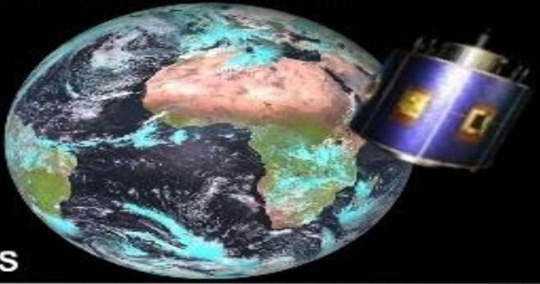
http://www.lapismet.com

LAPIS

Humberto A. Barbosa

LABORATÓRIO DE ANÁLISE E PROCESSAMENTO DE IMAGENS DE SATÉLITES



Weather and emergency services applied to management and disaster reduction supported by MTG in Brazil

MOTIVATION: **Is to generate technical elements to support the approved project "Analysis and Forecast of Extreme Events in Northeastern Brazil" by the Joint Call CAPES/CEMADEN/MTCI - Pro-Alerts in 24/2014.**

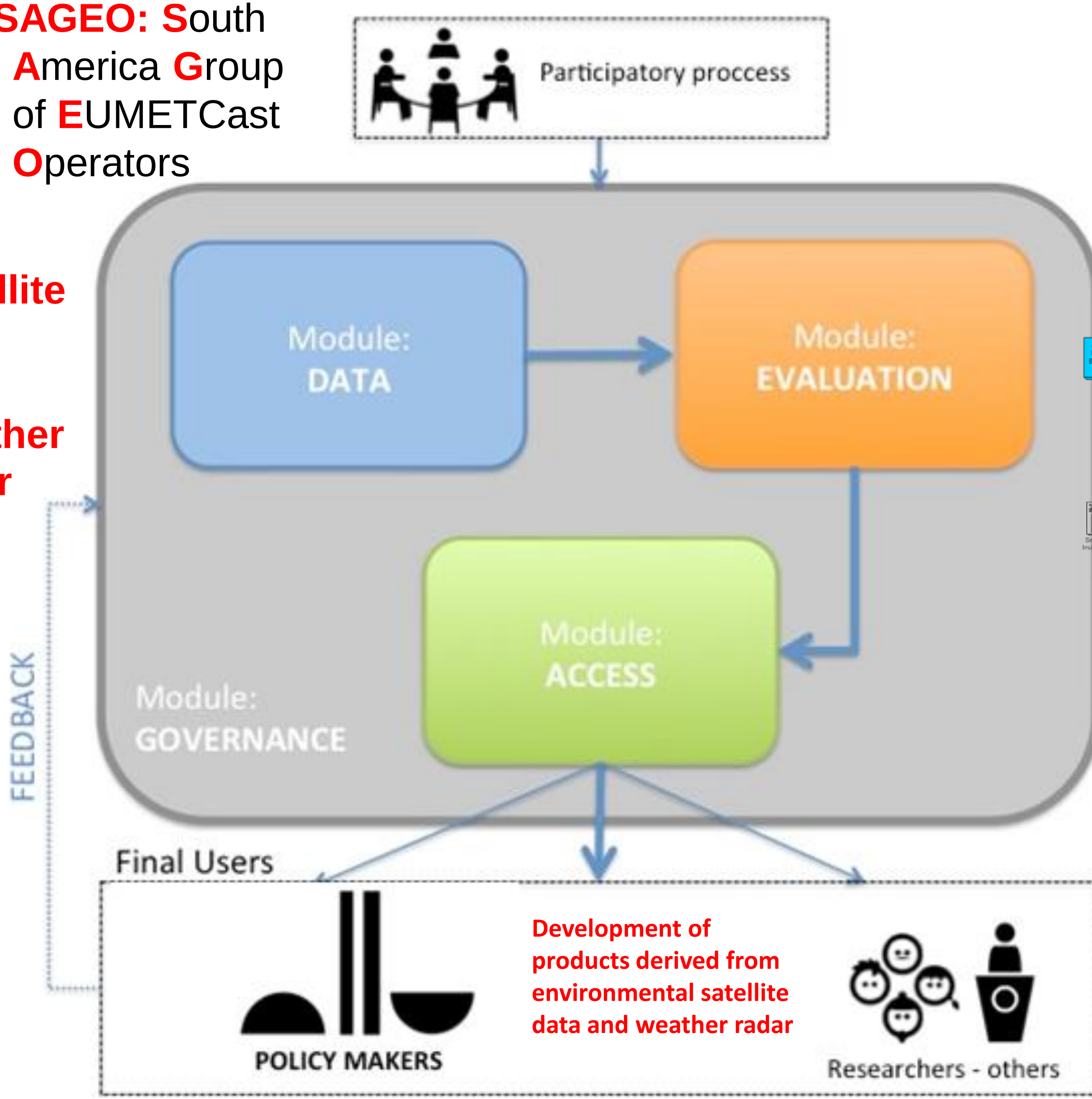
MAIN OBJECTIVE: **is to support the training of human resources for the development of products derived from environmental satellite data and weather radar, and international cooperation with emphasis on collaborative effort between: the UFAL, the UFCG, the UFPel and the EUMETSAT/EUMETCast.**

EUMETSAT's CWG Workshop (Florence, 4 – 8 April 2016)

General Framework of Project Overview

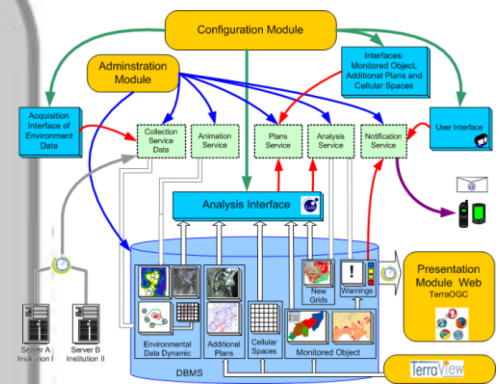
SAGEO: South **A**merica **G**roup of **E**UMETCast **O**perators

Satellite data and weather radar

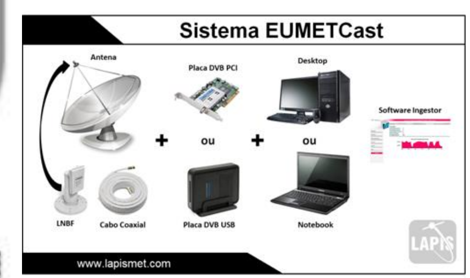


Development of products derived from environmental satellite data and weather radar

TerraMA2-INPE platform architecture



GEONETCast system

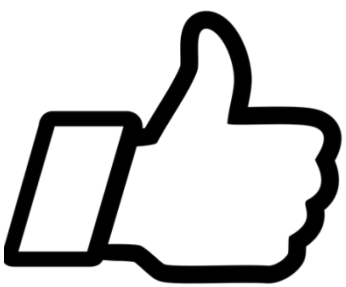


Challenges

Data Existence?

Data sources?

Access rights?

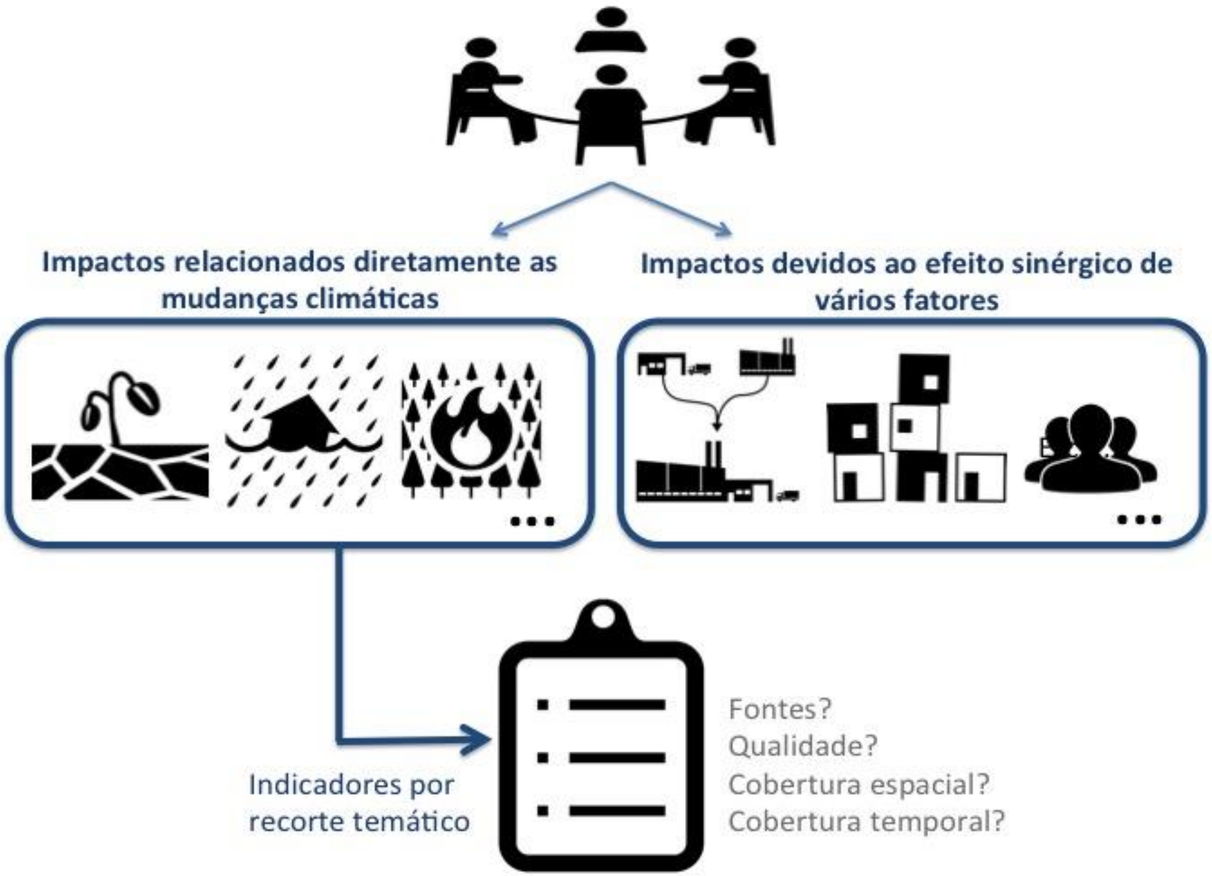


Data quality?

...

TIME AND RESOURCES CONCONSUMING!!!

Participatory process: SAGEO



Relevance?
Data Sources?
Quality?
Coverage?
Gaps?

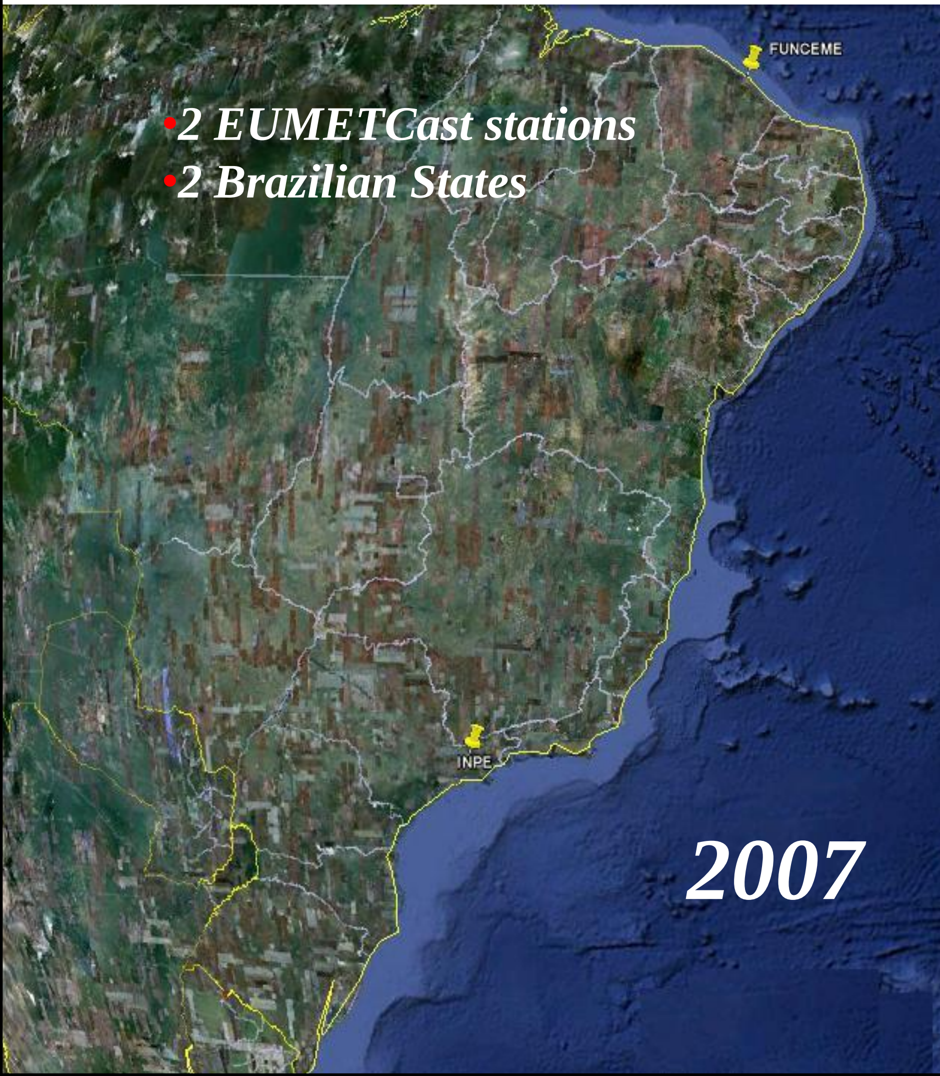
SAGEO: South America Group of EUMETCast Operators

- **SAGEO** has been established in September 2009 as a starting point for collaborative effort between **EUMETSAT workshops** and **EUMETCast Brazil Operators** to strengthen regional capacities of use MSG satellite data and products.

SAGEO activities:

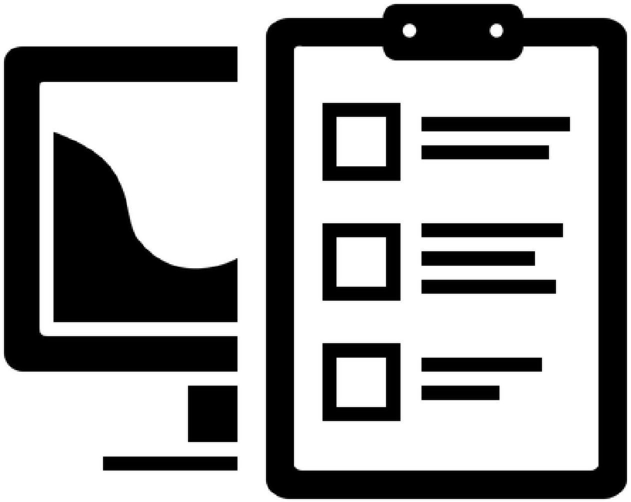
- The installation of a “standard” **EUMETCast station**, with an appropriate training for the operation of the station;
- Network of **experts** across the Brazil;
- Facilitating **the EUMETCast operators** with the visualization;
- Seeking **mechanisms** for regional partnership.

SAGEO: III Meeting 2011, Brazil

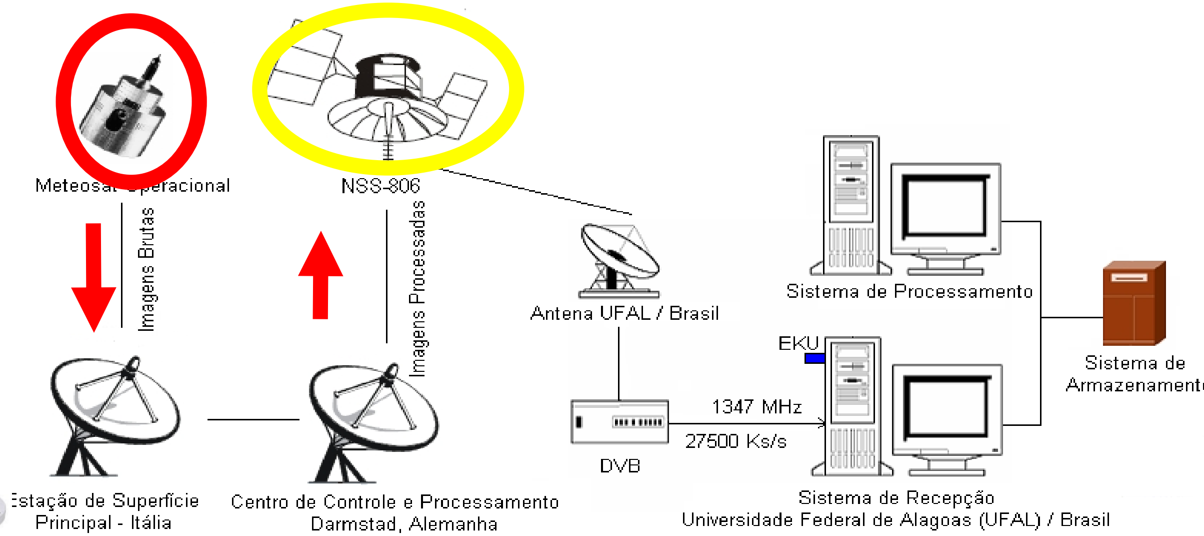


Module 1: DATA

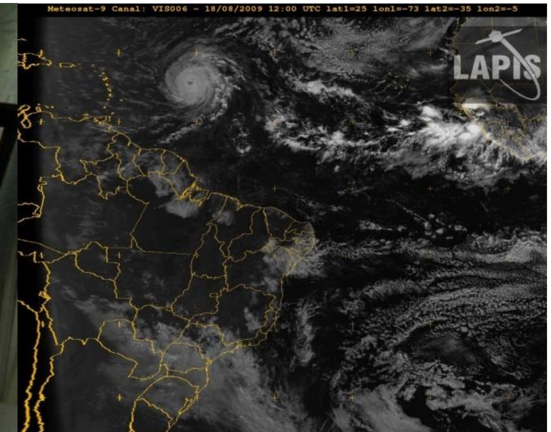
ACTIVITIES & ISSUES TO BE ADDRESSED:

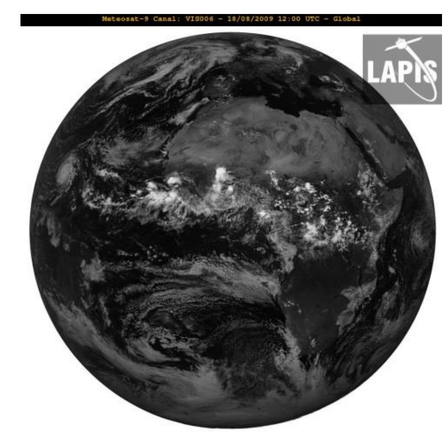


- Inventory of existing data and sources
- Data access, collection and updating by interconnecting existing databases
- Quality control (WHO?)
- Space-time coverage
- Selection of RS data
- Observations vs. retrieved values vs. proxies


Meteosat Operacional
NSS-806
Imagens Brutas
Imagens Processadas
Estação de Superfície
Principal - Itália
Centro de Controle e Processamento
Darmstad, Alemanha
Antena UFAL / Brasil
DVB
1347 MHz
27500 Ks/s
EKU
Sistema de Processamento
Sistema de
Armazenamento
Sistema de Recepção
Universidade Federal de Alagoas (UFAL) / Brasil

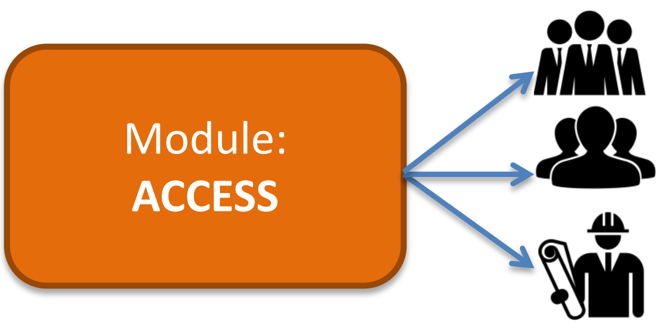

EUMETCast Lapis

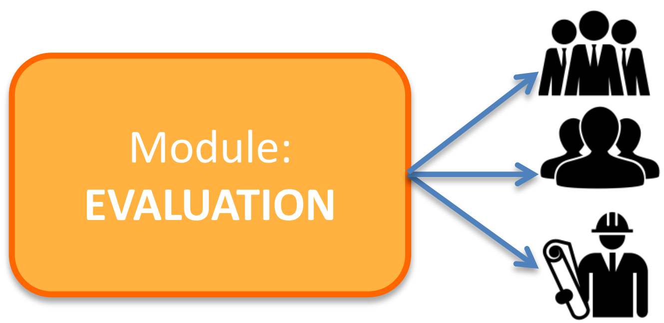




Modules: APPROACH FOR SEVERE THUNDERSTORMS

- Provide final user with useful information and a clear message
- Handle and Summarize huge volumes of complex data (multidimensionality) by means of composite indicators easier to understand
- Select a small number of key-indicators per thematic area





Accountability!!!!

DE ALAGOAS
CIÊNCIAS ATMOSFÉRICAS
EM METEOROLOGIA

APPROACH FOR SEVERE THUNDERSTORMS

Carlos Pinto da Silva Neto
Humberto Alves Barbosa

Approach for Convective Systems

• This methodology does not aim to detect overshooting tops, but is based in steps that estimate deep convection in overshooting detection techniques.

•The techniques are:

•Brightness Temperatura Diference (WV 6.2 – IR 10.8)

-Explanation according to **Schmetz et al (1997)** : When the top of a deep convective cloud approaches the tropopause, it blocks radiation from the troposphere from escaping into space. Then the radiation at the top of the atmosphere consists of radiation from the cloud top and from the stratosphere. In the stratosphere, the temperature increases with height, resulting in an emission spectrum. This is more pronounced in the WV channel than in the IR channel because of the larger strength of the absorption lines. The actual difference between the brightness temperatures depends on the actual height of the cloud top and on the amount of stratospheric water vapor.

- WV-IRW BTD greater that 0 K indicates presence of deep convective cloud. Setvak et al. (2007) using 1 km MODIS data, determined WV-IRW BTD in the range of 4 to 7K in the overshooting above the coldest cloud tops.

Approach for Convective Systems

• This methodology does not aim to detect overshooting tops, but is based in steps that estimate deep convection in overshooting detection techniques.

•The techniques are:

•IRW-texture (Bedka, 2010)

-Includes a combination of infrared channel brightness temperatures and their spatial gradients, a numerical weather prediction model tropopause temperature forecast and OT size criteria.

- To identify OTs during both day and night at their proper spatial scale. Pixels with an IRW BT ≤ 215 K and near to or colder than the NWP tropopause are considered candidate OT pixels. A maximum OT diameter of 15 km and maximum anvil cloud IRW BT of 225 K are assumed based upon detailed analysis of OT signatures in satellite imagery. The anvil is sampled at a ~8 km radius from a candidate OT pixel in 16 directions to compute the mean anvil IRW BT. A candidate OT pixel that is 6.5 K colder than the surrounding anvil is considered an OT.

Approach for Convective Systems

• This methodology does not aim to detect overshooting tops, but is based in steps that estimate deep convection in overshooting detection techniques.

- •The techniques are:

•IRW-texture (Bedka, 2010)

NWP TROPOPAUSE TEMPERATURE:

- Temporal resolution 6h

- 0.5º Resolution Global Forecast System (GFS)

- This NWP field is remapped to the resolution and projection of the corresponding satellite imagery using the Man Computer Interactive Data Access System (McIDAS-X) software package so that a tropopause temperature is associated with every satellite pixel.(Bedka et al, 2010)

New Approach for Convective Systems

• This methodology does not aim to detect overshooting tops, but is based in steps that estimate deep convection in overshooting detection techniques. And inspired by NEFODINA.

•NEFODINA

- The NEFODINA (DYNAmic NEFOanalisys) product has been developed by Italian Air Force Met Service (IAFMS) to estimate thunderstorms presence and intensity using only geostationary satellite data. More precisely using a multichannel approach it provides information on convective nuclei inside cloudy systems (from mesoscale down to single cell thunderstorm)

DATA

This metodology only requires to sources of data:

- Meteosat Second Generation (MSG)
    - *Band 5 – Water Vapor 6.2 µm*
    - *Band 9 – Infrared 10.8 µm*

-Numerical Weather Prediction Tropopause Temperature
    - In this case: NCEP/ NCAR Reanalysis

The data are manipulated and integrated using:

Man-computer Interactive Data Access System (McIDAS-V)
    - Science and Engineering Center (SSEC) na Universidade de Wisconsin-Madson
    - Free Source software.

METODOLOGY

This approach is compoused by 3 primary parameters and 2 secondary ones:

PRIMARY

-IR TEMP < 233 k (Bottom limit for pixels start to become interesting)

-BTD WV-IR > 0 (Estimate intrusion of moisture in high levels)

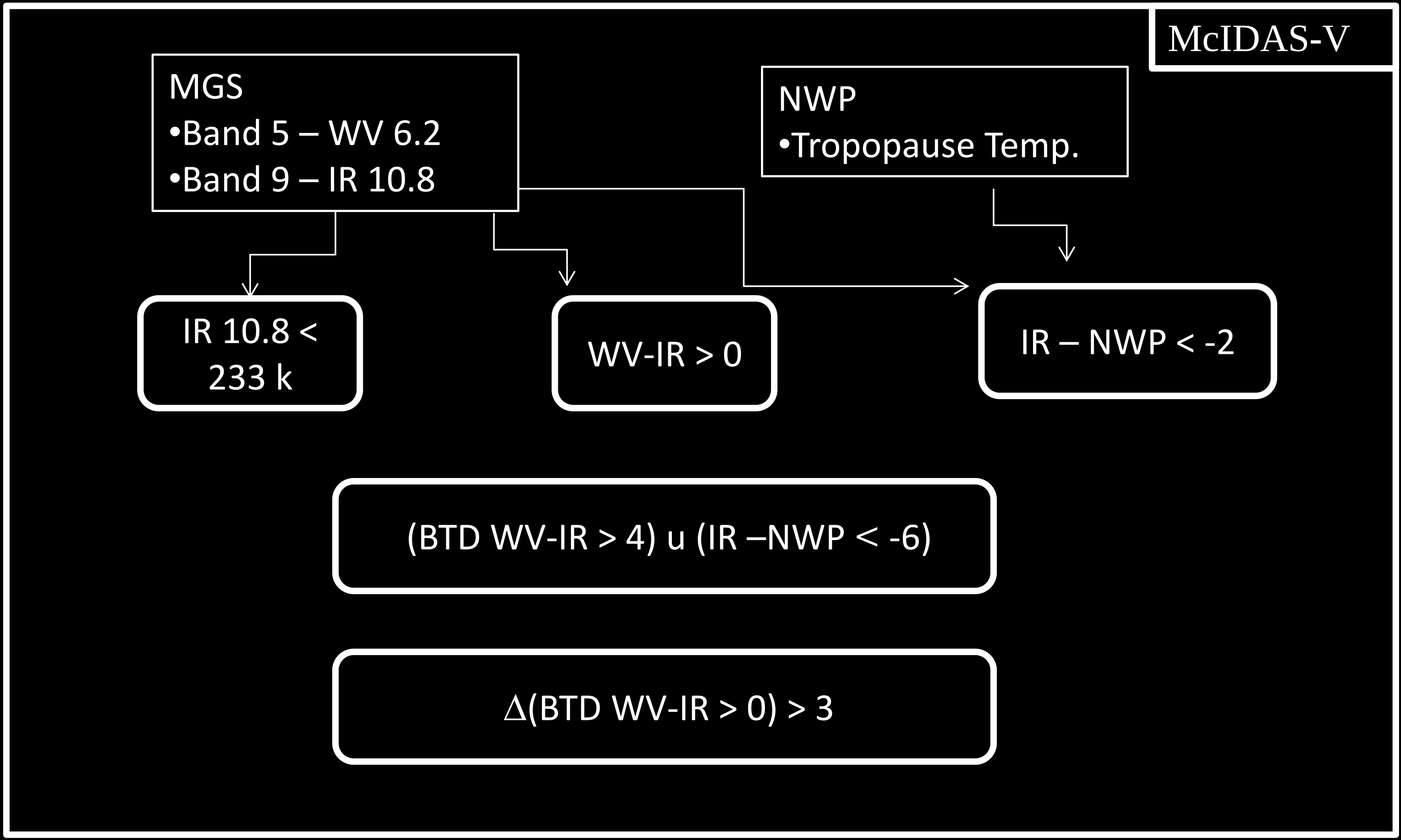
-IR – Tropopause Temperature < -2 (Show pixels that are significantly colder than the temperature in tropopause)

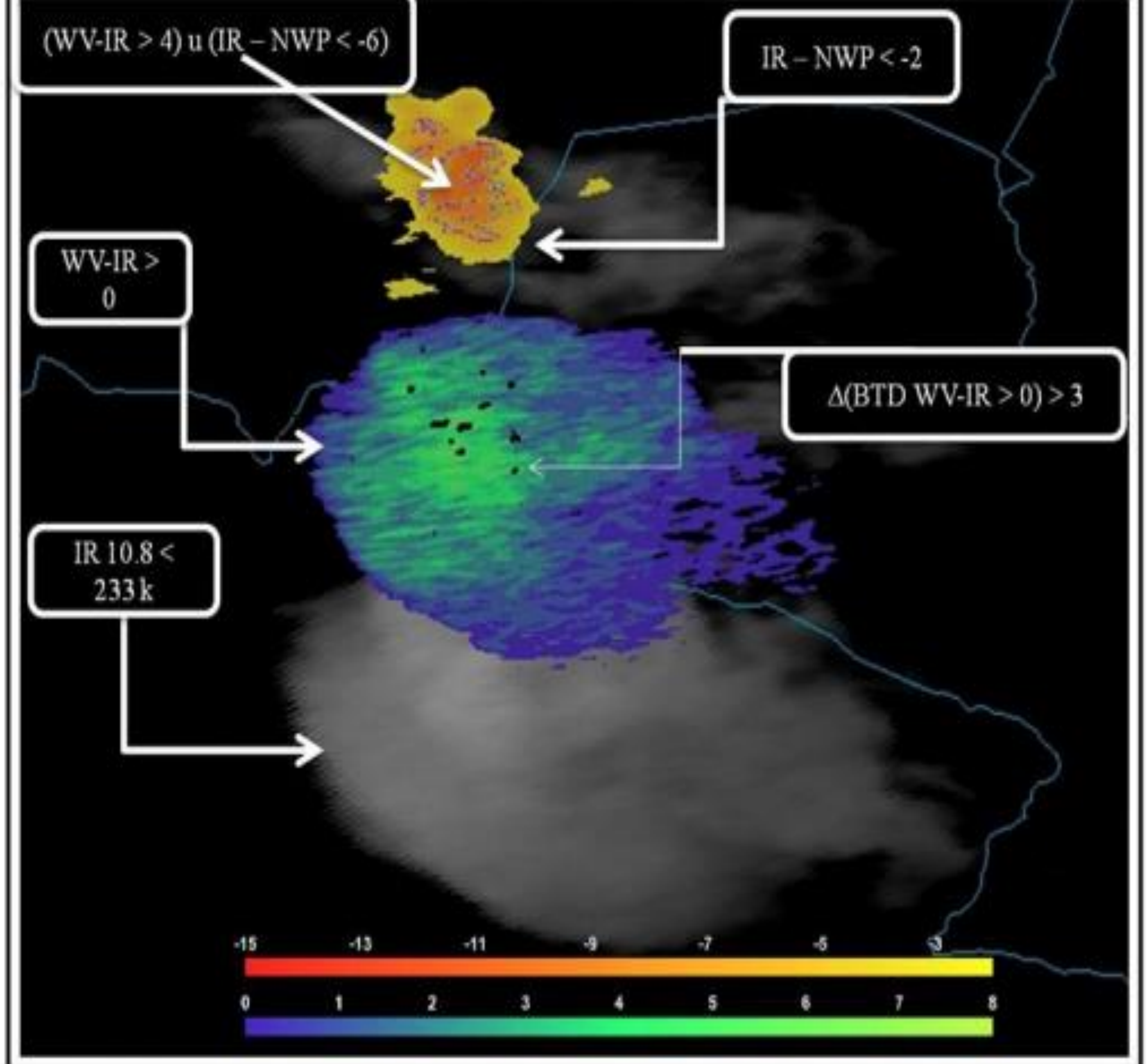
-SECONDARY

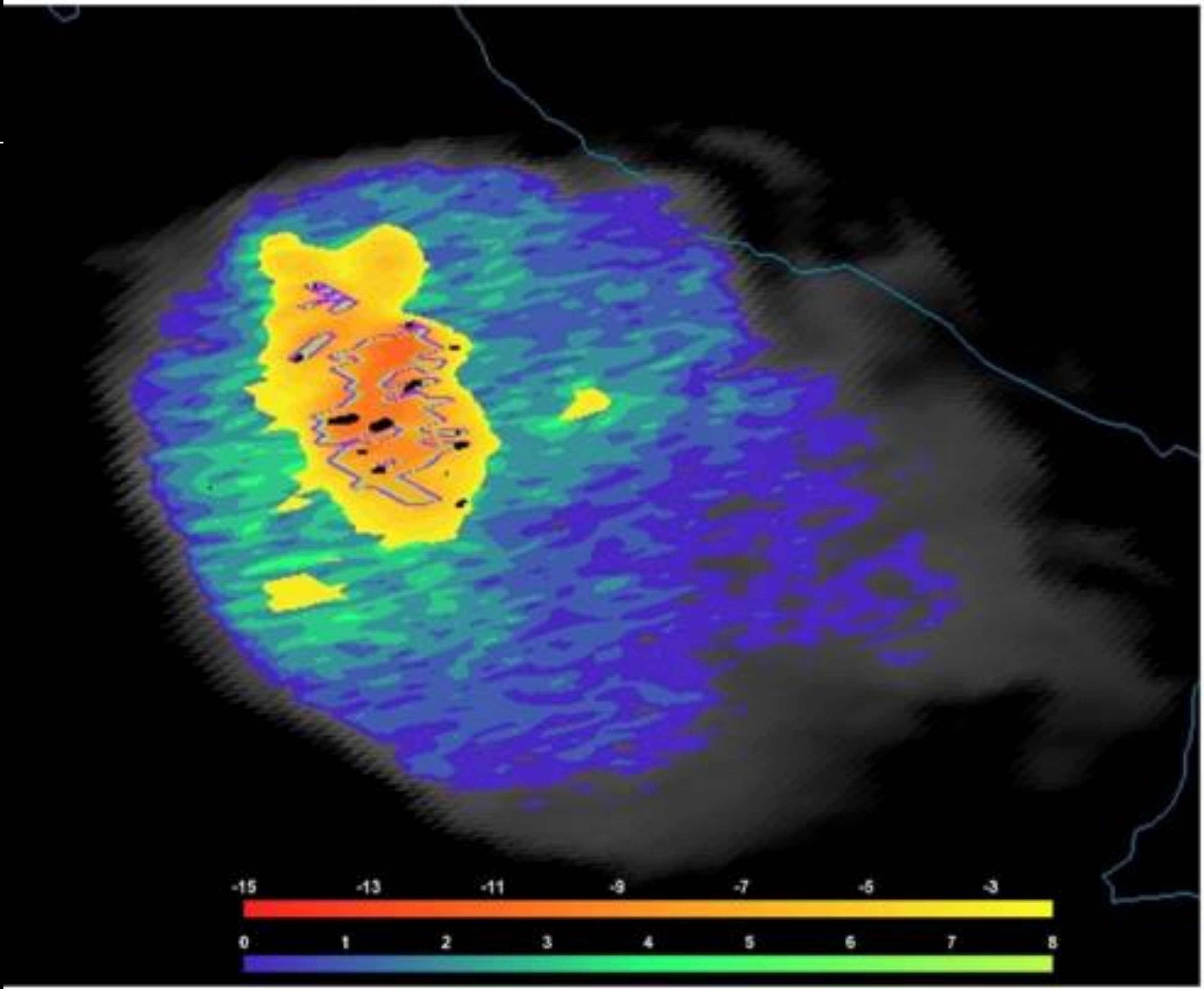
- Δ**(BTD WV-IR > 0) > 3 - (**Show regions of rapidly intensification)

-(BTD WV-IR > 4) u (IR –PNT < -6) – (Show regions of more intense convective activity estimated by both WV-IR and IR-NWP techniques.

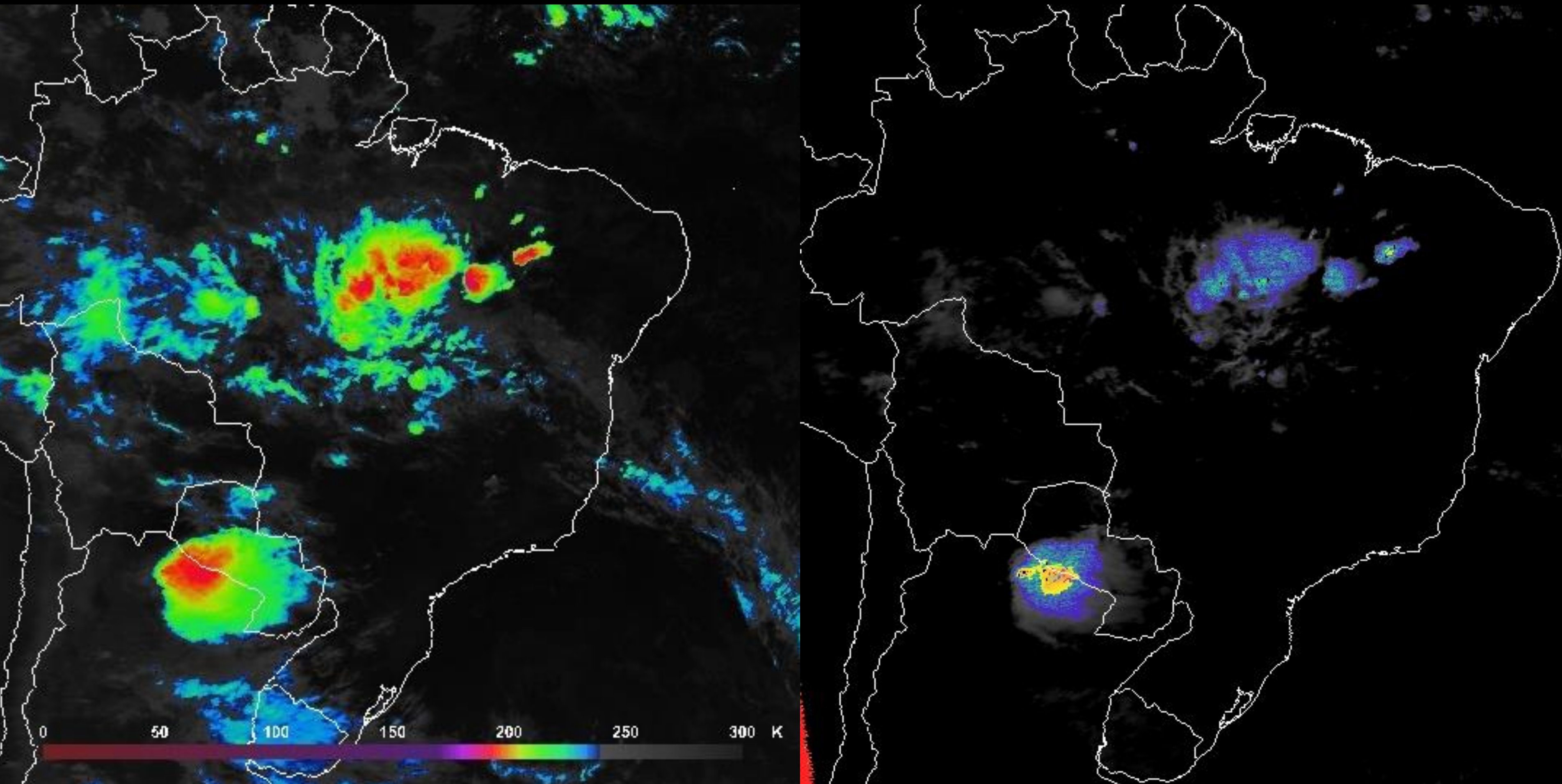
METODOLOGY


McIDAS-V
MGS
•Band 5 – WV 6.2
•Band 9 – IR 10.8
NWP
•Tropopause Temp.
IR 10.8 < 233 k
WV-IR > 0
IR – NWP < -2
(BTD WV-IR > 4) u (IR –NWP < -6)
Δ(BTD WV-IR > 0) > 3

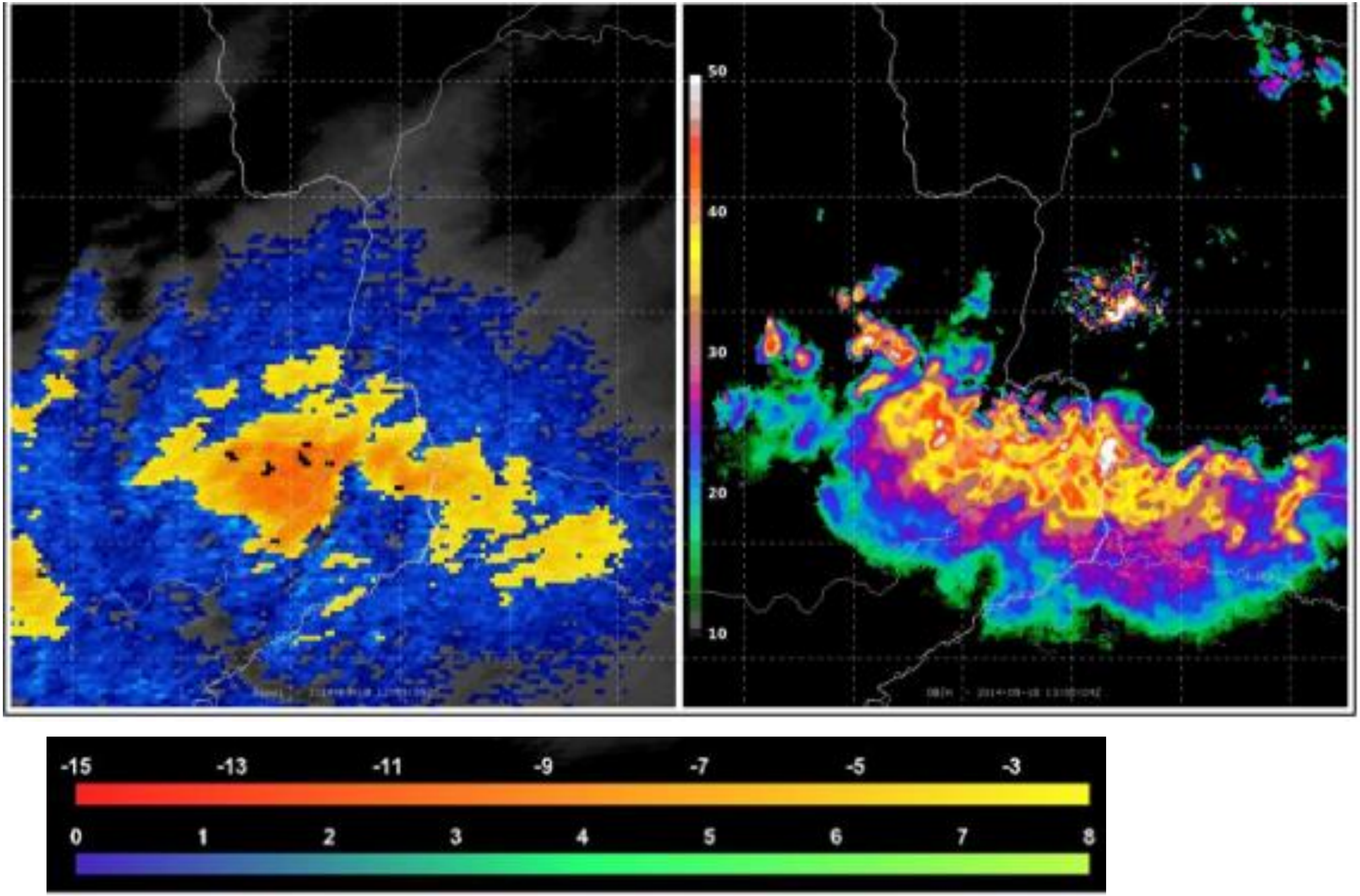

(WV-IR > 4) u (IR – NWP < -6)
IR – NWP < -2
WV-IR > 0
Δ(BTD WV-IR > 0) > 3
IR 10.8 < 233 k
-15 -13 -11 -9 -7 -5 -3
0 1 2 3 4 5 6 7 8


-15 -13 -11 -9 -7 -5 -3
0 1 2 3 4 5 6 7 8

VISUALIZATION: Blended method



Satellite Imagery (left), Radar Reflectivity (Right) for 2014-09-18 13:00 UTC



Hypothesis

- Interaction between gravity waves & convection well studied
  - Convection initiation by gravity waves, vice versa
  - Wave-conditional instability of the second kind (CISK)

- **Ducted gravity waves can produce vertical wind shear**
  - Creates horizontal vorticity which can be tilted into the vertical by storm updrafts (streamwise vorticity).

Background

- **Form under statically stable conditions**
- **Generated by**
  - Mountains
  - Convection
  - Density impulses
  - Shear instabilities

- Transport momentum
- Enhancement of weather
- Ducted waves longer travel time and life span

Gravity Waves

- *$f=A\cos(kx-\omega t)$*
  - K – wavenumber, ω – angular frequency, A – amplitude
- Both horizontal and vertical waves

- Can become ducted
  - Trapped between two reflective surfaces
  - Ground and inversion can form duct
  - Upward and downward moving waves interact in duct

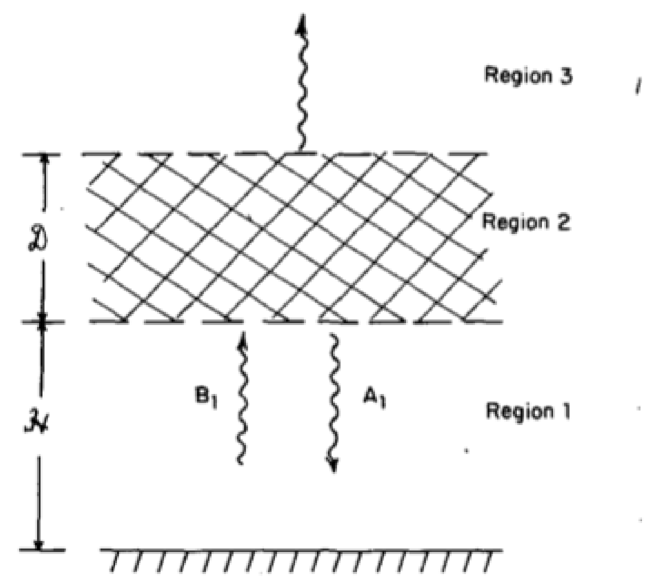


FIG. 1. Schematic diagram of the model atmosphere. Region 1 is the wave duct, region 2 the "black box" reflector, and region 3 is a semi-infinite propagating region.

Lindzen and Tung 1976

Genesis via the CISK Mechanism

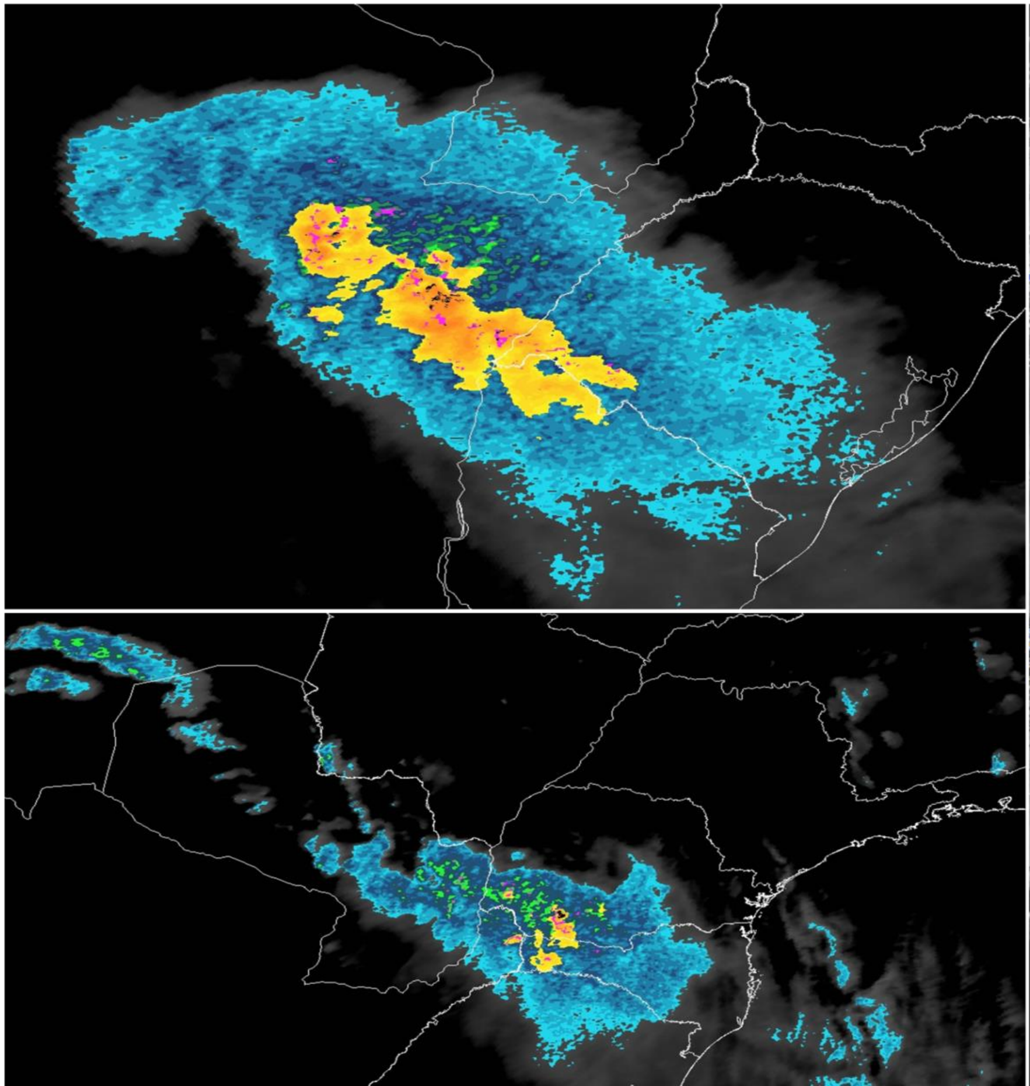
Convective Instability of the Second Kind (CISK):

- First proposed by Jule Charney in 1964
- Assumes the atmosphere is conditionally unstable
- Requires the presence of a finite amplitude synoptic scale disturbance (gravity wave)
- Assumes latent heat release results from synoptic-scale frictional convergence

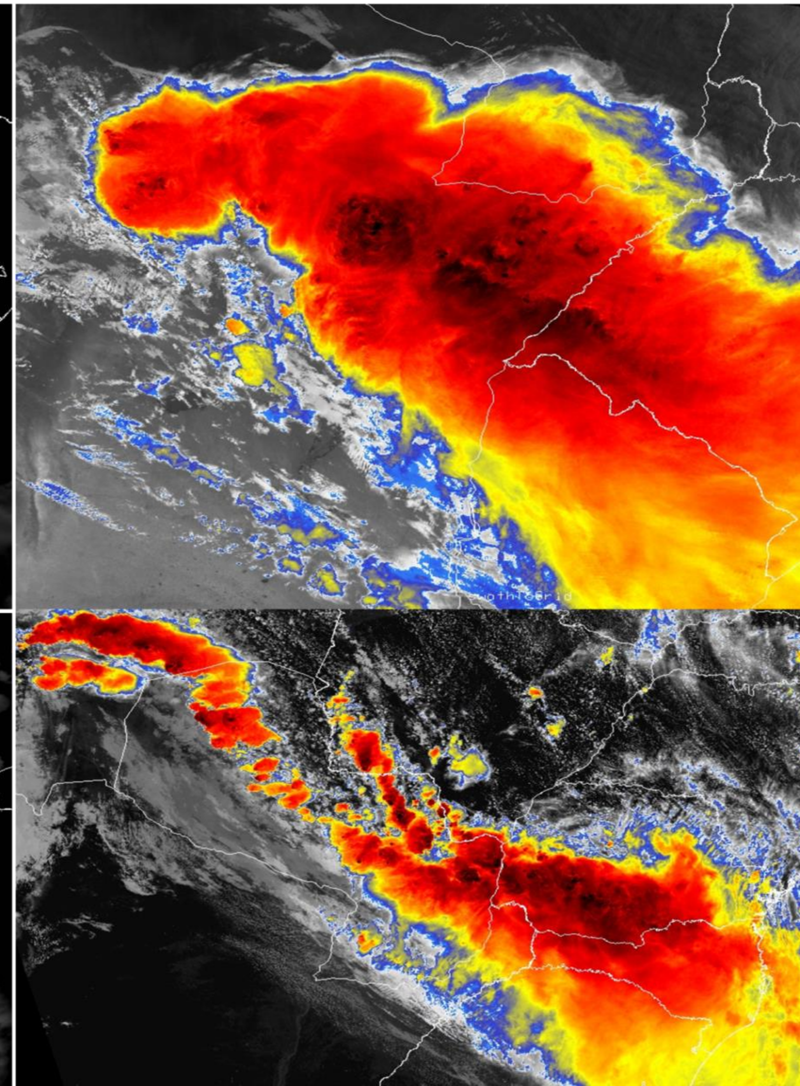
Remaining question: How does the surface vortex form?

The interactions of Gravity Waves with MCS over south parts of Brazil: 18_09_2012 at 10 UTC

Blended method (MSG data)

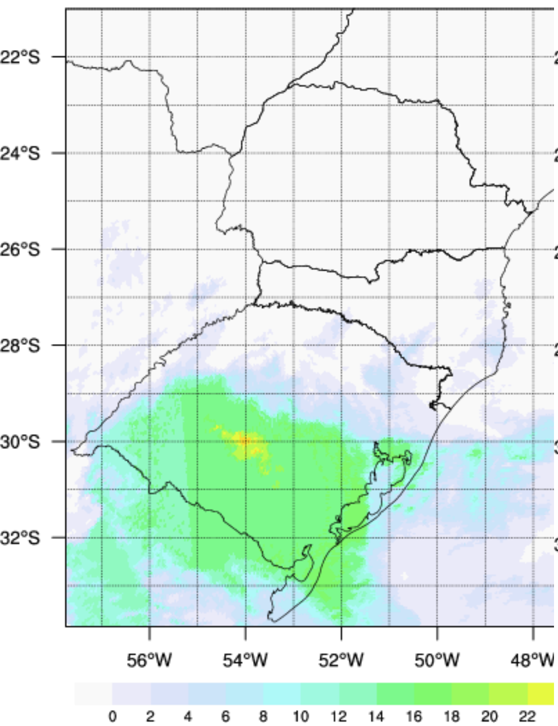


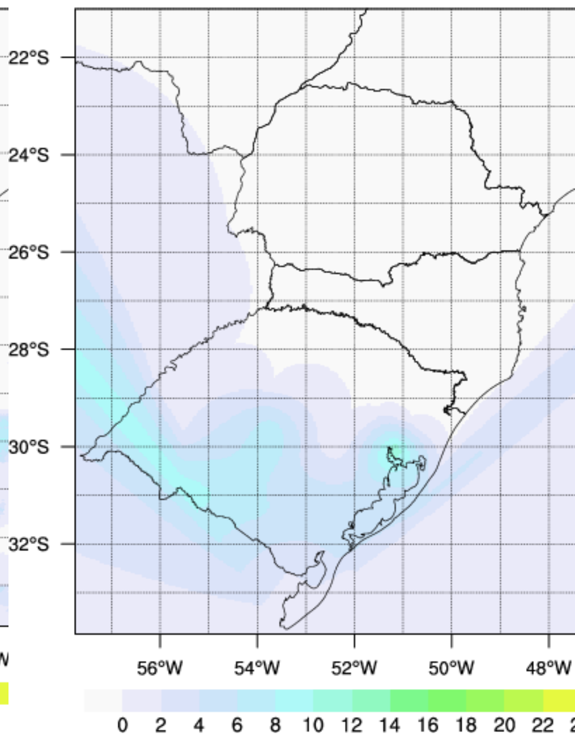
VIIRS 375 m IR BT

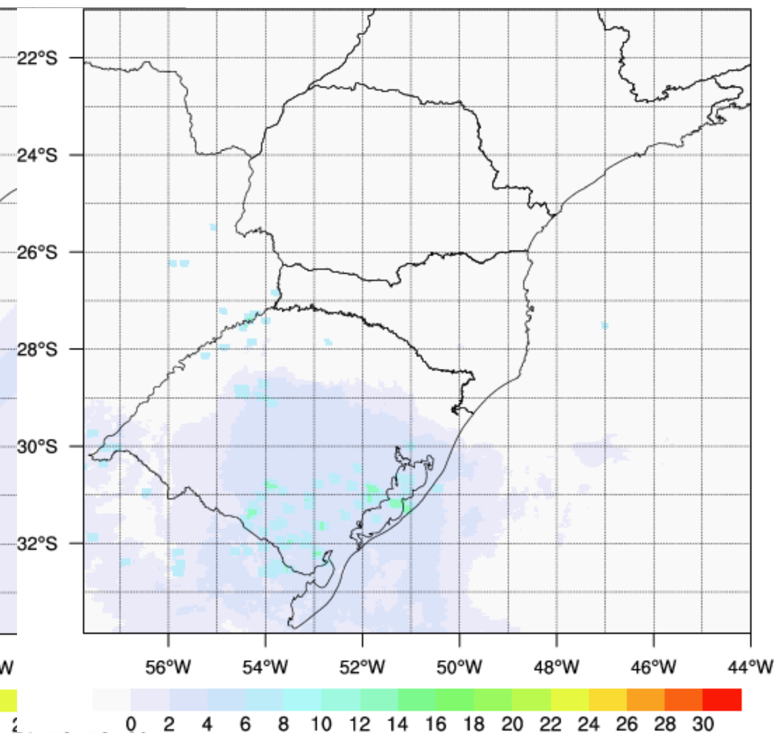


Validation

Total rainfall over 1 hour: 18_09_2012 11 UTC





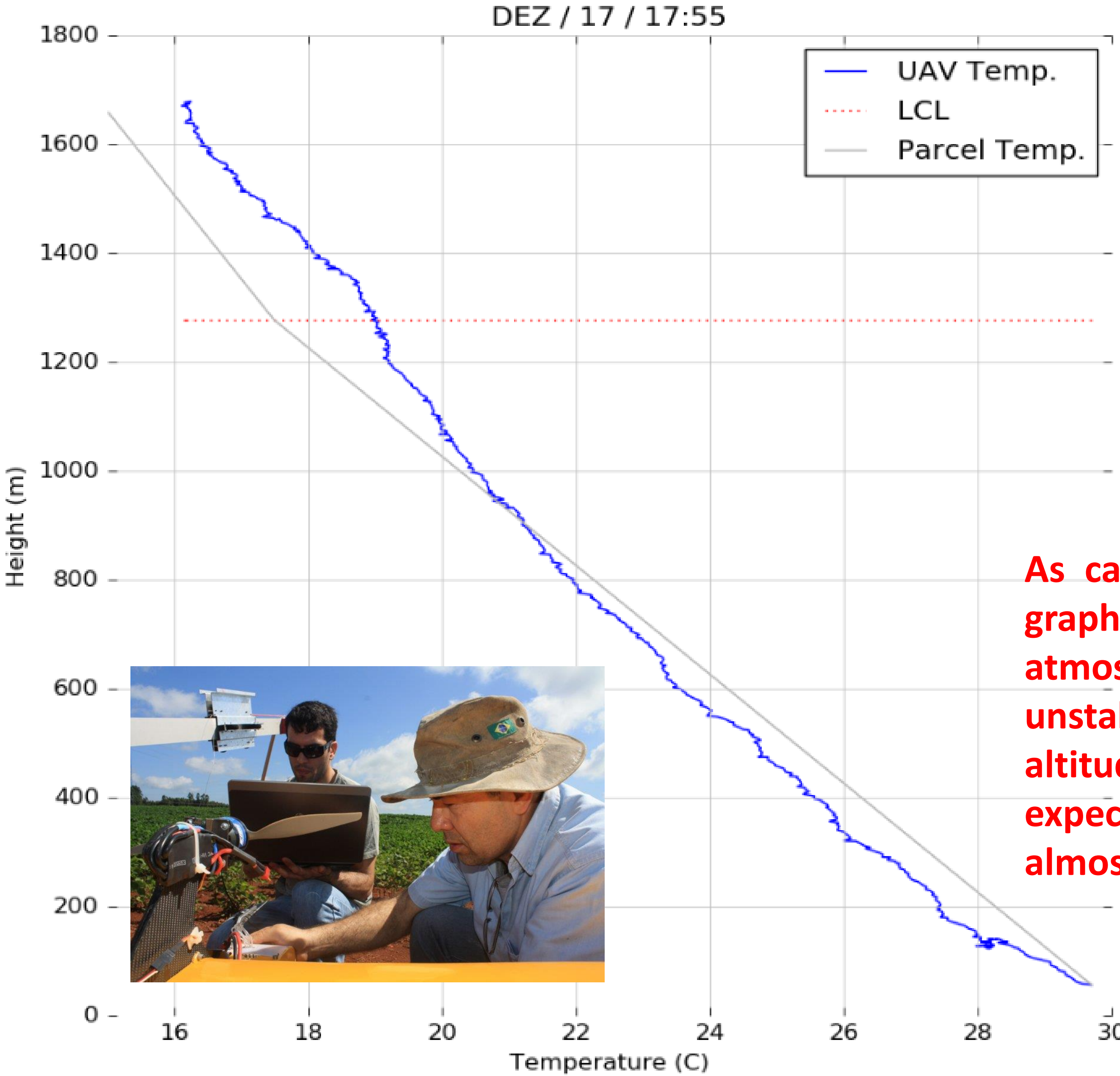


MPE
Meteosat

Rain-gauge

CST (Adler & Negri, 1988)
Goes

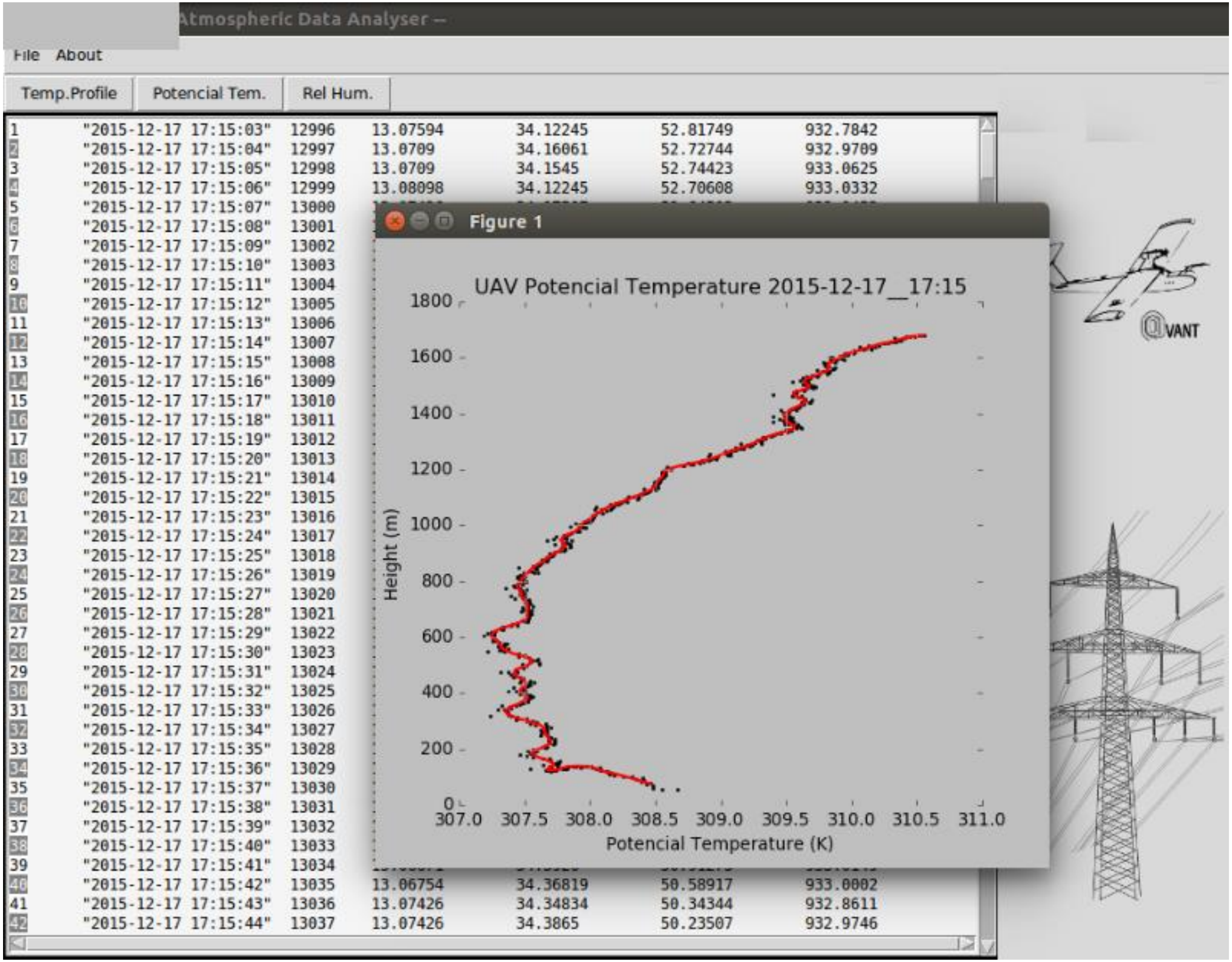
Preliminary results: UAV data collection Field Campaign in Brazil : 17_12_2015



The Unmanned Aerial Vehicle (UAV) is equipped with **temperature and pressure sensors, and pitot tube (wind measurement sensor)**.

As can be seeing in the graphics below, the atmosphere was a little unstable in lower altitudes as can be expected in a beautiful almost summer day .

Developed tool for UAV data analysis



Module 4: GOVERNANCE

Definition of clear rules and norms sustaining the correct developemt of activities, cooperation between institutions, tecnical issues, etc...

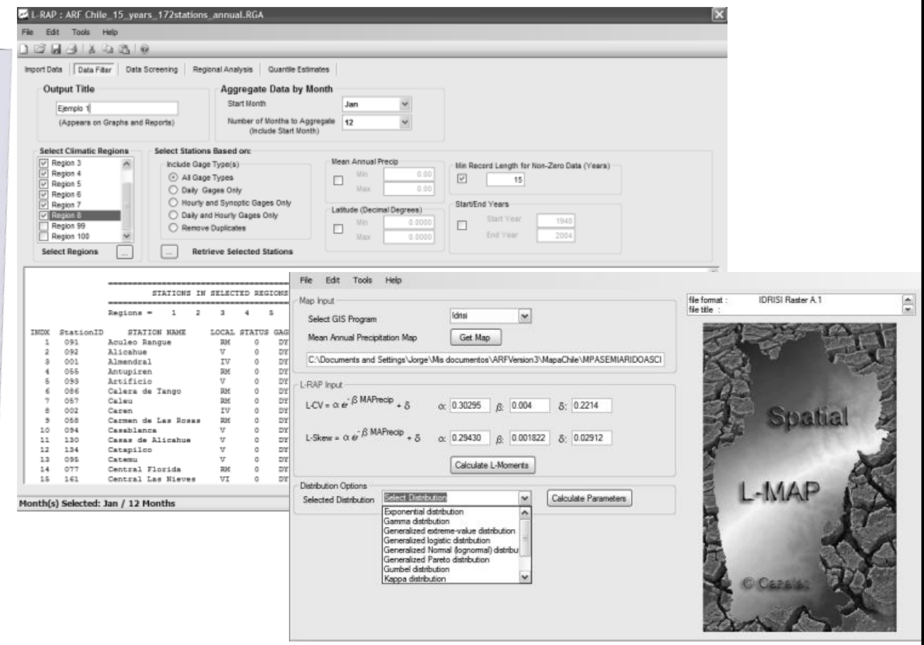
- Meta-data
- Monitoring and reporting
- Cooperation agreements and working groups

Universities and research institutes are key stakeholders in ensuring sustainability by continuing the development of a critical mass of experts who will be able to support the disaster risk assessment at local level.

Products developed

Books

Software



Workshops

Scientific papers

Nat Hazards
DOI 10.1007/s11069-015-1635-8

ORIGINAL PAPER

Recent trends in vegetation dynamics in the South America and their relationship to rainfall

H. A. Barbosa · T. V. Lakshmi Kumar · L. R. M. Silva

Summary

The joint initiative between the EUMETSAT and the LAPIS/UFAL. Three characteristics of the SAGEO appear to be contributing to its success, which are:

(1) to bring together the EUMETCast network operators to identify areas for regional cooperation;

(2) to provide a technical and scientific exchange in environmental and atmospheric sciences between various Brazilian research institutes, while they broaden the knowledge about their applications;

3) tools used are freeware and are at disposal of the group;

4) Strong interest and commitments from universities and others institutions with weather, climate a/o natural resources monitoring mission;

5) Increasing interest by national operational authorities e.g. National Met Services, Gvt. agencies, NGO’s;

6) Joint ventures of European with Brazilian and other research partners are increasing.

Thank you for your attention

LAPIS

EUMETSAT

Monitoring weather and climate from space
Surveiller le temps et le climat depuis l'espace