New approaches for Nowcasting Techniques over Brazilian Territory

Convection Working Group

Convection Working Group - Florence, Italy, 4-8 April, 2016

satelite.cptec.inpe.br

OUTLINE

- Division of Satellite and Environmental Systems at CPTEC/INPE
- Current approaches on nowcasting at CPTEC/INPE using satellite imagery
- Summary of Research Activities using ForTrACC-Satellite
- SCOPE-Nowcasting - Pilot Project: Precipitation / Severe Rainfall Risk Reduction

CPTEC

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- **Satellite and Environmental Systems Division**
- Operation Dvision
- Administative Support
- Super Computing Support
- Instruments and Calibration Laboratory

Division of Satellites and Environmental Systems (DSA)

The Division of Satellites and Environmental Systems (DSA) belong to the Center for Weather Forecasting and Climate Studies (CPTEC / INPE). The Division works in continuous operation of several reception systems and meteorological and environmental satellites information.
This work covers all steps involving the processing, storage and dissemination of remote sensing data. The data and derived products generated by DSA are of particular importance for a number of applications in various fields.

Meteorologia
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Oceanografia
Meio Ambiente

Clima
Hidrologia
Defesa Civil

Gerenciamento de Recursos Hídricos
Agricultura
Proteção ao Vôo




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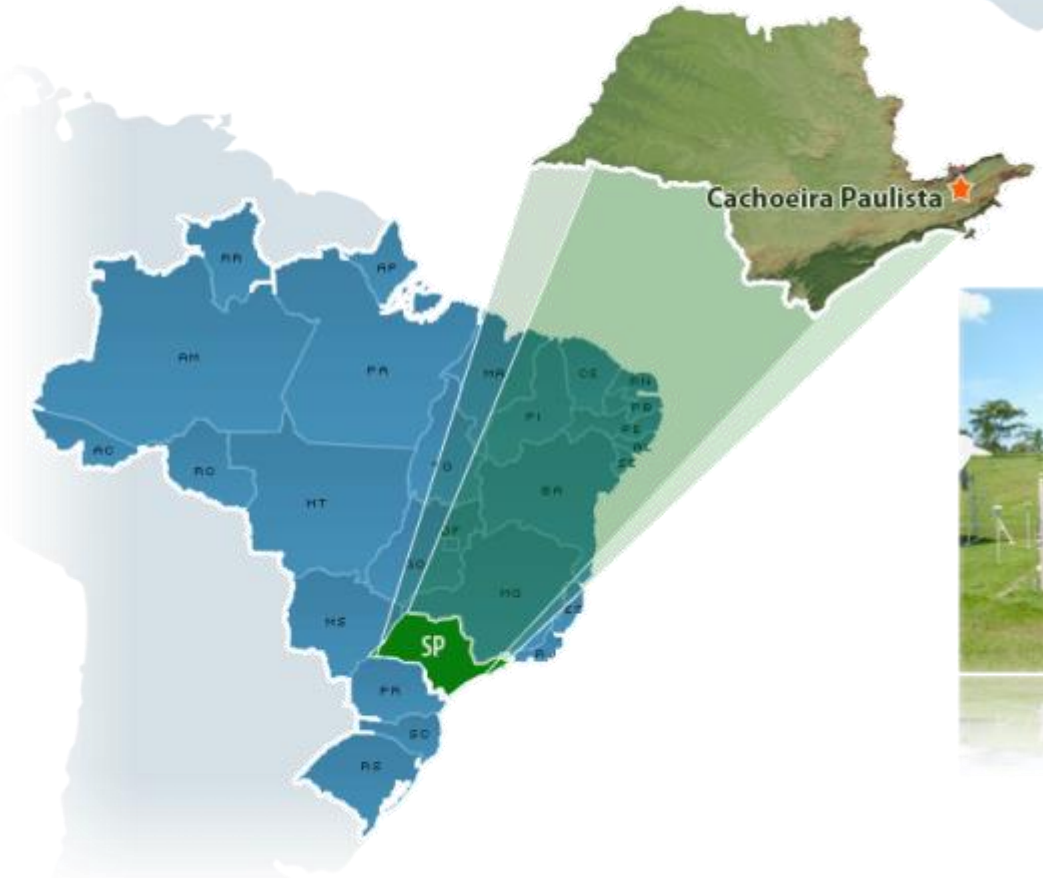

Presidente Dutra Hwy, Km 39, Cachoeira Paulista, SP
CEP 12630-000 - Phone: (12) 3186 - 9546 / 3186 - 9441
E-mail: atusdsa@cptec.inpe.br

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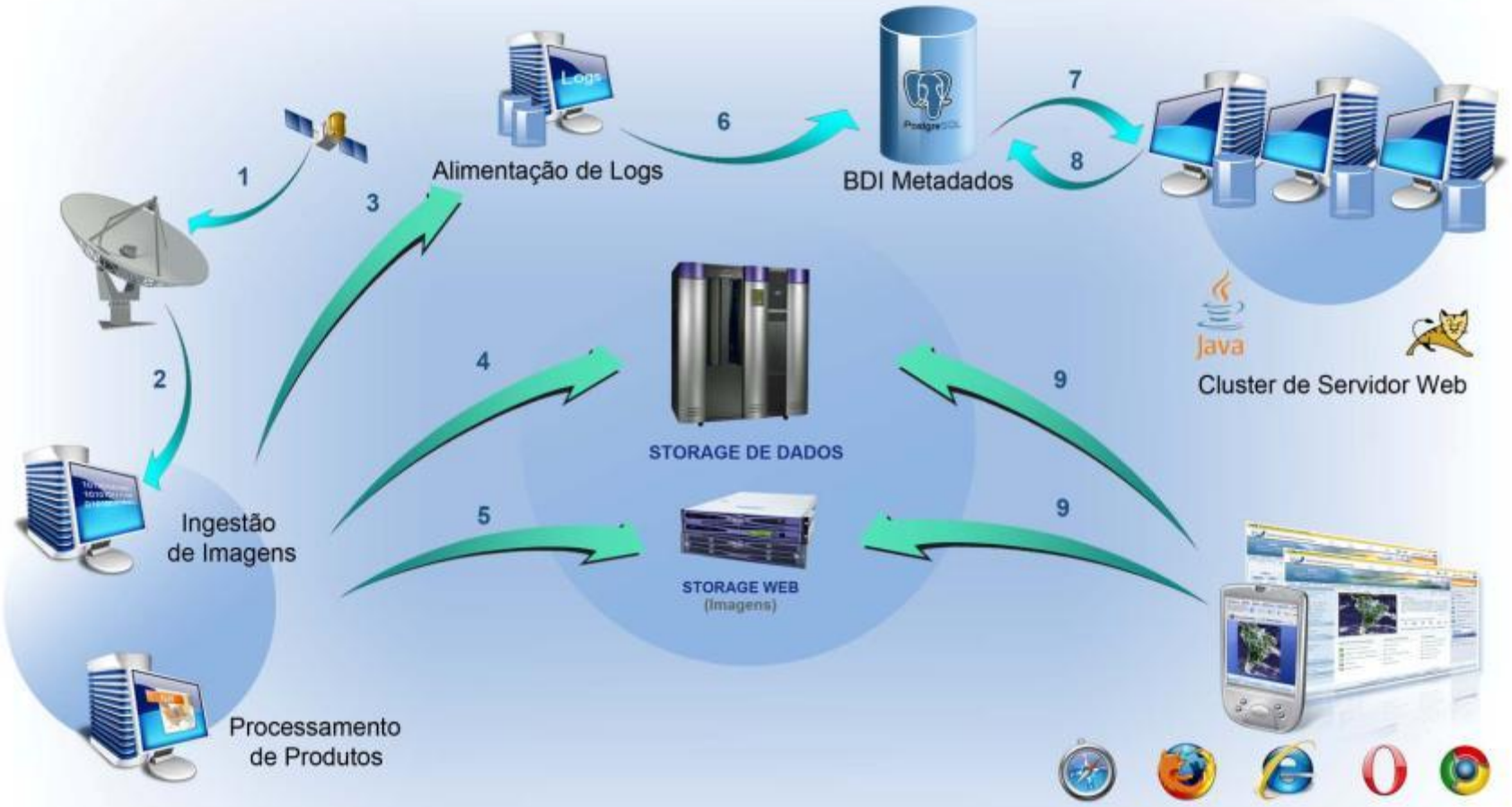

1- Recepção do satélite.
2- Recepção do Arquivo Binário.
3- Geração de Log para Alimentação do Banco.
4- Armazenamento em Storage Binário.
5- Armazenamento do Produto em Storage Web
6- Alimentação dos Metadados (Log de Produtos)
7- Aplicação Web busca Imagens no Banco de Dados (BDI)
8- BDI retorna o Link físico da Imagem / Binário.
9- Aplicação acessa o local correto da Imagem / Binário selecionando o Storage Web ou Storage Binário.

DSA
Satellite Division and Environmental Systems

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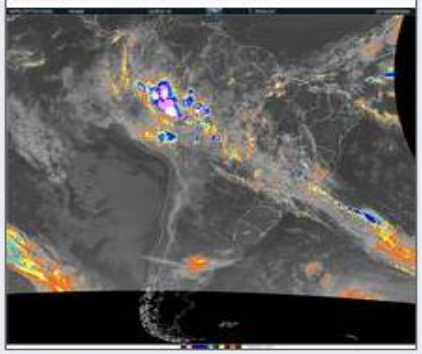
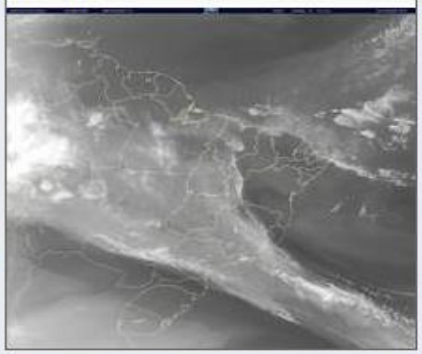
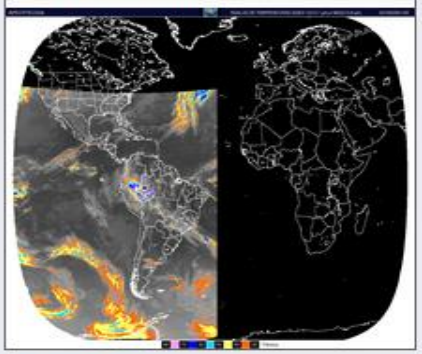
Goes 13



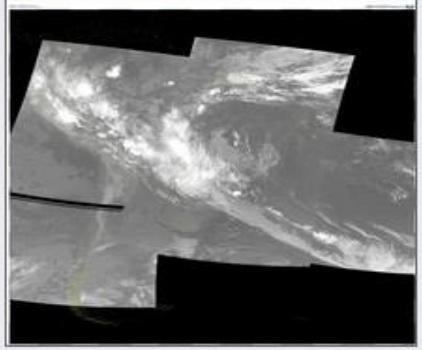
Meteosat



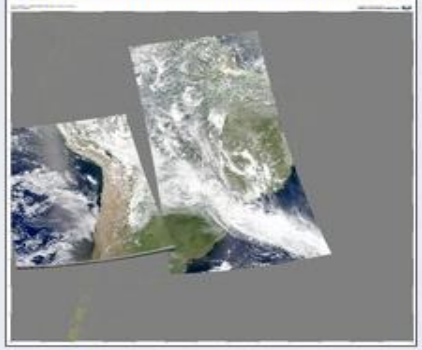
GOES + Meteosat



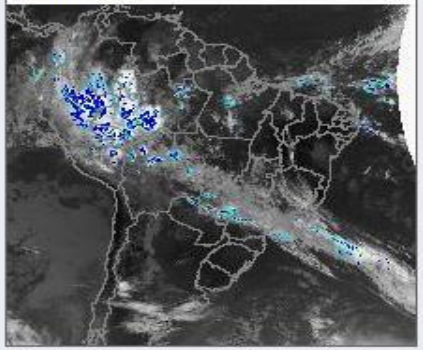
NOAA - Mosaic



TERRA/AQUA - RGB Composition



Precipitation



WEATHER

- Cloud Classification
- Atmospheric Eletricity
- Fog
- Drought Monitoring
- Radar Precipitation
- Satellite Precipitation
- Convective Cloud Clusters
- Cloud Drift Winds

RADIATION

- Zenith Tropospheric Delay
- Ultraviolet Index
- Solar Radiation

SURFACE AND ATMOSPHERE

- Aerosols
- MODIS Products
- Burnt Areas
- Atmospheric Soundings

OCEAN

- Satellite Oceanography

FEATURED PRODUCTS

Sigma | SigmaCast | Sigma/SOS | Web Request

Divisão de Satélites e Sistemas A...

Curtir Página 8 mil curtidas

NEWS AND CURRENT EVENTS

2015.09.30

High resolution images of KM 1 and 4 KM

Leia Mais

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Atmospherical Eletricity

Atmospherical Eletricity

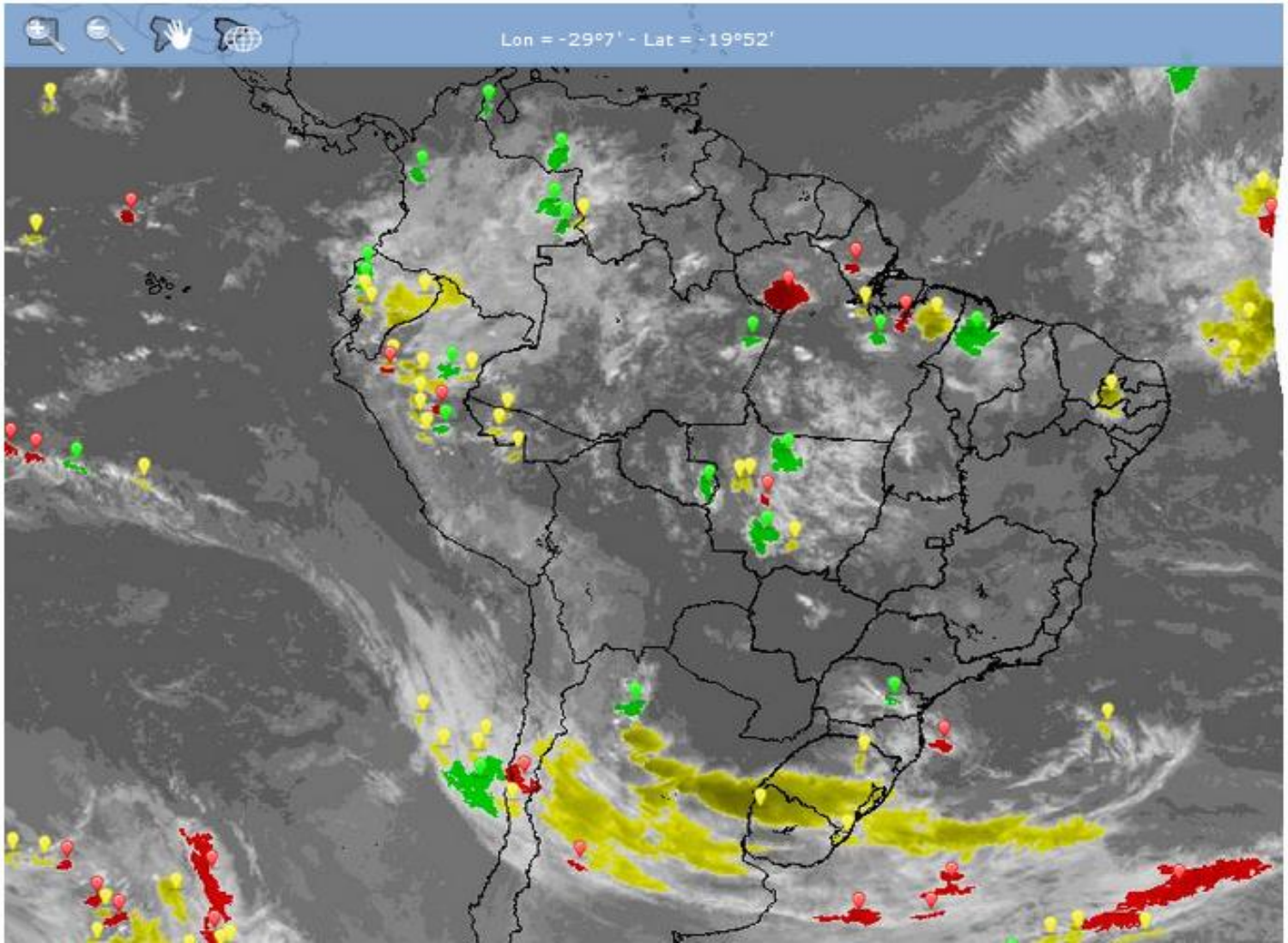
Fortracc

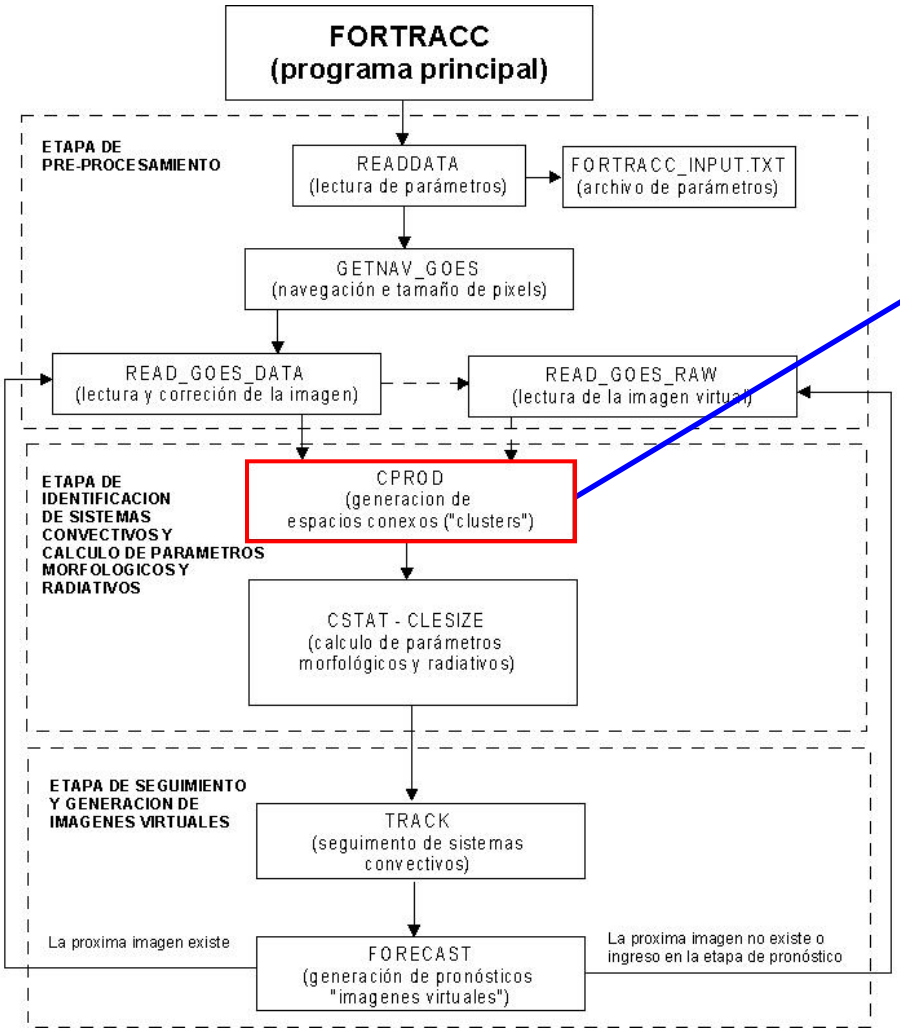
The program FORTRACC - Severe Storm, was developed with the objective of to detect and to follow Cloud Cluster with penetrative clouds (clouds with great vertical development), through the difference of canals WV and IR. In general, these Cloud Cluster are associates with electric activities, precipitation tax and strong winds.

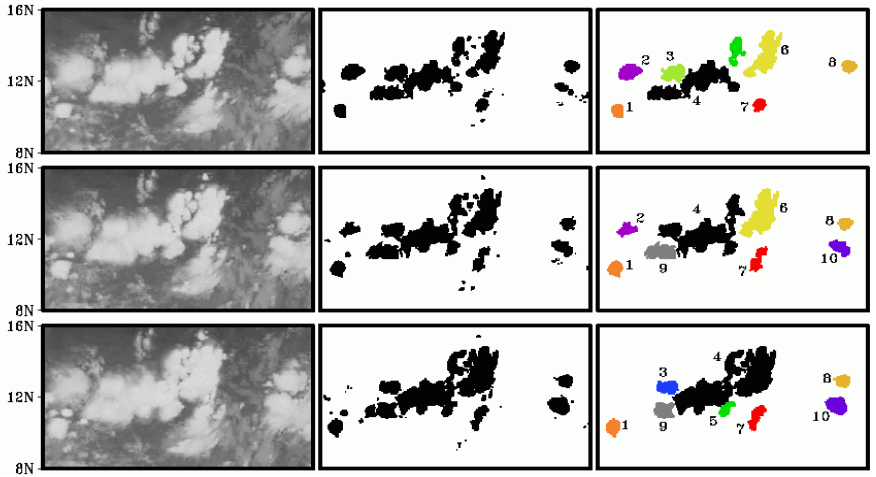
+ More Details...

Storm | Severe Storm | Forecasts - Storm

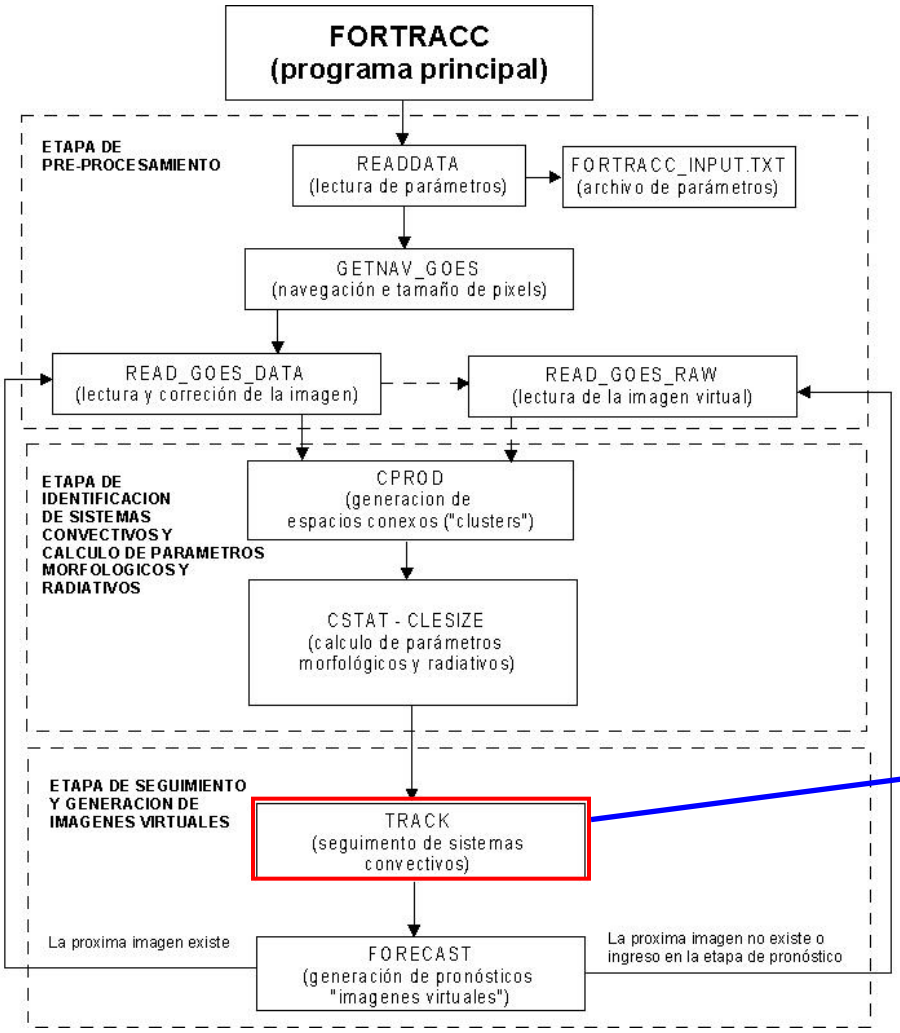
Sistemas Convectivos - DSA/CPTEC/INPE - 2016-04-05 04:00:00 GMT





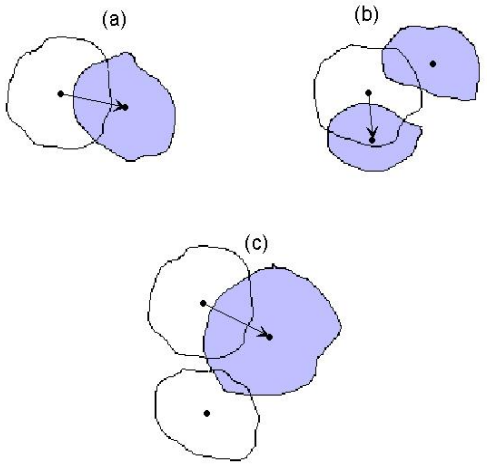


Conex space generation (*"clusters"*). Temperature threshold $T \leq 235$ K – Minimun Area $A_{MIN} \geq$ 150 pix

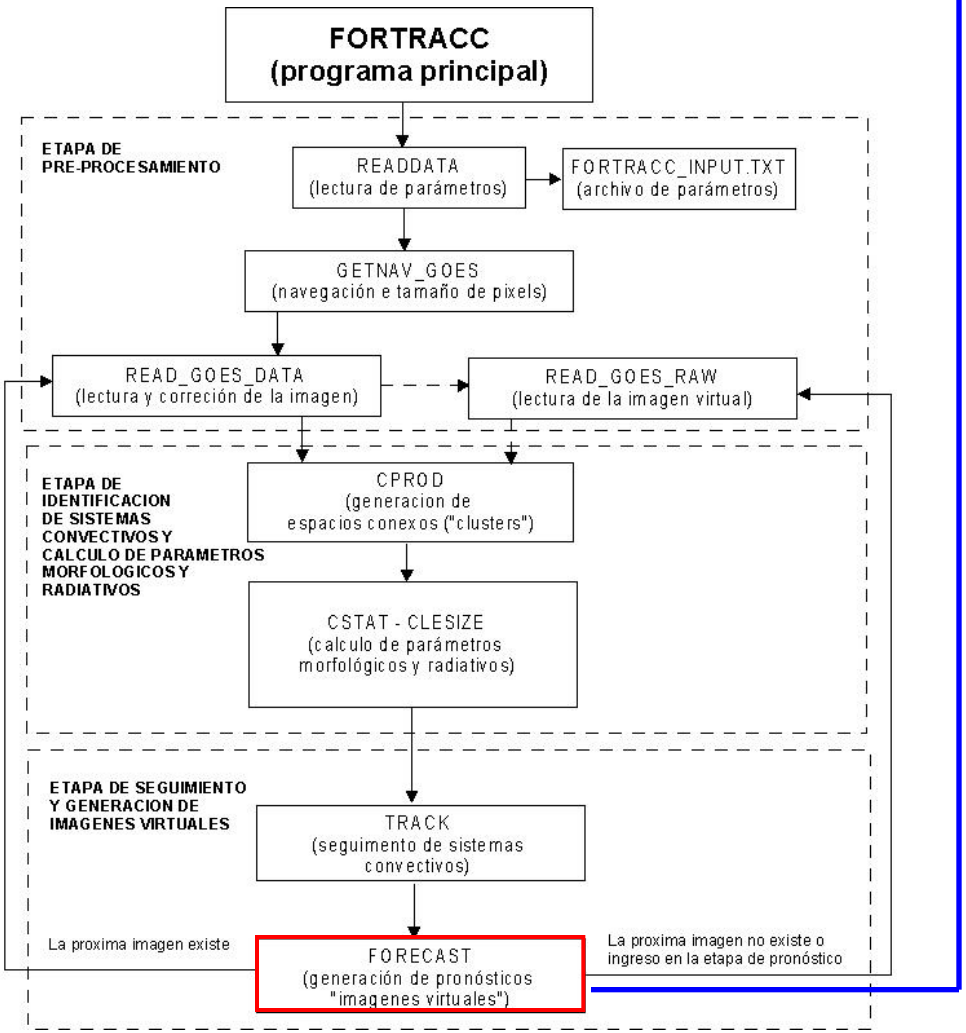


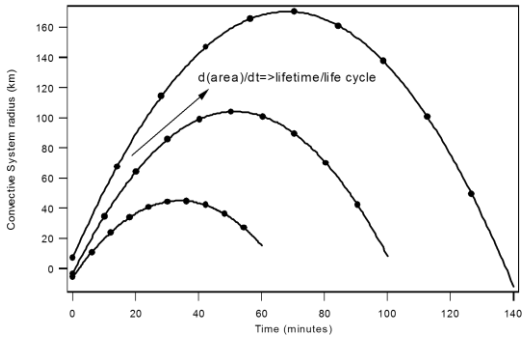
Tracking Methodology

- Tracking of convective clouds is based on an area overlap method.
- Comparison of successive satellite images is carried out "forward" and "backward" in time

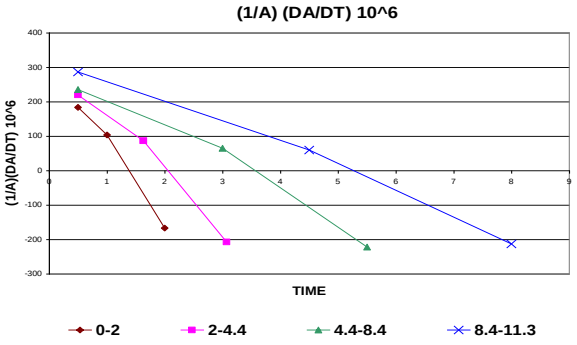


White dotted figures represent MCSs in the first time step while gray figures represent the second time step. Arrows represent MCS evolution. Gray lines represent the previous time step evolution, and solid lines represent the actual evolution for (a) continuity, (b) splitting, and (c) mergers.

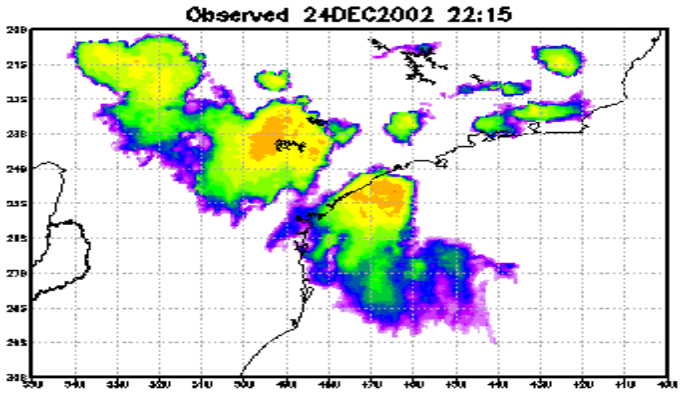


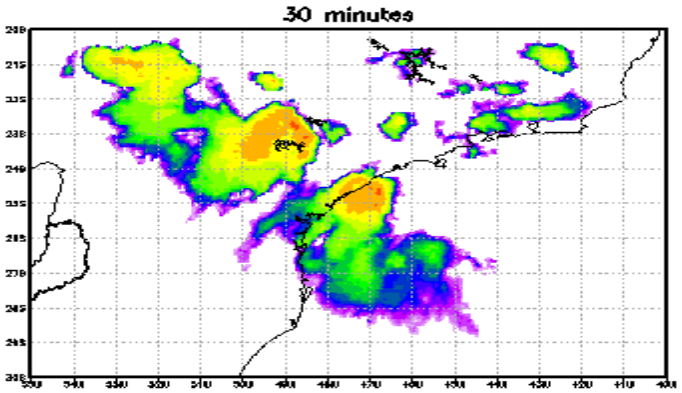


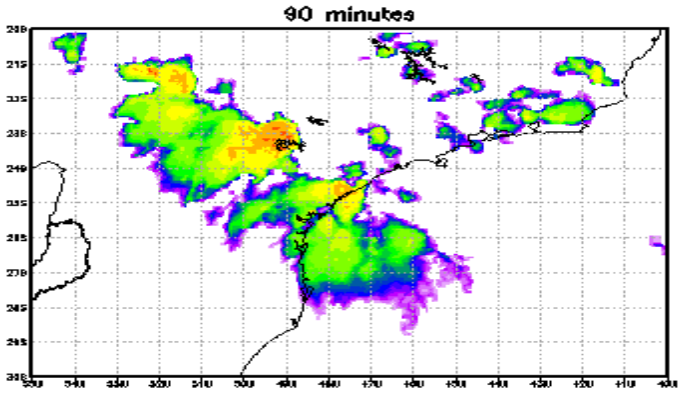
$$A(t) = \alpha * e^{at^2+bt+c}$$

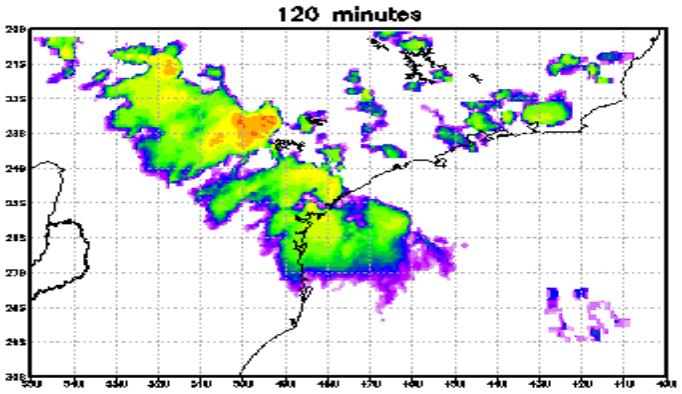


$$\Delta E = 1/A * (\partial A/\partial t) = at + b$$









	30 min	60 min	90 min	120 min
ACU	0.98	0.98	0.97	0.96
BIAS	0.96	0.95	0.91	0.87
POD	0.77	0.64	0.54	0.44
FAR	0.20	0.32	0.41	0.49

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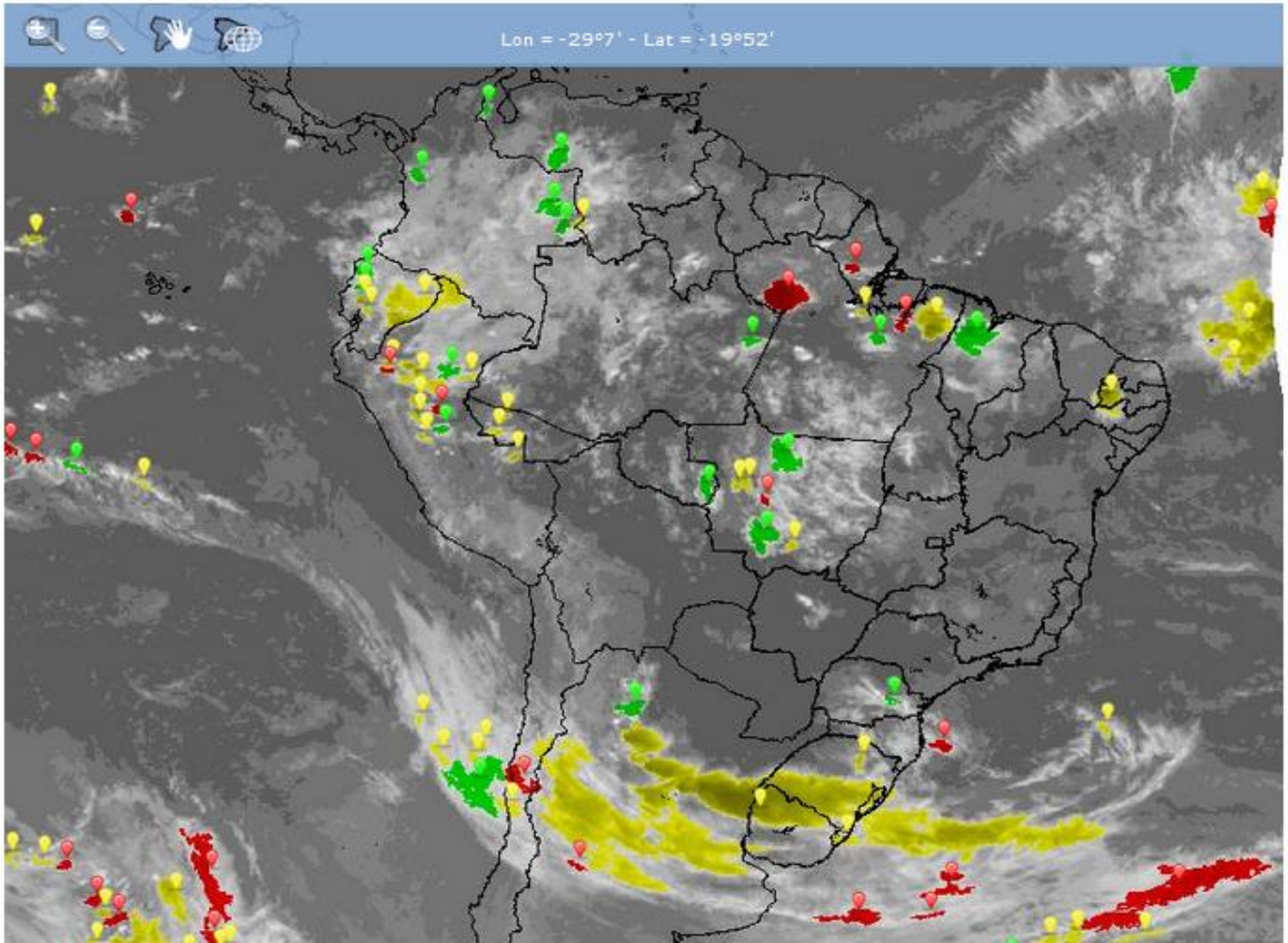
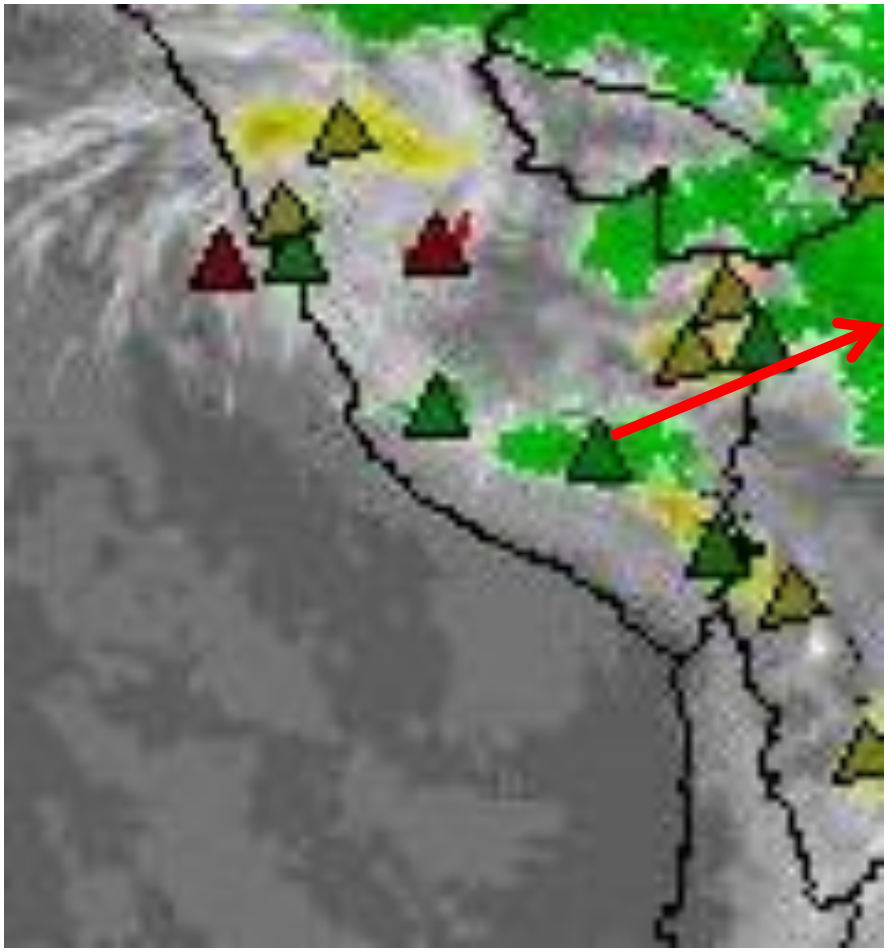
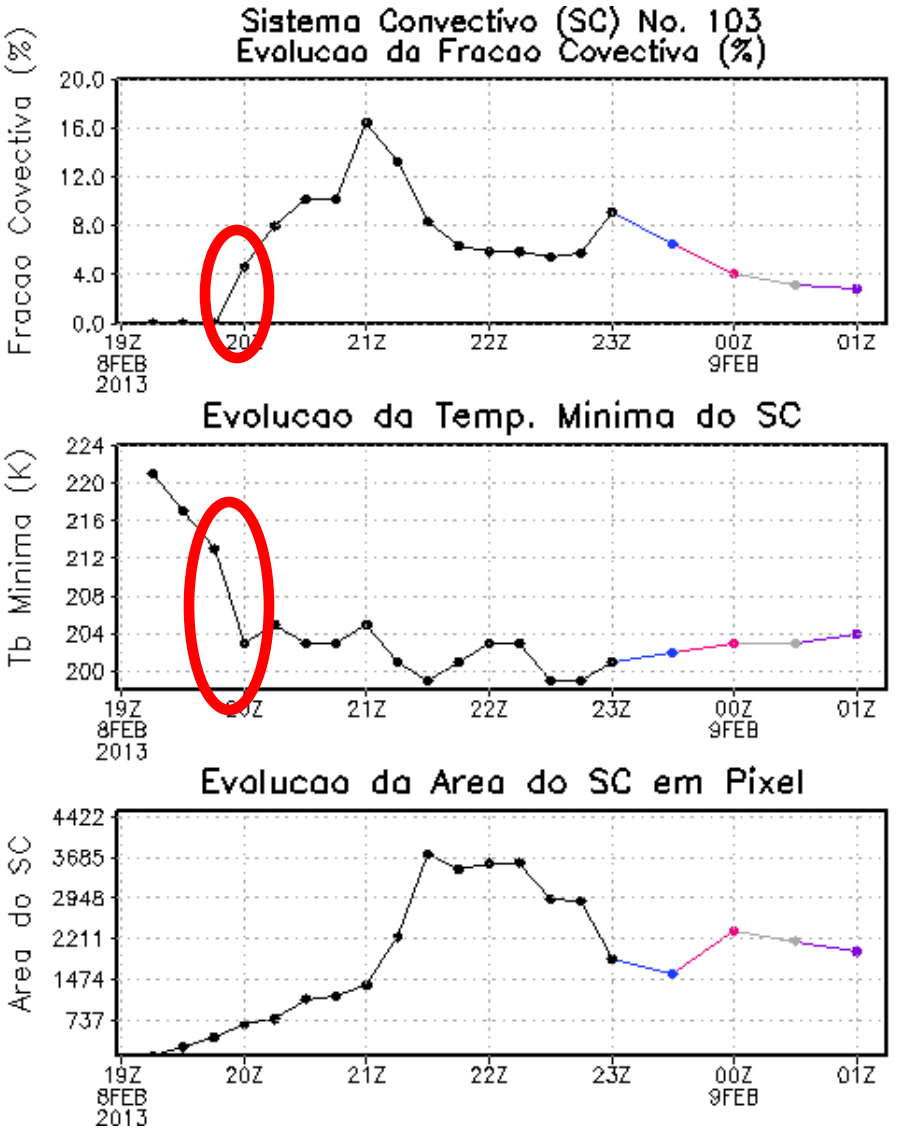
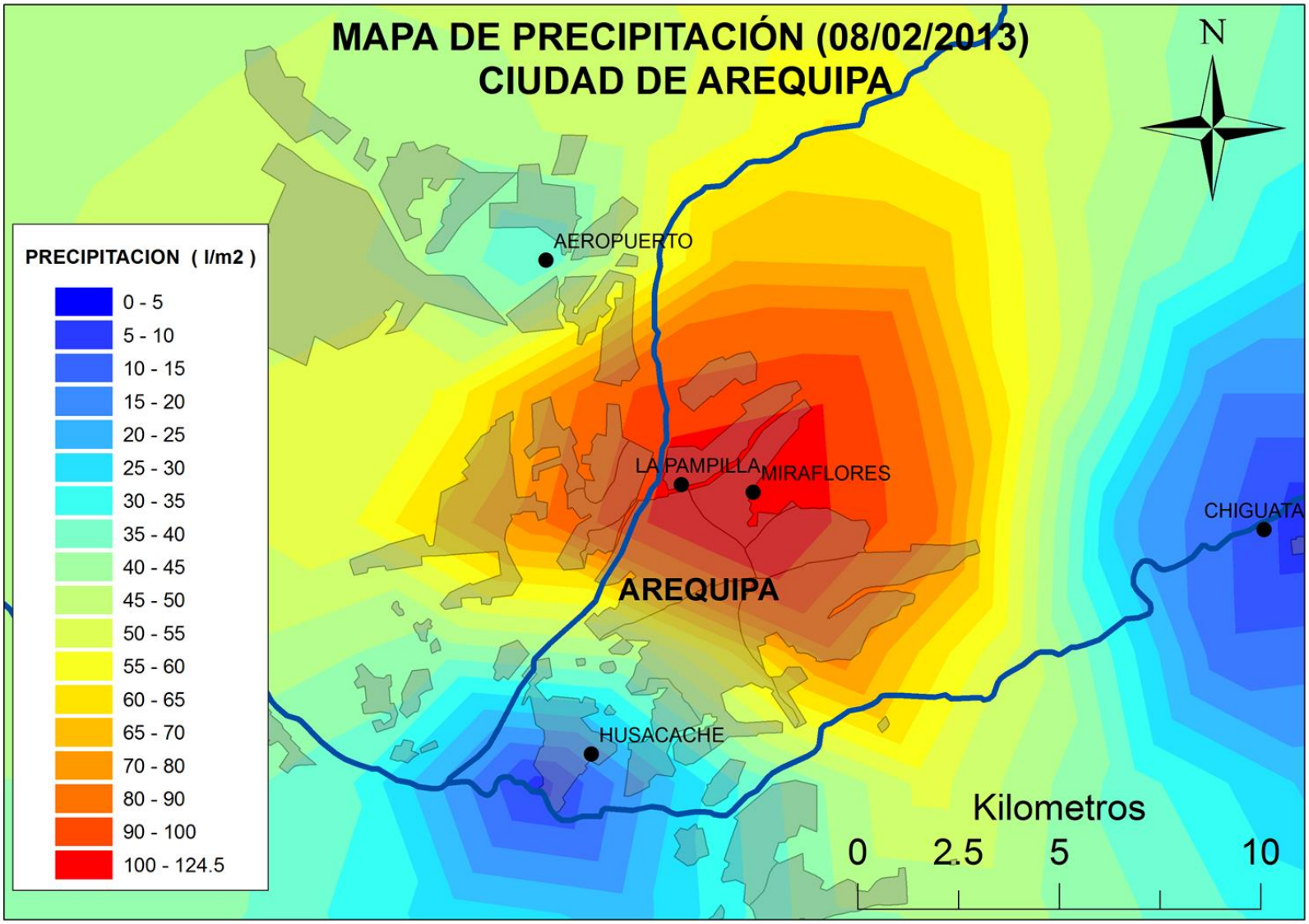


February 8th, 2013 – 23:00 UTC

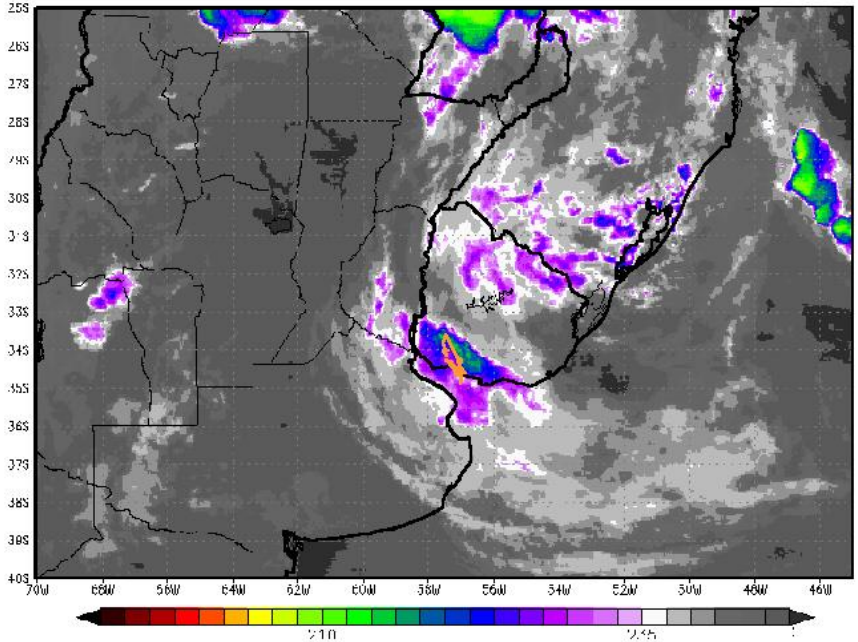


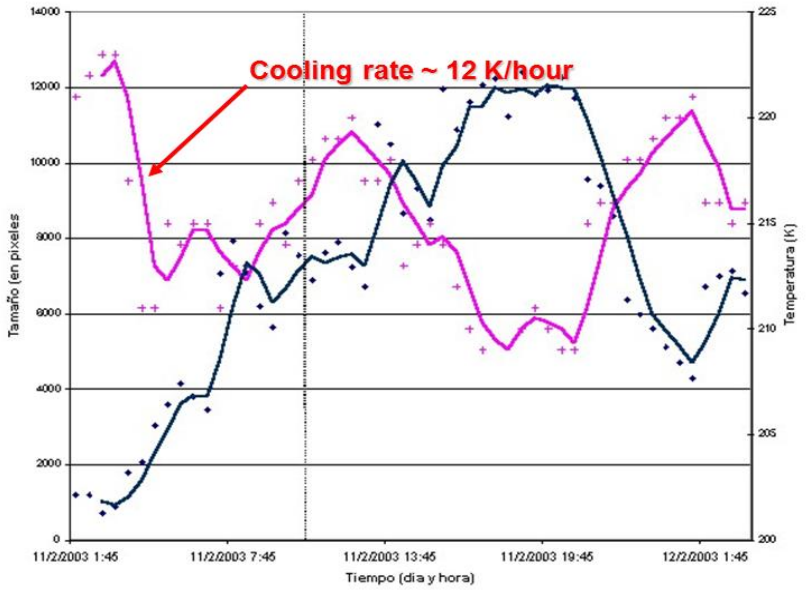



MAPA DE PRECIPITACIÓN (08/02/2013)
CIUDAD DE AREQUIPA
N
PRECIPITACION (l/m2)
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
70 - 80
80 - 90
90 - 100
100 - 124.5
AEROPUERTO
LA PAMPILLA
MIRAFLORES
CHIGUATA
AREQUIPA
HUSACACHE
Kilometros
0
2.5
5
10

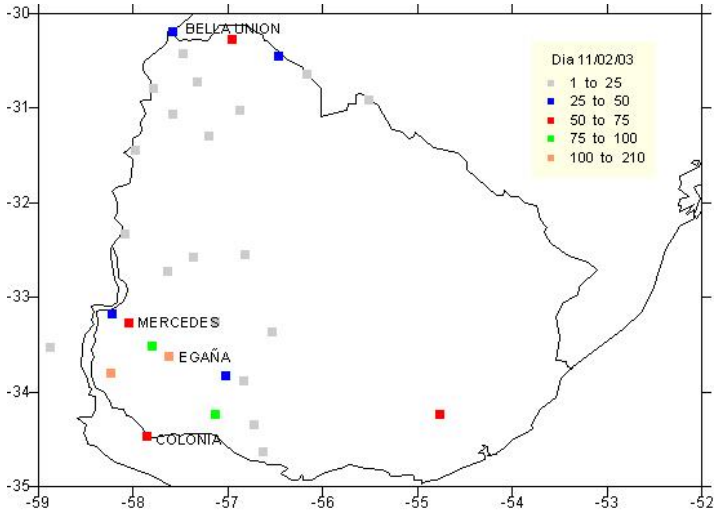
FEBRUARY 9th, 2013 - AREQUIPA

Other example….





February 11, 2003 – 02:15 UTC



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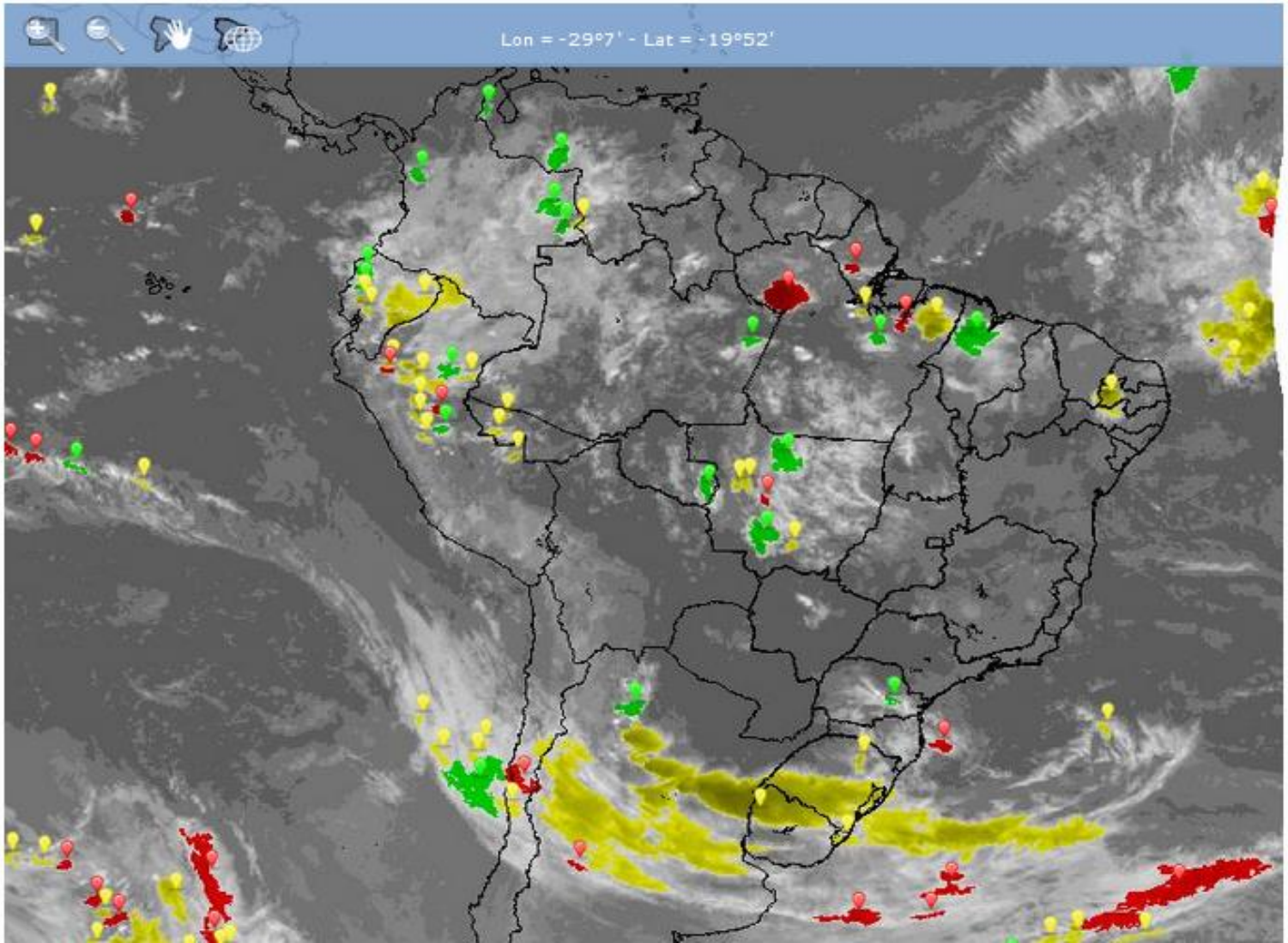
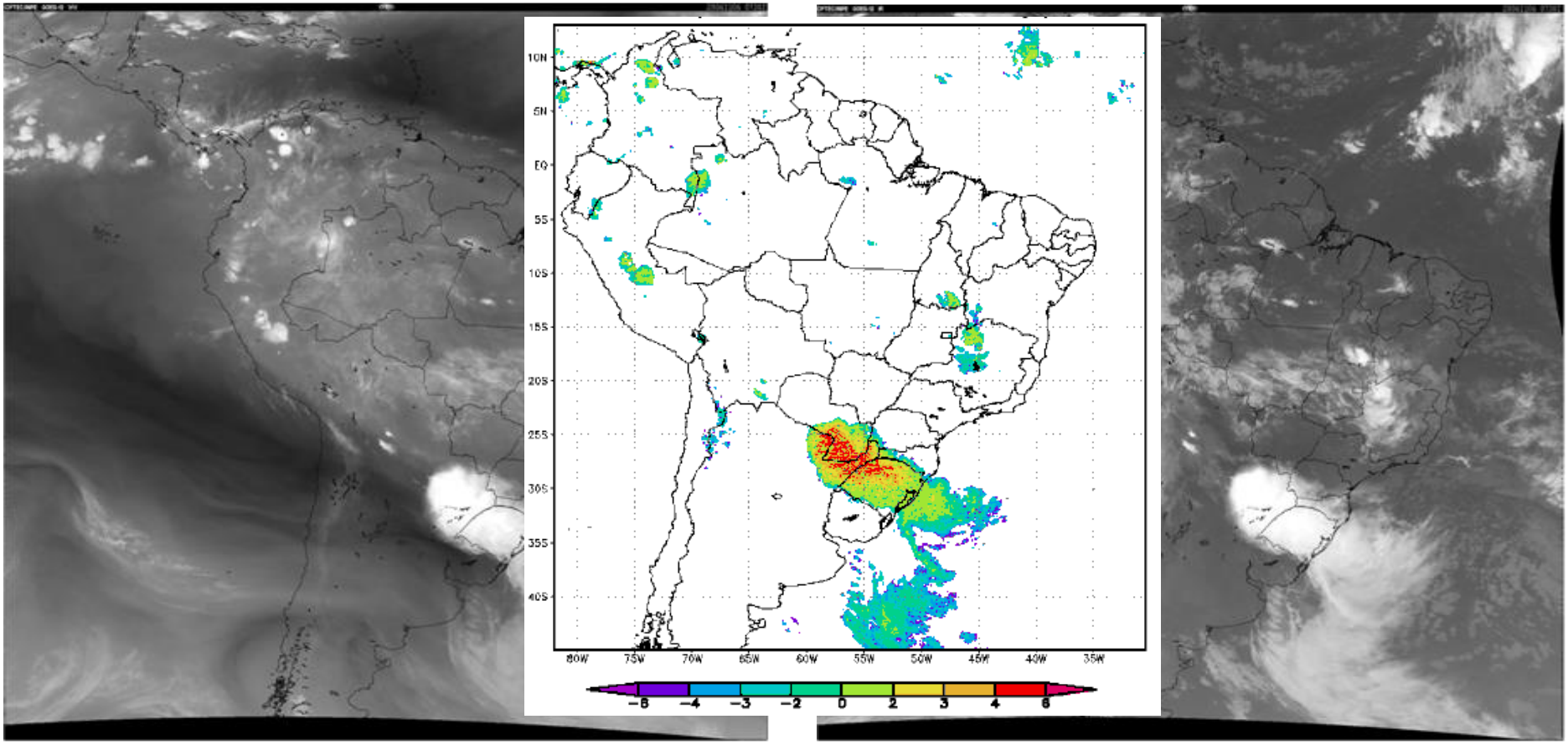
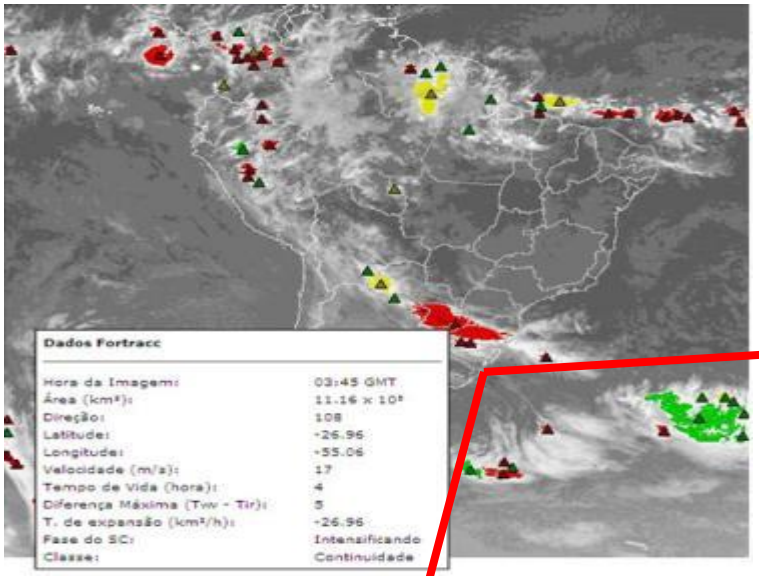
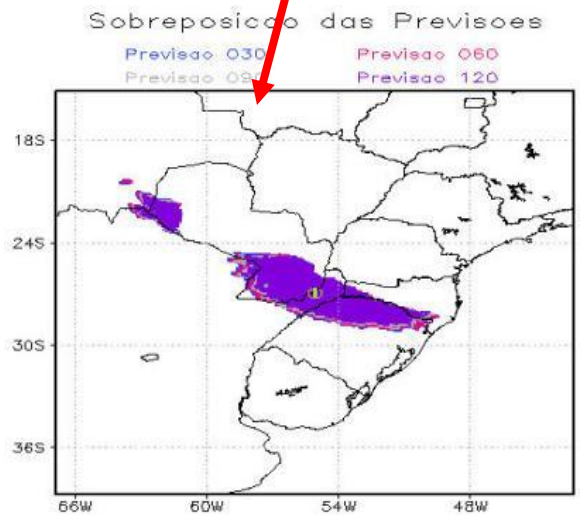
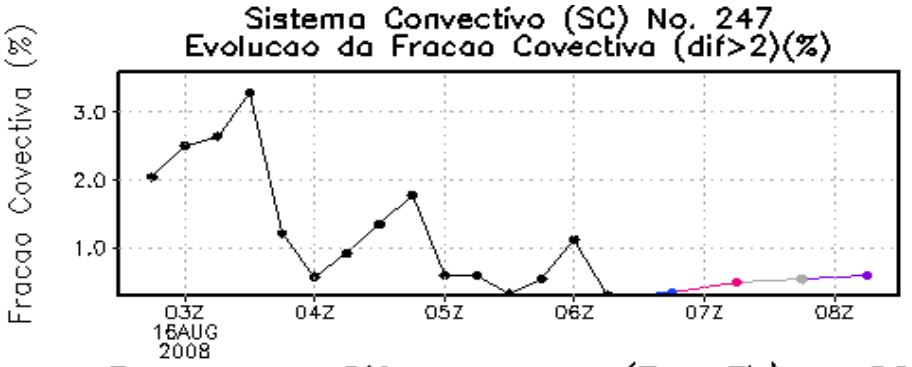


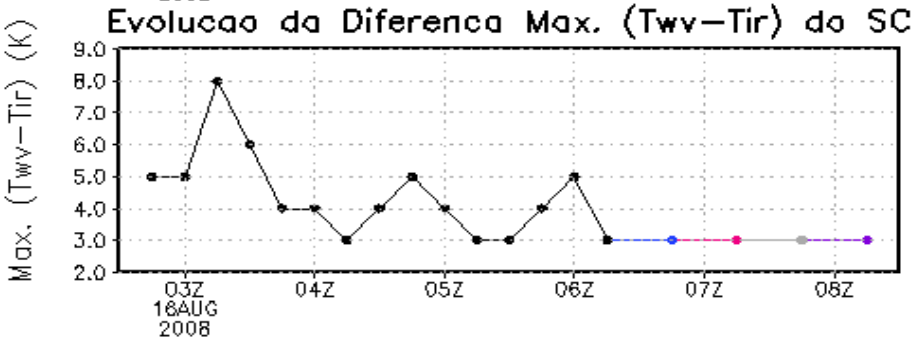
WV – IR Difference

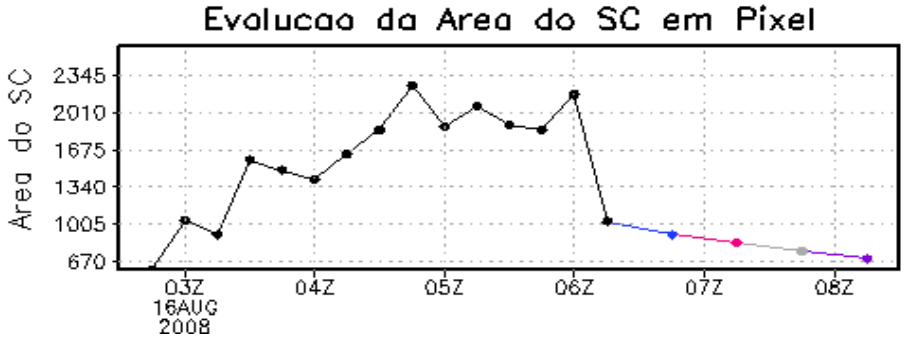



Dados Fortracc
Hora da Imagem: 03:45 GMT
Área (km²): 11.16 x 10⁴
Direção: 108
Latitude: -26.96
Longitude: -55.06
Velocidade (m/s): 17
Tempo de Vida (hora): 4
Diferença Máxima (Twv - Tir): 5
T. de expansão (km²/h): -26.96
Fase do SC: Intensificando
Classe: Continuidade

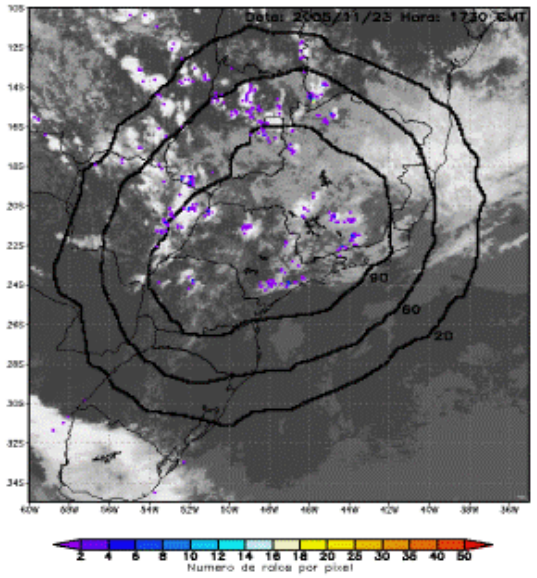

Sobreposicao das Previsoes
Previsao 030
Previsao 060
Previsao 090
Previsao 120
18S
24S
30S
36S
66W
60W
54W
48W


Sistema Convectivo (SC) No. 247
Evolucao da Fracao Covectiva (dif>2)(%)
Fracao Covectiva (%)
3.0
2.0
1.0
03Z 16AUG 2008
04Z
05Z
06Z
07Z
08Z


Evolucao da Diferenca Max. (Twv−Tir) do SC
Max. (Twv−Tir) (K)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
03Z 16AUG 2008
04Z
05Z
06Z
07Z
08Z


Evolucao da Area do SC em Pixel
Area do SC
2345
2010
1675
1340
1005
670
03Z 16AUG 2008
04Z
05Z
06Z
07Z
08Z

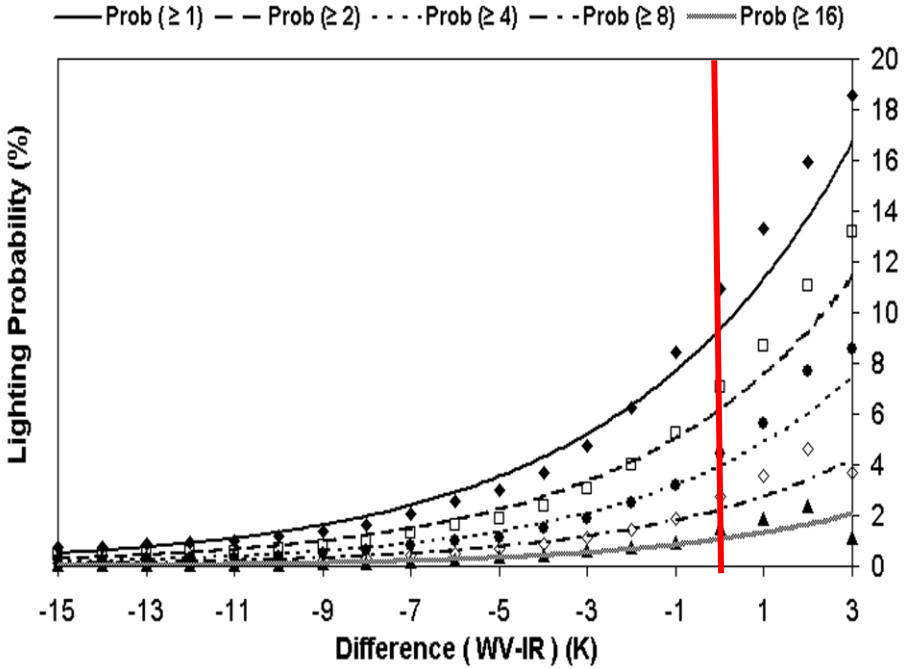
- **Machado et al. (2009)**

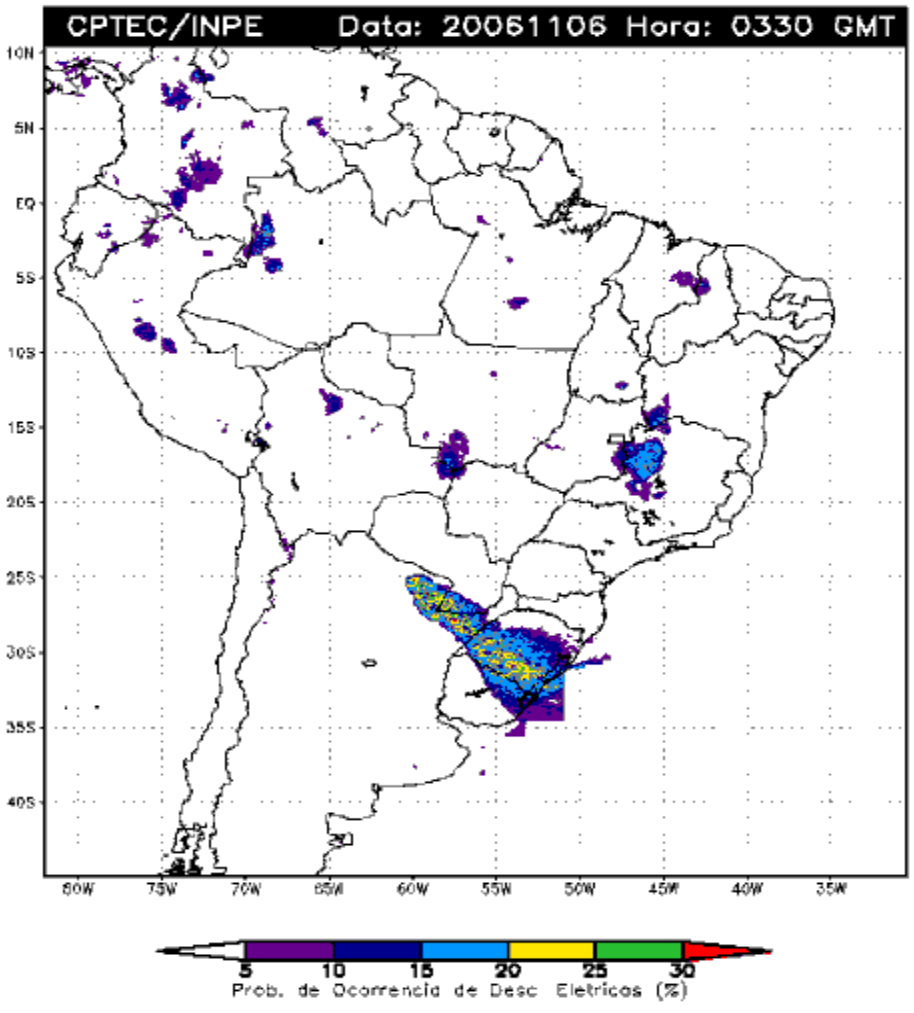


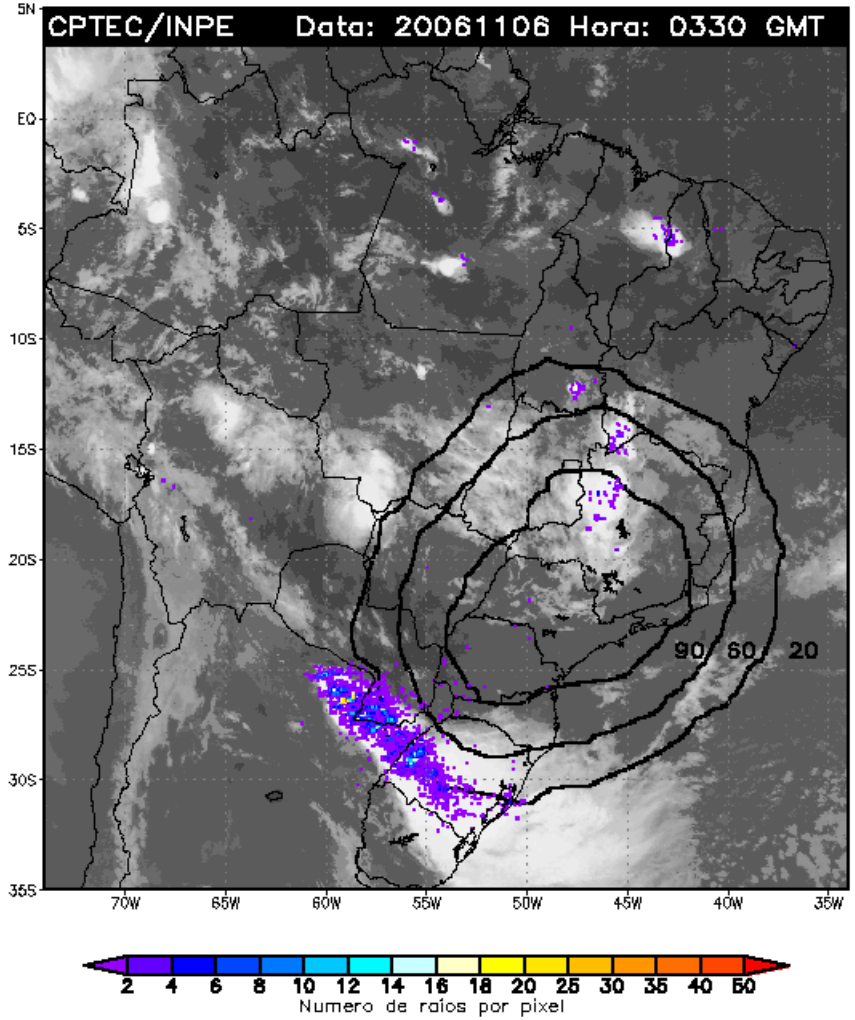
ΔT = Tb3- Tb4

ΔT ≥ Penetrating Clouds

For each ΔT, the probability of lightning activity was calculated

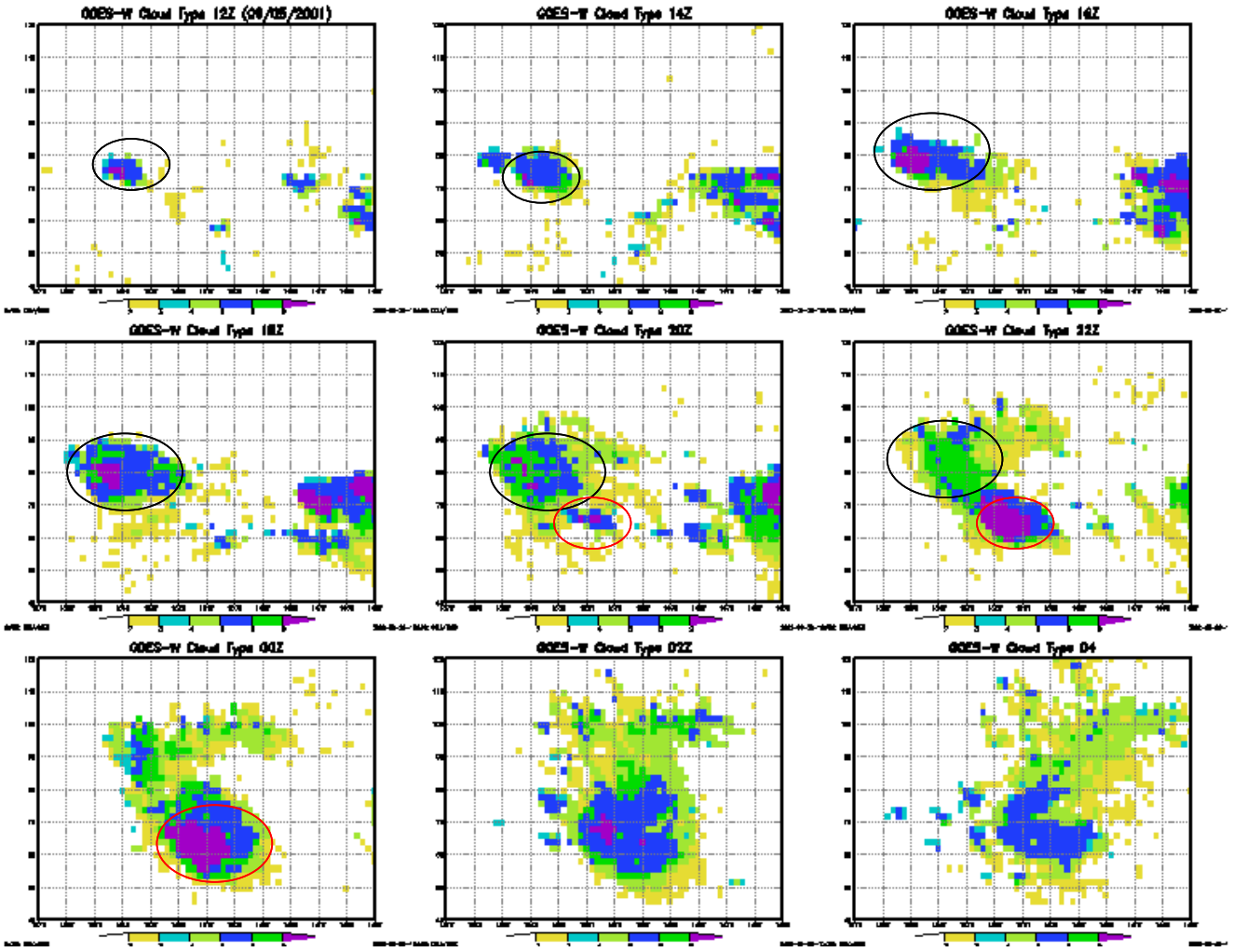






Machado,L.A.T.,et al.,Relationship between cloud-to-ground discharge and penetrative clouds: A multi-channel satellite application,Atmos.Res.(2009).

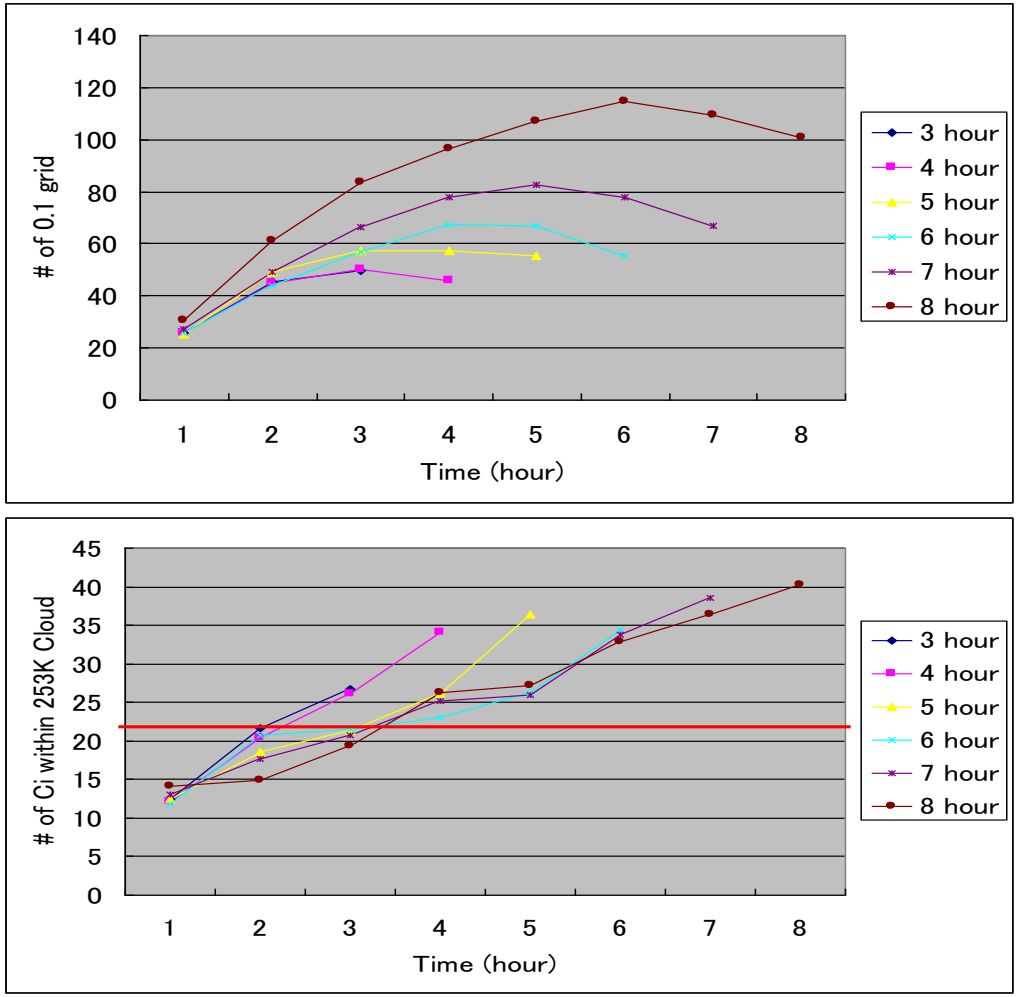
Cloud Classification– *'split windows' method*



Inoue et al., 2009.

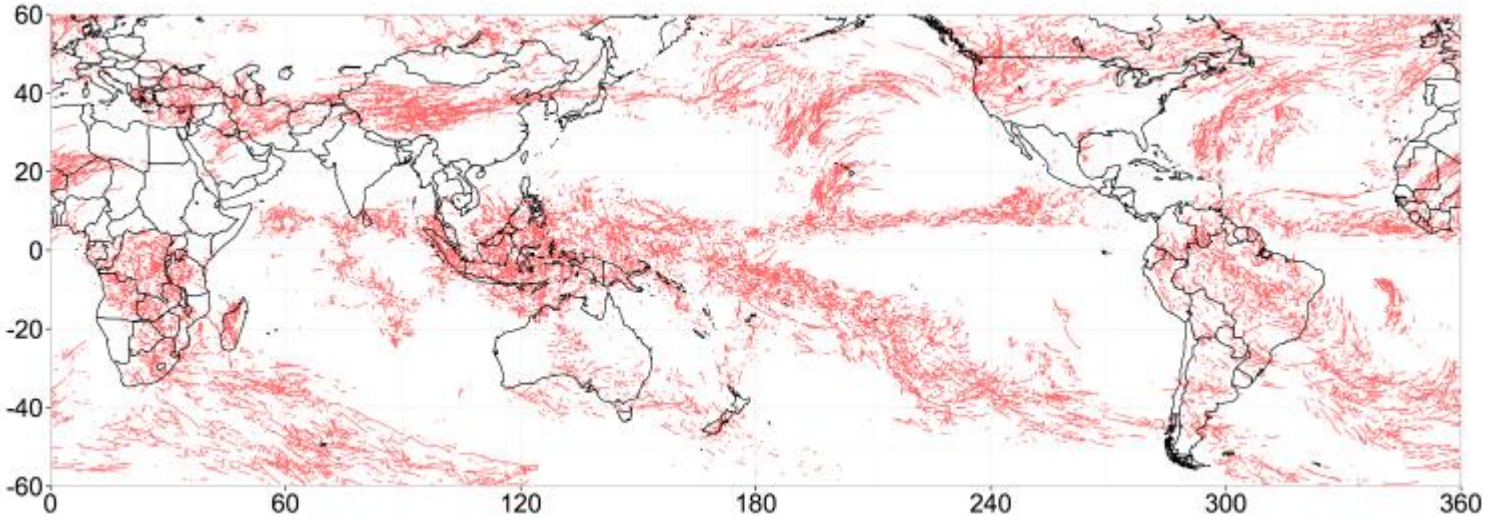
Cloud Classification– *'split windows' method*

Time evolution of size (top) and % of Ci (bottom)

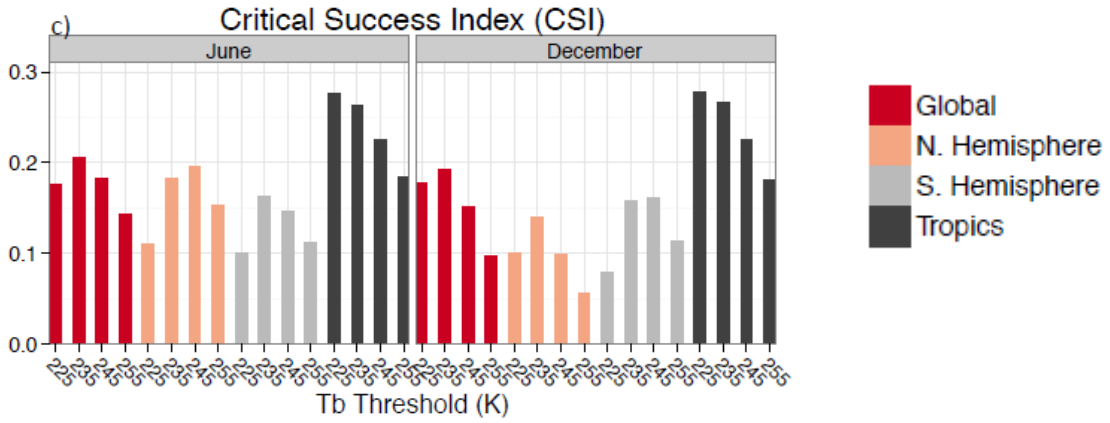


Inoue et al., 2009.

A Lagrangian analysis of cloud clusters and their life cycles using satellite observations

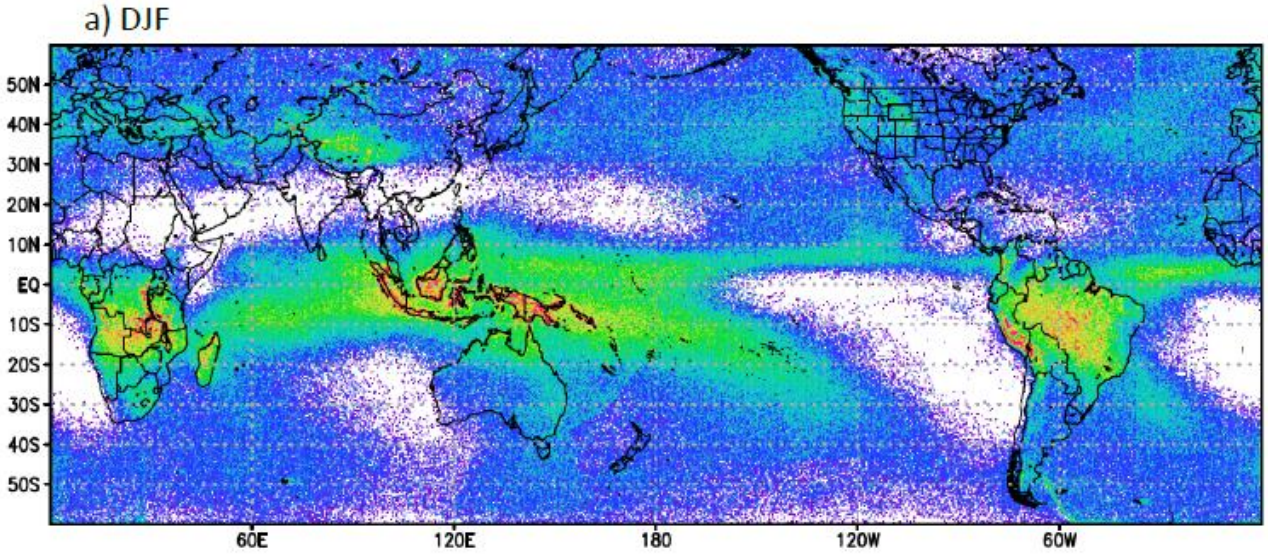


Storm trajectories from Dec 1-4, 2001 produced from using the ForTrACC algorithm.

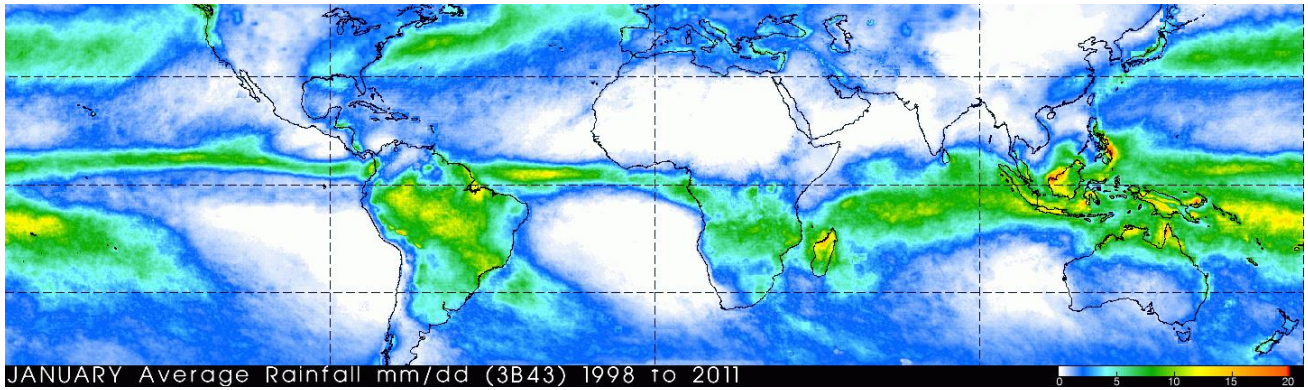


Credits: R. Esmaili

A Lagrangian analysis of cloud clusters and their life cycles using satellite observations



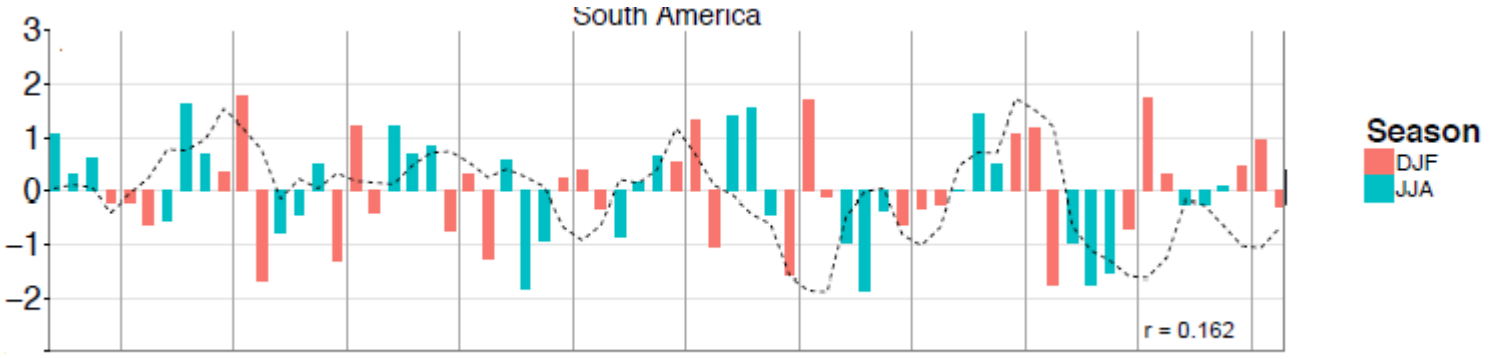
Average annual frequency of events at maturity over the 10-year study period,



January 3B43 Climatology

Credits: R. Esmaili

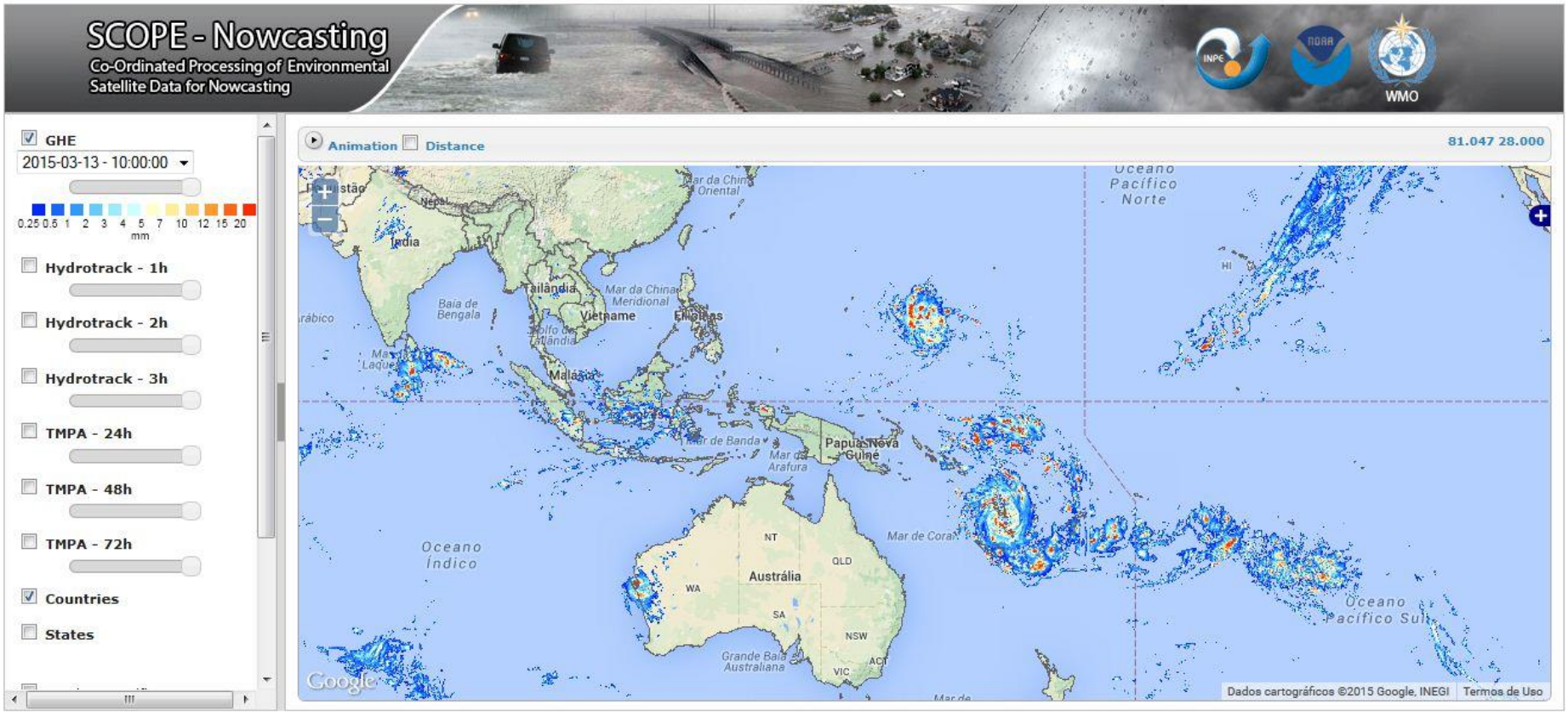
A Lagrangian analysis of cloud clusters and their life cycles using satellite observations



Time series of normalized anomalies of mature storm frequency in Tropical South America

Credits: R. Esmaili

SCOPE-Nowcasting - Pilot Project: Precipitation / Severe Rainfall Risk Reduction



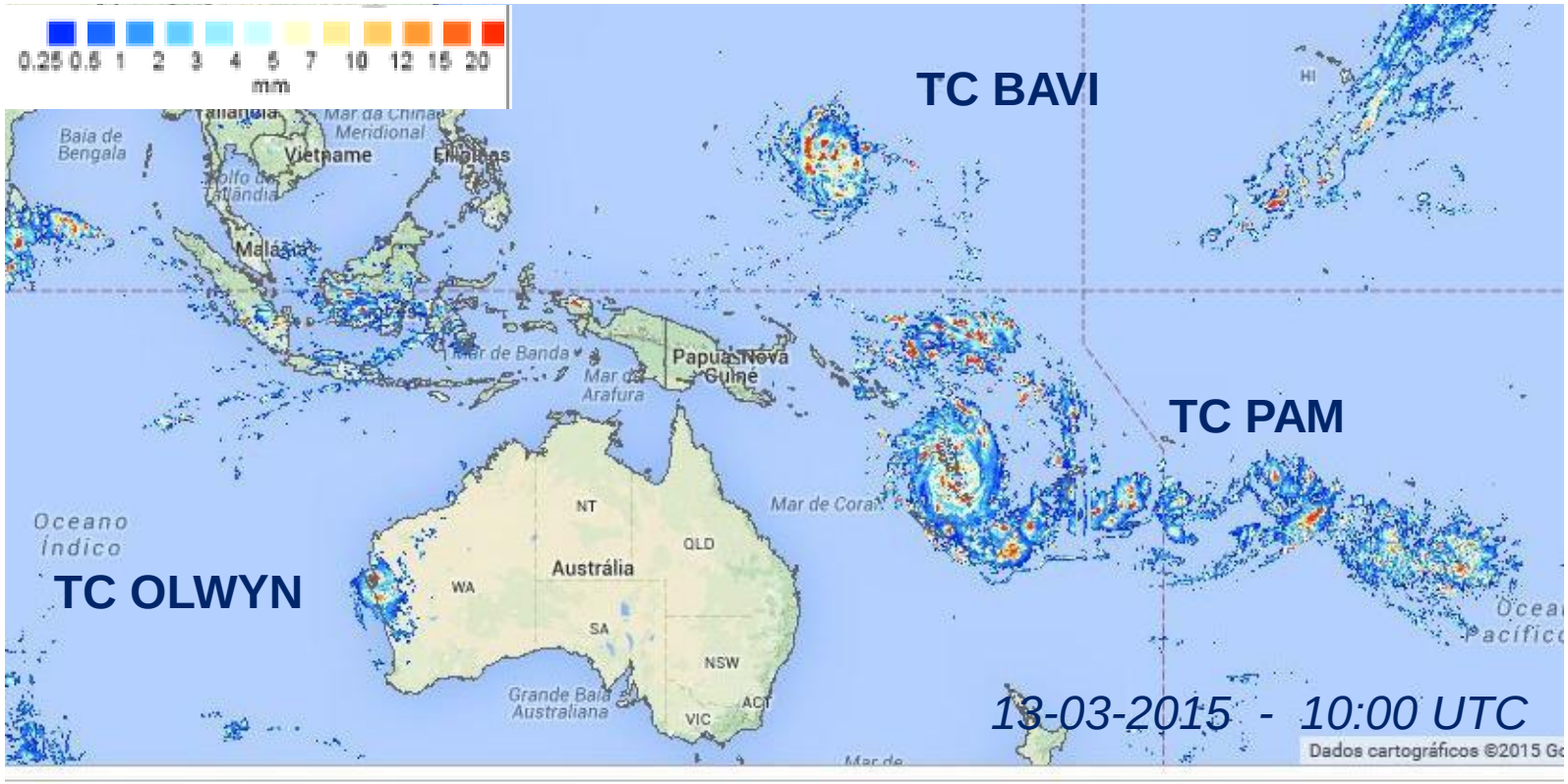
User requirements and expected benefits

- **Provide a reliable source of global rainfall accumulation at the highest possible temporal and spatial resolution**
- **Rapid and facilitated access to the information → Web based interface**
- **Interactive tool for emergency managers and civil defence authorities → GIS based tool**
- **Ability to include more products: flash flood guidance**
- **Reduced operating costs associated with technological change and software upgrades;**
- **Fast delivery of severe rainfall information to decision-makers and disaster response authorities (2h extrapolation forecast and ex-post 24h/48h/72h QPEs)**

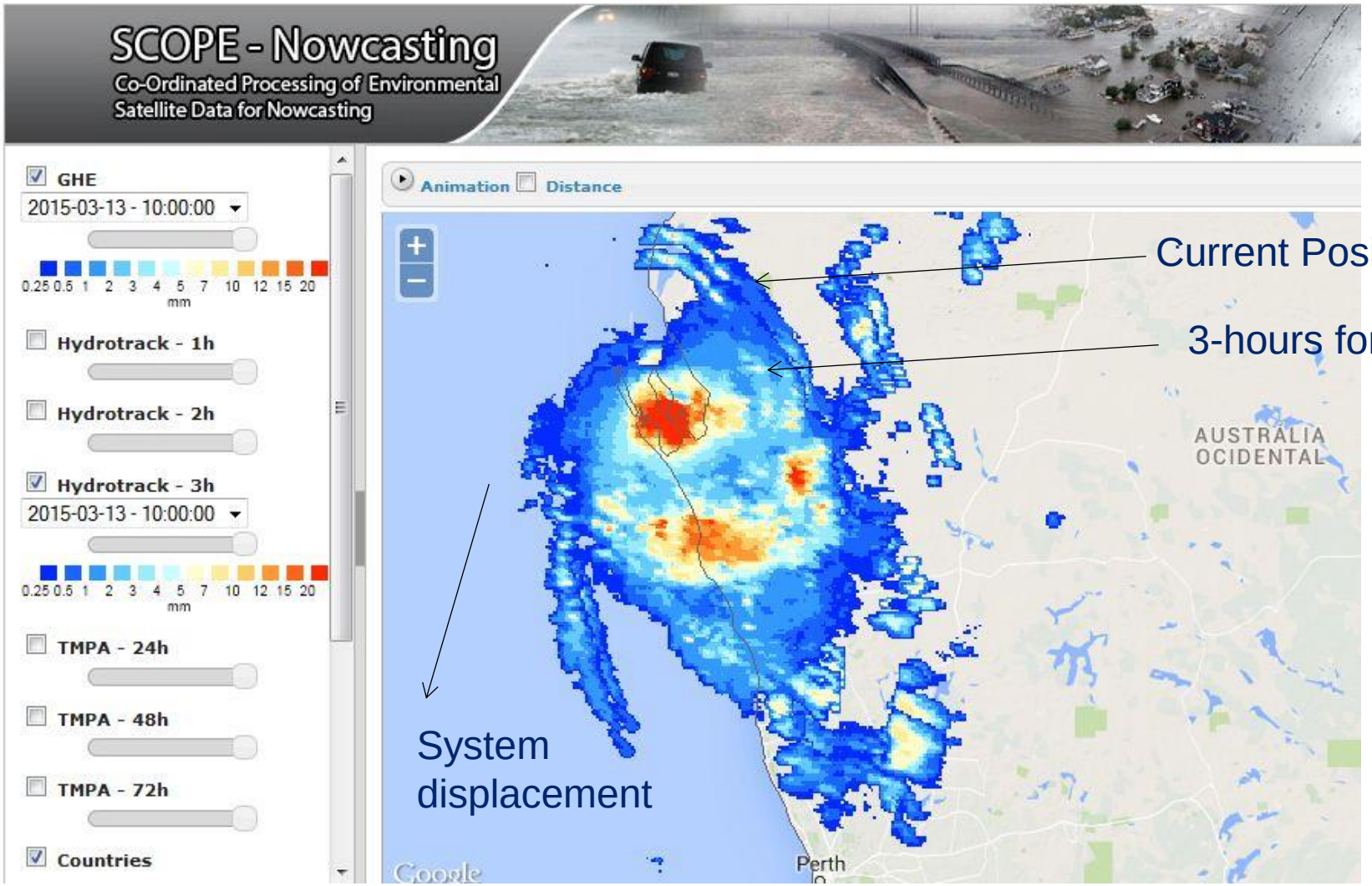
Main features

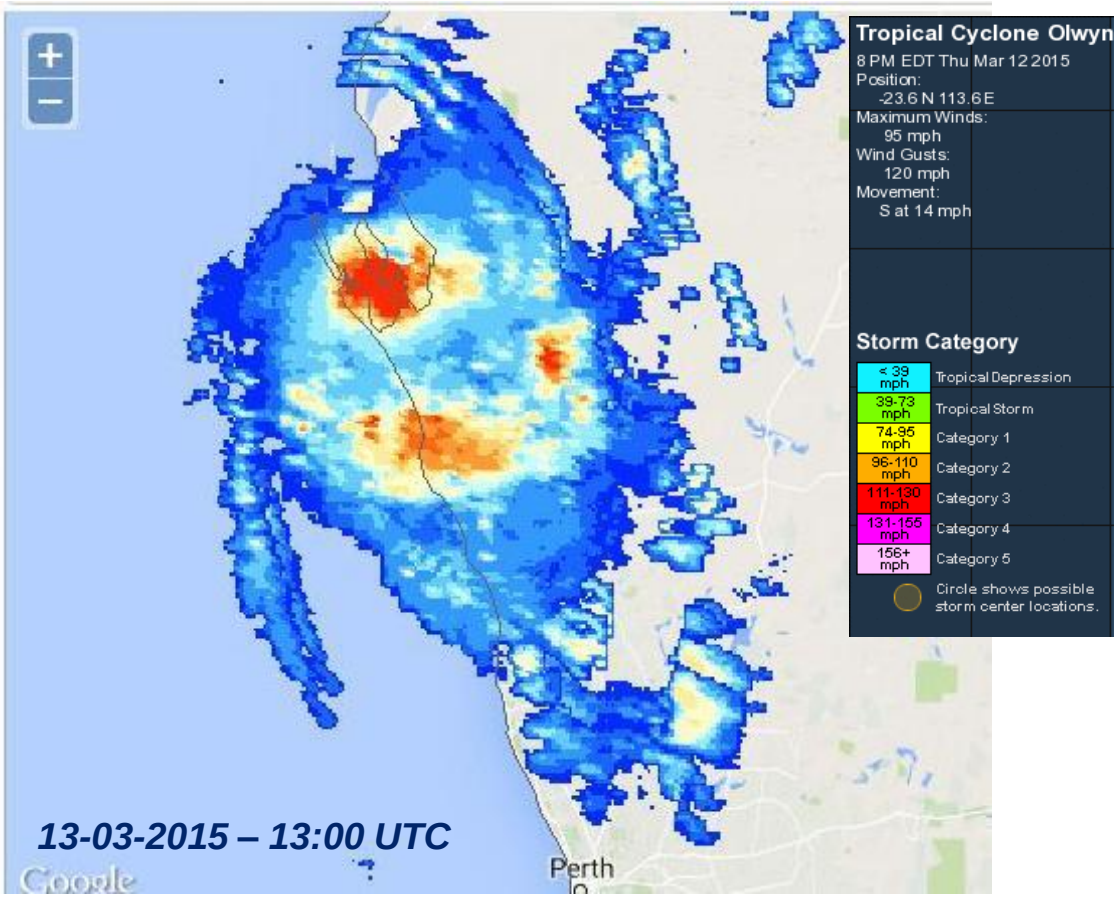
- *Current rain rates*: Global Hydroestimator (IR+NWP) → less accurate, low latency
  - 1 hour accumulation – 4 km spatial resolution
- *Short term forecast*: Hydrotrack → advection technique based on previous stages of the storm
  - 1 – 3 hours forecast

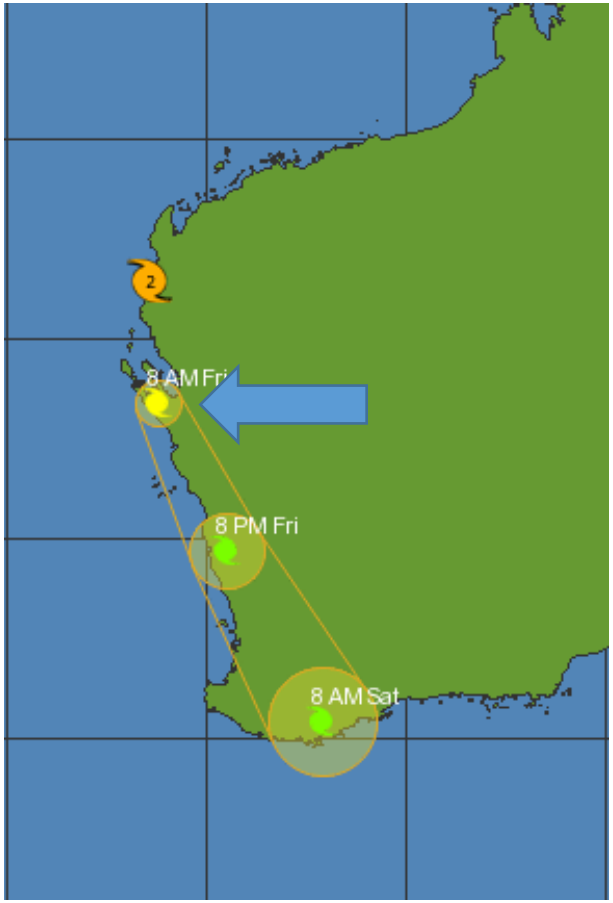
- *Blended (GEO+LEO) near real time precipitation product* – TMPA real time product (v7) → more accurate, high latency (~8 hours)
  - Last 24, 48 and 72 hours accumulation

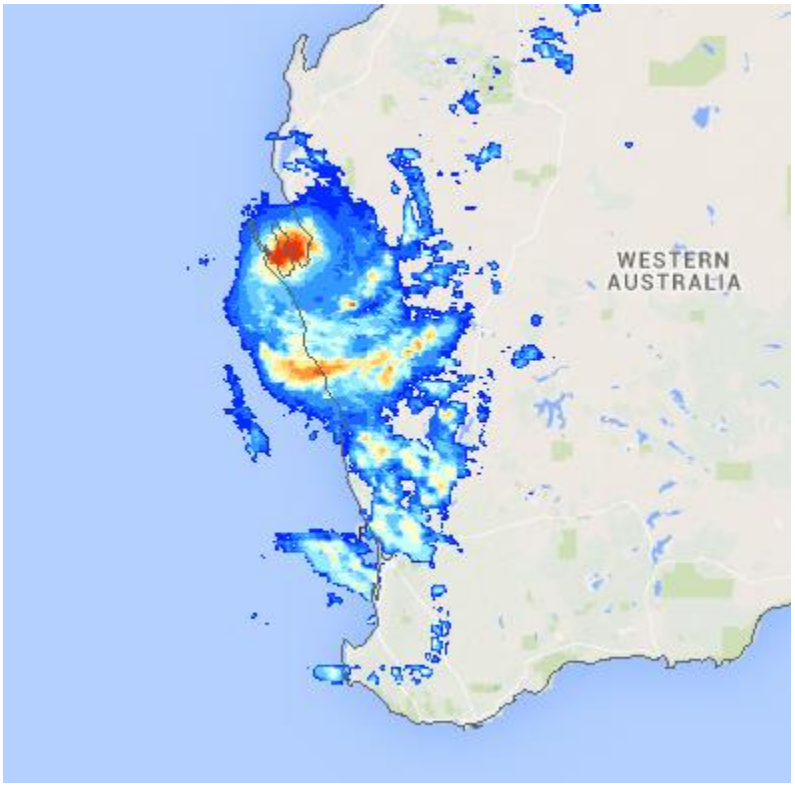


Residents of the South Pacific island nation of Vanuatu are bracing for the impact of Category 5 Tropical Cyclone Pam, one of the strongest tropical cyclones ever recorded in the waters east of Australia. Pam has rapidly intensified over the past two days and reached top sustained winds of 160 mph as of 2 pm EDT Thursday, making it one of only ten Category 5 storms ever recorded in the basin since satellite records began in 1970.

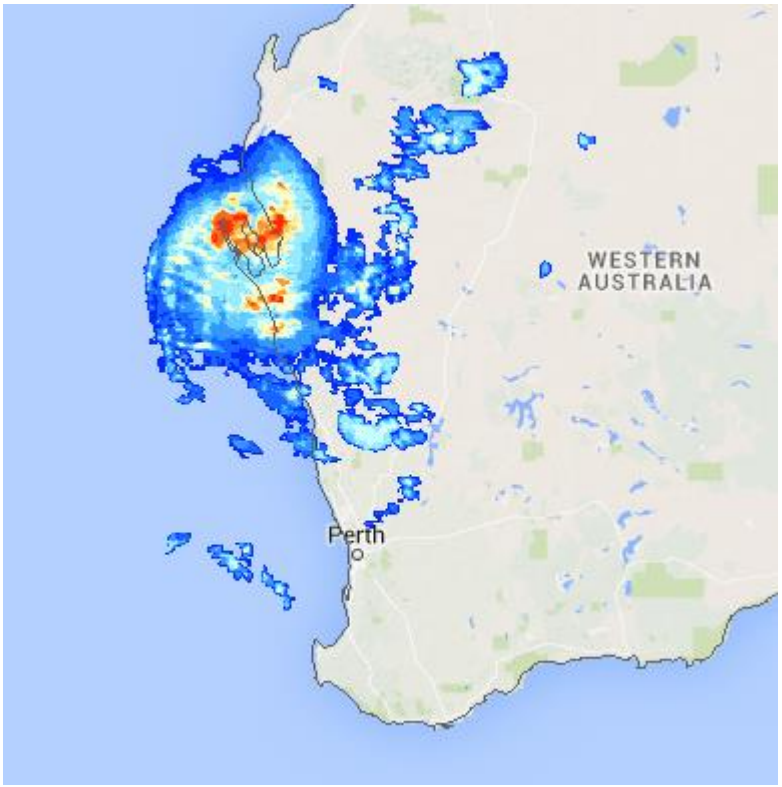

SCOPE - Nowcasting
Co-Ordinated Processing of Environmental Satellite Data for Nowcasting
GHE
2015-03-13 - 10:00:00
0.25 0.5 1 2 3 4 5 7 10 12 15 20
mm
Hydrotrack - 1h
Hydrotrack - 2h
Hydrotrack - 3h
2015-03-13 - 10:00:00
0.25 0.5 1 2 3 4 5 7 10 12 15 20
mm
TMPA - 24h
TMPA - 48h
TMPA - 72h
Countries
Animation
Distance
Current Position
3-hours forecast
System displacement
AUSTRALIA OCIDENTAL
Perth
Google


Tropical Cyclone Olwyn
8 PM EDT Thu Mar 12 2015
Position:
-23.6 N 113.6 E
Maximum Winds:
95 mph
Wind Gusts:
120 mph
Movement:
S at 14 mph
Storm Category
< 39 mph
Tropical Depression
39-73 mph
Tropical Storm
74-95 mph
Category 1
96-110 mph
Category 2
111-130 mph
Category 3
131-155 mph
Category 4
156+ mph
Category 5
Circle shows possible storm center locations.
13-03-2015 – 13:00 UTC
Google
Perth


2
8 AM Fri
8 PM Fri
8 AM Sat



13-03-2015 – 11:00 UTC



13-03-2015 – 8:00 UTC + 3 hours