Precipitation Features Observed during the first 5 CHUVA Field Campaigns in Brazil

Carlos Morales (1), L.A. Machado (2), C.F Angelis (2), M.A.F. Silva Dias (1), G. Fisch (3), D. Vila (2)

(1) Universidade of São Paulo, Departamento de Ciências Atmosféricas, São Paulo, Brazil (morales@model.iag.usp.br), (2) Instituto de Pesquisas Espaciais - INPE, Cachoeira Paulista, Brazil,
(3) Instituto de Aeronáutica e Espaço - IAE, CTA, São José dos Campos, Brazil
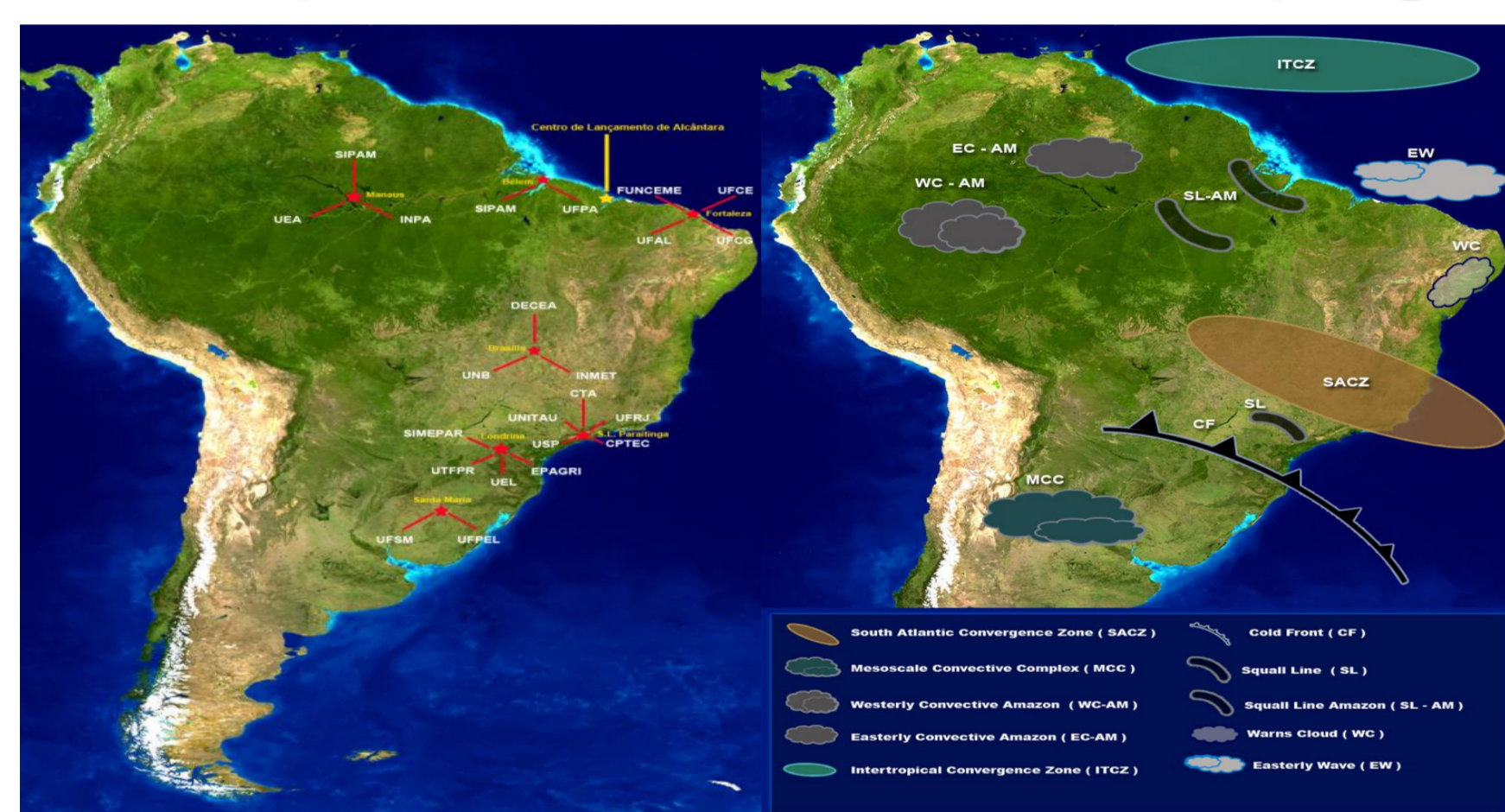
Cloud processes of t**H**e main precipitation systems in Brazil: A contrib**U**tion to cloud resol**V**ing modeling and to the GPM (Glob**A**l Precipitation Measurement)

This research project covers climate and physical processes studies using conventional and special observations (like polarimetric radar, radiometer, LIDAR, and several others instrumentations) to create a database that can describe the cloud processes of the main precipitating system observed in Brazil. In this sense, it intends to create and exploit this database to improve satellite rainfall retrievals and microphysical parameterizations. This Project proposes the collection of raining data at different sites, ranging from middle latitude to tropical humid and semi-arid regions.

CHUVA is structure in 5 groups name below:

- **WORKING GROUP–1:** CHARACTERISTICS OF THE PRECIPITATING SYSTEMS AS FUNCTION OF THE REGION AND LIFE STAGE (Luiz Machado)
- **WORKING GROUP–2:** PRECIPITATION ESTIMATION – DEVELOPMENT AND VALIDATION ALGORITHM (Daniel Vila)
- **WORKING GROUP–3:** ELETRIFICATION PROCESS: MOVING FROM CLOUDS TO THUNDERSTORMS (Carlos Morales)
- **WORKING GROUP–4:** CHARACTERISTICS OF THE BOUNDARY LAYER FOR DIFFERENT CLOUD PROCESSES AND PRECIPITATION REGIMES (Gilberto Fisch)
- **WORKING GROUP–5:** MODEL IMPROVEMENTS AND VALIDATION, WITH FOCUS IN CLOUD MICROPHYSICS AND AEROSOL INTERACTIONS, FOR SATELLITE PRECIPITATION ESTIMATES IN BRAZIL (Maria Assunção Dias)

Proposed CHUVA Field Campaigns

Instruments

- Mobile Dual-Pol X-band radar
- Micro Rain Radars (24 GHz)
- Radiometers
- Weather Stations (T, Td, V)
- Solar Radiation
- Parsivel Disdrometers
- Thies Disdrometers
- Joss Disdrometers
- Rain gauges
- GPS humidity
- Soil humidity
- Flux Station
- Air Quality measurements
- CCN counter
- Lidar
- Field-Mills
- Lightning Location Systems
- High Speed Video Camera
- Radiosonde stations
- Aircraft (microphysics)

Objectives:

- Characterization of the main precipitation features observed I in the 5 CHUVA Field according to DSD measurements.
- Evaluate the performance of TRMM 2A25-V7 and 2A12-V7 during the CHUVA experiments.

Data

CHUVA Field Campaigns

Alcântara – CLA	: 03/2010 - Joss-Waldvogel disdrometer
Fortaleza – FOR	: 04/2011 - Parsivel disdrometer
Belém – BEL	: 06/2011 - Parsivel disdrometer
Vale do Paraíba –VALE	: 11-12/2011 - Joss-Waldvogel disdrometer
Santa Maria – Santa	: 11-12/2012 - Joss-Waldvogel disdrometer

**TRMM Data:** PR 2A25 Version 7 and TMI 2A12 Version 7

CHUVA Precipitation characteristics

Rainfall Rate (mm/h)

Level (%)	CLA	FOR	BEL	VALE	SANTA
50	1.26	0.82	0.49	0.07	0.06
75	2.87	2.55	2.10	1.03	1.86
90	9.20	5.39	5.94	5.31	4.64
95	21.10	8.66	10.15	9.49	7.60
99	64.98	15.07	18.87	35.43	34.24

Liquid Water Content (g/m3)

Level (%)	CLA	FOR	BEL	VALE	SANTA
50	0.59	0.04	0.03	0.01	0.01
75	0.38	0.13	0.11	0.06	0.09
90	0.65	0.27	0.32	0.26	0.21
95	0.91	0.45	0.51	0.42	0.33
99	2.35	0.73	0.94	1.18	1.37

Radar Reflectivity (dBZ)

Level (%)	CLA	FOR	BEL	VALE	SANTA
50	21.68	23.16	22.66	18.57	25.09
75	29.74	29.88	30.37	28.69	33.13
90	37.05	34.29	34.88	36.34	37.15
95	41.27	46.41	38.26	40.05	40.38
99	51.40	40.07	44.74	48.67	47.40

Do (mm)

Level (%)	CLA	FOR	BEL	VALE	SANTA
50	1.77	1.06	0.99	0.85	1.02
75	1.64	1.30	1.30	1.25	1.56
90	1.81	1.70	1.70	1.72	1.79
95	2.39	1.77	1.79	2.11	2.17
99	3.75	2.23	3.13	3.05	2.78
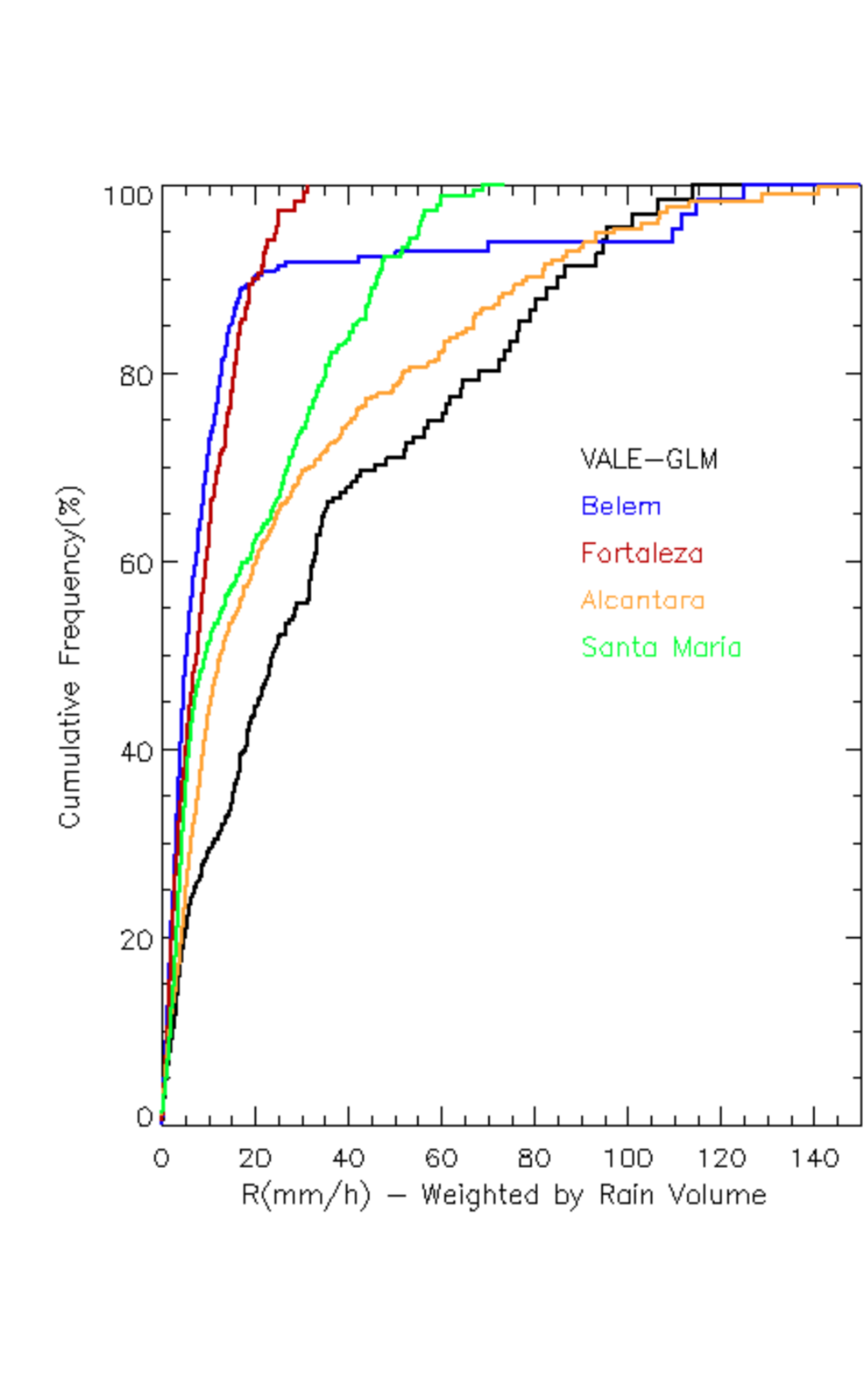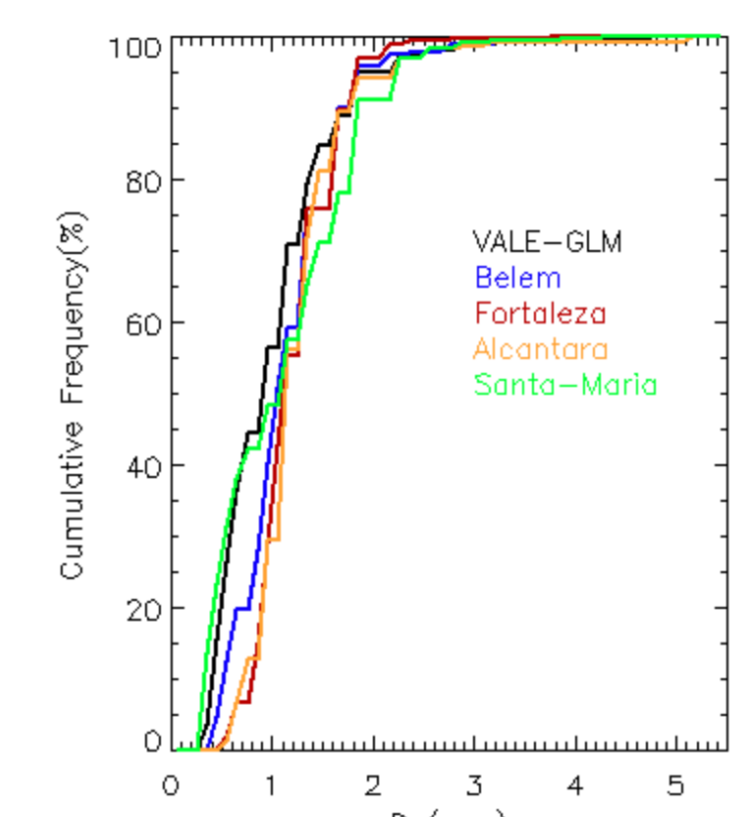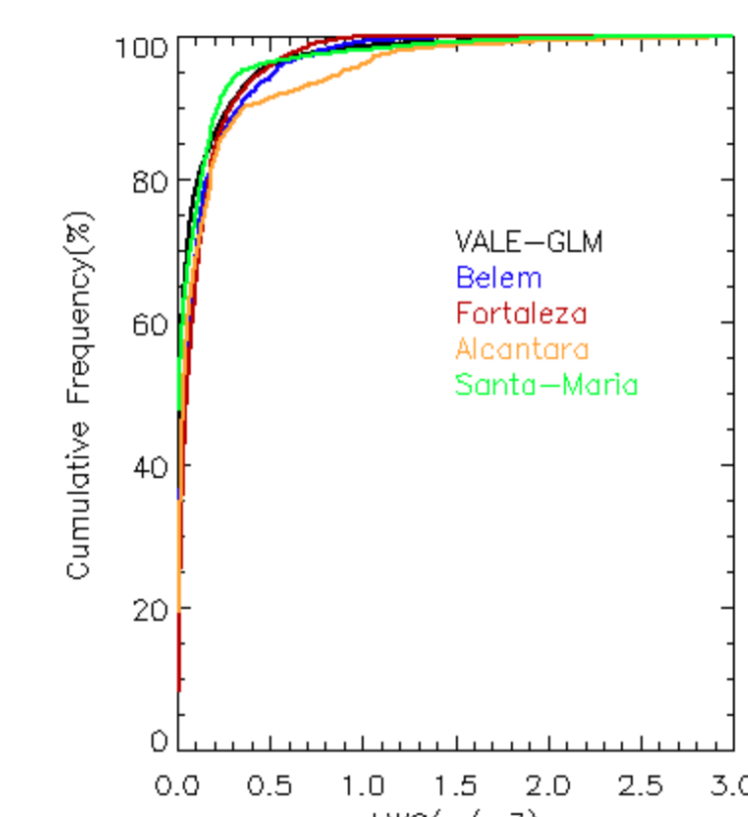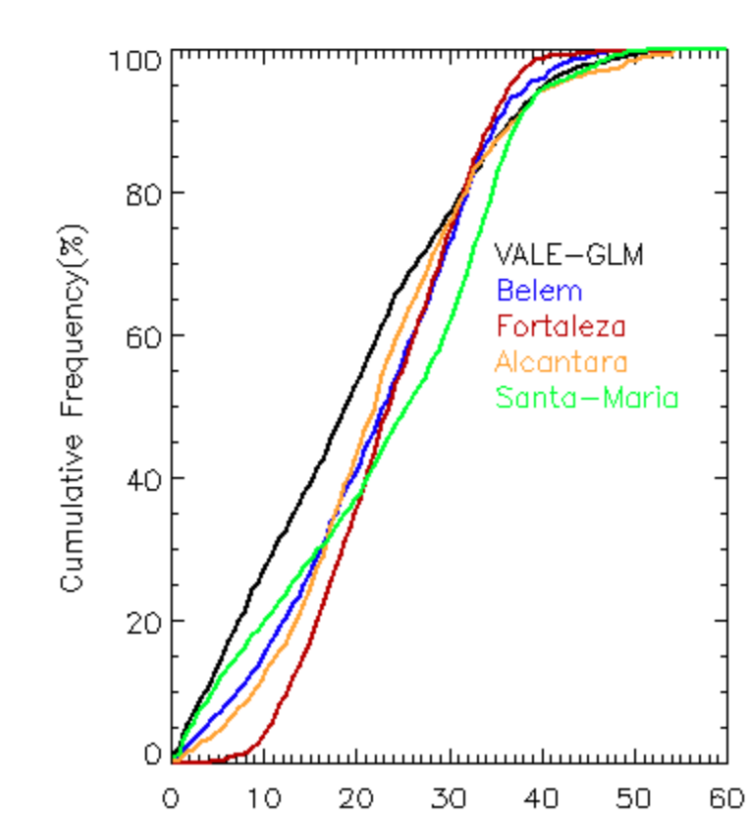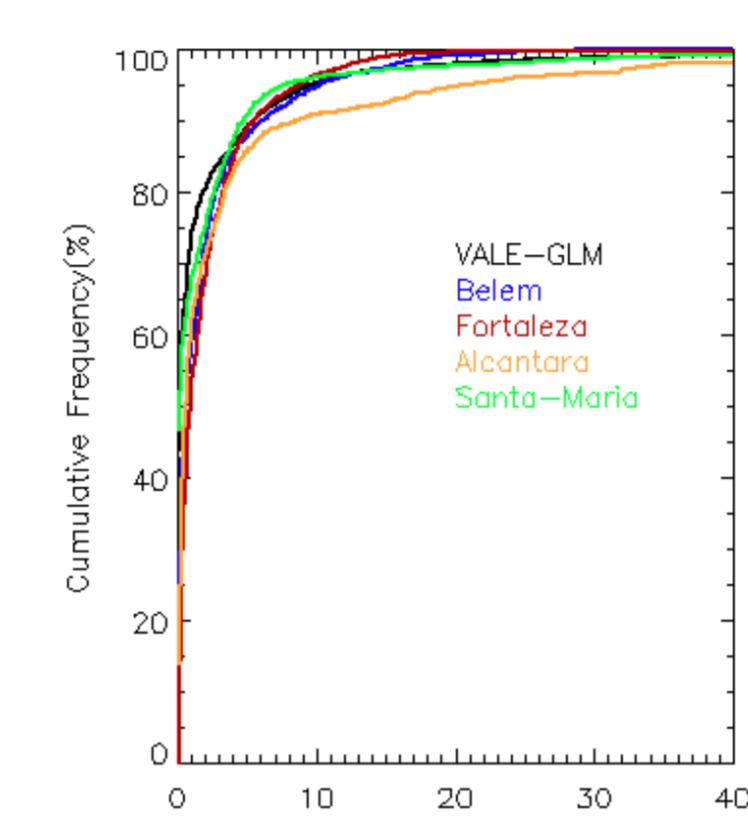
Rainfall rate(mm/h) weighted by Rain volume

Level (%)	CLA	FOR	BEL	VALE
50	23.91	5.38	8.26	12.86
75	60.49	11.45	14.6	40.76
90	85.62	20.27	20.89	78.73
95	96.25	110.45	24.54	97.40
99	114.35	125.16	31.33	140.85

ZR Relationships for CHUVA

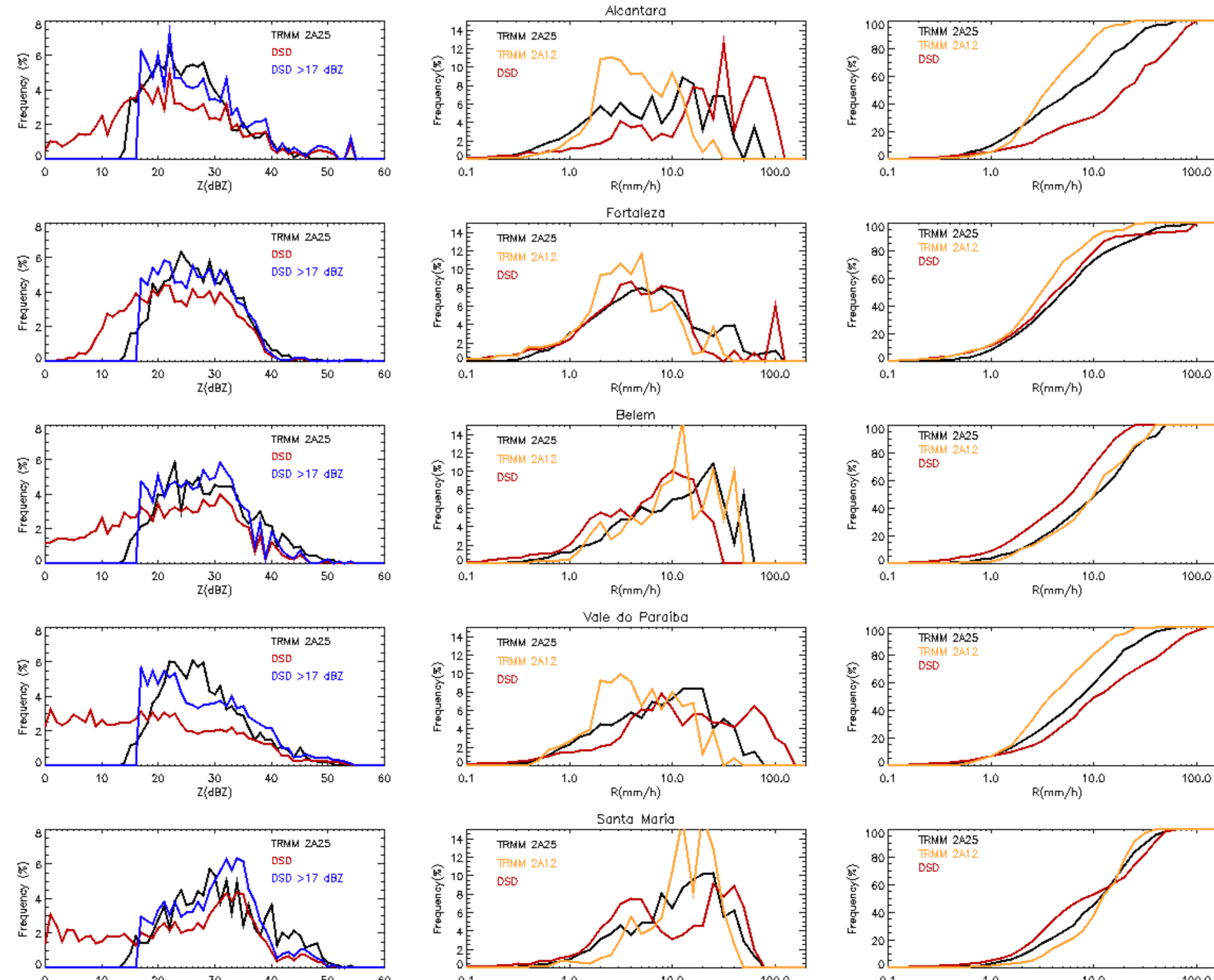| Sites	
ALCANTARA	$Z = 291.97R^{1.36}$
FORTALEZA	$Z = 258.94R^{1.35}$
BELÉM	$Z = 277.91R^{1.44}$
VALE DO PARAÍBA	$Z = 265.07R^{1.36}$
SANTA MARIA	$Z = 375.49R^{1.44}$

DSD Features
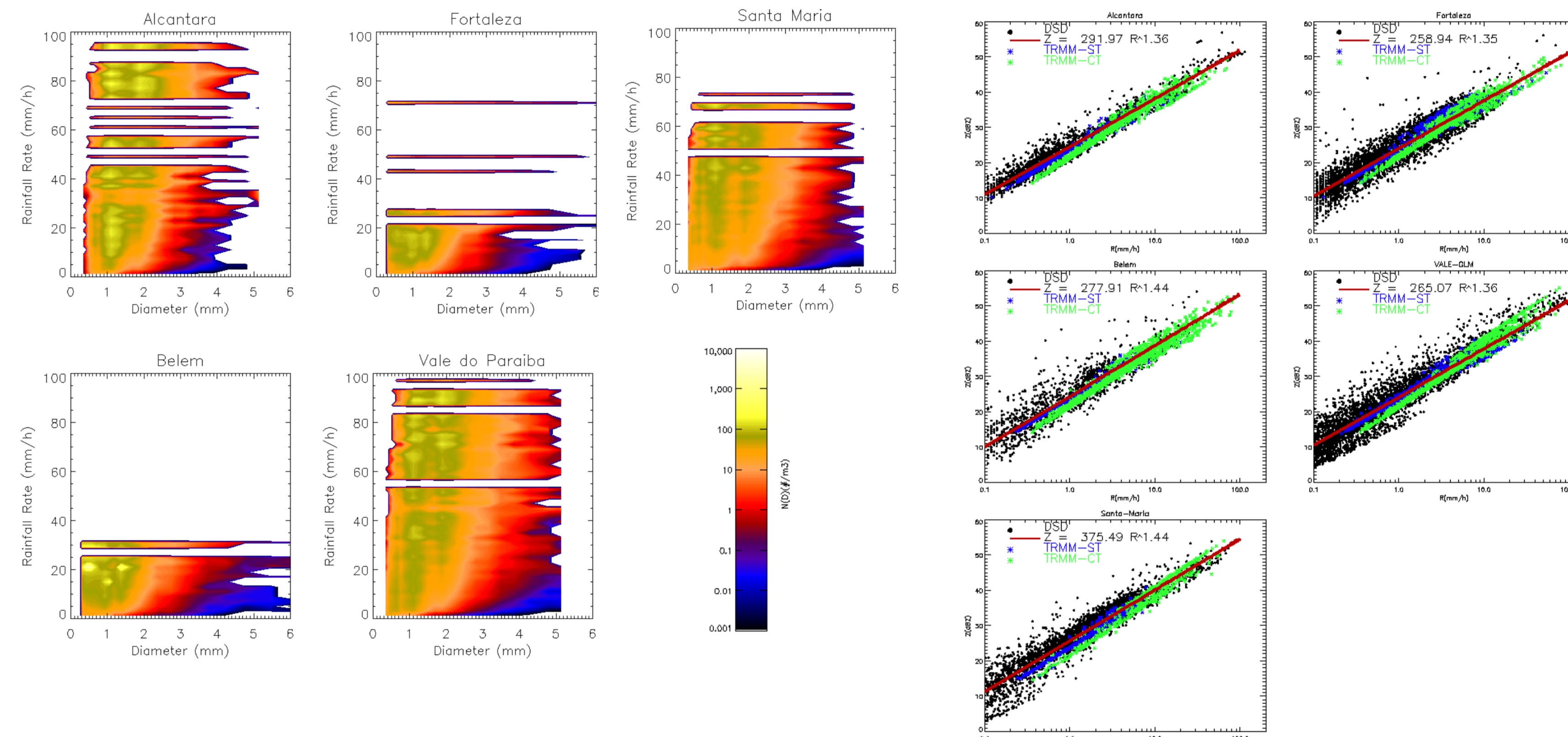
Evaluation of TRMM estimates: 2A25 and 2A12

- Select all TRMM orbits that crosses the CHUVA sites
  Extract all 2A25 and 2A12 rain products within 50 km of the DSD measurements
- Select all DSD measurements with +/- 1 hour of the TRMM overpass
- Build PDF and CDF based on the matched measurements.
  The PDF/CDFs are normalized by the total amount of precipitation measured by each sensor (disdrometer) or technique (2A25 and 2A12)

DSD

Freq(%)	CLA	FOR	BEL	VALE	SANTA
50	20.35	17.80	16.33	22.97	19.08
75	25.44	20.49	19.57	26.72	24.11
90	28.22	22.13	22.20	28.51	25.93
95	29.21	23.01	29.27	29.07	26.62
99	30.66	23.88	29.93	28.89	27.58

2A25

Freq(%)	CLA	FOR	BEL	VALE	SANTA
50	17.92	20.30	17.02	18.83	20.63
75	21.79	23.30	20.46	22.02	23.22
90	24.45	25.07	24.52	24.49	25.16
95	25.37	26.44	25.80	25.56	25.97
99	27.81	26.97	29.20	27.44	27.29

2A12

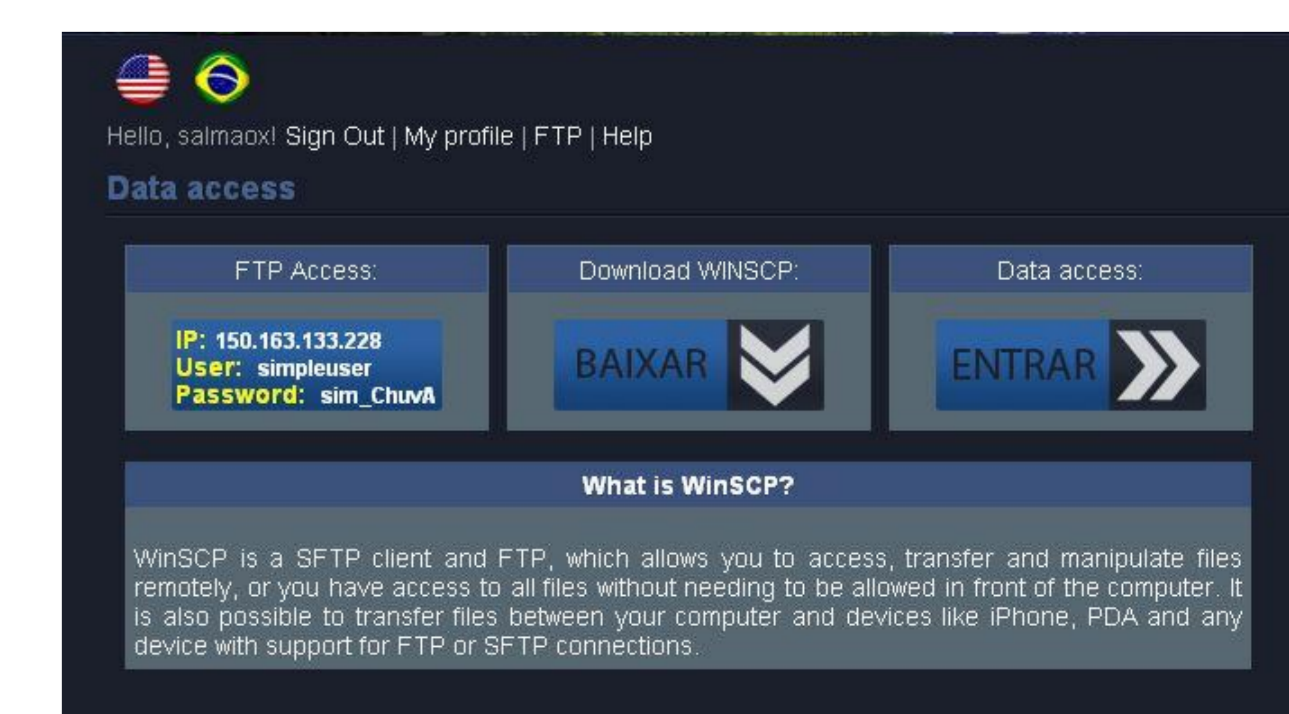| Freq(%)	CLA	FOR	BEL	VALE	SANTA
50	15.59	20.17	15.00	15.90	20.88
75	18.58	23.10	17.62	19.38	22.90
90	20.41	25.11	20.18	21.50	24.00
95	21.27	25.60	22.59	22.82	24.70
99	23.61	26.00	24.04	24.06	25.71

CONCLUSIONS AND PERSPECTIVES

- CHUVA is building a precipitation database over the Tropics
- Although coastal sites had almost the same precipitating systems, they showed different features
- TRMM Z-R relationships are within the CHUVA DSD dispersion curves, although it is possible to observed that it overestimates both the ST and CV precipitation for Z < 30 dBZ, and it underestimates for more continental regimes (VALE) when Z > 30 dBZ
- It was possible to see that 2A25 and 2A12 rain estimates distributions were able to capture the precipitating systems in Santa Maria and Fortaleza (2A25), while in the other sites we still need to work out.

CHUVA WEBSITE

http://chuvaproject.cptec.inpe.br