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On the use and significance of isentropic potential vorticity maps

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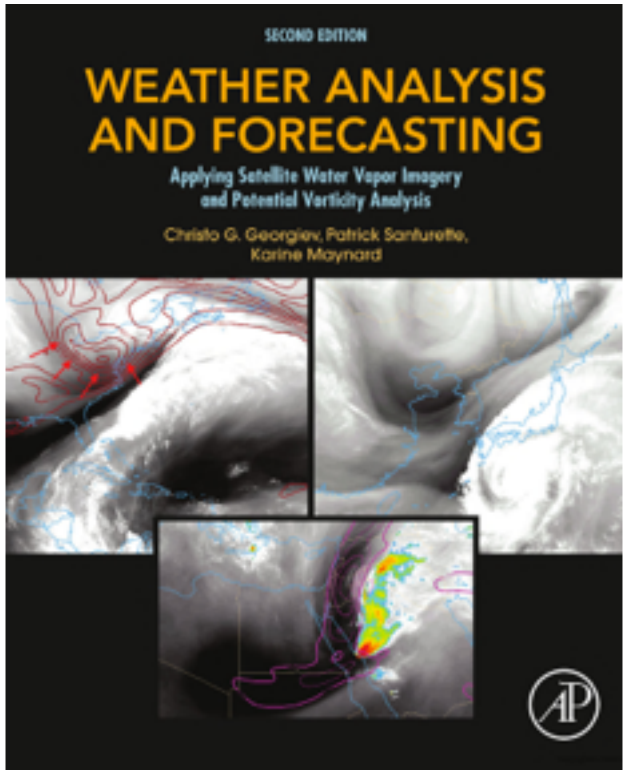
SUMMARY

“On the use and significance of isentropic **potential vorticity** maps”

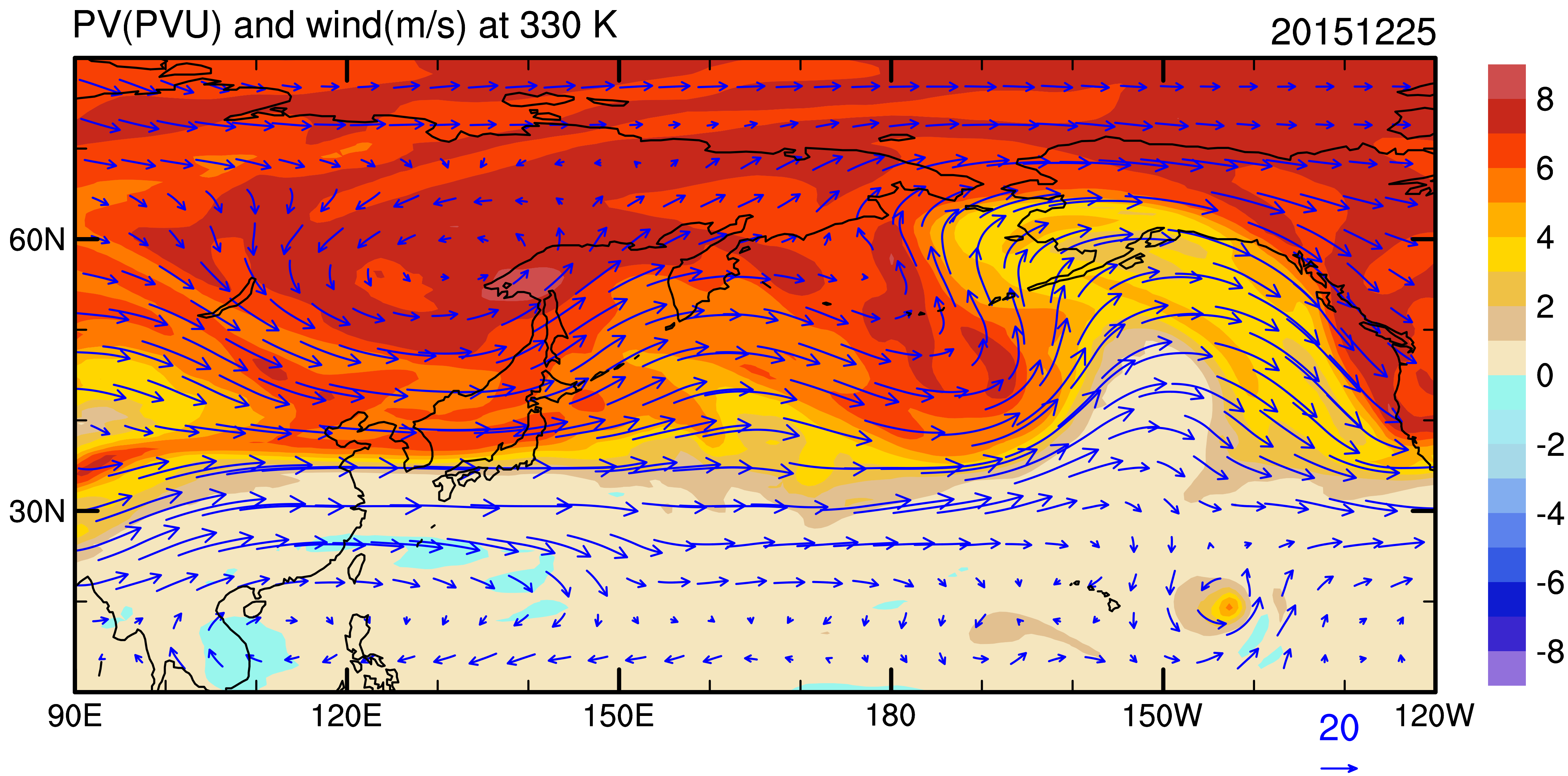
(By B. J. Hoskins, M. E. McIntyre, and A. W. Robertson)

(Professor Sir Brian Hoskins from http://www.getreading.co.uk/)

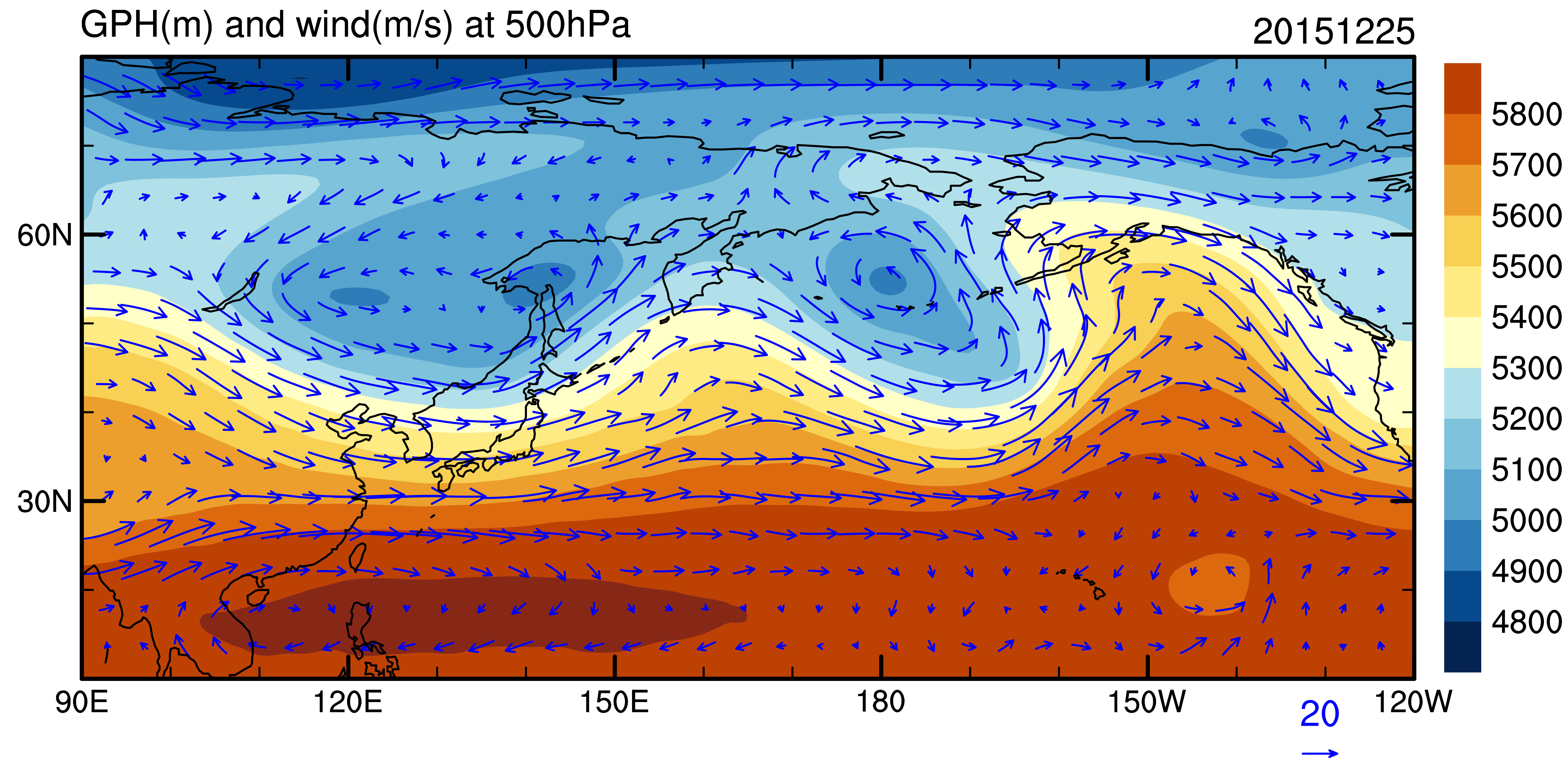


“Weather Analysis and Forecasting: Applying Satellite Water Vapor Imagery and **Potential Vorticity Analysis**”

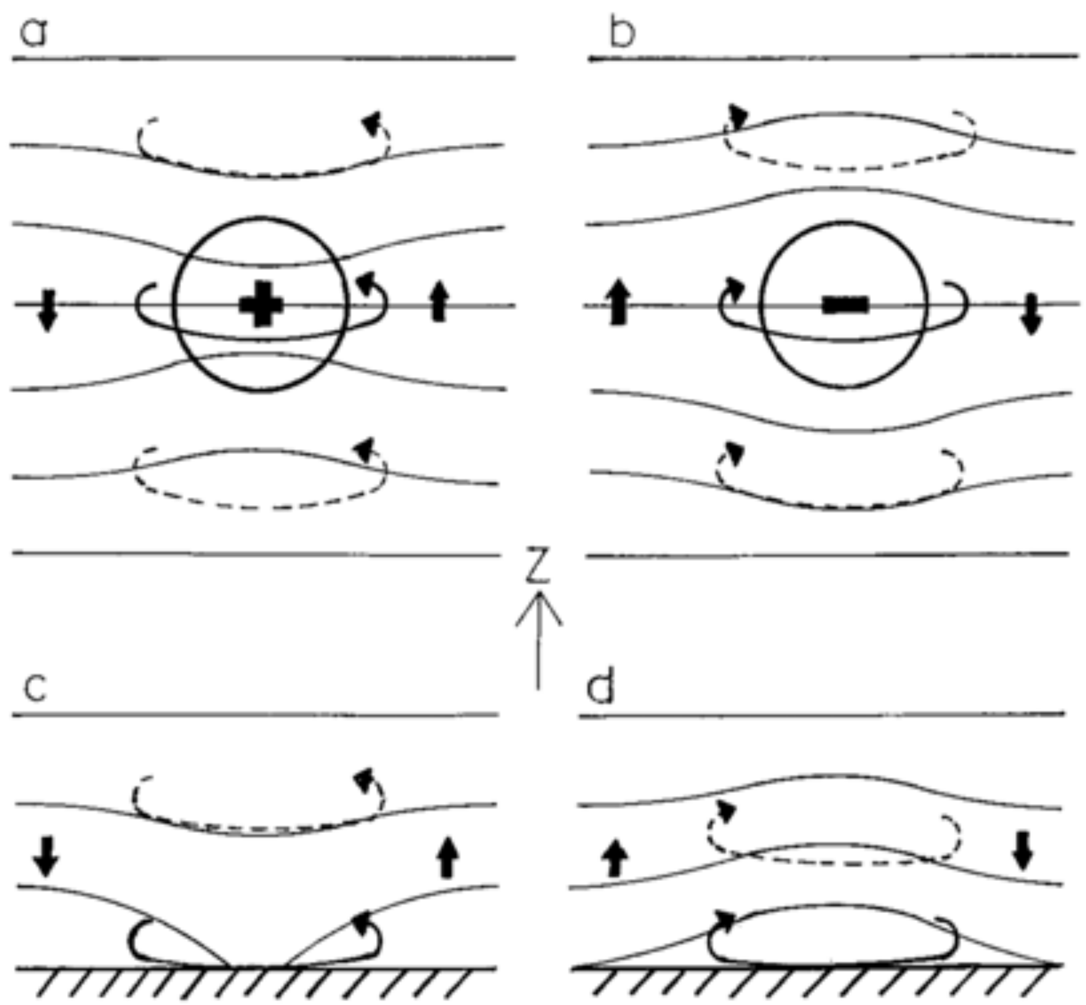
(By Christo Georgiev, Patrick Santurette, Karine)



Shading : potential vorticity


GPH(m) and wind(m/s) at 500hPa
20151225
60N
30N
90E
120E
150E
180
150W
120W
20
5800
5700
5600
5500
5400
5300
5200
5100
5000
4900
4800

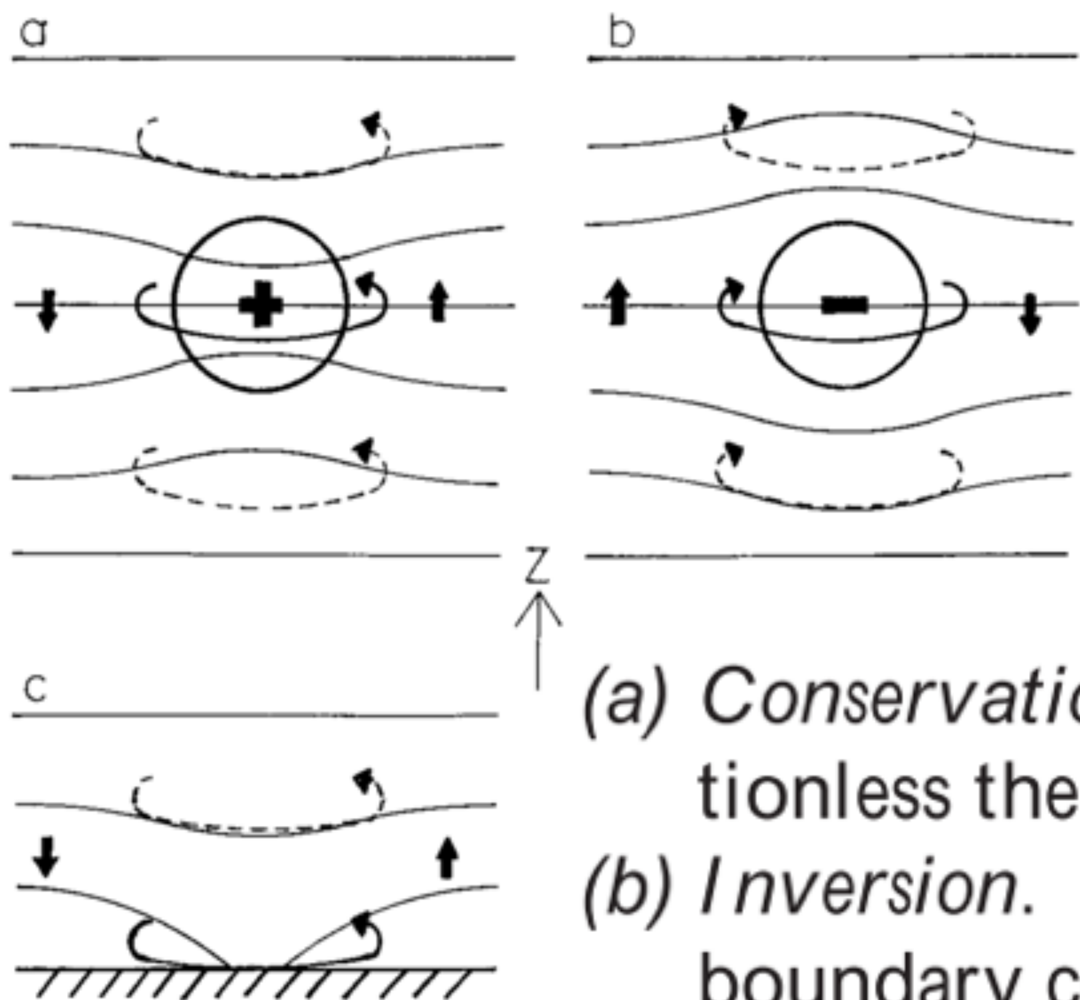
(Rossby-Ertel) **Potential Vorticity**



$$PV = \frac{\vec{\omega}_a \cdot \nabla \theta}{\rho}$$

(where $\vec{\omega}_a$ = absolute vorticity in 3D)

(Rossby-Ertel) **Potential Vorticity**



$$PV = \frac{\vec{\omega}_a \cdot \nabla\theta}{\rho}$$

(where $\vec{\omega}_a$ = absolute vorticity in 3D)

(a) *Conservation*. If the motion is adiabatic and frictionless then PV is conserved moving with the air.

(b) *Inversion*. Given PV everywhere and suitable boundary conditions, and assuming that the motion is balanced in the sense that it is not composed of fast gravity waves (or acoustic waves), then equations can be solved to obtain ϕ, v, θ, w, etc. This is analogous to the two-dimensional and QGPV cases discussed above. (remote response)

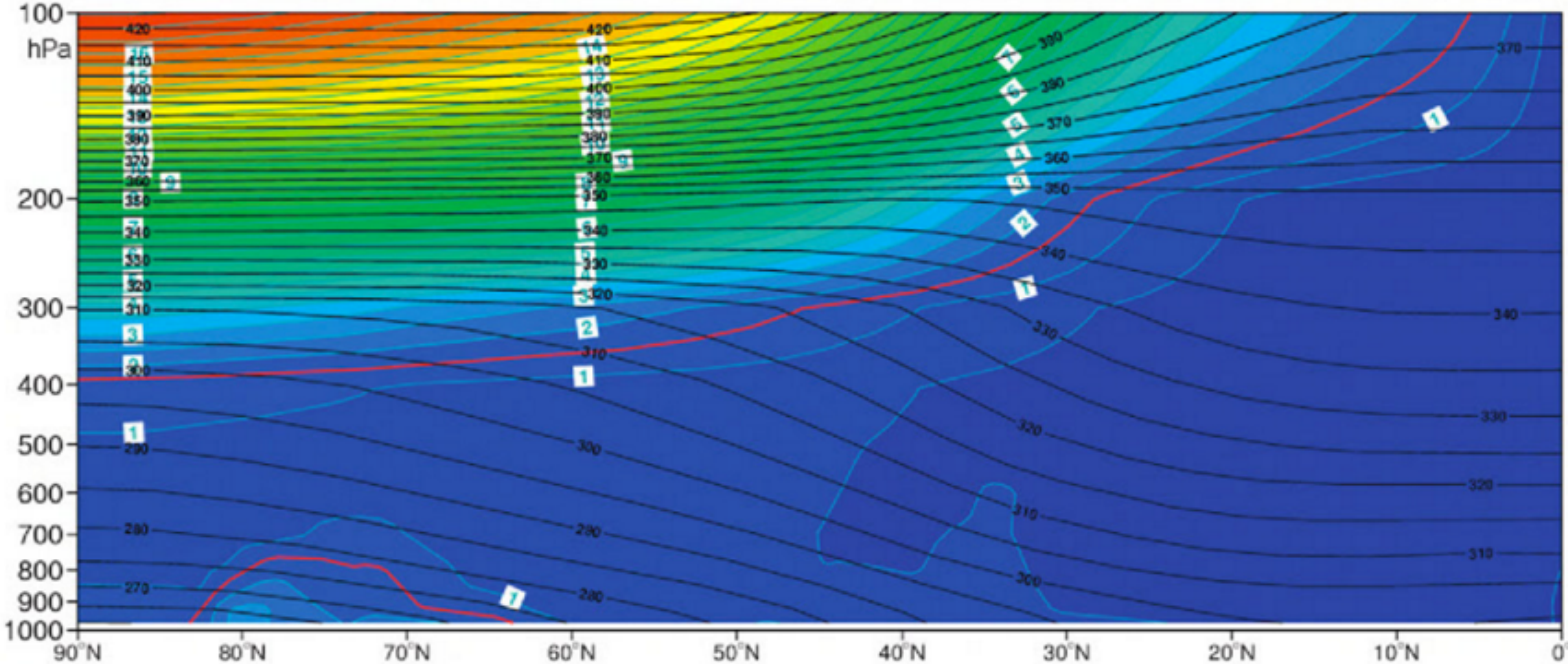


FIGURE 1.4

Zonal year average (vertical cross-section) of the potential vorticity (PV; *color areas*, every 0.5 PVU) and of the potential temperature (*black lines* in K, interval 5K) in the Northern Hemisphere. The contour of PV value = 1.5 PVU (the so-called dynamical tropopause) is given in *red*. This chart used data from 44 years of the European Center for Medium Range Weather Forecasting reanalysis, 1958–2001.

From Malardel (2008).

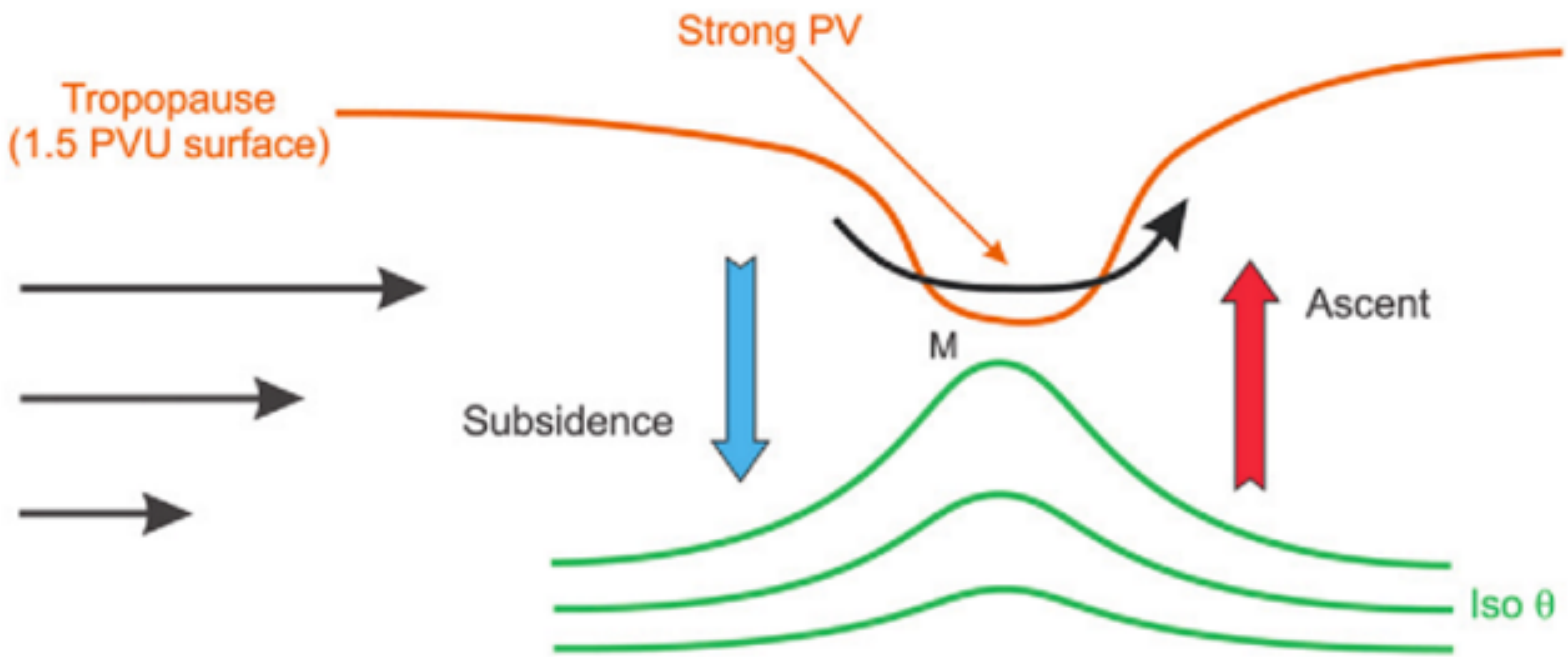


FIGURE 1.7

A schematic cross-section, showing an idealized model of the modification of the troposphere associated with an upper-level positive potential vorticity anomaly, which is referred to as a dynamical tropopause anomaly.

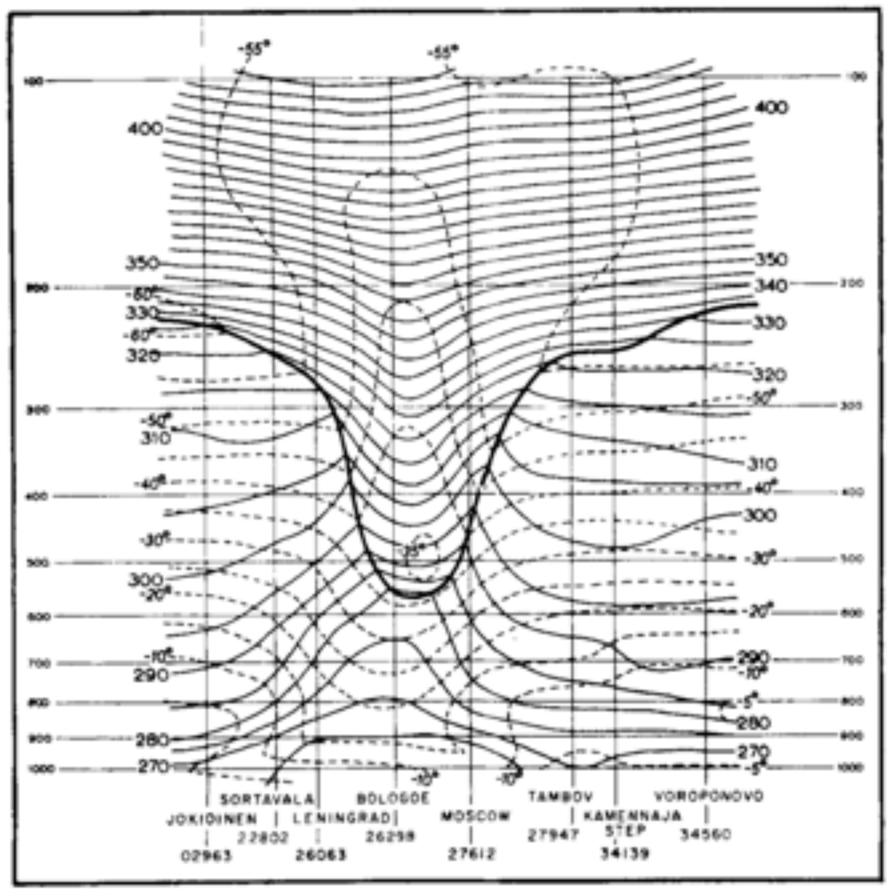
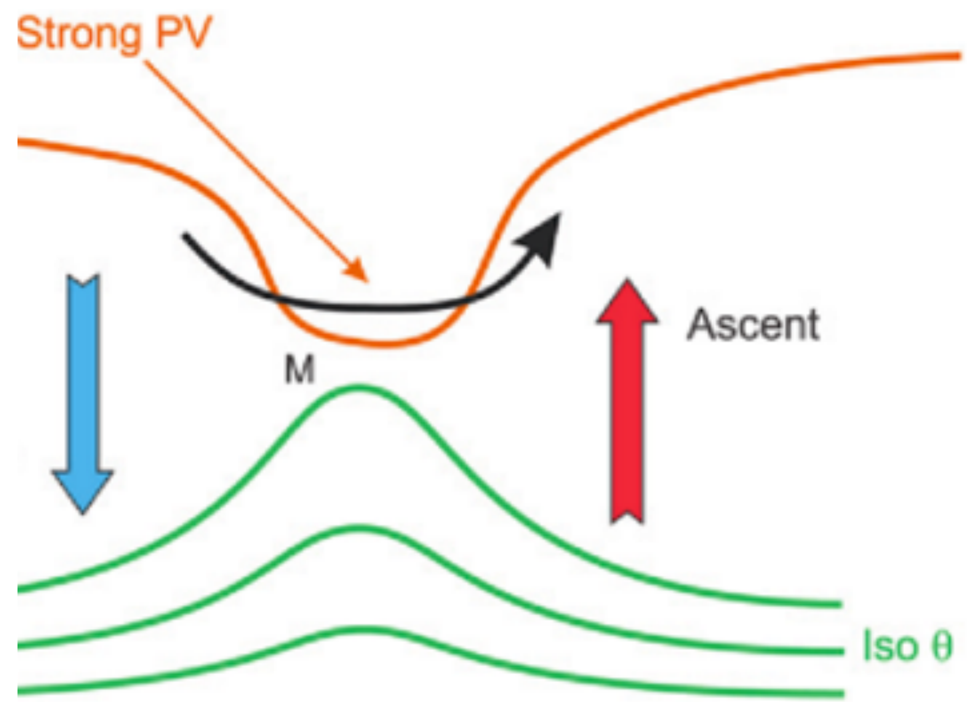


Figure 8. A vertical section through a cutoff cyclone at 12 GCT November 16 1959 produced by Peltonen (1963). The heavy line represents the tropopause; dashed lines are isotherms at 5°C intervals and solid lines isentropes every 5 K. The centre of the cyclone was at about 35°E, 58°N.



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which is referred to as a dynamical tropopause anomaly.

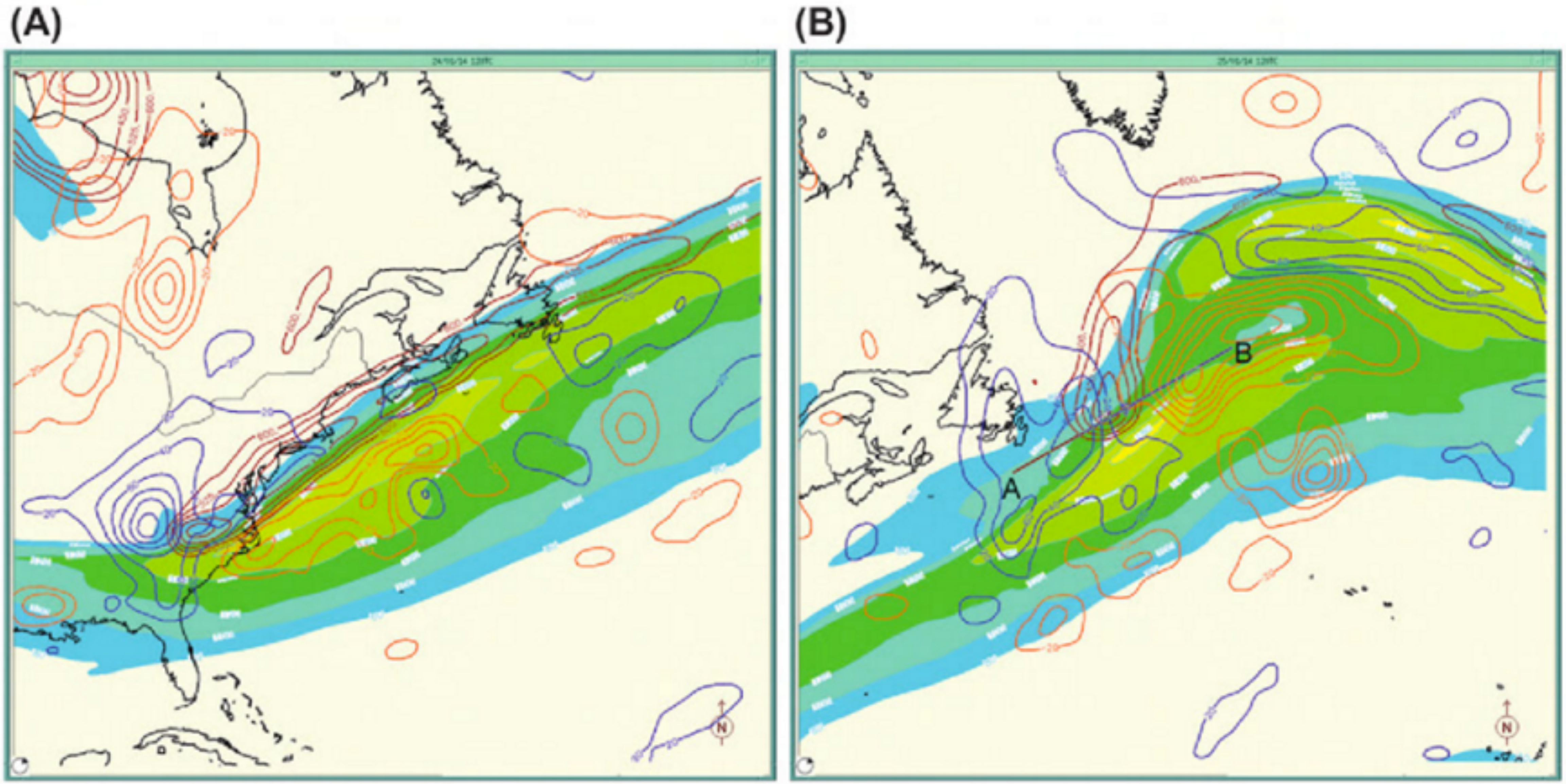


FIGURE 1.11

Isotachs of the wind at 300 hPa greater than 80 kt (*color*, every 20 kt) and vertical velocity at 600 hPa (ascending motion in *orange*, descending motion in *blue*, every 20 10^{-2} Pa/s). ARPEGE model analysis (A) 24 January 2014 1200 UTC, (B) 25 January 2014 1200 UTC. The *black line* in (B) is the axis of the cross-sections presented in Fig. 1.12.

(B)

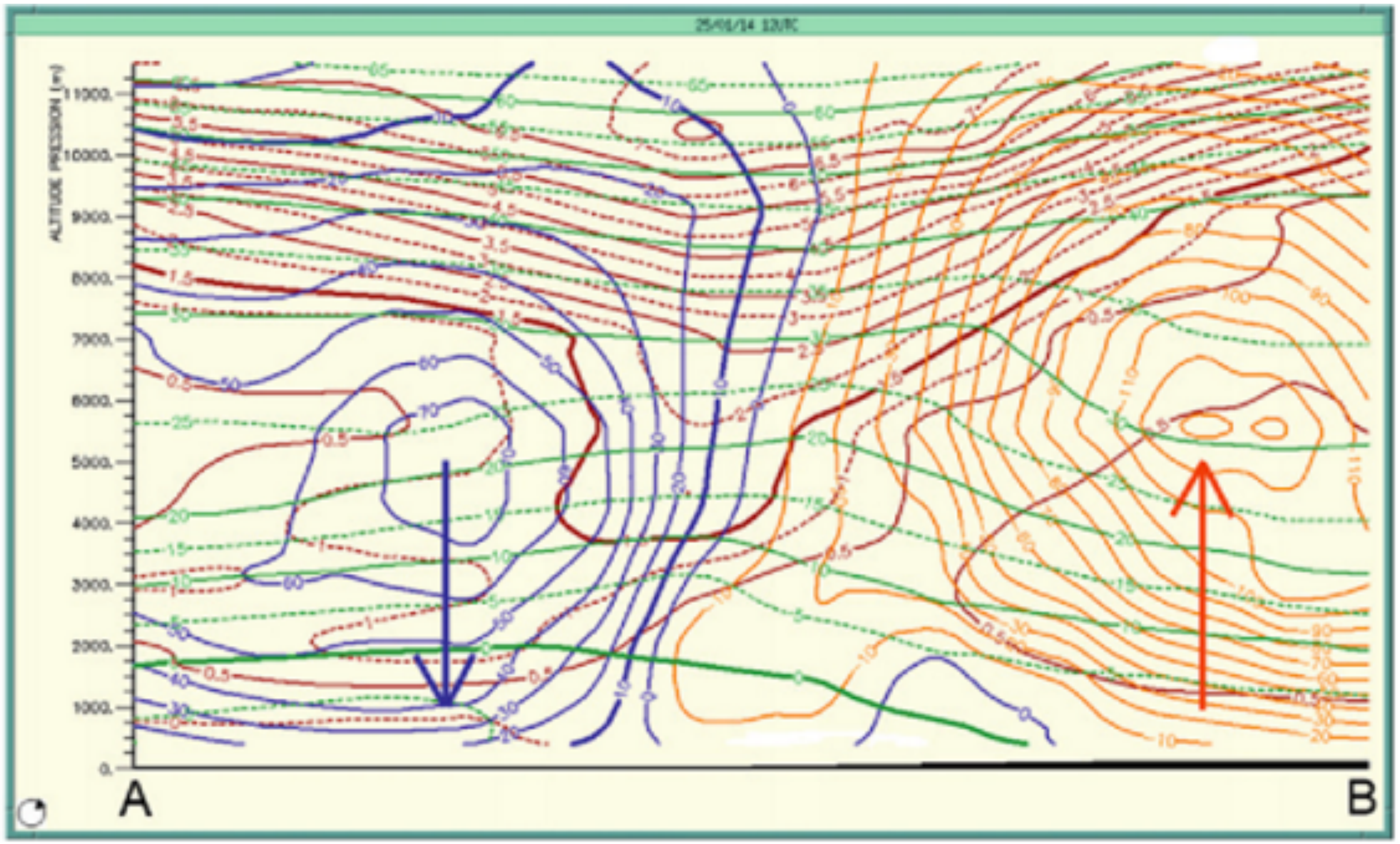
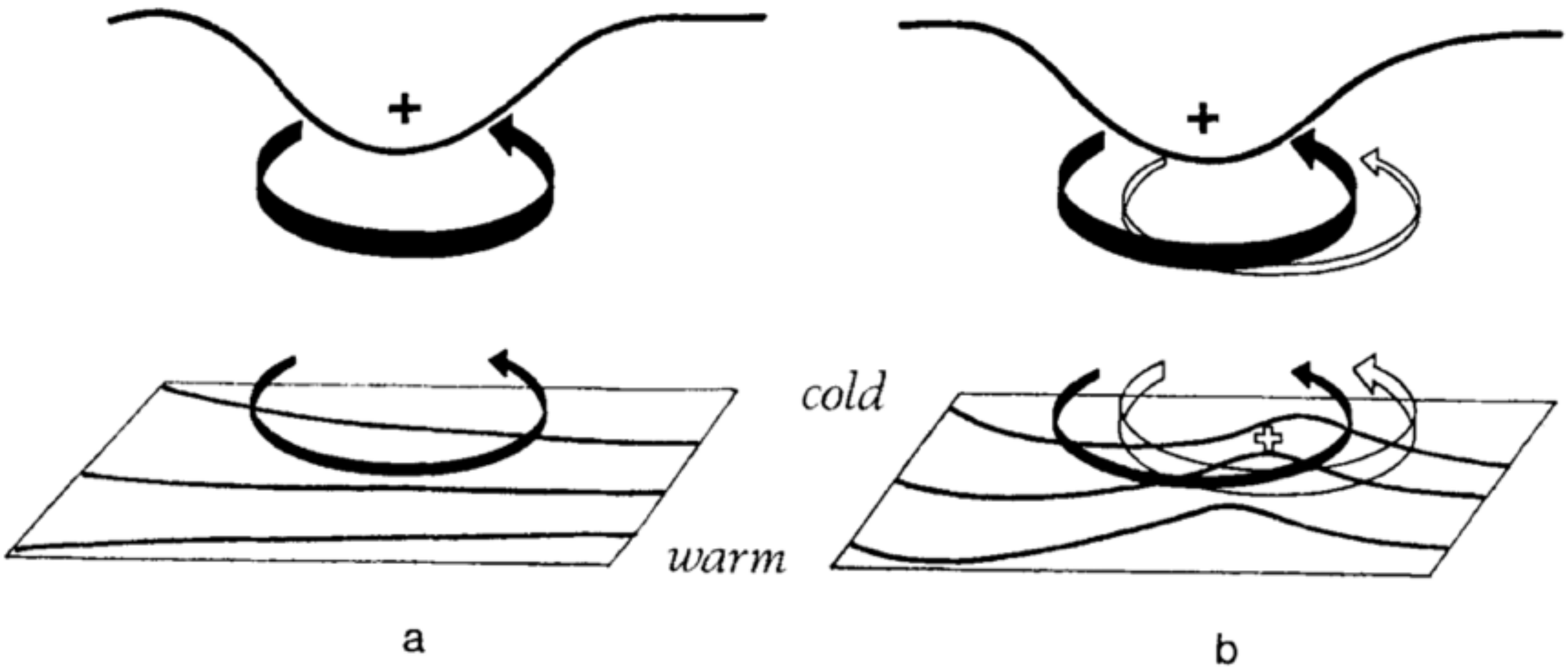


FIGURE 1.12

Vertical cross-section along the southwest—northeast (noted SW NE) axis marked in *black line* in Fig. 1.11B, from ARPEGE model analysis on 25 January 2014 at 1200 UTC. Potential vorticity contours are in *brown* (intervals of 0.5 PVU, 1.5 PVU contour solid); iso-θ surfaces (°C) are in *green*. Also shown in (A) the wind component transverse to the plane of the cross-section (in *black*, kt: *solid lines* indicate the wind in the cross-section plane, and the *dashed lines* indicate the wind out of the cross-section plane). Also shown in (B) the ascending (in *orange*) and the descending (in *blue*) motion (10^{-2} Pa/s).


+
cold
warm
a
b

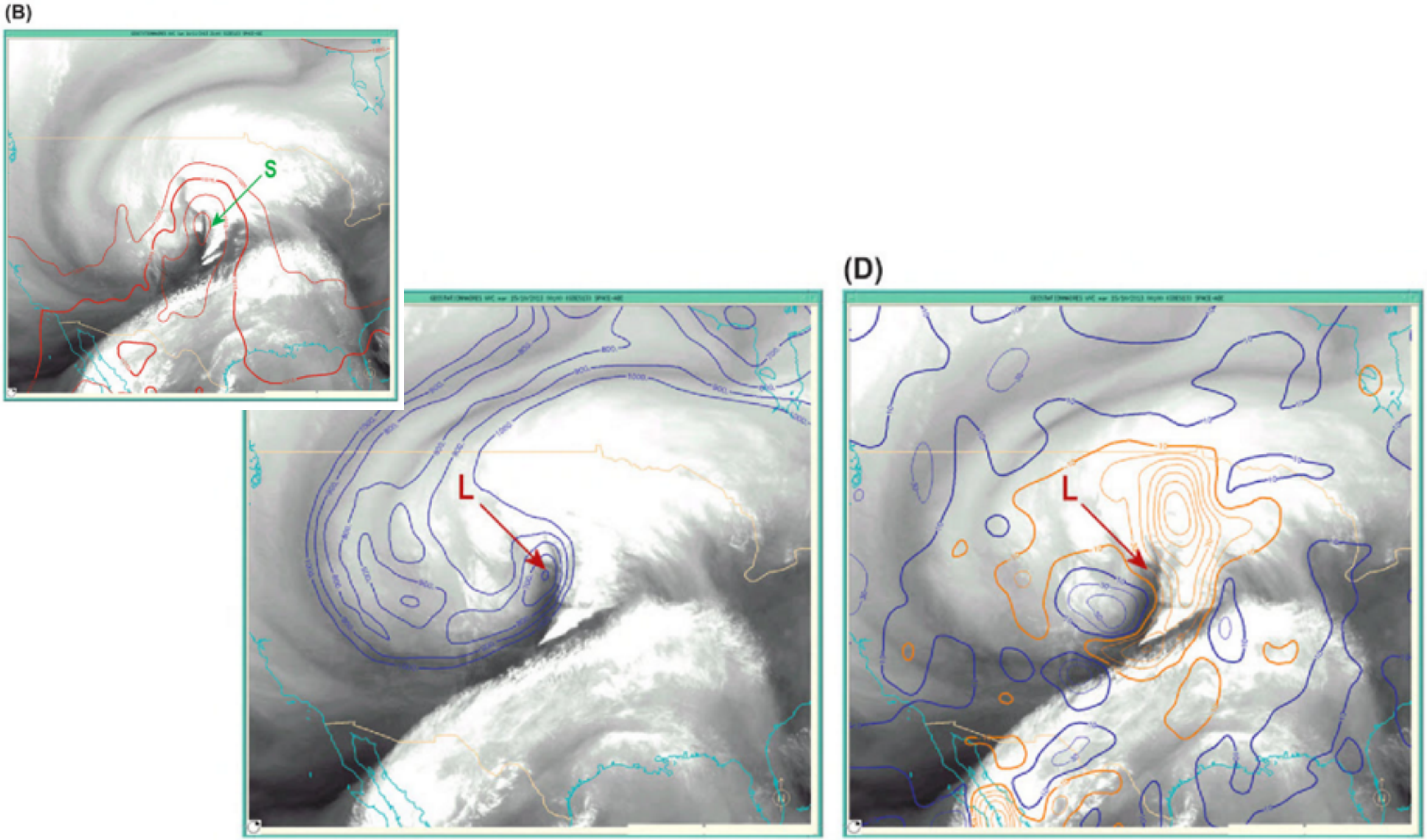


FIGURE 3.5

Dry intrusion over North America as seen in the GOES water vapor images overlaid by ARPEGE analysis fields: for October 14, 2013 of mean sea level pressure (brown, threshold 1020 hPa) (A) at 1800 UTC and (B) at 2100 UTC; for October 15, 2013, 0000 UTC of (C) 1.5 PVU surface heights (dam, blue only ≤1000 dam) and (D) vertical motions at 700 hPa (10^{-2} Pa/s, ascending in orange, descending in blue). Also marked: "L," the surface low center.

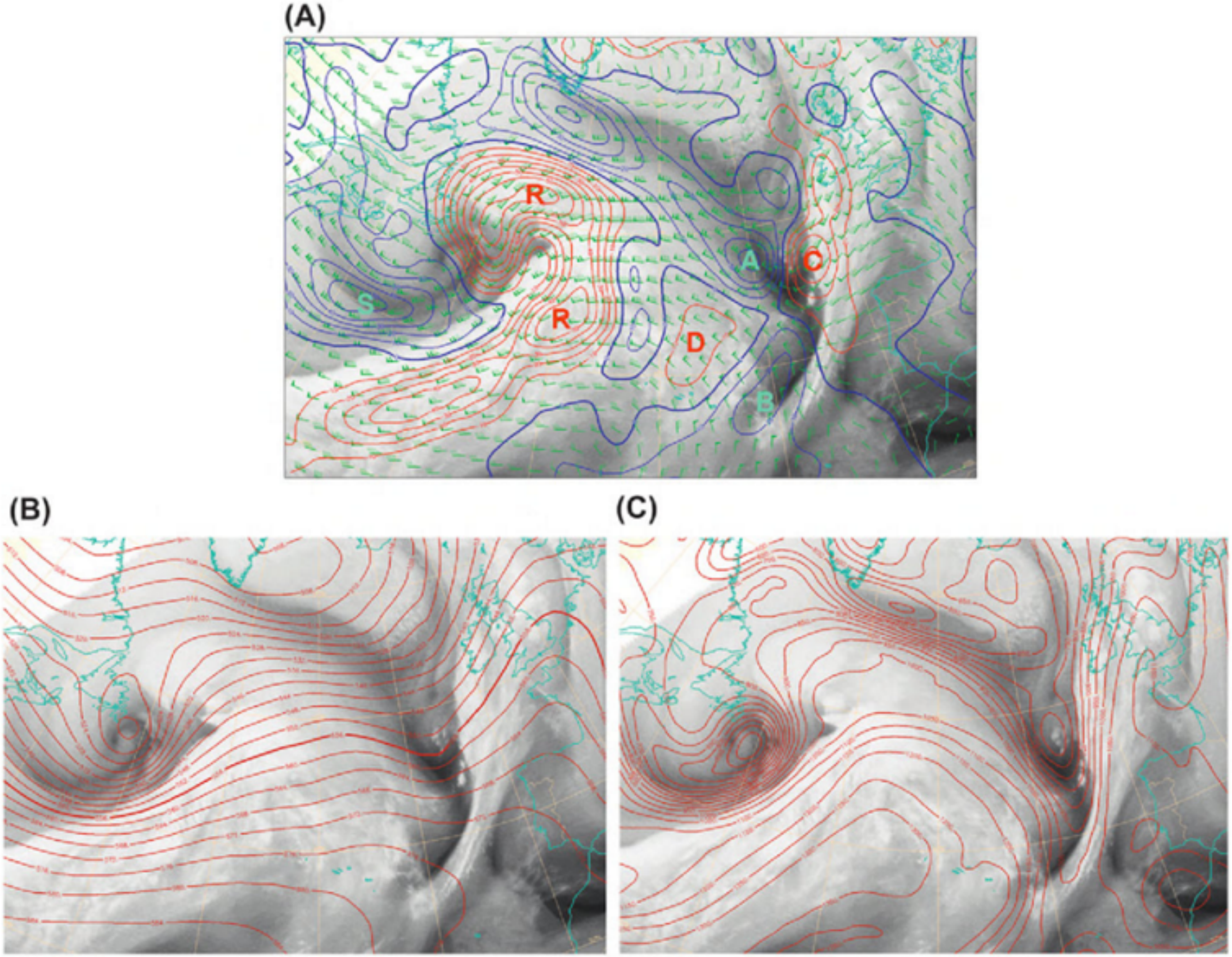


FIGURE 3.1

A water vapor image overlaid by (A) vertical motions (10^{-2} Pa/s, ascending in red, descending in blue) at 400 hPa and wind (*green arrows*) at 300 hPa; (B) 500 hPa heights (dam); (C) geopotential height (dam) of the 1.5 PVU surface.