Mesoscale Convective Systems: overview from Global Precipitation Measurement Mission….TRMM

Paola Salio

Julio 2010

Buenos Aires - Argentina

Overview

- Motivation
- Climatology and Variability
- First and second generation of precipitation estimations associated with MCSs
- Validation and Field Campaigns activities
- Conclusions

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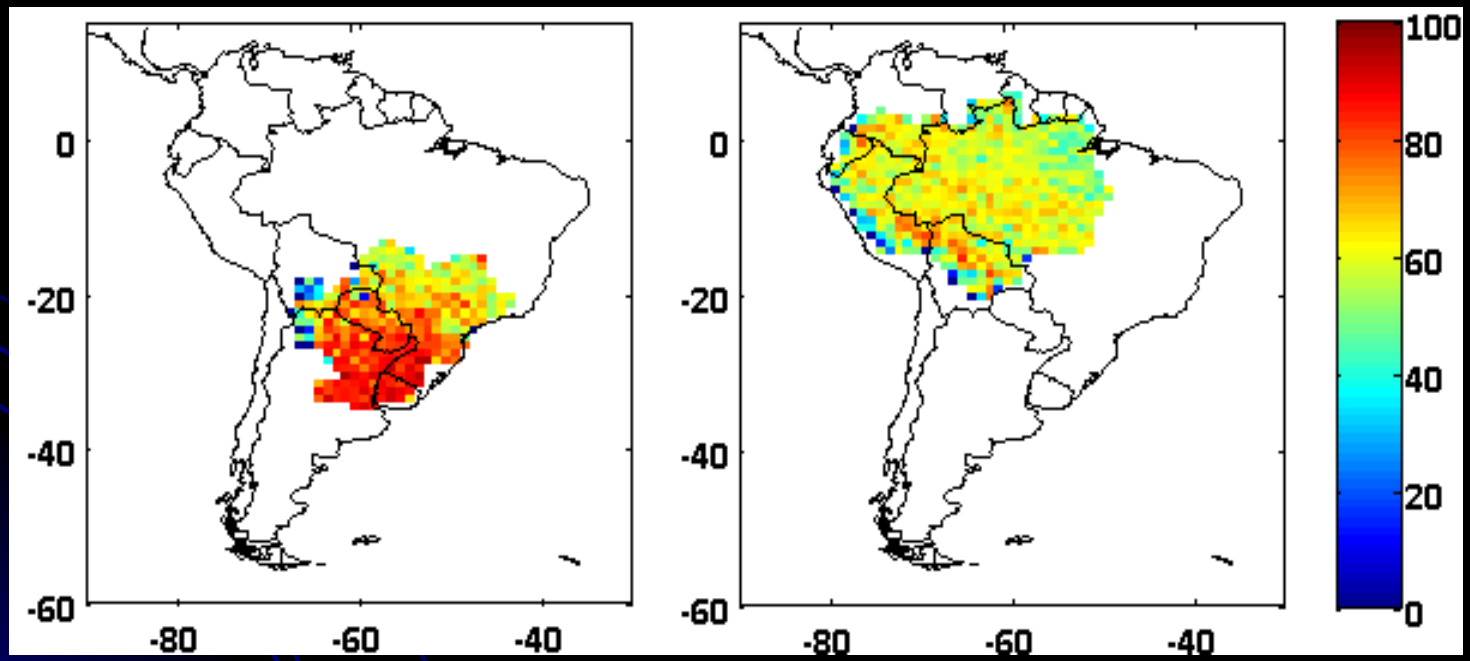
Why should we care about MCSs over South America?

MCSs are a significant rain producers. Large convective systems explain 90% of the precipitation over La Plata Basin and 60% over the Amazonas.

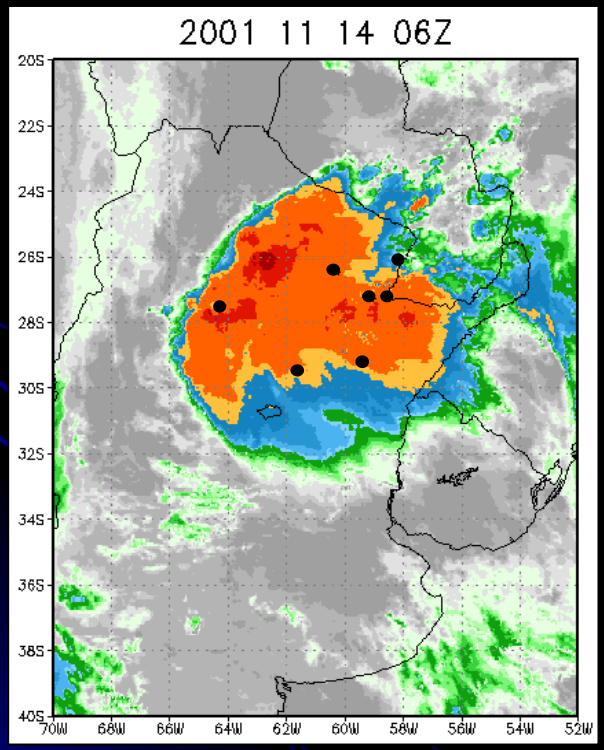


Precipitation Features observed by TRMM 1998-2010. Systems larger than 1500 km^2

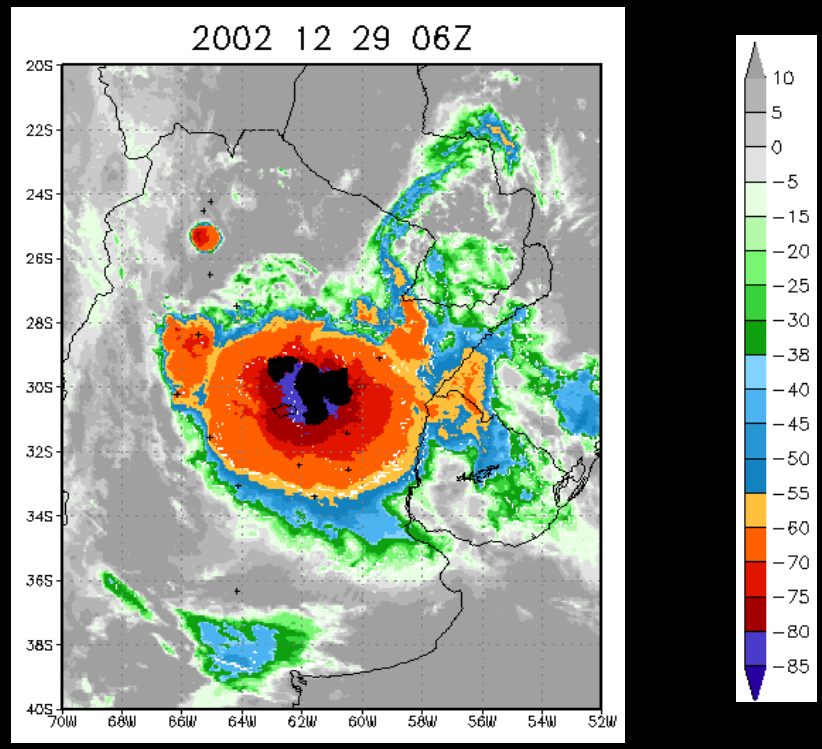
Why should we care about MCSs over South America?

MCSs produce a broad range of severe convective weather events: strong winds, hail, tornadoes, lightning, and flooding.

Hail Reports



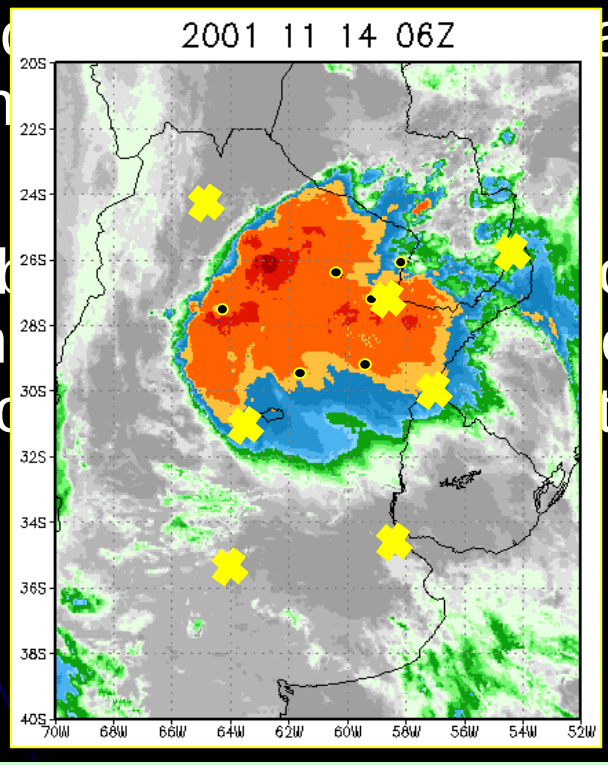
Precipitation reports higher than 20 mm/h



Why should we care about MCSs over South America?

MCSs are a real problem in quantitative precipitation forecast (QPF).

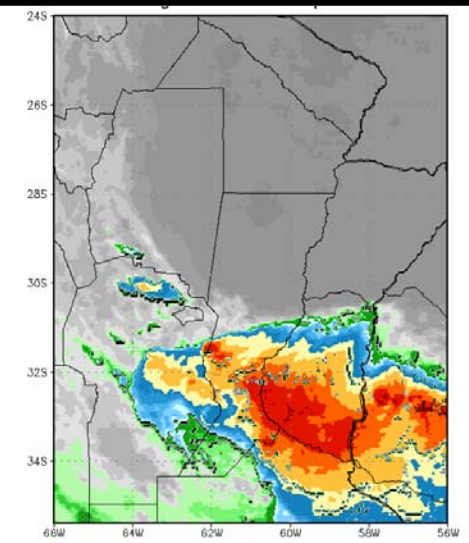
In general, these systems are small to be captured by the sparse routine upper-air so ailable in SA, but too large to be represen

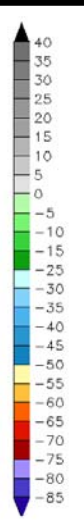


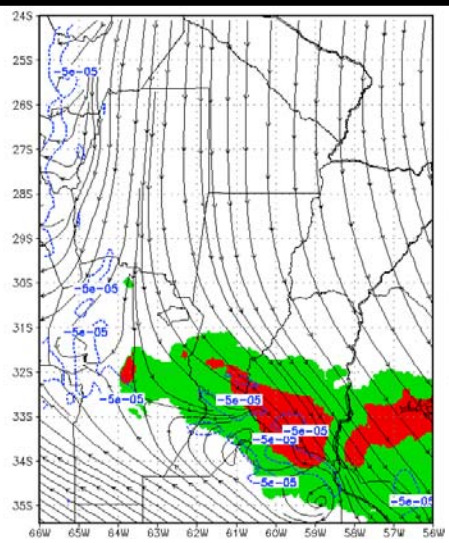
Pose a significant prob ce the systems require models with a dom ed kilometers, yet fine enough resolution to thunderstorm elements properly.

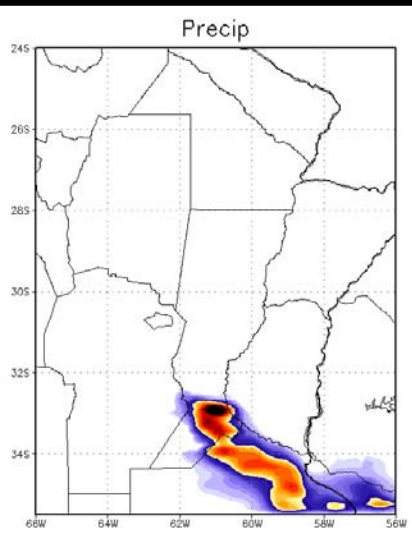
Why should we care about MCSs over South America?

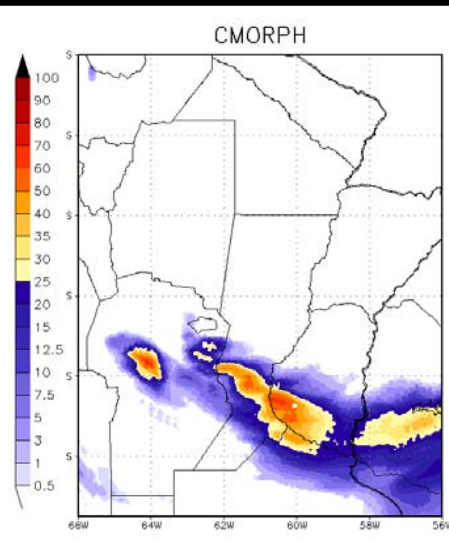
MCSs are a real problem in QPF……



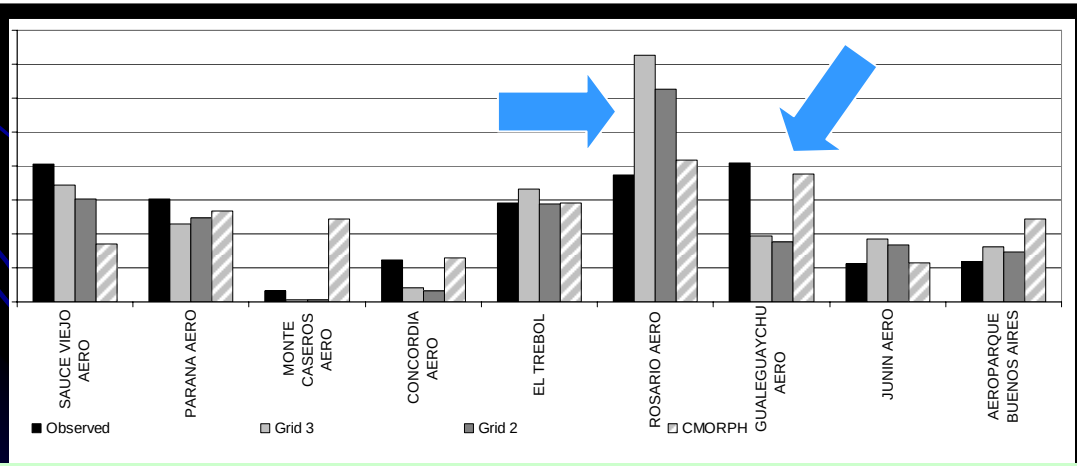








27 March 2007
06UTC



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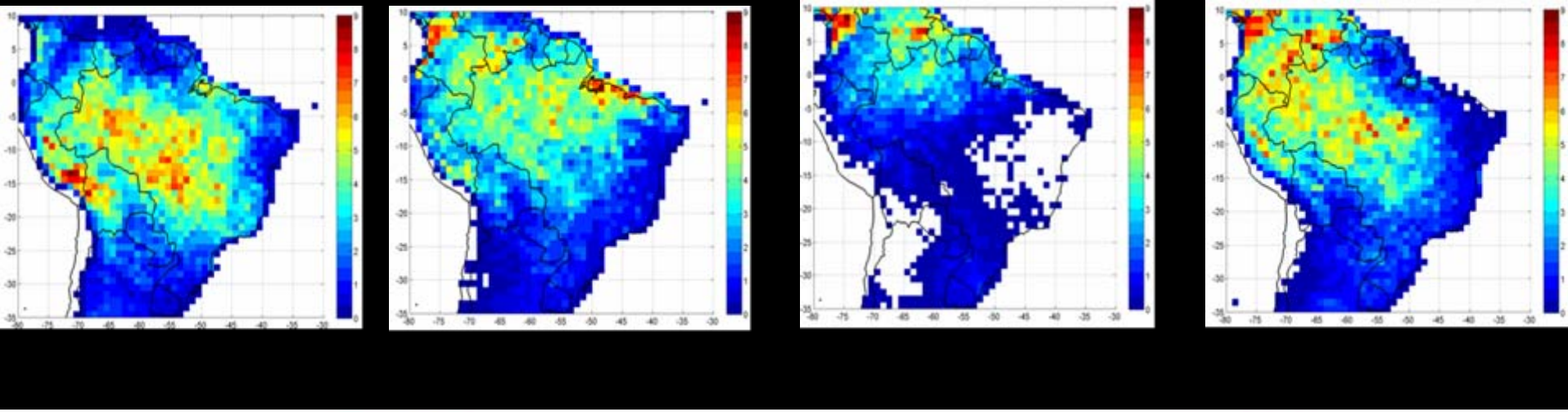
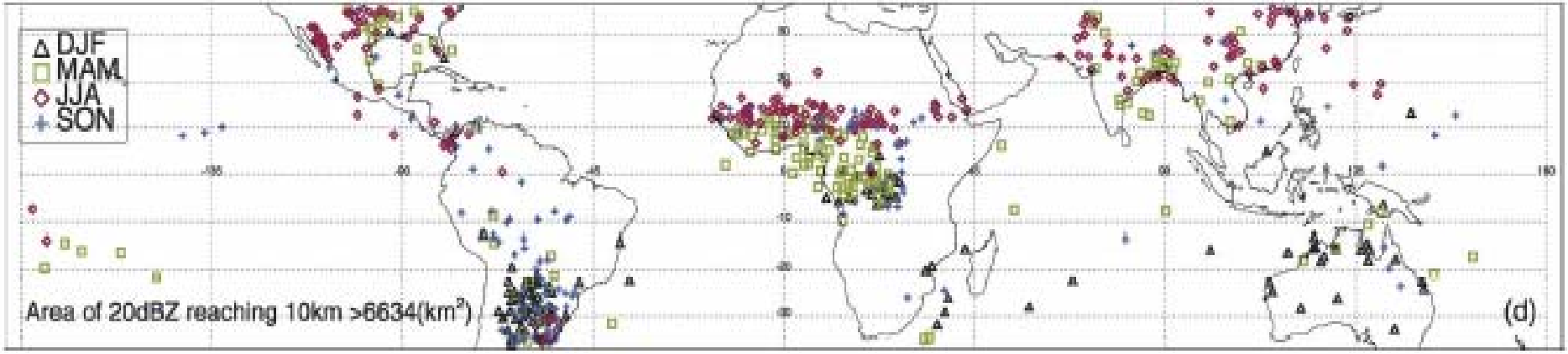
Climatology and Variability

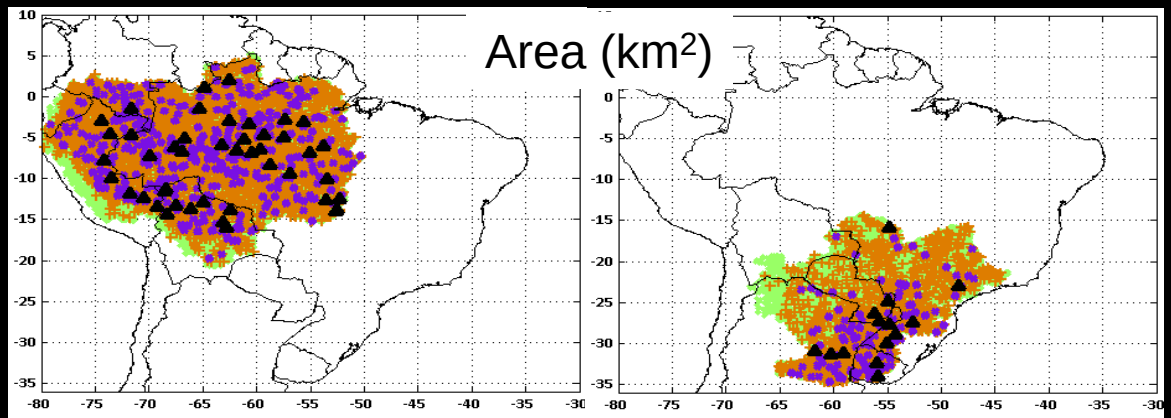
DJF MAM JJA SON

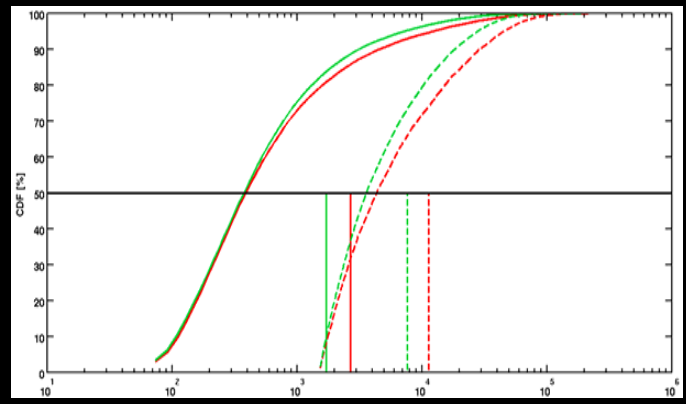


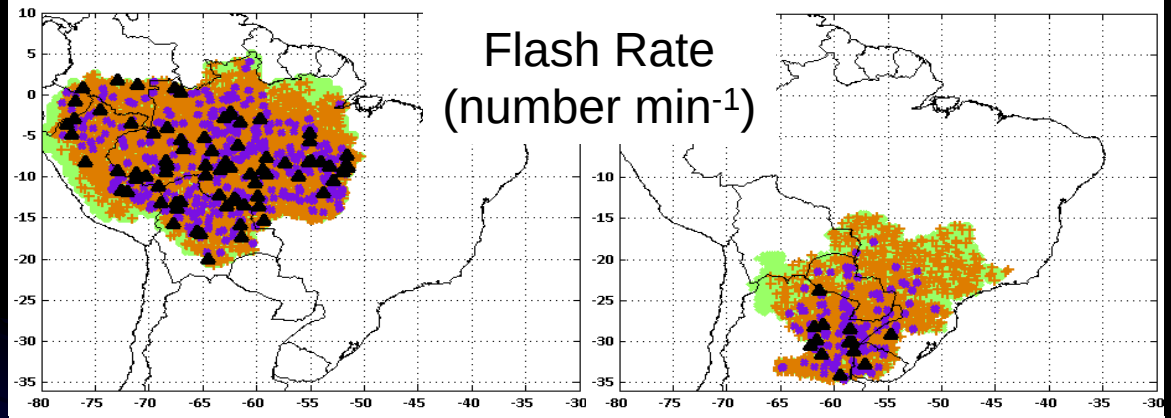


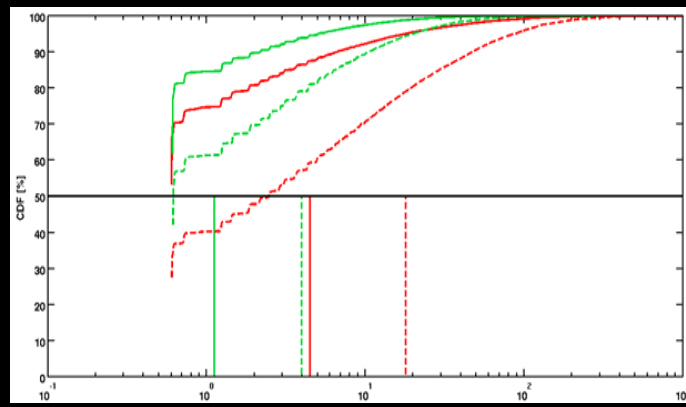
Liu and Zipser 2007

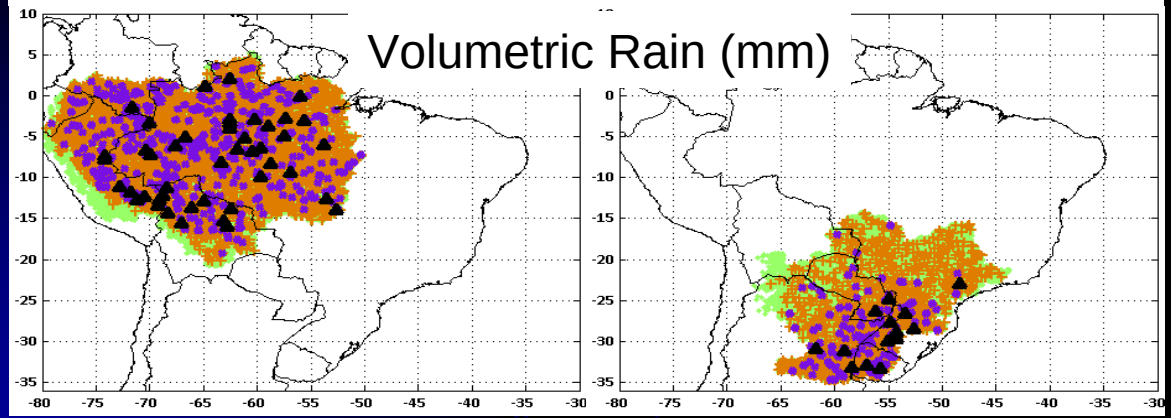
Extreme MCSs events in SA

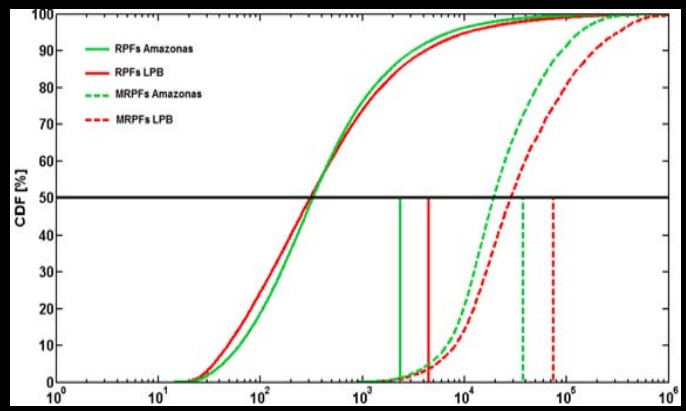










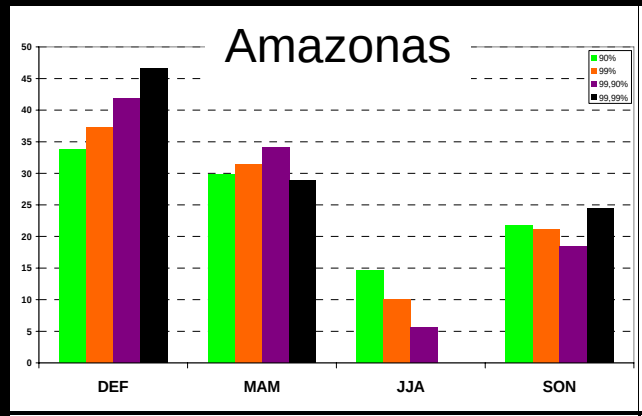


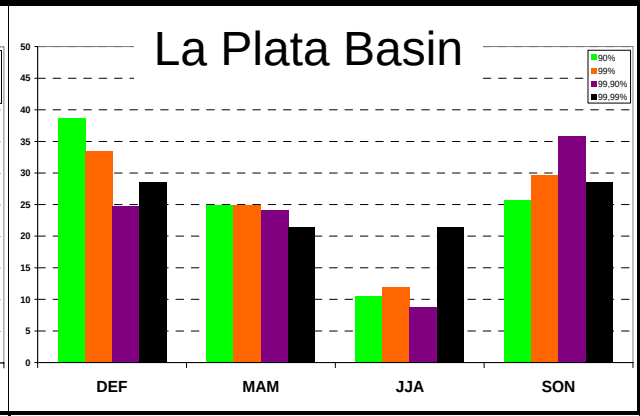
Extreme MCSs events in SA

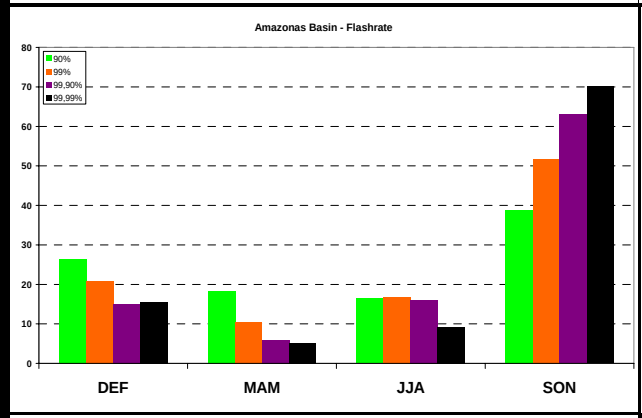
Area (km^2)

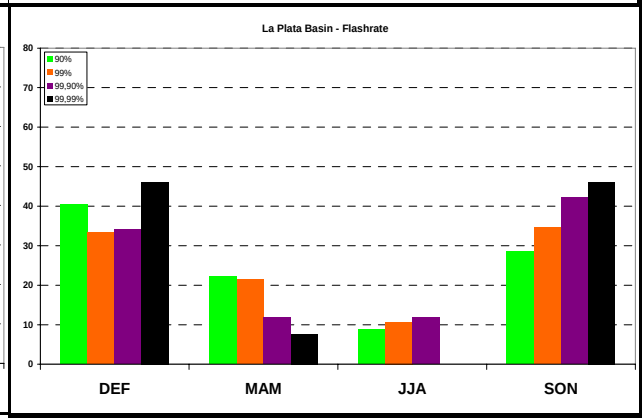
Flash Rate (number min^{-1})

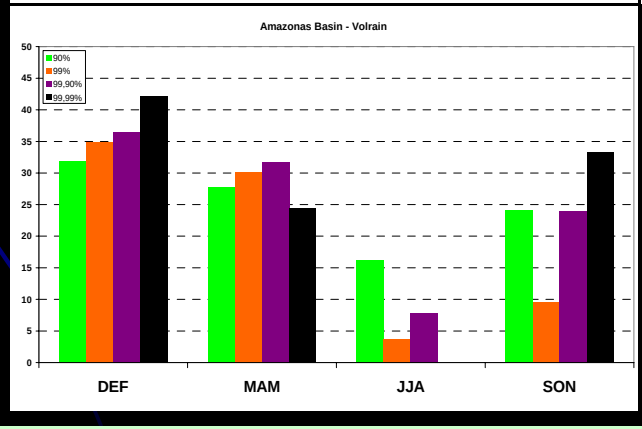
Volumetric Rain (mm)

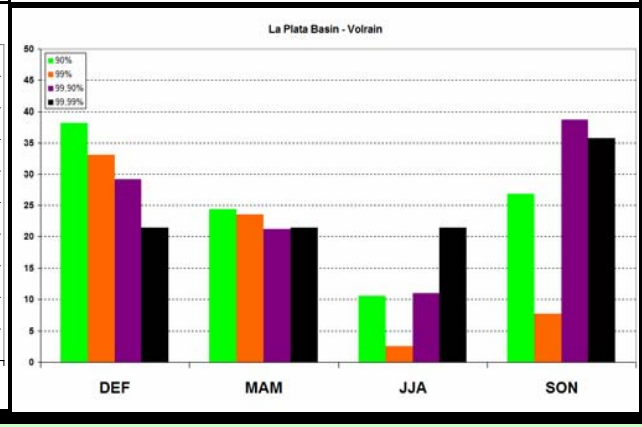












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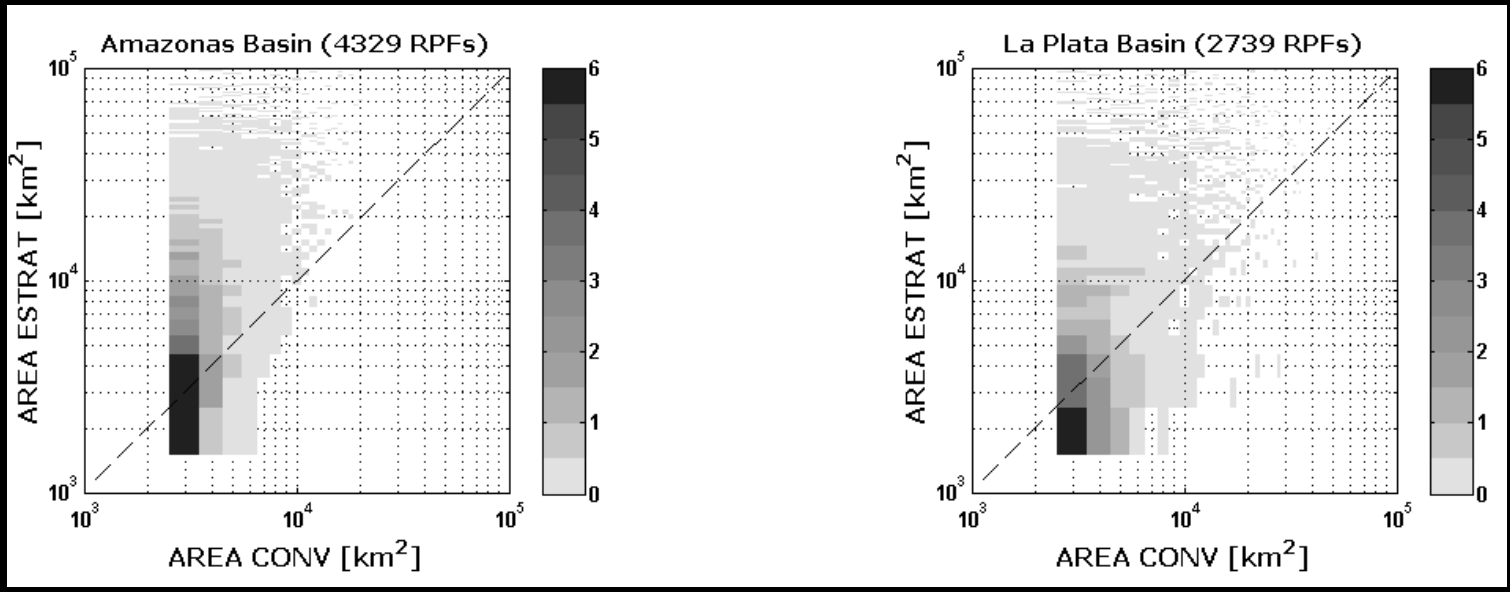
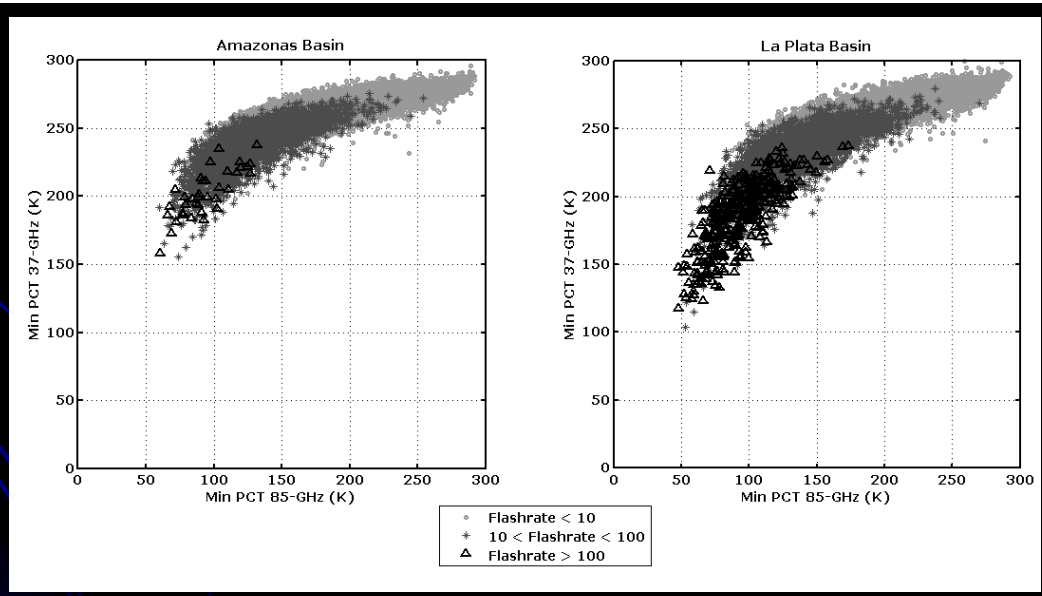
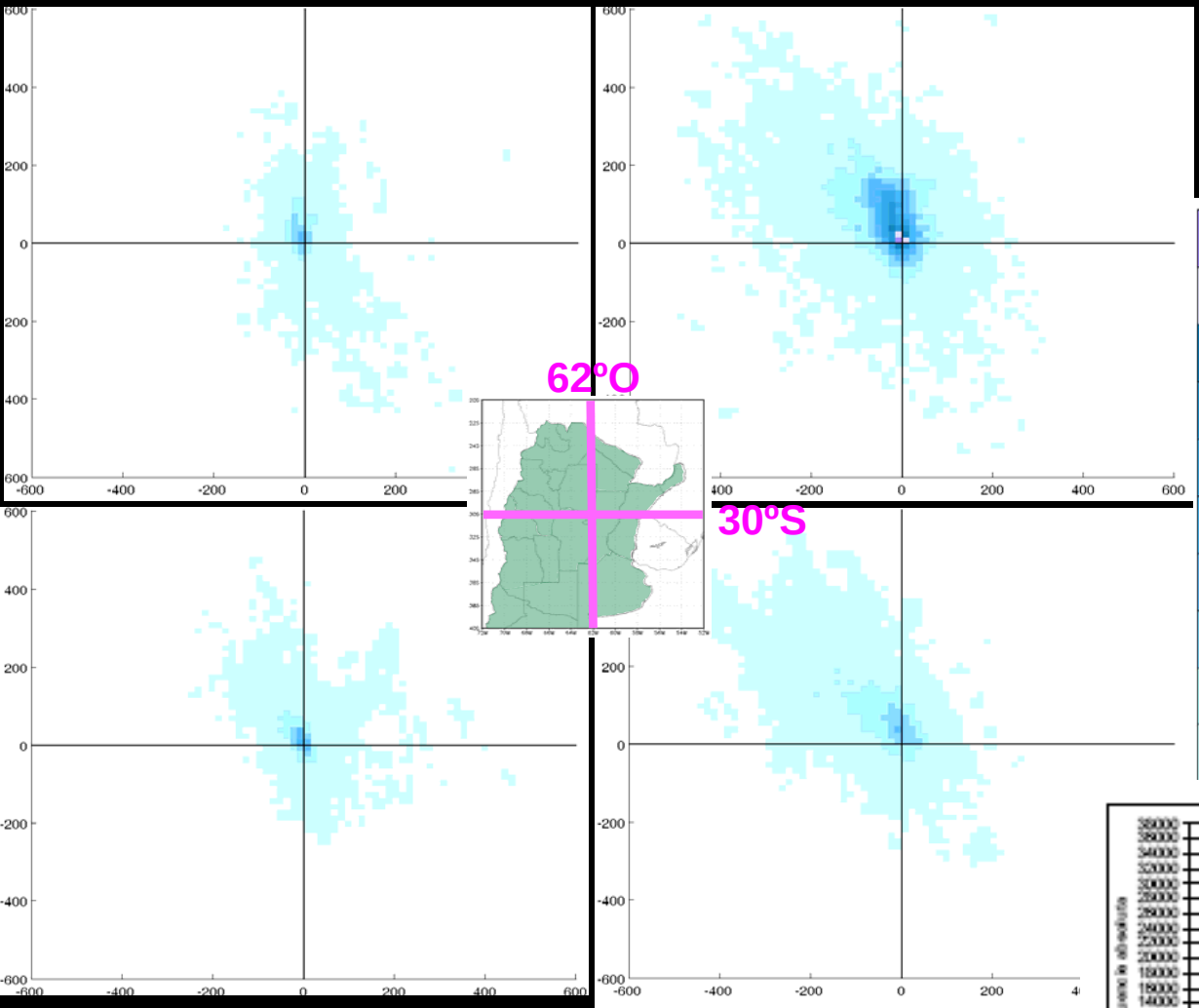
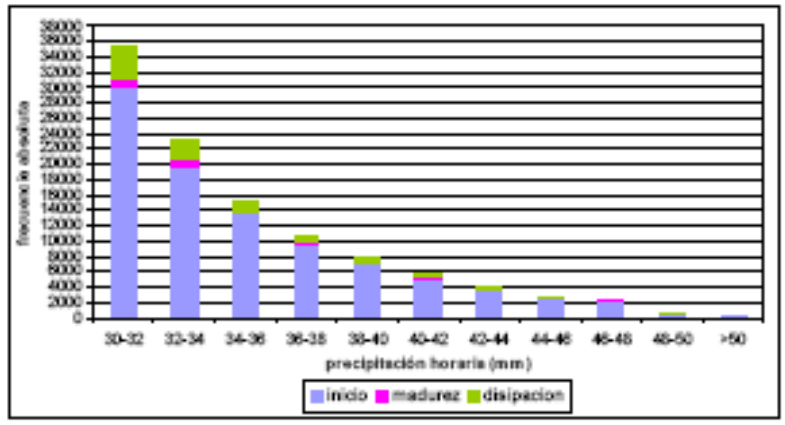




Extreme MCSs events in SA





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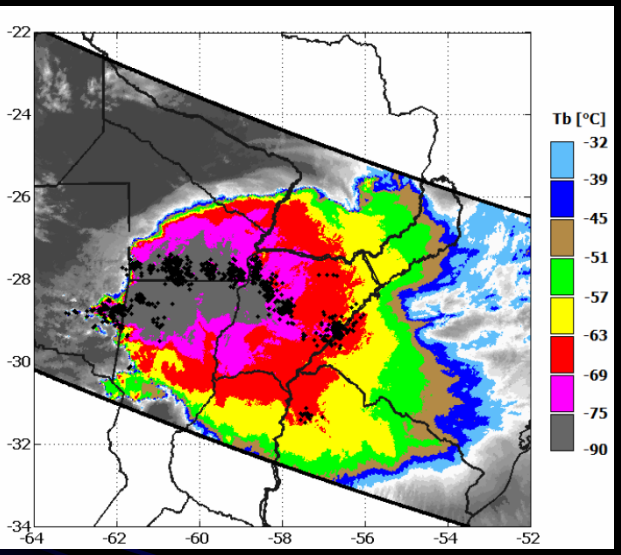
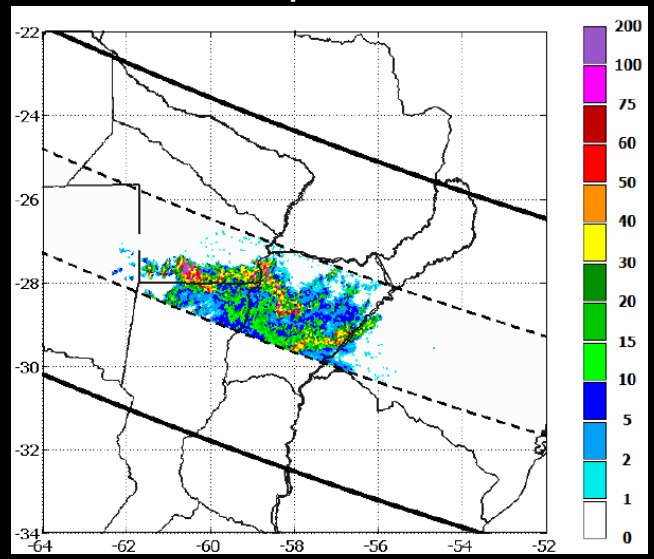
Precipitation Estimations over SA

Most extreme MCS in TRMM sample – 20 Dec 2003 8:24 Z

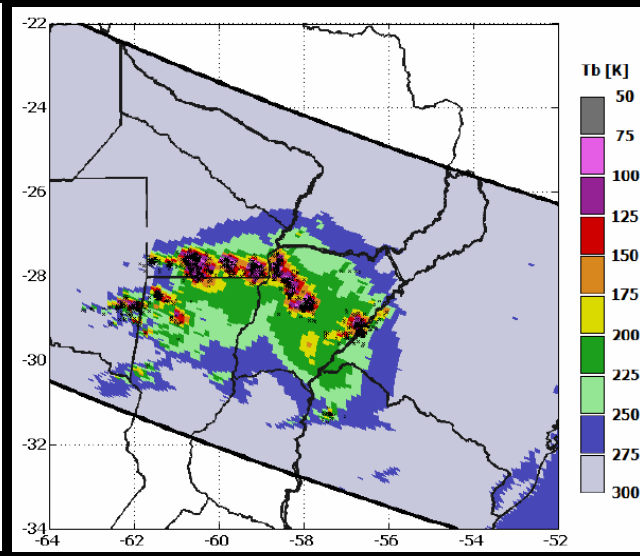
IR and LIS



2A25 Precipitation mm h^{-1}



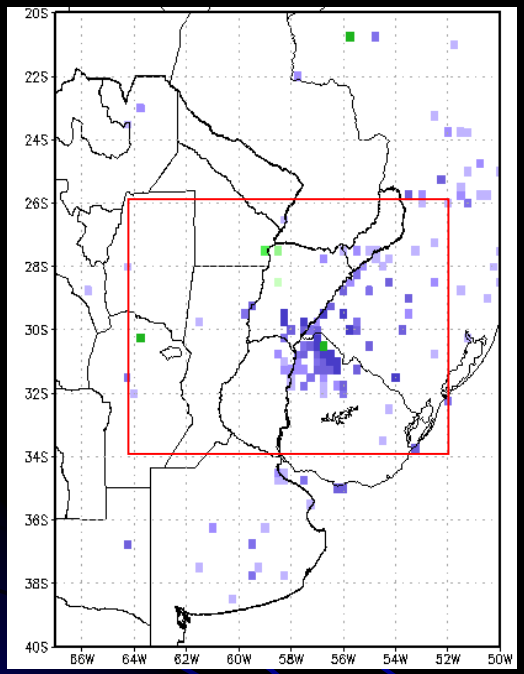
85 GHz PCT



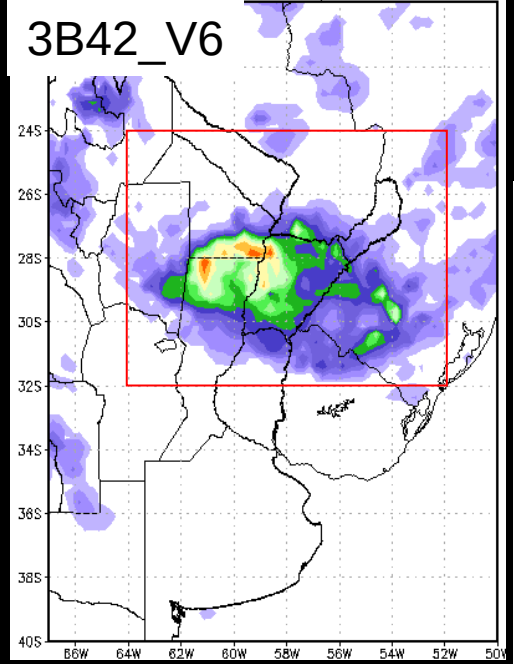
How does this system is represented by estimation of precipitation?

How do we trust in these estimations to climate purposes?

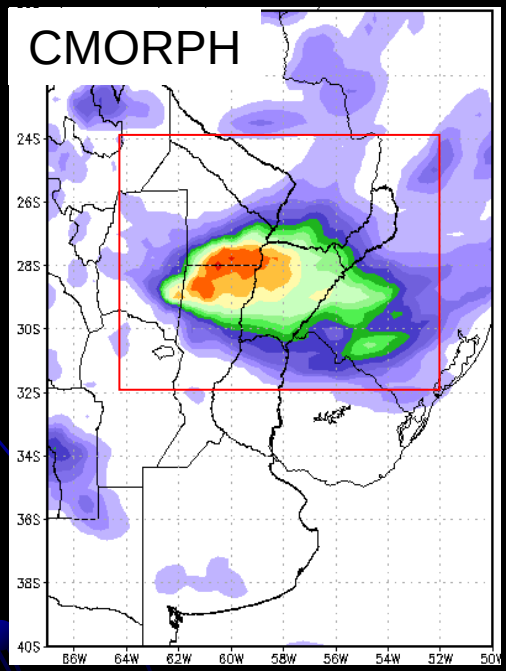
Observations

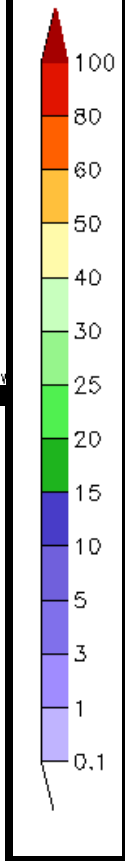


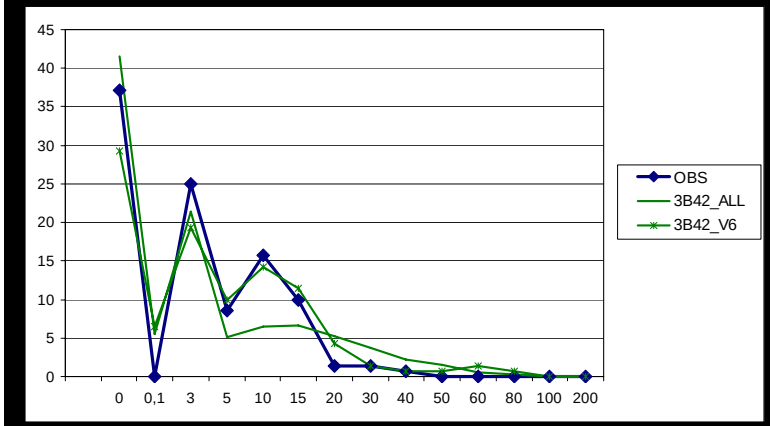
3B42_V6

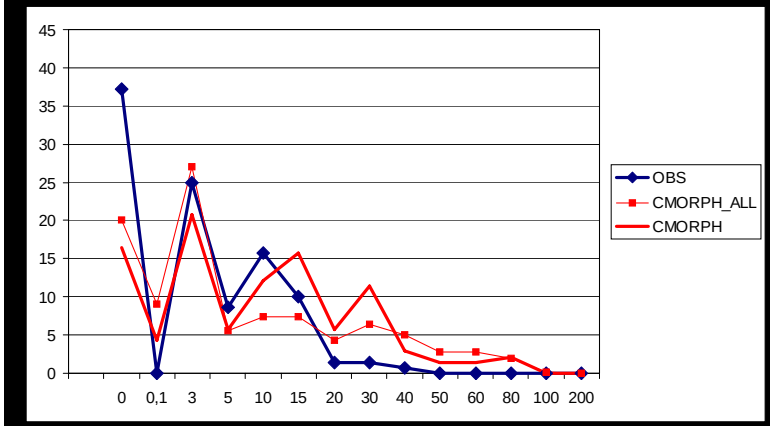


CMORPH



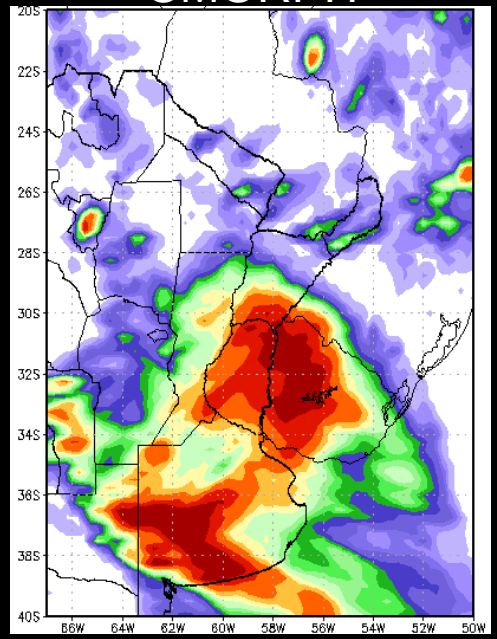






12 Jan 2010 12 UTC

CMORPH



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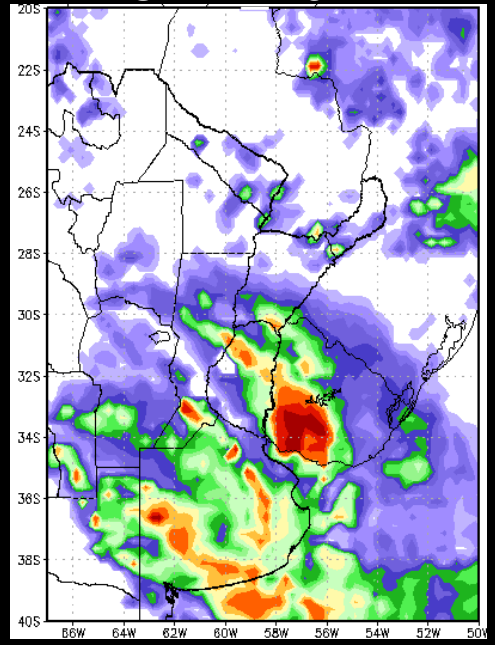
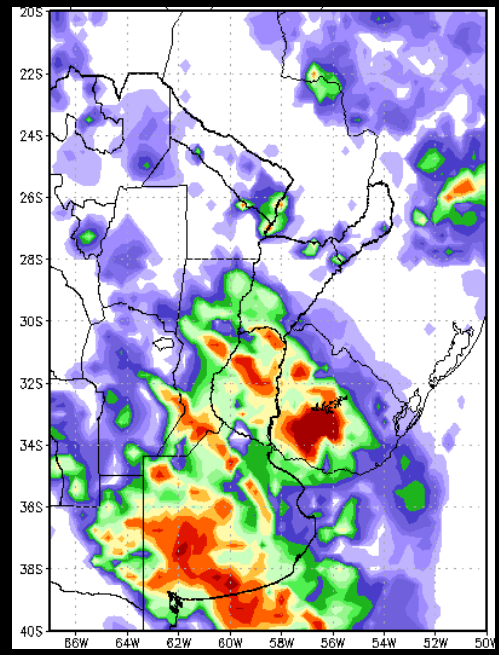
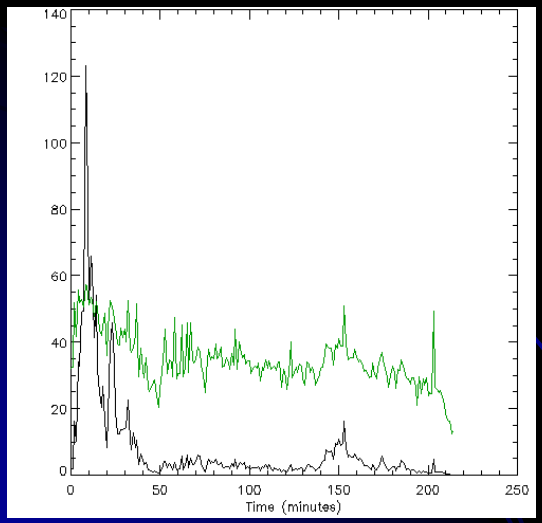
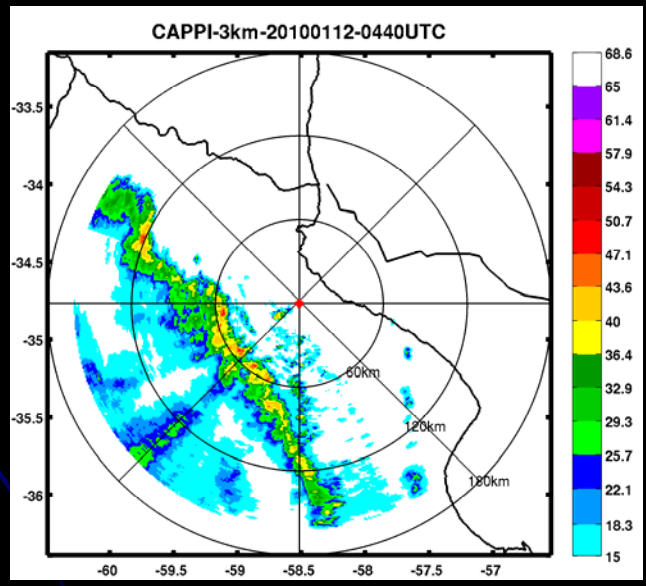


CoSch LPB

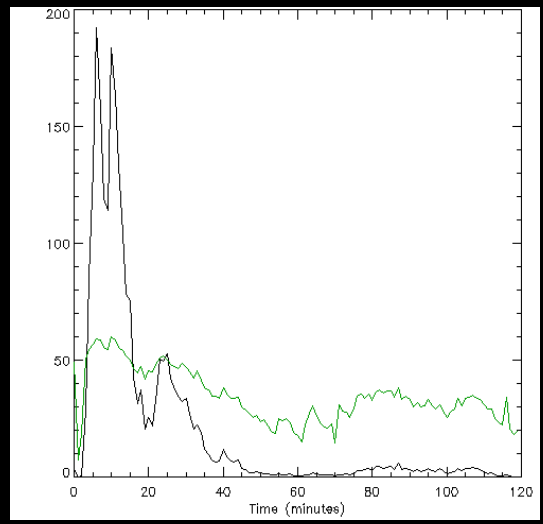


Castelar





Diamante



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Validation and Field Campaigns activities

GPM Reference Concept

An international satellite mission to unify and advance global precipitation measurements from dedicated and operational satellites

Low-Inclination Observatory (40º)

GMI (10-183 GHz)
(NASA & Partner LRD 2014)

- Enhanced temporal sampling for near-realtime monitoring of hurricanes and midlatitude storms
- Improved estimation of rainfall accumulation

GPM CORE Observatory (65º)

DPR (Ku-Ka band)
GMI (10-183 GHz)
(NASA-JAXA, LRD 2013)

- Precipitation physics observatory
- Reference standard for inter-calibration of constellation precipitation measurements

Partner Satellites:

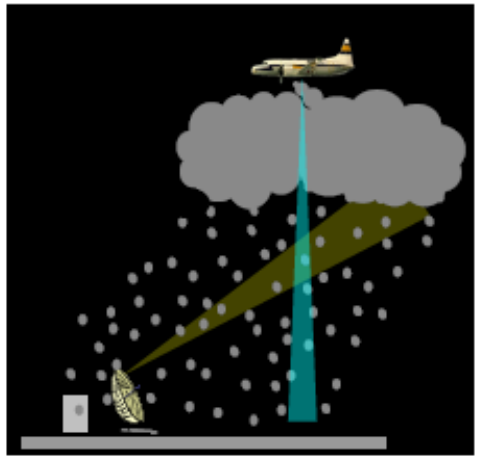
GCOM-W1, DMSP, Megha-Tropiques, plus MetOp, NOAA-N', NPP, NPOESS (over land)

From R. Kakar presentation al Helsinki, June 2010

Validation and Field Campaigns activities

International GV Science Collaboration

- *Direct statistical validation (surface)*
- *Precipitation physics validation (vertical column)*
- *Integrated science validation (4-dimensional)*



Active Projects

- Argentina (U. Buenos Aires)
- Australia (BOM)
- Brazil (INPE)
- Canada (EC)
- *Ethiopia (AAU)*
- Finland (FMI)
- France (CNRS)
- *India (ISRO)*
- Germany (U. Bonn)
- Israel (Hebrew U. Jerusalem)
- Italy (CNR-ISAC)
- *Italy (Sapienza U. Rome)*
- South Korea (KMA)
- Spain (UCLM)
- United Kingdom (U. Birmingham)

Proposals in Development

- Cyprus (CMS)
- Germany (MPI)
- Spain (Barcelona)
- Taiwan

Through No-Cost Proposals to NASA PMM Science Program

From R. Kakar presentation al Helsinki, June 2010

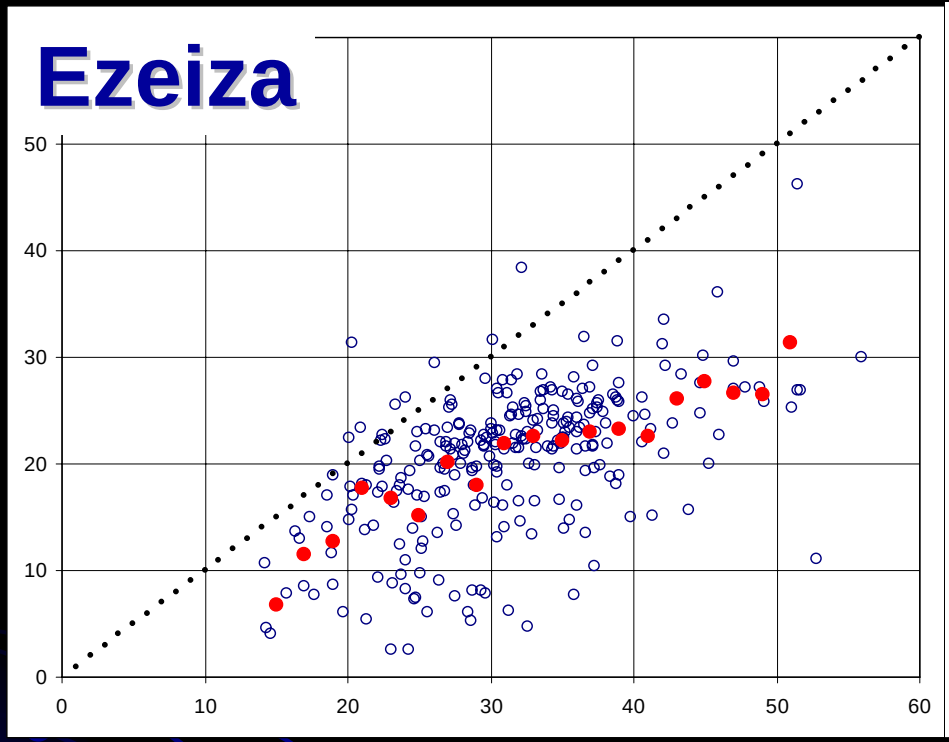
Validation and Field Campaigns activities

Last austral summer: Two Thies disdrometers from DSA-CPTEC were deployed close two:
Paraná Radar Dual Polarization
Ezeiza
November 2009 – January 2010

Future: Two new disdrometers are comming and make field campaings during CHUVA windows over the four radars

Preliminar results…….Radar and disdrometer comparation

1.3 km

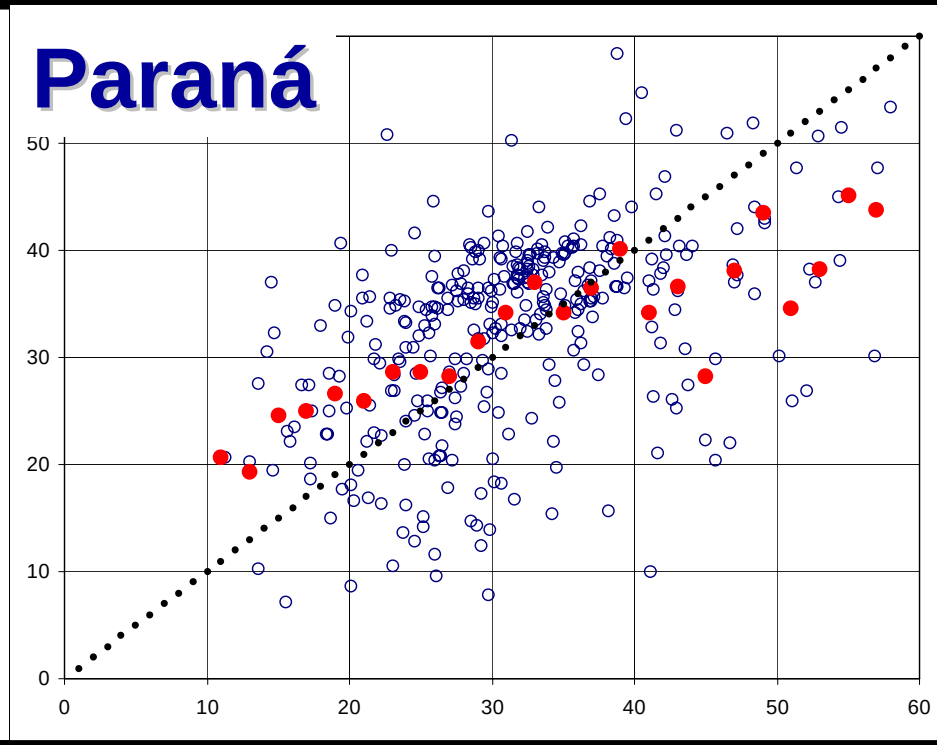


10 to 40 dB

RMS 1.3 km 4.7 dB

BIAS 1.3 km -9.2 dB

1.3 km



10 to 40 dB

RMS 1.3 km 6.6 dB

BIAS 1.3 km 4.4 dB

Blue 10'-running mean

Red SIFT 2 dBZ

CHUVA Project
Lead: Luiz Agusto Toledo Machado

Experiments

Table I : Field Campaign Schedule

	Jan	FEB	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dez
2010			Centro de Lançamento de Alcântara									São Luiz Paraitinga
2011	São Luiz Paraitinga		Fortaleza	Fortaleza		Belém	Belém				Manaus	Manaus
2012				Londrina	Londrina		Santa Maria	Santa Maria		Brasília	Brasília	

Field Activities

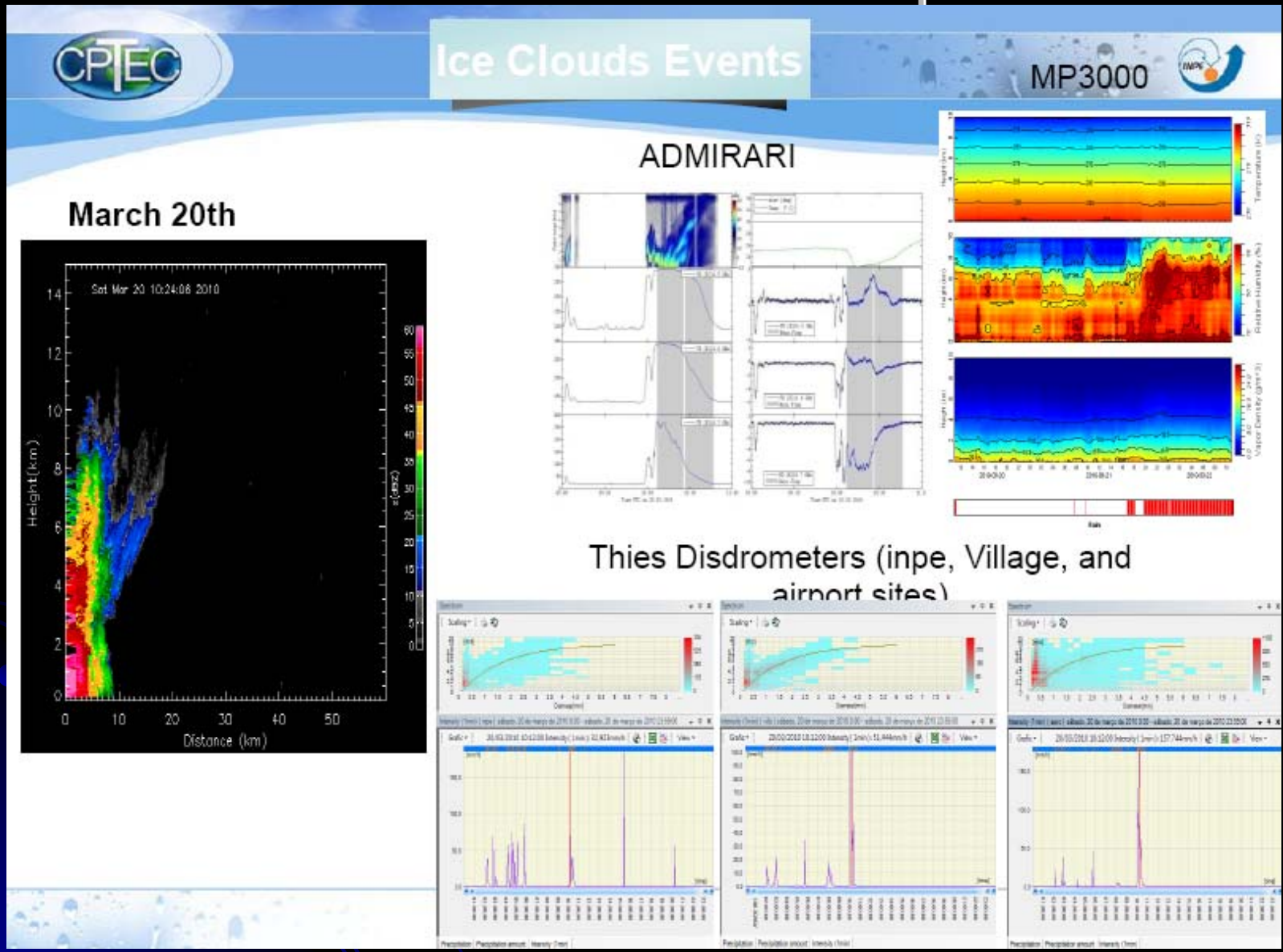
Table III – Main precipitation systems for each region

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dez
2010			Warm Clouds, Tropical Squall Lines, Easterly Waves									SACZ, local convection and orographic enhancement of precipitation Warm Clouds
2011	SACZ, local convection and orographic enhancement of precipitation Warm Clouds			Warm Clouds, Easterly Waves, ITCZ	Warm Clouds, Easterly Waves, ITCZ		Tropical Squall Lines, Warm Clouds, Easterly Waves	Tropical Squall Lines, Warm Clouds, Easterly Waves			Easterly and Westerly Convection type, local convection SACZ Warm clouds	Easterly and Westerly Convection type, local convection SACZ Warm clouds
2012				Cold Front, squall lines, MCC General convective system	Cold Front, squall lines, MCC General convective system		Cold Front, squall lines, MCC General convective system	Cold Front, squall lines, MCC General convective system		Continental convective system Warm clouds	Continental convective system Warm clouds	

Cloud microphysics and electrification processes
Cloud scale processes
PBL evolution supporting MCSs
Cloud modelling

New experiment at Foz de Iguazu
From 10-2012 to 1-2013
Joint effort with LPB field activities

Firts results …… Alcantara initial experiment



from Luiz Machado presentation al Helsinki, June 2010

Conclusions

What should we do in order to understand MCSs behavior….

Develop a methodology that will make it possible to have reliable rainfall estimates from different observation sources in the Plata Basin during MCSs events.

Advance the characterization of deep moist convection over SESA.

Study the impact of mesoscale convective systems on rainfall over SESA and their impact on the diurnal cycle of rainfall.

Advance the knowledge on the mesoscale mechanisms that trigger and affect the evolution of organized deep moist convection and its impact on rainfall and possible generation of severe phenomena.

Perform field campaigns that help to advance in those objectives, waiting for GPM mission to be launched at 2013 considering dual polarization plataform.

Conclusions

What should we do in order to understand MCSs behavior….

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Advance the characterization of deep moist convection over SESA.

Study the impact of mesoscale convective systems on rainfall over SESA and their impact on the diurnal cycle of rainfall.

Advance the knowledge on the mesoscale mechanisms that trigger and affect the evolution of organized deep moist convection and its impact on rainfall and possible generation of severe phenomena.

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Thanks for your attention

Thanks to Luiz Machado, Daniel Vila and Luciano Vidal providing information

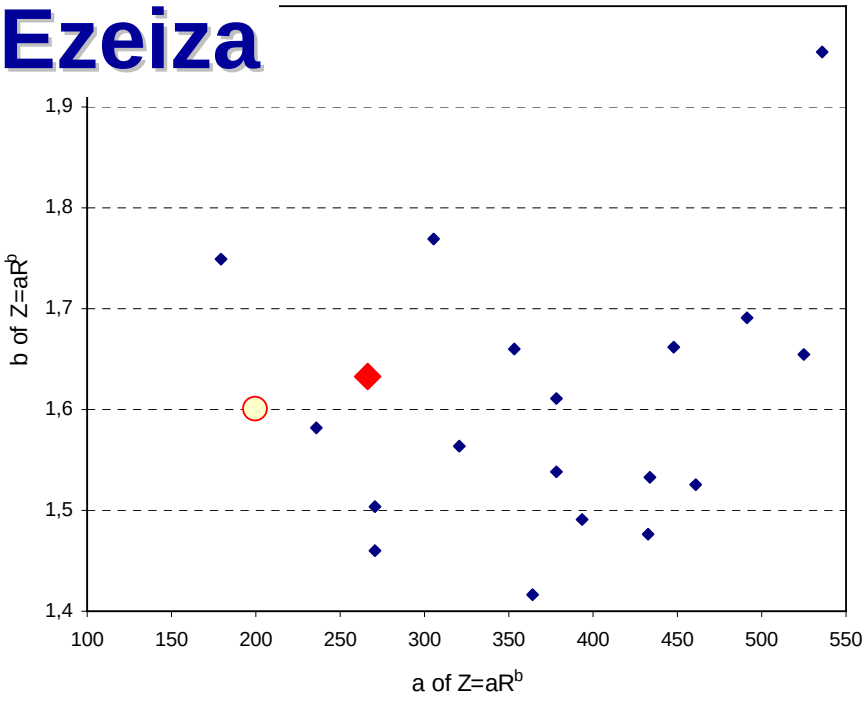
Climatology and Variability

	AREA (km2)		FLASHRATE (#/min)		VOLRAIN (mm km2)	
	AB	**LPB**	**AB**	**LPB**	**AB**	**LPB**
90,00%	943	1128	0	0,6	3148	4119
99,00%	11174	20905	8	31,6	42544	91215
99,90%	43411	76323	39	181,4	185310	456660
99,99%	82351	132880	79,5	472,6	399370	1053500

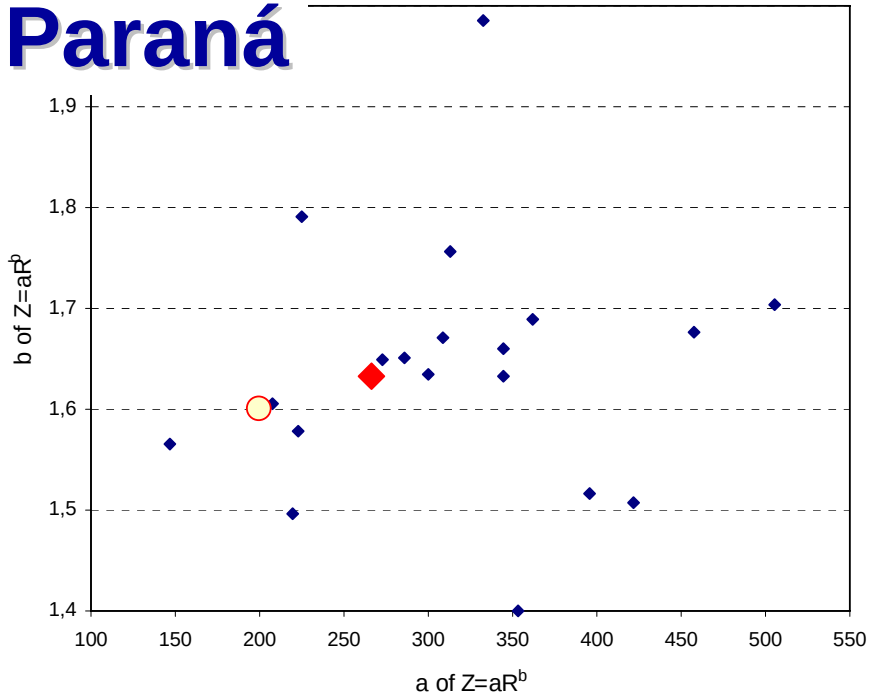
Preliminar results….

Estimation of Z-R relationshionship

Ezeiza



Paraná



Red $Z=aR^b$ according with DSD

Yellow $Z=200\ R^{1.6}$

19 + 20 events longer than 1 hour
Most of them were nocturnal

Ezeiza
BIAS= -3.5 $mm^6\ m^{-3}$

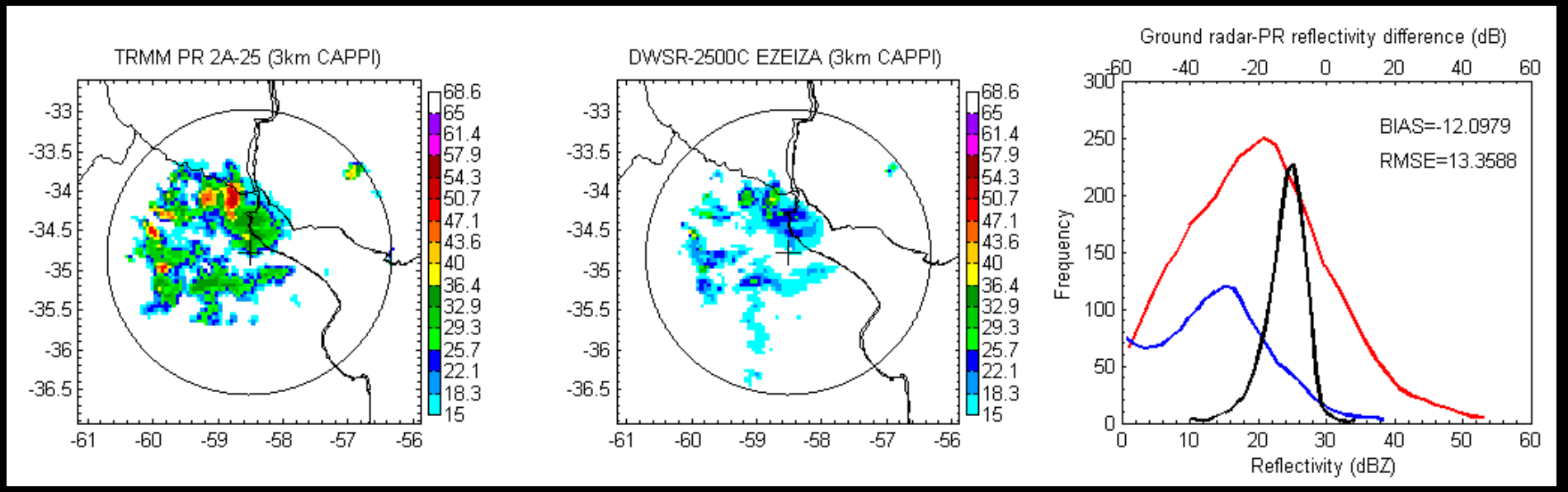
RMS = 7.5 $mm^6\ m^{-3}$

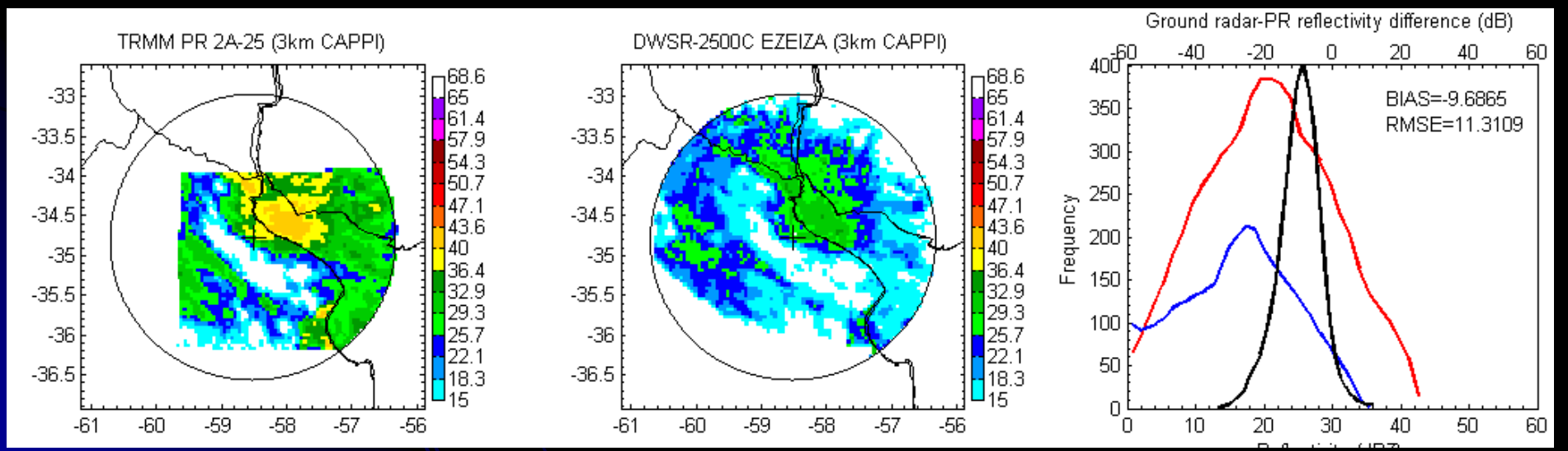
Paraná
BIAS= -2.7 $mm^6\ m^{-3}$

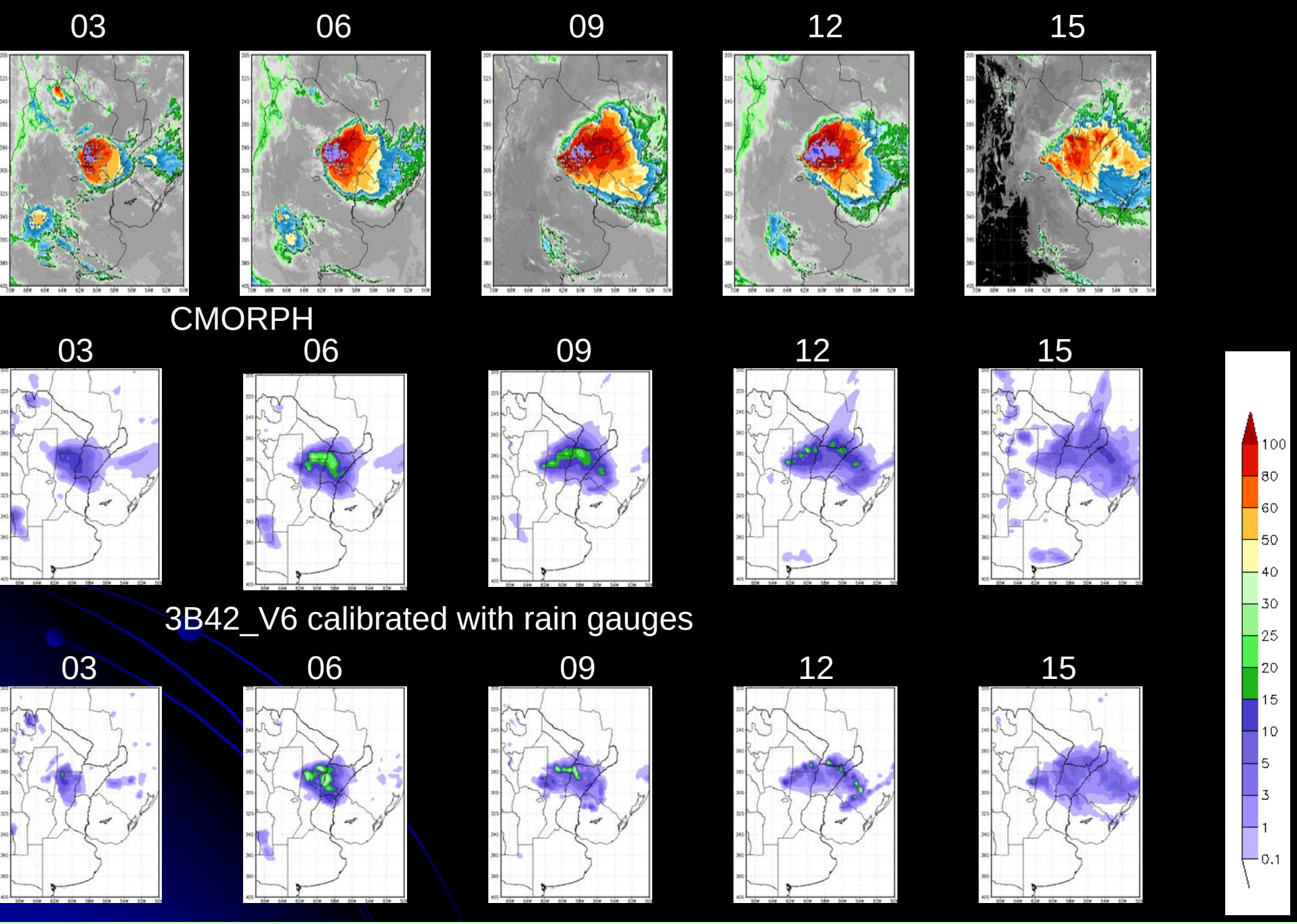
RMS = 6.4 $mm^6\ m^{-3}$

Preliminar results….

Comparation between TRMM and Ground Radar - Ezeiza






03
06
09
12
15
CMORPH
03
06
09
12
15
3B42_V6 calibrated with rain gauges
03
06
09
12
15
100
80
60
50
40
30
25
20
15
10
5
3
1
0.1