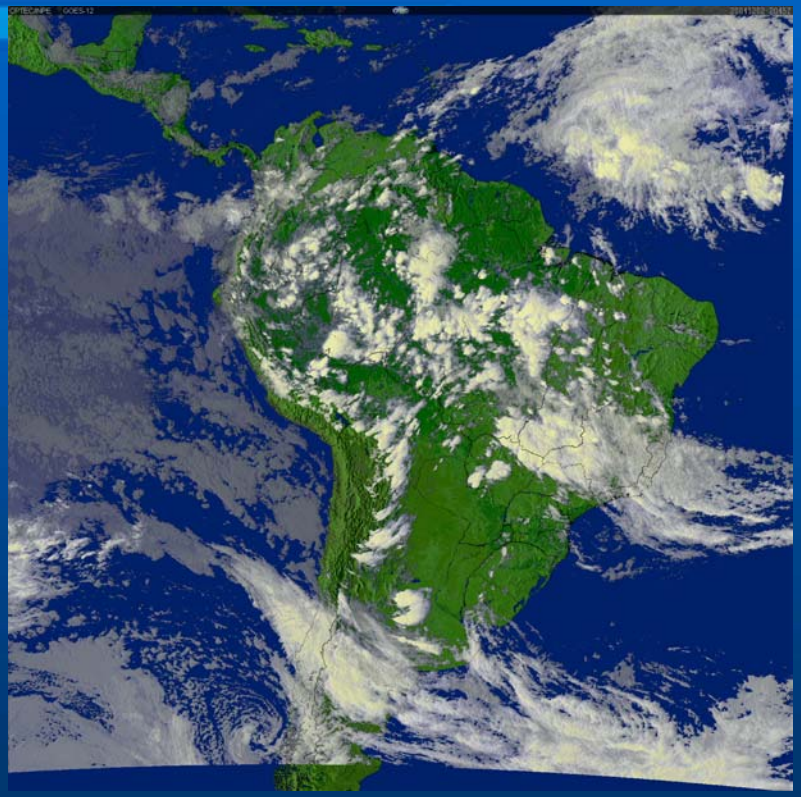
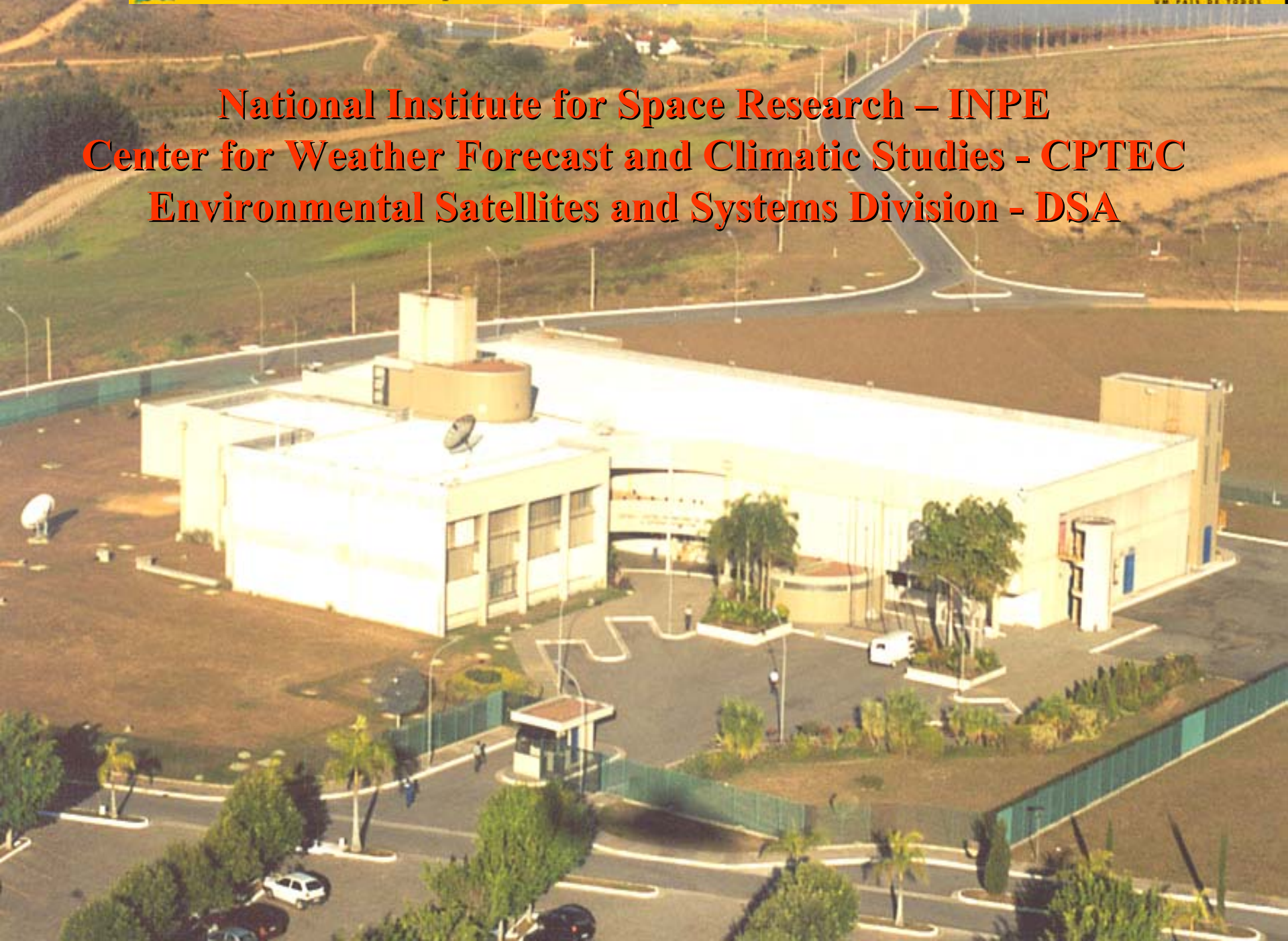
CPTEC SATELLITE OPERATIONAL PRODUCTS AND RESEARCH ACTIVITIES

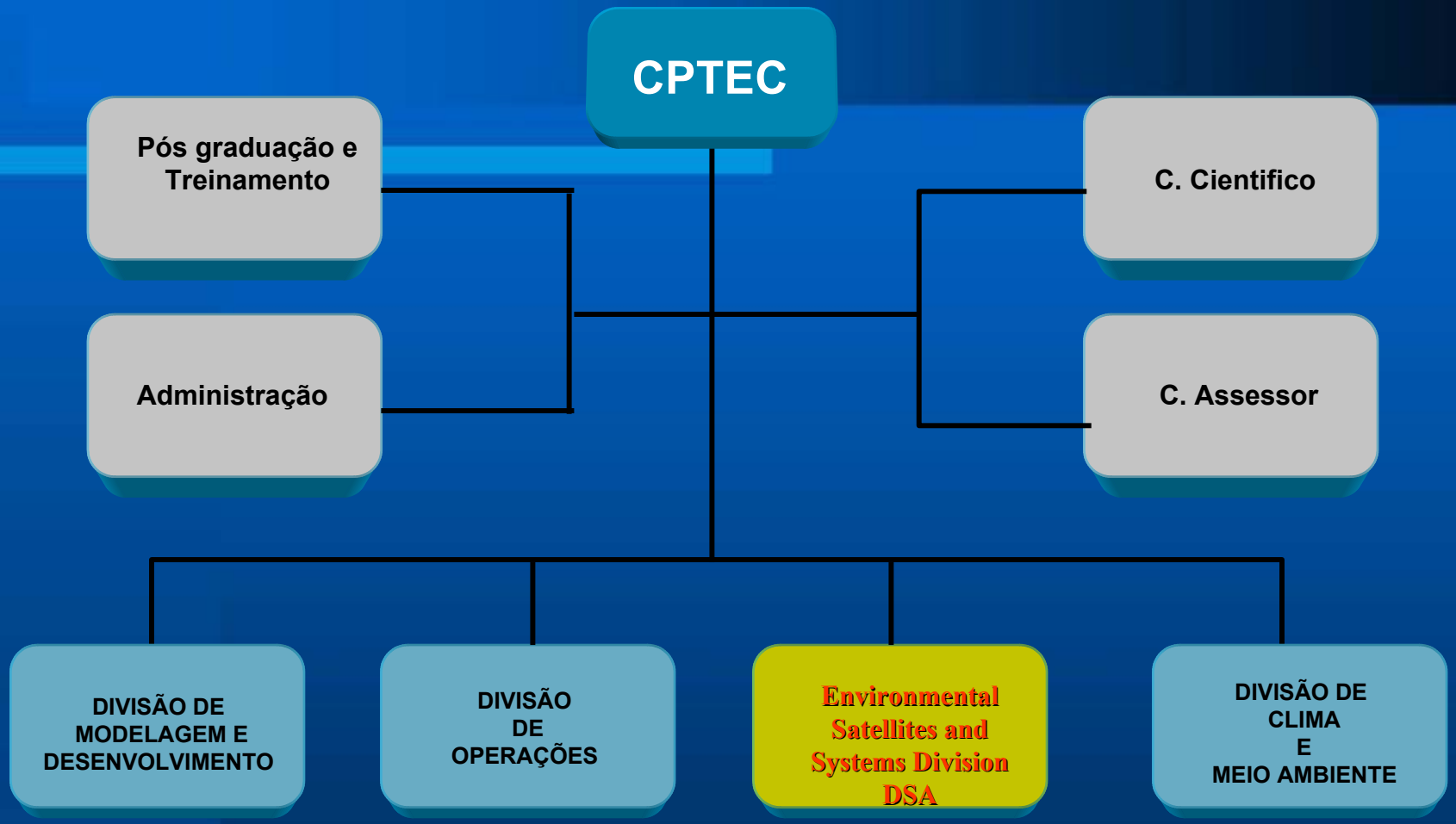


LUIZ A. T. MACHADO
CPTEC/INPE/DSA
machado@cptec.inpe.br

National Institute for Space Research – INPE
Center for Weather Forecast and Climatic Studies - CPTEC
Environmental Satellites and Systems Division - DSA



CPTEC -Structure

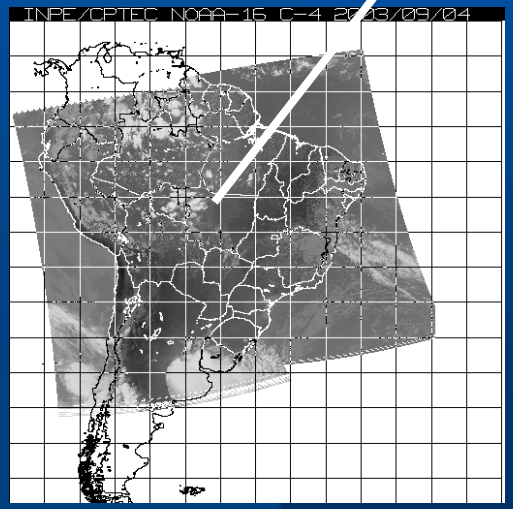


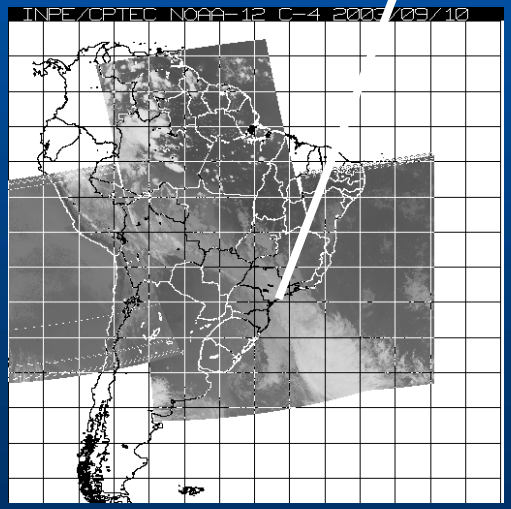
CPTEC Satellite Reception Stations

CPTEC – Satellite Division

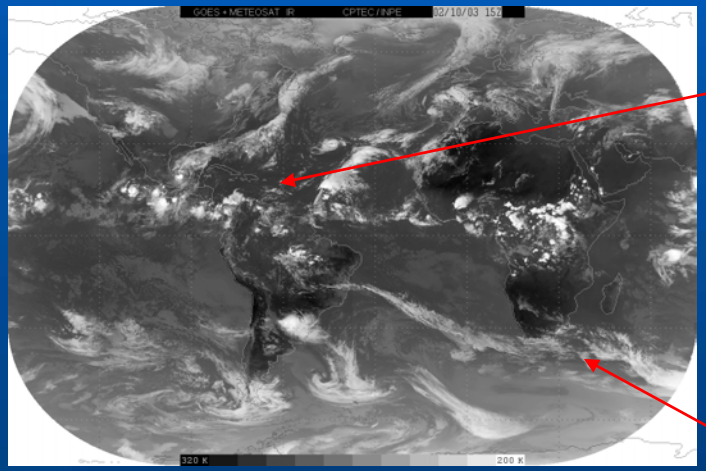
Cuiabá Satellite Facilities Center

NOAA



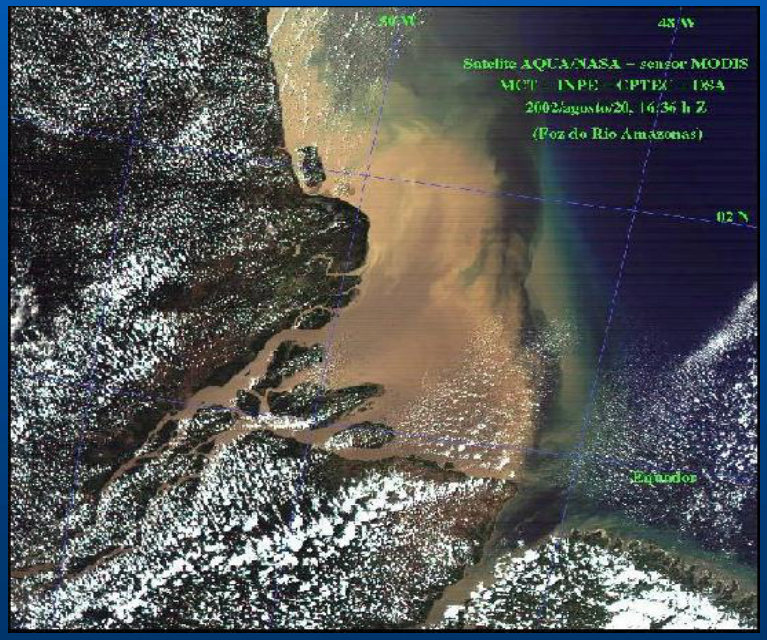


CPTEC Satellite Reception Stations



CPTEC Satellite Reception Stations

TERRA and AQUA – Cuiabá



CPTEC Satellite Data

Data Available

NOAA – Since NOAA-8 (1988)

GOES – Since 1998

METEOSAT since 2001

Terra – Aqua – Since 2002

http://satelite.cptec.inpe.br/

Imagens CPTEC - Microsoft Internet Explorer

Arquivo Editar Exibir Favoritos Ferramentas Ajuda

Endereço http://satelite.cptec.inpe.br/index_in.htm

Ministério da Ciência e Tecnologia

Meteorological Satellites

CPTEC

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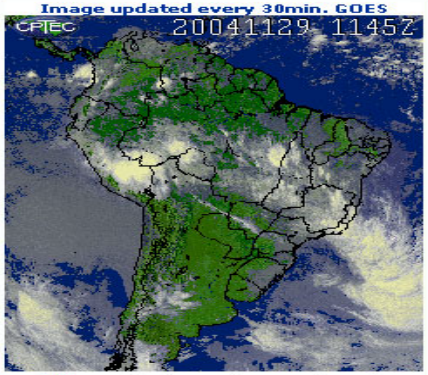
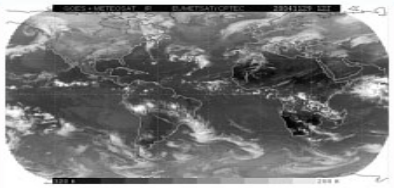
::Products

- Zenithal Tropospheric Delay
- Cloud Classification - NEW -
- Data Collection Platforms
- NDVI
- Ultraviolet index
- MODIS
- Fog
- Precipitation
- Fire spots
- Solar and Terrestrial Radiation
- Convective Cloud Clusters Tracking
- TOVS-ATOVS sounding
- Brightness Temperature
- Sea Surface Temperature
- Cloud drift winds

Image updated every 30min. GOES



Click on the image to magnify each region, or choose **South America (300Kb or 1.5Mb)**



AMERICA and AFRICA
Click on the image to magnify

Português English

Animation

DSA team

Research & Development

DSA

::Events

- Satellite Meteorology for Portuguese Speaking Countries

::Note

- Meteorological Satellites
- Information about GOES images
- RACCI classification
- Specials Bulletins - GOES
- Images use warning

::Images

GOES, Meteosat and GMS
- South America
- Geostationary Satellites
- Global
- Enhanced and High Resolution Visible
- Regions

AVHRR-NOAA
- 12,14,15,16,17

MODIS
- Aqua/Terra

::Previous

- South America and Global
- America and Africa
- Goes (South America - 1/2 h)
- Regions

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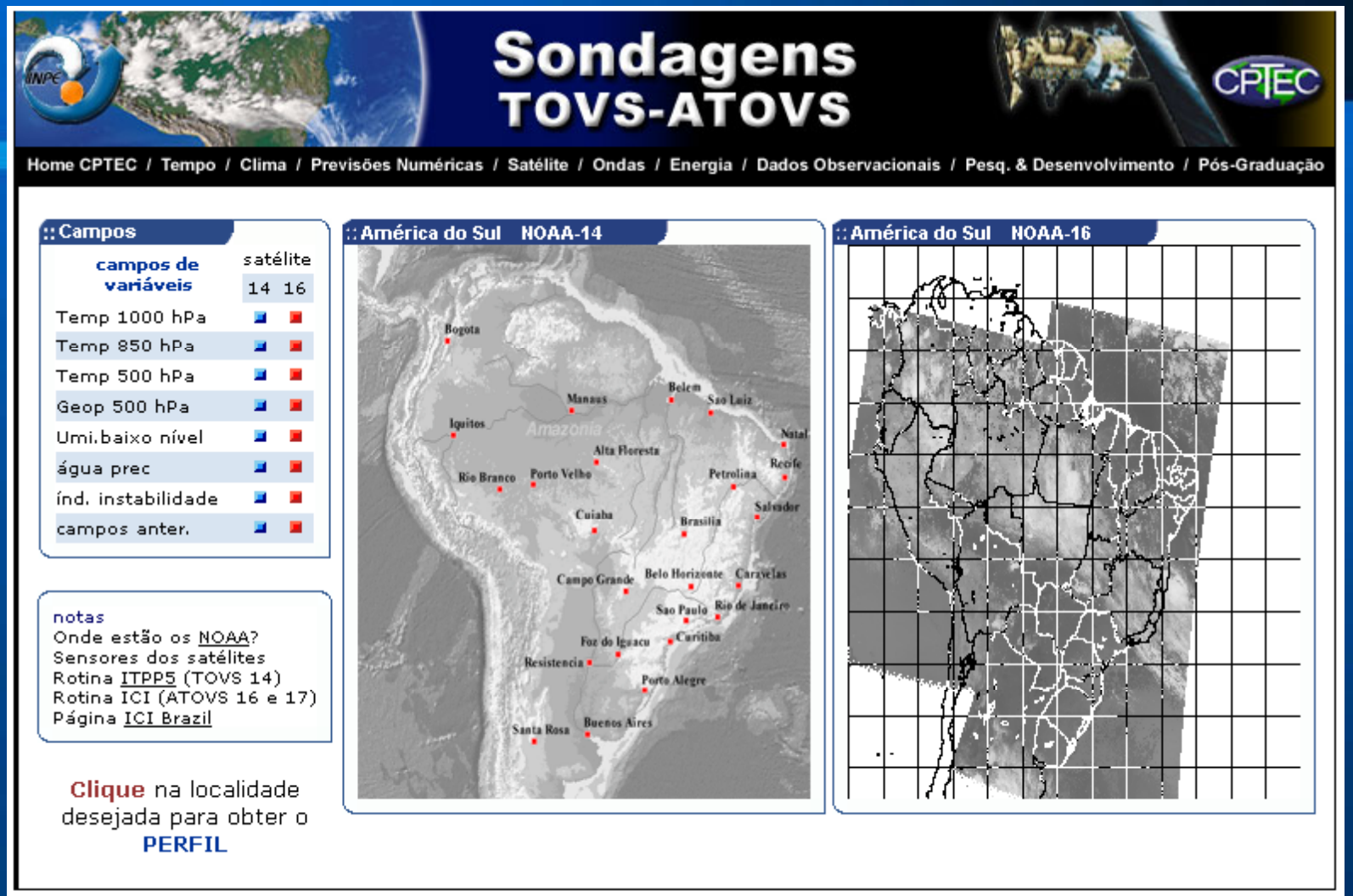
Comments and/or suggestions:
satelite@cptec.inpe.br

TOVS – ATOVS Sounding

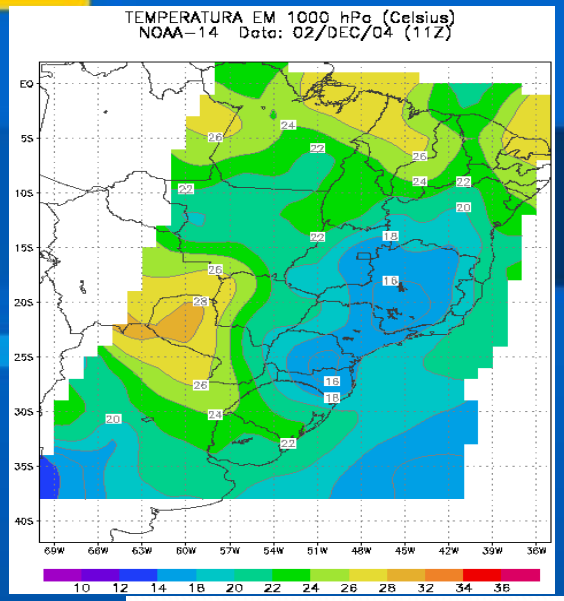


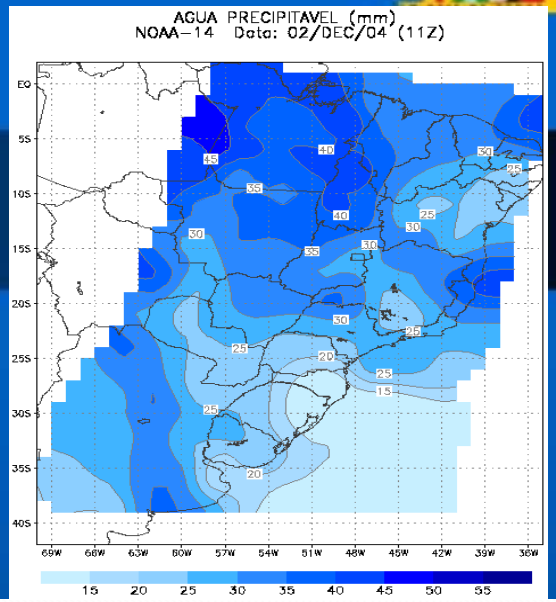
TOVS Sounding

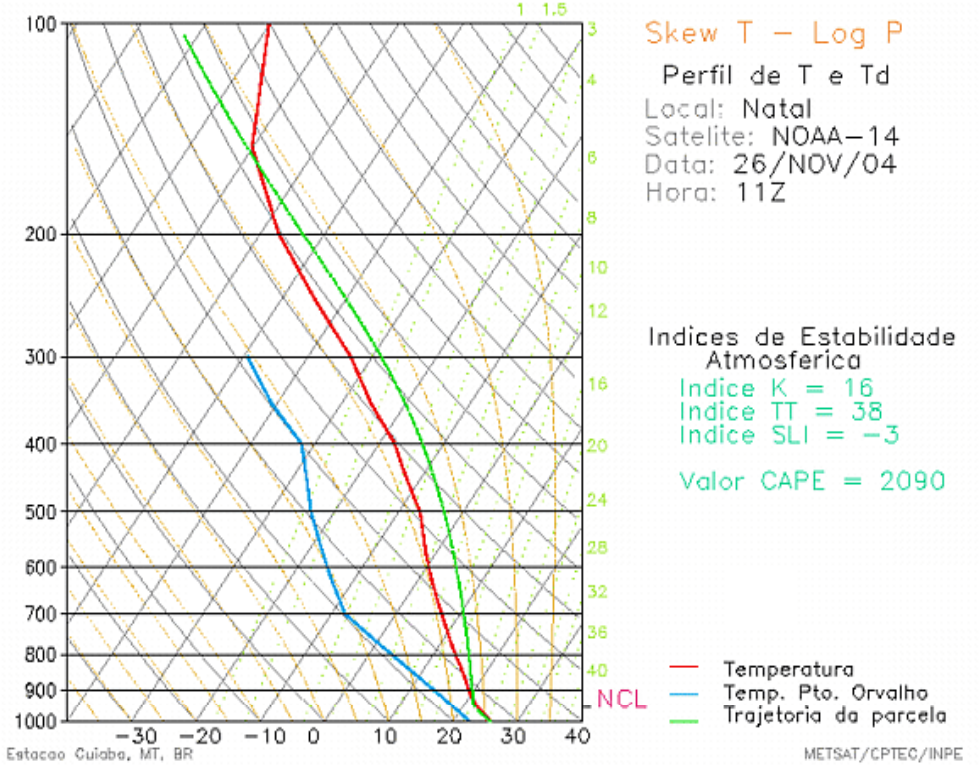
NOAA-14 → ~00 e ~12 Z

ITPP → Profiles (T,q)

First guess ITPP → PNT CPTEC





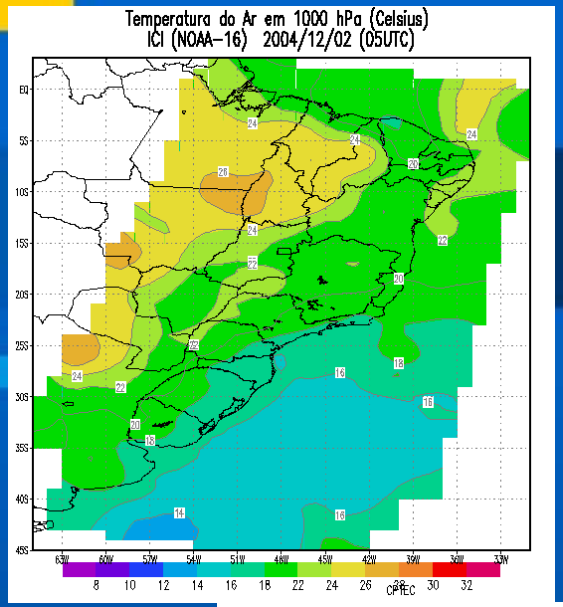


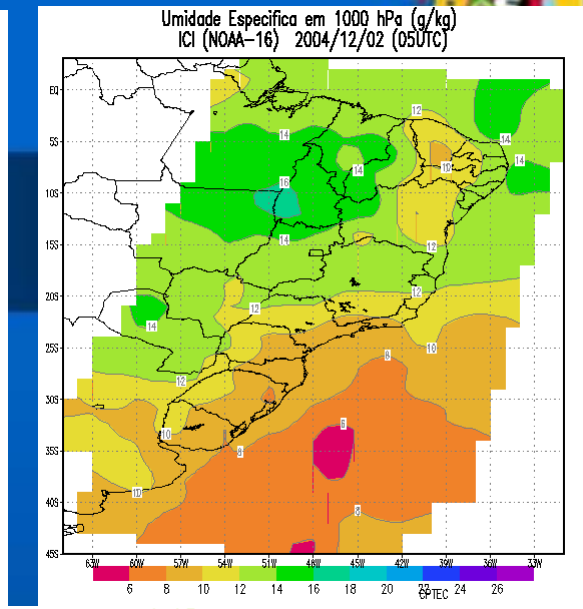
ATOVS Sounding

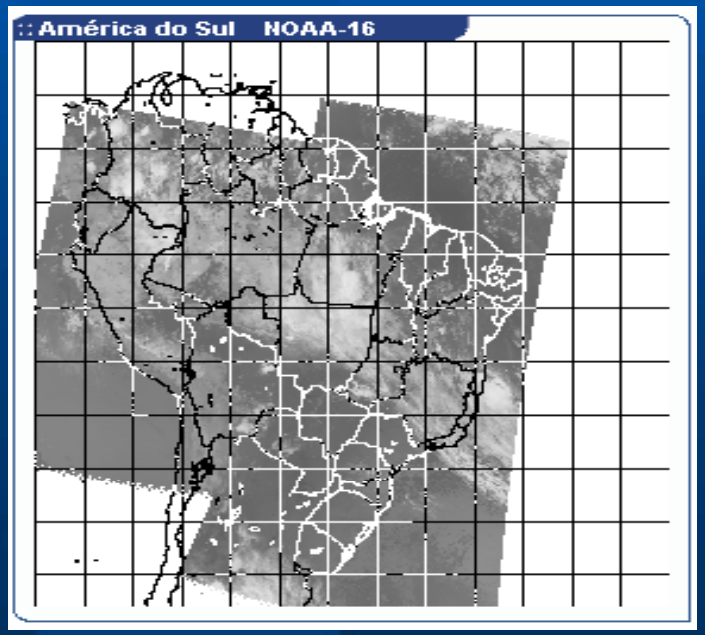
NOAA-16 → ~06 e ~18 Z

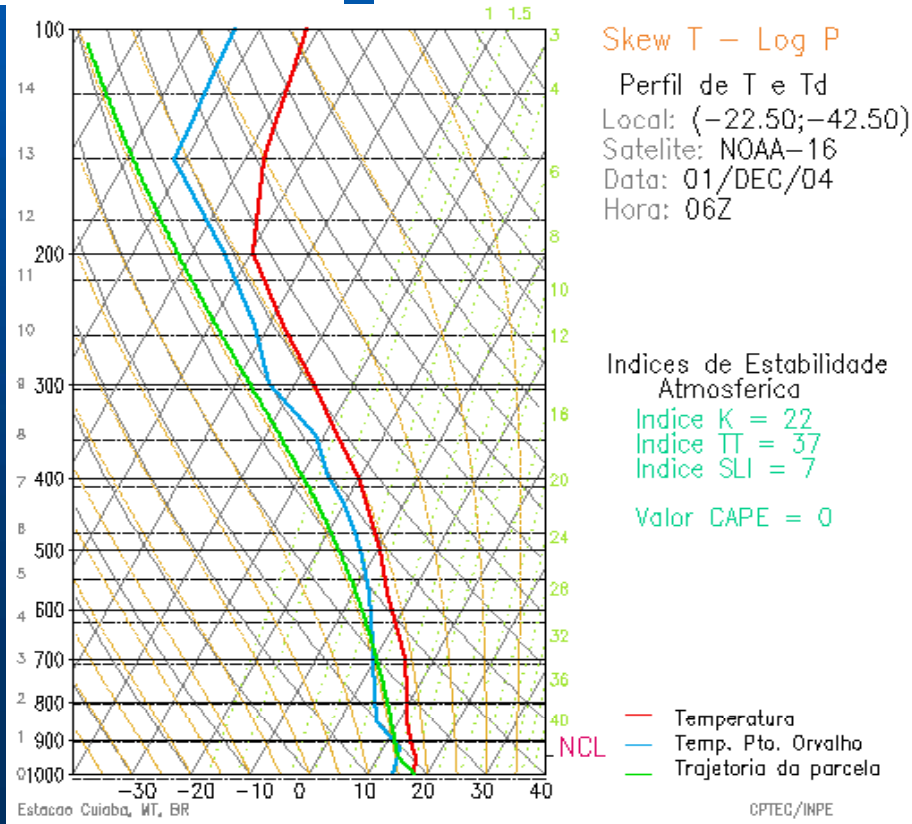
ICI → Profiles (T,q)

First guess ICI → PNT CPTEC



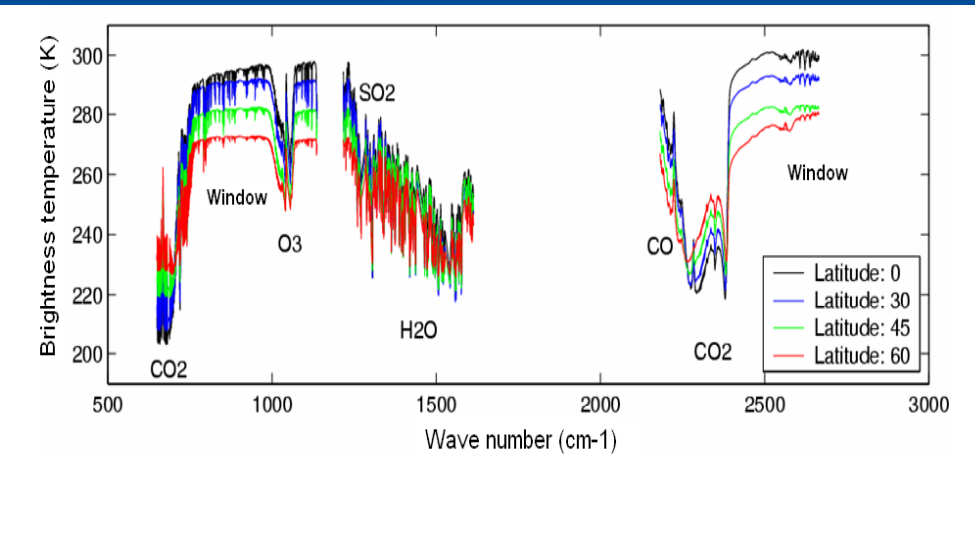


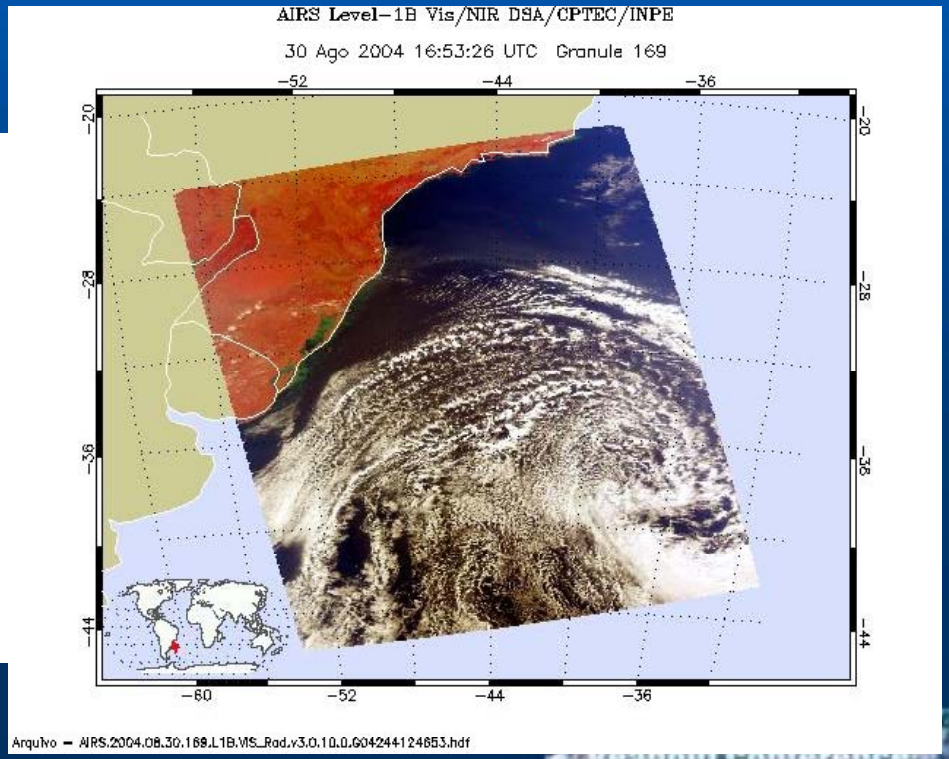




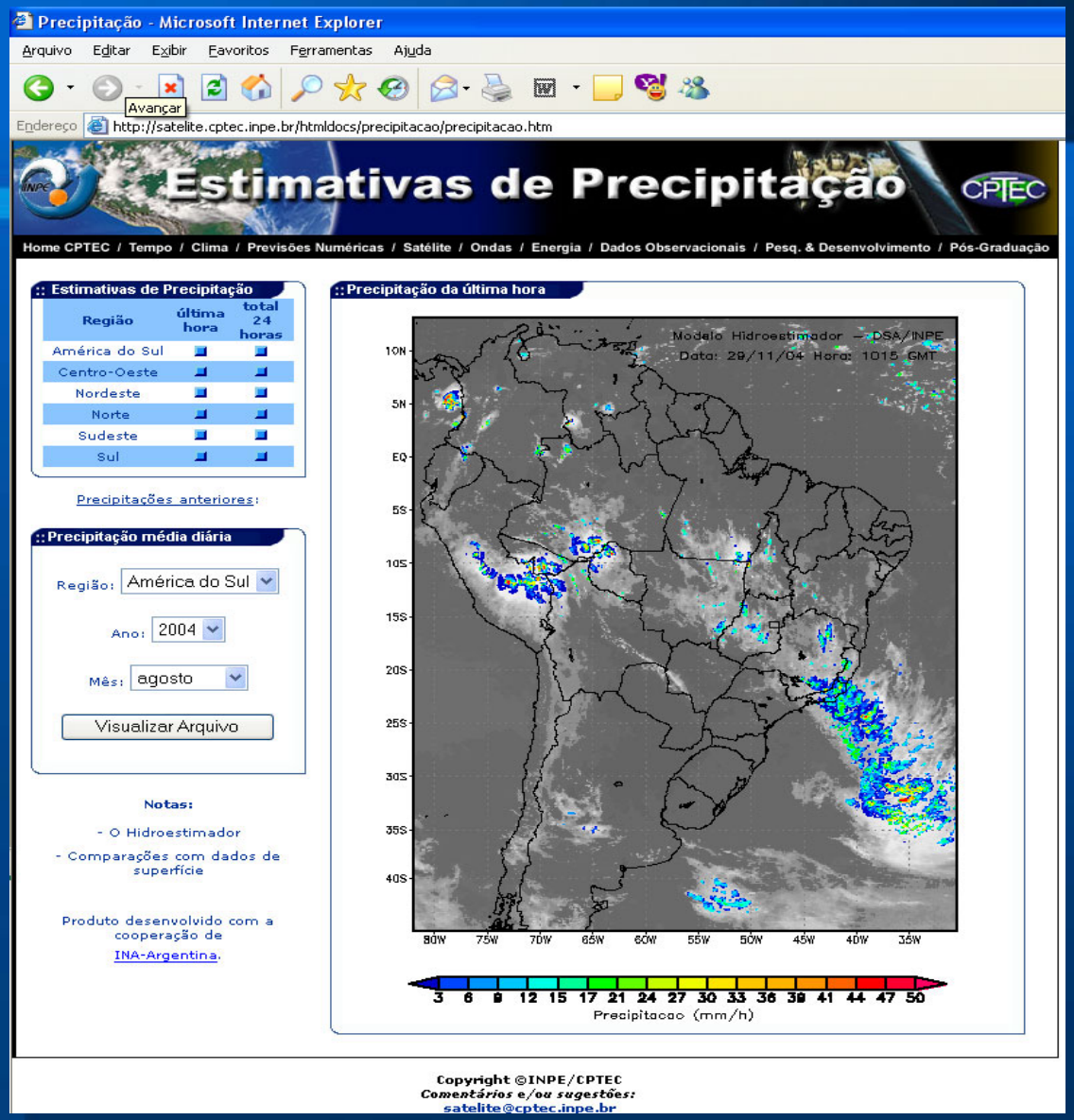
PERSPECTIVES

- Neural network → New retrieval code (NOAA and AQUA)
- EOS – AQUA plataform → NASA retrieval code (T, q)
- AIRS – AQUA → Measurement of atmospheric gas



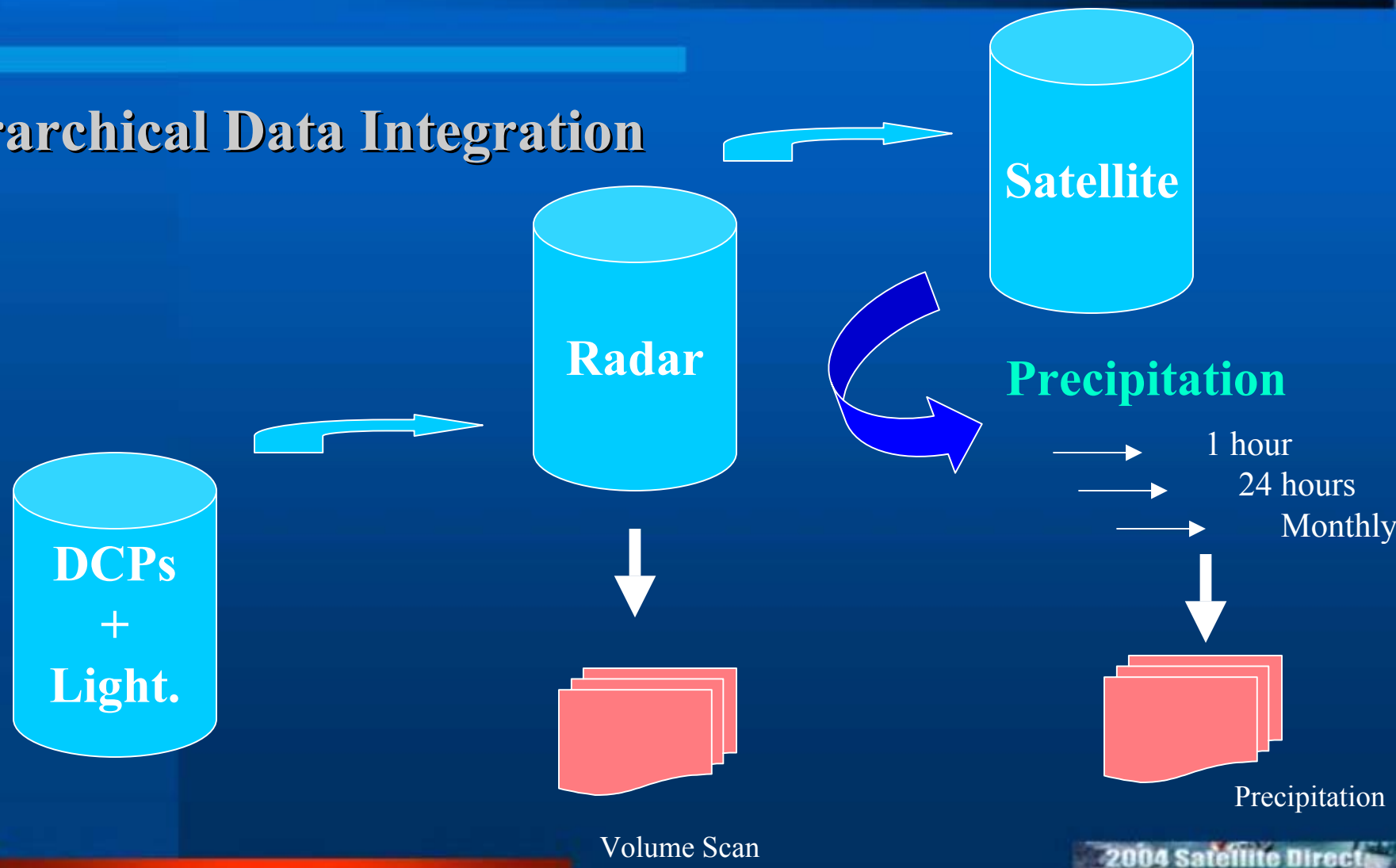


PRECIPITATION ESTIMATION - HYDROESTIMATOR



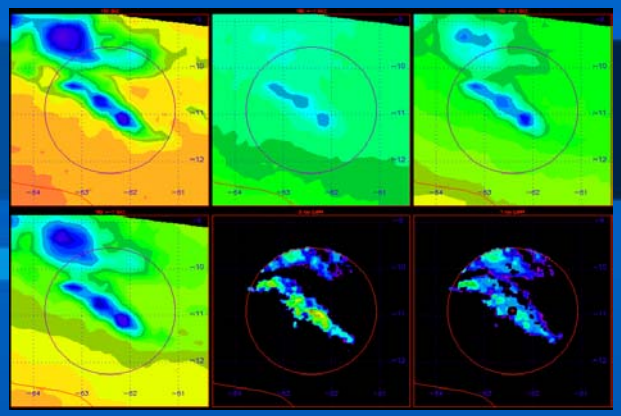
PERSPECTIVES

Hierarchical Data Integration

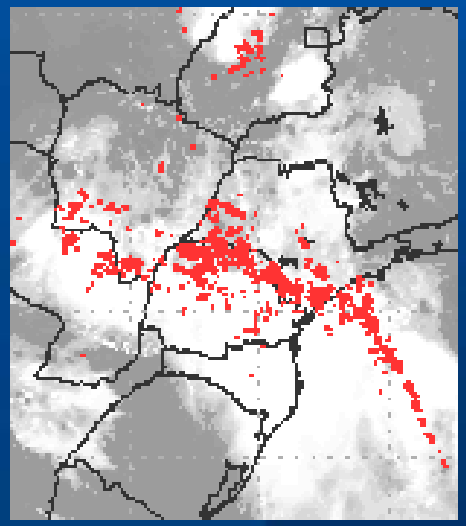


PERSPECTIVES

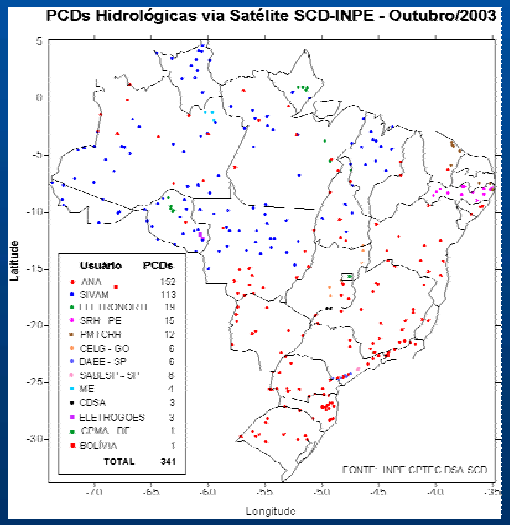
MICROWAVE



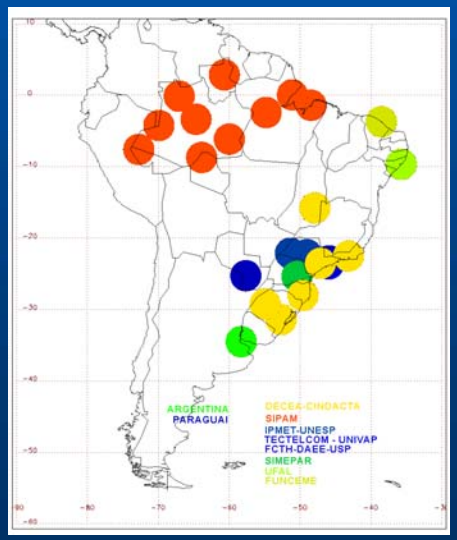
LIGHTNING



DATA COLLECT PLATFORM

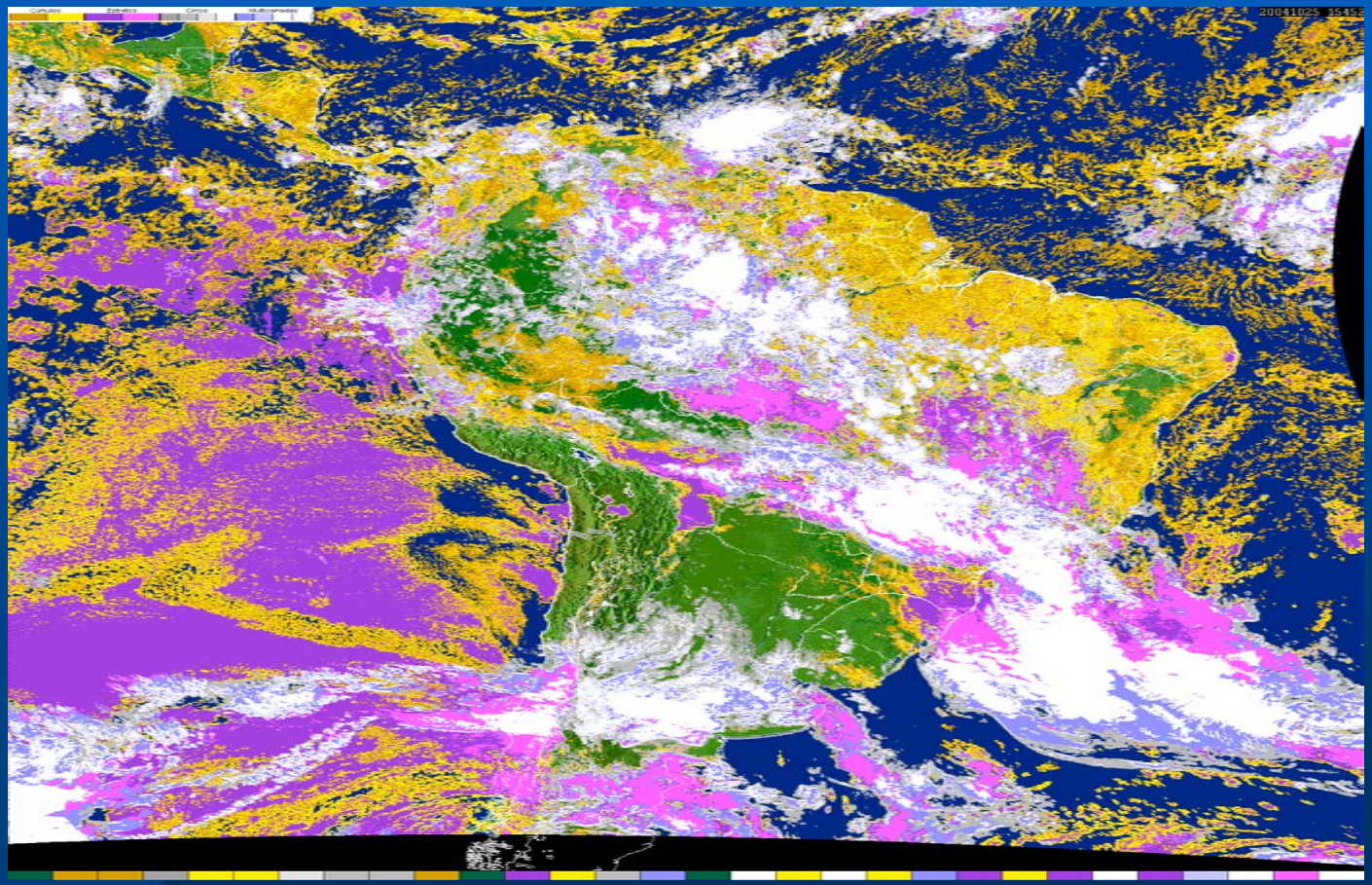


WEATHER RADARS



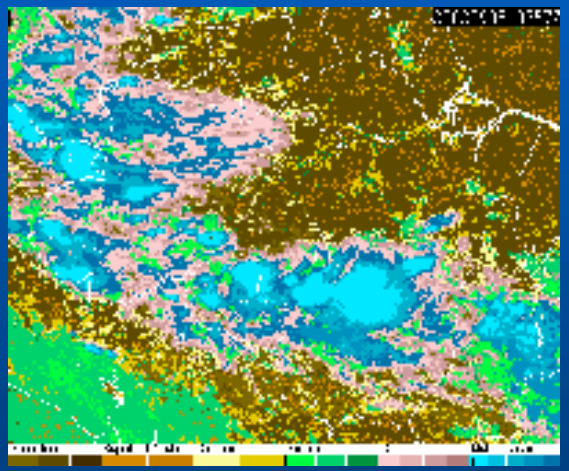
Classificação de Nuvens

CLOUD CLASSIFICATION - GOES



PERSPECTIVES

- Night Time Cloud Classification
- Smoke Detection



Ministério da Ciência e Tecnologia

Queimadas - Vegetation Fires

Home Satélite | Tempo | Focos GOES | Persistencia GOES | Focos NOAA | Focos MODIS | Todos Focos | Total Anual | Total Mensal

Focos de Calor - *Hot pixels*

Satélite: NOAA-12/AVHRR Data: 2003/09/27
Cruz.Equador: 20:22:36.0 Z Long: 54.76 CB
Cruz.Equador: 22:03:41.5 Z Long: 80.06 CB

Descrição do mapa *(Map description)*
Todos os mapas *(All maps)*
Informe PROARCO *(Proarco reports)*
*Ver aviso *(See note)*

Selecionar / *Select*

Brasil *Brazil*			Nuvens *Clouds*	Países *Countries*			Nuvens *Clouds*
AC		T	5%	ARG	29	P	79%
AL		N	0%	BOL	7	P	19%
AM		P	72%	BRA	1521	P	42%
AP	2	P	17%	CHI		P	44%
BA	148	P	11%	COL		P	77%
CE		N	0%	GUF		P	36%
DF		T	96%	GUI		P	83%
ES	7	P	8%	EQU		P	81%
GO	92	P	61%	PAR	22	P	0%
MA	107	P	11%	PER	13	P	51%
MG	275	P	36%	SUR		P	65%
MJ	2	T	10%	URU		P	91%
MT	509	P	32%	VEN		P	89%
MS	9	P	14%	Total	1592		
PA	211	P	50%				
PB		N	0%				
PE		P	28%				
PI	28	P	14%				
PR	3	T	5%				
RJ		T	96%				
RN		N	0%				
RO	4	P	49%				
RR		P	87%				
RS		P	31%				
SC		T	18%				
SE		N	0%				
SP	7	P	36%				
TO	117	P	54%				
*Total	1521						

BOLIVIA BRASIL PARAGUAY PERU

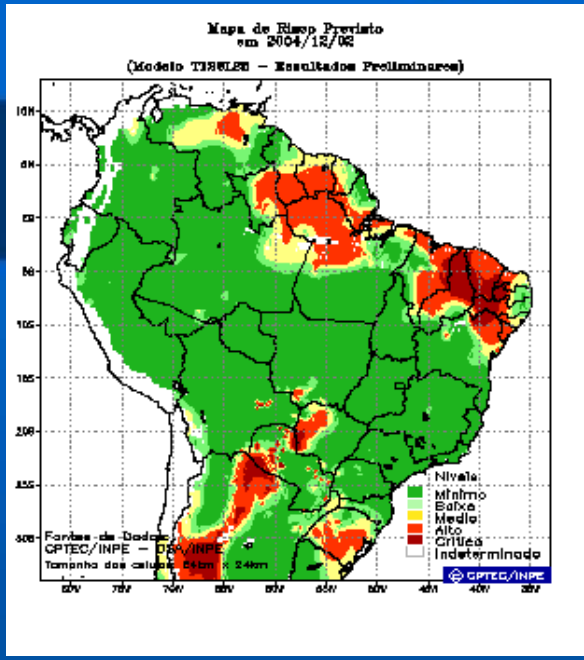
Imageamento
T = Total
P = Parcial
N = Nenhum

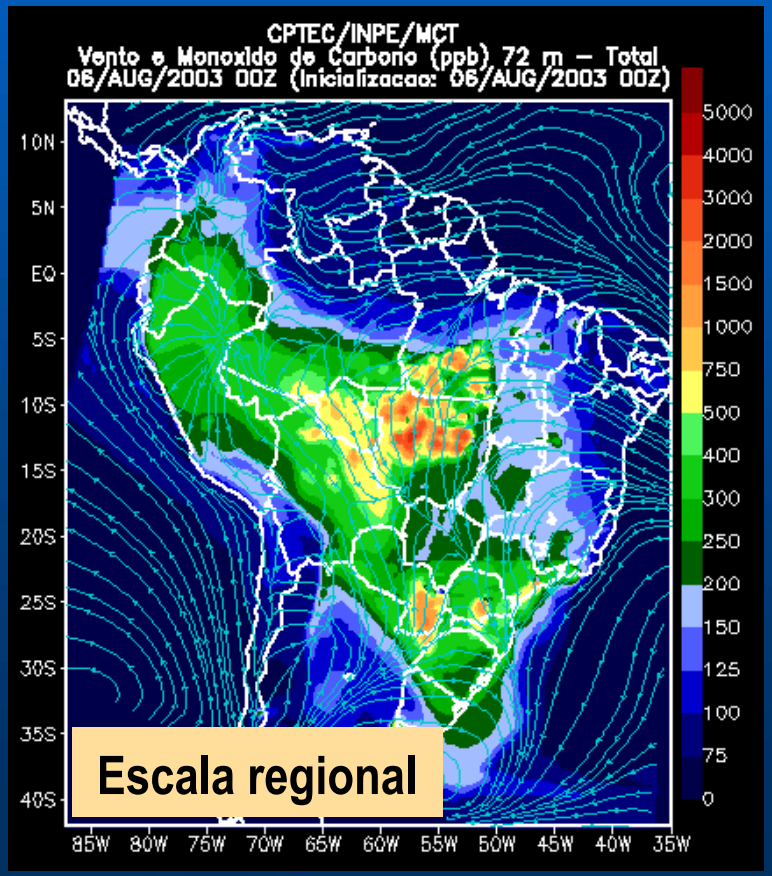
http://www.cptec.inpe.br/products/queimadas/

NOAA
GOES
TERRA
AQUA

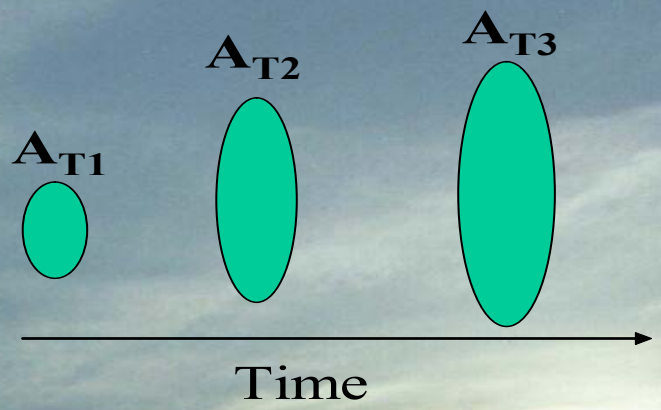
PERSPECTIVES

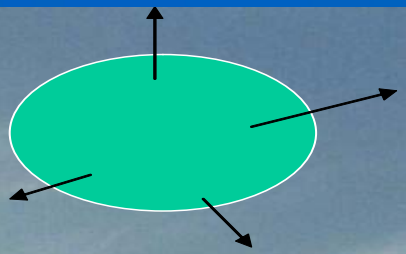
- Fire spots assimilated in mesoscale model
- Improve Fire risk



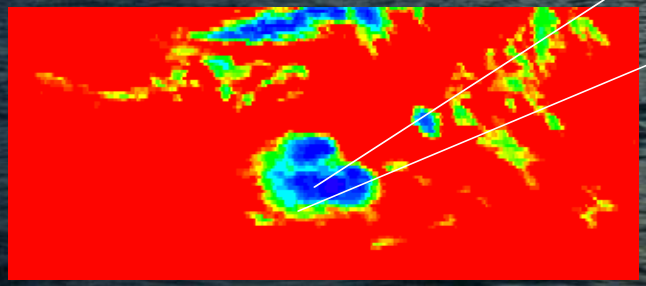


FORTRACC
Forecasting and Tracking of Active Convective Cells

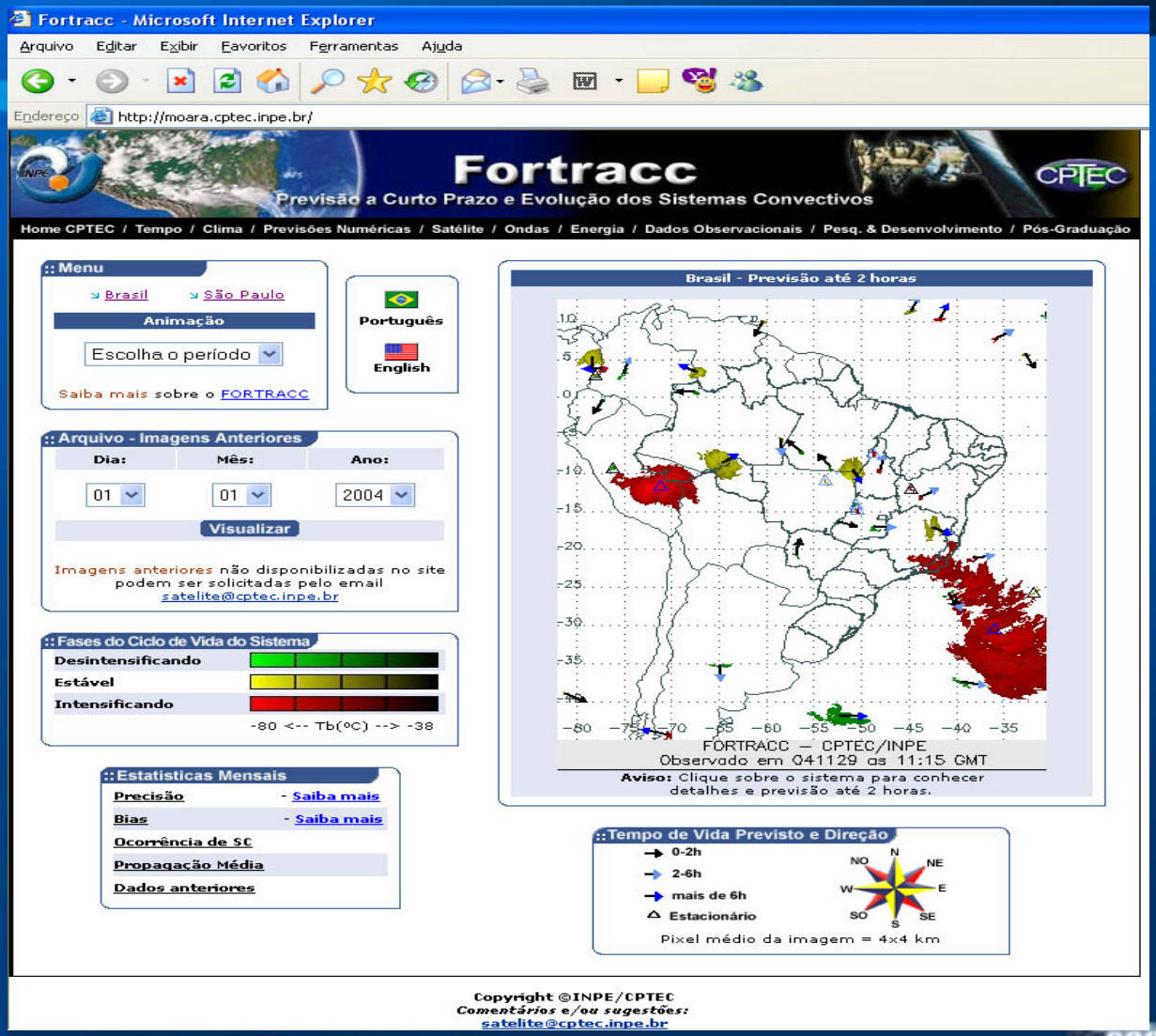




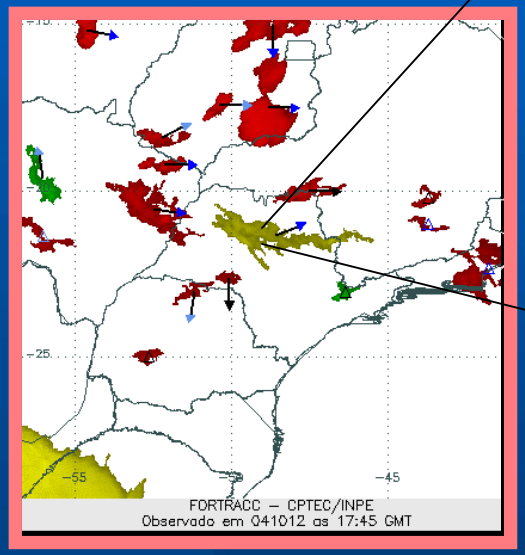
$$AE = \frac{1}{A}\frac{\partial A}{\partial t} = \vec{\nabla}.\vec{v}$$

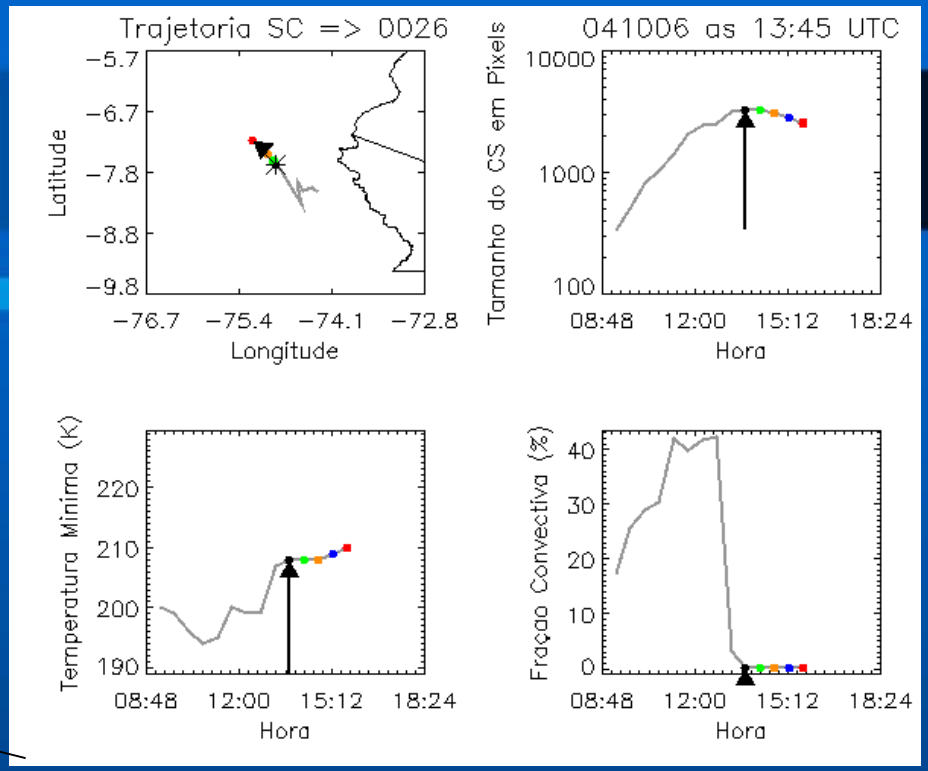


MESOSCALE CONVECTIVE SYSTEMS FROM GOES IMAGES



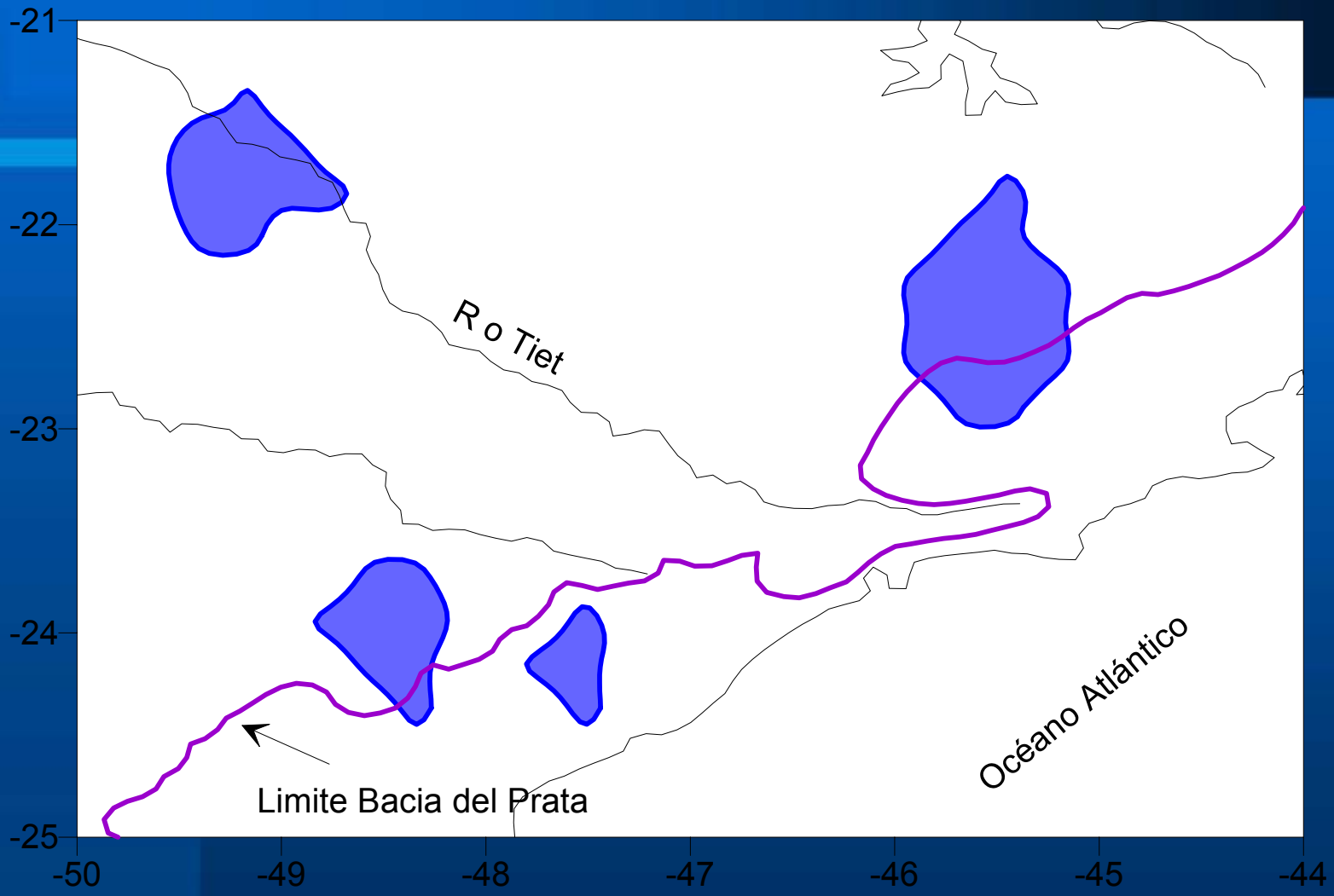
Nowcasting





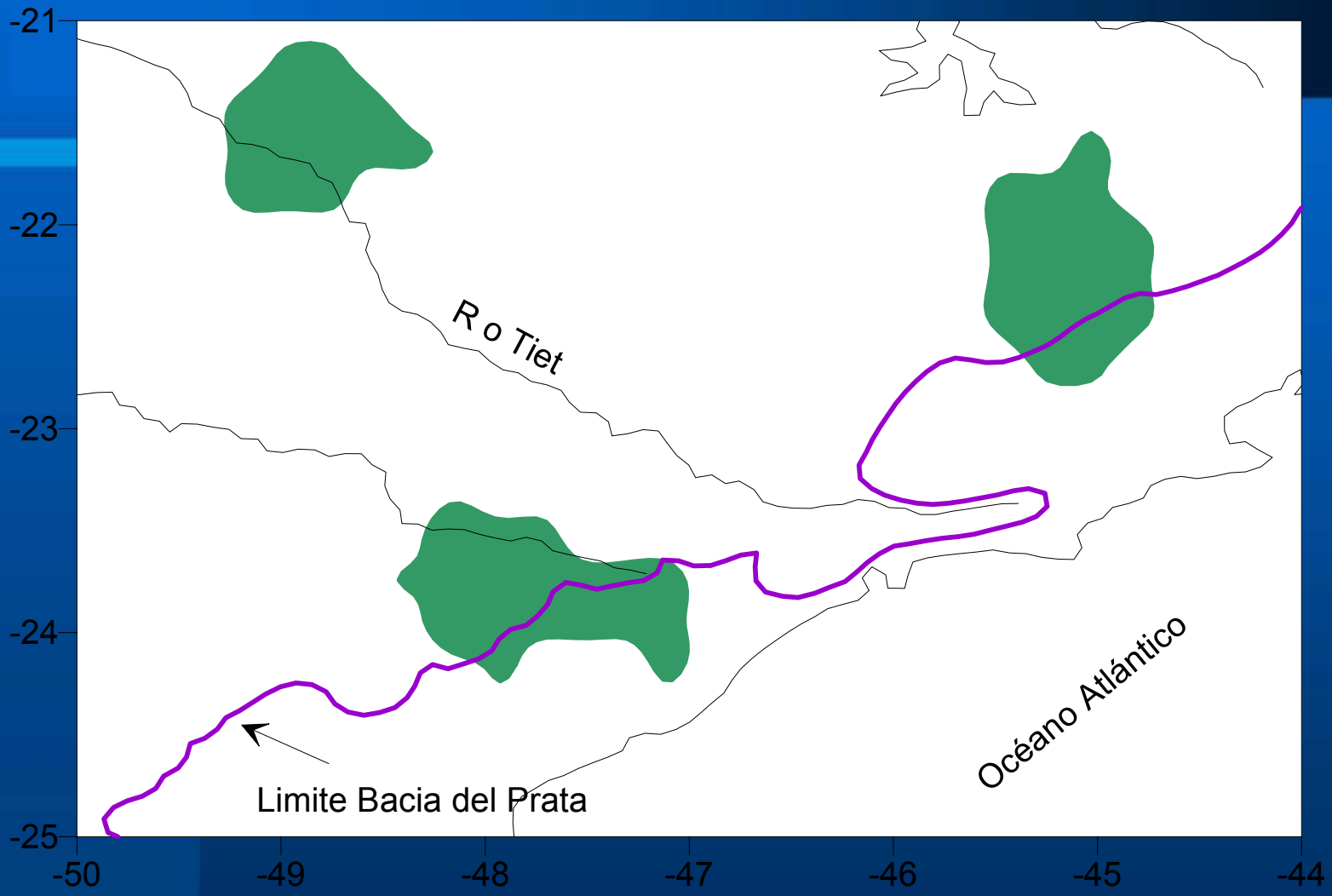
- LAST IMAGE
- ½ hour
- 1 hour
- 1½ hour
- 2 hours

Convective Systems



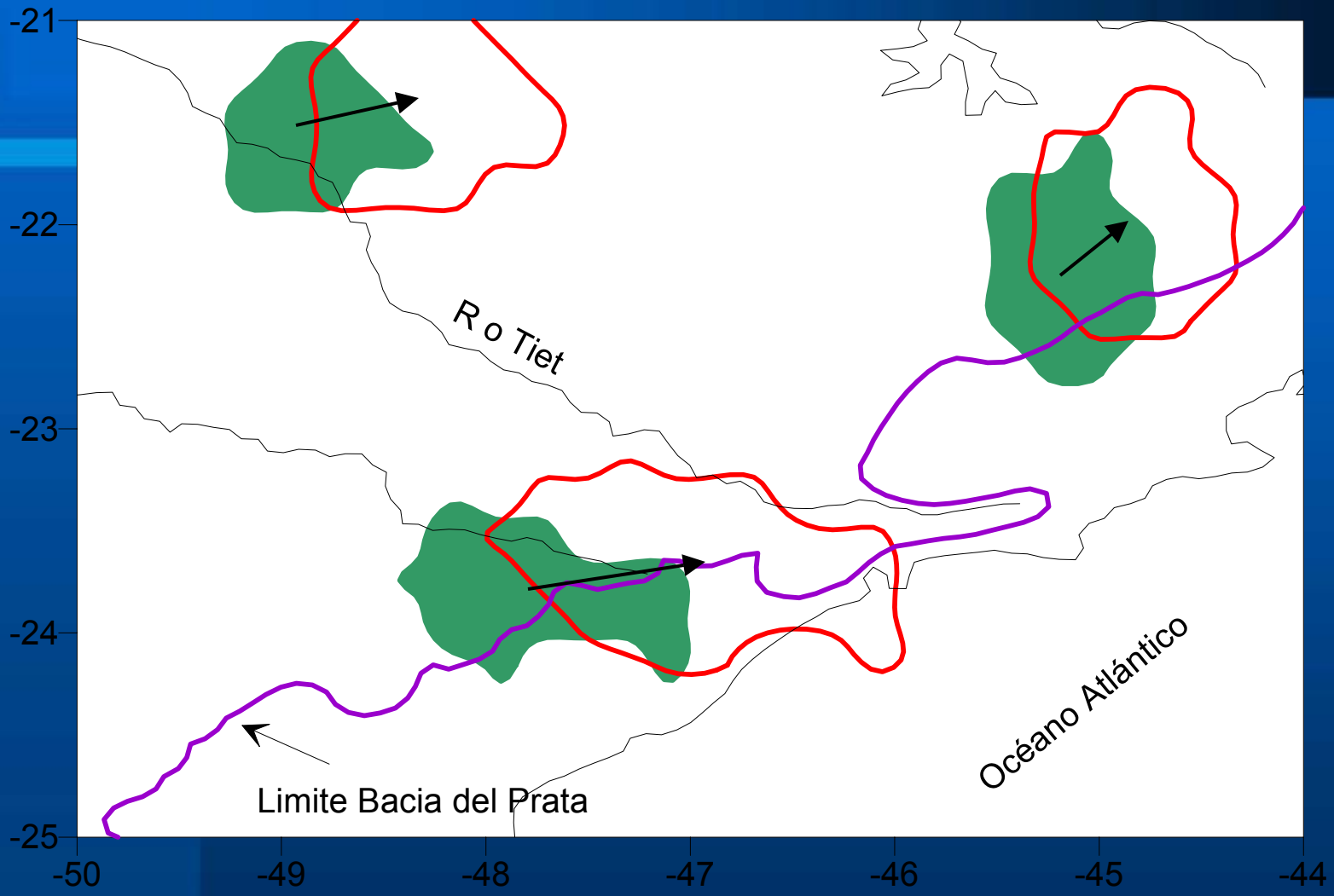
First Image

Convective Systems



Second Image (30 minutes later)

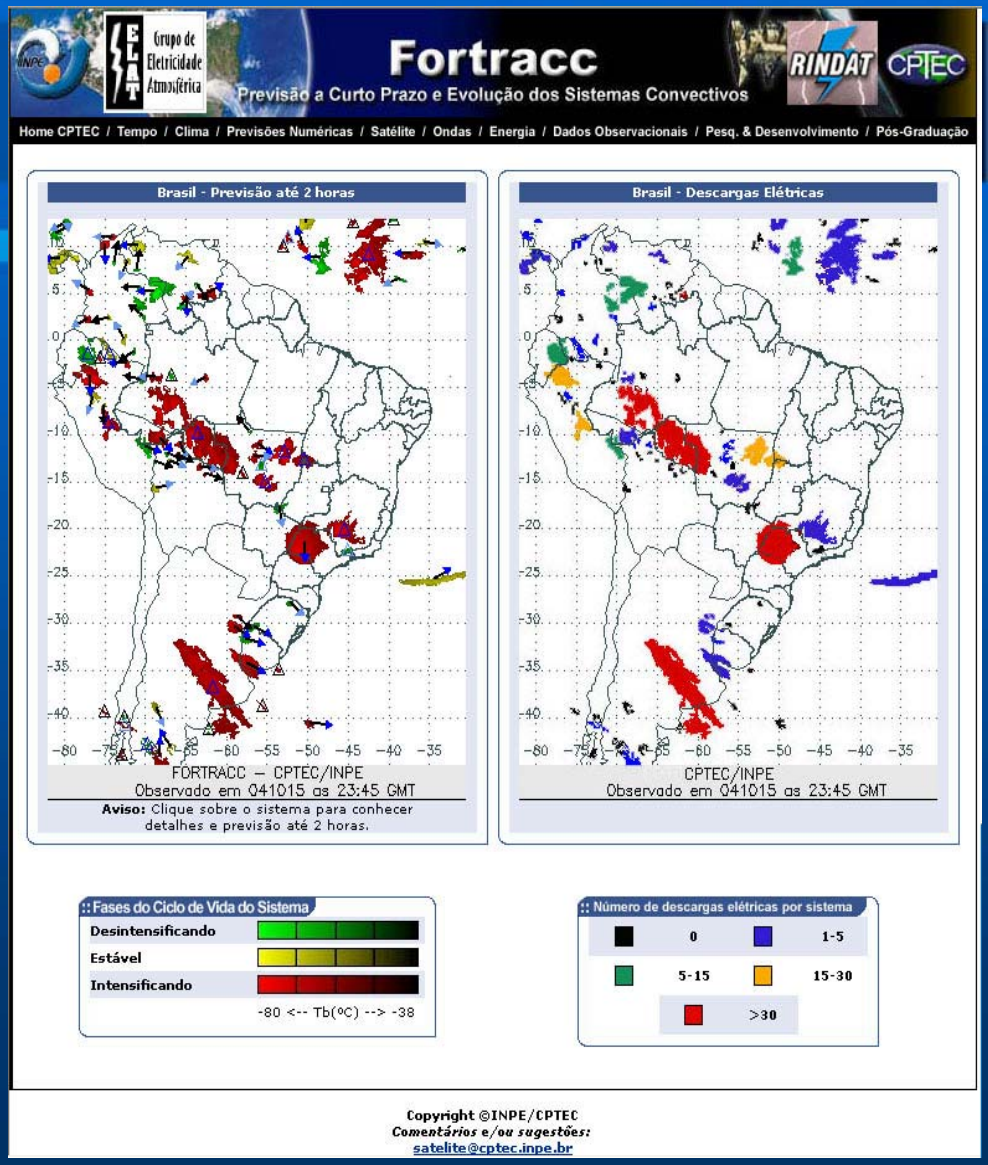
Convective Systems



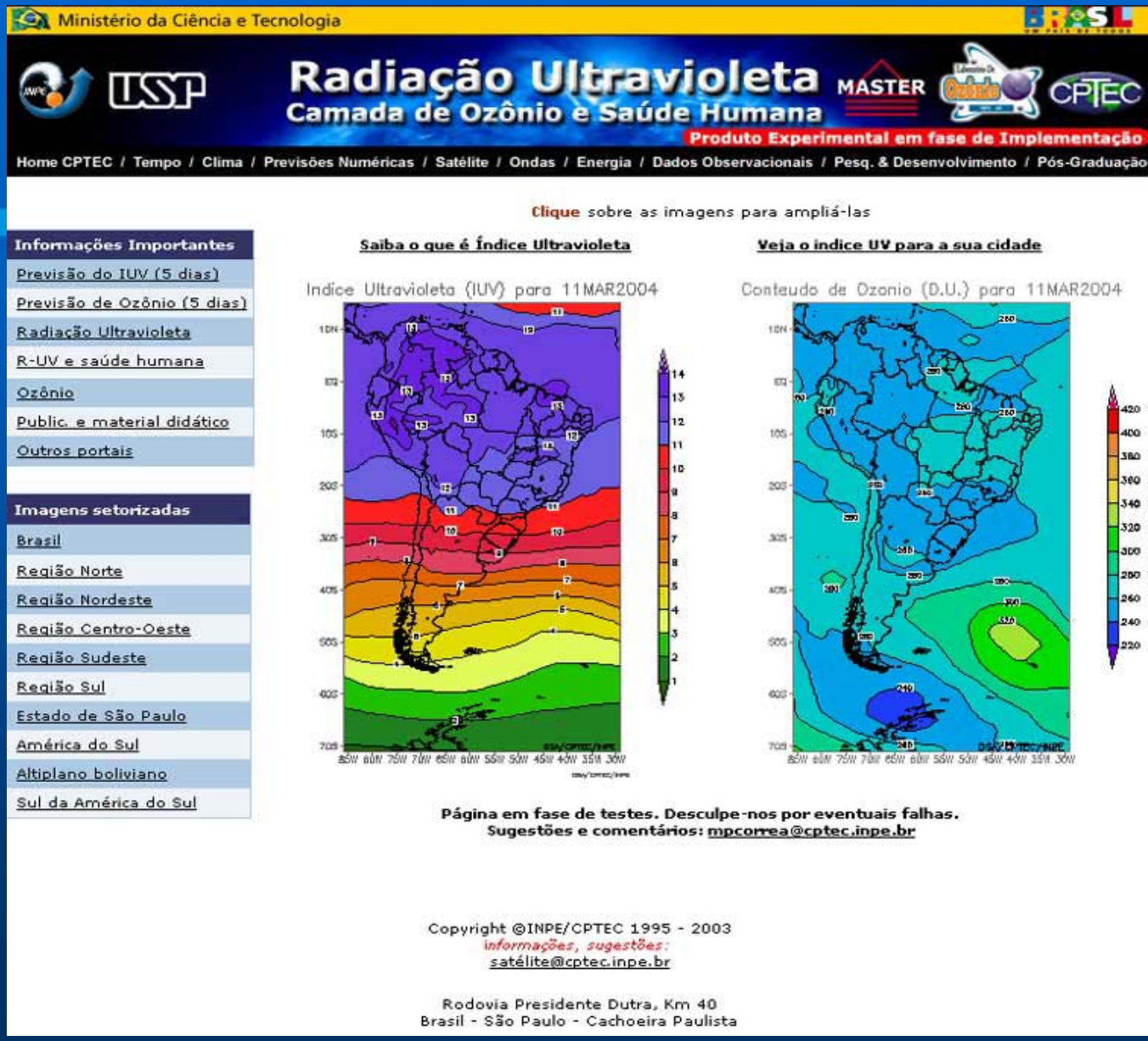
Nowcasting

PERSPECTIVES

- Include Evolution of Lightning
- Improve MCS Detection
- Tracking Precipitation Cells

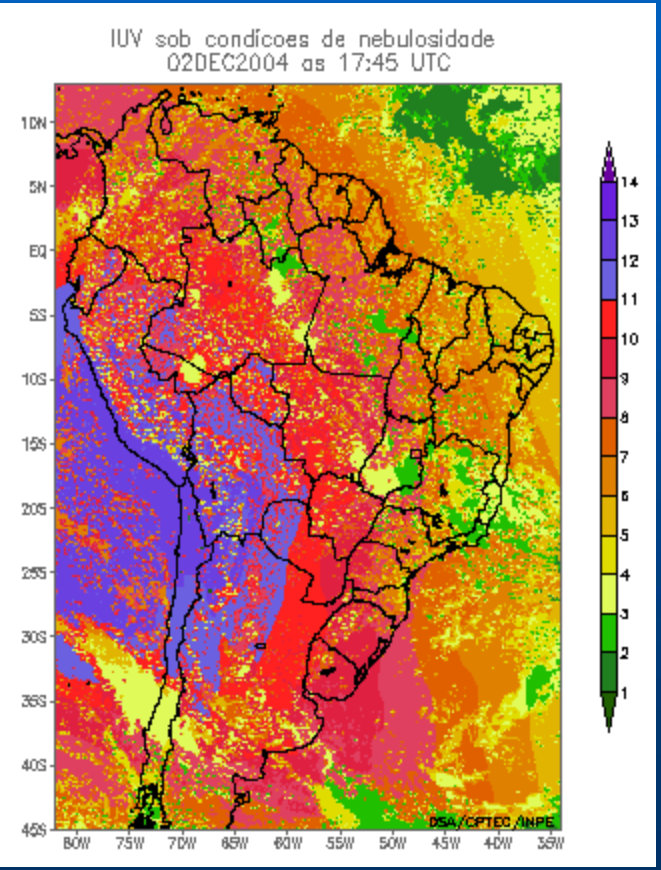


- Ozone from TOMS
- Two Stream UV model
- CPTEC model

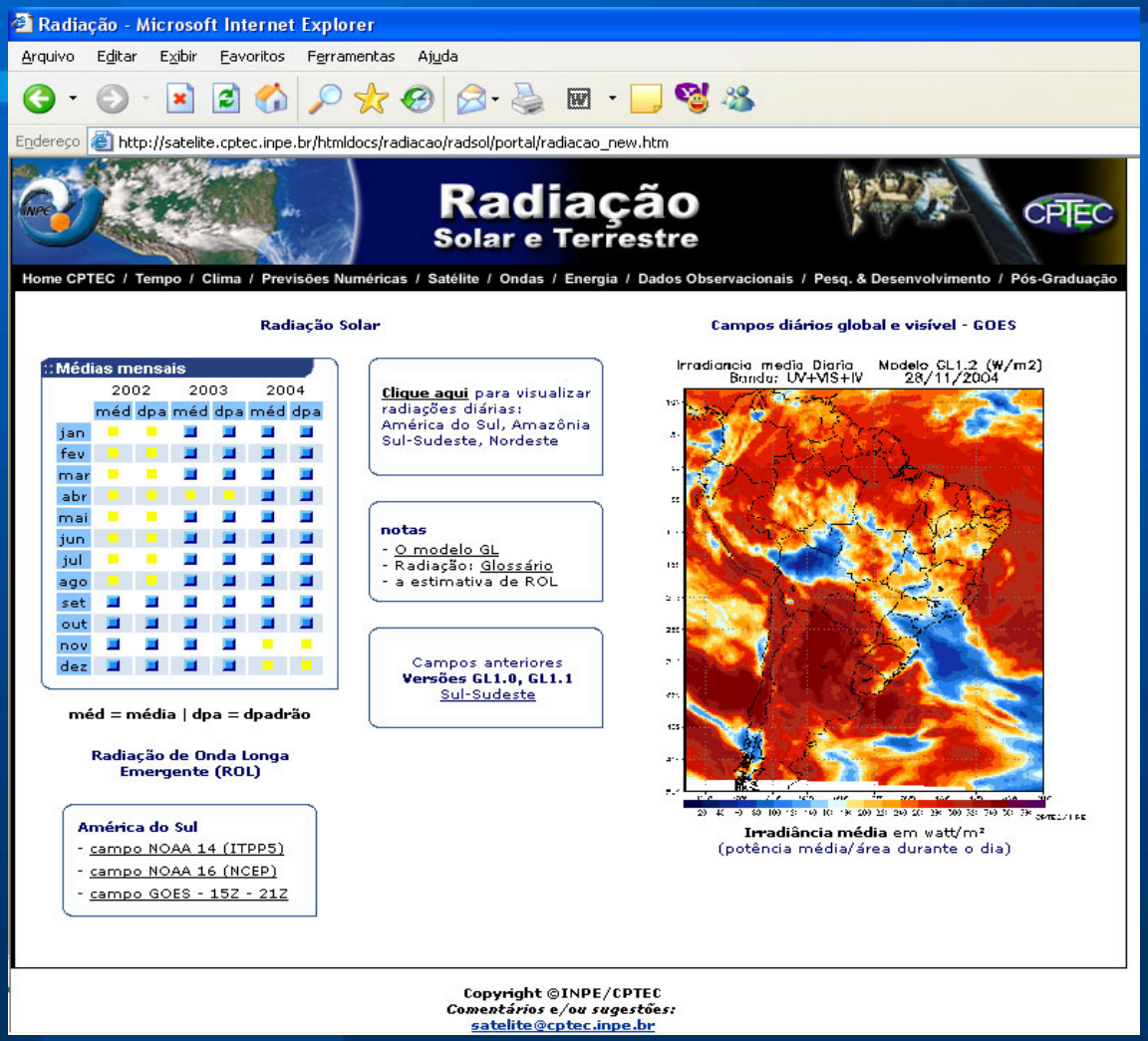


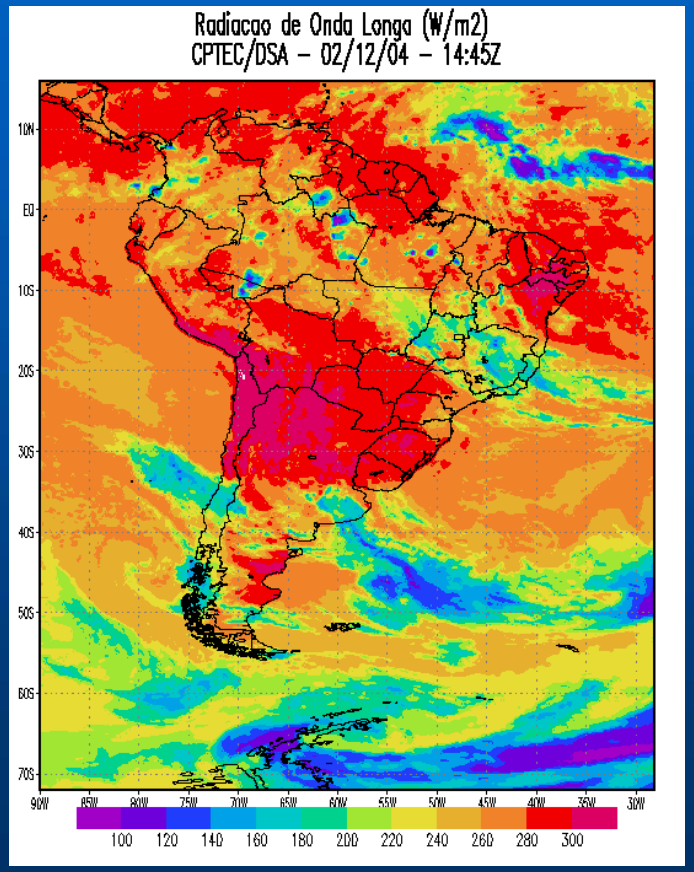
PERSPECTIVES

- Include Ozone from MODIS
- Include cloud classification



Surface Insolation and Outgoing Longwave Radiation from GOES



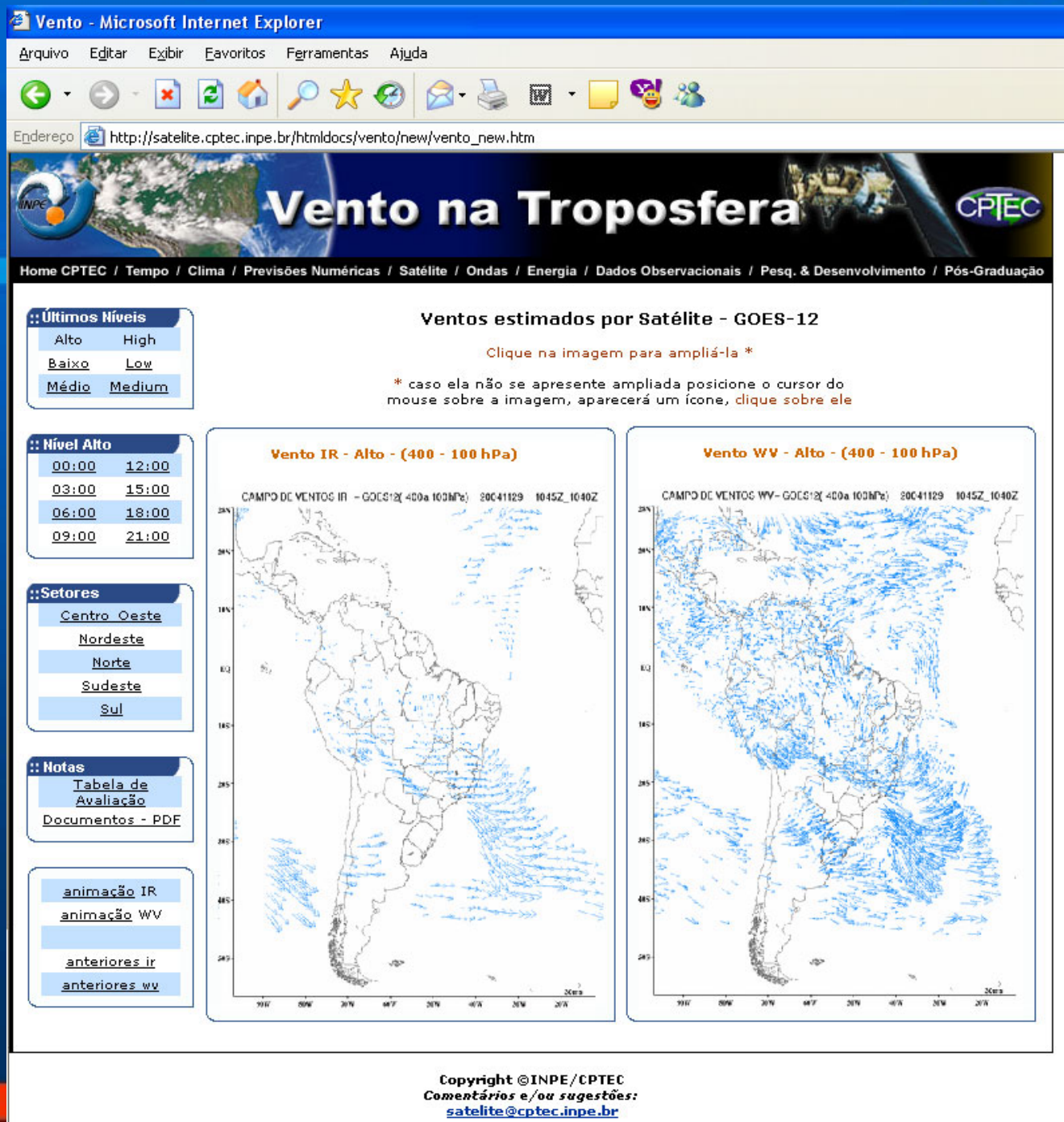


PERSPECTIVES

- Include Aerossols in Solar Surface Model (GL2.0)
- Cover the Tropical Atlantic Using METEOSAT
- Aerossols Detection using MODIS – Regionalization of NASA model

Cloud Drift Winds

- IR channel (using WV for height correction)
- WV channel



Avaliação do Produto Vento para Setembro/2004 (Sep/2004)

Canal	Região	Niveis(mbar)	Bias-VT	RMS-VT	Bias-VL	RMS-VL	VL_MVT_R	VL_MVT_S	VL_M_R	VL_M_S	VT_M_DF	NUM
Vapor d'água	Tropical	sfc-700	-	-	-	-	-	-	-	-	-	0
		700-400	0,39	9,45	0,31	4,03	7,65	8,05	8,05	7,73	9,57	11
		400-100	1,98	8,52	1,84	5,38	8,76	10,74	10,74	8,91	7,33	72
	Sub-Tropical	sfc-700	-	-	-	-	-	-	-	-	-	0
		700-400	1,63	4,30	1,49	3,43	12,56	14,19	14,19	12,70	10,91	7
		400-100	-0,31	3,56	-0,38	3,25	17,36	17,05	17,05	17,42	14,07	7
	Todas	sfc-700	-	-	-	-	-	-	-	-	-	0
		700-400	1,05	6,16	0,95	3,46	10,25	11,31	11,31	10,36	9,40	18
		400-100	1,50	7,49	1,37	4,94	10,55	12,06	12,06	10,68	8,74	79
Infravermelho	Tropical	sfc-700	-1,61	6,33	-1,71	6,07	8,88	7,27	7,27	8,98	10,74	16
		700-400	1,83	3,27	1,77	3,33	5,42	7,26	7,26	5,48	6,88	3
		400-100	-2,08	4,34	-2,16	3,28	10,60	8,52	8,52	10,68	4,42	13
	Sub-Tropical	sfc-700	2,50	2,50	2,31	2,31	6,21	8,71	8,71	6,40	6,34	1
		700-400	-	-	-	-	-	-	-	-	-	0
		400-100	2,51	6,95	2,51	6,95	24,29	26,81	26,81	24,30	21,82	2
	Todas	sfc-700	-1,79	5,55	-1,89	5,29	9,60	7,81	7,81	9,70	11,72	17
		700-400	3,63	4,59	3,59	4,63	4,52	8,14	8,14	4,56	7,17	3
		400-100	-1,16	4,86	-1,23	4,01	13,34	12,18	12,18	13,41	7,90	15

Bias-VT = Bias Vetorial
RMS-VT = rms Vetorial
B-VL = Bias da Velocidade
RMS-VL = rms da Velocidade

VL_MVT_R = Velocidade Média Vetorial da Radiossonda
VL_MVT_S = Velocidade Média Vetorial da Sondagem
VL_M_R = Velocicade Média da Radiossonda
VL_M_S = Velocicade Média da Sondagem

VT_M_DF = Diferença Vetorial Média
NUM = Numero de Dados
sfc = Superfície

Bias Vetorial (Vector Bias)
rms Vetorial (Vector rms)
Bias da Velocidade (Speed Bias)
rms da Velocidade (Speed rms)

Velocidade Média Vetorial da Radiossonda (Rawinsonde Mean Vector)
Velocidade Média Vetorial da Sondagem (Satellite Mean Vector)
Velocicade Média da Radiossonda (Rawinsonde Mean Speed)
Velocicade Média da Sondagem (Satellite Mean Speed)

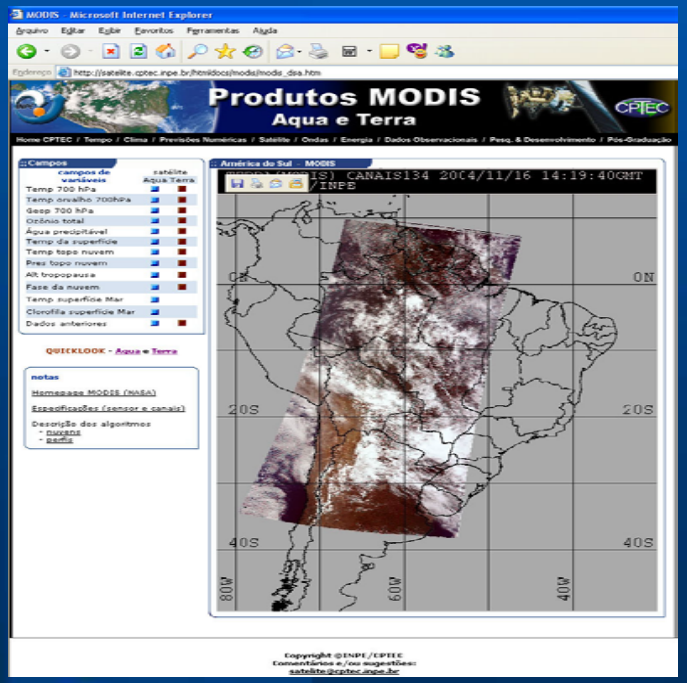
Diferença Vetorial Média (Mean Vector Difference)
Numero de Dados (No.of Collocations)
Superfície (Surface)

PERSPECTIVES

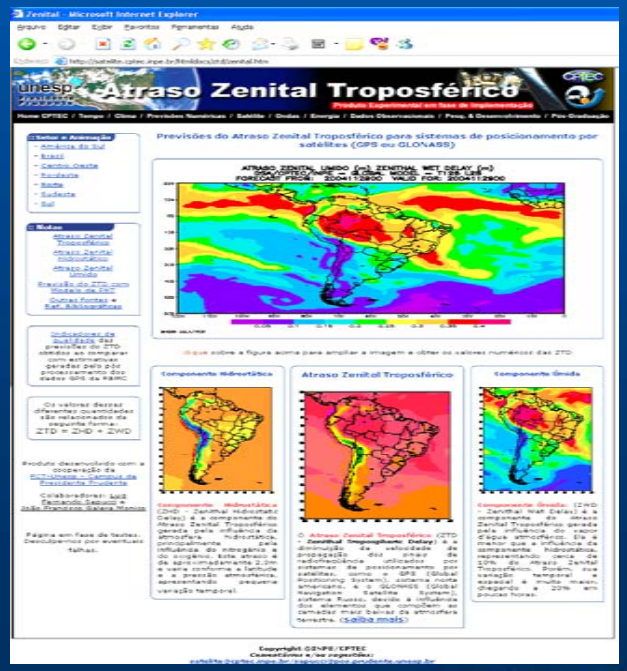
- Cloud Drift Winds using Visible channel
- Cloud Drift Winds using 3.9 μm channel

Others Operational Products

Satellite Products from MODIS
Obtained from Seaspace
Terascan

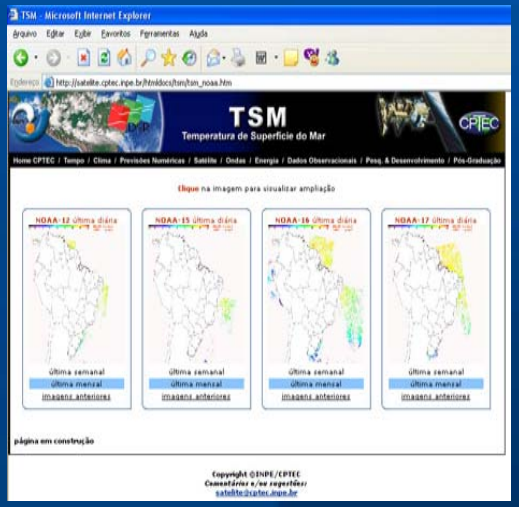


Zenithal Tropospheric Delay
IWV - GPS



Others Operational Products

SST

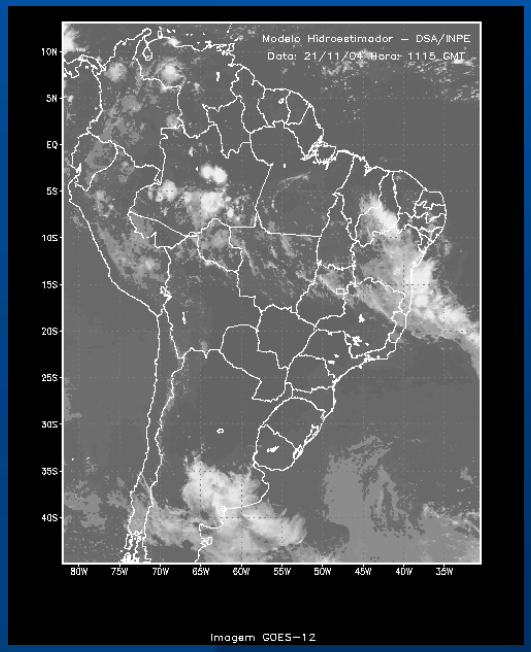


FOG

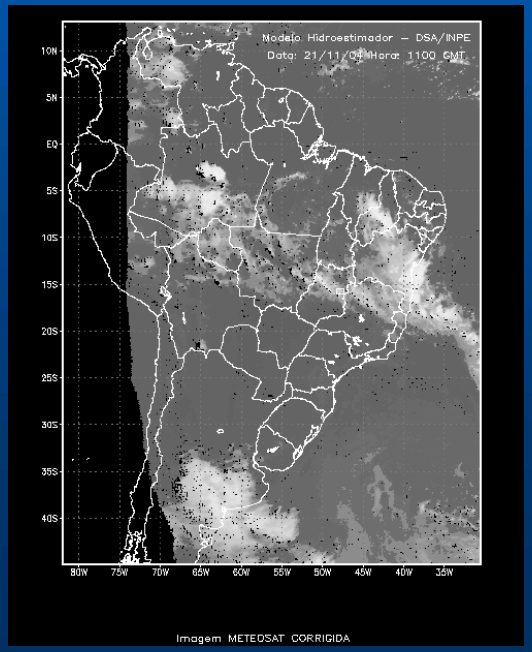
NDVI

Studies in Progress

GOES-12

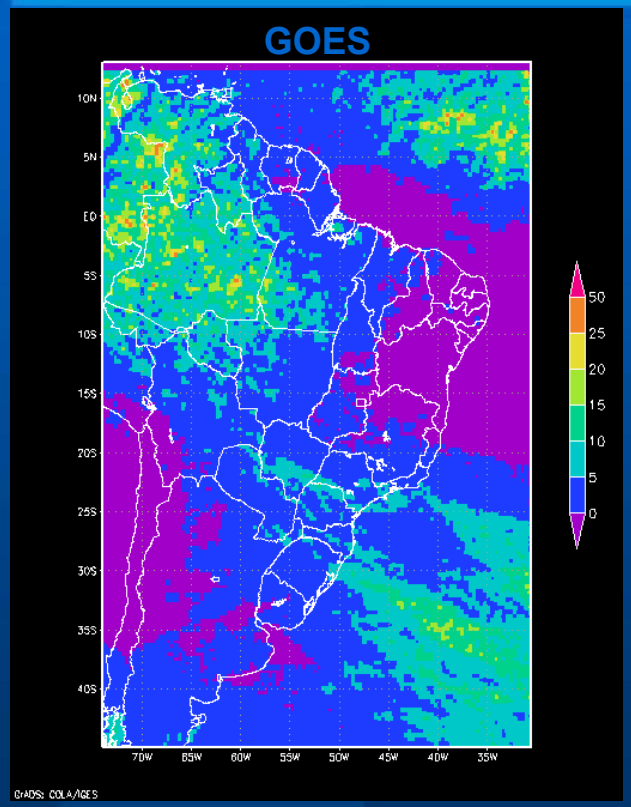


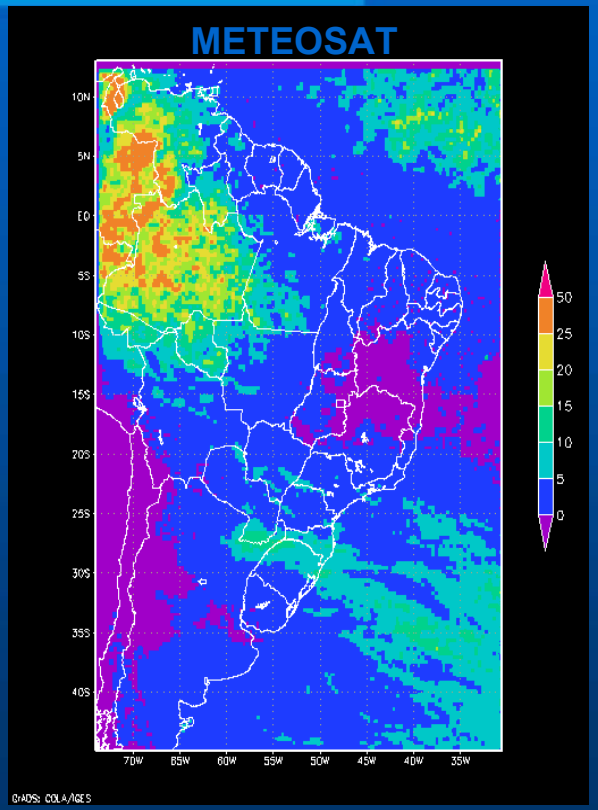
METEOSAT-7
Adjusted – parallax and zenithal angle correction

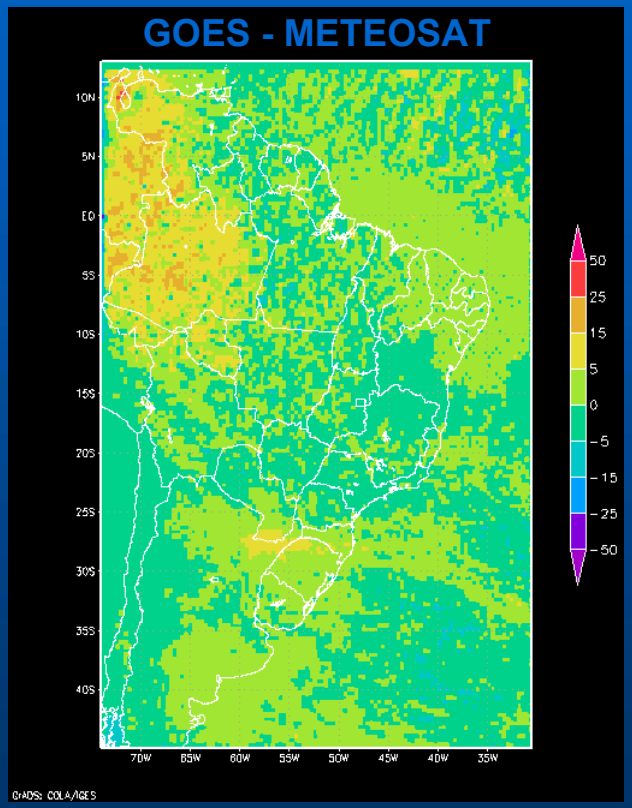


The Hydroestimator uses only GOES images for precipitation estimation

METEOSAT images have just been introduced to Hydroestimator when GOES images are not available







Mean precipitation - October/2004

FLISS
Fast Line-by-line Satellite signal Simulator

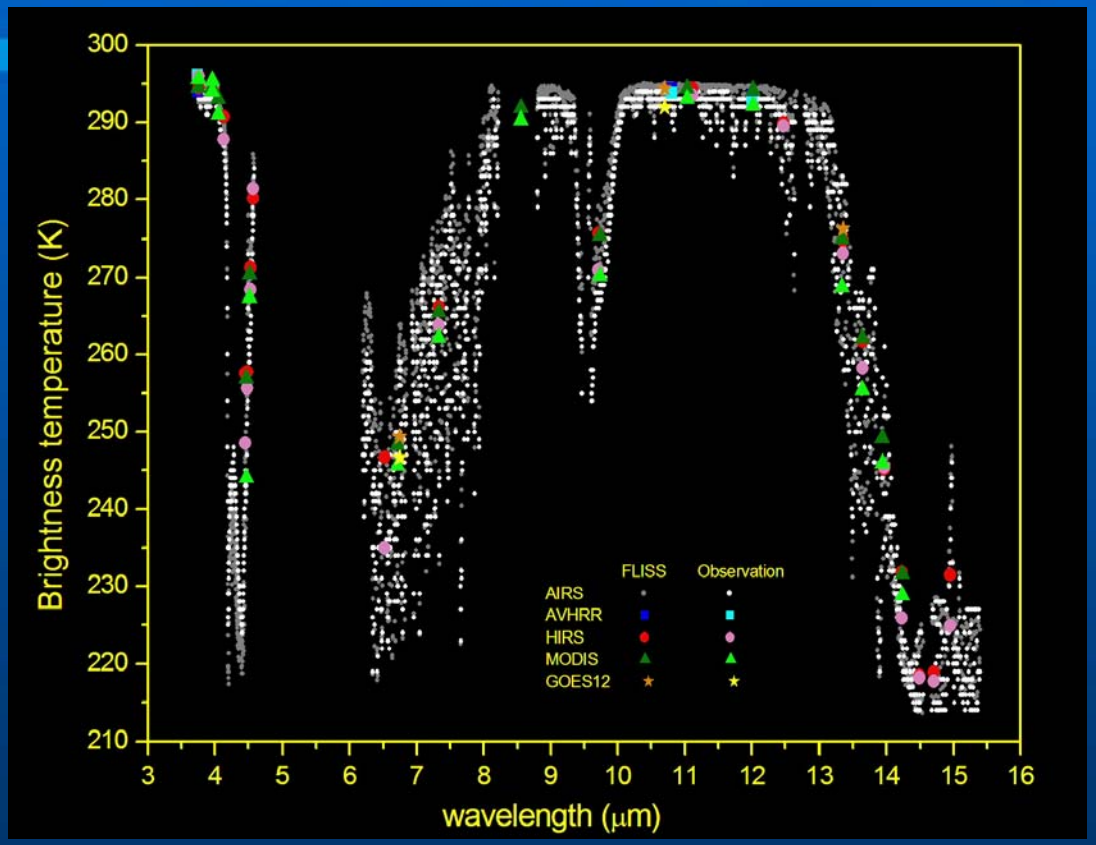
FLISS is a multi-platform computer program developed in Fortran90, compatible with MS-Windows, Linux and UNIX

Studies in Progress

Spectral database:
HITRAN-11 v (Rothman et al., 2003) and continuum model by N_2, O_2, O_3, CO_2 and H_2O (CKD-2.4)

Calculations:
line-by-line algorithms for gas absorption calculations (Fomin, 1994) and vertical integration (Fomin et al., 2004)

In this version: a) model atmospheric profiles (McClatchey et al., 1972); b) spectral ground reflectances; c) response function for several sensors (MODIS, AIRS, AVHRR, HIRS and GOES Imager).



FLISS-S for solar radiation, including applications for clouds and aerosols, and **FLISS-L** for infrared and microwave spectrum. Version L does not include absorption/scattering by atmospheric particulate (aerosol or cloud).

Studies in Progress

- Expand Products to MSG – Atlantic Ocean
- Improve Radiative Transfer Models: Monte Carlo method for scattering in IR and microwave spectrum

Brazilian Space Program Revision
PNAE 2005 - 2014

PROPOSAL FROM METEOROLOGICAL WORK GROUP

- **Geostationary Satellite for CNS/ATM (Communication – Navigation – Surveillance – Air Traffic Management) include a Meteorological Mission**

•PRELIMINARY SPECIFICATION

CANAL	FAIXA ESPECTRAL (MICRON)	RESOLUÇÃO ESPACIAL (KM)	
		IDEAL	MÍNIMA
VIS 1	0,55 – 0,90	1	1
VIS 2	0,74 – 0,90	1	1
IR 1	10,3 – 11,3	2	4
IR 2	11,5 – 12,5	2	4
IR 3	6,50 – 7,00	2	4
IR 4	3,50 – 4,00	2	4

Brazilian Space Program Revision
PNAE 2005 - 2014

PROPOSAL FROM METEOROLOGICAL WORK GROUP

- **Satellite Tropical Orbit equipped with microwave sensor and lighting detector to monitoring precipitation - GPM**

PRELIMINARY SPECIFICATION

CANAL	FREQUENCIA (GHz)	RES. ESPACIAL (km) Desejável
Microondas passivo #1	89	15
Microondas passivo #2	150	15
Microondas passivo #3	183 +- 1	15
Microondas passivo #4	183 +- 3	15
Microondas passivo #5	183 +- 7	15

Tipo de varredura – Ideal cônica – aceitável: “cross tracking”.