Addendum Items and Notes for Chapter 6

Page 113. A component of the Coriolis force was not included, as described below. The term associated with this component appears in Eq. 12.6, but it was not included in the derivation in section 6.

(a) Modify Eq. 6.16, adding a superscript "x": $\vec{F}_M$ becomes $\vec{F}_M^x$

(b) Insert the following paragraph before the section on Centrifugal Accelerations

If a parcel of air or water has meridional velocity relative to the earth, v, the absolute angular momentum associated with that motion is

$$M = V_{ABS} r = v(a+z)\cos\phi . \tag{6.16a}$$

Note that since the earth does not have a component of rotation in the meridional direction, $V_{ABS} = v$. Then, conservation of absolute angular momentum gives

$$\frac{dM}{dt} = 0 \Rightarrow \frac{dv}{dt} = -\frac{vw}{a} \quad \text{and} \quad \overline{F_M^y} = -\frac{vw}{a}\hat{j}, \tag{6.16b}$$

where the thin atmosphere approximation was made after the differentiation. Then, the Coriolis acceleration that arises due to the requirements of conservation of angular momentum in the absolute frame of reference is

$$\vec{F}_M = \left(2\Omega v\sin\phi + \frac{uv}{a}\tan\phi - 2\Omega w\cos\phi - \frac{uw}{a}\right)\hat{i} - \frac{vw}{a}\hat{j} \tag{6.16c}$$

Page 115. With the above addition, the full Coriolis force in Eq. 6.25 should be

$$\begin{aligned}\vec{F}_{COR} = &\left(2\Omega v\sin\phi + \frac{uv}{a}\tan\phi - 2\Omega w\cos\phi - \frac{uw}{a}\right)\hat{i} + \left(-2\Omega u\sin\phi - \frac{u^2\tan\phi}{a} - \frac{vw}{a}\right)\hat{j} \\ &+ \left(2\Omega u\cos\phi + \frac{u^2+v^2}{a}\right)\hat{k}\end{aligned} \tag{6.25}$$