Solutions: Chapter 11

1) $\frac{D}{Dt}\ln\zeta_{abs} = -div_h \mathbf{v}_h = 10^{-6}s^{-1}$.

Integrating gives $(\ln\zeta_{abs})_2 - (\ln\zeta_{abs})_1 = (10^{-6}s^{-1})(t_2 - t_1)$ where the subscripts 1 and 2 denote the start and finishing times respectively.

Thus $\ln 2 = (10^{-6}s^{-1})(t_2 - t_1)$, giving $\boxed{(t_2 - t_1) = 6.9\times10^5 s \sim 8 days}$

Part 2, proceed in a similar manner to previously. Gives

$$\boxed{div_h \mathbf{v}_h = -8.0\times10^{-6}s^{-1}}$$

2) Assuming this is locally a solid body rotation the vorticity is $2\times\frac{100ms^{-1}}{100m} = 2s^{-1}$.

Assume absolute vorticity starts at $(f + 0) \sim 10^{-4}s^{-1}$. This means that we need $\ln(2/10^{-4}) = (10^{-6}s^{-1})(t_2 - t_1)$. Giving

$$\boxed{(t_2 - t_1) = \sim 114 days}$$

As tornadoes form in about an hour, clearly some other mechanism is at work.