

Conservation laws for "tracers" (conserved quantities) become transport equations

$$\frac{dq}{dt} = 0 + S_q \quad (q \text{ is conserved}) \quad \left( \begin{array}{l} \text{except for} \\ \text{source or} \\ \text{sink terms} \\ S_q \end{array} \right)$$

$$\Rightarrow \frac{\partial q}{\partial t} = - \vec{V} \cdot \underbrace{\vec{\nabla} q}_{\substack{\text{gradient} \\ \text{of } q}} + S_q$$

time diff  $\leftrightarrow$  advection  
flux convergence  $\leftrightarrow$  advection

advection of  $q$  or advective tendency.

$$\approx - \vec{\nabla} \cdot (q \vec{V})$$

Convergence of flux of  $q$

$$- q (\vec{\nabla} \cdot \vec{V}) + S_q$$

this vanishes for 3D flow in p coords.  
this is small for 2D @ 500mb

Consider the tracer  $\zeta$  (relative vorticity)  
(more later!)

Sorta conserved especially at 500mb.  
Let's look at data about it.

① confirm that  $\frac{\delta \zeta}{\delta t} \approx -\vec{v}_h \cdot \vec{\nabla}_h \zeta \approx -\vec{v} \cdot (\zeta \vec{v})$

② confirm that trajectories follow blobs  
and filaments of  $\zeta$ .

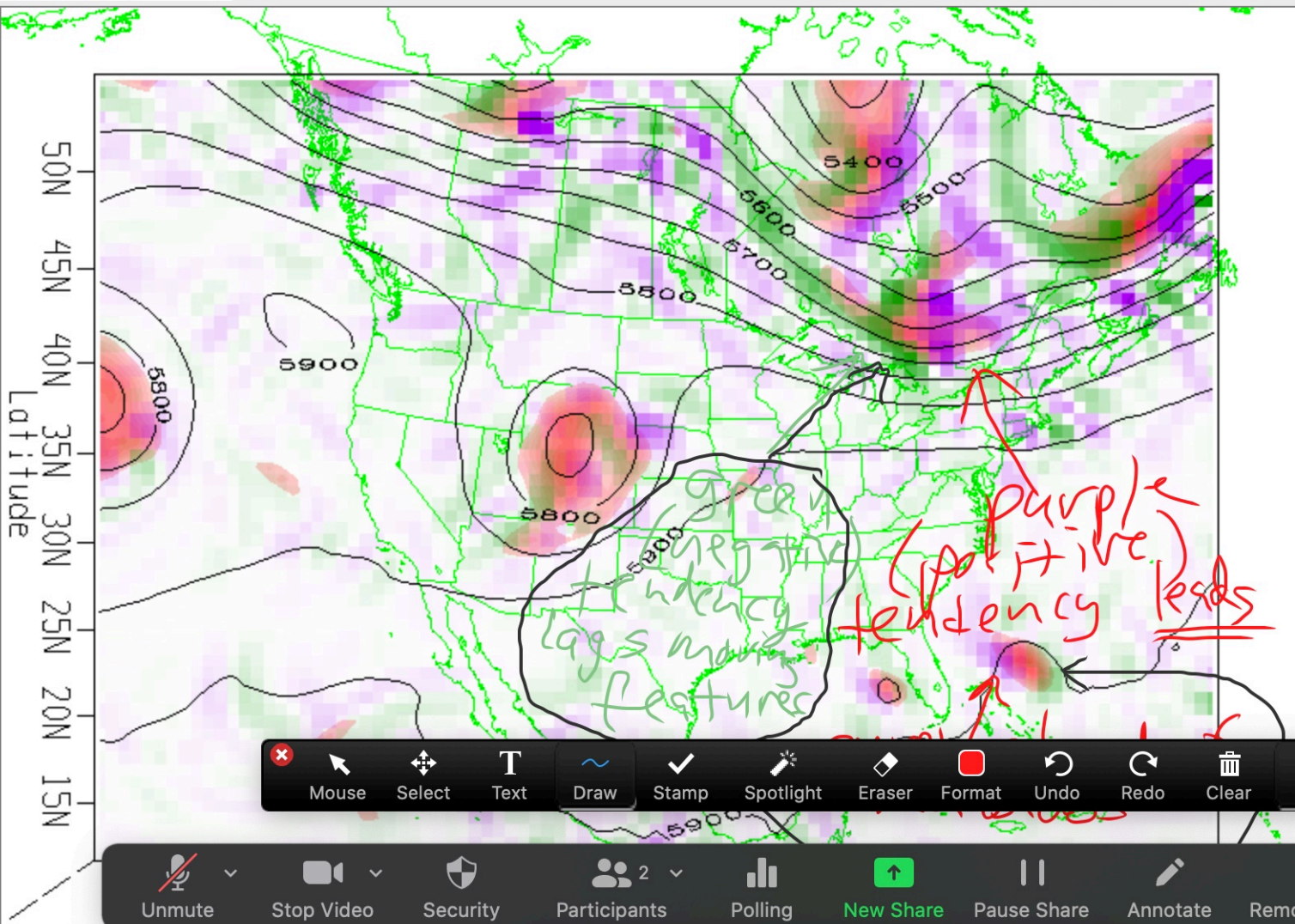
A trajectory is a mathematical curve given by:  
$$\underline{X_T(t)} \approx X_T(0) + \int_0^t u(x, y, z, t') dt'$$
  
must iterate this integral.

File Edit Displays Data Bundles Tools History Help

MapesIDV AMS LMT Lab Manual MapesIDV\_CCS

View Projections

2020-09-11 06:00:00 UTC



## Legend

- ☒ Maps
- ☒ Plan Views
- ☐ [relvort - Color-Filled ...](#)  
Level: 500 hPa  
-100
- ☐ [Time step difference](#)  
Level: 500 hPa  
-2
- ☐ [hor. flux convergence](#)  
Level: 500 hPa  
-2 2
- ☒ [advection of scalar S b...](#)  
Level: 500 hPa  
-2 2
- ☒ [relvort - Color-Filled ...](#)  
Level: 500 hPa  
0 200
- ☒ [Geopotential height i...](#)
- ☒ 3D Surface
- ☐ [relvort - Isosurface](#)  
Level: 100 1E-6 s-1  
0 200
- ☐ Flow Displays

Unmute

Stop Video

Security

Participants 2

Polling

New Share

Pause Share

Annotate

Remote Control

More

History

Factory

15:53:04 UTC Latitude: 11.3 Longitude: -118.2 Altitude: 0.0

You are screen sharing

Stop Share



Leave

Zoom

Join Audio

Start Video

Share Content

Participants

More

Brian

Daily

ATM

ATM

Com

GFS

Ross

h. P. x

Atlan

ATM

ATM

RSM

dawi

Post

Natio

+

Hypothesis - Web &amp; PDF Annotation chrome-extension://bjfhmgliciechodpfehhlphglcehbme/pdfs/w...

Pencil Only

321 of 505

-

+

100%

÷

↔

📁

🖨

📄

🔖

⋮

&lt;



12



7.5 Explain or interpret the following on the basis of the principles discussed in this chapter.

- A diffluent flow does not necessarily exhibit divergence. *streamlines move apart*
- A flow with horizontal shear does not necessarily exhibit vorticity.
- A person of fixed mass weighs slightly less when flying on an eastbound plane than when flying on a westbound plane.
- A satellite can be launched in such a way that it remains overhead at a specified longitude directly over the equator in a so-called geostationary orbit.
- The oblateness of the shape of Jupiter is more apparent than that of the Earth.
- The Coriolis force has no discernible effect on the circulation of water going down the drain of a sink.
- The vertical component of the Coriolis force is not important in atmospheric dynamics, nor is the Coriolis force induced by vertical motions.
- The strong winds encircling hurricanes are highly subgeostrophic.
- Cyclones tend to be more intense than anticyclones.
- The wind in valleys usually blows up or down the valley from higher toward lower pressure rather than blowing parallel to the isobars.

the circulation around any closed loop that lies on a pressure surface.

- Motions in the middle troposphere tend to be quasi-nondivergent.
- The primitive equations assume a simpler form in pressure coordinates than in height coordinates.
- The thermodynamic energy equation assumes a particularly simple form in isentropic coordinates.
- In middle latitudes, local rates of change of temperature tend to be smaller than the changes attributable to horizontal temperature advection.
- Temperatures do not always rise in regions of warm advection.
- The release of latent heat in the midtroposphere has the effect of increasing the isentropic potential vorticity of the air in the column below it.
- Rising of warm air and sinking of cold air result in the generation of kinetic energy, even in hydrostatic motions.
- The Hadley cell does not extend from equator to pole.
- A term involving the Coriolis force does not appear in Eq. (7.42).
- The easterlies in the lower branch of the Hadley cell are maintained in the presence of friction.
- Baroclinic waves and monsoons tend to be more prominent in general circulation models

