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School on the Physics of Equatorial Atmosphere

(24 September - 5 October 2001)

Wave Forcing and Cumulus Convection in the Equatorial Atmosphere

(FIGURES)

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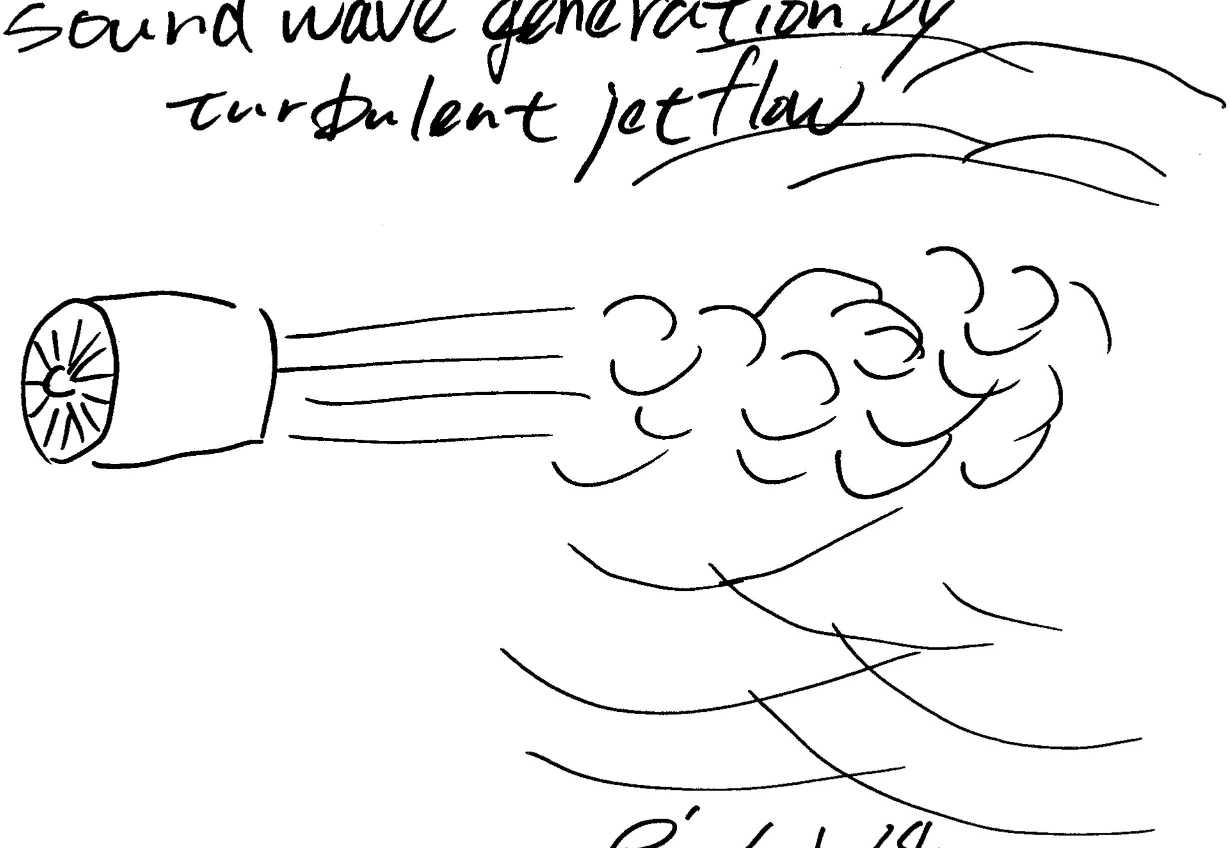
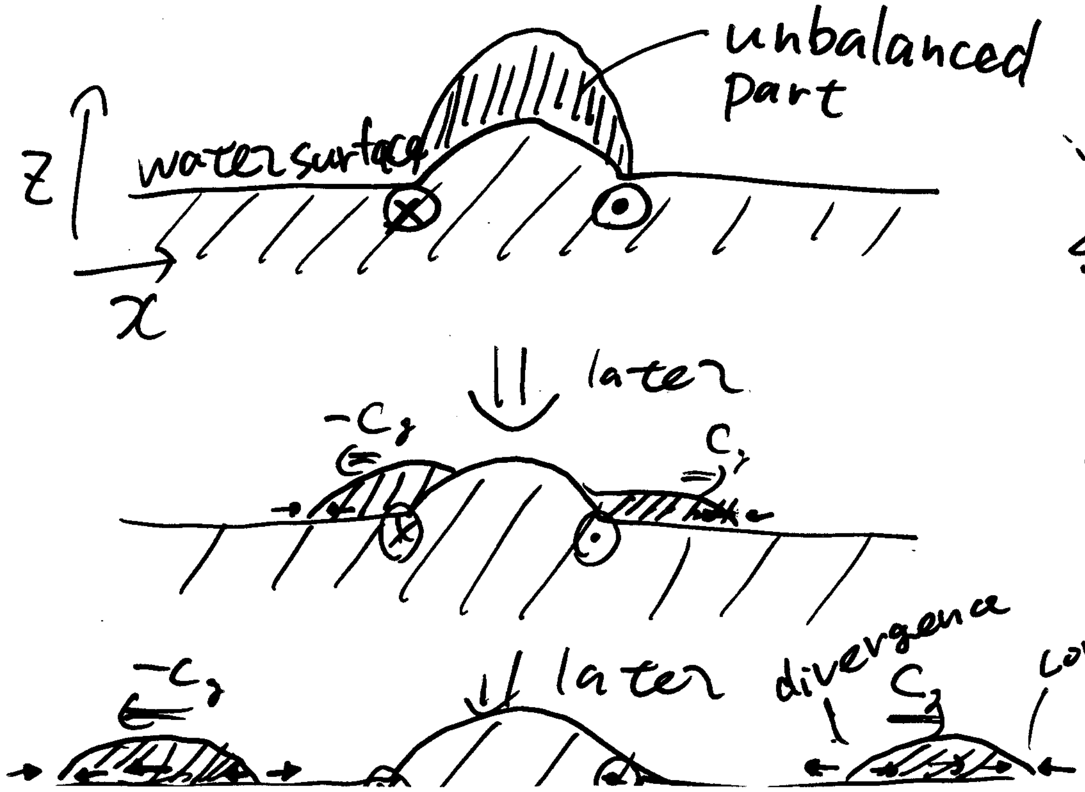
sound wave generation by turbulent jet flow



$\rho' \propto U^4$

$\frac{1}{2}\rho'^2 \propto U^8$

geostrophic adjustment



spreads out as gravity waves

Magaña & Yanai (1995)

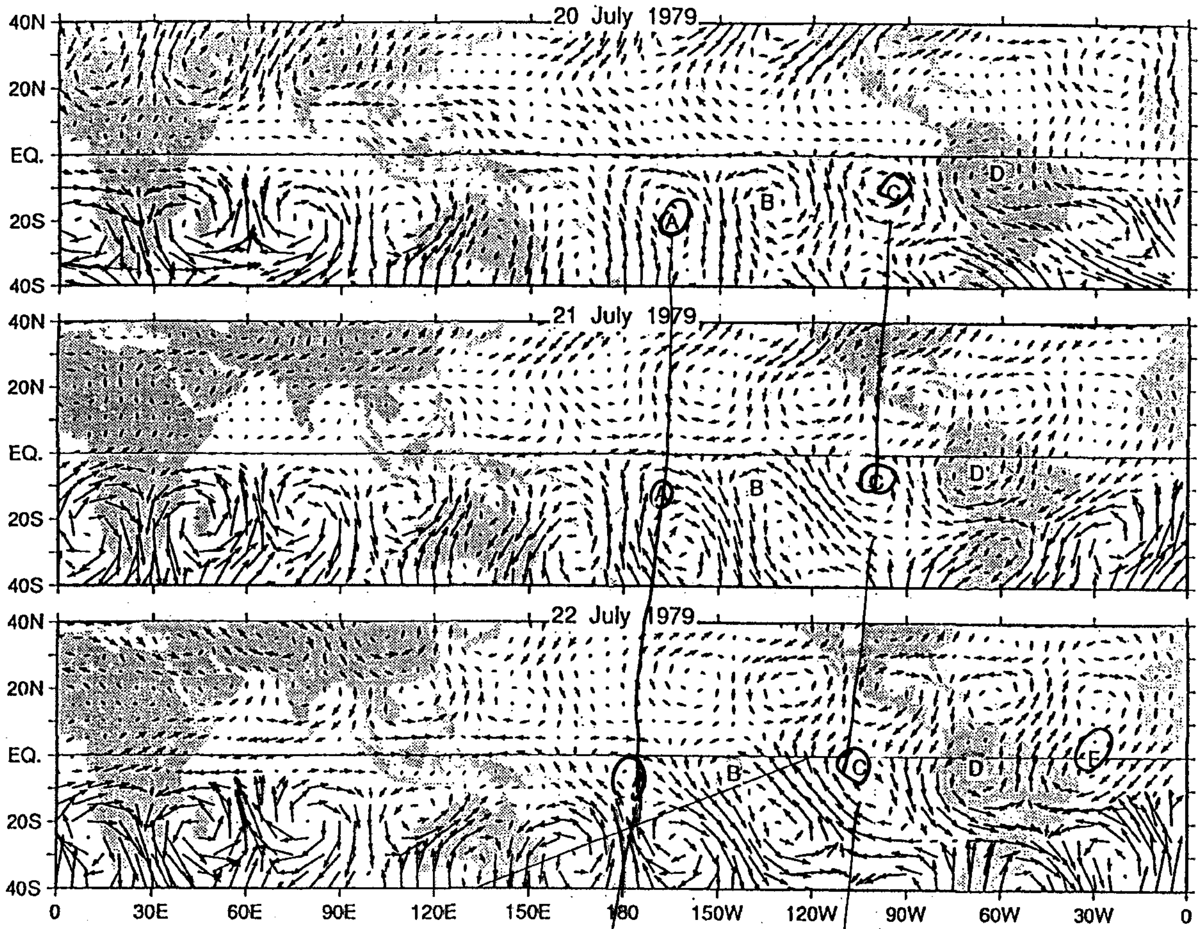
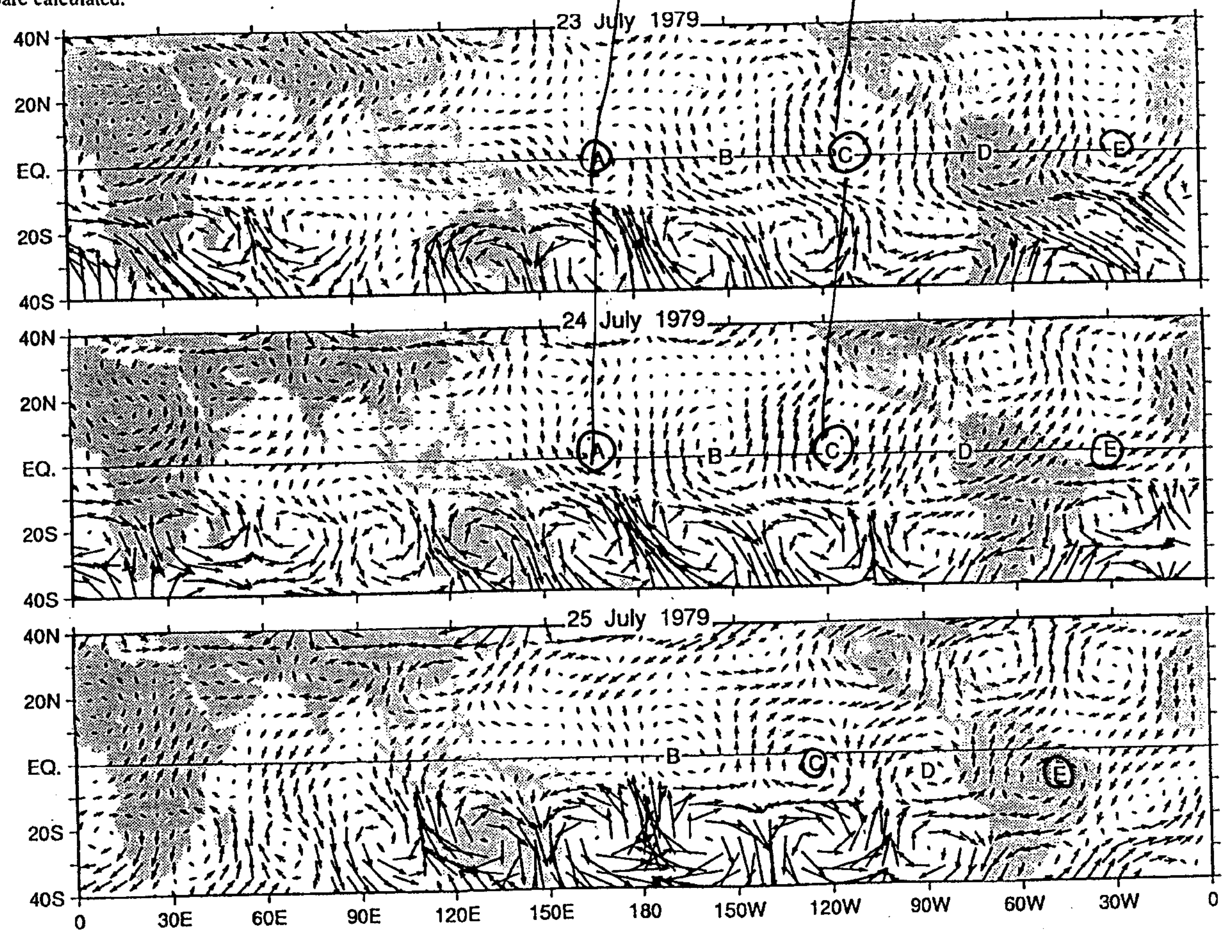


FIG. 11. Synoptic maps of wind disturbances at 200 mb with zonal wavenumbers 4–6 for the period 20–25 July 1979 (see text for details). The diagonal line in the SH central Pacific on the map for 22 July indicates the path along which the lag cross correlations shown in Fig. 14 are calculated.



from Houze

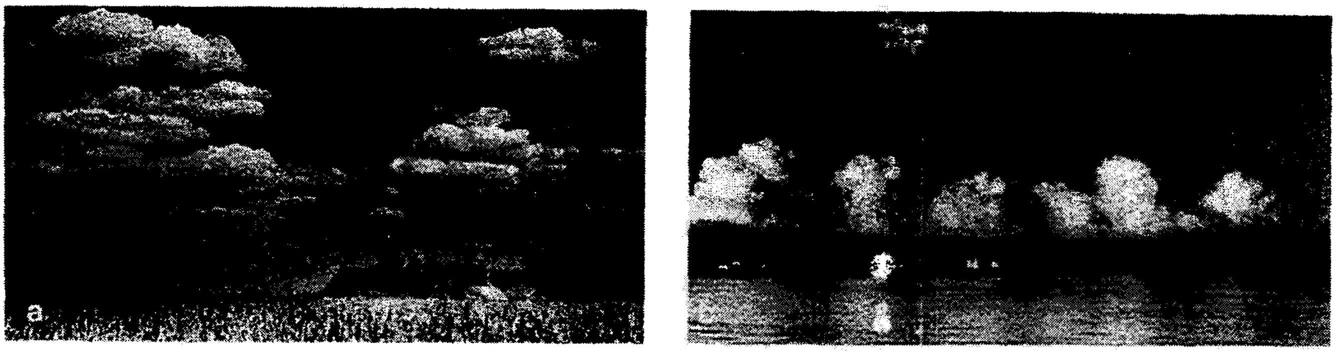


Figure 1.3

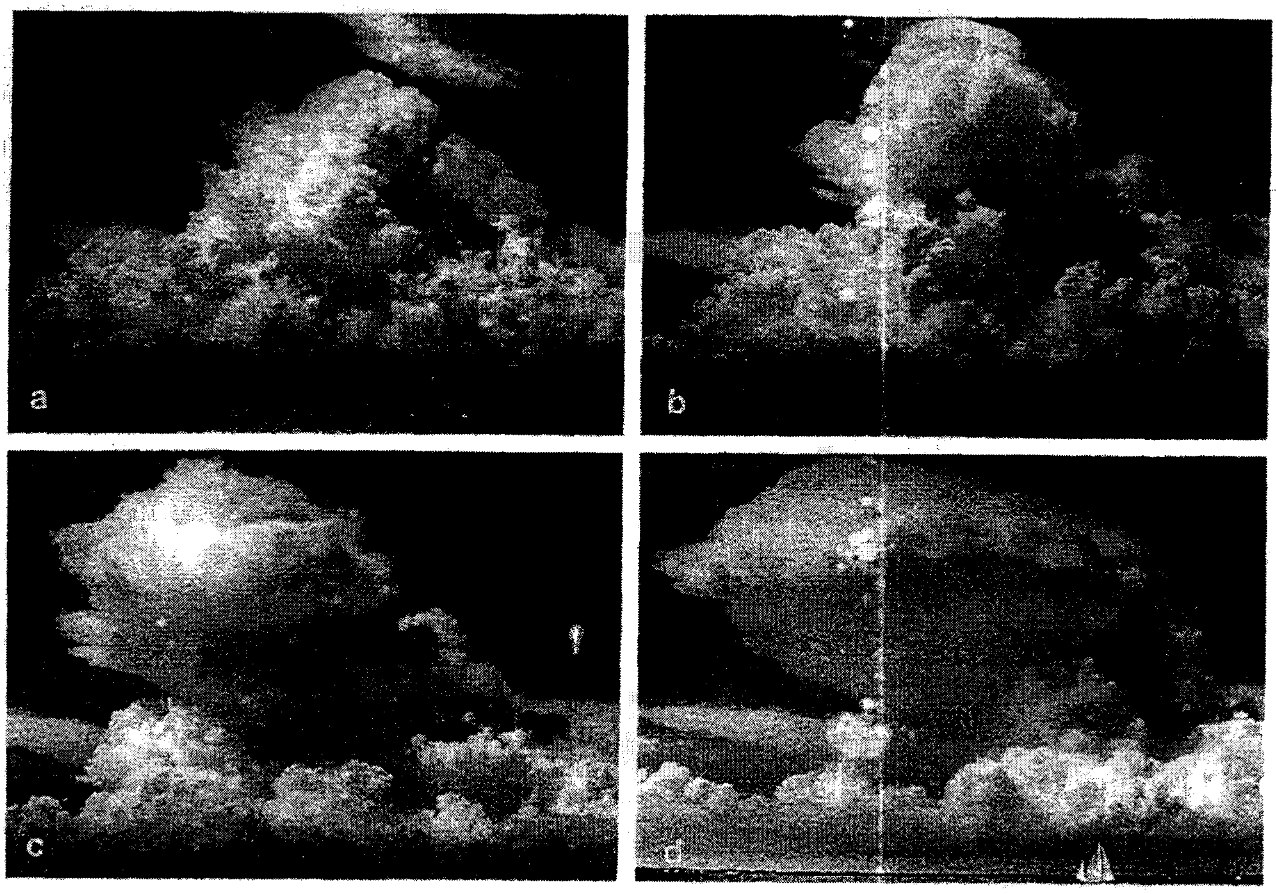


Figure 1.4

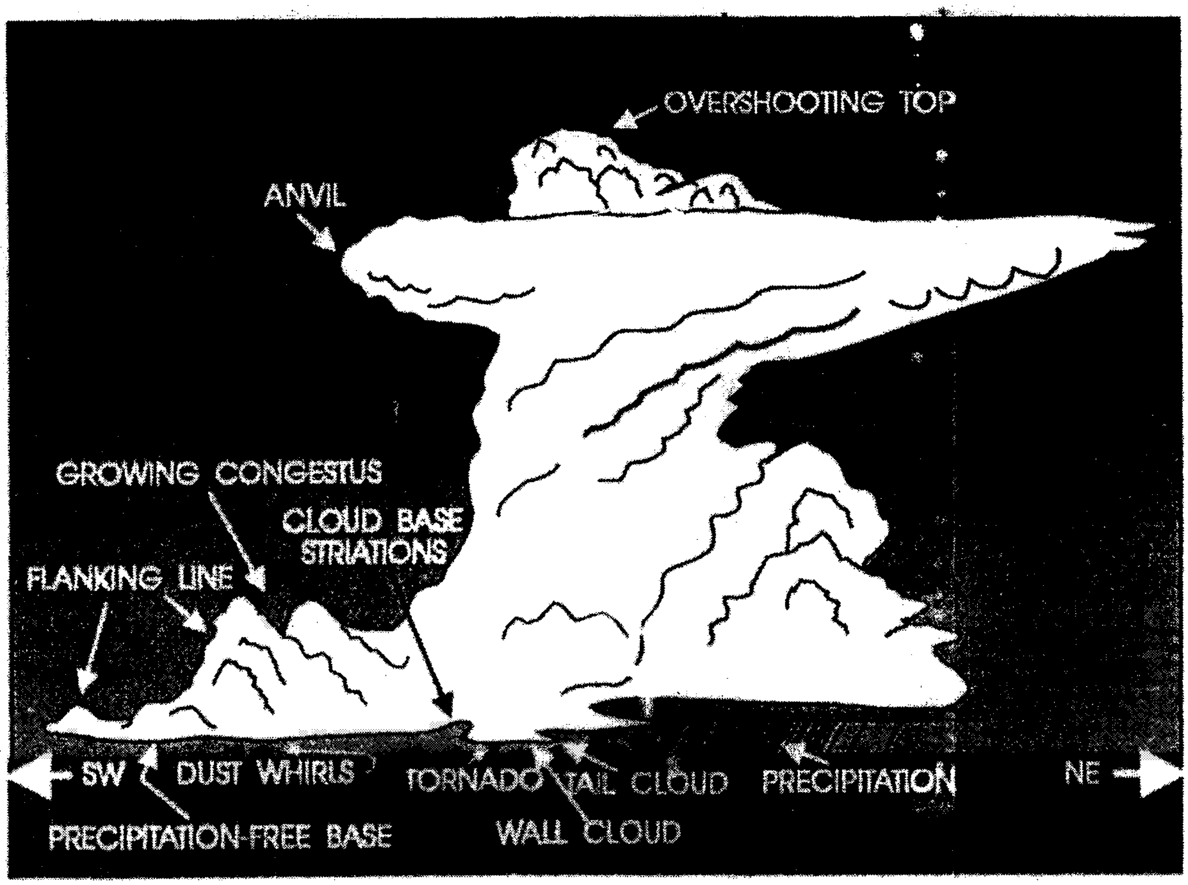


Fig. 9.15 Sketch of tornadic thunderstorm as viewed from the southeast. Vertic scale is exaggerated by about a factor of two. (*Courtesy of Joseph Golden.*)

from Emanuel (1994)

from Emanuel (1994)

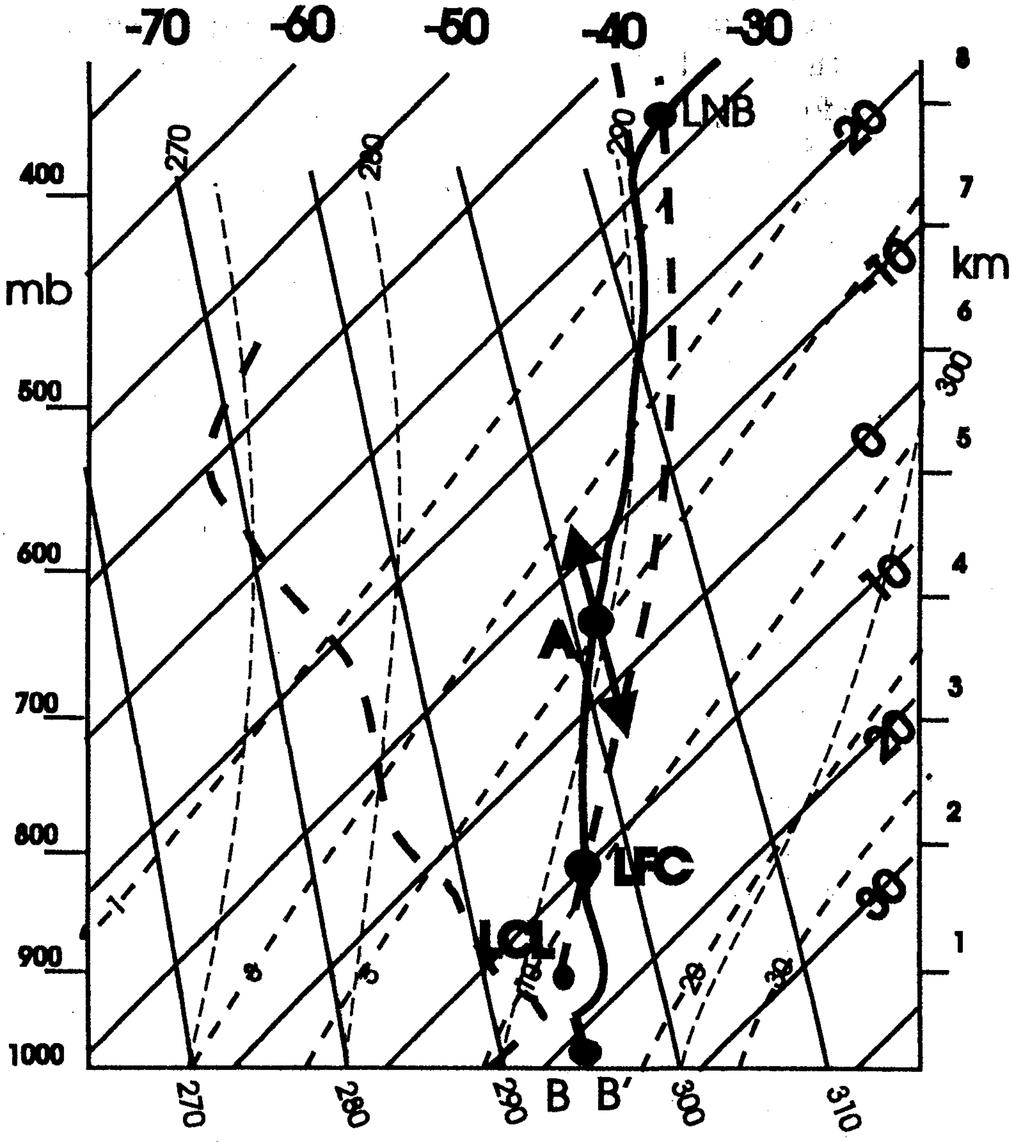


Fig. 6.1 This thermodynamic diagram is a skew T_ρ–log p diagram with log p on the ordinate and T_ρ on a diagonal axis. Parcel A, when displaced in any direction to any pressure, will experience a buoyancy that accelerates it back toward its initial position. It is therefore *absolutely stable.* Parcel B, when lifted, eventually reaches its *lifted condensation level (LCL).* Thereafter, it ascends pseudoadiabatically. If it is forced beyond its *level of free convection (LFC),* it will attain a positive buoyancy until it reaches its *level of neutral buoyancy.* This sounding exhibits *conditional instability* because at least one parcel (B, for example), attains positive buoyancy when lifted. A finite amount of energy must be supplied to parcel B to raise it to its LFC. Parcel B′ is the same parcel as B but we assume that, once saturated, it ascends along a *reversible* moist adiabat. Here its density temperature is plotted. As it happens, B′ ascends exactly along the sounding in this case, so that the sounding is *conditionally neutral* to the reversible ascent of B.

From (6.1.4), this can be expressed

$$\mathrm{CAPE}_i = \int_i^{\mathrm{LNB}} g \frac{\alpha_p - \alpha_a}{\alpha_a}\, dz, \qquad (6.3.3)$$

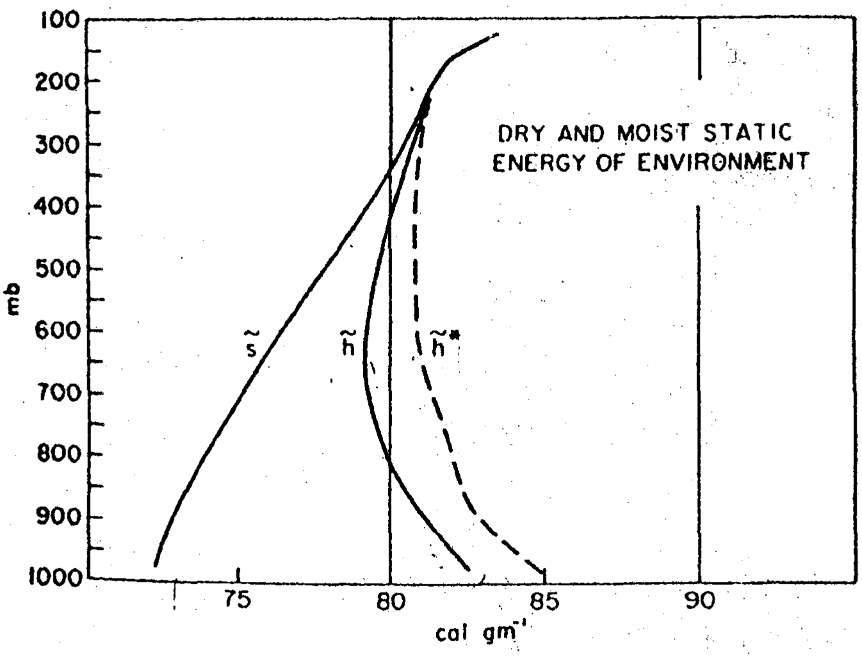
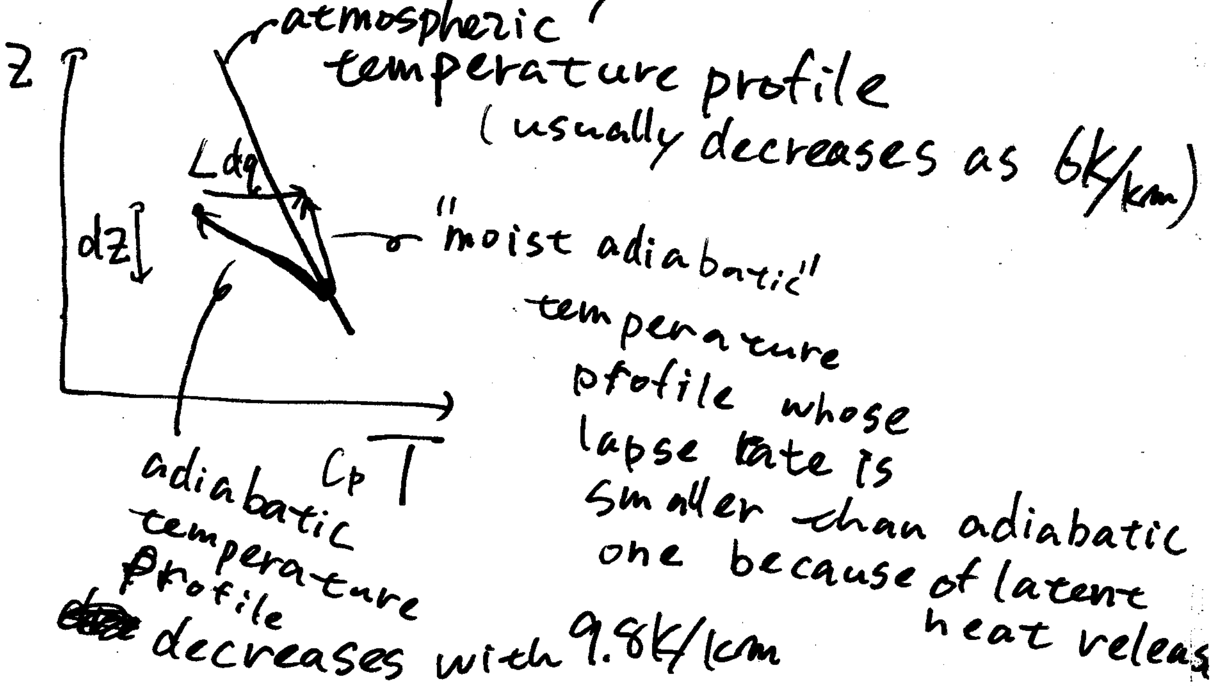


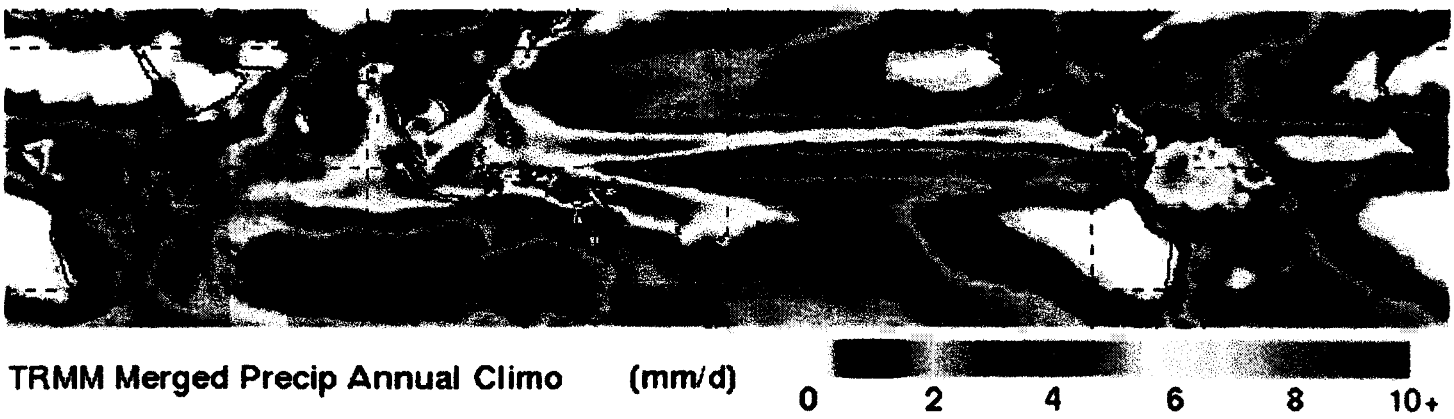
Fig. 14.6 Dry static energy ($\tilde{s}$), static energy ($\tilde{h}$), and saturation static energy ($\tilde{h}^*$) averaged over time from soundings taken from the Marshall Islands of the Pacific. [*From Yanai et al. (1973).*]

conditional instability



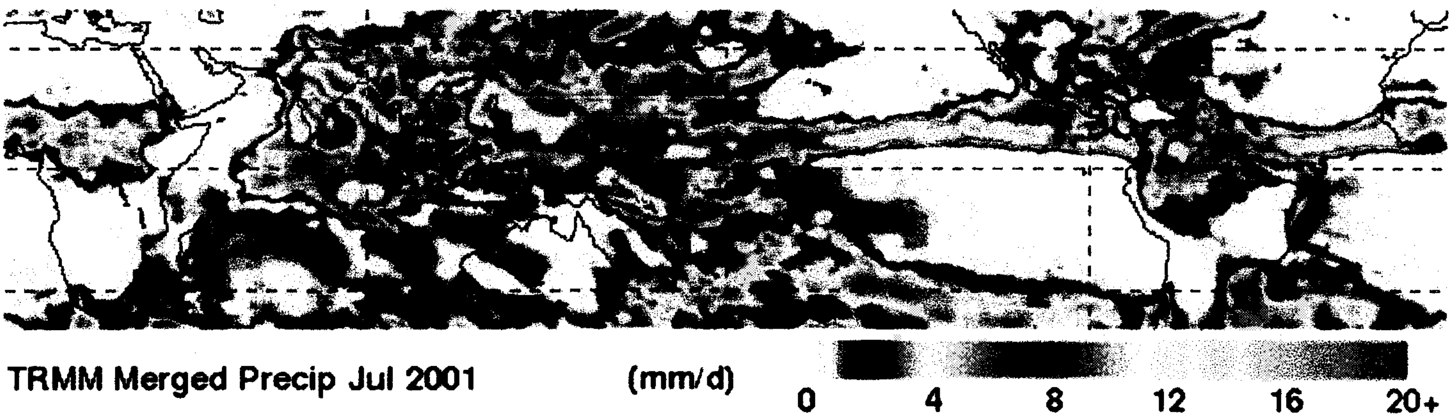
Tropical Rainfall Measuring Mission (TRMM)

Three–Year TRMM Climatology

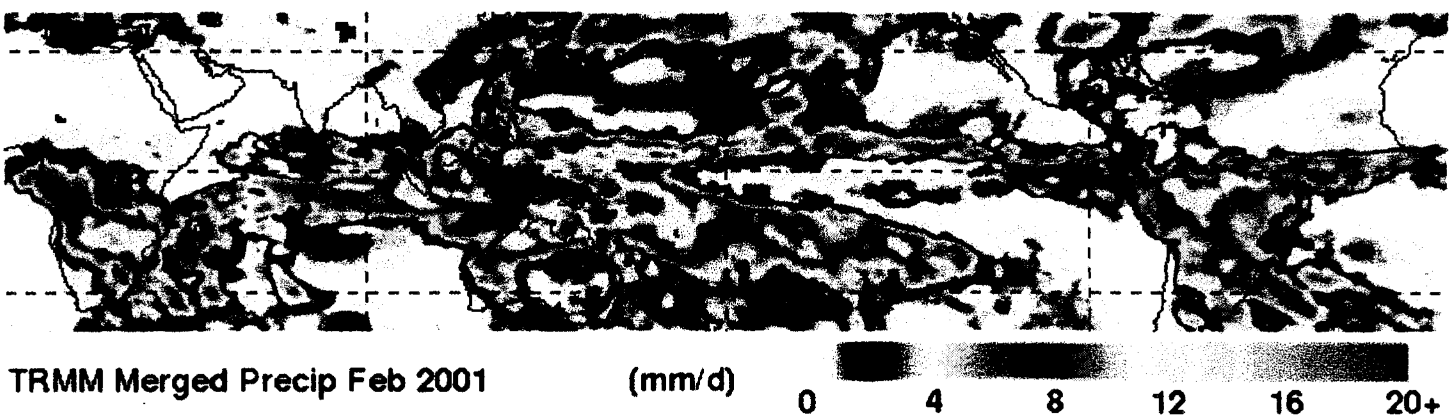


January 1998 – December 2000

July 2001



Feb 2001



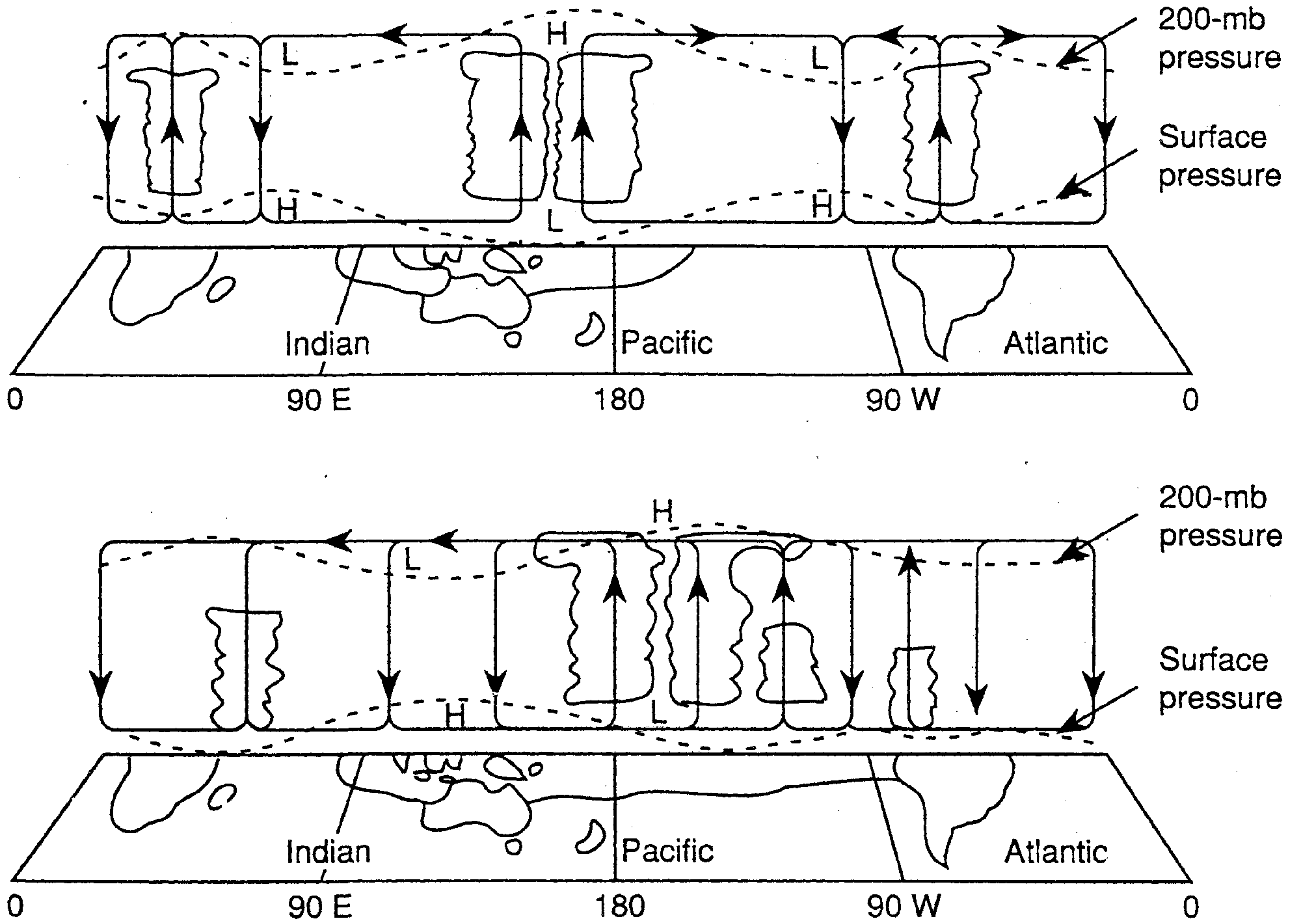
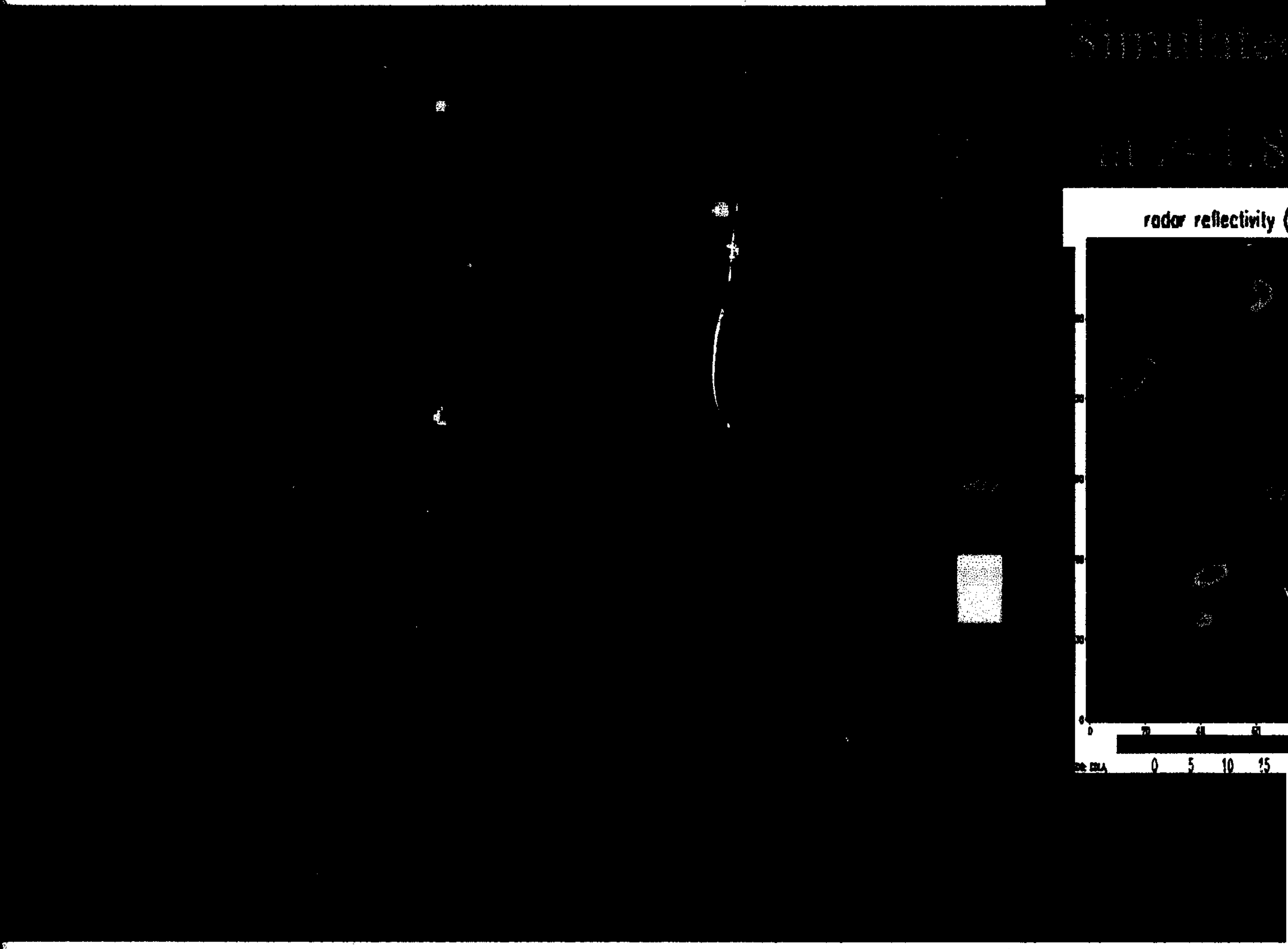


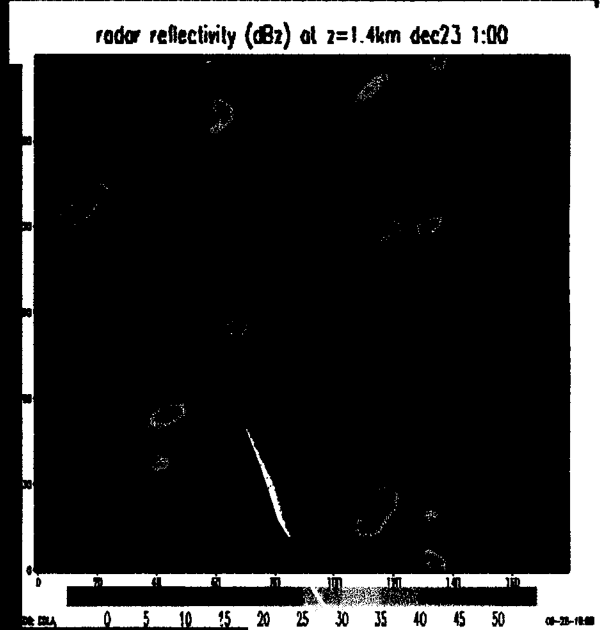
Fig. 11.10 Schematic diagrams of the Walker circulations along the equator for normal conditions (upper panel) and El Niño conditions (lower panel). (After Webster, 1983 and Webster and Chang, 1988.)

Comparison with radar reflectivity

Inactive convective period (0300 23 dec)

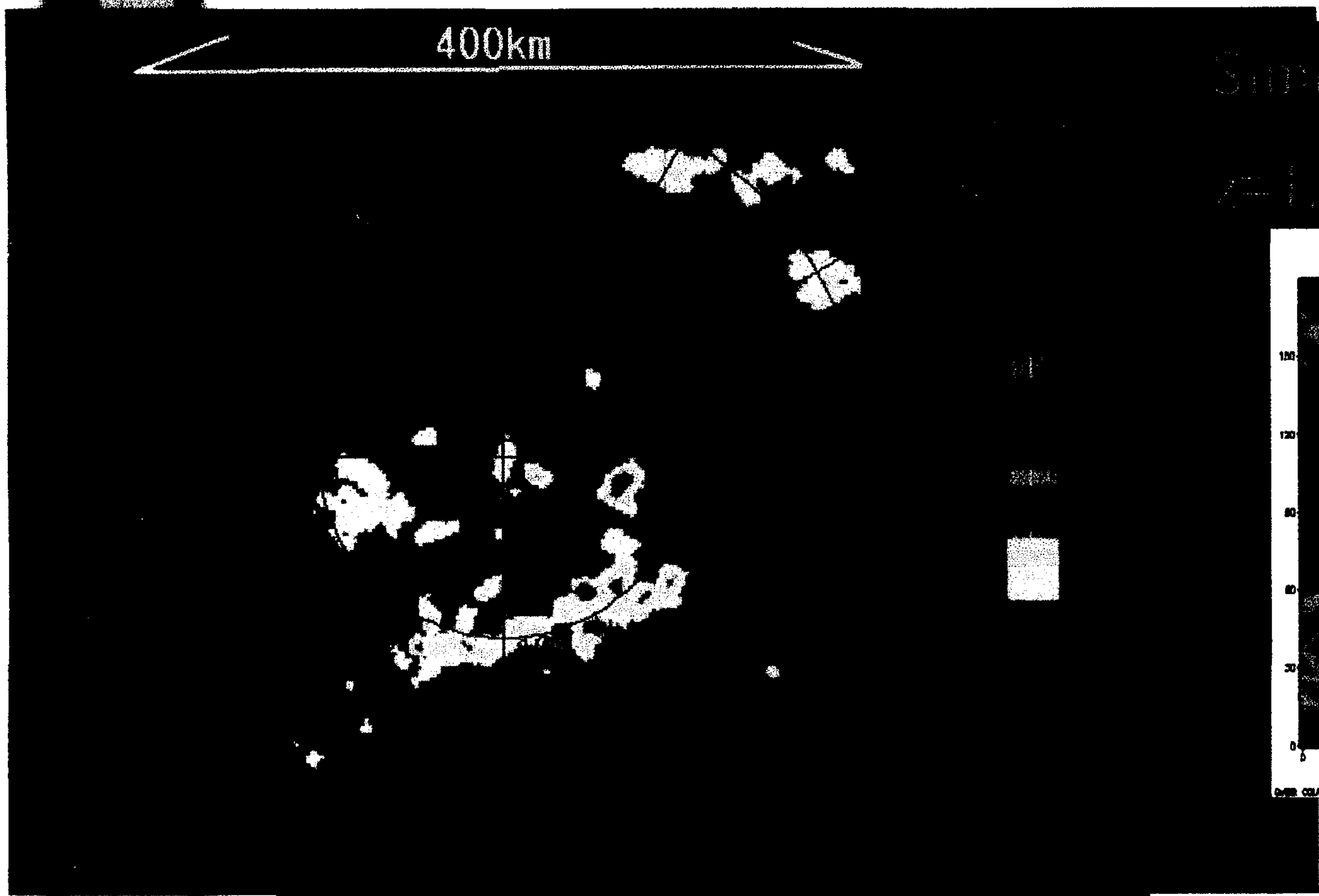


Simulated



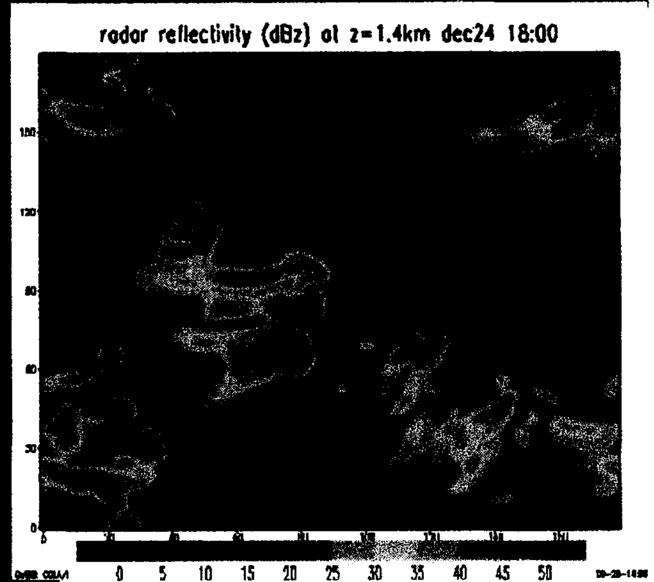
Comparison with radar reflectivity

Active convective period (1800 24 dec)



Simulated refle

z=1.8km same area



鉛直流水平断面のスナップショット

高度 31.6km

Horizontal cross sections of w at 31.6km

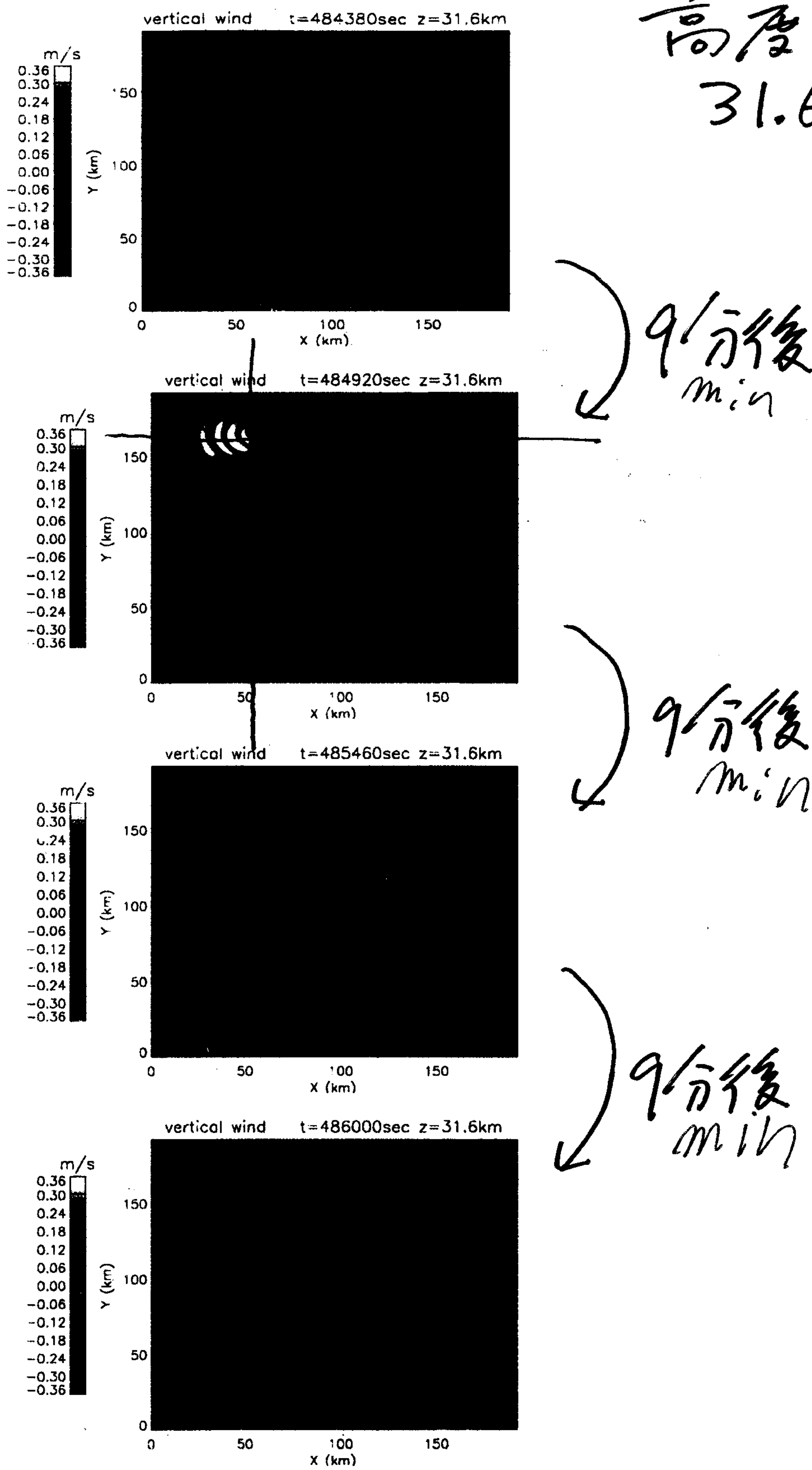


Figure 4.9: much1 期間中の高度 31.6km における鉛直風の時間変化。much1 開始 2.55 時間後から 9 分間隔で書いてある。

w 鉛直流 鉛直断面スナップショット

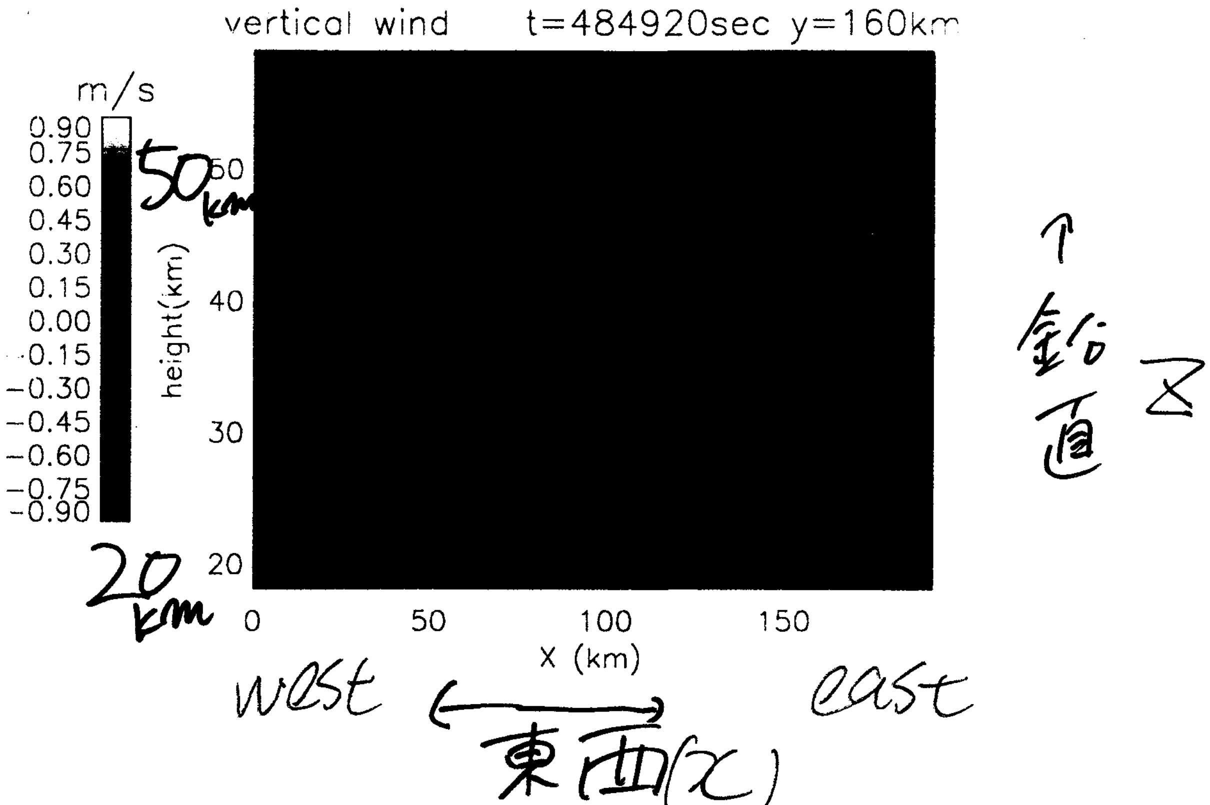


Figure 4.10: 図 (4.9) における鉛直風の東西方向の鉛直断面図 (y=160km、t=much1 開始 2.7 時間後)

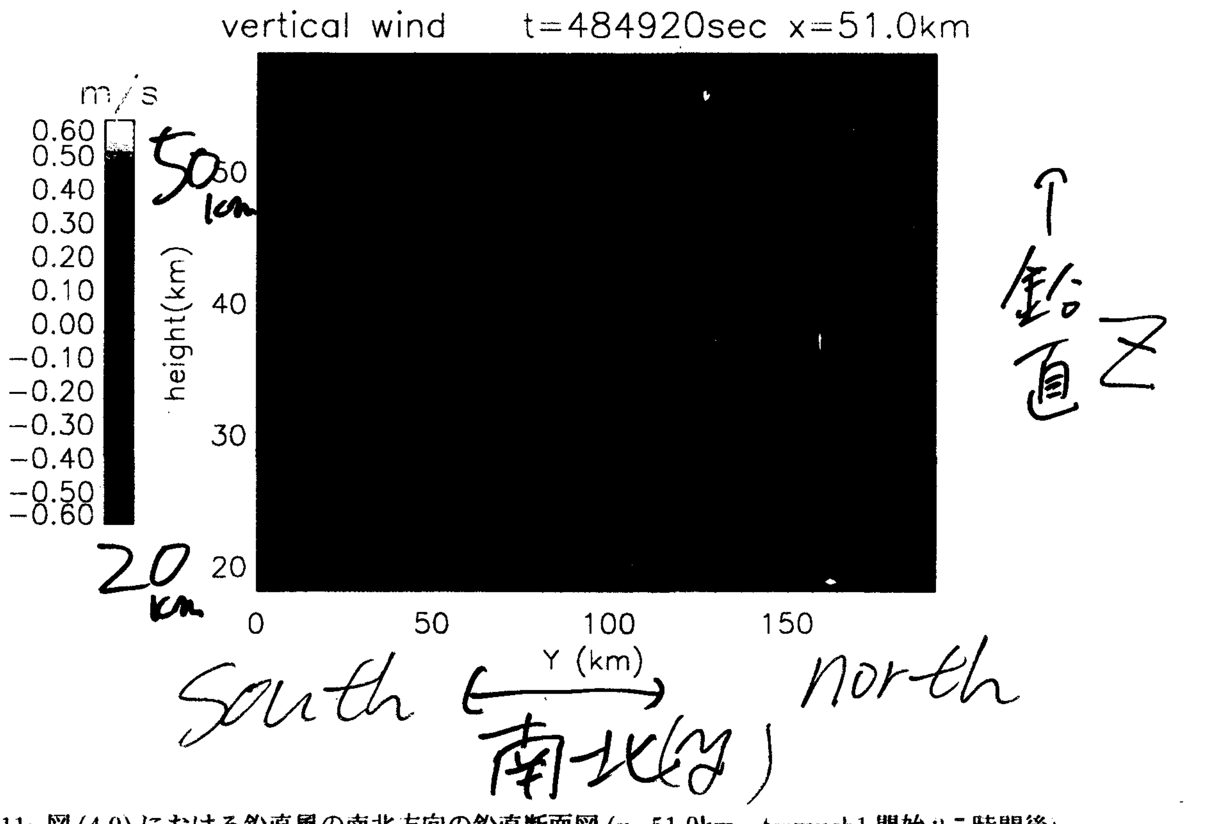


Figure 4.11: 図 (4.9) における鉛直風の南北方向の鉛直断面図 (x=51.0km、t=much1 開始 2.7 時間後)

Horinouchi & Yoden (1996)

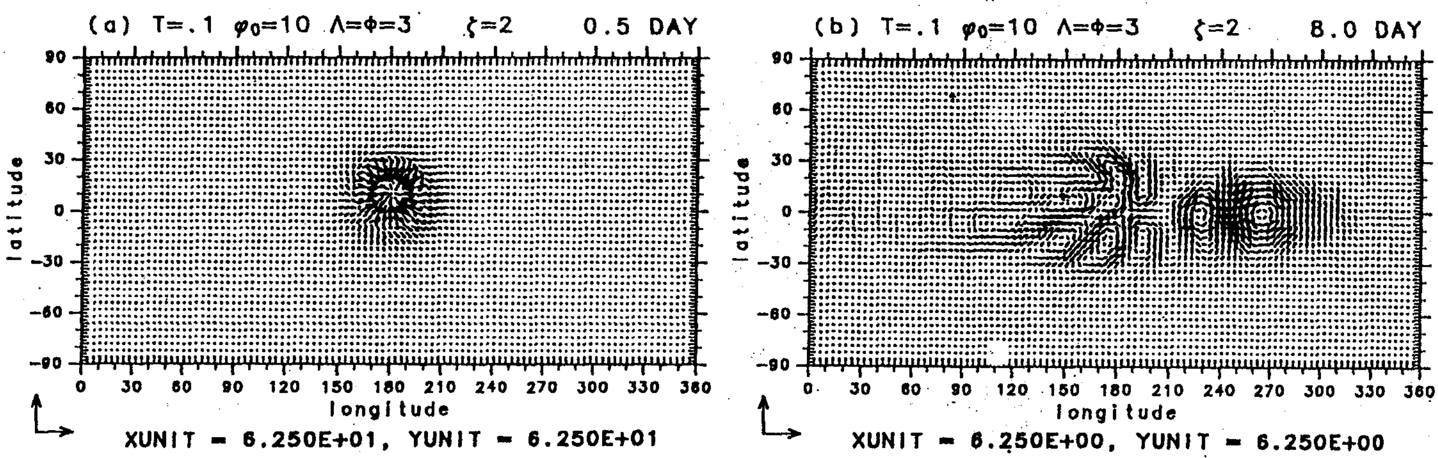


Fig. 6. Time evolution of horizontal wind field in Experiment (A) at $\zeta = 2$: (a) $t = 0.5$ days and (b) $t = 8$ days. The center of the heating is at $\lambda_0 = 180°$ and $\varphi_0 = 10°$. Unit vectors and their scale [ms^{-1}] are shown at the left-bottom corner and at the bottom, respectively.

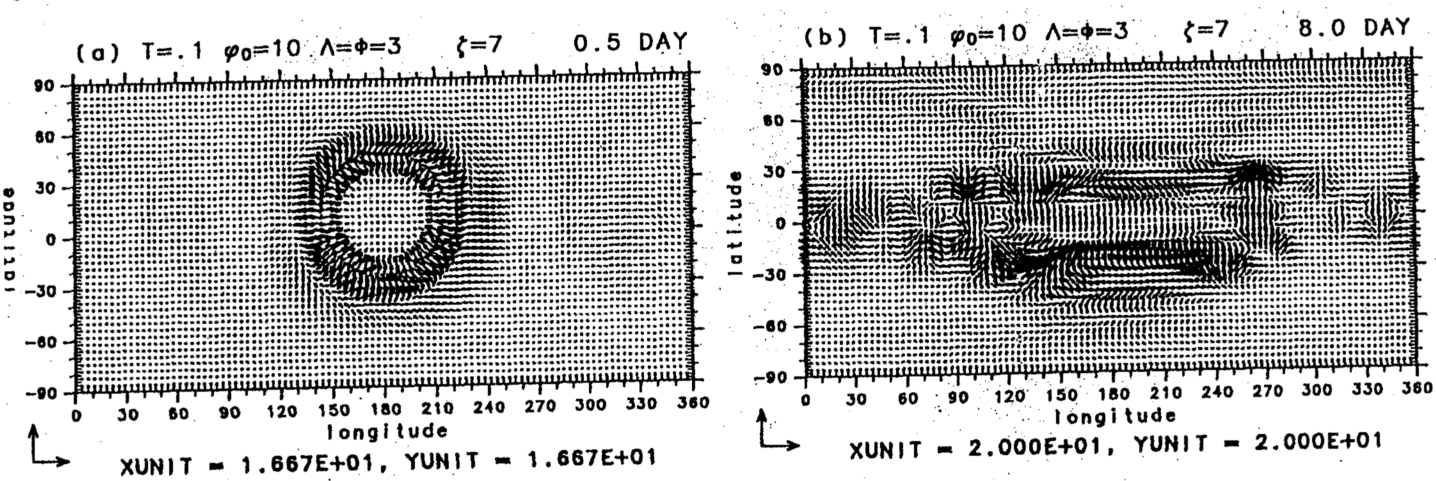


Fig. 7. As in Fig. 6, but for $\zeta = 7$.

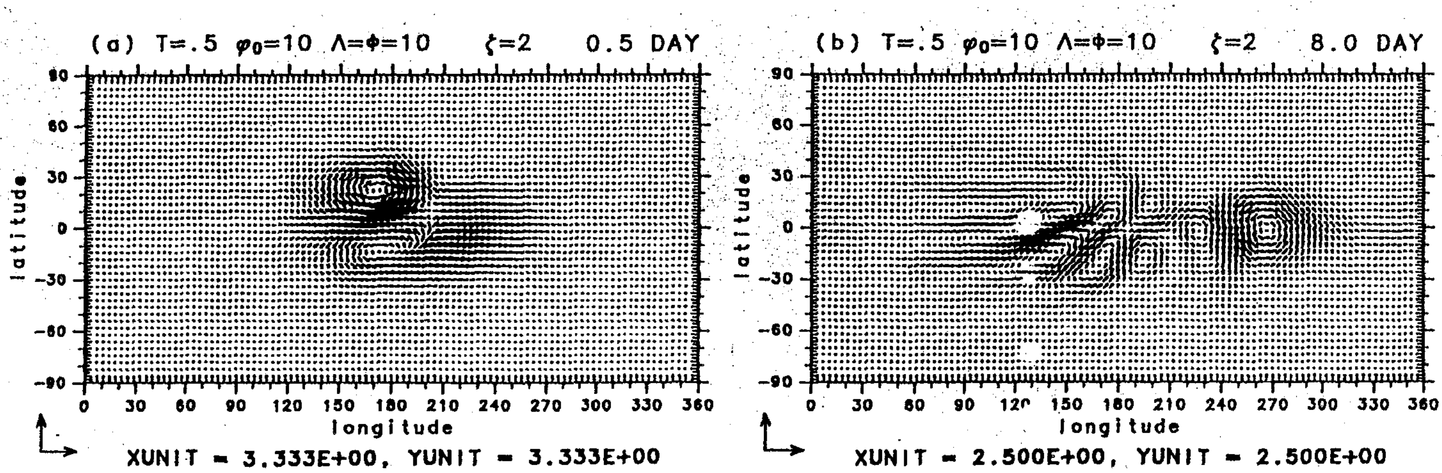


Fig. 9. As in Fig. 6, but for Experiment (D).