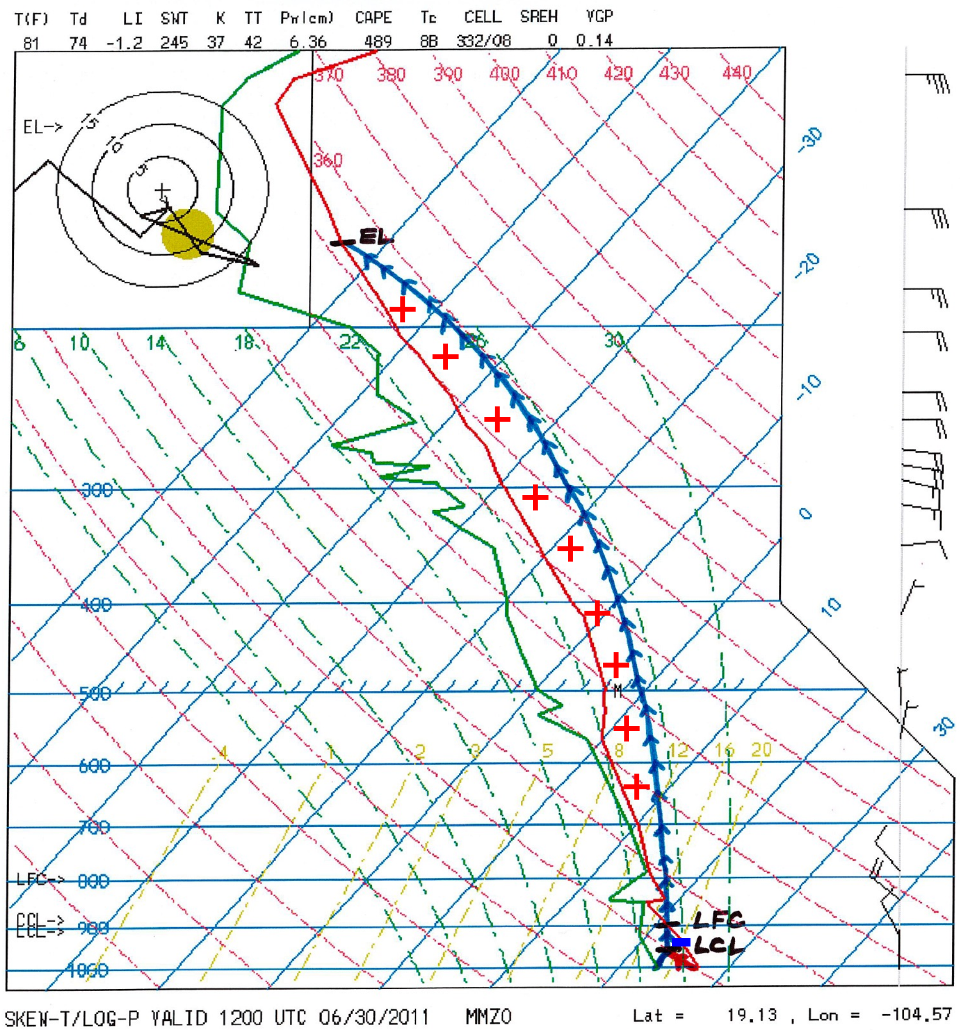
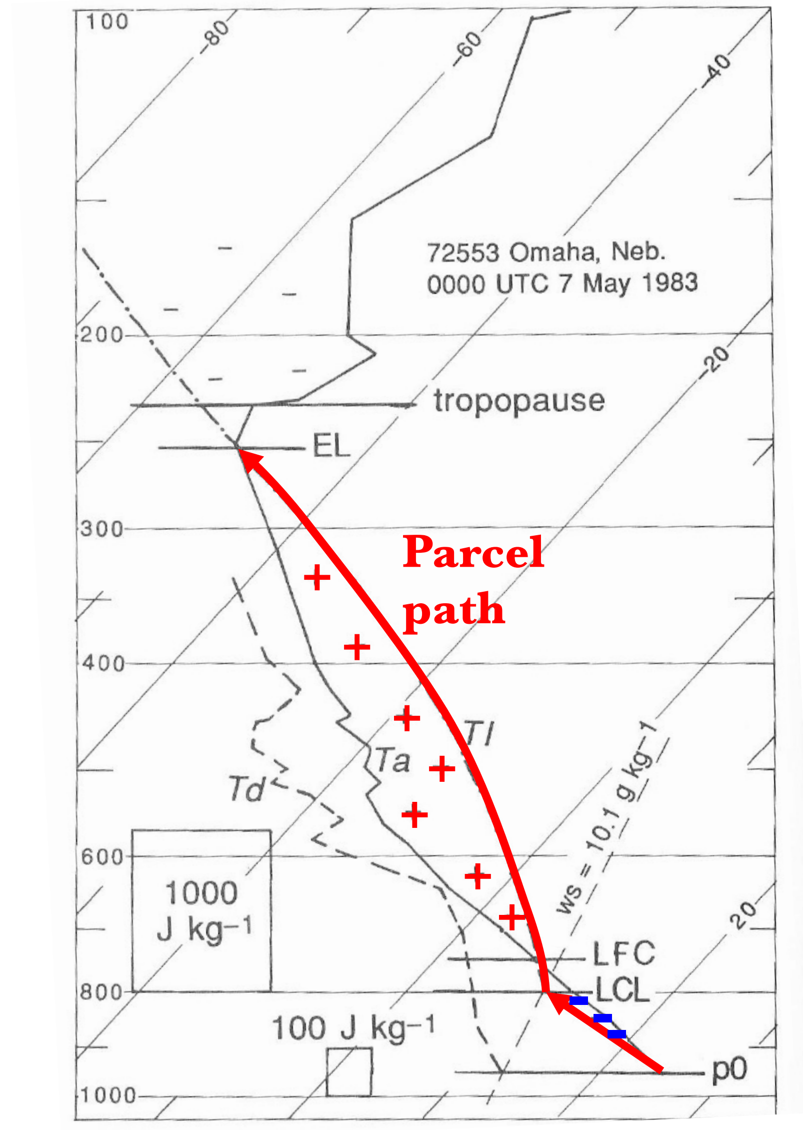
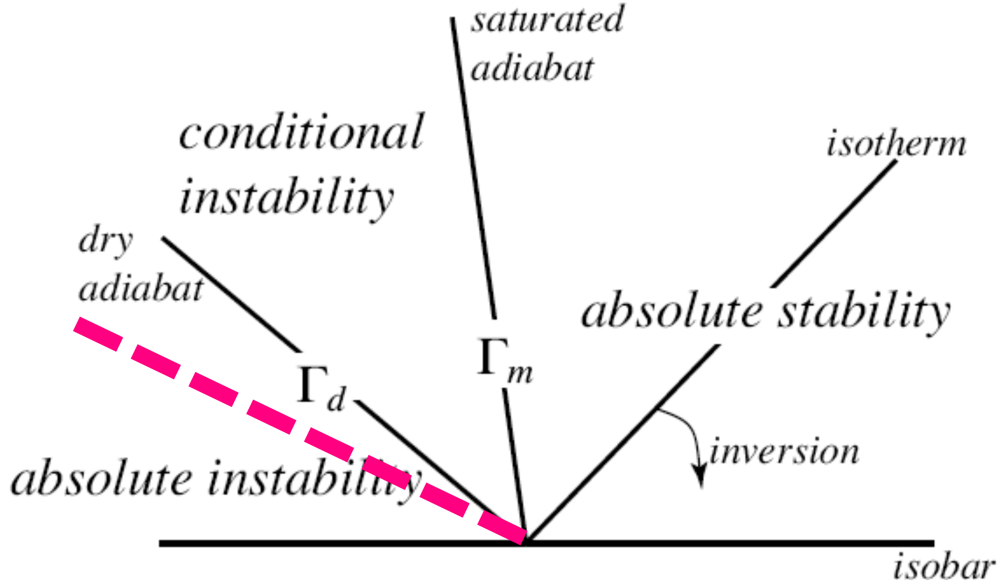
Midlatitude versus tropical convection: Skew T-log p diagrams



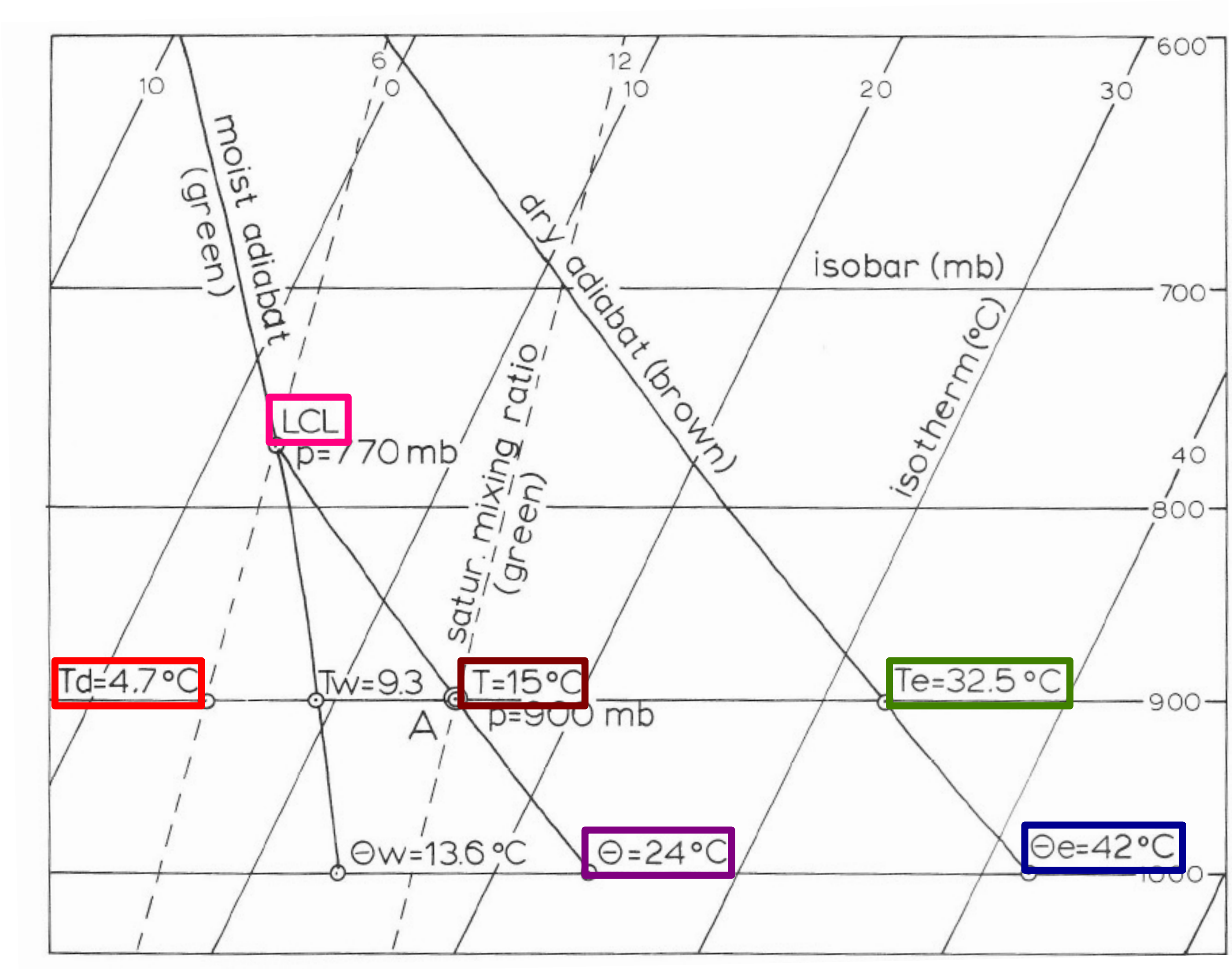


Lapse rates and stability

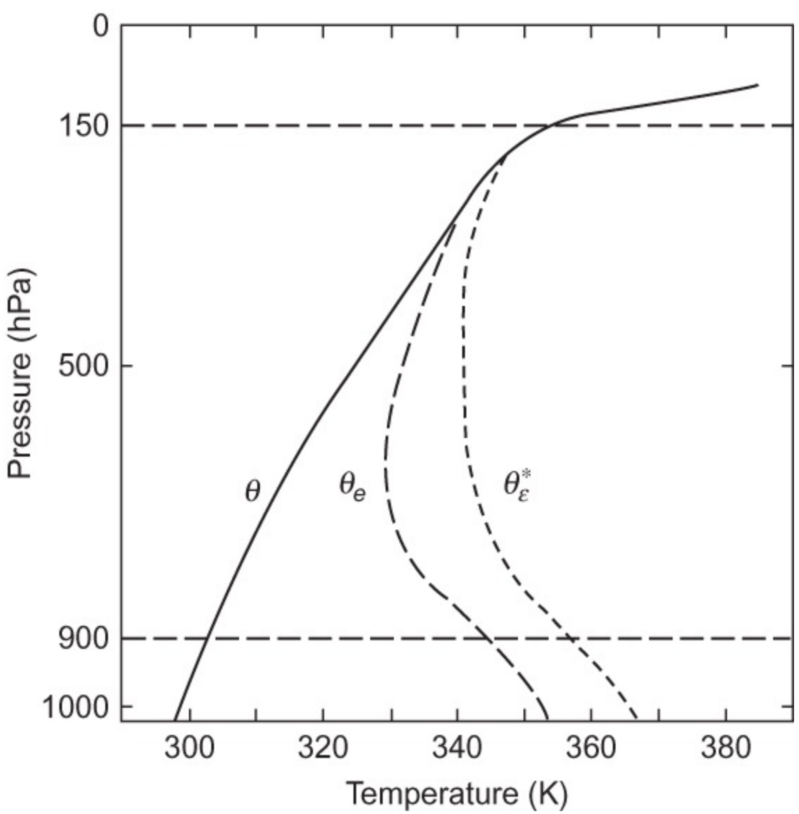
$\gamma < \Gamma_m$	**Absolutely stable**
$\gamma = \Gamma_m$	**Saturated neutral**
$\Gamma_m < \gamma < \Gamma_d$	**Conditionally unstable**
$\gamma = \Gamma_d$	**Dry neutral**
$\gamma > \Gamma_d$	**Absolutely unstable**



Finding Θs on a skew T-log p diagram



Typical tropical thermodynamic profiles

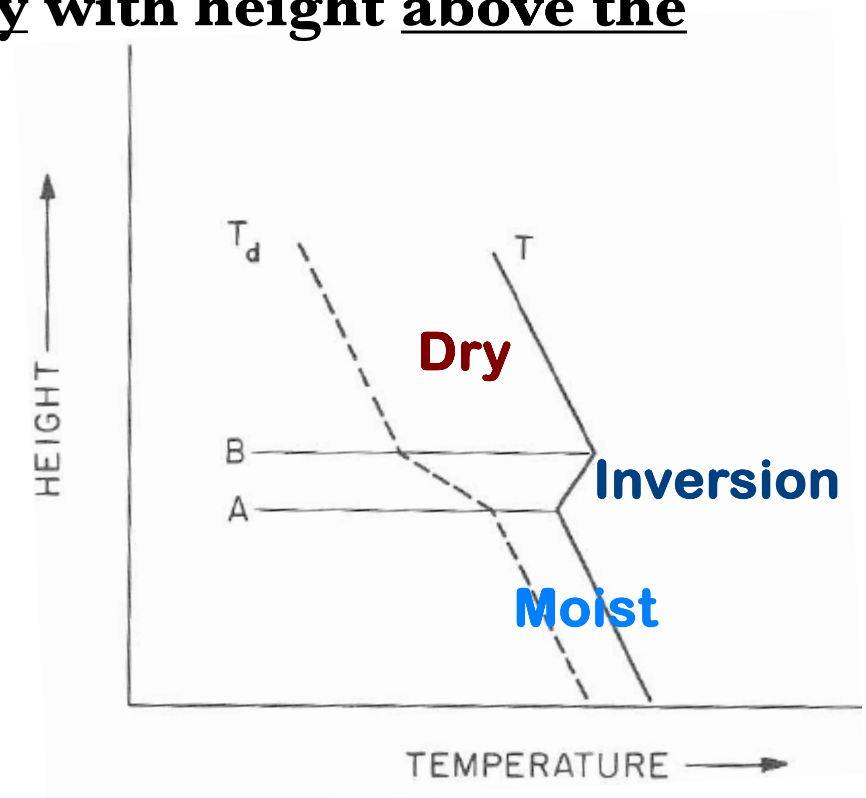


Potential instability

- **Potential instability is related to the <u>lifting of layers</u>, instead of individual air parcels, and the <u>vertical stratification of moisture</u>.**

- **The <u>dew point</u> <u>decreases rapidly</u> with height <u>above the inversion</u> layer AB.**

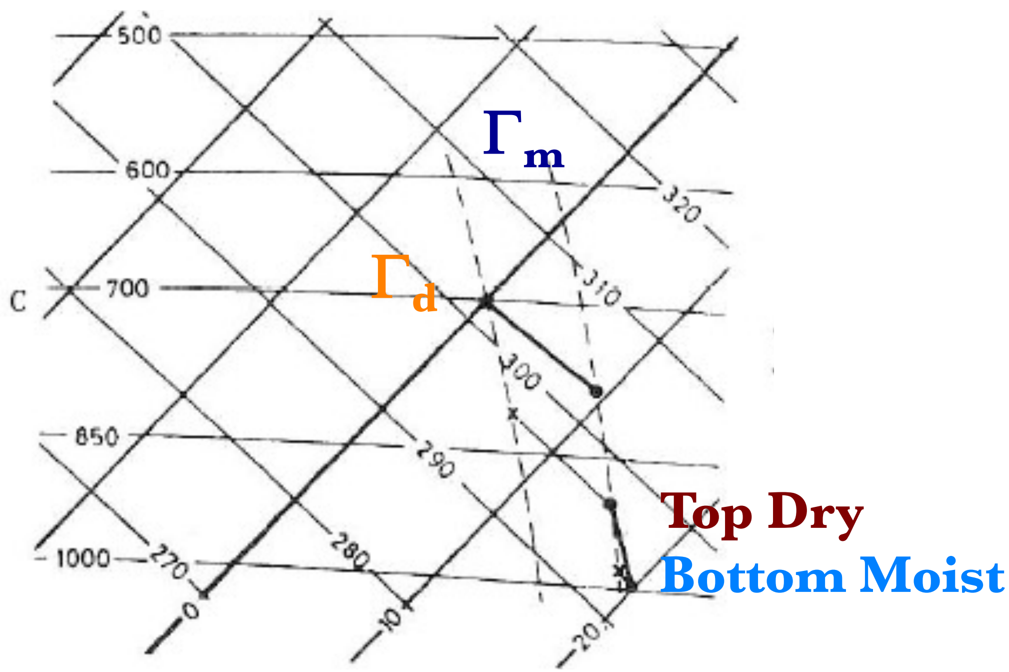
- **Suppose <u>layer AB is lifted</u>. The <u>air at A</u> will <u>reach its LCL</u> almost <u>immediately</u> and <u>cool moist adiabatically</u> <u>above</u> that, while the <u>air at B</u> will <u>need to cool</u> <u>dry adiabatically</u> though a <u>deep layer before</u> saturation.**



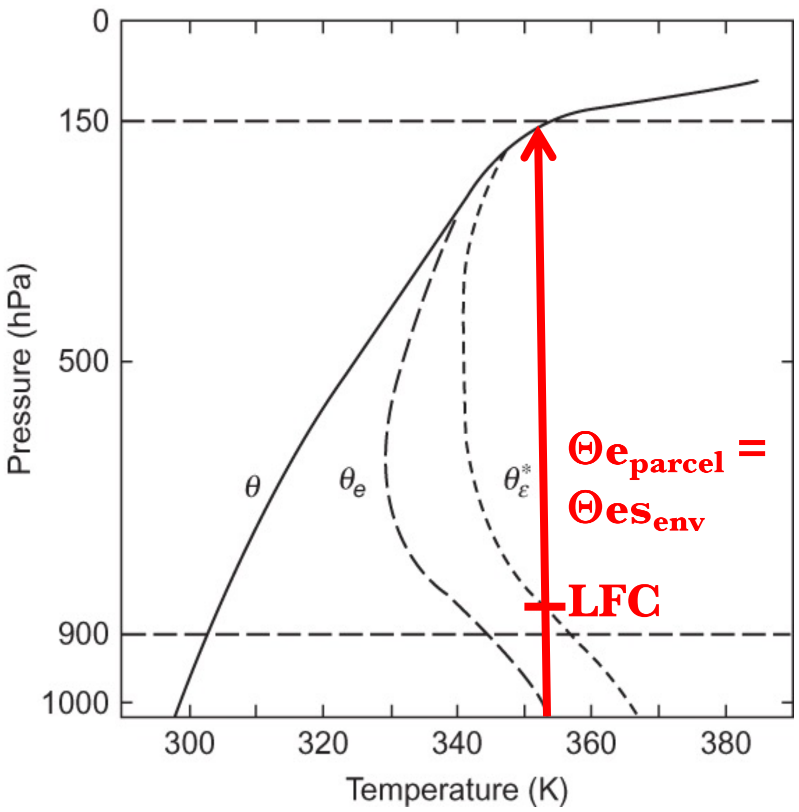
Potential instability

- **Therefore, the top part of the layer cools much more rapidly than the bottom part & the lapse rate destabilizes!**

- **Sufficient lifting may cause the layer to become conditionally unstable, even if the entire sounding is absolutely stable to begin with!**



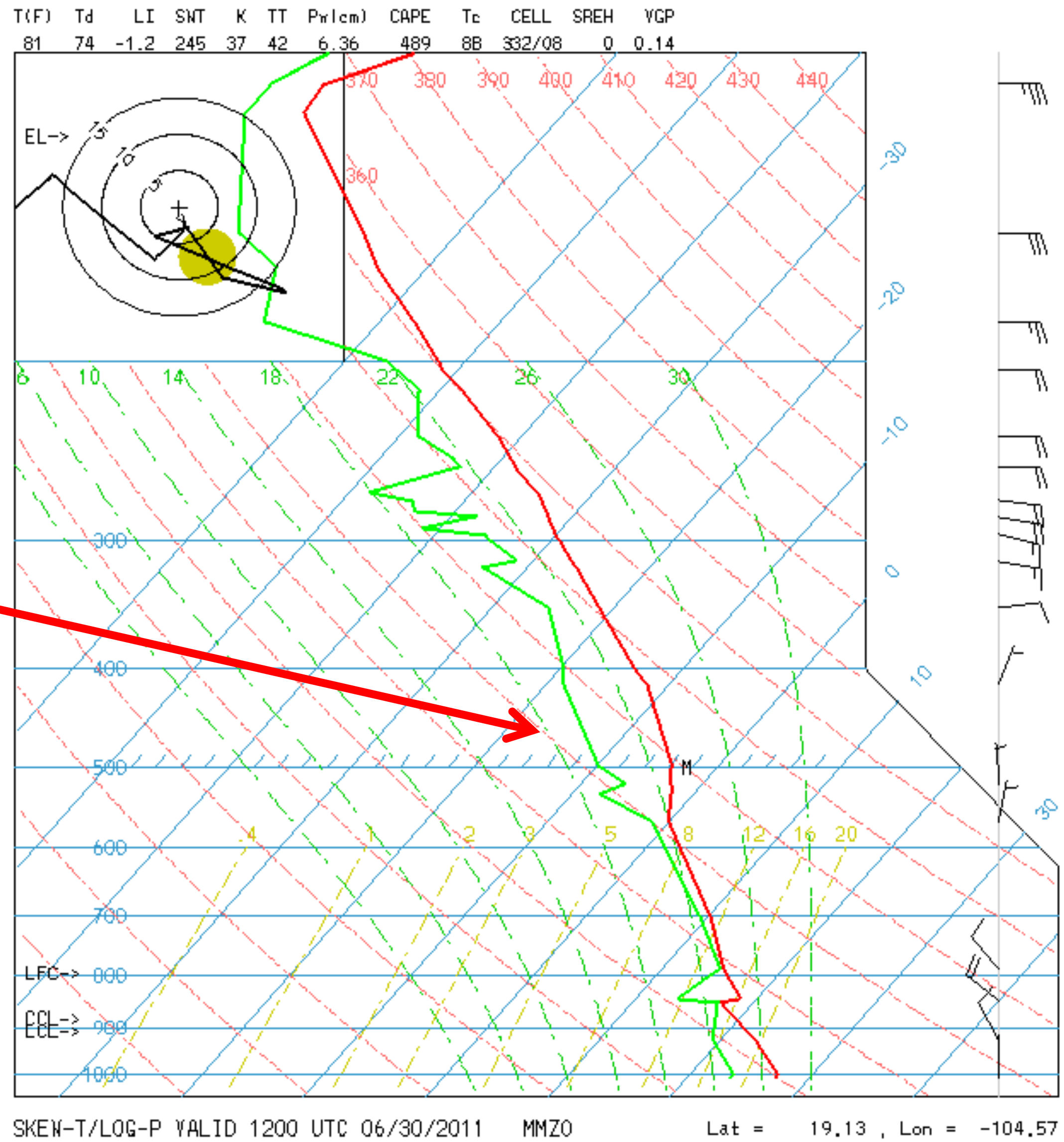
Typical tropical thermodynamic profiles



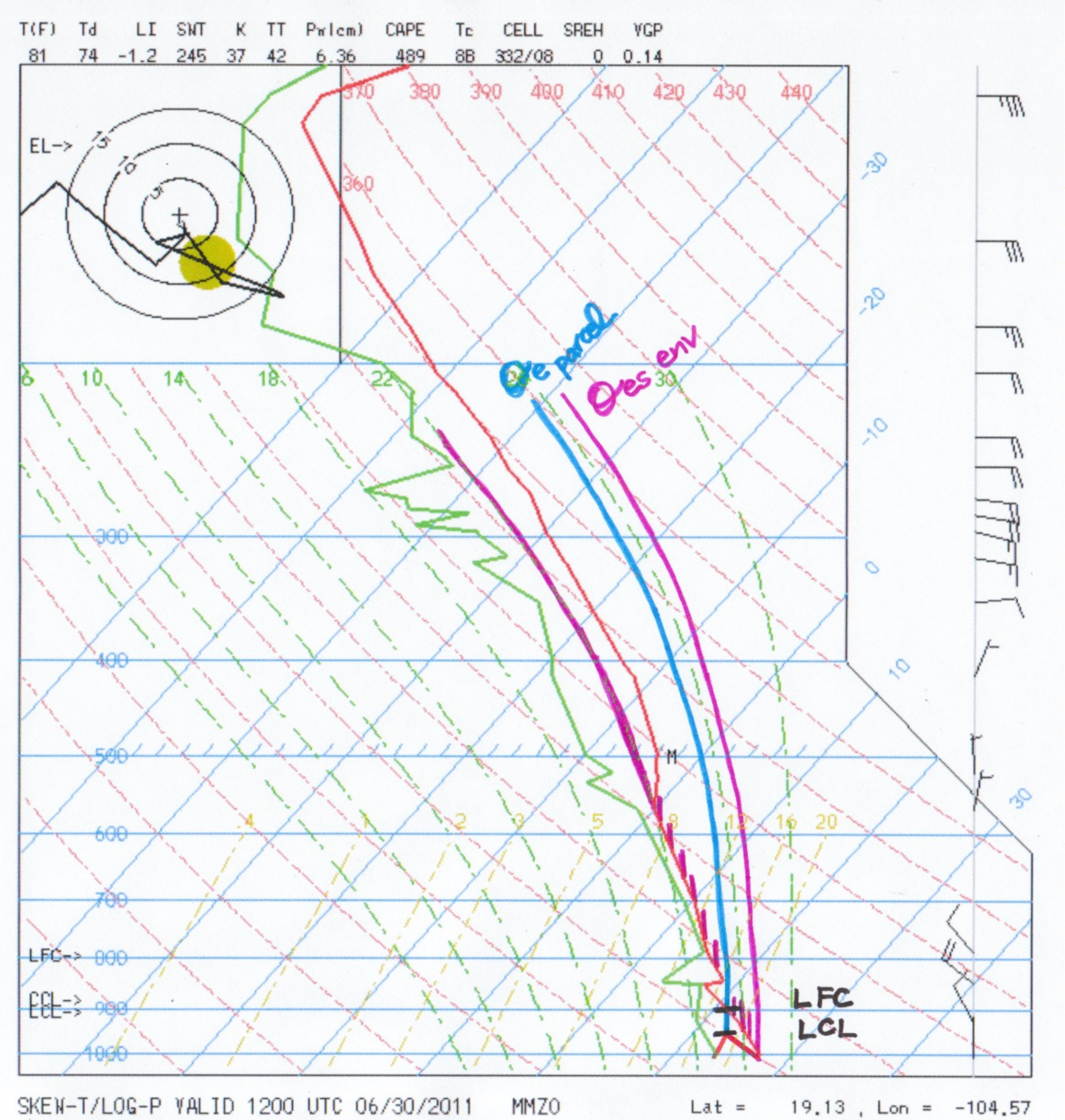
The LFC, Θ_e, and Θ_{es}

Skew-T/Log-P diagrams created from rawinsonde data

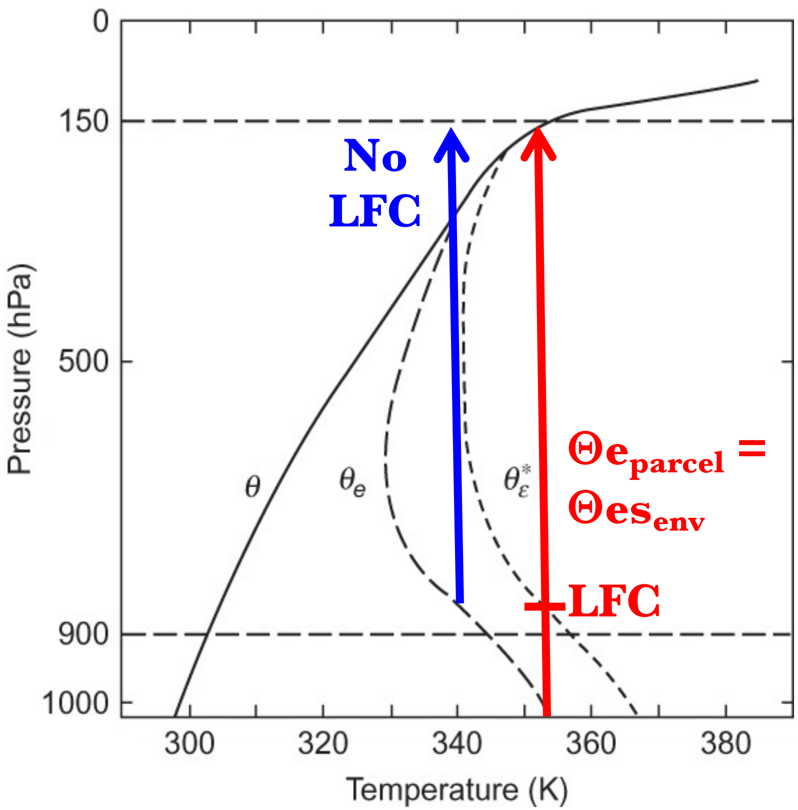
Can we see that $\Theta e_{parcel} = \Theta es_{env}$ at the LFC from a "normal" sounding?



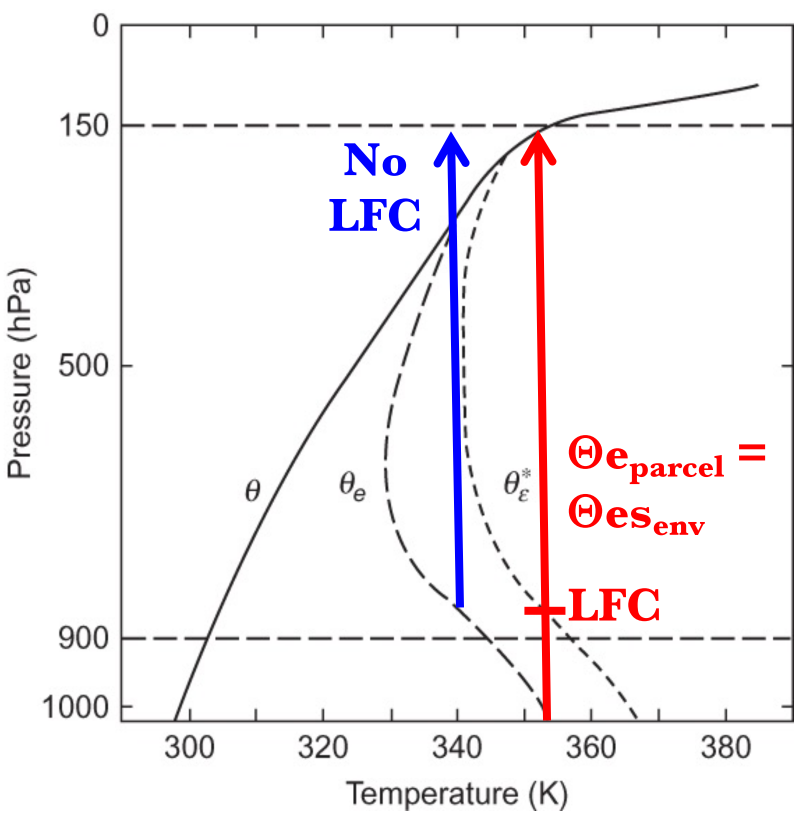
The LFC, Θ_e, and Θ_{es}

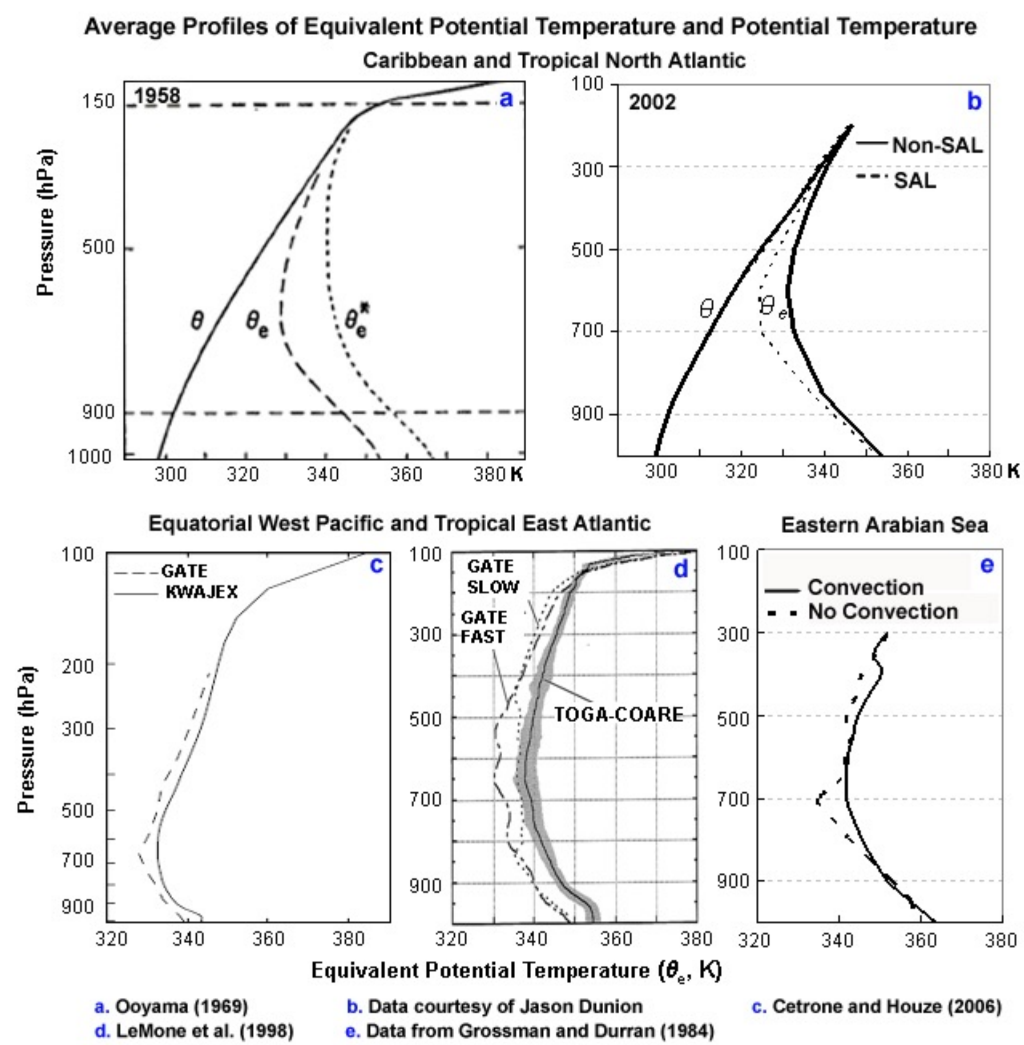


Typical tropical thermodynamic profiles



Typical tropical thermodynamic profiles





How convection changes the thermodynamic profile
Miller and Betts (1977)

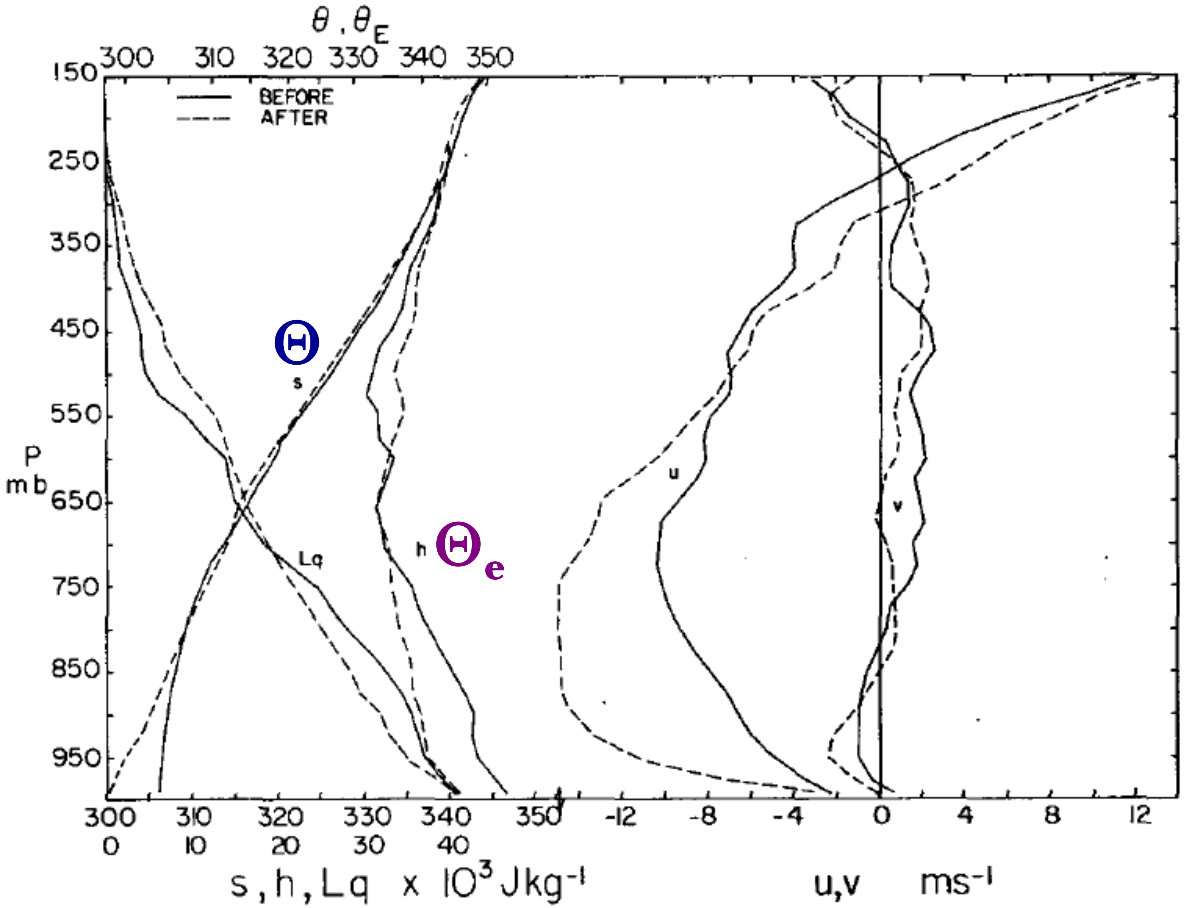


FIG. 1. Mean tropospheric profiles of static energy s, moist static energy h, water vapor (as latent energy Lq) and wind components u, v before and after the passage of a traveling convective storm over the rawinsonde site. The upper scale shows potential temperatures θ, θ_E corresponding (with slight approximation) to s and h. The averages include all soundings in Table 1 except 203 and 204.

How convection changes the thermodynamic profile
Miller and Betts (1977)

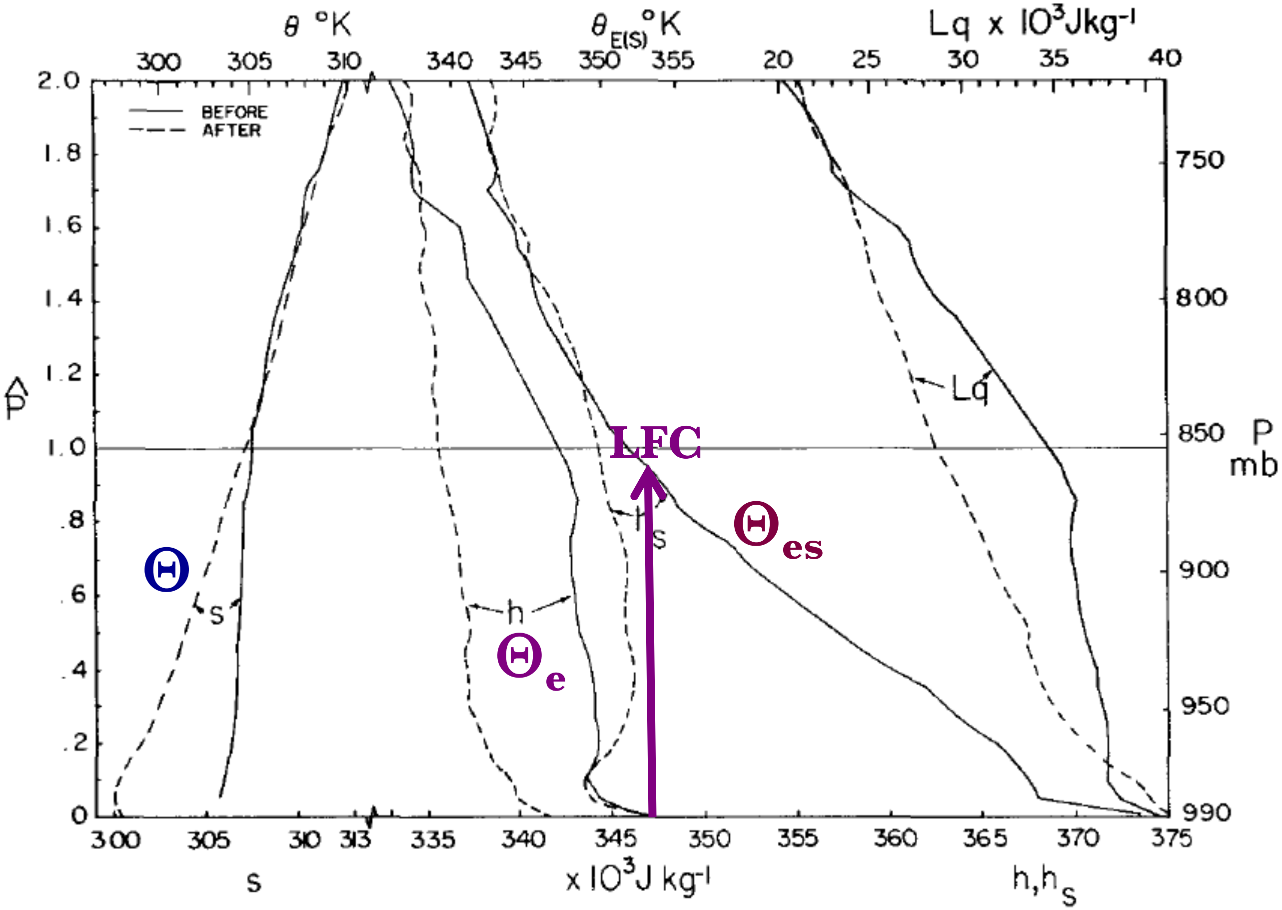


FIG. 4. Mean thermodynamic profiles before and after the passage of a traveling storm; $\hat{p}=1$ corresponds to the mean cloud base before the storm. Potential temperature (θ, θ_E, θ_{ES}) corresponding to static energies s, h, h_s are shown on the upper scale. The two averages include all soundings in Table 1.