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Atmospheric Modeling

Homework #4, Chp 5.

## 5.1b

Given:

dlx = 5000#m$,   
dly = 5000#m$,   
dlpa = -10# hPa$,   
u1 = -2 #ms^{-1}$,   
u2 = 1 #ms^{-1}$,   
v3 = 1 #ms^{-1}$,   
v4 = -2 #ms^{-1}$,   
w5 = 0.3 #ms^{-1}$,   
tav = 284#K$,   
Pa = 980 #hPa$,   
grv = 9.80665 #m s^{-2}$,   
rg = 287.04 #m^{2}s^{-2}K^{-1}$,   
q1 = .004 #kg kg^{-1}$,   
q2 = .005 #kg kg^{-1}$,   
q3 = .003 #kg kg^{-1}$,   
q4 = .004 #kg kg^{-1}$,   
q5 = .0045 #kg kg^{-1}$,   
q6 = .0055 #kg kg^{-1}$  
hh = 500 #s

wp5 <- -w5\*(Pa/(tav\*rg))\*grv

wp6 <- wp5 - dlpa \* (((u2-u1)/dlx) + ((v4-v3)/dly))

qtt <- hh \* -( ( (u2+u1)/2 ) \* ( (q2-q1)/dlx ) + ( (v4+v3)/2 ) \* ((q4-q3)/dly ) + ( (wp6+wp5)/2 ) \* ( (q6-q5)/dlpa) )

The change in q after 500 seconds is -0.0016684 kg kg-1 . This seems likely, as the windspeeds indicate that more air is exiting the grid cell than entering.

## 5.3a

Given:

dlxa = 4000#m$,   
dlya = 5000#m$,   
dlo = .05   
u1a = -2 #ms^{-1}$,   
pia1 = 748 #hPa  
u2a = 1 #ms^{-1}$,  
pia2 = 752 #hPa  
v3a = -1 #ms^{-1}$,  
pia3 = 749 #hPa  
v4a = -2 #ms^{-1}$,  
pia4 = 753 #hPa  
w5a = 0.02 #ms^{-1}$,   
tava = 298#K$,   
Patop = 250 #hPa$,  
obot = .9  
grv = 9.80665 #m s^{-2}$,   
rg = 287.04 #m^{2}s^{-2}K^{-1}$,

pia <- (mean(pia1,pia2,pia3,pia4))  
  
  
o5 <- (-w5a\*(Patop/(tava\*rg))\*grv) / pia

o6 <- -dlo \* ((pia \* (u2a - u1a)/dlxa) + (pia \* (v4a - v3a)/dlya))/pia + o5

The sigma-pressure coordinate vertical scalar velocity at the top of the cell is -2.826635610^{-5}. I am fairly certain that I missed a step somewhere in this problem. I suspect that I should have first found w6, then convert that to vertical scalar velocity. It is also possible that I incorrectly expanded the dot product in the continuity equation for air.