Further Exploration of DTDM and GrADS outputs

1)Hovemöller Diagrams

Are used to display the time evolution of the horizontal flow (in our case).
They are widely used in meteorology to investigate the presence of waves.

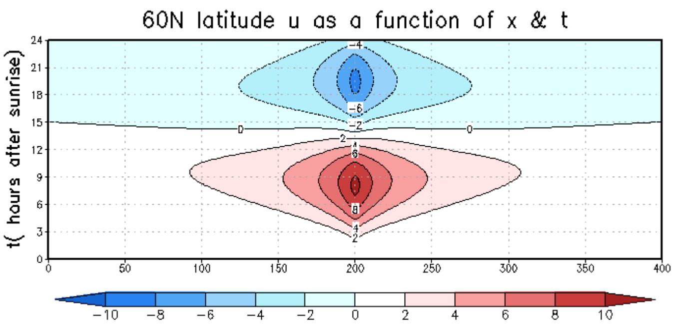
We will use the script seabreeze_hov.gs for this purpose.

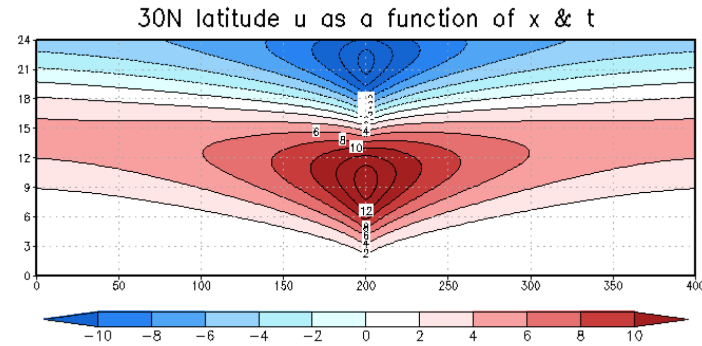
```
'set mproj off'
'set display color white'
'clear'
'set grads off'
* time length hardcoded
'set t 1 289'
'set z 1'
'run scripts/rgbset.gs'
'set gxout shaded'
* 400 km wide domain hardcoded
'set xaxis 0 400 50'
* 24 hour simulation hardcoded
'set yaxis 0 24 3'
'set clevs -10.0 -8.0 -6. -4. -2. 0 2. 4. 6. 8. 10.0'
'set ccols   49  47  45  43 42 41  0 61 63 65 67 69'
'd u'
'scripts/cbarn 1.0 0 6.0'
'set gxout contour'
'set cint 2.0'
'set ccolor 1'
'd u'
```

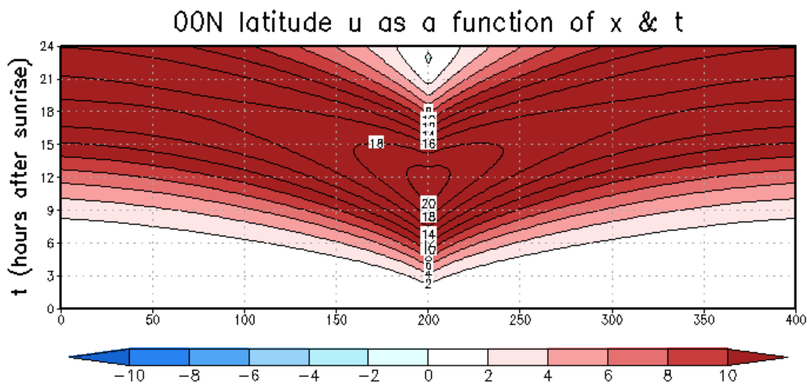
In grads open the data files for 0, 30, 60 degrees one at a time and run

>seabreeze_hv.gs

Note what happens to the cross-shore flow as it evolves in time (up). When does it change







>>This shows clearly that at the Equator there is no land=breeze for the Rotunno model

2) Spin-up time

Up to this point we have run the simulation for only one period of 24 hours (86400 seconds).

In the file “input_seabreeze.txt” this is controlled by the command “timend”

Locate this command and change it as to run the simulation for 2 days.
Select the latitude at 0 degrees.
Label the output file seabreeze.rotunno.2days.00deg

In GrADS plot the cross-shore velocity at the coastline.

First close all files and open the new file.
Check the time span using the query command

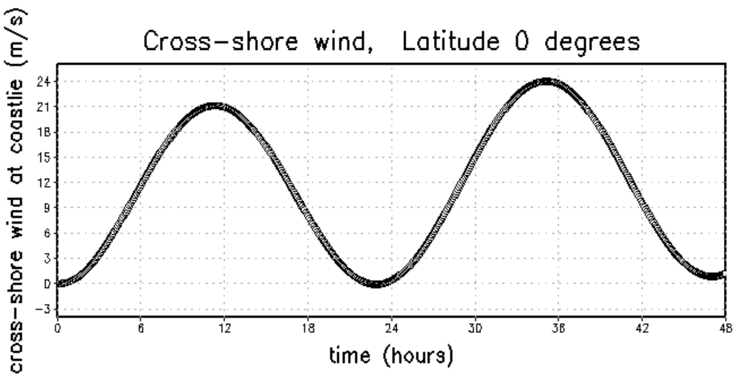
>q file

Now to plot:

> set mproj off
> set grads off

> set t 1 577
> set z 1

\>   set x 100
\> set xaxis 0 48 6
\>   display u



\>>In a two day run still there is no land breeze at the Equator

3)Non-linear effects

As you recall from class in the case of the Rotunno paper the atmospheric dynamics equations were linearized. This permitted the analytical approach to the problem. As we have seen the linear dtdm leads to some results which are not realistic.

The next step consists on running dtdm for the non-linear case. To do this the following changes must be made in the input_seabreeze.txt file:

Set sb_linear = 0

Increase the diffusion coefficients dkx, dkz to avoid computational instability

For the linear case dkx=dkz= 5 m^2/s was adequate.

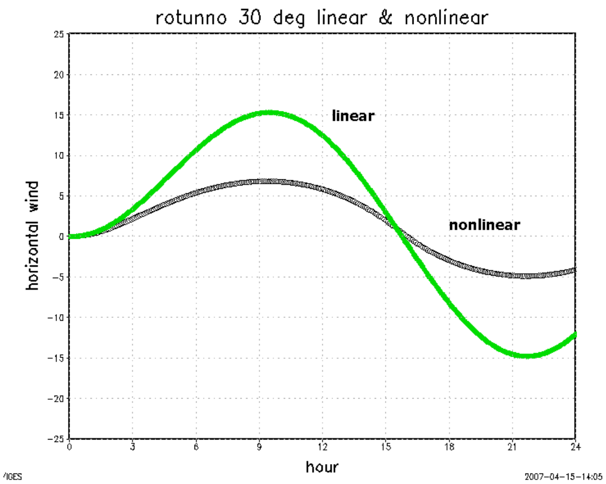
For the nonlinear case we can try dkx = 500, dkz = 50 m^2/s (probably excessive)

Make sure to return the time to 24 h (86400s)

For a run at 30 degrees a suggestive name for the output file is seabreeze.nlin.30deg

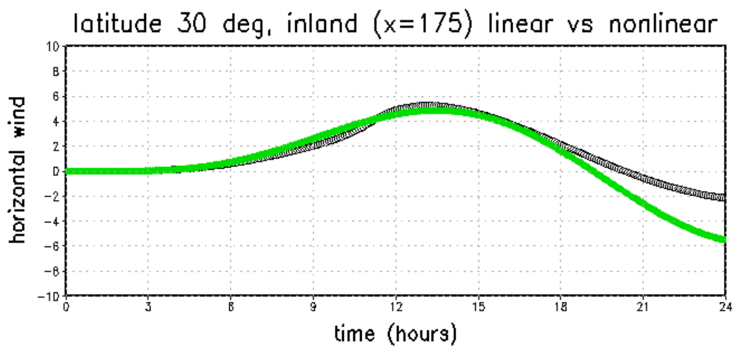
In GrADS open this file as well as the one for the linear case at latitude of 30 deg

On the same graphs plot the cross-shore flow for the linear and nonlinear cases at the coastline.



>>The additional diffusion in the nonlinear case decreases the strength of the flow

Now investigate what happens inland. For example select x=175 and repeat the exercise.



>> The nonlinear keeps its magnitude but in the linear case the strength drops.

Now display the cross-shore flow at sunset by running seabreeze.gs (remember that the script refers to the variables in the first open file)