San Francisco State University Name _____
Department of Earth & Climate Sciences Fall 2017

ERTH 465
Homework 5
Due Tuesday 24 September

Please answer on back or on separate sheets, in complete sentences where appropriate. DO NOT JAM ANSWERS BETWEEN EQUATIONS. (100 pts)

Here is the equation of motion in natural coordinates, as we worked with it on the handout on the Equation of Motion.

$$\frac{dV}{dt}\vec{t} + \left(KV^2\right)\vec{n} = -\left(\frac{1}{\rho}\frac{\partial p}{\partial s}\right)\vec{t} - \left(\frac{1}{\rho}\frac{\partial p}{\partial n} + fV\right)\vec{n} \quad (5)$$

Full Equation of Motion in Natural Coordinates

$$\frac{dV}{dt} = -\frac{1}{\rho}\frac{\partial p}{\partial s} \quad (6)$$

t components in Equation (5)

$$KV^2 = -\frac{1}{\rho}\frac{\partial p}{\partial n} - fV \quad (7)$$

n components in Equation (5)

Flow around tornadoes tends to be parallel to local isobars or height contours, and the same is true for flow around and in the eyewalls of hurricanes. For the very small distances around tornadoes and short distances around the center of hurricanes, Coriolis Effect (and accelerations) are one to two orders of magnitude

smaller than the local centrifugal accelerations at the radius of curvature of each (~100 m for tornadoes, ~50 km for hurricanes).

1. Simplify equations (5), (6), and (7) by consideration of the constraints listed in the previous paragraph. You do not need to solve for the velocity. (30 pts).

2. Winds around the eyewall (about 50 km from the center) of Maria were estimated to be on the order of 80 m s^{-1} when it moved over Domenica, at roughly 20N. (30 pts)
    a. Compute the local centrifugal acceleration at 50 km from the center of the storm.
    b. Compute the value of the Coriolis Acceleration at 20N for that wind speed. The angular velocity of the earth is 7.292 X 10^{-5} s^{-1}.

3. Perform the same calculations as you did in (2) for a minimal hurricane (same latitude and radius), wind speed sustained at 35 m s^{-1}. 30 pts)
    a. Compute the local centrifugal acceleration at 50 km from the center of the storm.
    b. Compute the value of the Coriolis Acceleration at 20N for that wind speed. The angular velocity of the earth is 7.292 X 10^{-5} s^{-1}.

4. Based upon your results, comment on whether the assumption that Coriolis Acceleration can be neglected on an order of magnitude basis for very fast flow around a weather system with extremely large streamline (and trajectory) curvature. (10 pts)