New Developments Related to Gross Moist Stability[1]

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Normalized Gross Moist Stability (*NGMS*)

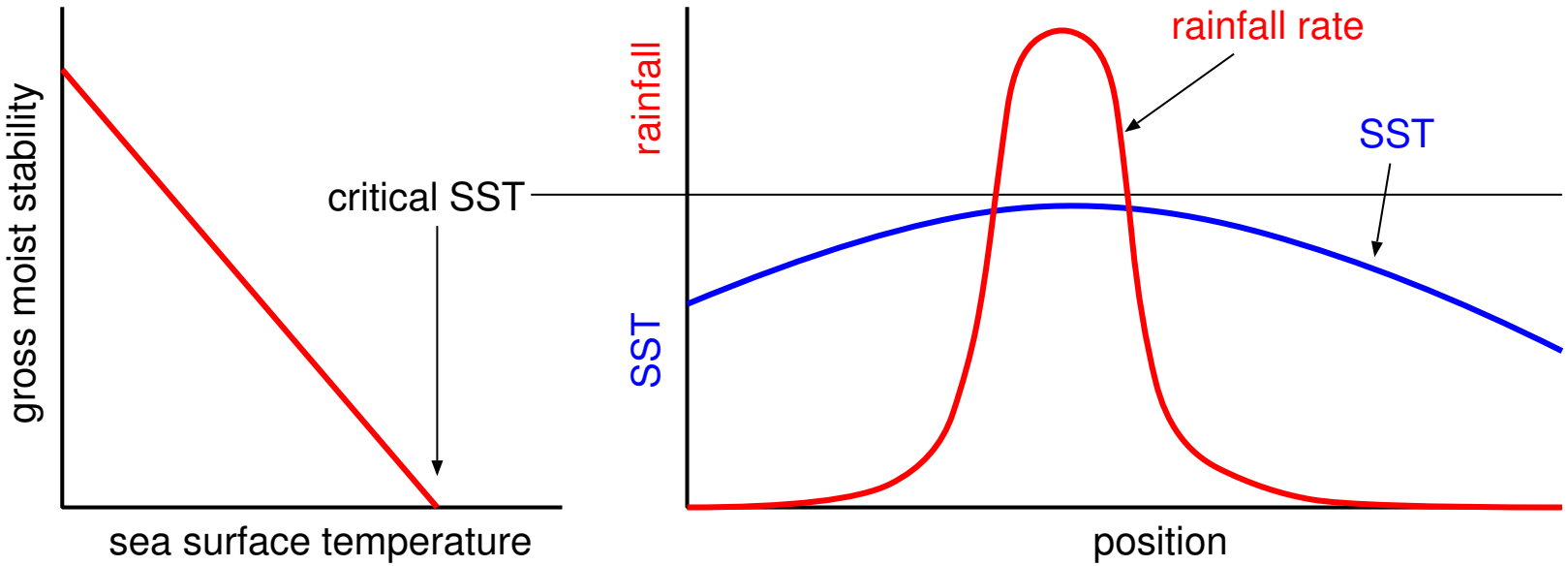
$$NGMS = \frac{lateral\ entropy\ div}{lateral\ vapor\ conv} = \frac{(surf - top)\ ent\ flux}{rain - evap} = \frac{\Delta F_{ent}}{R - E}$$

$$\Downarrow$$

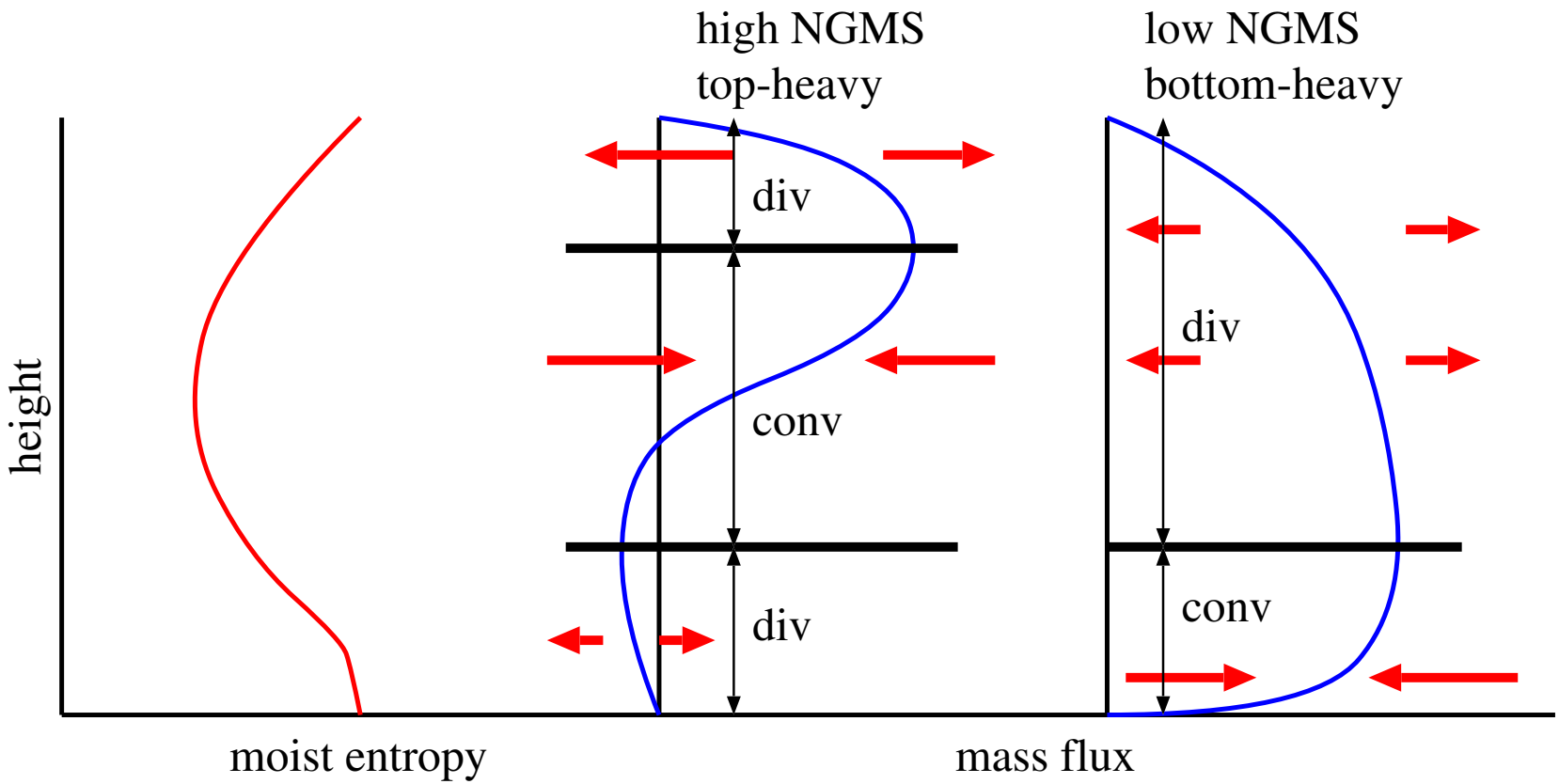
$$R = E + \frac{\Delta F_{ent}}{NGMS}$$

(Noted by Neelin and Held, 1987.)

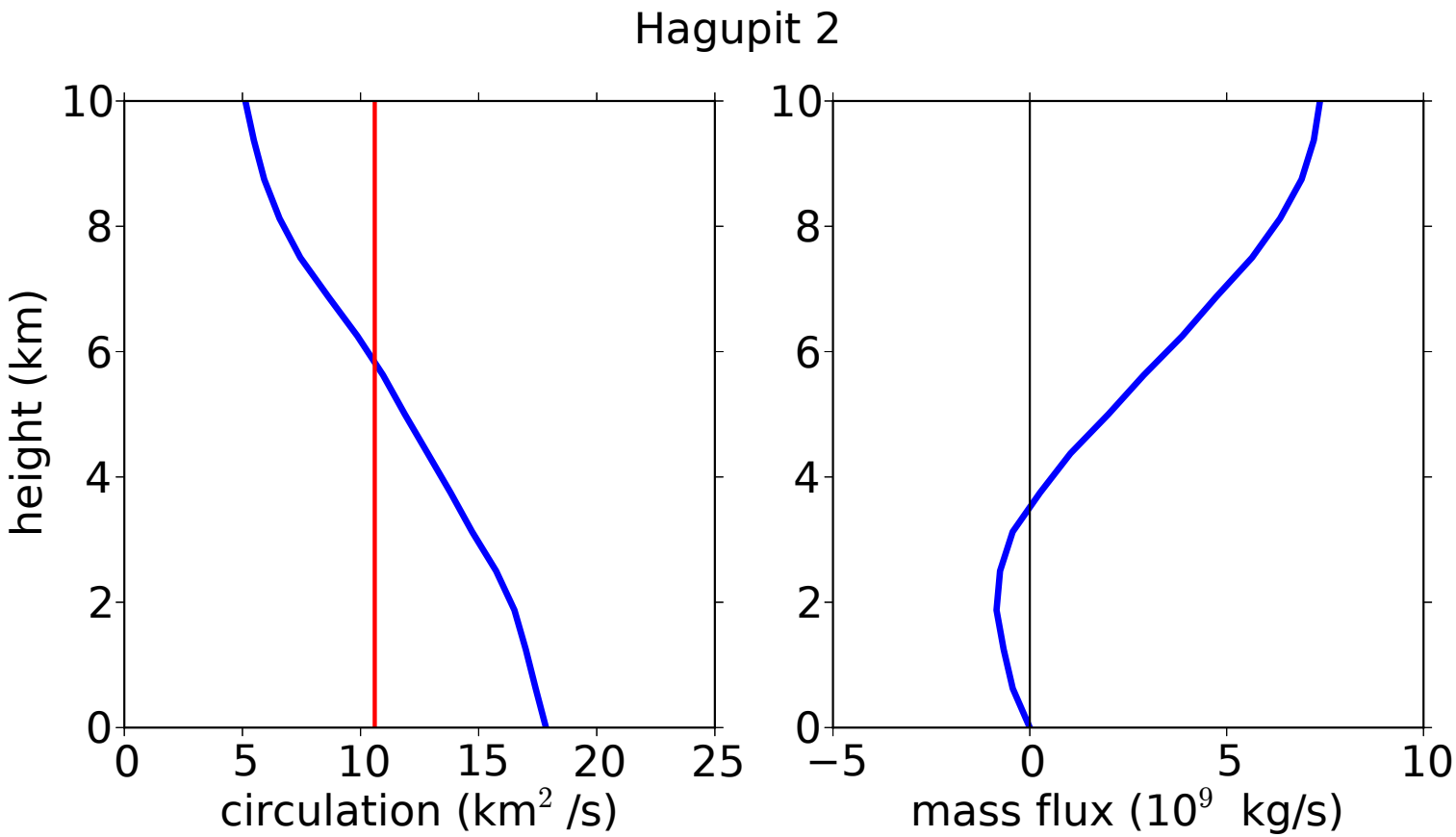
Neelin-Held Model for Gross Moist Stability



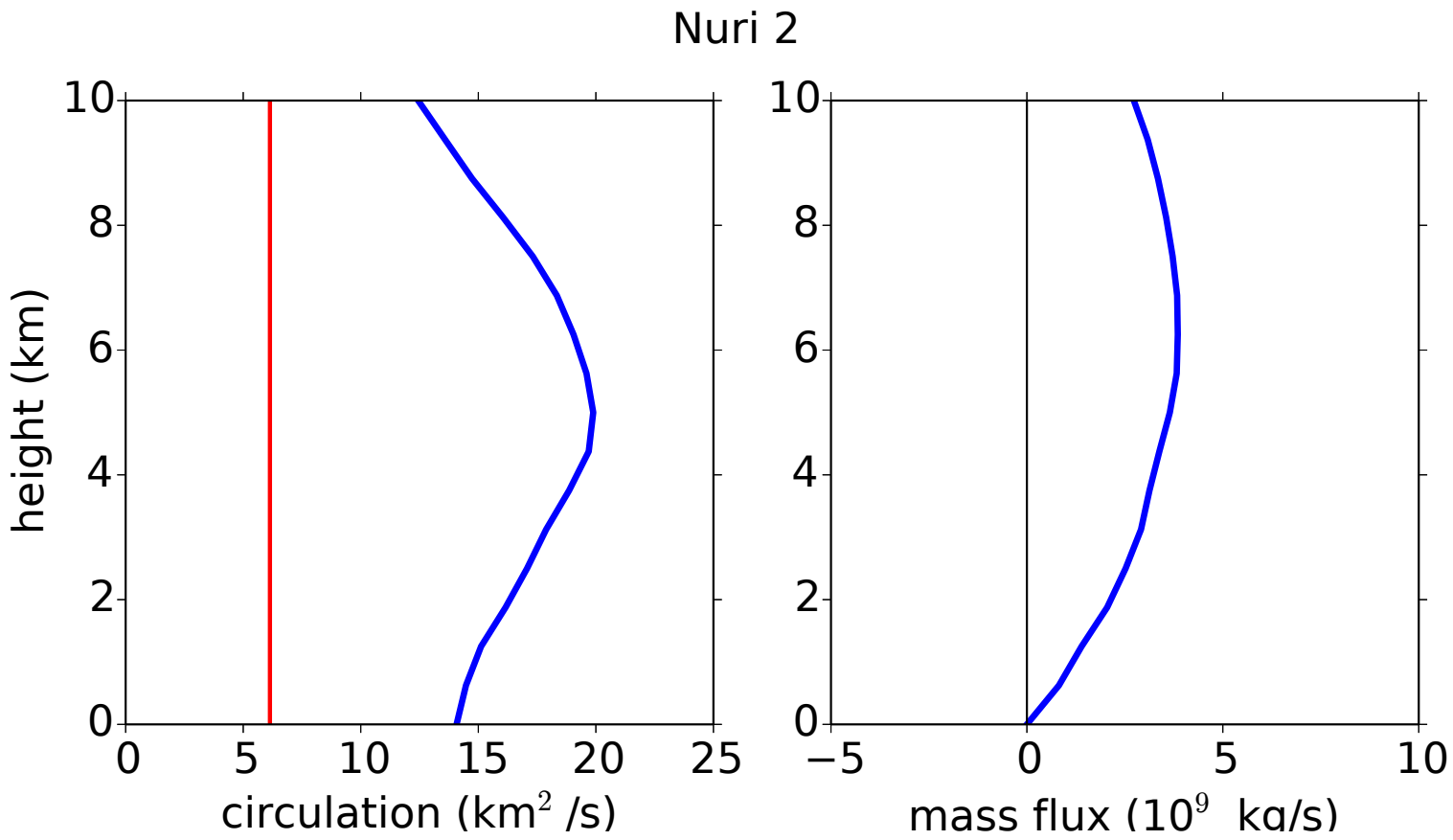
NGMS and the Convective Mass Flux Profile



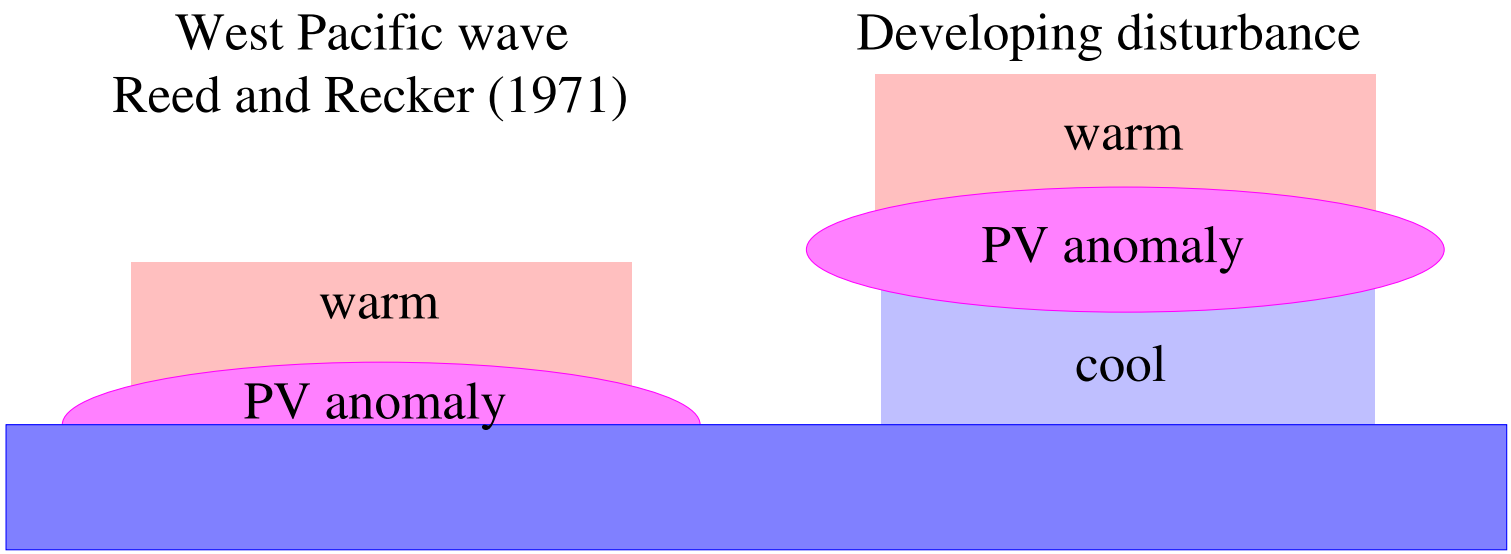
Hagupit2: Weak Wave, $NGMS = 0.64$



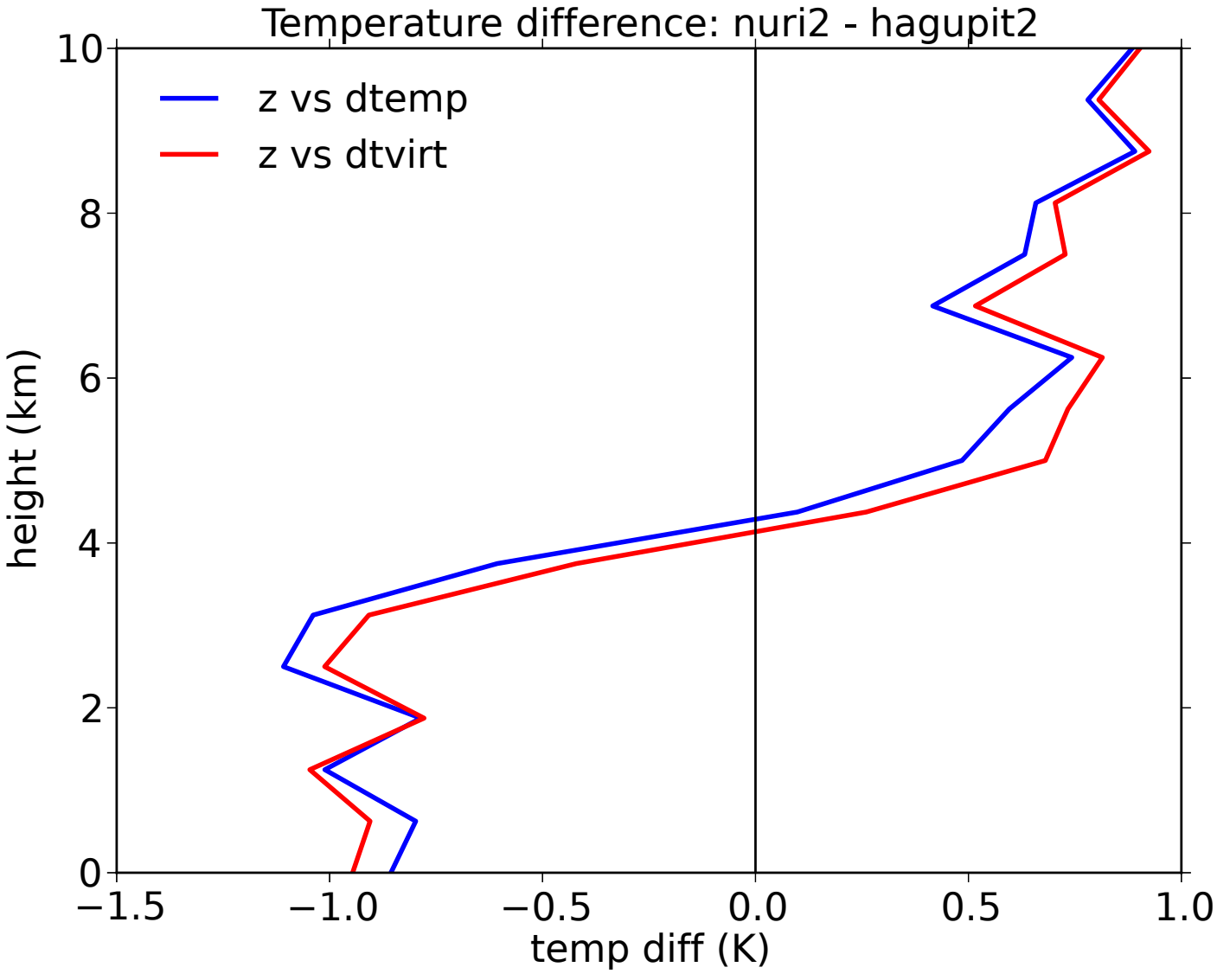
Nuri2: Intensifying Depression, $NGMS = -0.01$



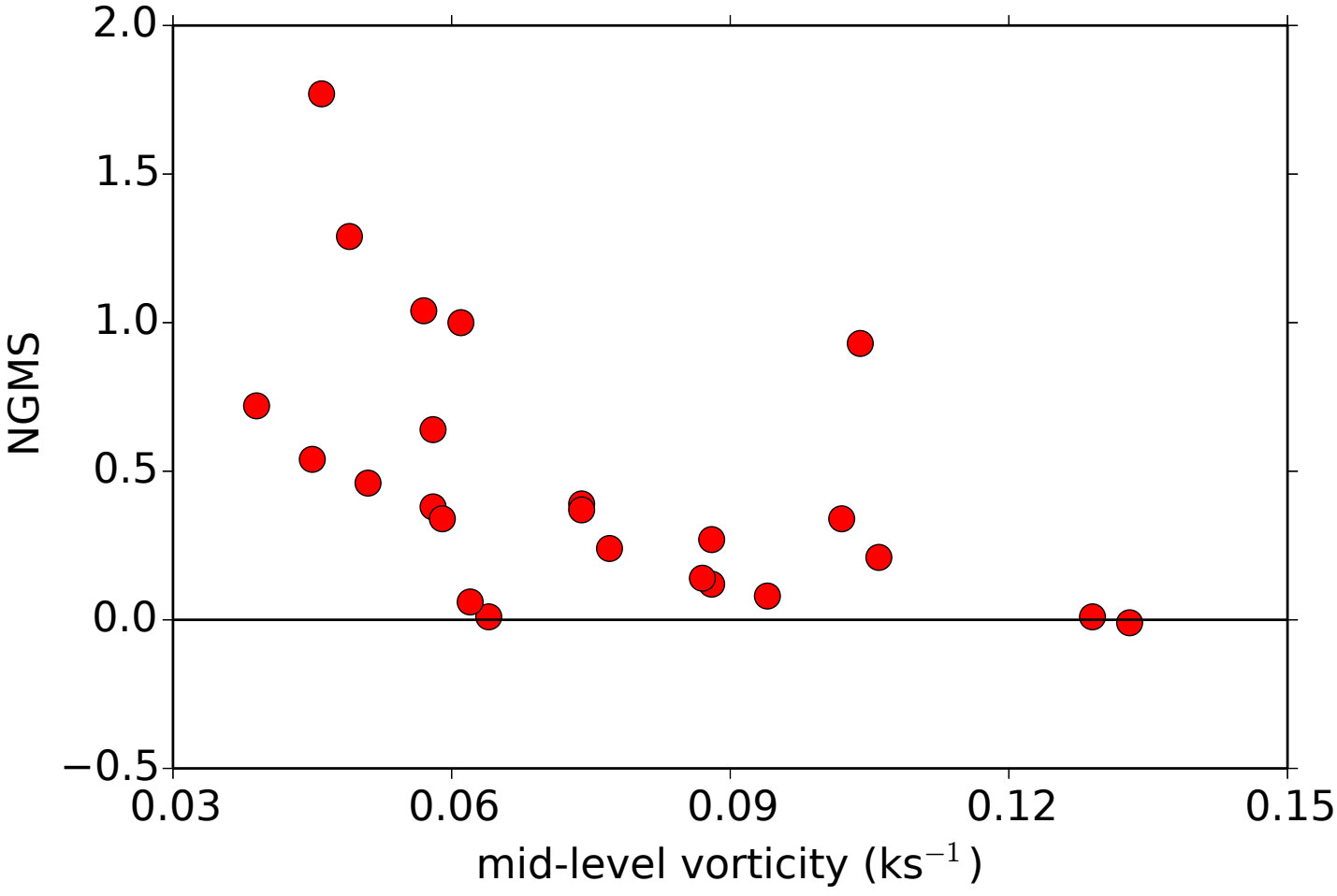
Thermodynamic Effect of Vortices



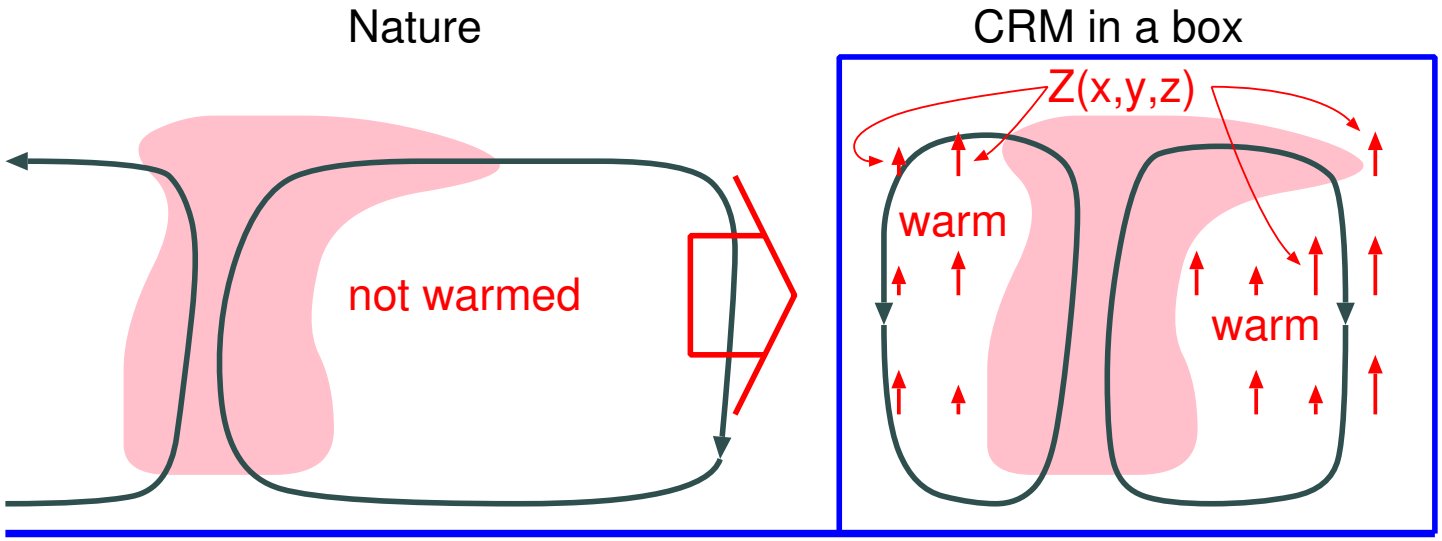
Mean Nuri2 - Hagupit2 Temperatures



From Observations (Saška Gjorgjievska)



CRM in a box (Mike Herman)



Impose θ cooling tendency: $(d\theta/dt)_{WTG} = -w_{WTG}(d\theta_0/dz)$

Adiabatic lifting needed: $Z(x,y,z) = \theta'(x,y,z)/[d\theta_0(z)/dz]$

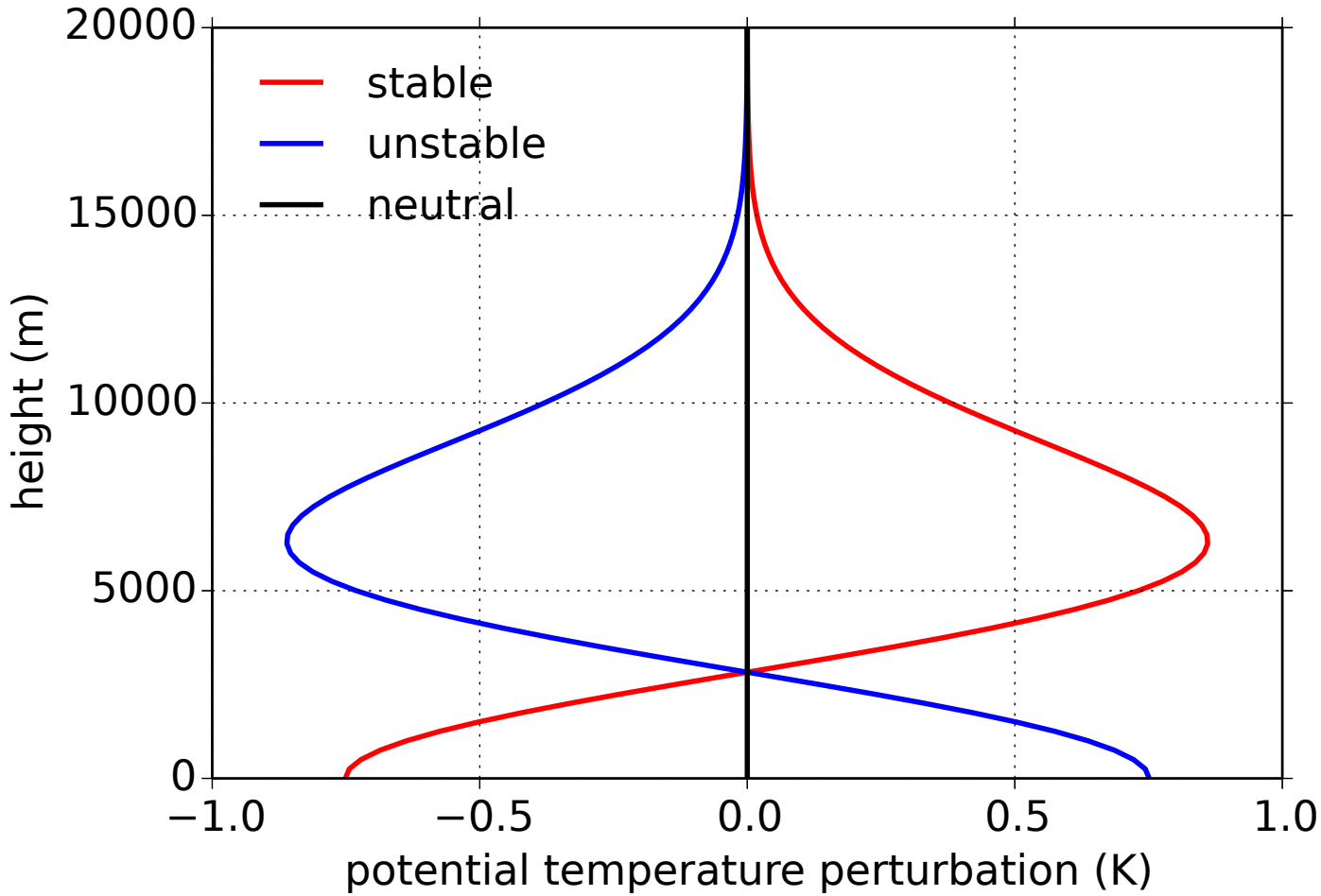
$$w_{WTG}(z) = \frac{Z_0(z)}{\tau} \qquad better: \; w_{WTG}(z) = \sum_i \frac{Z_i \sin(m_i z)}{\tau_i}$$

w_{WTG} is large-scale ascent needed to balance warming.

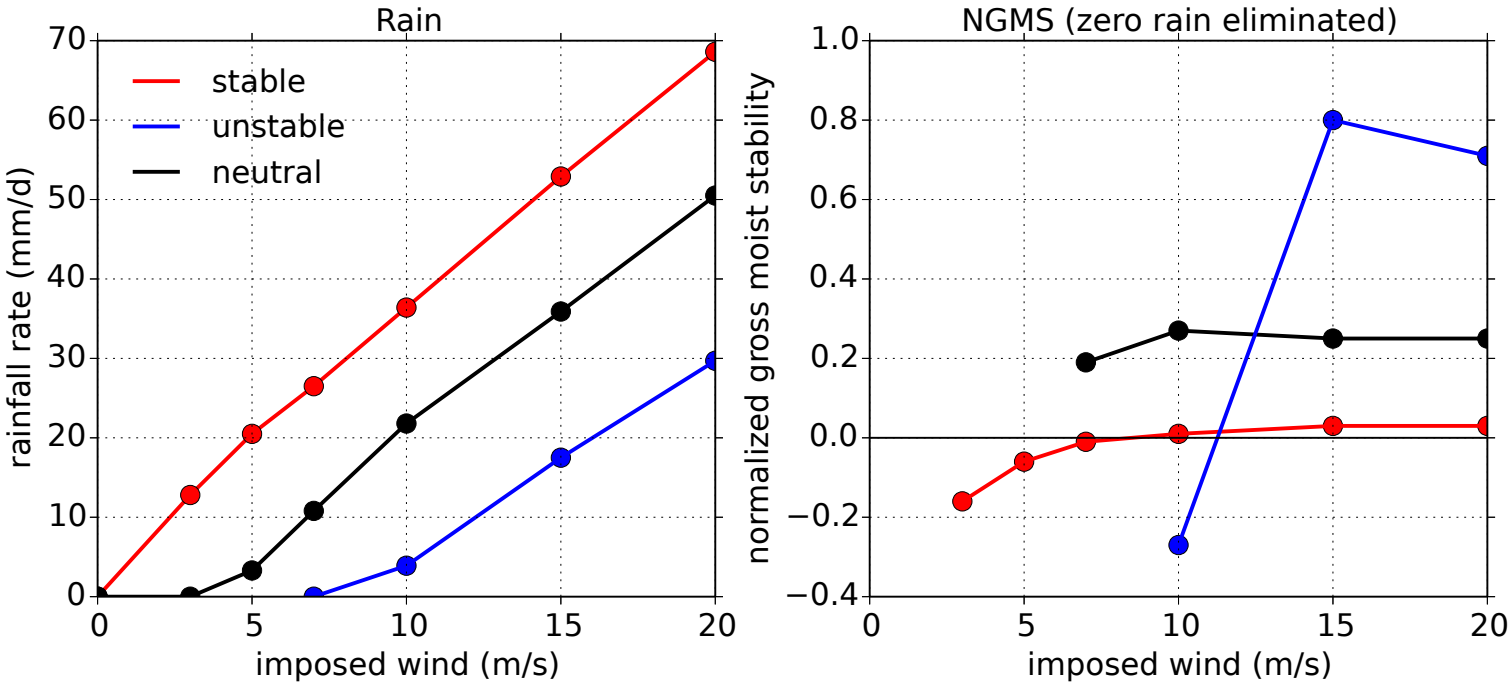
WTG Simulations of Convection

- Make reference profile: RCE calculation with imposed surface wind 5 m s^{-1}.
- Make WTG calculations with modified reference profiles and different imposed surface winds.

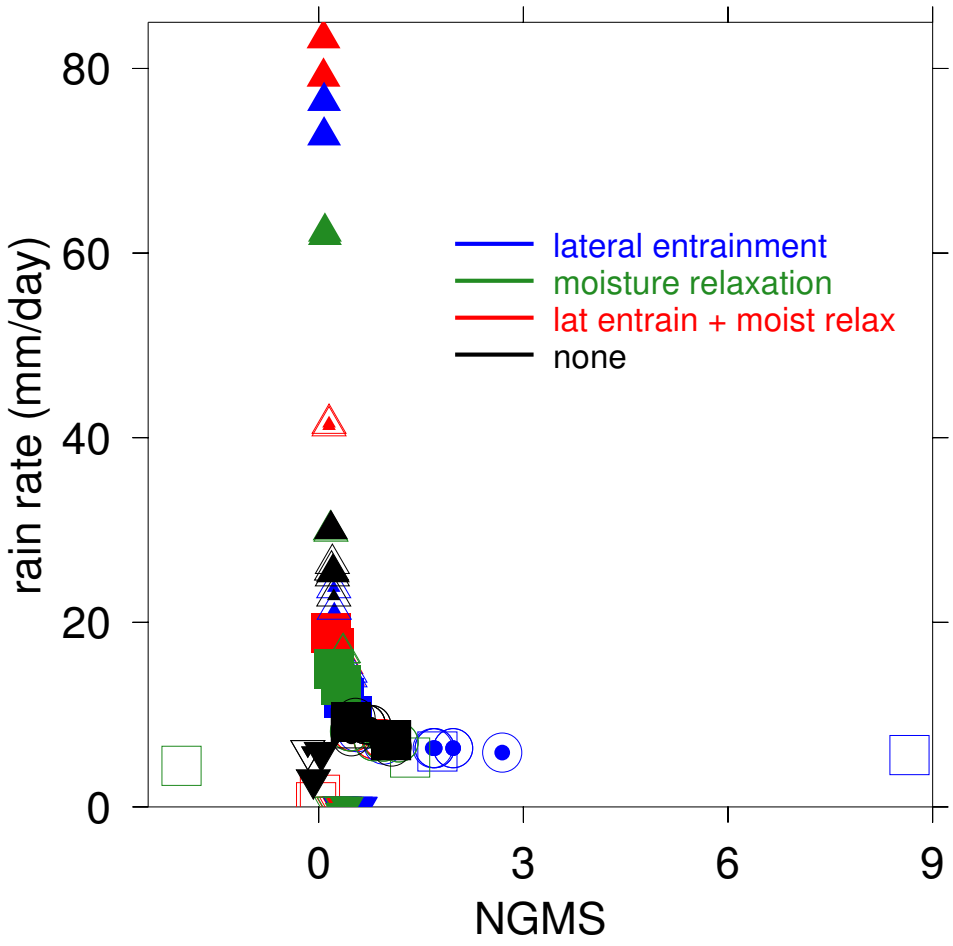
Reference Potential Temperature Perturbations



WTG Rainfall and NGMS



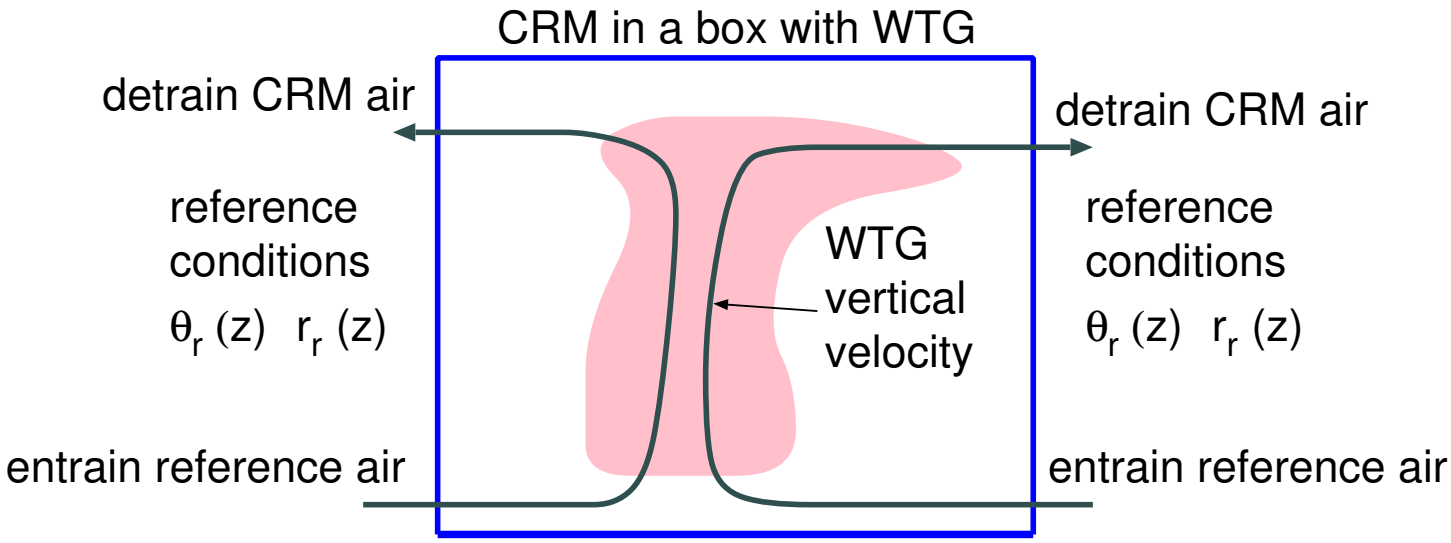
Extensive WTG Calculations (Sharon Sessions)



Conclusions

- NGMS decreases with increasing mid-level potential vorticity via its balanced effect on thermal structure.
- Rainfall rate increases with decreasing NGMS and increasing surface wind.
- $\Rightarrow$ strong implications for the dynamics of moisture in the tropical atmosphere.

WTG Treatment of Moisture and Moist Entropy



Entrained air distributed instantly and uniformly across box at each level (magic!).