

How rapid y does
L-S flow tighten
isotherms

$$\gamma = -K_{xy}$$

$$v_g = +K_x$$

$$v_g = -K_y$$

$$D_g \left(\frac{\partial T}{\partial y} \right) = - \left[\frac{\partial h_g}{\partial y} \frac{\partial T}{\partial x} + K \frac{\partial T}{\partial y} \right]$$

Following the motion

$$\frac{D}{Dt} \ln \left\{ \frac{\partial T}{\partial y} \right\} = K$$

$$\ln \left(\frac{\partial T}{\partial y} \right) \Big|_c^* = K^*$$

$$\ln \left\{ \frac{\sigma_{\text{sy}}^2}{\sigma_{\text{sy}}^2} \right\} = K \sigma$$

$$\frac{\sigma}{\sigma_{\text{sy}}} (A) = \frac{\sigma}{\sigma_{\text{sy}}} (0) \exp \{ K \sigma \}$$

Note $u_g = K \lambda$

$$L_x \sim 10^6 \text{ m} \quad U \sim 10 \frac{\text{m}}{\text{s}}$$

$$K \sim 10^{-5} - 1$$

$$K = 10^{-5} \text{ s}^{-1}$$

$\Rightarrow$ e-folding time = 1.2 d

10-fold increase?

$$t = 10^5 \ln(10) = 2.3 \text{ d}$$

Semi-geostrophic Theory

(a) Boussinesq approx.

$\rho = \rho_0$ except in buoyancy
force

(5) pressure, density & temperature fields have small deviations from a reference atm. (standard atmosphere)

$$\Phi(x, y, z, t) = \frac{(P - P_0)}{P_0}$$

$$\Theta(x, y, z, t) = (\theta - \theta_0)$$

Conservation Laws

$$\frac{Du}{Dt} - f_v + \frac{\partial \Phi}{\partial x} = 0$$

$$\frac{Dv}{Dt} + f_u + \frac{\partial \Phi}{\partial y} = 0$$

$$\frac{D\theta}{Dt} + w \frac{\partial \theta}{\partial z} = 0$$

$$\frac{D}{Dt} = \frac{\partial}{\partial t} + u \frac{\partial}{\partial x} + v \frac{\partial}{\partial y} + w \frac{\partial}{\partial z}$$

$$b \equiv \frac{q \oplus}{\ominus_{\infty}} = \frac{\Phi}{Z}$$

$\Theta_{00} = \text{const. reference}$

Value

consider Scale

Separation:



$$W \sim 10 \text{ ms}^{-1}$$

$$V \sim 1 \text{ ms}^{-1}$$

$$L_z \sim 1000 \text{ km}$$

$$L_y \sim 100 \text{ km}$$