

Conservative variables on isentropic surfaces:

Mixing ratio

Use mixing ratio to determine moisture transport and RH to determine cloud patterns

Isentropic Potential Vorticity

$$P = -g(\zeta_{\theta} + f) \frac{\partial \theta}{\partial p}$$

Where:
$$\zeta_{\theta} = \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y} \right)_{\theta}$$

Isentropic potential vorticity is of the order of:

$$P = -g(\zeta_{\theta} + f) \frac{\partial \theta}{\partial p} \approx (10 \text{ m s}^{-2})(10^{-4} \text{ s}^{-1}) \left(\frac{10 \text{ K}}{10 \text{ kPa}} \right) \frac{1 \text{ kPa}}{10^3 \text{ kg m s}^{-2} \text{ m}^{-2}}$$

$$P = 10^{-6} \text{ m}^2 \text{ s}^{-1} \text{ K kg}^{-1} = 1 \text{ PVU}$$

Isentropic Potential Vorticity

Values of IPV < 1.5 PVU are generally associated with tropospheric air

Values of IPV > 1.5 PVU are generally associated with stratospheric air

Global average IPV in January

Note position of IPV = 1.5 PVU

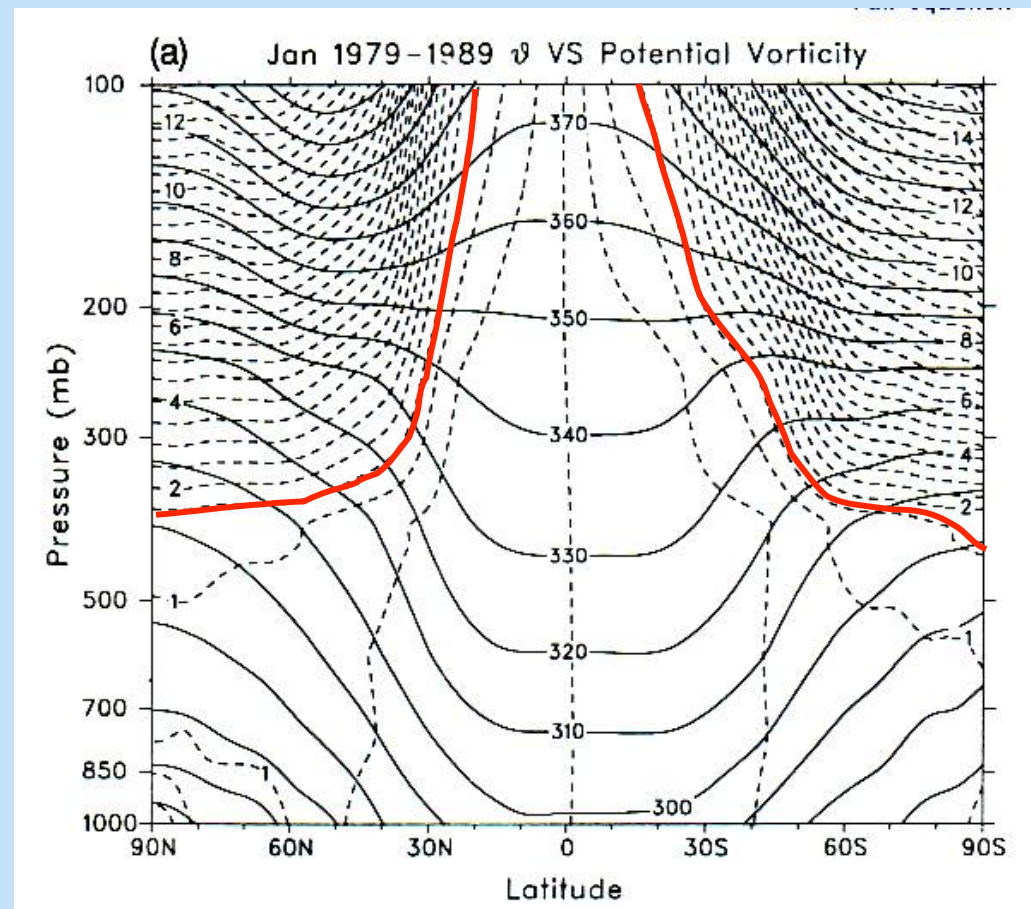
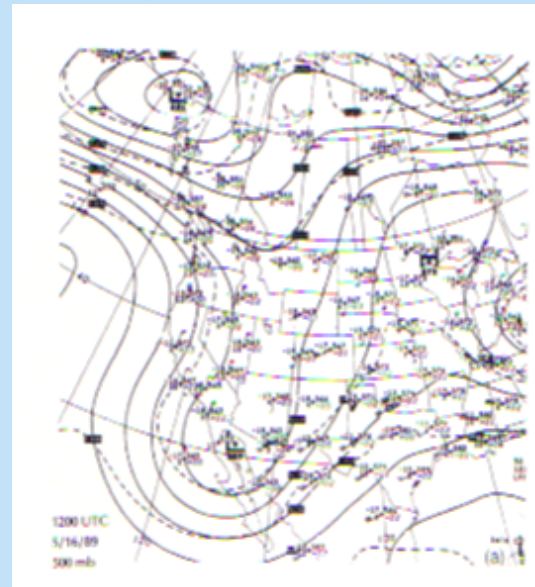
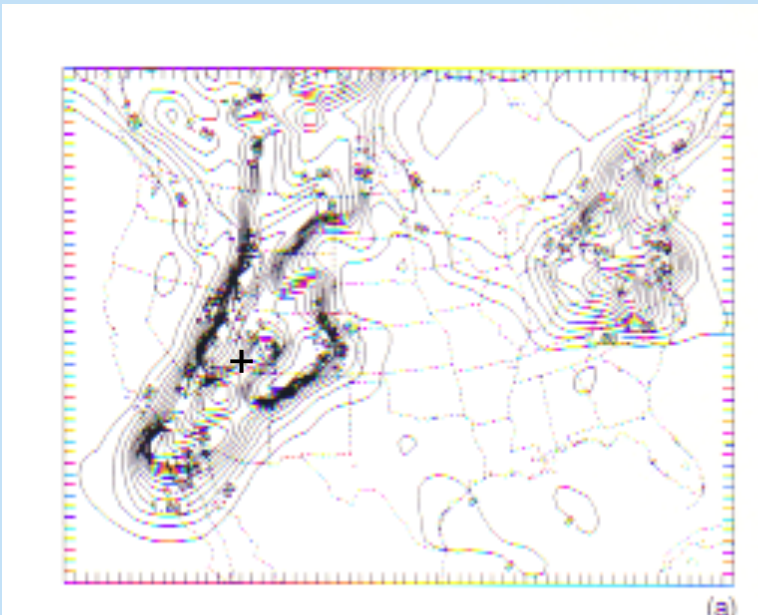
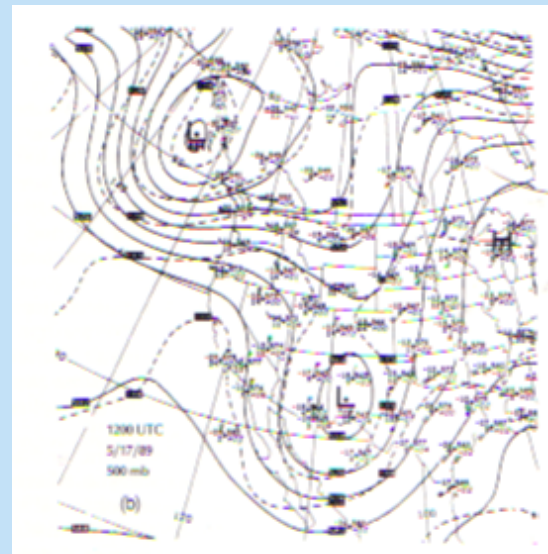
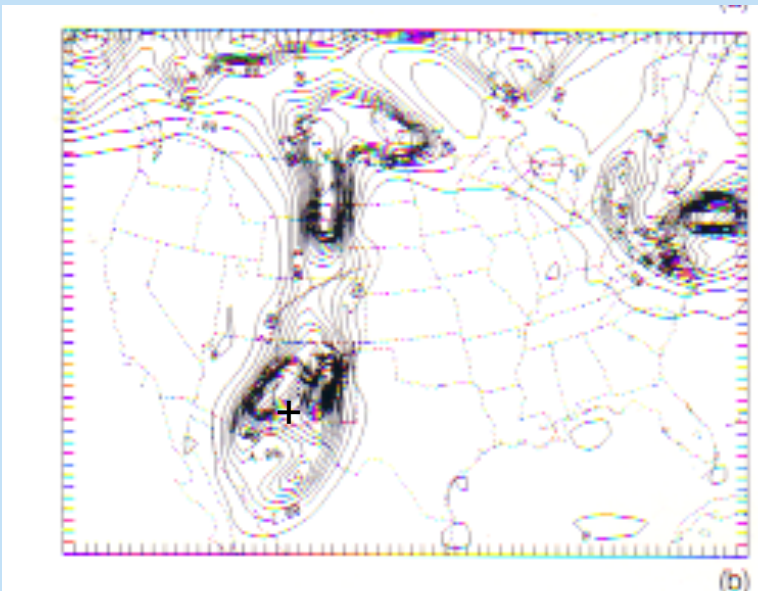


Fig. 1.137 Bluestein II

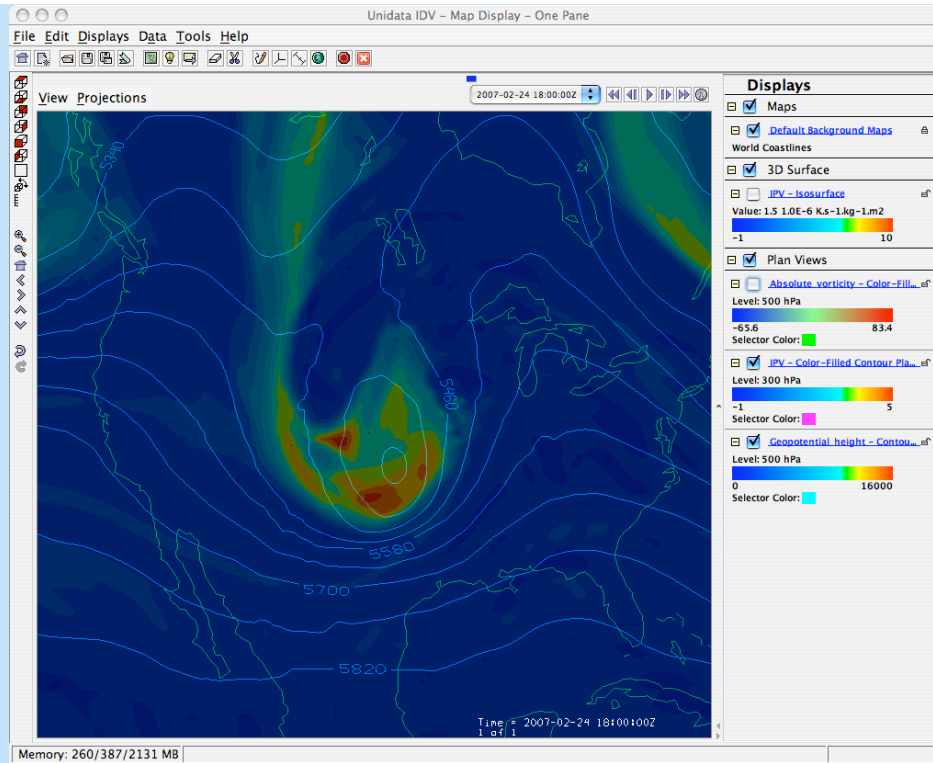


Relationship
Between IPV
Distribution on
The 325 K surface
And 500 mb height
contours

12Z May 16 1989



12Z May 17 1989



Regions of relatively high PV are called “positive PV anomalies”

These are associated with cyclonic circulations and low static stability in the troposphere

Regions of relatively low PV are called “negative PV anomalies”

These are associated with anticyclonic circulations and high static stability in the troposphere

For adiabatic, inviscid (no mixing/friction) flow, IPV is a conservative tracer of flow.

IPV has the interesting property of invertibility:

If one assumes a balance condition (e.g. geostrophic balance, gradient wind balance or higher order balances), specification of the IPV field allows one to deduce the pressure and wind fields.