Mind maps of climate models and their components:
http://proj.badc.rl.ac.uk/pimms/browser/CASCADE/ControlledVocabs/trunk/Software?rev=48&order=size

(Must have Flash player installed)

Secondary flow: a strategic tool. Examples:

① → Mean plus deviations

$\bar{\psi} + \psi'$ • clima + anomalies ← timescale separation

$\bar{\psi} + \psi'$ • smoothed + eddies ← spatial scale separation

$[\psi] + \psi^*$ ← • zonal mean + eddy

② → Flywheel plus engine

geostrophic wind ← Contains most KE + "inertia" ← "the propensity to persist"

ageostrophic flow
• is many things" waves, turbulence, etc. etc!
• ONE PART is what maintains TWB
• divergent ⇔ ω, controls $\frac{d}{dt}$

Ageostrophic winds doing their job to maintain TWB in a geostrophic flow pattern:

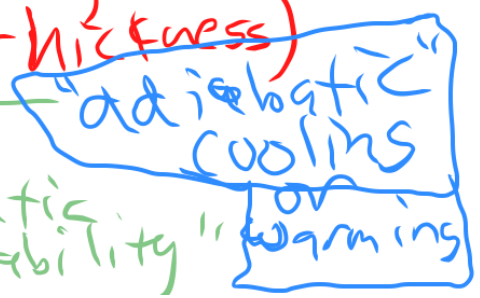
- Two tools to do the job

1. $\frac{d\vec{V}}{dt} = f(\vec{V}_g \times \hat{k}) \approx \frac{d}{dt}(V_g)$ — can adjust V_g

2. $\frac{\partial \omega}{\partial p} = -(\vec{\nabla} \cdot \vec{V}) = -(\vec{\nabla} \cdot \vec{V}_g)$

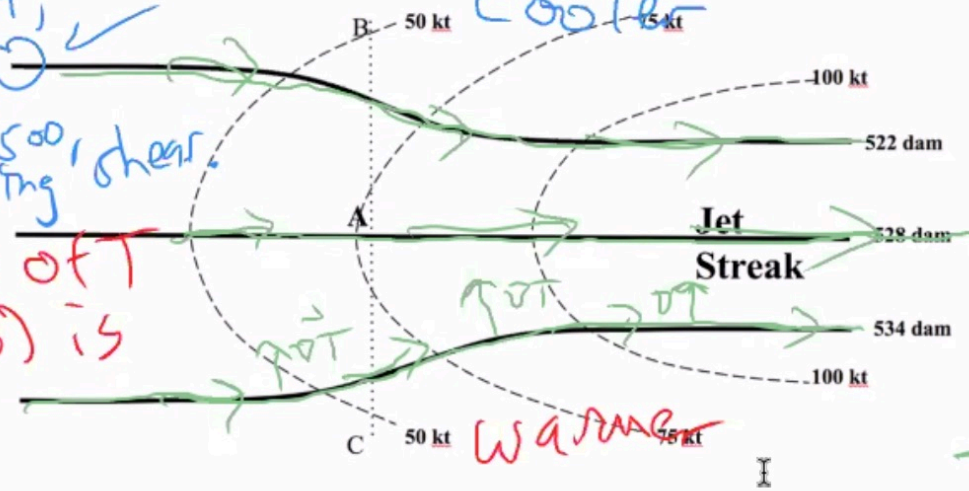
↖ ageostrophic wind's divergent part connects to ω, which can adjust I (thickness)

via $\frac{dT}{dt} = \omega S_p$ ← "static stability"



LMT_QGomega_and_Qvectors_11pages.pdf (page 1 of 11)

jet streak situation. Suppose the 1000-hPa geopotential height surface $Z_{1000} = 0$ everywhere (i.e., the 1000-hPa surface is flat, with no geostrophic wind at that level). On the following diagram, the 500-hPa height contours are shown as bold solid lines, and the 500-hPa isotachs are shown as dashed lines. The cross section B-C is marked for later reference.



LMT_QGomega_and_Qvectors_11pages.pdf (page 2 of 11)

This is Eq. (1.44) in MSM. Here, the subscripts "U" and "L" correspond to "upper" and "lower" levels, and "C" is a constant for a given pressure layer. **Would thermal wind balance be sustained in locations such as point A as the advective tendencies from a) and b) act together? Why or why not?**

d) If the answer to c) is "no," **explain the sense of the imbalance** that would develop at point A. In other words, would the vertical shear of the westerly flow become too weak for the north–south temperature gradient, or vice versa?

e) **Based on your answer to d), what would need to happen in order to bring the atmosphere back toward thermal wind balance in the vicinity of point A?**

The magnitude of the temperature gradient would need to decrease by $\frac{dT}{dt} = -w S_p$

AND/OR

The magnitude of vertical wind shear would need to increase by $\frac{d\vec{V}_s}{dt} = f\vec{V}_g \times \hat{k}$