CPTEC
Centro de Previsão de Tempo e Estudos Climáticos

The Use of Geostationary Satellite Data for Nowcasting – Part 2

Luiz Augusto T. Machado

luiz.machado@cptec.inpe.br

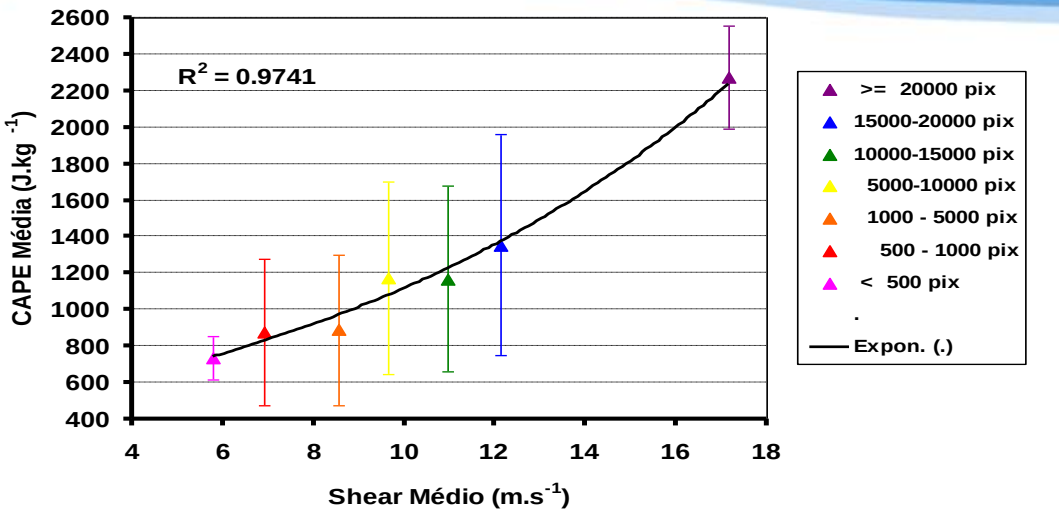
MINISTÉRIO DA CIÊNCIA E TECNOLOGIA
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

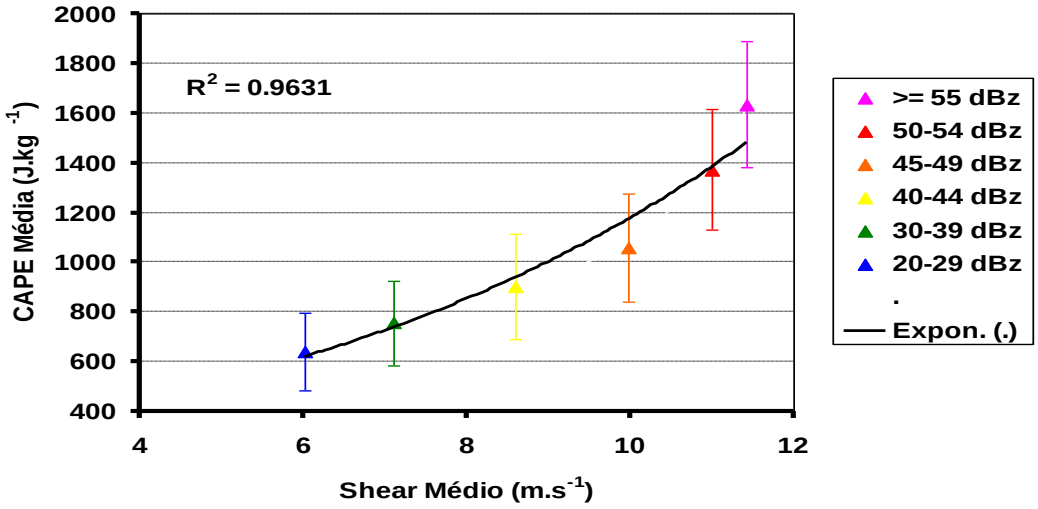
Outline

- ✓Rain Cells in the Richardson Space.
- ✓An Example of the Squall Line Internal Structure
- ✓The Rain Cells propagation and Characteristics

- ❖Analysis from ETA – 20 km resolution
- ❖Santiago S band Doppler Radar – Rio Grande do Sul.

Rain Cells and the Richardson Space

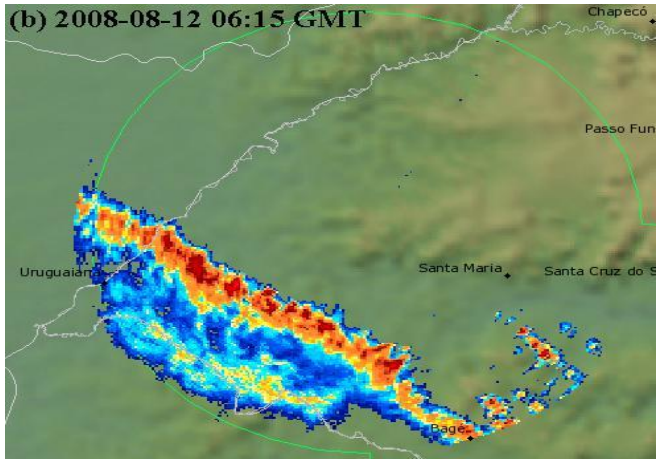


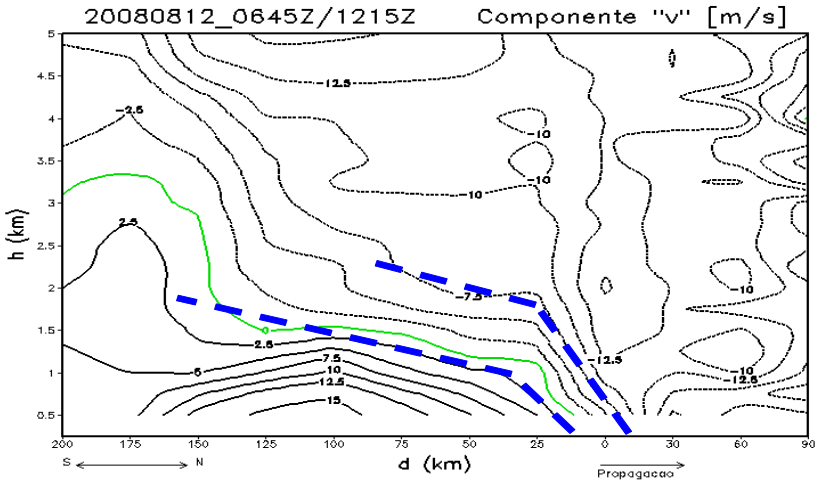


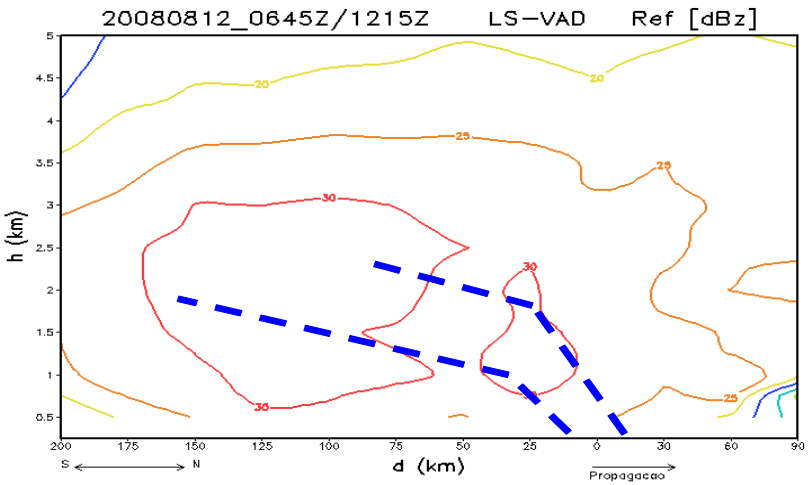
Results from Marco Aurelio Teixeira Master Degree

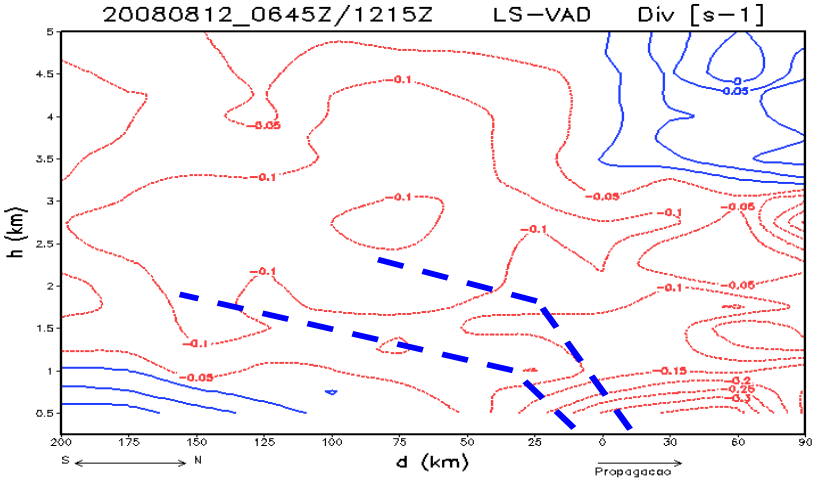
Squall line Internal Strucuture -

Squal line Circulation using LS-VAD - "*Least Square Velocity Azimuth Display* (*LS-VAD*), Developped by Dr. M. Chong from Laboratoire d'Aérologie. Université de Toulouse, France





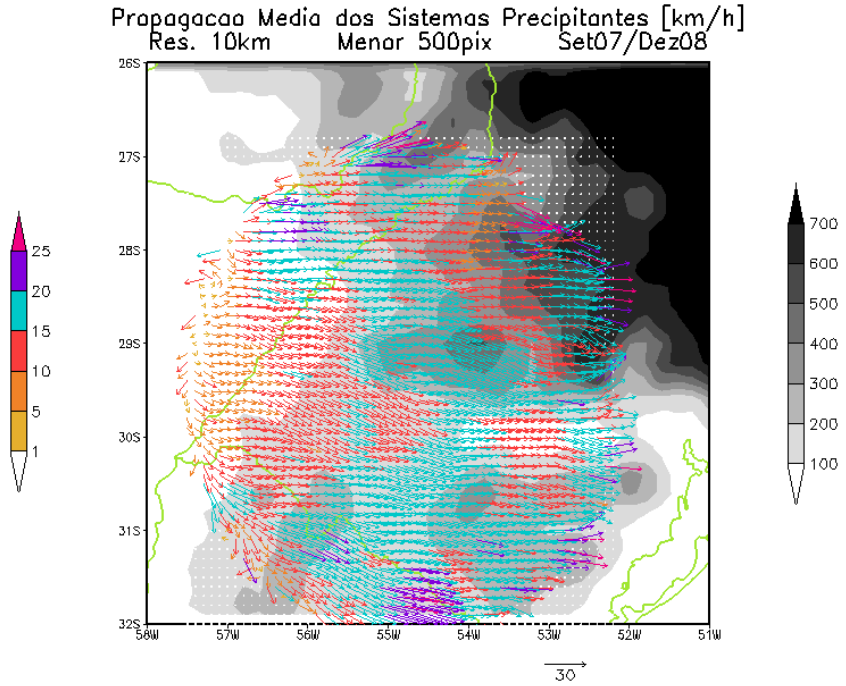




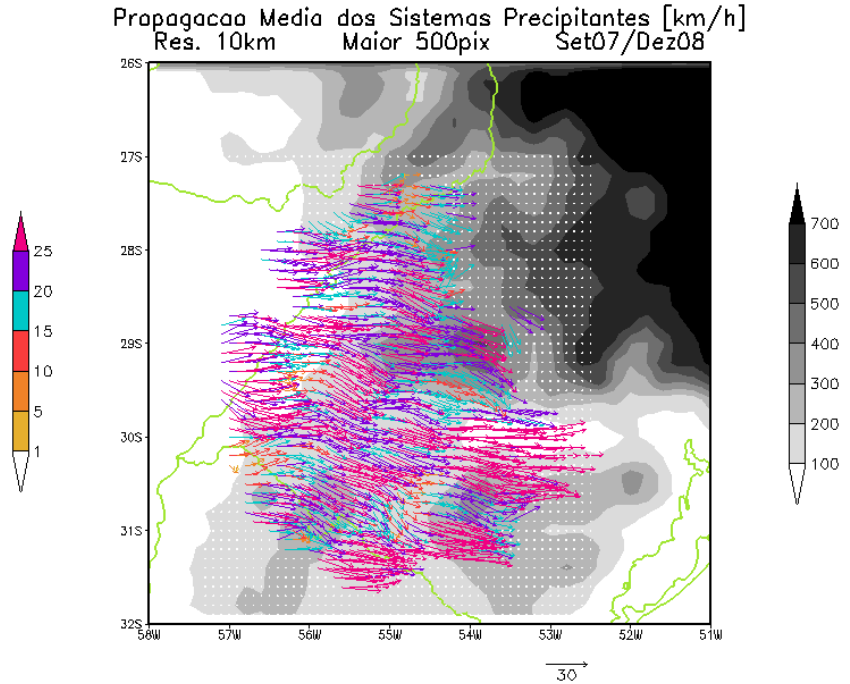
Results from Marco Aurelio Teixeira Master Degree

Rain Cells Propagation

Small Rain Cells – Predominately linear



Large Rain Cells – Short Waves

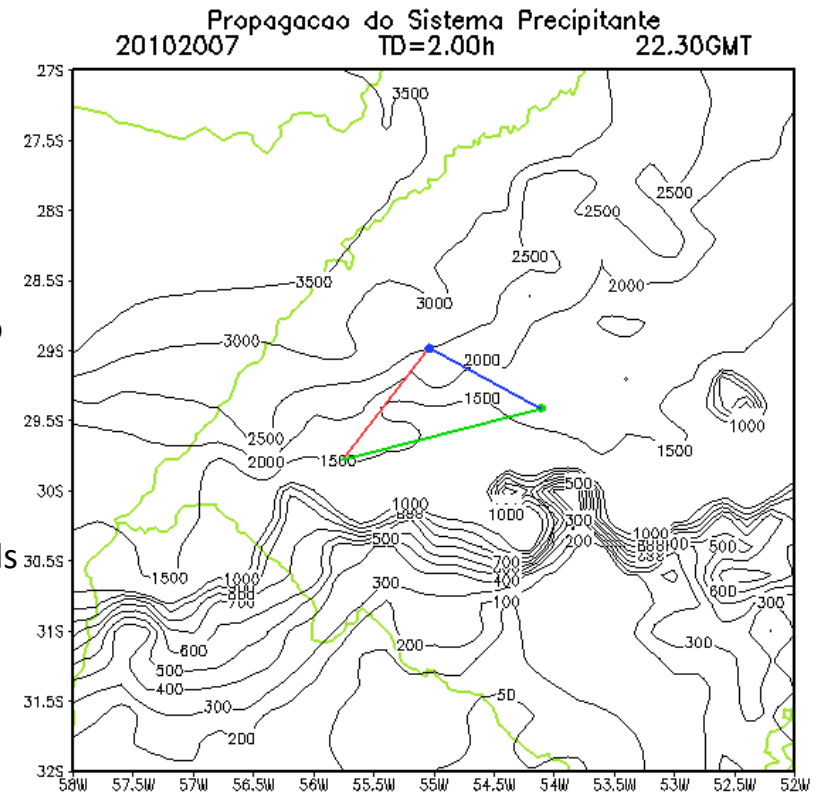


Results from Marco Aurelio Teixeira Master Degree

MCS Propagation

Steering-level model, Moncrieff and Green 1972 : In a general sense, sqrt (CAPE) dependence of the squall-line speed derives from the convective Richardson number: R = CAPE/1/2 (U-c)^2 where U-c is the surface relative inflow to the squall line. So the travel speed equal to the mid-level wind at the "steering level") is c = U + sqrt (2 * CAPE/R).

Propagating model, Moncrieff and Miller : This model travels faster than the wind at any level . Propagation speed in an unsheared atmosphere approximately, c = UM + 0.3 sqrt CAPE.



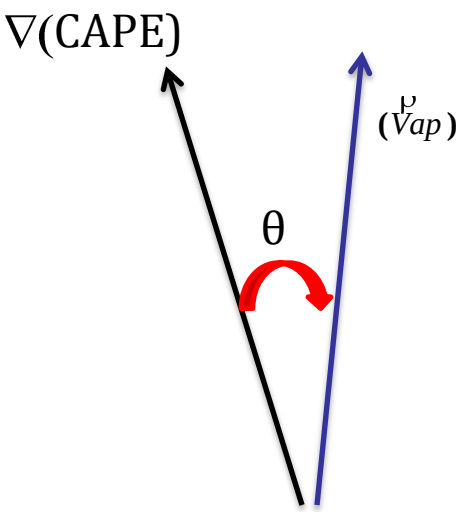
MCS Direction of Propagation obtained from Fortracc $(\vec{V}p)$

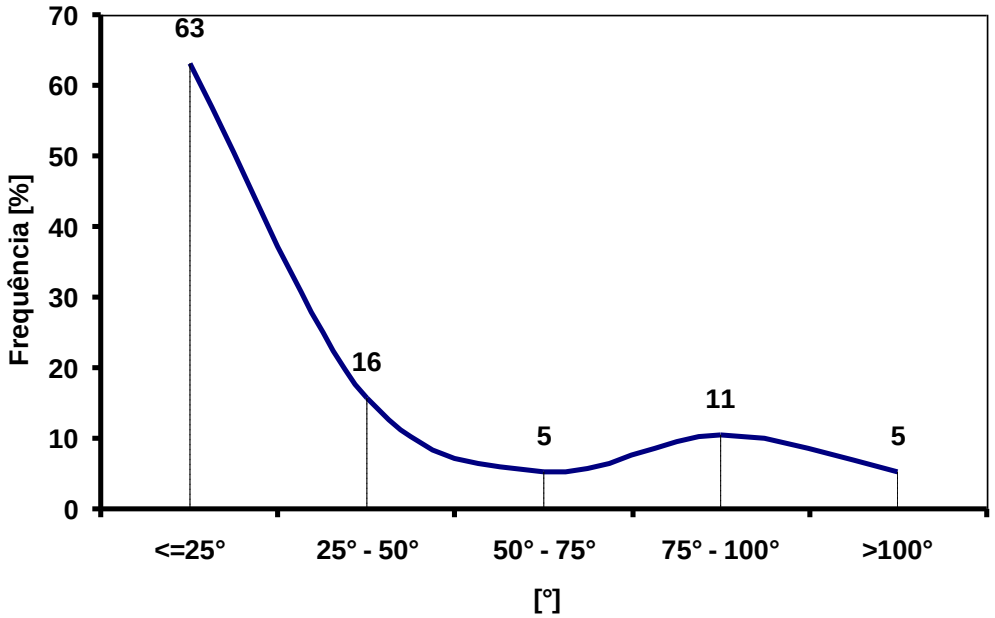
Mid-level Wind – Density weighted average Wind (6 km) $(\vec{V}adv)$

Apparent Force $(\vec{V}ap)$

Results from Marco Aurelio Teixeira Master Degree

Rain Cells Propagation





Frequencies for θ . The difference between the Apparent Force and the Average CAPE Gradient (ACG) directions.

Results from Marco Aurelio Teixeira Master Degree

Rain Cells Propagation

Vectors are considered linearly dependent

$$\vec{A} = \alpha \vec{B}$$

Considering the present situation:

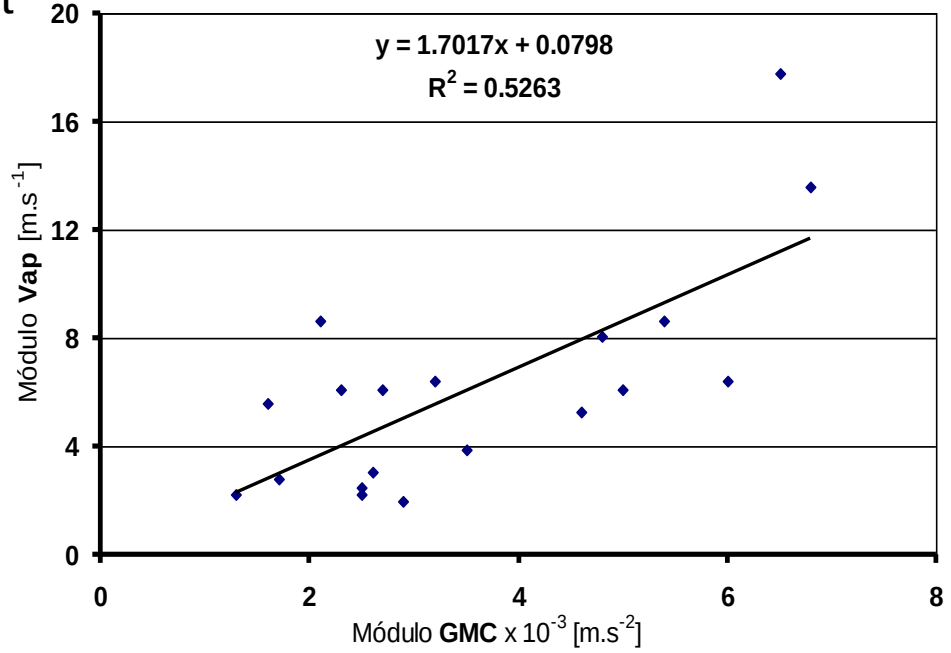
$$\left|\vec{\omega}_{Vap}\right| = 1702 \left|\overline{\nabla}_{CAPE}\right|$$

$$\alpha = 1702 \rightarrow \nabla(\text{CAPE}) = \text{m/s}^2$$

α is Time unit and correspond to a Seconds

Considering a Uniformly Accelerated Motion

$$\begin{cases} y = 1702\,x + 0{,}08 \\ V = t.a + V_0 \\ \left|\vec{Vap}\right| = 1702 \left|\overline{\nabla}_{CAPE}\right| + \left|\vec{Vap}_0\right| \end{cases} \Rightarrow$$



$$V_0 = \left|\vec{Vap}_0\right| = 0{,}08 \cong 0$$

Time is 30 minutes – 1800 s

MCS – actually rain cells moves as combination of

$$\vec{Vp} = \vec{Vadv} + \overline{\nabla}_{CAPE} .\Delta t$$

Results from Marco Aurelio Teixeira Master Degree

CPTEC
Centro de Previsão de Tempo e Estudos Climáticos

Thank You

MINISTÉRIO DA CIÊNCIA E TECNOLOGIA
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS