onshore flow strongest at **noon**
- circulation amplitude decreases poleward

If f < w (equatorward of 30˚) equation is hyperbolic

- sea-breeze circulation is extensive
- circulation, heating out of phase
- f = 0 onshore flow strongest at **sunset**
- f = 0 circulation strongest at **midnight**

If f = w (30˚N) equation is <u>singular</u>

- some friction or diffusion is needed
- circulation max at **sunset**
- onshore flow strongest at **noon**