Wakimoto RM (1985) Forecasting Dry Microburst Activity over the High Plains. Monthly Weather Review: Vol. 113, No. 7 pp. 1131–1143

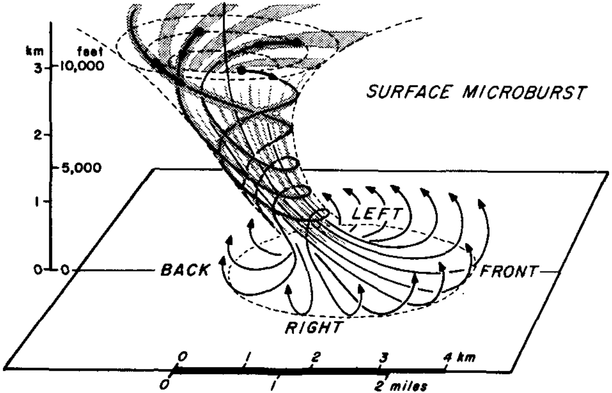


FIG. 11. Model of the descent of a microburst from cloud base. A rotating downdraft was frequently observed by the Doppler radars (from Fujita and Wakimoto, 1983b).

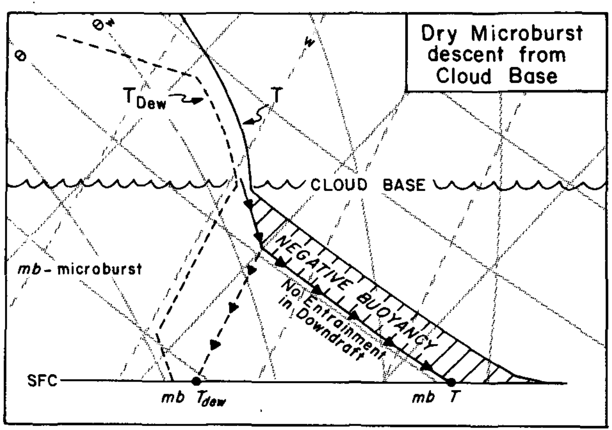


FIG. 10. Model of the thermodynamic descent of a dry microburst from cloud base. Surface temperature and dew-point temperature within the microburst are determined from PAM data. No entrainment into the downdraft is assumed.

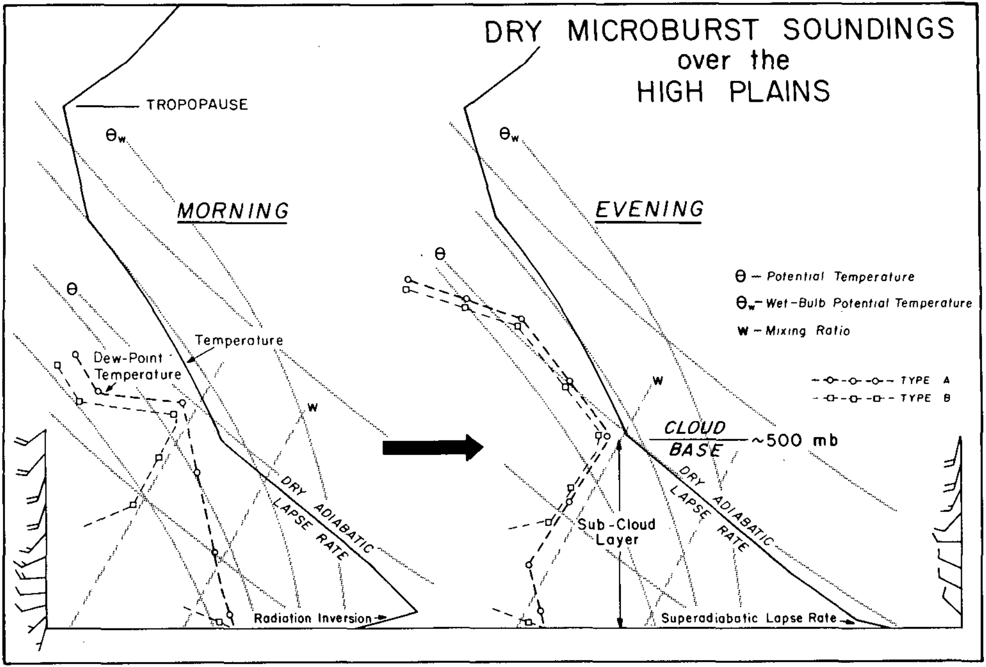


FIG. 8. Model of the characteristics of the morning and evening soundings favorable for dry-microburst activity over the High Plains.

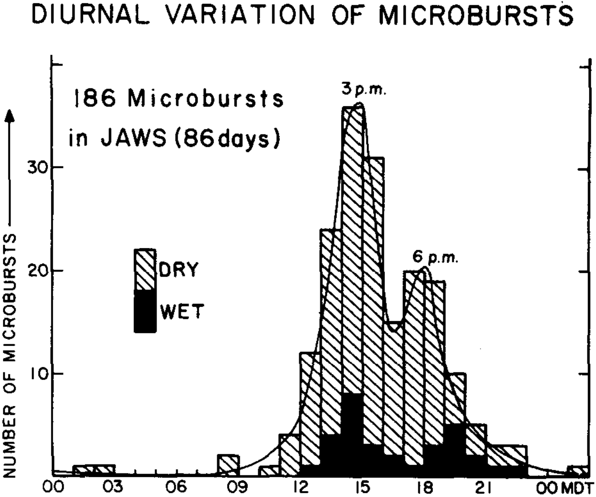
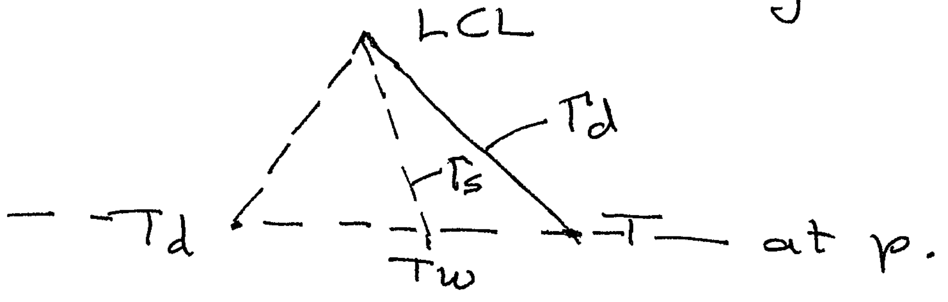


FIG. 4. Diurnal variation of the 186 microbursts during the JAWS Project. Most of the activity occurs during daylight hours with two peak periods at 1500 and 1800 MDT (MDT + 6 h = GMT).

microburst Downdrafts 4-20-06

T_w, wet-bulb temperature =
is achieved by isobaric evaporation and cooling to saturation.

Can be determined using skew-T:



(1) Find LCL for given T, T_d.

(2) Follow saturation adiabat from LCL to original pressure.

Application: To determine evaporative cooling potential; for example, "swamp" coolers.

DCAPE = downdraft CAPE.

$$\equiv -\int_{P_{CB}}^{P_{sfc}} R(T-\overline{T})\, d\log p.$$

T: parcel temperature

$\overline{T}$: environment temperature

Parcel is assumed to have $T=\overline{T}$, $T_d=\overline{T_d}$ at cloud base pressure, P_{CB}.

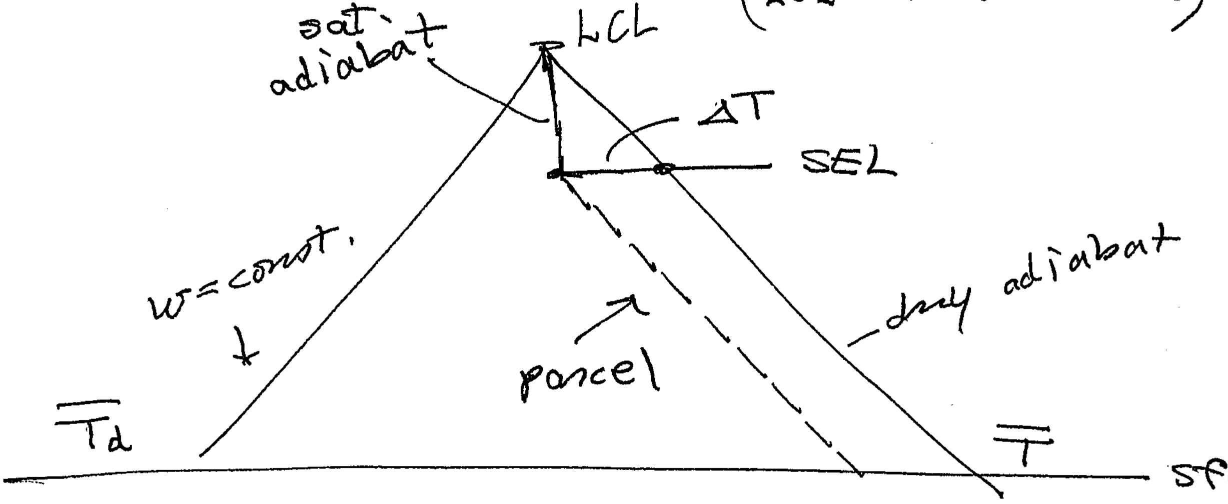
Just below cloud base, air is slightly subsaturated. Rain or snow falls into this air, evaporates (sublimates) and cools the air, to its T_w. Due to negative buoyancy, parcel accelerates downward:

$$\frac{dw}{dt} = \frac{g}{T_e}\left(T-\overline{T}_e\right) < 0.$$

Assume that as parcel descends, evaporation of rain keeps it saturated, so it remains on saturation adiabat,

In "dry" microburst conditions, rain totally evaporates a short distance below cloud base, Assume that parcel remains saturated ~~until~~ to this level, then continues to descend (if $w<0$) ~~at~~ dry adiabatically, below this level (the Sinking Evaporation Level).

consider $\overline{T}_e$, $\overline{T}_d$ typical of a well mixed BL; constant θ, constant w from sfc ($p = p_{sfc}$) to LCL ($p = p_{LCL}$):
(LCL = cloud base)



Calculate DCAPE for parcel in this & environment :

$$DCAPE = DCAPE_{upper} + DCAPE_{lower}$$

$$\equiv -\int_{p_{LCL}}^{p_{SEL}} R(T-\overline{T})\, d\log p - \int_{p_{\cancel{SEL}\,sfc}}^{\;}\!\!{}_{p_{\cancel{LCL}\,SEL}} R(T-\overline{T})\, d\log p$$

$$= -\frac{R\,\Delta T}{2}\log\left(p_{SEL}/p_{LCL}\right) - R\,\Delta T \log\left(\frac{p_{sfc}}{p_{SEL}}\right)$$

where $\Delta T \equiv (T-\overline{T})_{SEL}$.

See HW for example.

$$(w_{down})_{max} = \sqrt{2 \cdot DCAPE}\,.$$

$(w_{down})_{max}$ occurs at surface in this case.

With a different $\overline{T}$, negative buoyancy may not exist all the way to the surface.

$\frac{dw}{dt} < 0$ may occur due to drag of rain drops, despite $T-\overline{T} > 0$.