

ATOC 5050: Atmospheric dynamics

Exercise 1

(due in class Thursday 3 September)

1. Using conservation of angular momentum (M), what is the zonal (westerly) velocity of a parcel initially at rest at the equator when displaced to 30 N?

Hint: $M = (\Omega + u/R)R^2$,

u relative (westerly) velocity

R the distance to the rotation axis
(relative angular velocity is u/R)

Earth is spherical, so $R = a \cos \phi$

A radius of the earth = 6,391,000 m

Ω Rotation rate 2π radians per day

2. (Holton 2.1) A ship is steaming northward at a rate of 10 km/hr. The surface pressure increases toward the northwest at a rate of 5 Pa/km. What is the pressure tendency recorded at a nearby island station if the pressure aboard the ship decreases at a rate of 100 Pa in 3 hours?

Hint: this problem encourages you to review partial derivatives and advection!

3. **(Bonus discussion question)** Read Hadley's (short) paper from 1735 (available on the class web site). What physical principle was he evoking to explain the easterlies in the tropics? What was, as he explains, the problem with his explanation?