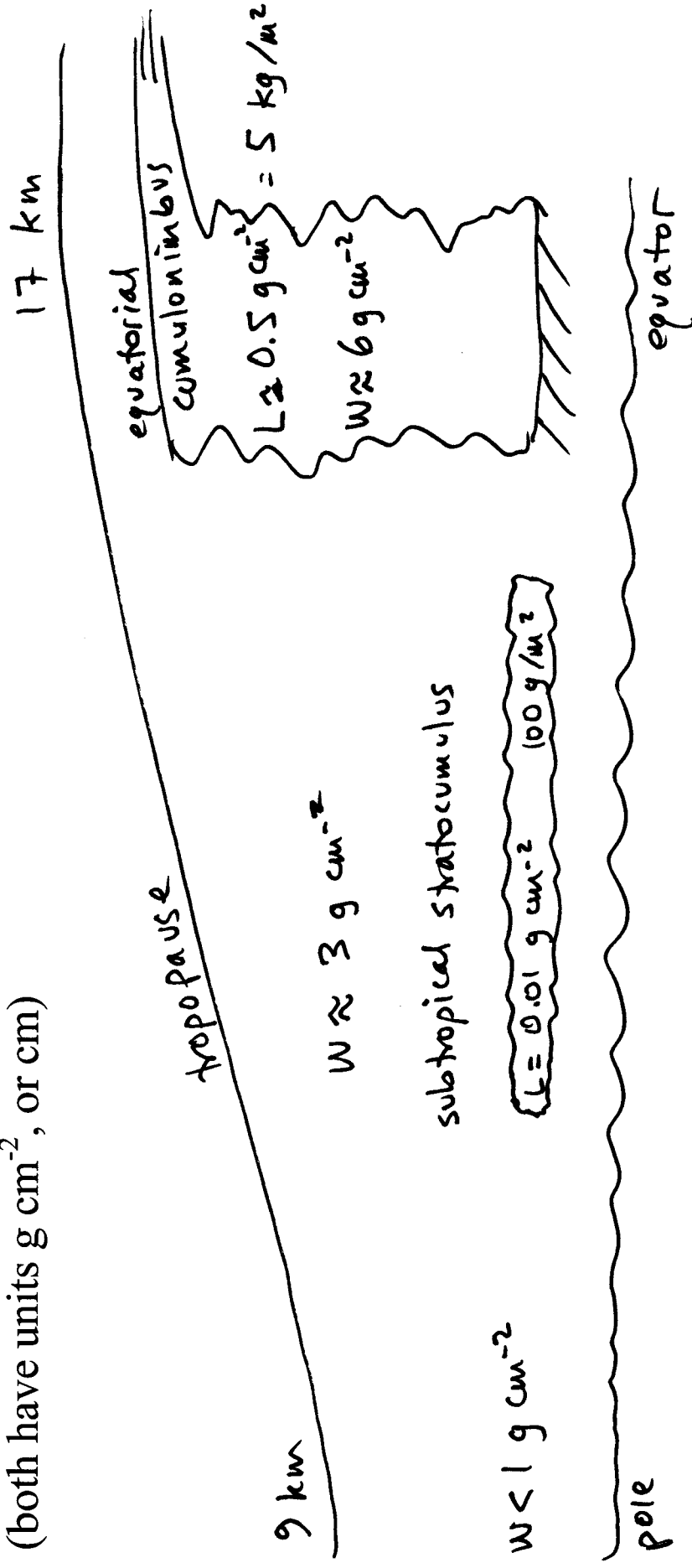


Water: vapor, liquid, ice

W = precipitable water vapor

L = liquid (or ice) water path

(both have units g cm^{-2} , or cm)



Condensed water is only about 10% of the total water in a cloud, but is responsible for most of the infrared emission and all the solar reflection. Limit of visibility for thin cirrus: optical depth $\tau \sim 0.03$; $L \sim 10^{-4} \text{ g cm}^{-2}$.

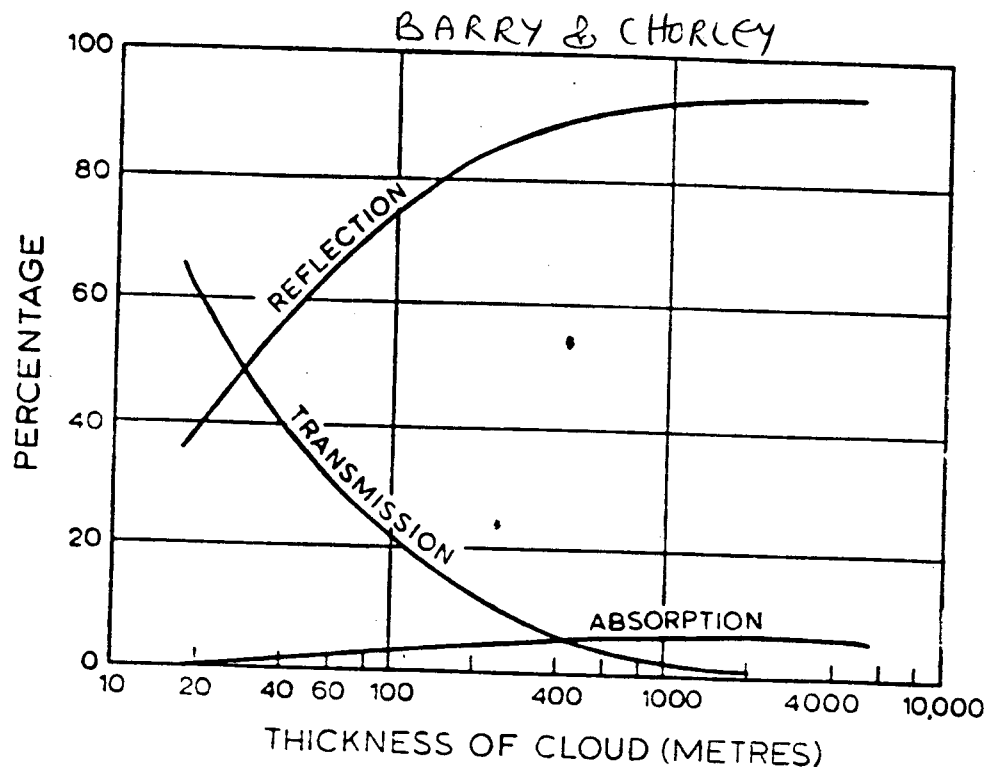
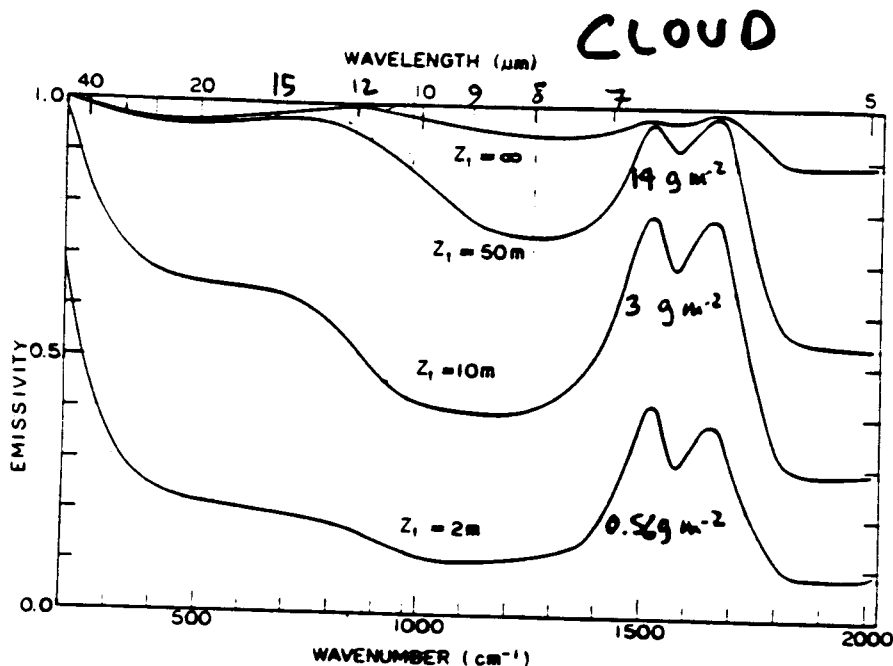


Fig. 1.9. Percentage of reflection, absorption and transmission of solar radiation by cloud layers of different thickness (from Hewson and Longley 1944).



[California stratus have $70-100 \text{ g m}^{-2}$]

Fig. 8.3. Spectral emissivity of a cloud. Same characteristics as Fig. 8.1. (After Yamamoto et al., 1970.)

Paltridge & Platt.

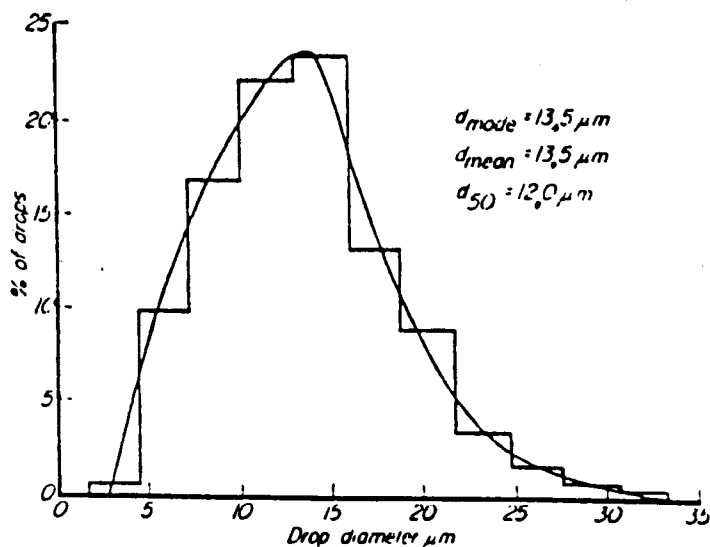


FIG. 5. --- Average drop size spectrum for the arctic stratus clouds.

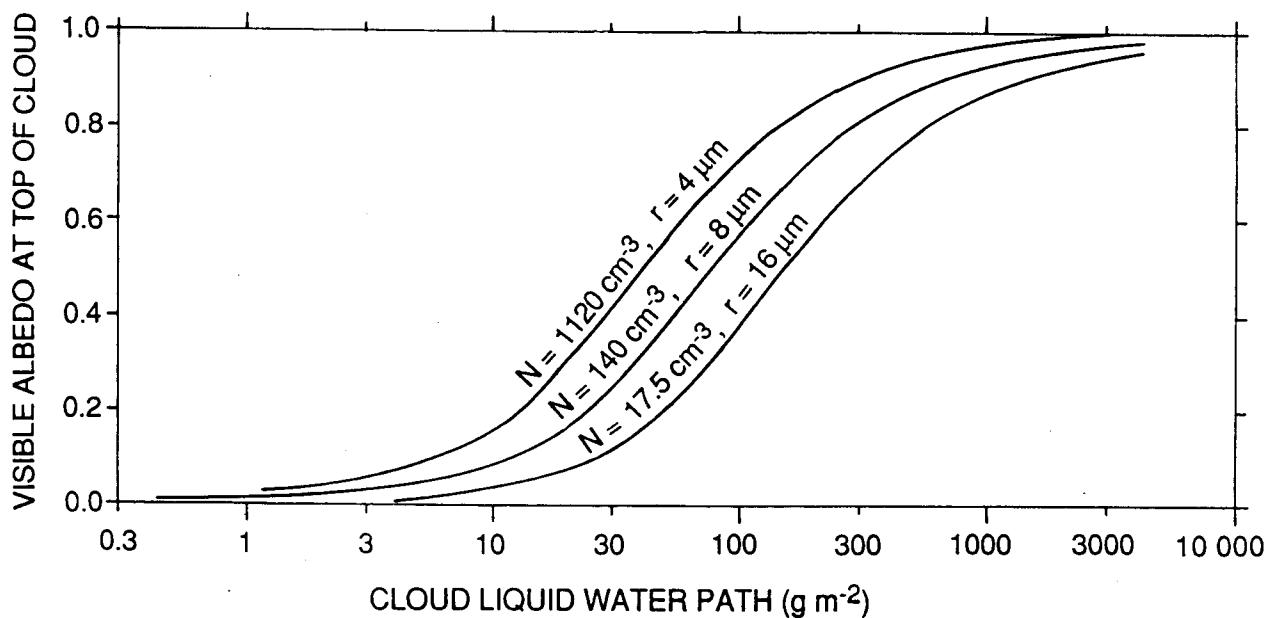
Jaya weera & Ohtake, 1973.

J. Rech. Atmos. 7, 199-207.

S. Twomey, 1977: Atmospheric Aerosols p. 289.

Nonabsorbing cloud over a black surface. $\theta_0 = 0^\circ$

N = number-density of CCN. r = droplet radius



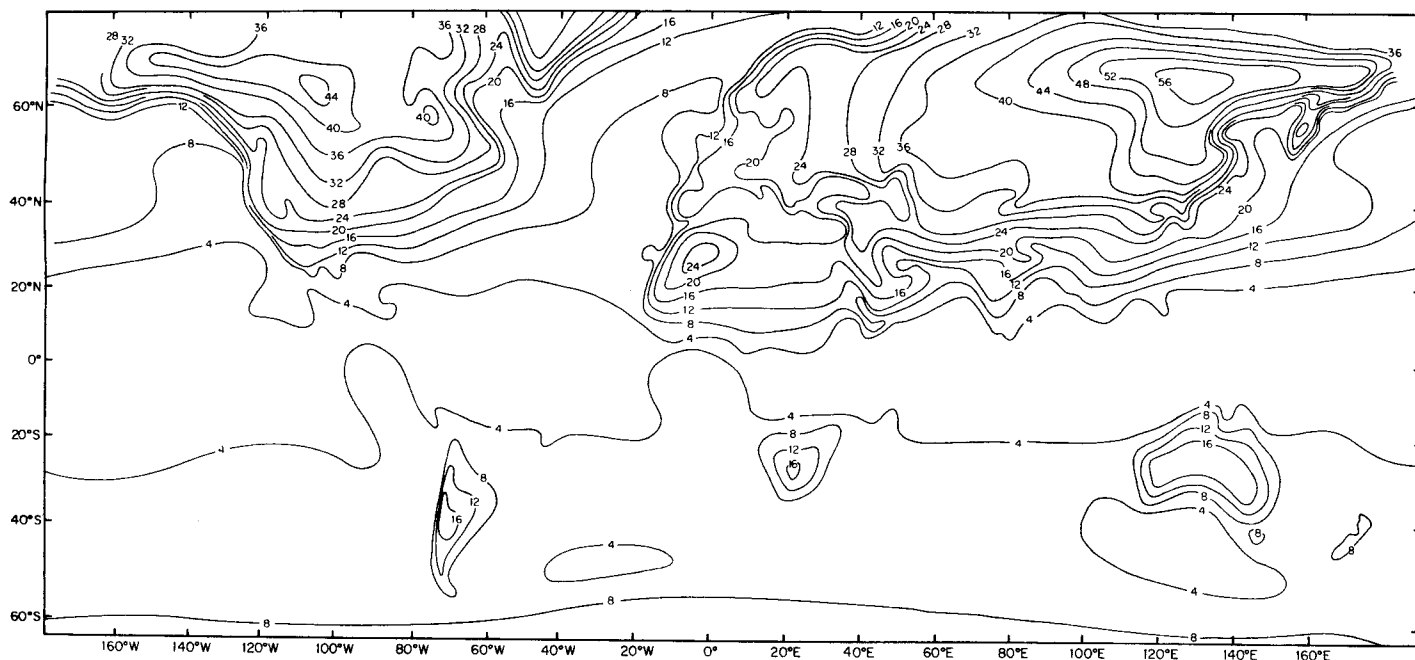
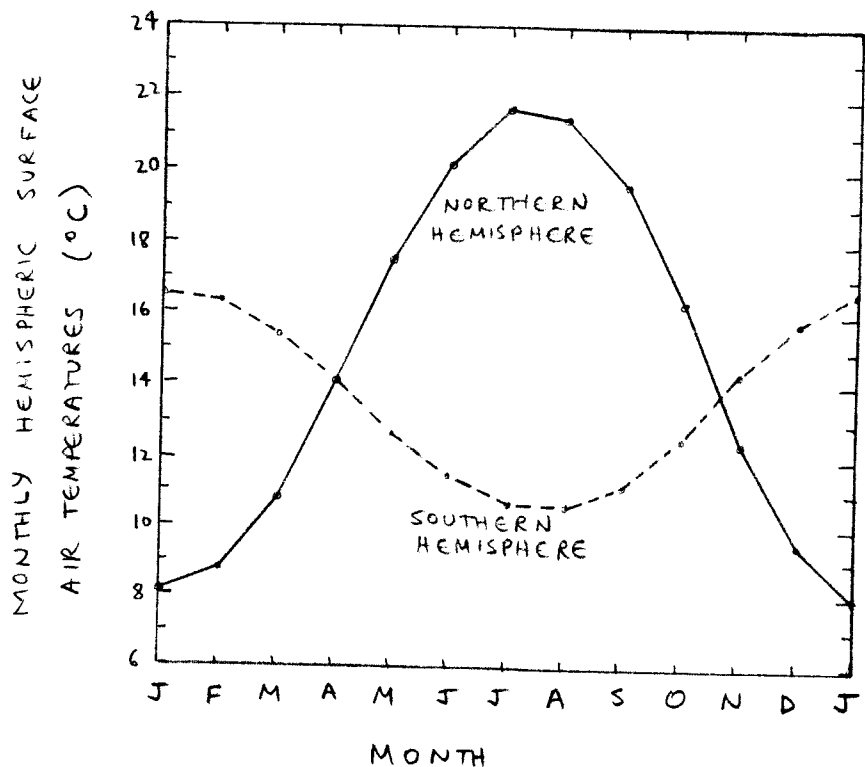


Fig. 7.20 The "Find the Continents" game! Annual range in temperature at the earth's surface, in degrees Celsius. (Adapted from a figure by A. S. Monin and P. P. Shirshov which appeared in Report No. 16, *GARP Publications Series*, World Meteorological Organization—International Council Scientific Unions, p. 203.)



Surface water budget

Hydrological equation

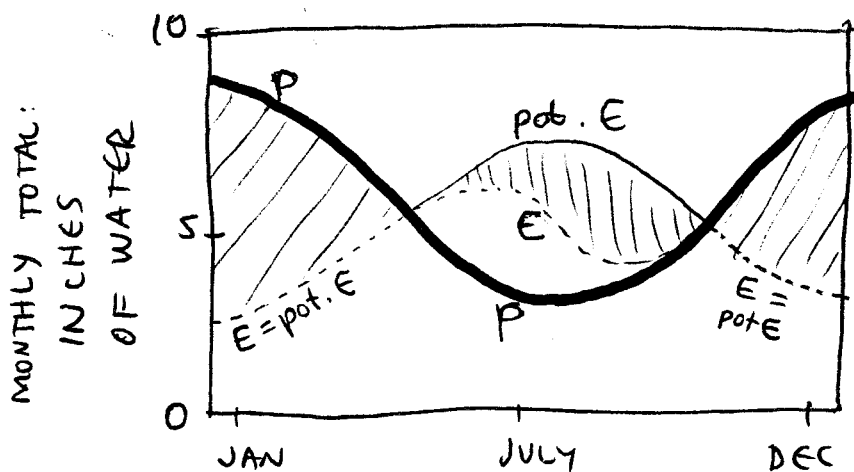
$$\text{STORAGE} = \text{PRECIPITATION} - \text{EVAPOTRANSPIRATION} - \text{RUNOFF}$$

$$g = P - E - \Delta f$$

$$P > E \quad \text{wet season, } g + \Delta f > 0$$

$$P < E \quad \text{ground is drying out, } g < 0$$

DIAGRAM:



"pot. E" = potential evaporation