Characteristics of the X-Band Polarimetric Radar Associated With the Lightning Electrical Activity

Doctoral Thesis in Meteorology - INPE

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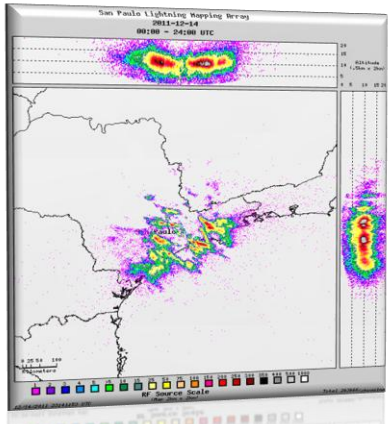
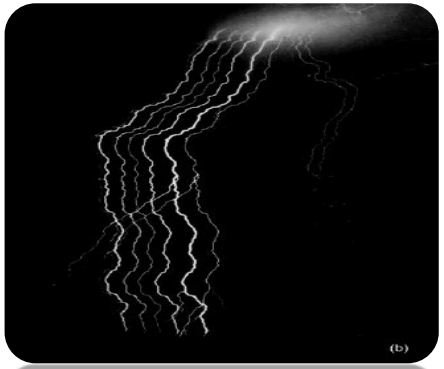
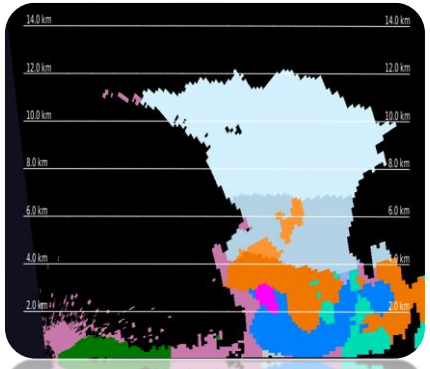
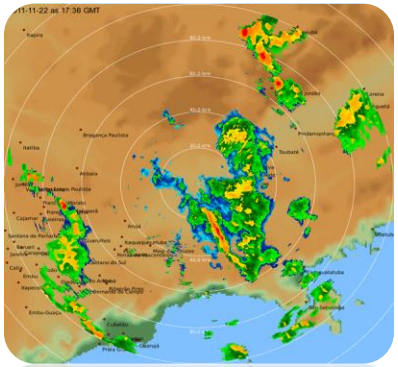


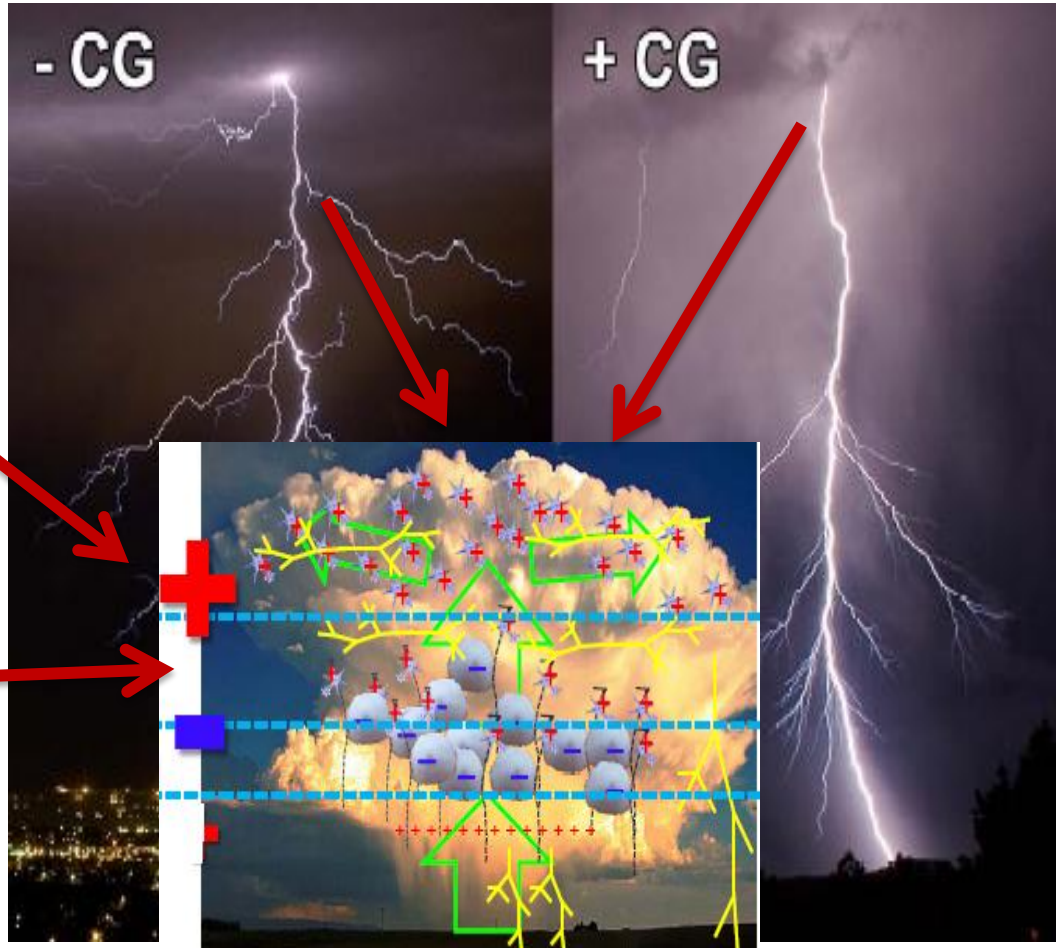


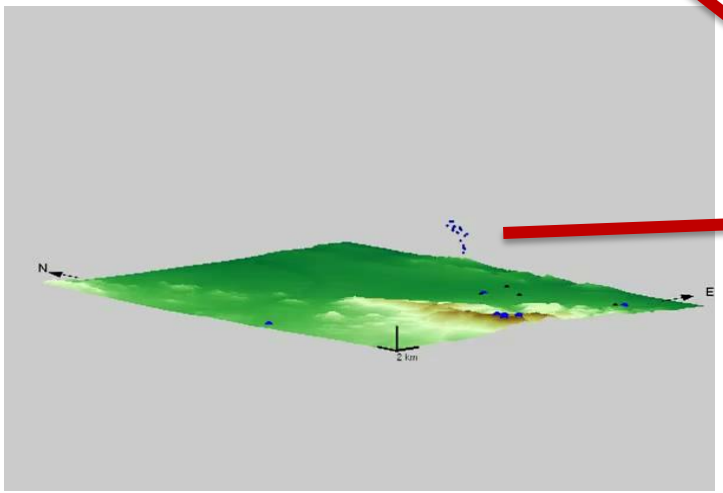




IAG-USP São Paulo - May 10, 2013

SOME SCIENTIFIC QUESTIONS:





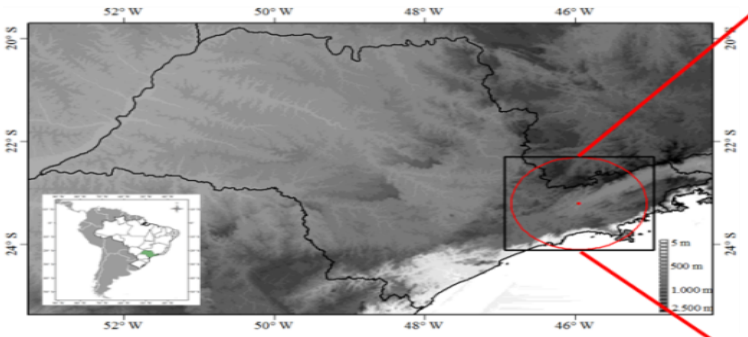
OBJECTIVE:

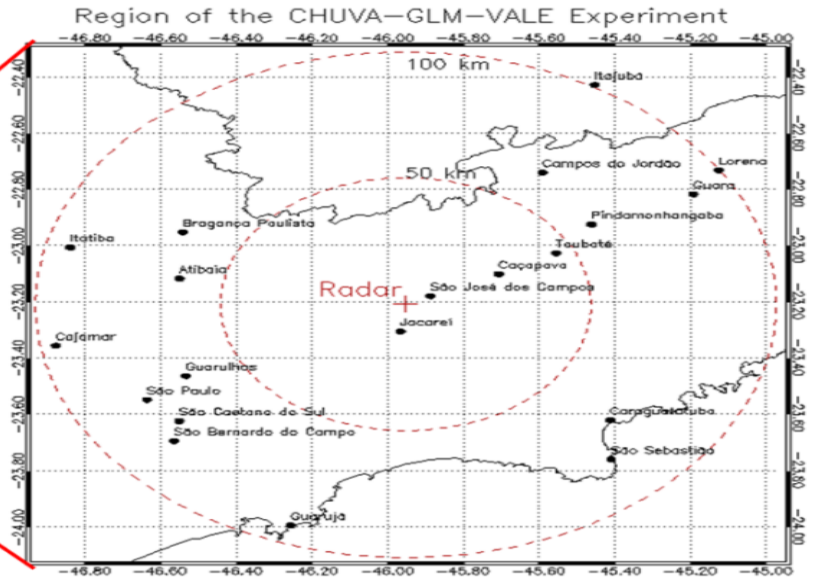
This work have the objective of the evaluate the impact of cloud microphysics on the intensity of lightning electrical activity

DATA DESCRIPTION:

XPOL RADAR

EXPERIMENT: CHUVA-GLM-VALE (Nov/2011 to Mar/2012)





DATA: RADAR

(1) Radar xpol:

(a) dBZ → LEVEL 1B
(b) ZDR → LEVEL 1B
(c) CORR → LEVEL 1A
(d) KDP → LEVEL 1A

Correction #1: Wet radome

(a) dBZ (Bechini et al. (2010)

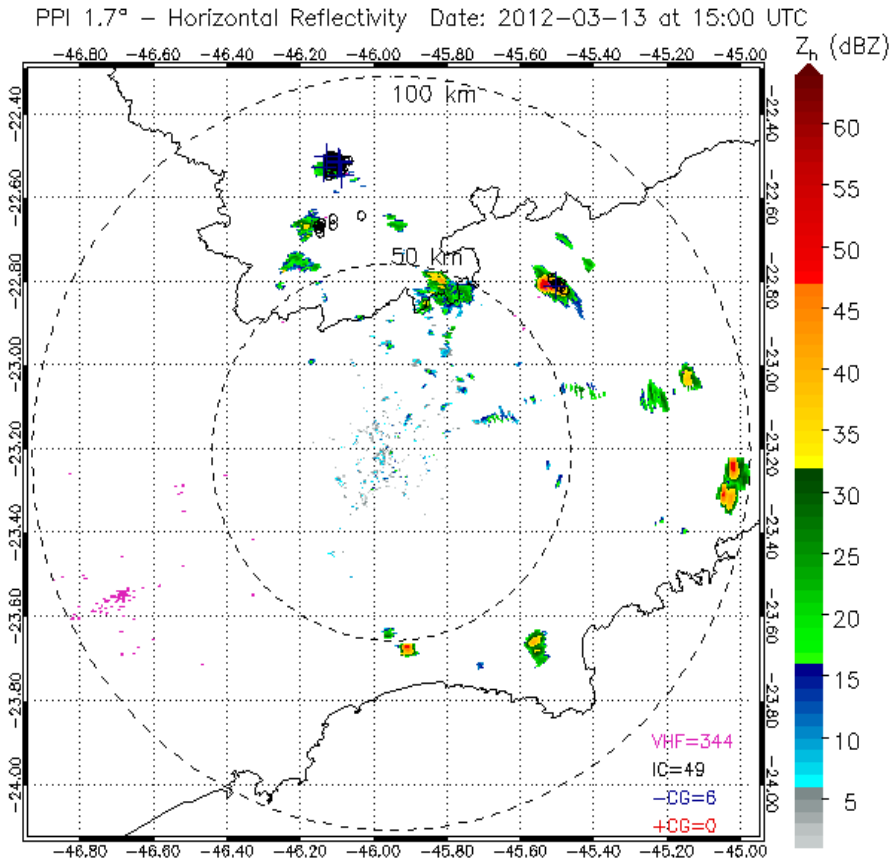
$$L_{rad} = 2\left(-0,34 + 1,61(r * R)^{1/3}\right)$$

Correction #2:

(a) ZDR (Sakuragi and Biscaro (2012)

Initial Period	Final Period	Offset (dB)
01/11/2011	11/12/2011	-0,271
12/12/2011	27/01/2012	-0,328
28/01/2012	31/03/2012	-0,587

PPI for Second Elevation



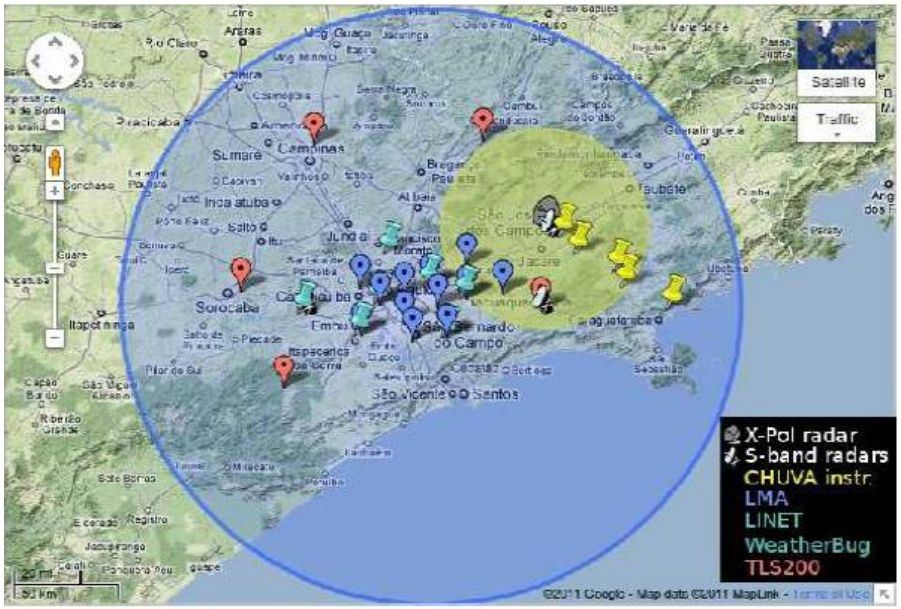
DATA: LIGHTNING

(2a) LMA (*sources VHF) → LEVEL 1B

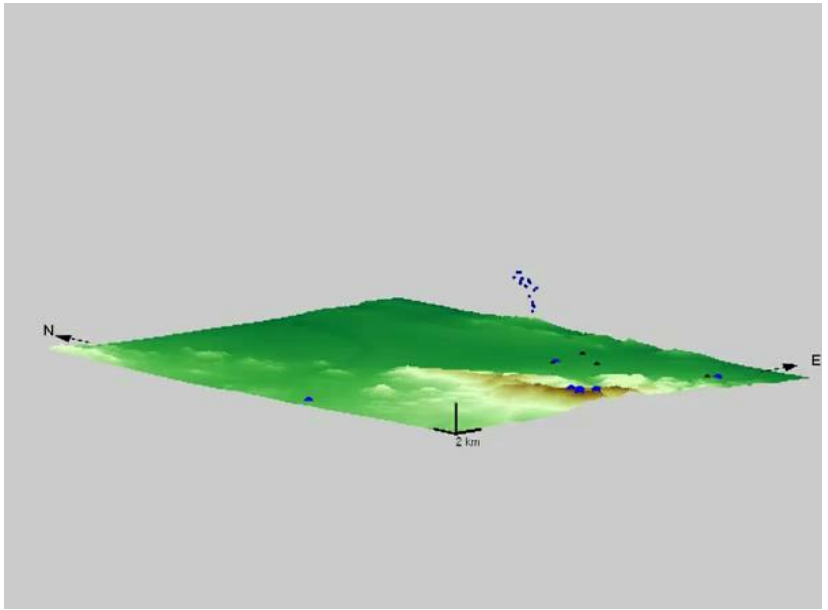
(2b) Rindat (*CG,*PC) → LEVEL 1A

(2c) BrasilDat (*IC,*CG,*PC) → LEVEL 1B

Example: Flash propagation using LMA data

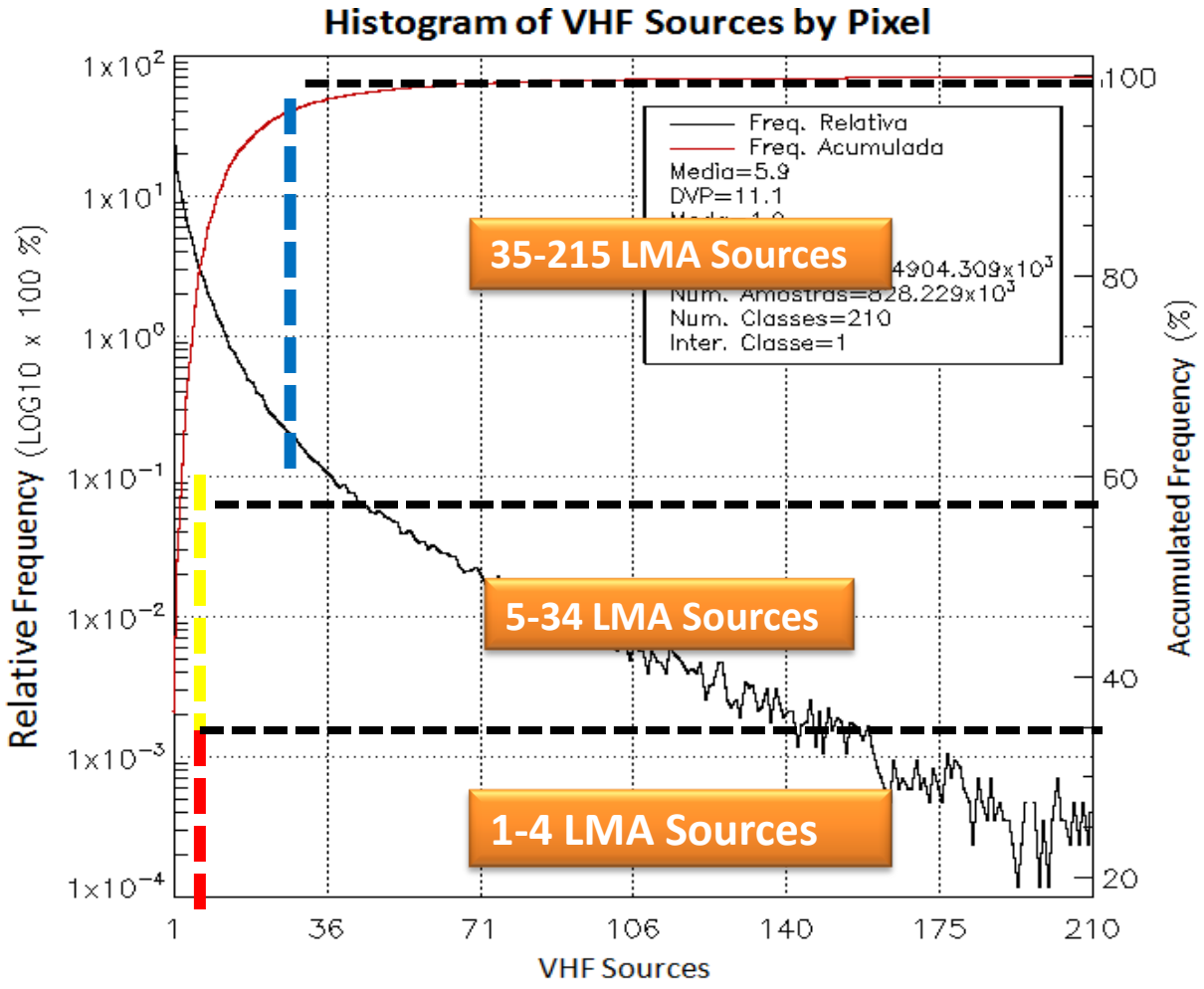


Courtesy from Rachel



ICAE Newsletter

RESULTS: LMA Distribution

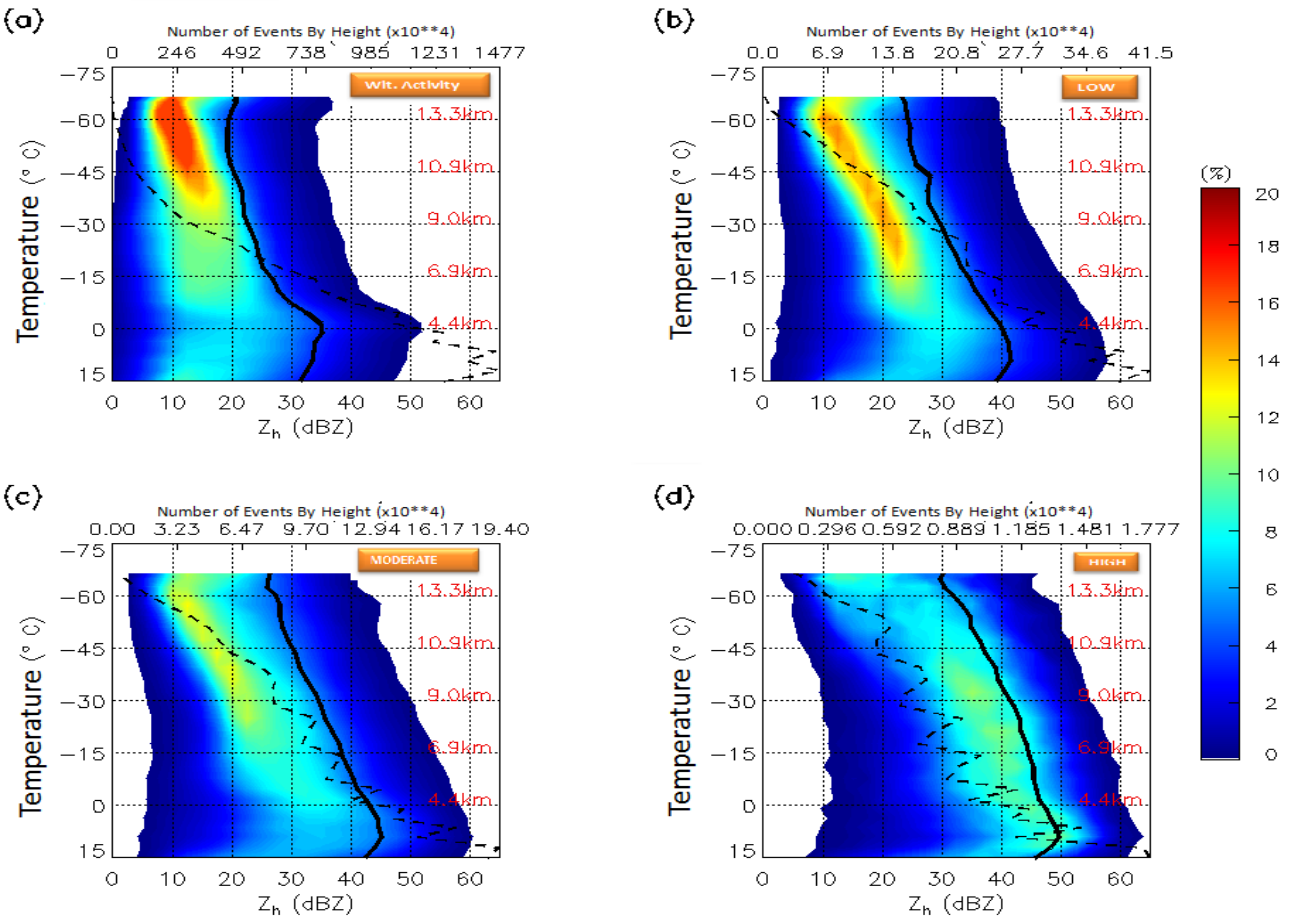


RESULTS: Amount of Lightning by LMA Sets

LMA Sets	Sets Intensity Namely	#Profile	#Sources	-CG	+CG	IN
0	Wit. Activity	24389612	0	2484	320	15502
1-4	Low	563543	1015778	3243	642	24989
5-34	Moderate	244342	2659489	6466	1994	60717
35-215	High	20356	1231596	3081	1185	29384

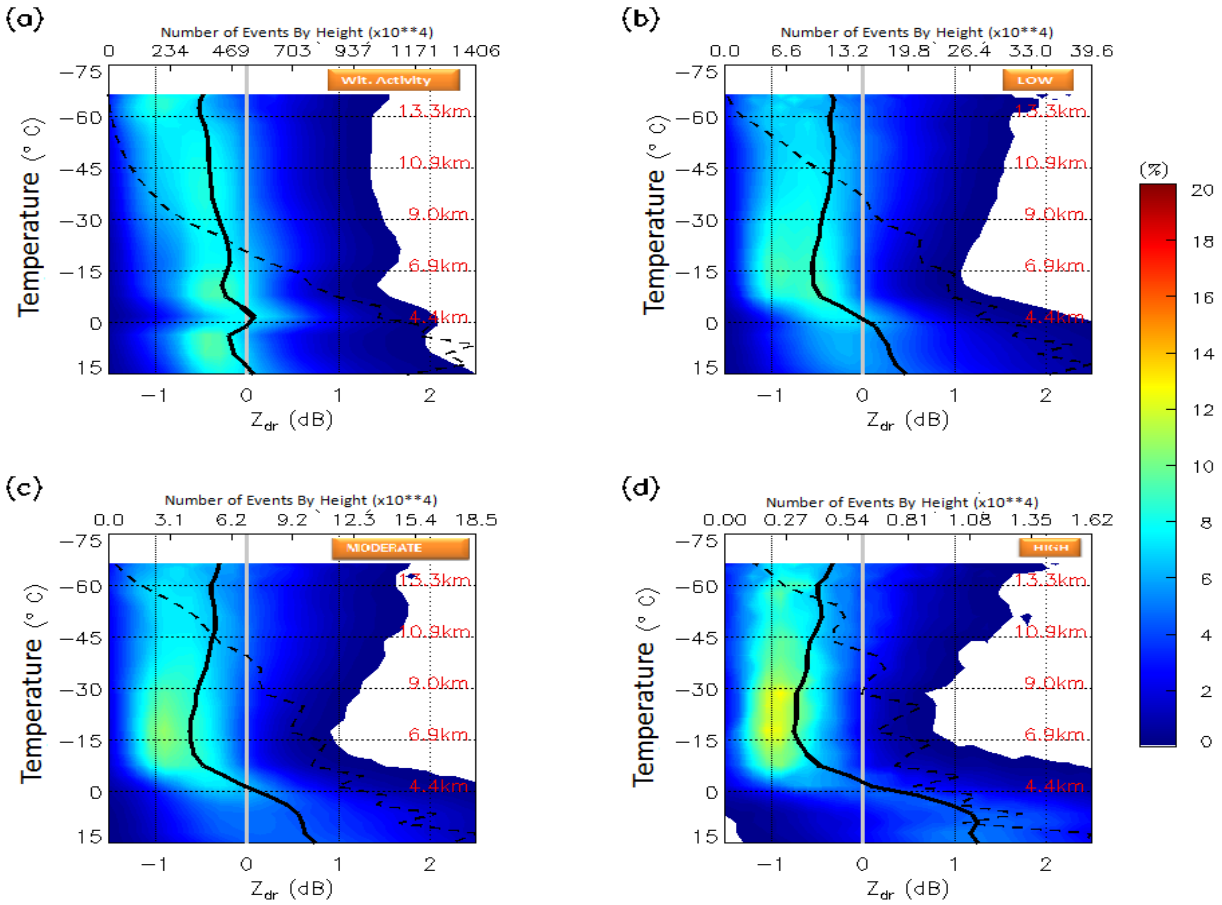
RESULTS: CFADS - DBZ

Distribution Shifts toward higher concentration of droplets



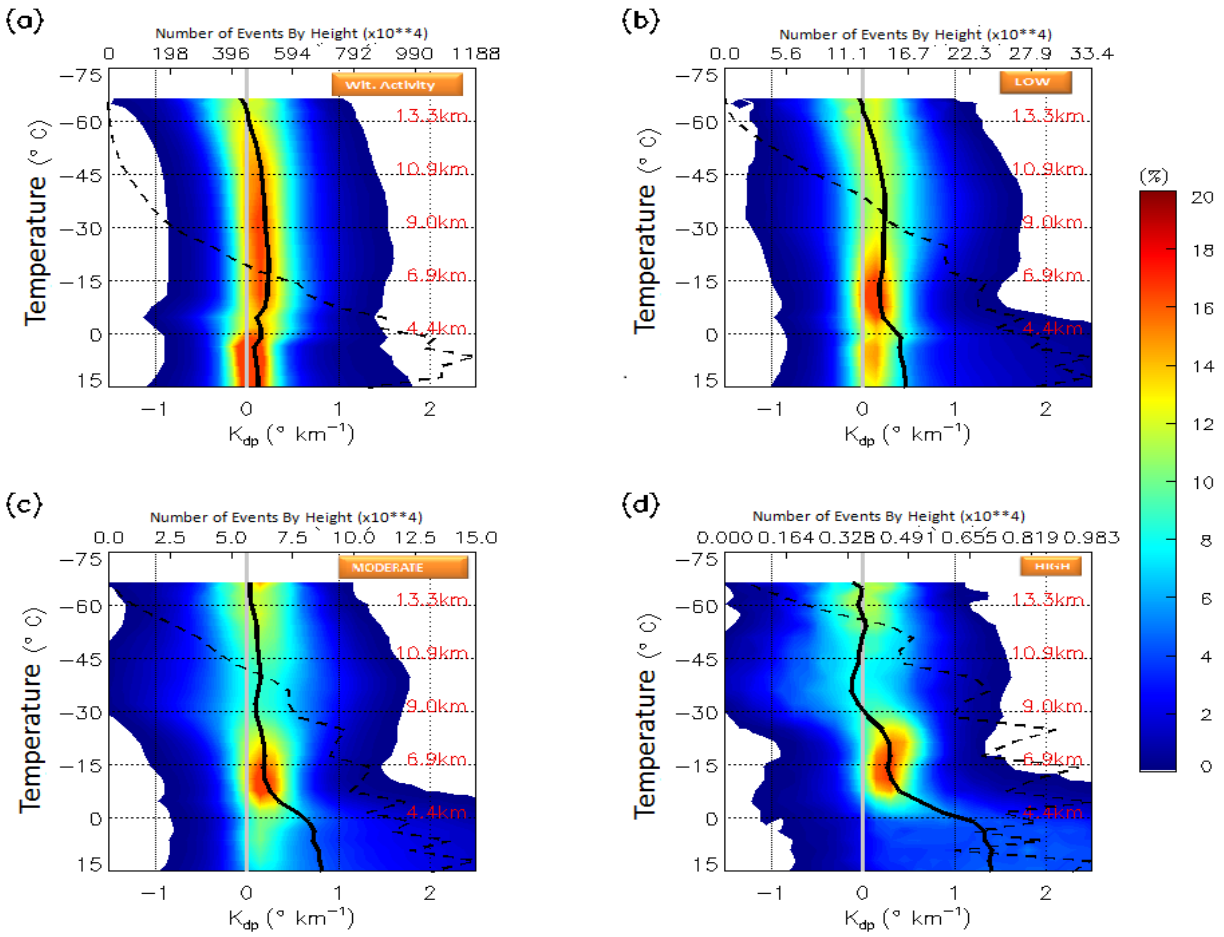
RESULTS: CFADS - ZDR

Distribution shifts toward negative ZDR and close ~7 Km



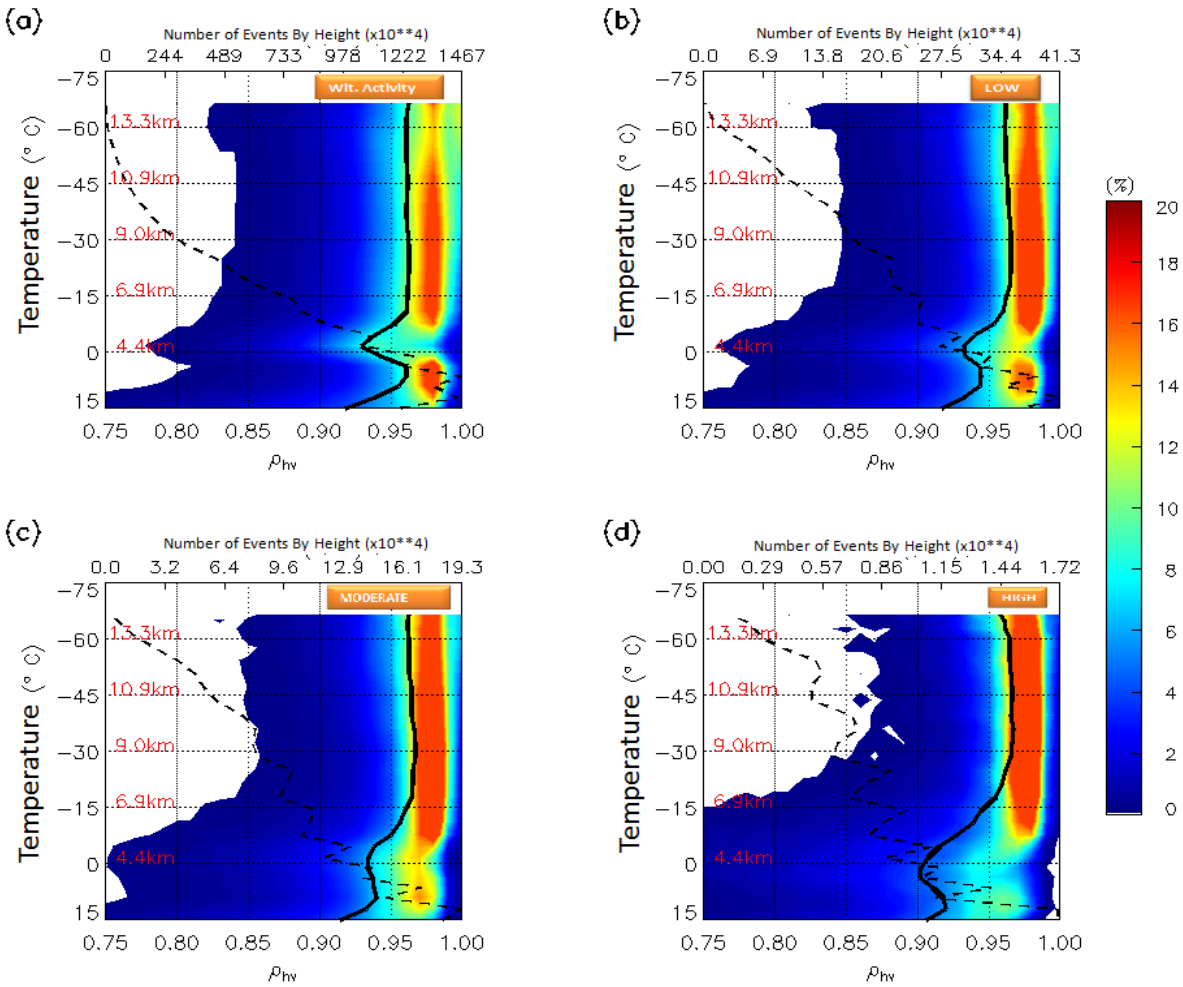
RESULTS: CFADS - KDP

Higher Electrical Activity is associated with distribution of KDP with more negative values



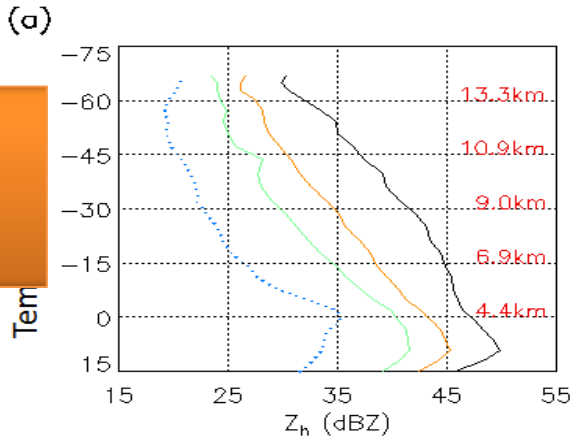
RESULTS: CFADS - CORRELATION

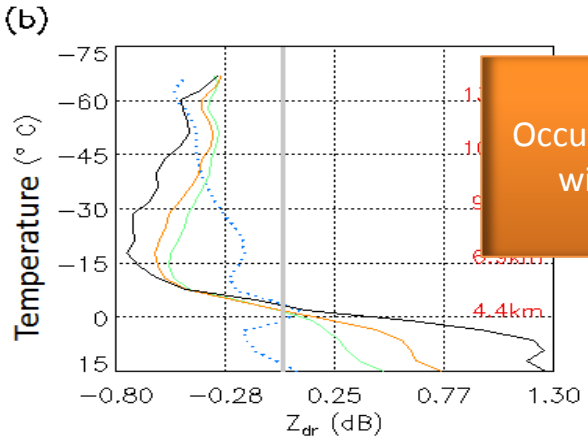
Higher Electrical Activity happens for highest values of Correlation Factor



RESULTS: Vertical Profile of Polarimetric Variables

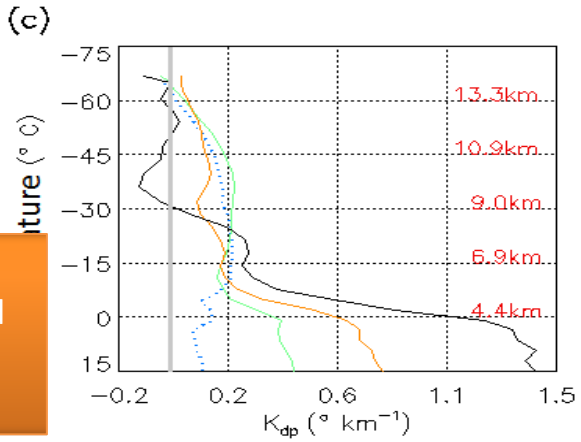
DBZ: Higher Occurrence associated with Convective Profile

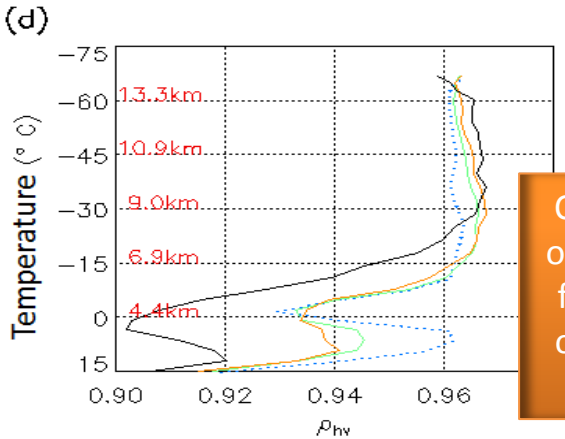




ZDR: Higher Occurrence associated with Ice Aliigned vertically

KDP: Electrical Activity associated with Oblatos hydrometeors

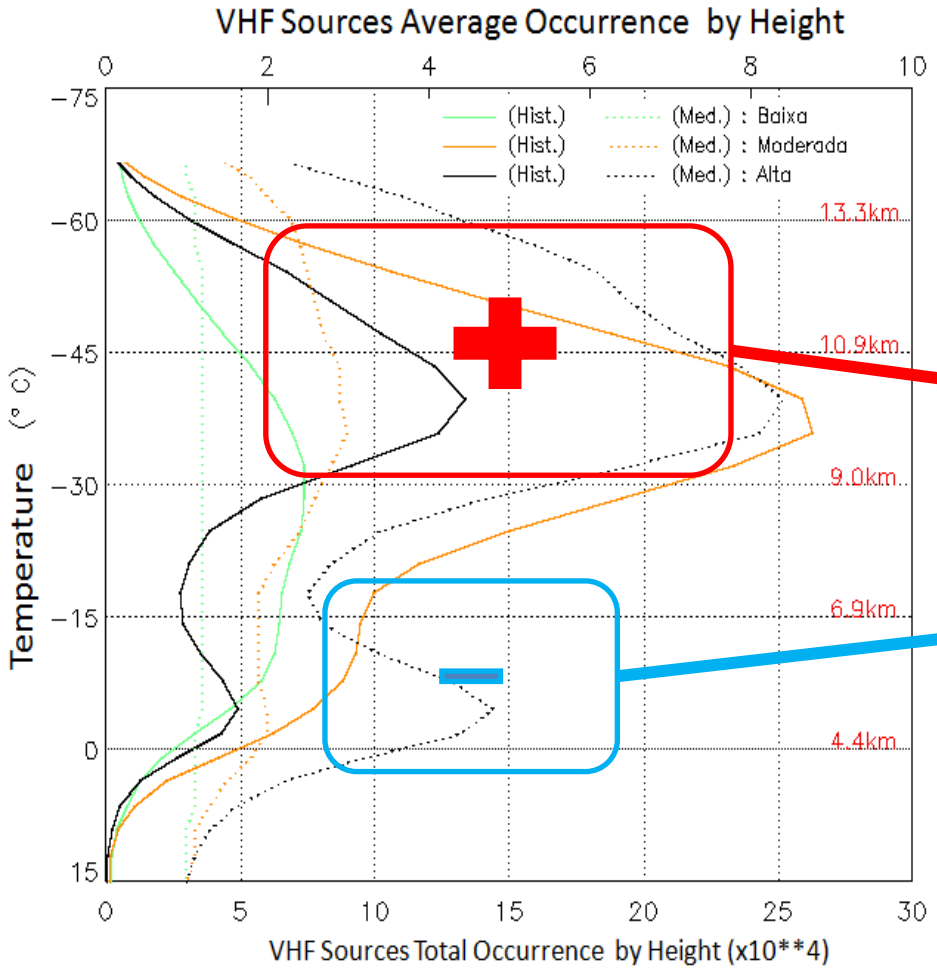


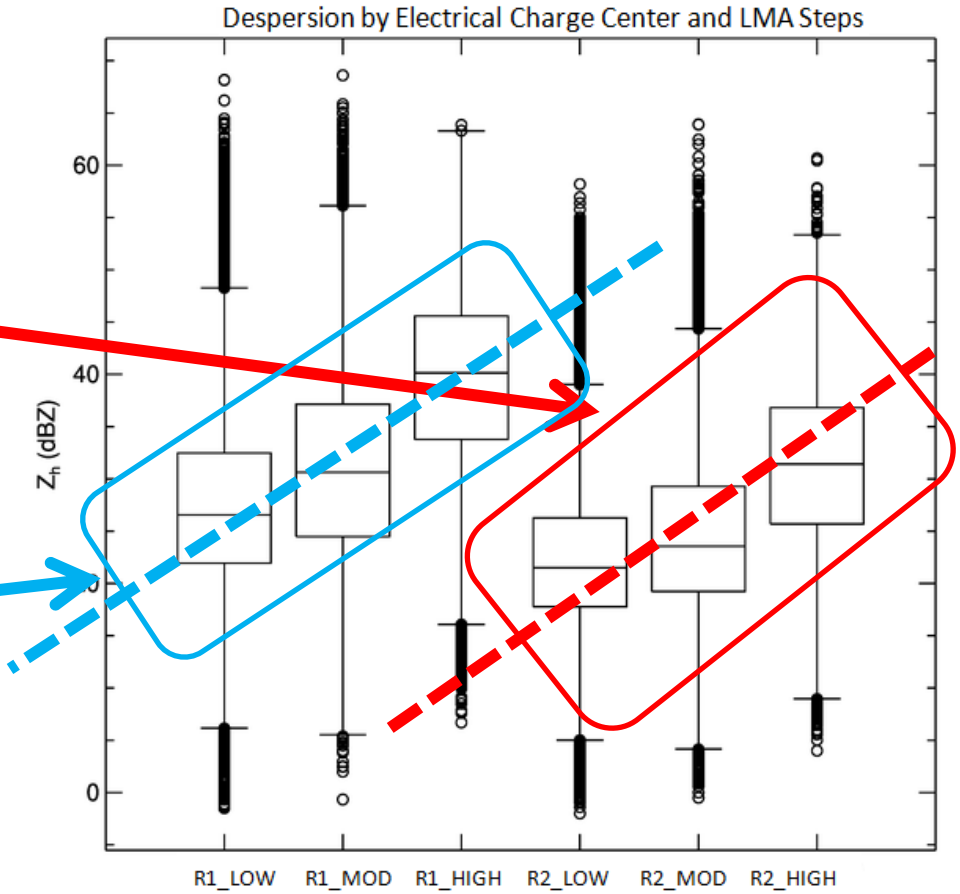


CORR: Warm Phase of cloud is very clear for Differents stpes of LMA. Cold Phase is more moderate

Wit. Activity Low Moderate High

RESULTS: Electrical Charge Center





1) Distribution of VHF Sources has an logarithmic form

2) Convective Profile has a good signature for differentiate electrical activity

3) Higher Electrical Activity is more correlated with ice crystal aligned vertically or with the conical graupel

4) Eletrification is correlated for an kind of hydrometeoror and has not good relathionship with mix of ice/water together.

5) Polarimetrics variables has a good signature for indentifie the Negative and Positive Center of Electrical Charge

WORK IN PROGESS:

Analysis for Polarimetrics Variables for intra-cloud lightning, Negative CG and Positive CG strokes

Creat an Conceptual Model that describe to the four "kind" of activity electrical in terms of Cloud Polarimetric Characteristics

•**ACKNOWLEDGEMENTS**
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THANK YOU FOR YOUR ATTENTION