Nowcasting the ForTraCC, lightning and the CHUVA campaign

Luiz Machado et al.

INPE

The Convective System Area Expansion over Amazonia and Its Relationships with Convective System Life Duration and High-Level Wind Divergence

LUIZ AUGUSTO T. MACHADO* AND HENRI LAURENT+

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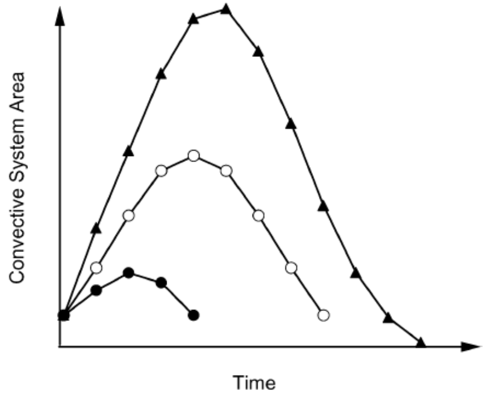

FIG. 6. Schematic diagram of the convective system size evolution for different initial area expansions.

Forecast and Tracking the Evolution of Cloud Clusters (ForTraCC) Using Satellite Infrared Imagery: Methodology and Validation

DANIEL ALEJANDRO VILA

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Departamento de Ciencias de la Atmósfera, y los Océanos, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina

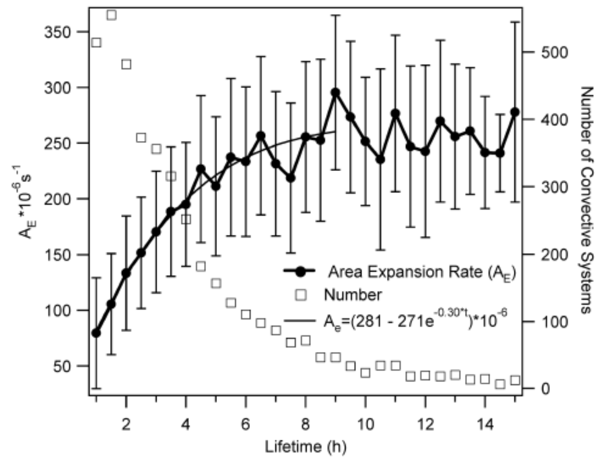


FIG. 2. Area expansion (A_e; 10^{-6} s^{-1}) and associated std dev as a function of the convective system lifetime (h). The number of cases is also plotted (right axis).

MONTHLY WEATHER REVIEW

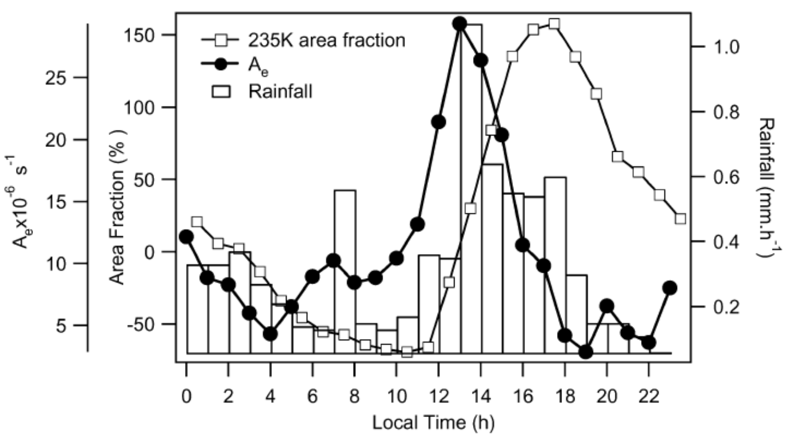
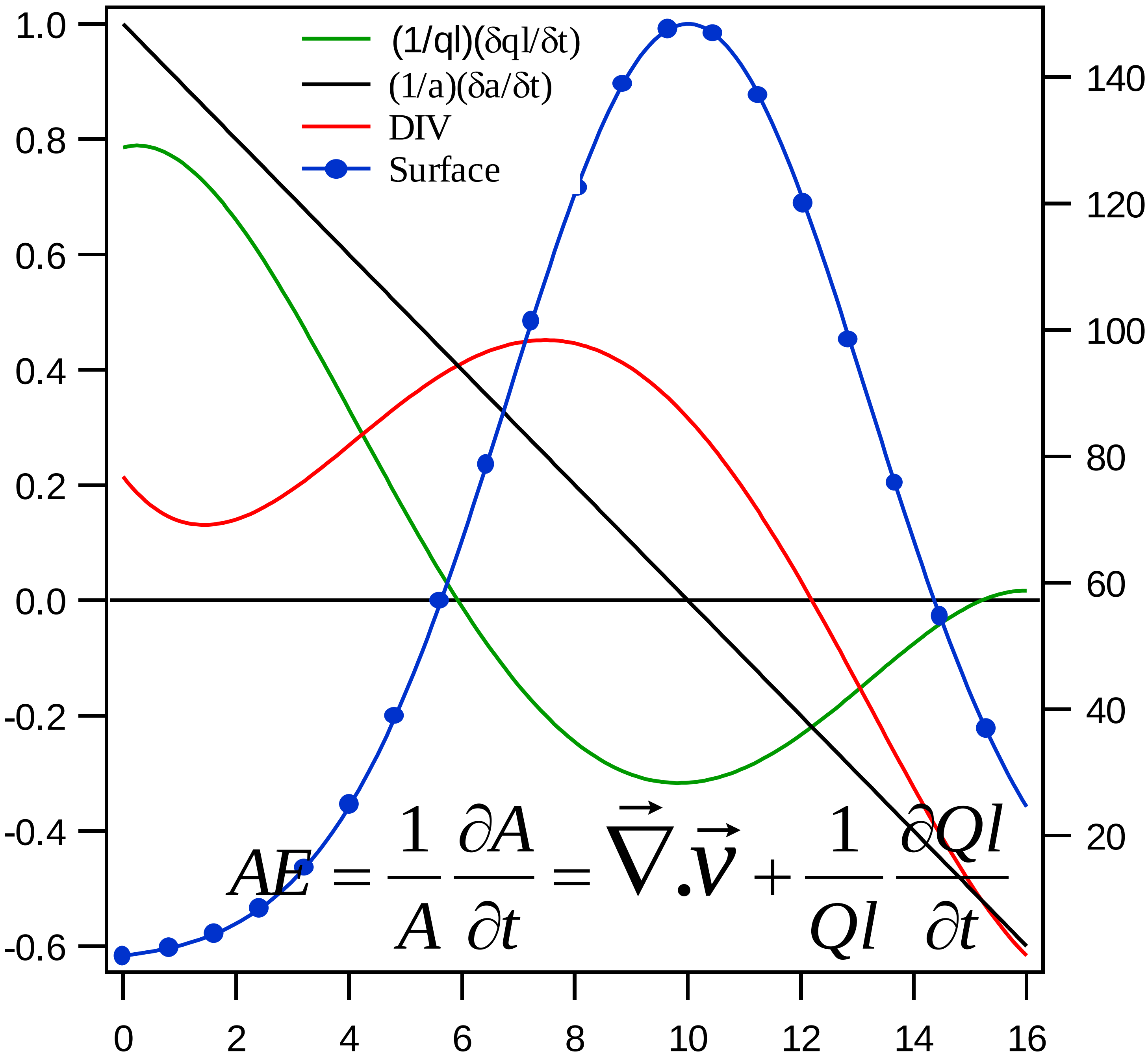
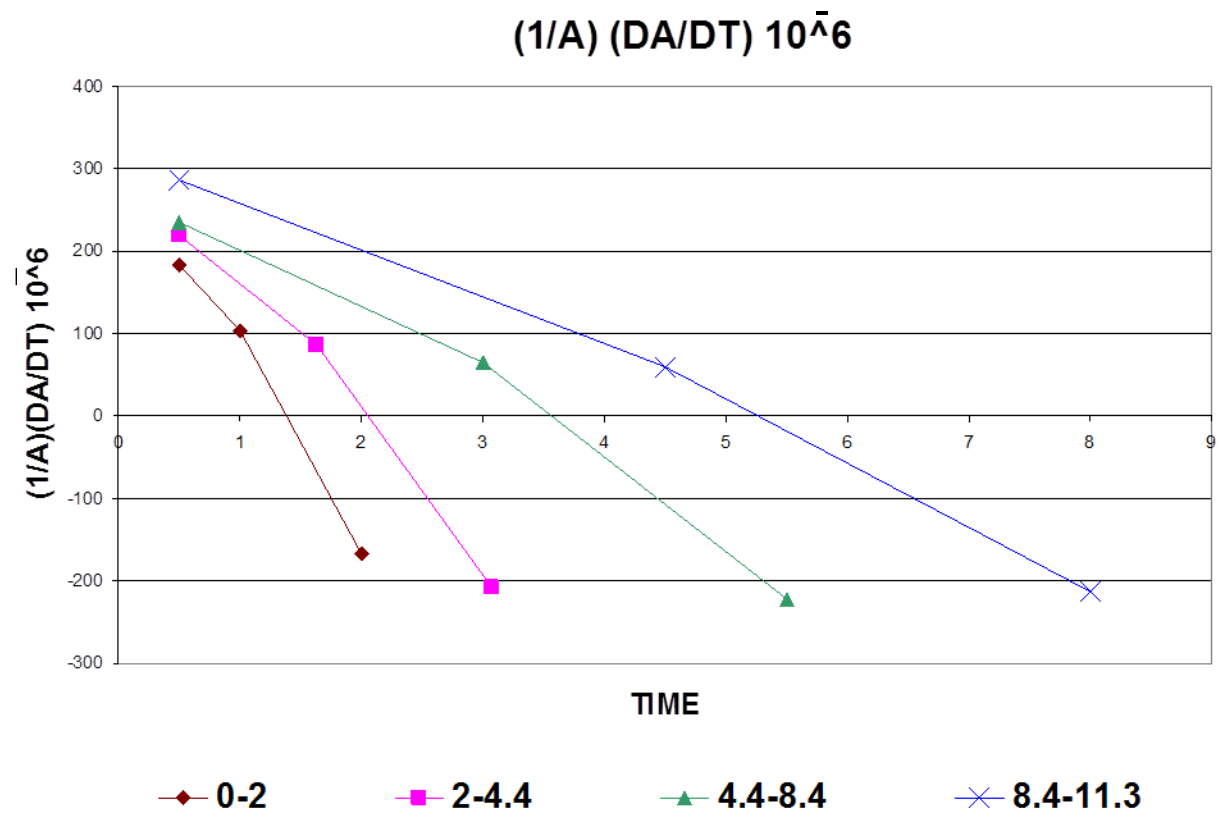


FIG. 11. Mean hourly area expansion (10^{-6} s^{-1}), rainfall (mm h^{-1}), and 235-K area fraction (%) for the WETAMC/LBA region.

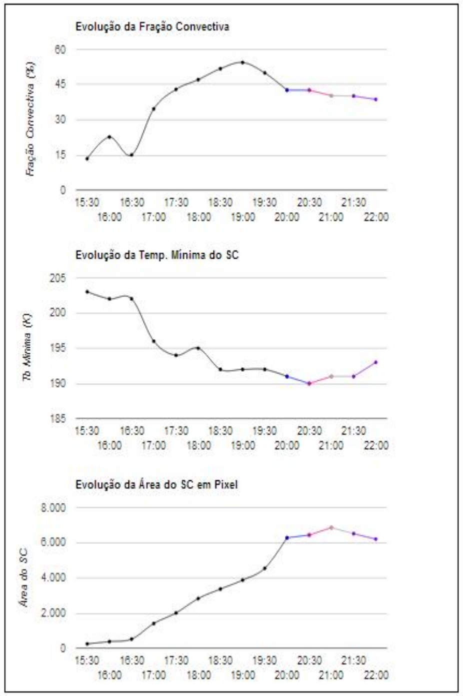


(1/ql)(δql/δt)
(1/a)(δa/δt)
DIV
Surface
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
140
120
100
80
60
40
20
0
2
4
6
8
10
12
14
16
$AE = \frac{1}{A}\frac{\partial A}{\partial t} = \vec{\nabla}.\vec{v} + \frac{1}{Ql}\frac{\partial Ql}{\partial t}$

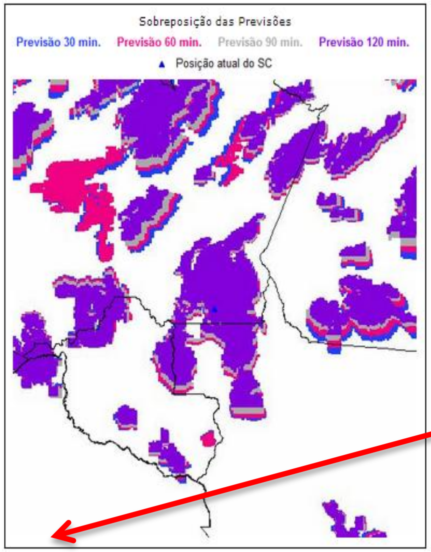
Space Area Expansion x Life Cycle - Statistical Diagram

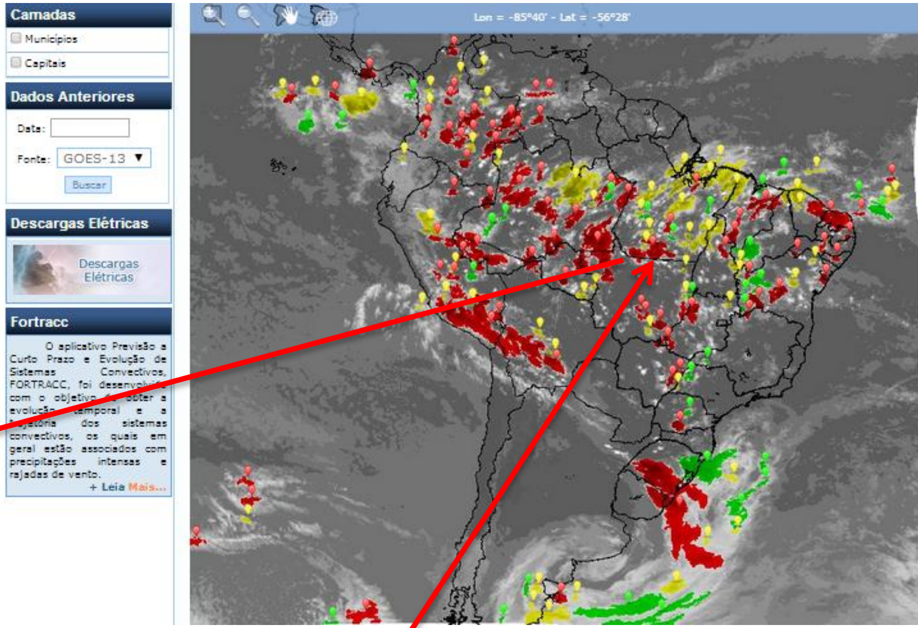


ForTraCC



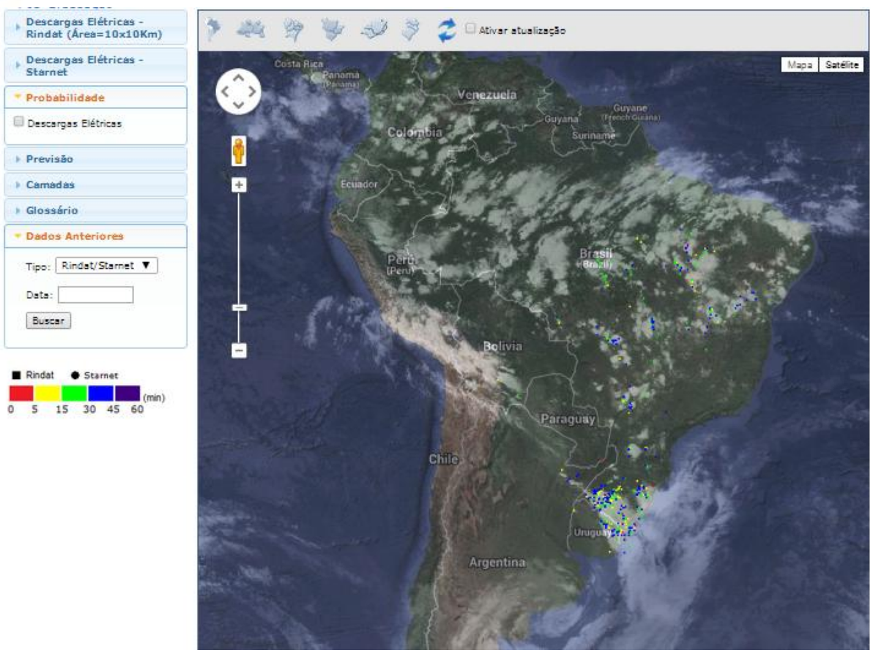
Lat	Lon	Tmin	Vel	Dir	TVida	Área	Taxa	Situação	Classe	Tipo
-6.97	-59.57	203	-999.9	-999	0	260	-999.9	Desintensificando	Novo	Atual
-6.98	-59.6	202	3.47	225	0.5	388	219.5	Intensificando	Continuidade	Atual
-6.97	-59.67	202	5.5	296	1	531	172.9	Intensificando	Continuidade	Atual

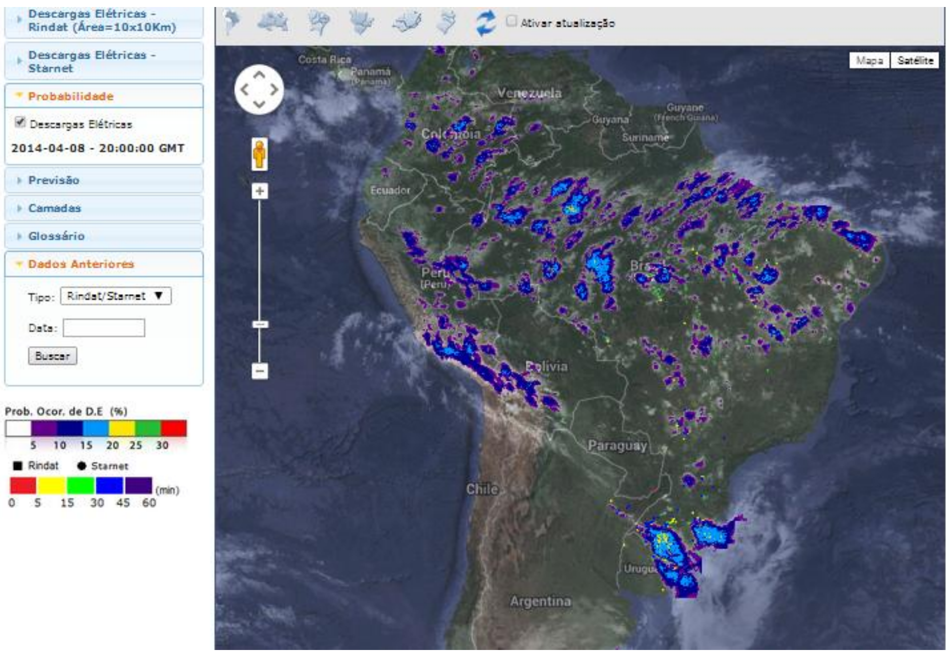




Latitude:	-8.33
Longitude:	-60.08
Temp. Mínima:	191 K
Velocidade:	3.47 m/s
Direção:	225 graus
Tempo de Vida:	4.5 horas
Área:	6273 km²
Taxa de expansão:	177.2 10^-6/s
Fase do SC:	Intensificando
Classe:	Fusão
Data:	2014-04-08 20:00:00

Probability of Lightning





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Relationship between cloud-to-ground discharge and penetrative clouds: A multi-channel satellite application

Luiz A.T. Machado [a,*], Wagner F.A. Lima [a], Osmar Pinto Jr. [a], Carlos A. Morales [b]

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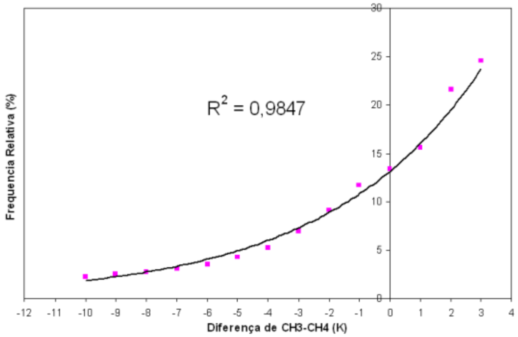
[b] Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Rua do Matão, 1226-Cidade Universitária-Sao Paulo/SP-05508-090, Brazil



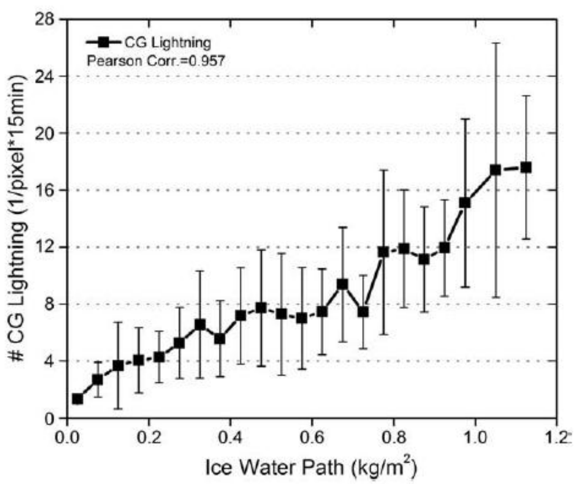


Fig. 9. Average and standard deviation of CG lightning occurrence in 15 min intervals by pixel (# CG lightning/pixel * 15 min) as a function of Ice Water Path (kg/m^2).

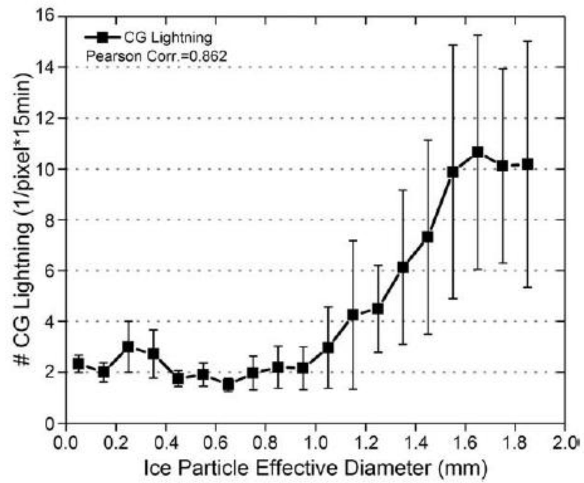


Fig. 8. Average and standard deviation of CG lightning occurrence in 15 min intervals by pixel (# CG lightning/pixel * 15 min) as a function of ice particle effective diameter (mm).

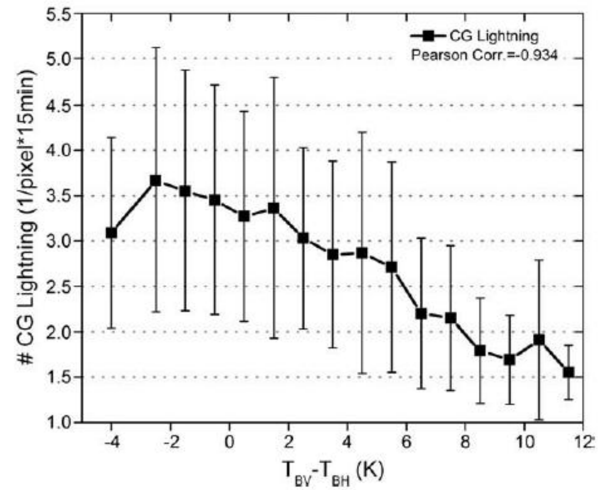


Fig. 10. Average and standard deviation of CG lightning occurrence in 15 min intervals by pixel (# CG lightning/pixel * 15 min) as a function of the Polarized Temperature Difference at 85 GHz (T_{BV}–T_{BH}).

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Cloud-to-ground lightning and Mesoscale Convective Systems

Enrique V. Mattos*, Luiz A.T. Machado
National Institute for Space Research – INPE, Center for Weather Forecast and Climate Studies – CPTEC, Rodovia Presidente Dutra, km 40, Cachoeira Paulista-SP 12630000, Brazil

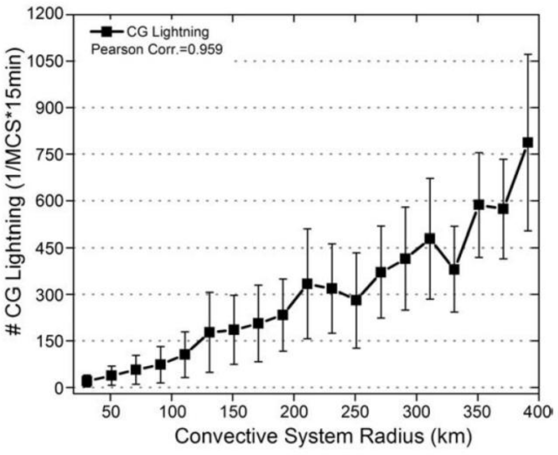


Fig. 4. Average and standard deviation of CG lightning occurrence per convective system in 15 min intervals (#CG lightning/MCSs*15 min) as a function of the effective radius (km).

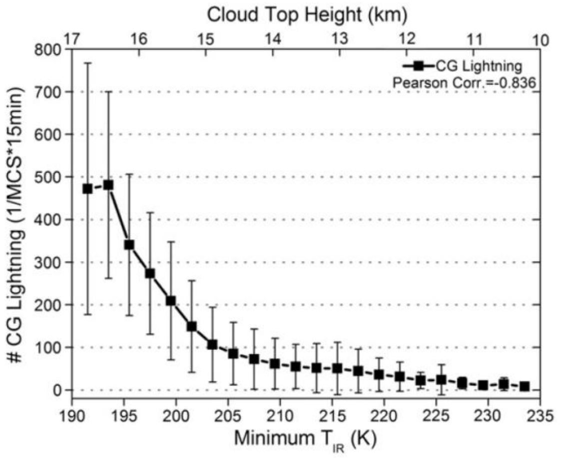


Fig. 5. Average and standard deviation of CG lightning occurrence per convective system in 15 min intervals (#CG lightning/MCSs*15 min) as a function of the IR Minimum Temperature (K) and cloud top height (km).

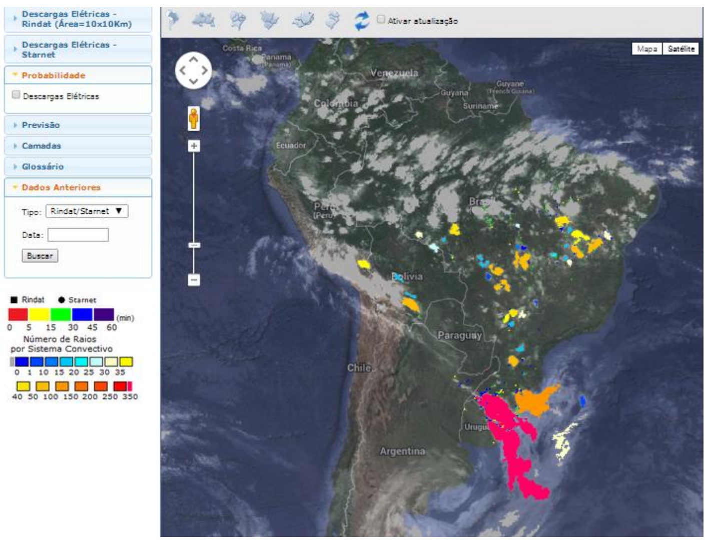
A principal component analysis shows that theses three variables in the equation are the most correlated with CG lightning occurrence and mutually independents. In this way, the following parameterization was obtained: (NI – Number of CG)

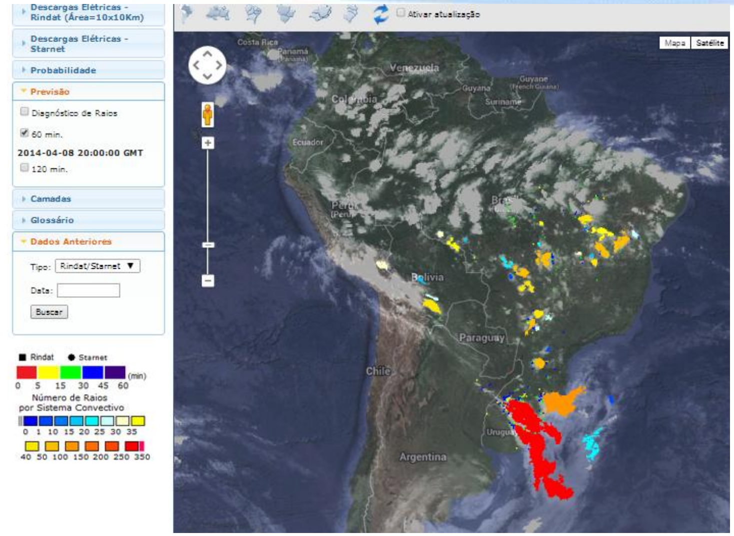
NI= 413.07 + 0.0173926*(***SIZE***) + 0.004800*(***DSIZE***) -1.84902*(***TMIN9***),

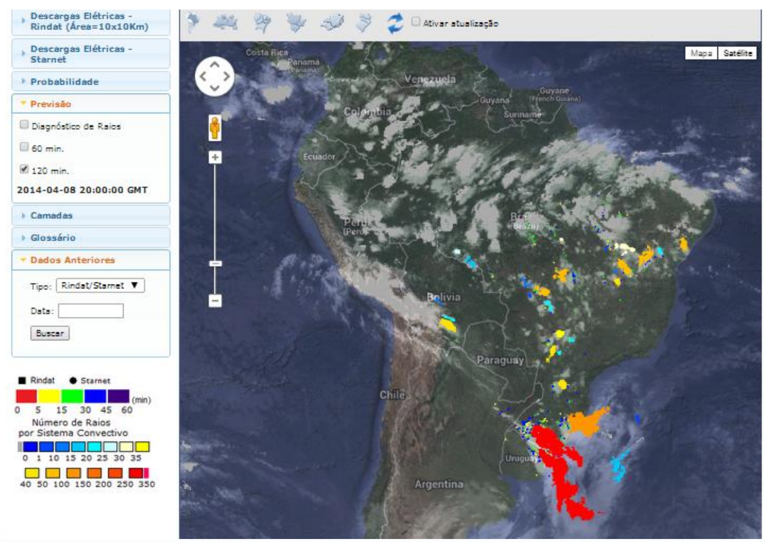
Table 1 - Validation statistics through POD, FAR, P. CORREL., BIAS e RMSE for diagnostic and prognostic for 30, 60, 90 and 120 minutes nowcasting between Sep-Oct 2009.

	Diag	*30 min*	*60 min*	*90 min*	*120 min*
POD (%)	95.08	96.21	95.75	94.87	94.14
FAR (%)	40.08	45.49	45.21	43.61	43.24
P. CORREL.	0.76	0.75	0.74	0.73	0.71
BIAS	-10.69	-10.81	-12.30	-16.60	-19.91
RMSE	131.78	143.90	150.75	159.97	168.59

ForTraCC - Lightning



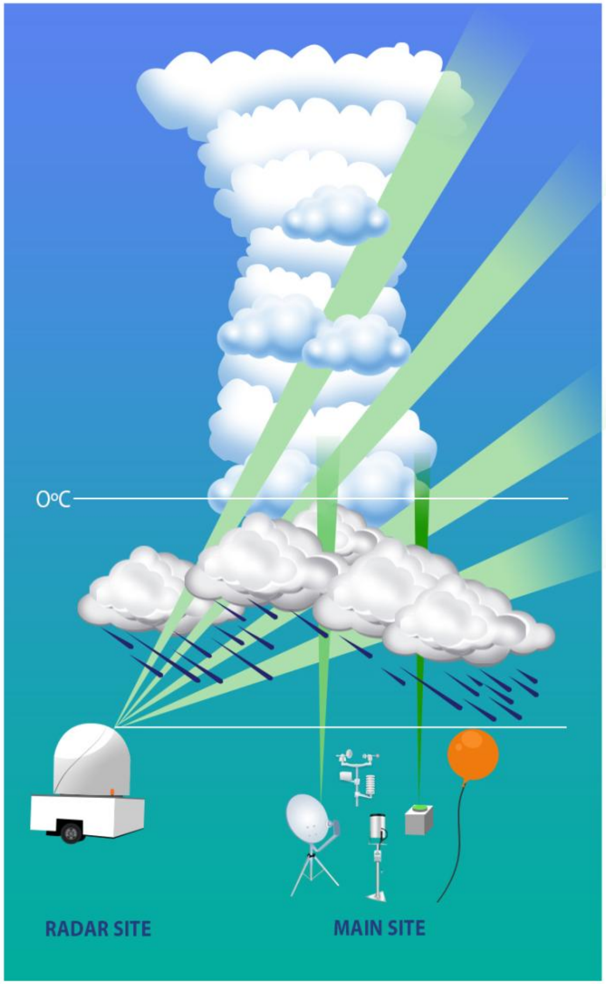


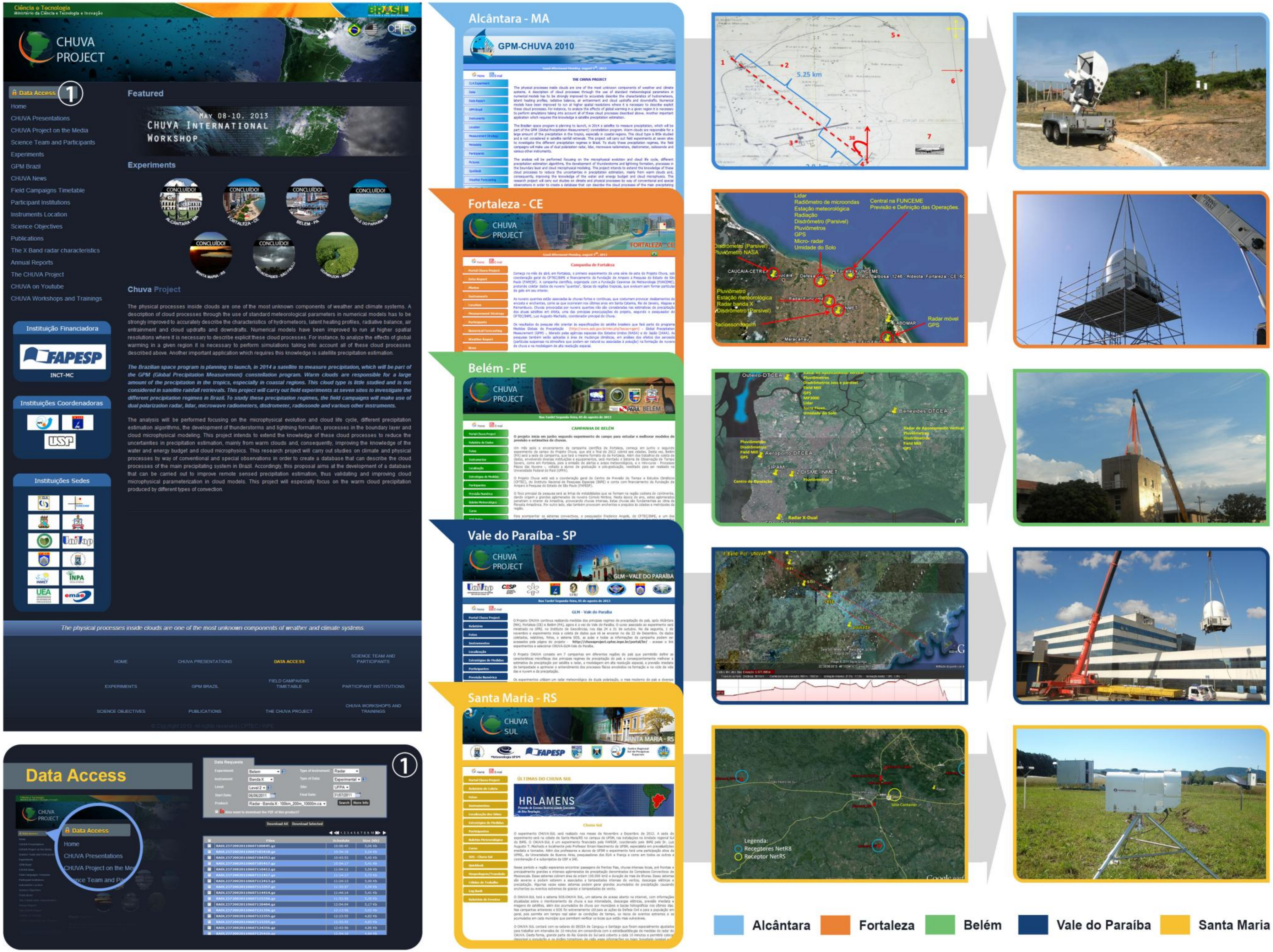


CHUVA Project:

Cloud processes of tHe main precipitation systems in Brazil:
A contribUtion to cloud resolVing modeling and to the GPM (GlobAl Precipitation Measurement)


ITCZ
Intertropical Convergense Zone
EW
Easterly Wave
SL-AM
Squall Line Amazon
WC
Warm Cloud
EC-AM and WC-AM
Easterly and Westerley Regimes
SACZ
South Atlantic Convergence Zone
SL
Squall Line
MCC
Mesoscale Convective Complex
CF
Cold Front
1 Alcântara
2 Fortaleza
3 Belém
4 Vale do Paraíba
5 Santa Maria
6 Manaus


0ºC
RADAR SITE
MAIN SITE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The X Band radar characteristics
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Featured
MAY 08-10, 2013
CHUVA INTERNATIONAL WORKSHOP
Experiments
CONCLUÍDO!
Chuva Project
The physical processes inside clouds are one of the most unknown components of weather and climate systems. A description of cloud processes through the use of standard meteorological parameters in numerical models has to be strongly improved to accurately describe the characteristics of hydrometeors, latent heating profiles, radiative balance, air entrainment and cloud updrafts and downdrafts. Numerical models have been improved to run at higher spatial resolutions where it is necessary to describe explicit these cloud processes. For instance, to analyze the effects of global warming in a given region it is necessary to perform simulations taking into account all of these cloud processes described above. Another important application which requires this knowledge is satellite precipitation estimation.
The Brazilian space program is planning to launch, in 2014 a satellite to measure precipitation, which will be part of the GPM (Global Precipitation Measurement) constellation program. Warm clouds are responsible for a large amount of the precipitation in the tropics, especially in coastal regions. This cloud type is little studied and is not considered in satellite rainfall retrievals. This project will carry out field experiments at seven sites to investigate the different precipitation regimes in Brazil. To study these precipitation regimes, the field campaigns will make use of dual polarization radar, lidar, microwave radiometers, disdrometer, radiosonde and various other instruments.
The analysis will be performed focusing on the microphysical evolution and cloud life cycle, different precipitation estimation algorithms, the development of thunderstorms and lightning formation, processes in the boundary layer and cloud microphysical modeling. This project intends to extend the knowledge of these cloud processes to reduce the uncertainties in precipitation estimation, mainly from warm clouds and, consequently, improving the knowledge of the water and energy budget and cloud microphysics. This research project will carry out studies on climate and physical processes by way of conventional and special observations in order to create a database that can describe the cloud processes of the main precipitating system in Brazil. Accordingly, this proposal aims at the development of a database that can be carried out to improve remote sensed precipitation estimation, thus validating and improving cloud microphysical parameterization in cloud models. This project will especially focus on the warm cloud precipitation produced by different types of convection.
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INCT-MC
Instituições Coordenadoras
USP
Instituições Sedes
INPA
UEA
The physical processes inside clouds are one of the most unknown components of weather and climate systems.
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GPM BRAZIL
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GPM-CHUVA 2010
5.25 km
Fortaleza - CE
CHUVA PROJECT
FORTALEZA - CE
Campanha de Fortaleza
Lidar
Radiômetro de microondas
Estação meteorológica
Radiação
Disdrômetro (Parsivel)
Pluviômetros
GPS
Micro- radar
Umidade do Solo
Central na FUNCEME
Previsão e Definição das Operações
Pluviômetro
Estação meteorológica
Radar banda X
Disdrômetro (Parsivel)
Radiossondagem
Radar móvel
GPS
Belém - PE
CHUVA PROJECT
PARÁ - BELÉM
CAMPANHA DE BELÉM
Outeiro-DTCEA
Benevides DTCEA
Aeroporto DTCEA
SIPAM
2 DISME INMET
Radar X-Dual
Vale do Paraíba - SP
CHUVA PROJECT
GLM - VALE DO PARAÍBA
GLM - Vale do Paraíba
Santa Maria - RS
CHUVA SUL
SANTA MARIA - RS
FAPESP
ÚLTIMAS DO CHUVA SUL
HRLAMENS
Chuva Sul
Legenda:
Receptores NetR8
Receptor NetR5
Alcântara
Fortaleza
Belém
Vale do Paraíba
Santa Maria

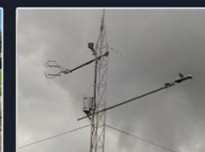
CHUVA PROJECT

Alcântara - MA




Fortaleza - CE



Belém - PA




Vale do Paraíba - SP

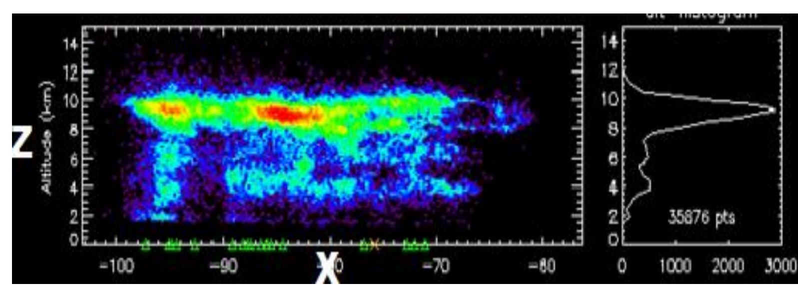


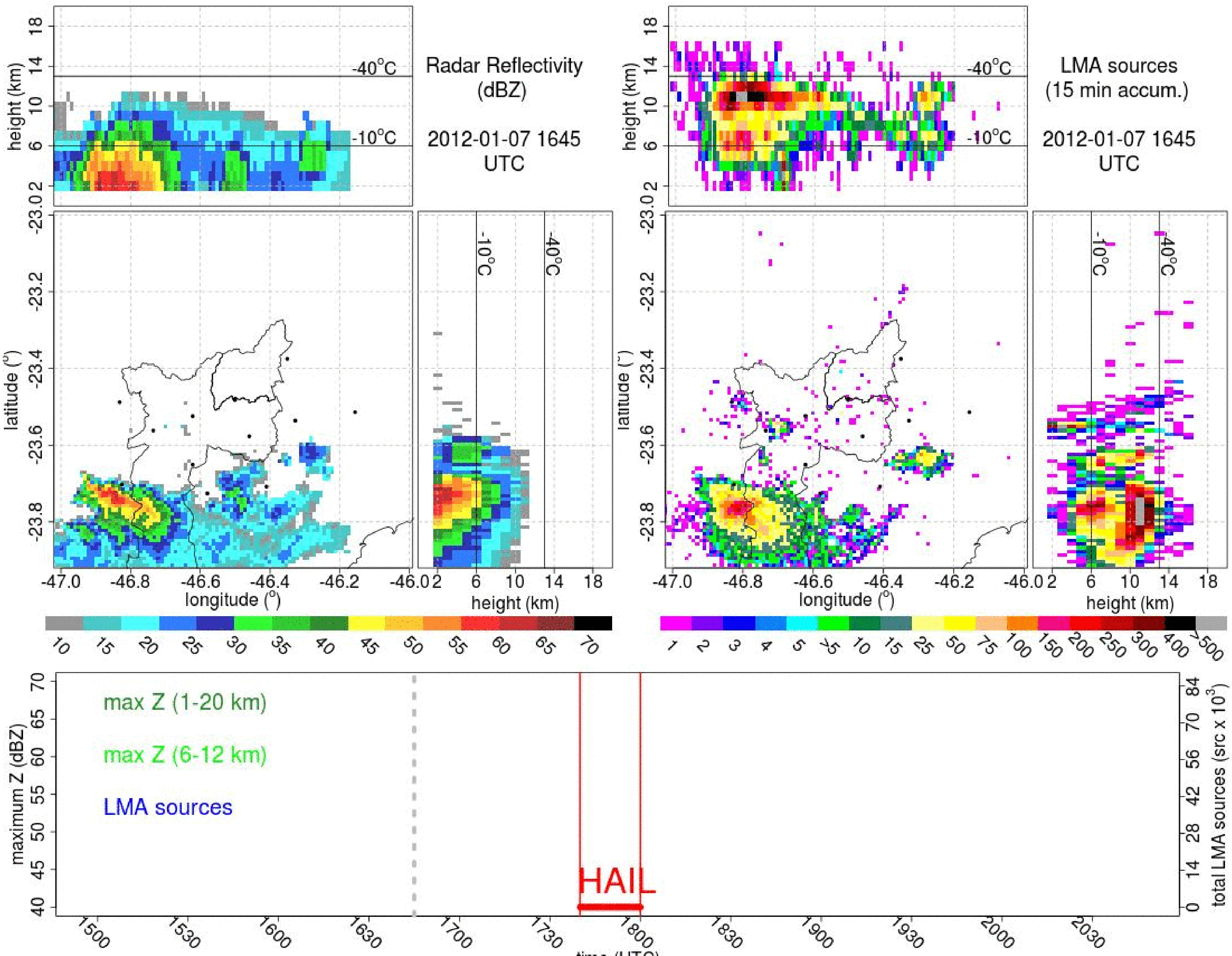

Santa Maria - RS



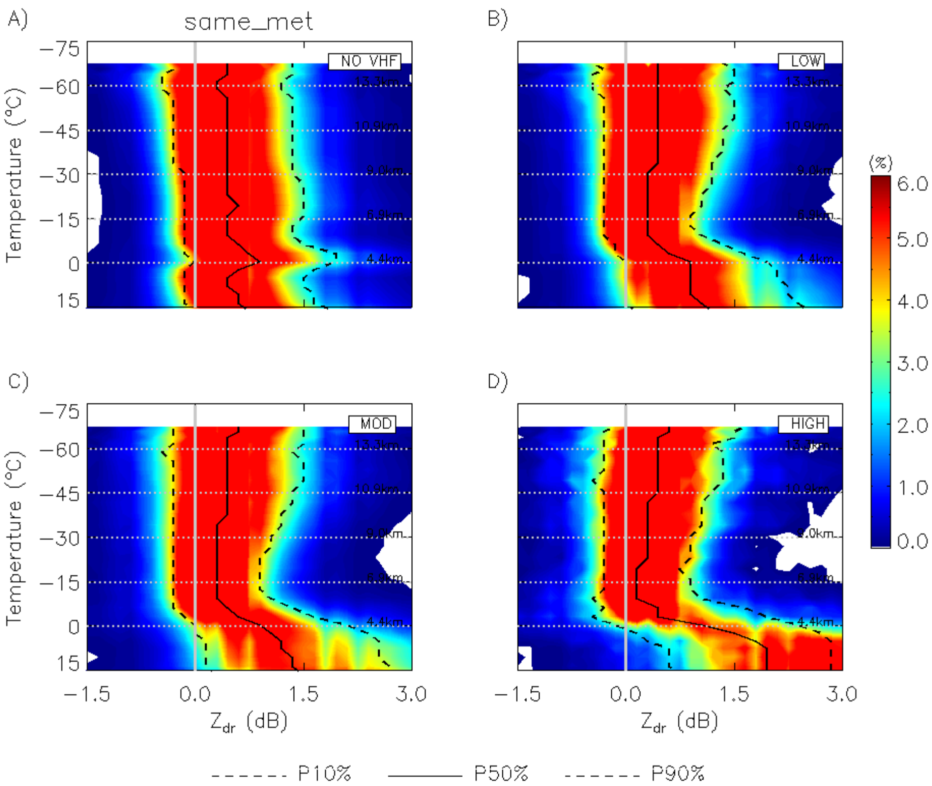

GOES-R Geostationary Lightning Mapper (GLM):
Pre-Launch Algorithm Validation-CHUVA Campaign Report

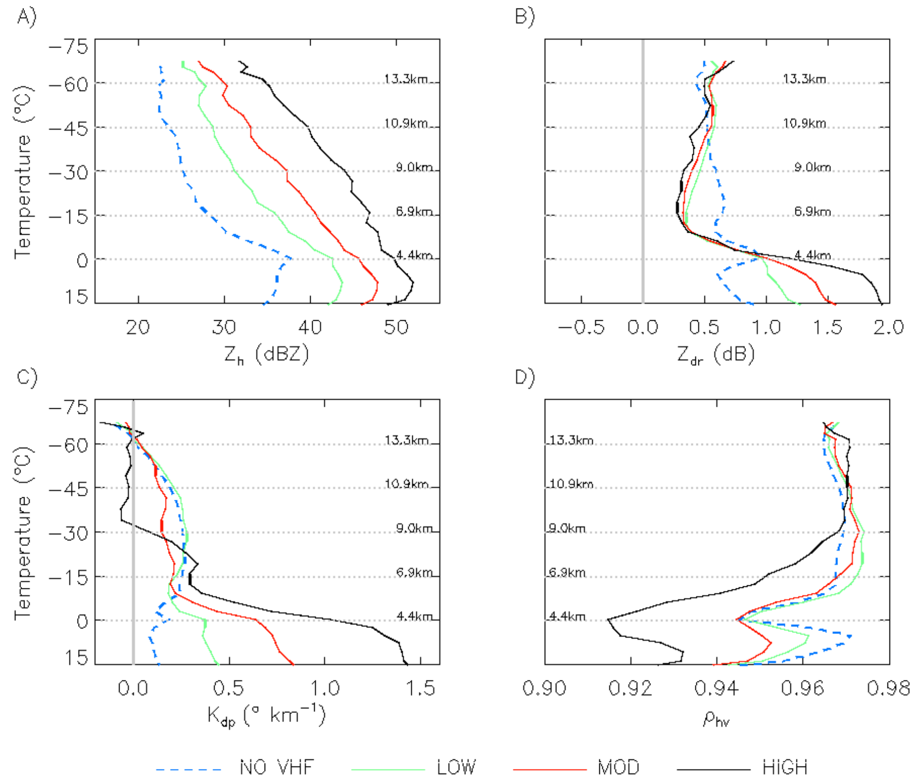
Contribution to the CHUVA Campaign



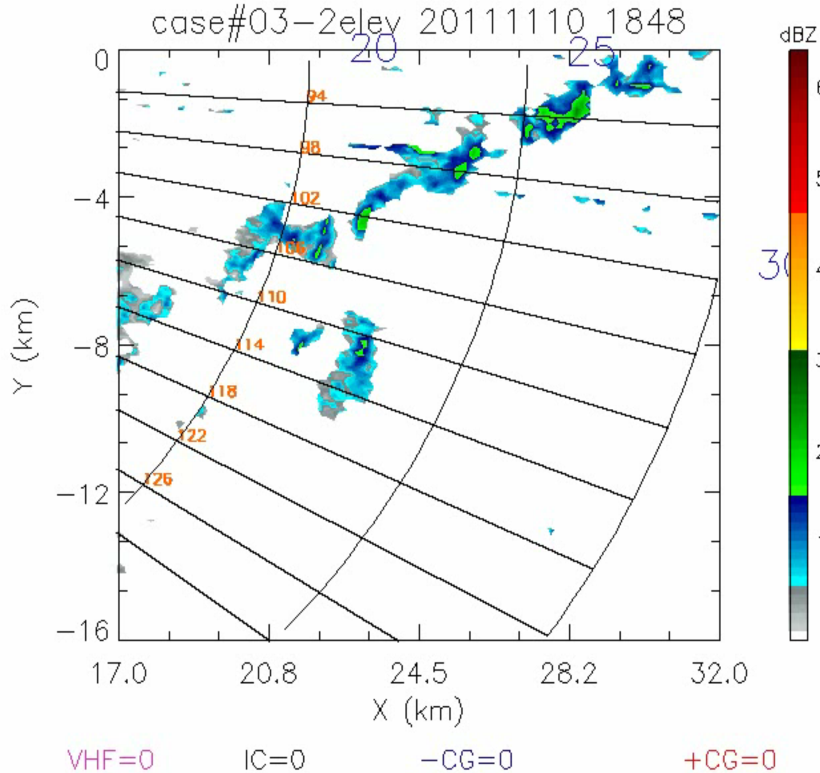


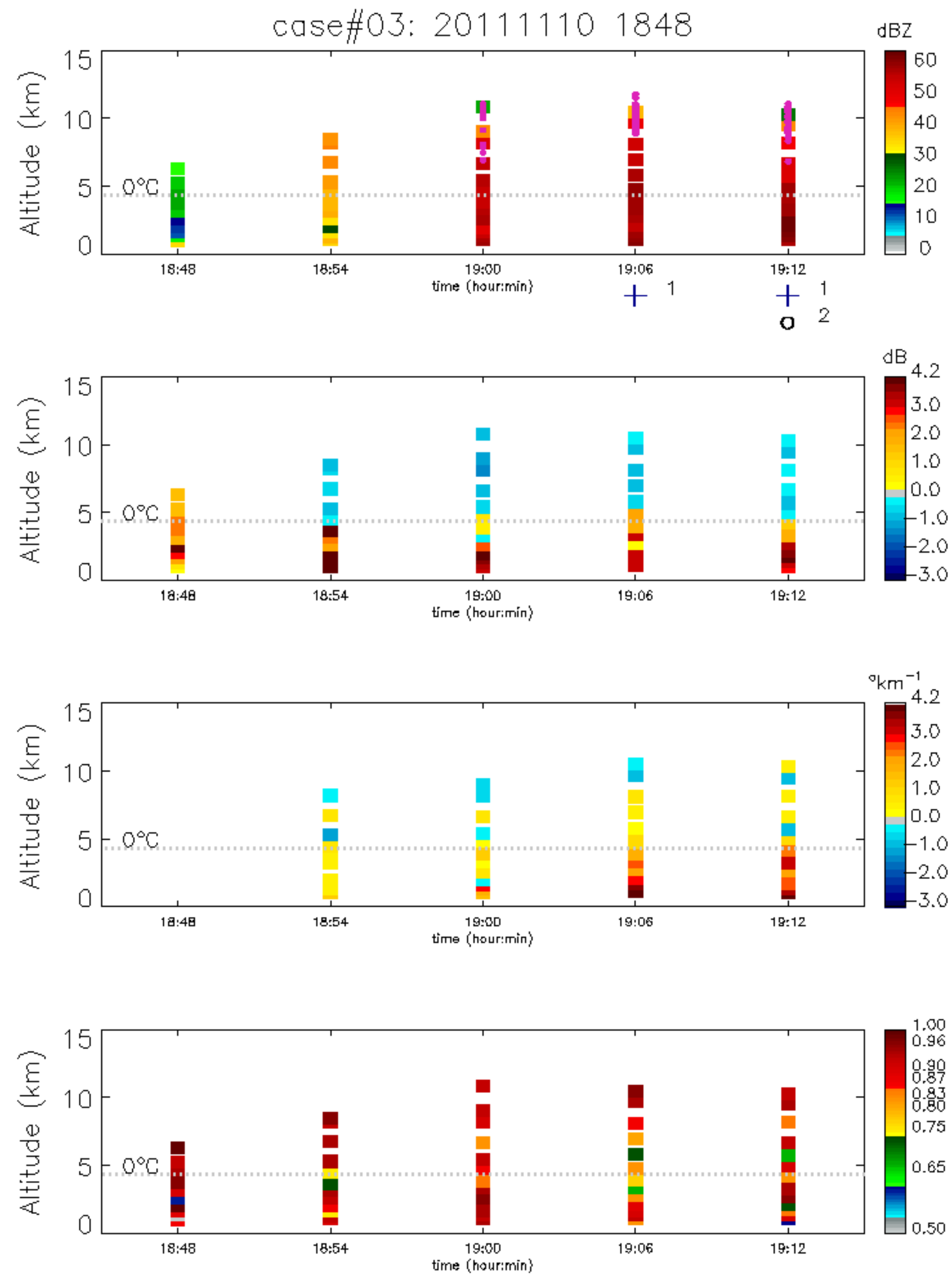
See Rachel Albrecht for details





Enrique V. Mattos, Luiz. A. T. Machado and E. Williams in submission process

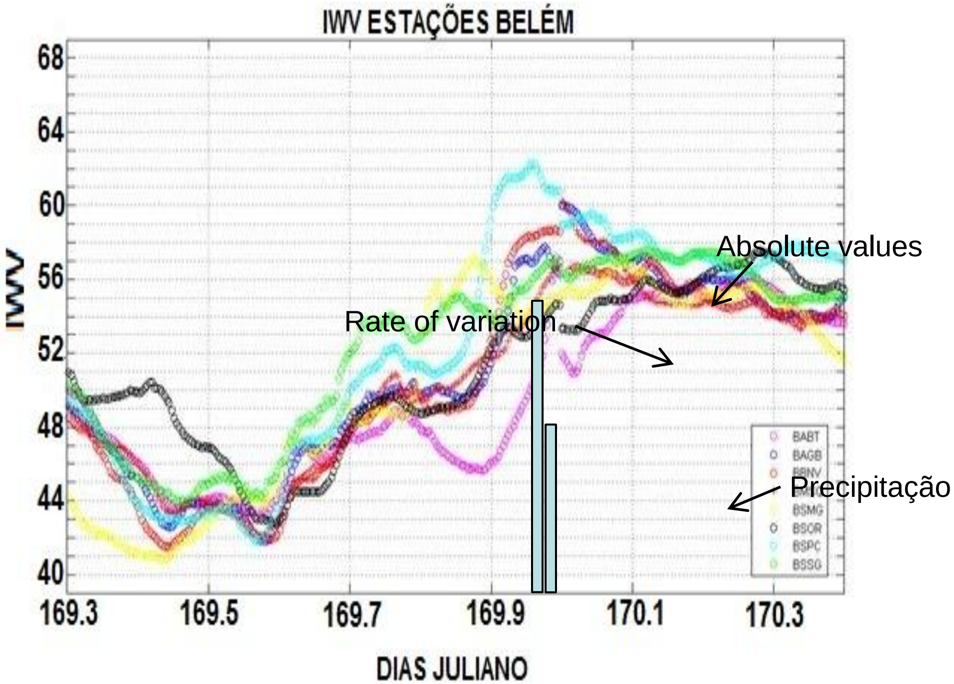


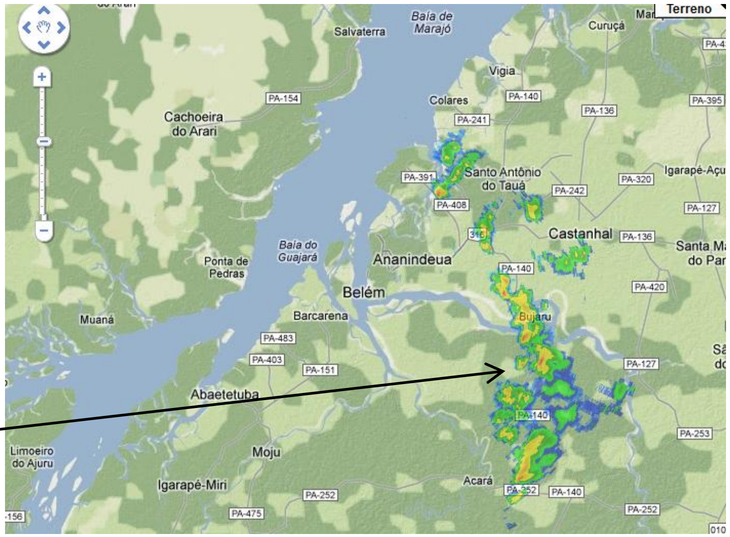


Now we need to look MSG data

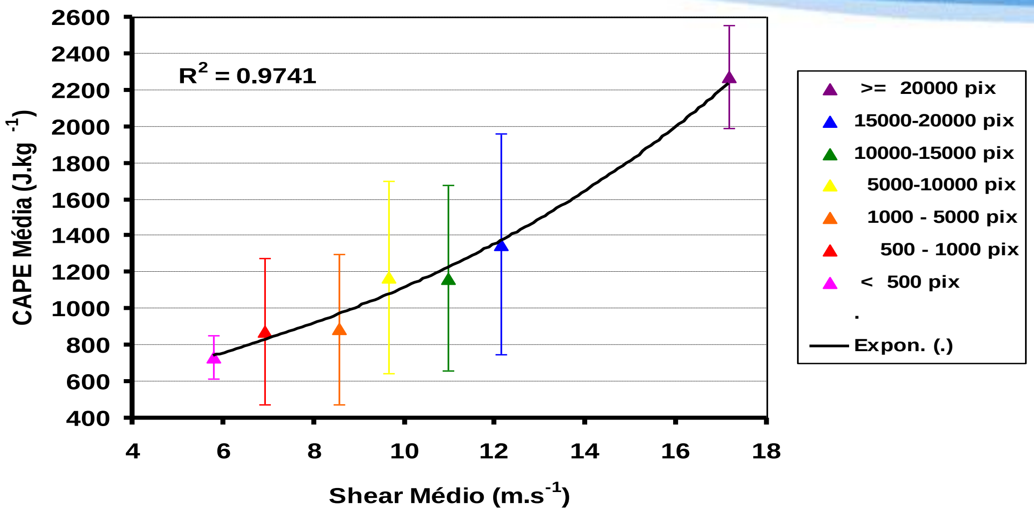
Enrique V. Mattos, Luiz. A. T. Machado and Earle Willians in preparation

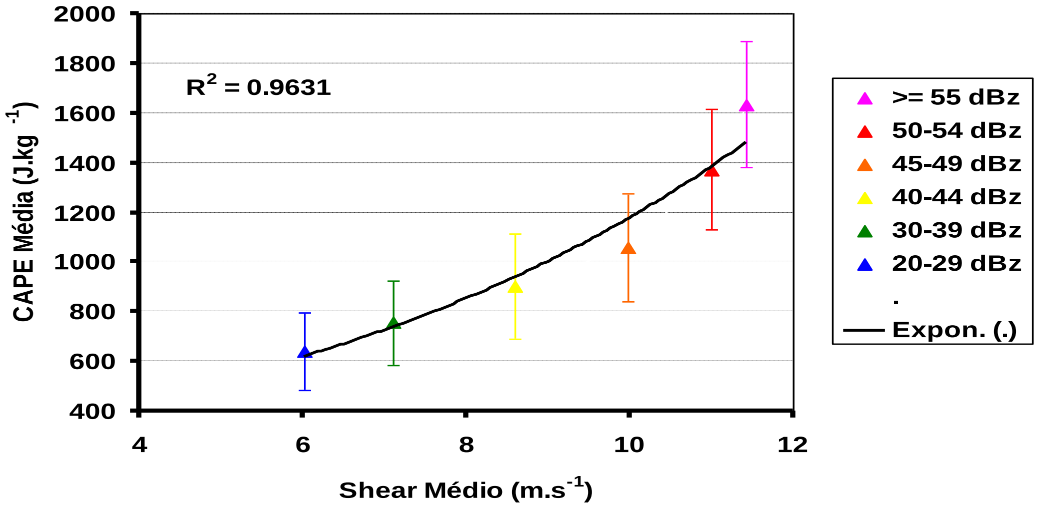
GPS-IWV Jumping





Rain Cells and the Richardson Space



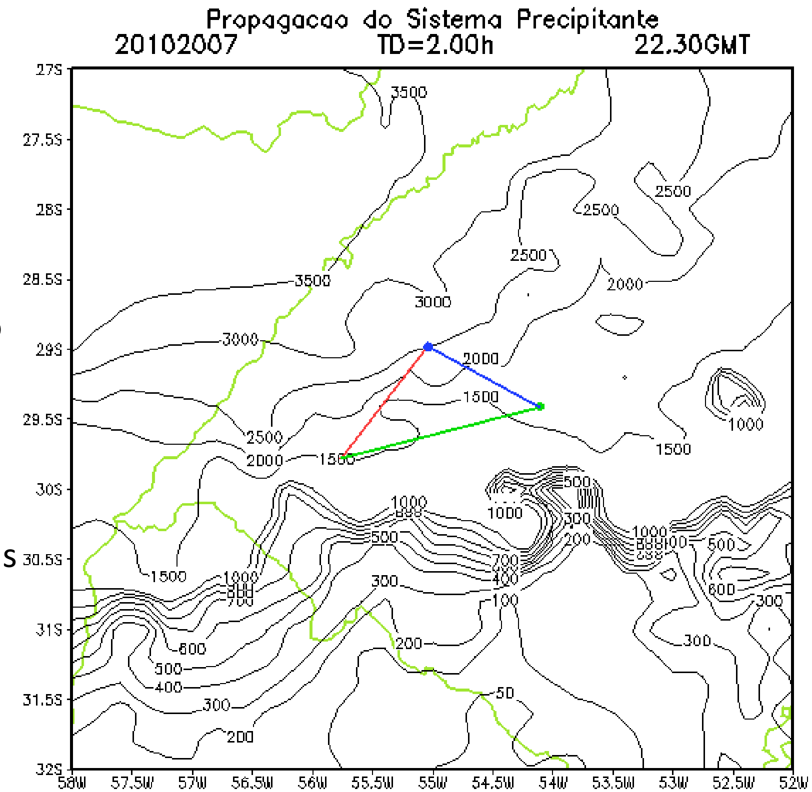


Results from Marco Aurelio Teixeira Master Degree

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.

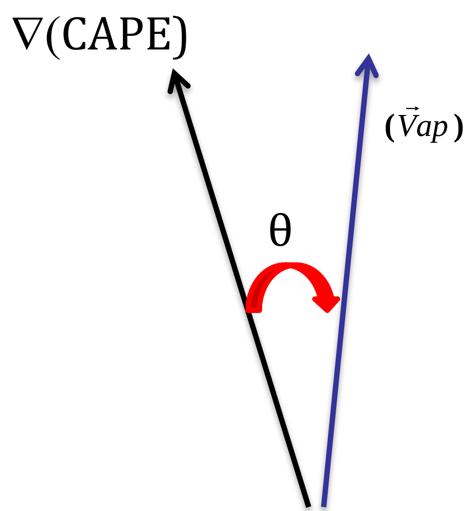


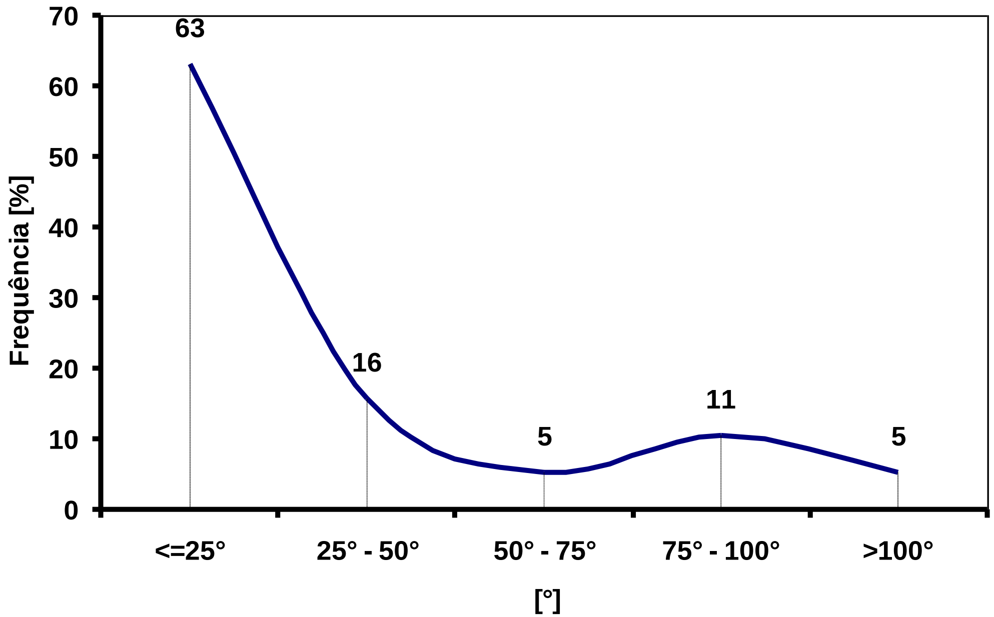
MCS Direction of Propagation obtained from Fortracc $(\vec{V}p)$

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

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

Rain Cells Propagation





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

Rain Cells Propagation

Vectors are considered linearly dependent

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

Considering the present situation:

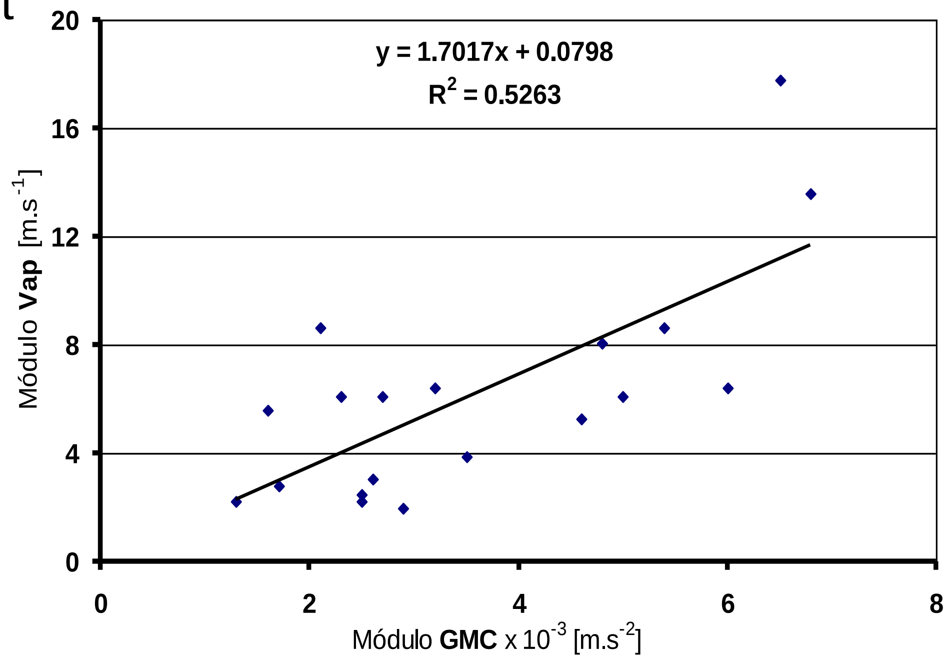
$$\left|\vec{Vap}\right| = 1702\left|\overline{\nabla}_{CAPE}\right|$$

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

α is Time unit and correspond to a Seconds

Considering a Uniformly Accelerated Motion

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



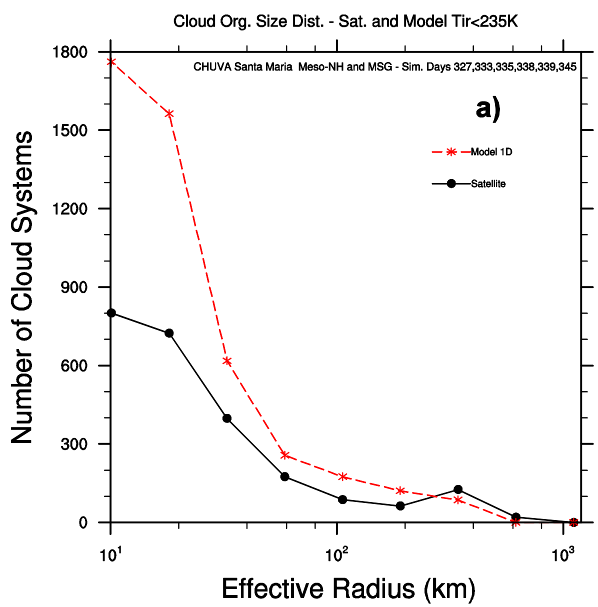
$$V_0 = \left|\vec{Vap}_0\right| = 0{,}08 \cong 0$$

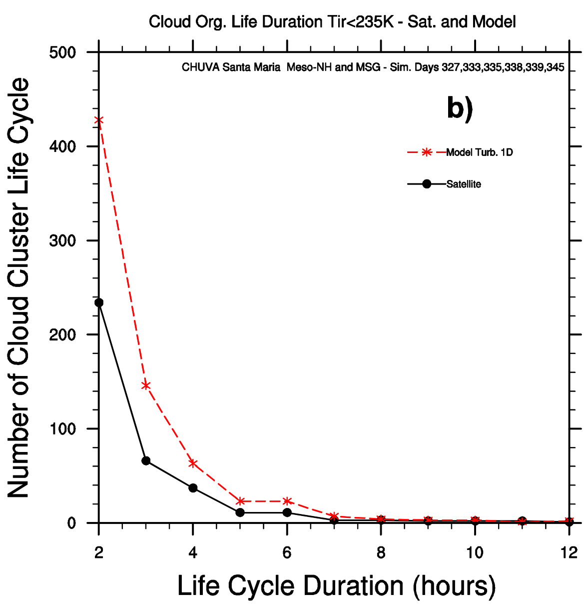
Time is 30 minutes – 1800 s

MCS – actually rain cells moves as combination of

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

Cloud Resolving Model – does not describe correctly the cloud field





Organization of clouds (Tir < 235 K) observed by MSG and simulated by Meso-NH for the 6 golden days (during the 36-h period from 1200 UTC of the specific day). (a) Size distribution and (b) life cycle duration.

Machado and Chaboureau in preparation

- Thank You

- Hvala lijepa