Meteorology 455/555 Group Problems - 1

Due 25 January 2006

1. Suppose $v' = \left(10\tfrac{m}{s}\right)\cos\{\omega t\}\cos\{6\lambda\}$

(a) If $q' = \left(2\tfrac{g}{kg}\right)\cos\{6\lambda\}$, what is $\left[\overline{v'q'}\right]$ if time averaging covers the period $0 \le t \le 2\pi/\omega$?

(b) If instead, $q' = \left(2\tfrac{g}{kg}\right)\cos\{\omega t\}\cos\{6\lambda\}$, what is $\left[\overline{v'q'}\right]$?

2. (a) Suppose the 850 mb temperature field at 45 N is given by the function

$$T_{850} = 278K + (10\,K)\cos(2\lambda) + (5K)\cos(4\lambda)\ ,$$

where λ is longitude. What is [T]?

(b) Suppose that the 850 mb meridional wind field at 45 N is given by

$$v_{850} = (10m/s)\cos(4\lambda)$$

What is [vT]?

(c) What is [v*T*]? How is it related to [vT] in this problem? Why?

Some equations that might be useful:

$$\int\cos(ax)dx = +\frac{1}{a}\sin(ax)$$

$$\int\cos^2(ax)dx = +\frac{1}{2}x + \frac{1}{4a}\sin(2ax)$$

$$\int\cos(ax)\cos(bx)dx = +\frac{\sin((a-b)x)}{2(a-b)} - \frac{\sin((a+b)x)}{2(a+b)}$$

$$\int\cos^3(ax)dx = +\frac{1}{3a}\sin(ax)\left(\cos^2(ax)+2\right)$$

$$\sin\{n\pi\} = 0\ ,\ n = 0, \pm1, \pm2, \ldots$$