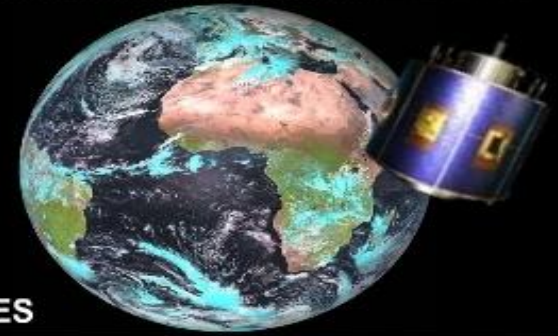




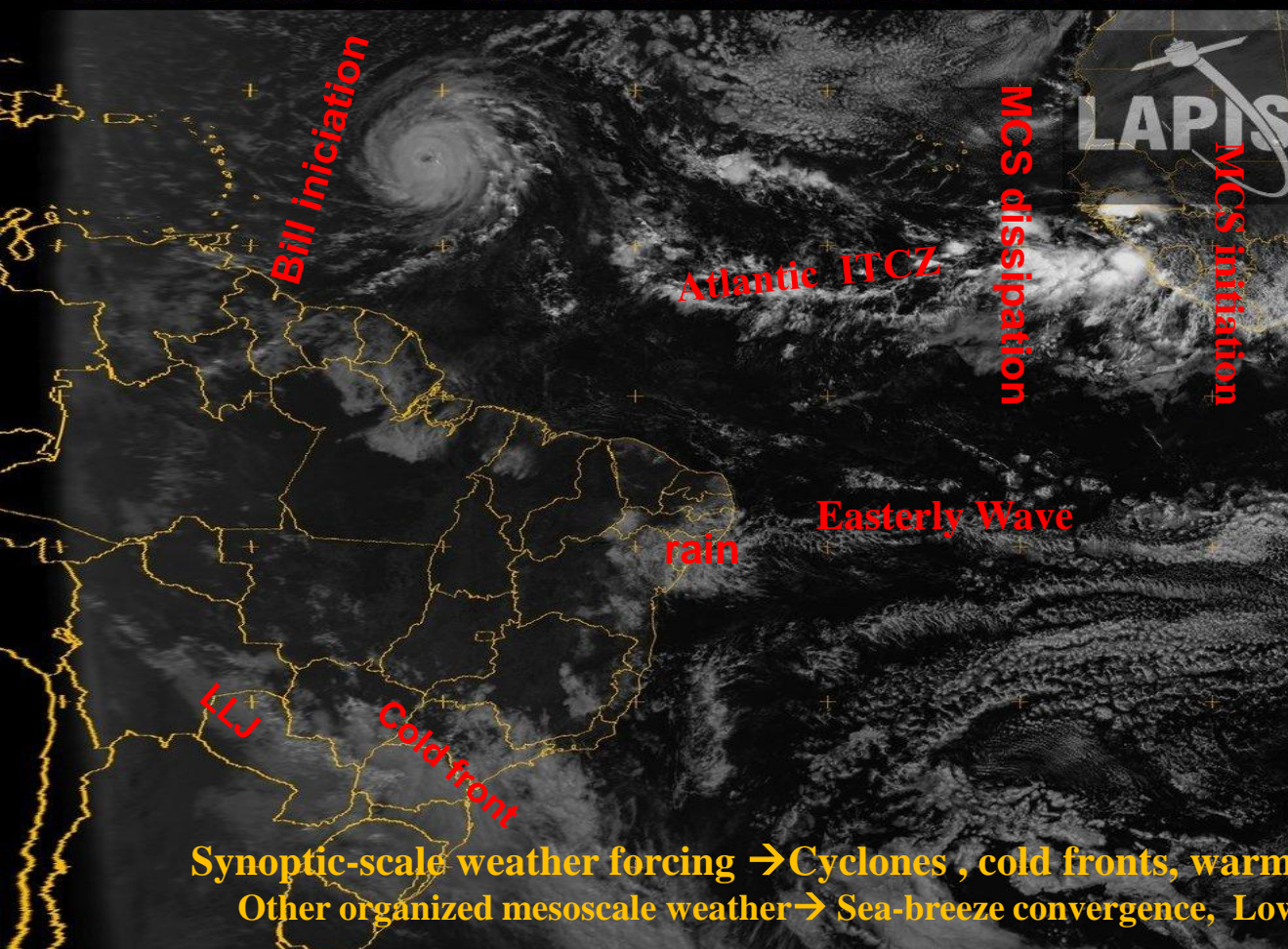
CWG Workshop,
07-11 April 2014, Zagreb, Croatia

Humberto A. Barbosa

LABORATÓRIO DE ANÁLISE E PROCESSAMENTO DE IMAGENS DE SATÉLITES



Meteosat-9 Canal: VIS006 - 18/08/2009 12:00 UTC lat1=25 lon1=-73 lat2=-35 lon2=-5



**The African
Easterly Waves and
their influence on
hurricane activity
in the tropical
North Atlantic: An
assessment of
hurricane Bill
(2009) using
SEVIRI data and
its products**

Synoptic-scale weather forcing → Cyclones, cold fronts, warm / cold air advection etc
Other organized mesoscale weather → Sea-breeze convergence, Low-level jet streaks, MCSs

MOTIVATION

Conceptual Models - the online collection Conceptual Models for Southern Hemisphere is a joint project between four southern hemispheric Centres of Excellence: Argentina, Australia, Brazil and South Africa. The project is co-funded by **WMO** and **EUMETSAT**. The purpose of the project is to improve warnings and awareness of weather risks through the use of conceptual models.

Conceptual Models for Southern Hemisphere

<https://sites.google.com/site/cmsforsh/>

- ARGENTINA
- SALLJ & MCSs
- ZONDA
- AUSTRALIA
- RAPID
- CYCLOGENESIS
- SHALLOW COLD FRONTS
- BRAZIL
- ATLANTIC CONVERGENCE ZONE
- MESOSCALE CONVECTIVE COMPLEXES
- SOUTH AFRICA
- COL
- CONTINENTAL TROPICAL LOWS
- ALL CATEGORIES
- CONTRIBUTORS

Conceptual Models - the online collection

Conceptual Models for Southern Hemisphere is a joint project between four southern hemispheric Centres of Excellence: Argentina, Australia, Brazil and South Africa. The project is co-funded by WMO and EUMETSAT.

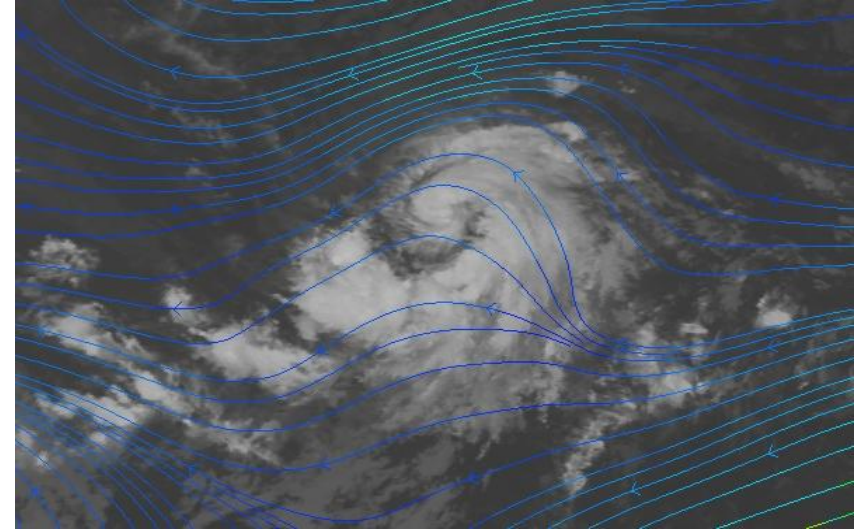
The purpose of the project is to improve warnings and awareness of weather risks through the use of conceptual models.



Genesis of TC: The transformation of a “disorganized” cold-core convective system into a self-sustaining synoptic-scale warm-core vortex with a cyclonic circulation at the surface

Necessary (but not sufficient) Conditions:

- Pre-existing convection
- Significant planetary vorticity
- Favorable wind shear pattern
- Moist mid-troposphere
- Warm ocean with deep mixed layer
- Conditionally unstable atmosphere



SEVIRI IR 10.8 image + ECMWF wind data
Source: Lapis

One of the greatest puzzle of tropical meteorology

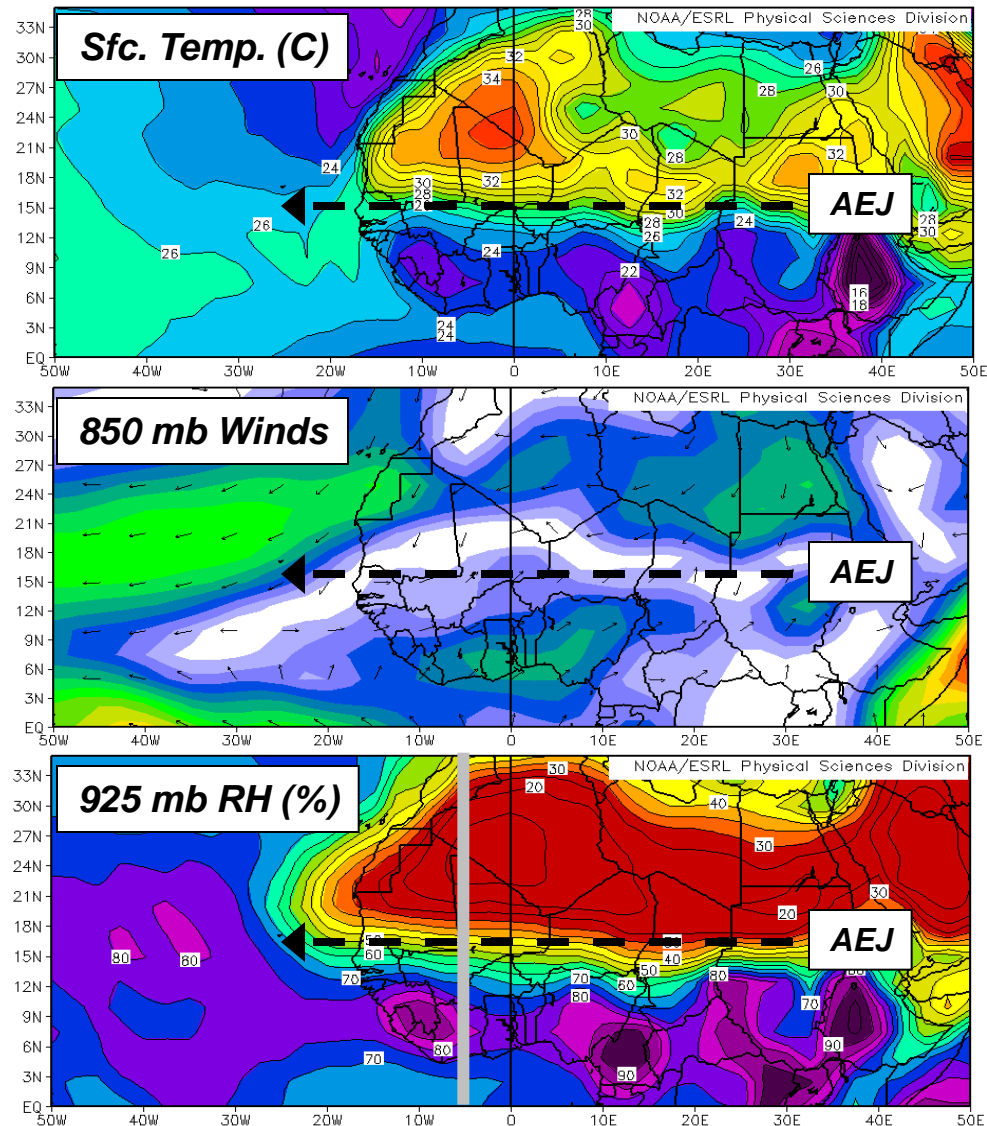
How do we transform a cold-core synoptic-scale disturbance with a mid-level vortex to a warm-core system with a surface vortex?

African Easterly Jet (AEJ)

Origin: Develop over sub-Saharan Africa from instabilities along the African Easterly Jet

Basics:

- Wavelengths of ~3000 km
- Move westward at 6-8 m/s
- 60-80 easterly waves cross the Atlantic each year between June and October
- 7-9 develop into tropical cyclones



OVERALL SCIENTIFIC APPROACH

Use of conceptual models in the design of a comprehensive assessment for a case study (CM)

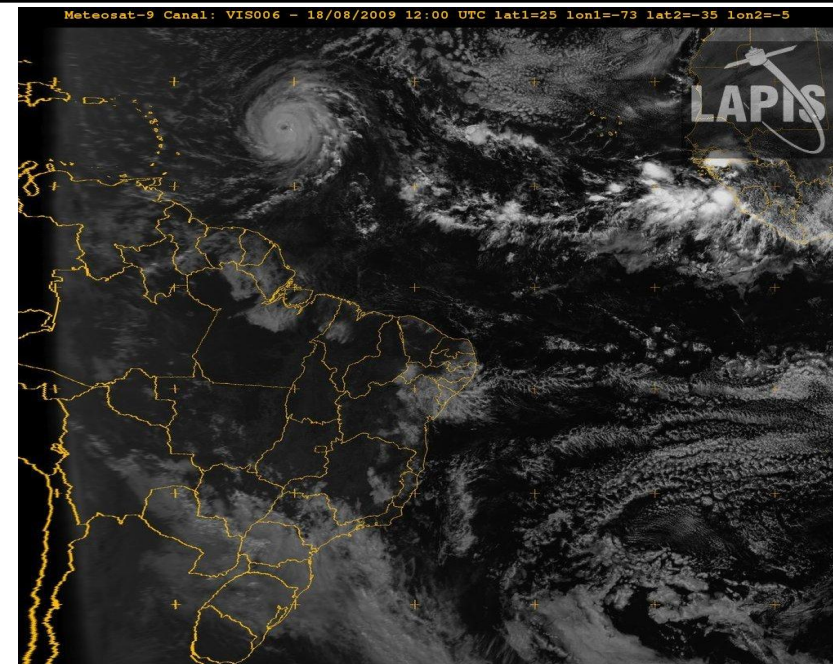
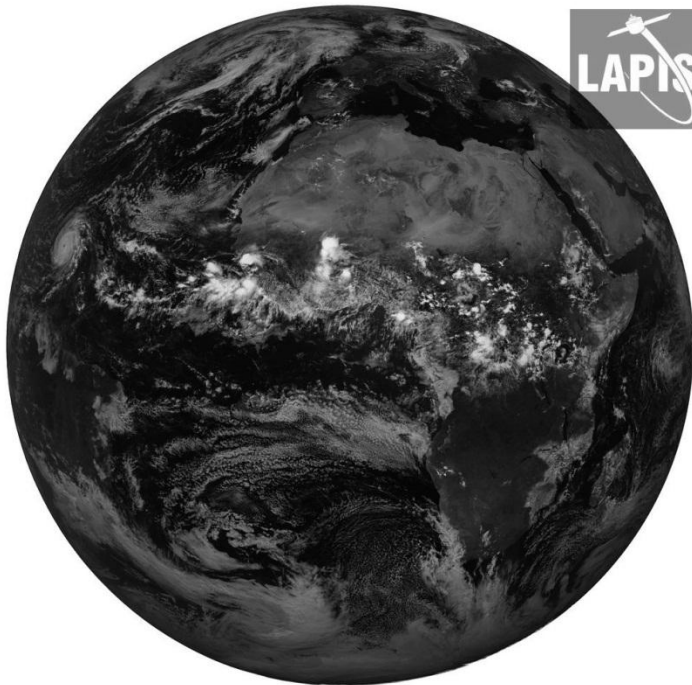
**Teleconnections between the North Atlantic and the Tropical Atlantic
(ITCZ, Easterly Waves, MCS, Hurricanes)**

- # 1 Develop a conceptual model (prepare a design)**
- # 2 Identify stressors**

**Mesoscale Convective Systems (MCSs) tracking
with METEOSAT –9 (MSG-2) images**

ECMWF ERA Interim, wind data

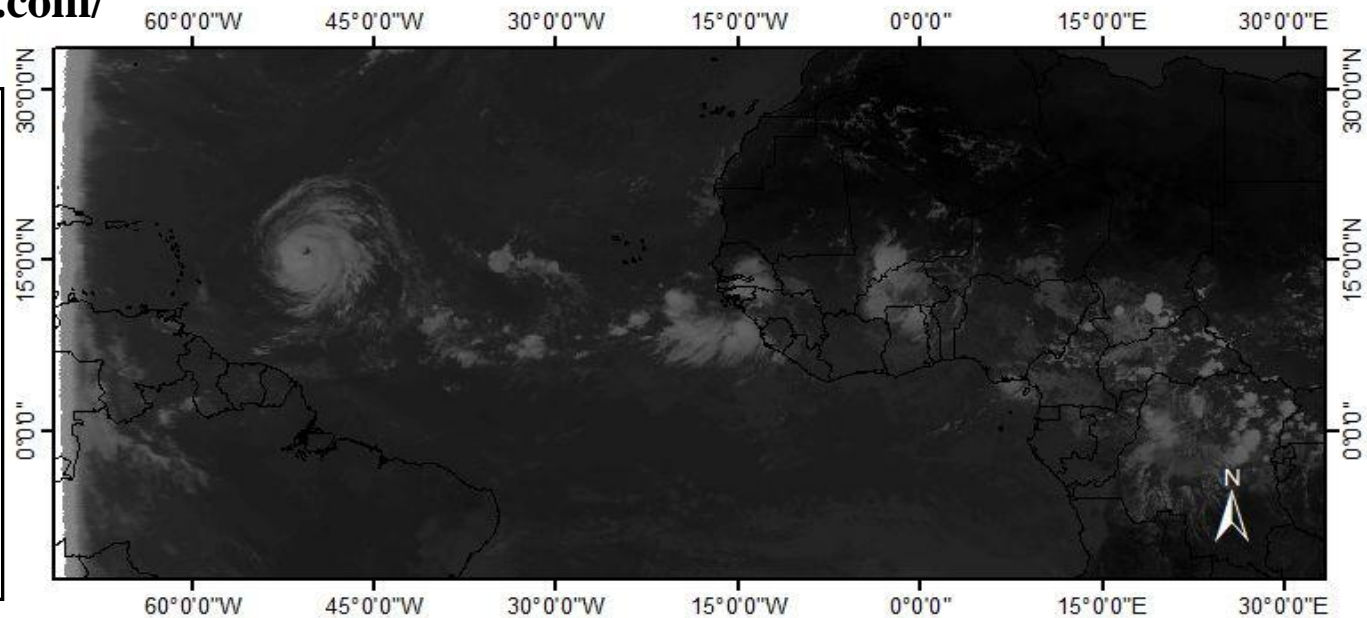
- #3 Establish hypotheses**
 - #4 Scale of problem**
 - #5 Establish indicators**
- MPE (precipitation) product from MSG**



<http://www.lapismet.com/>

MSG IR10.8
Aug 18th, 2009
1200 UTC

From
EUMETCast
station at LAPIS



Data through the system of low cost for receiving environmental data – the EUMETCast system

Mesoscale Convective Vortices (MCVs)

Origin: Develop within persistent mesoscale convection from heating aloft (convection) and cooling below (cold downdrafts)

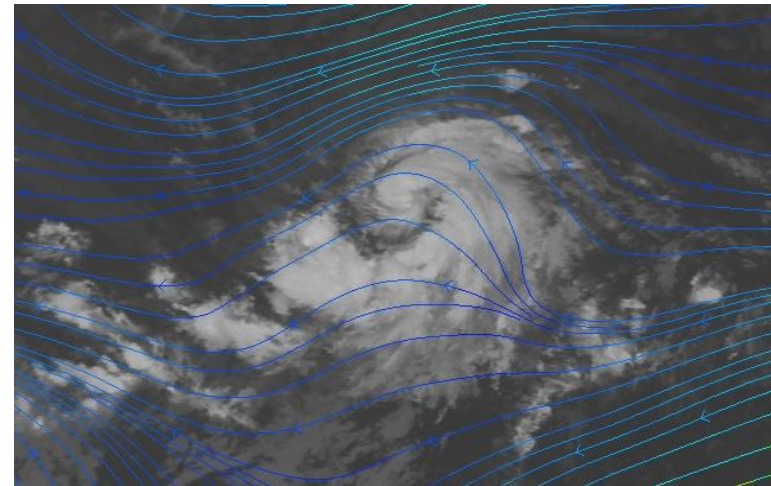
Basics:

- Confined to mid-levels with little or no signature at the surface
- Often present in easterly waves
- Dynamically stable (last several days)
- Multiple convective cycles
- Can emerge from the continental U.S. and developed into tropical cyclones (e.g. Hurricane Danny 1997)

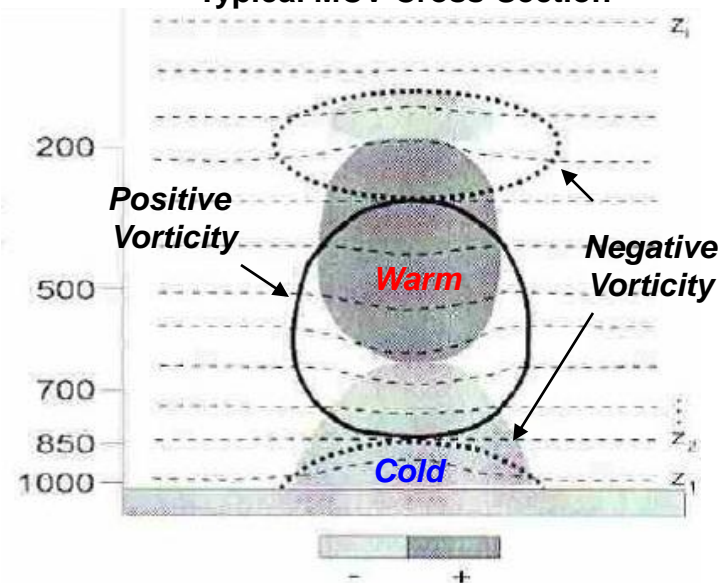
Why do we care about MCVs?

- Often emerge over warm waters with convection
- Systems “pre-conditioned” for successful genesis

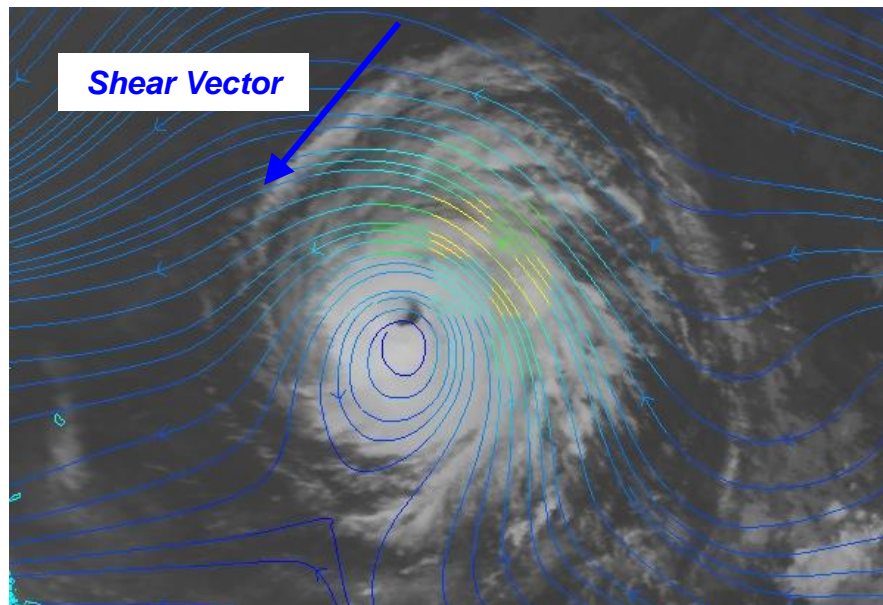
SEVIRI IR 10.8 image



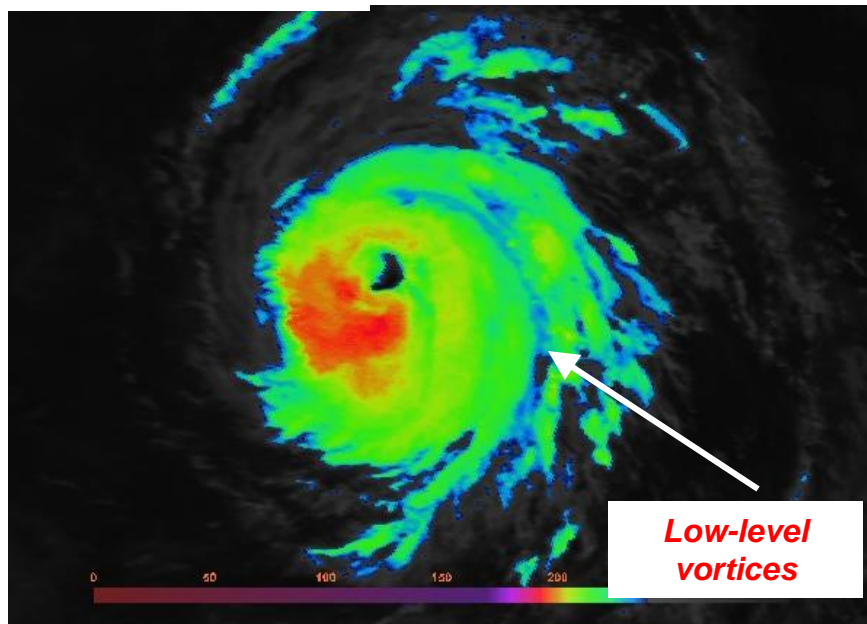
Typical MCV Cross-Section



SEVIRI Image



IR 10.8 + wind 250



IR 10.8 enhanced

Observational Evidence:

TC Aug 18th, 2009

Vertically sheared from the
northeast

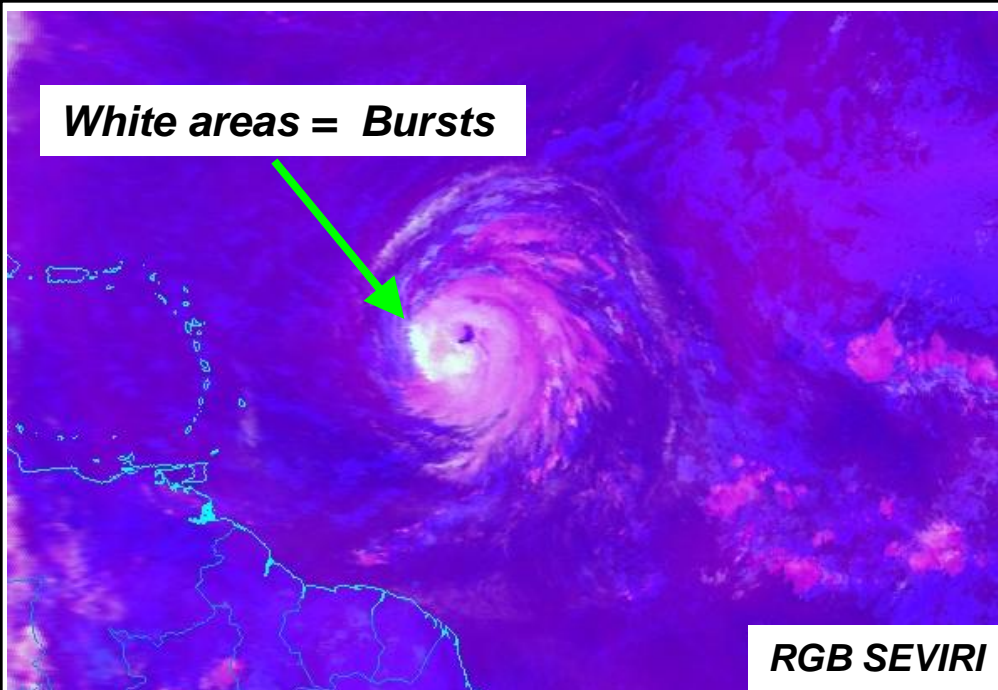
- Exposed low-level circulation
- Convection confined to the southwest

Episodic convective bursts (hot
towers)

developed multiple low-level
vortices that
rotated around to the northeast

Source: Lapis

White areas = Bursts



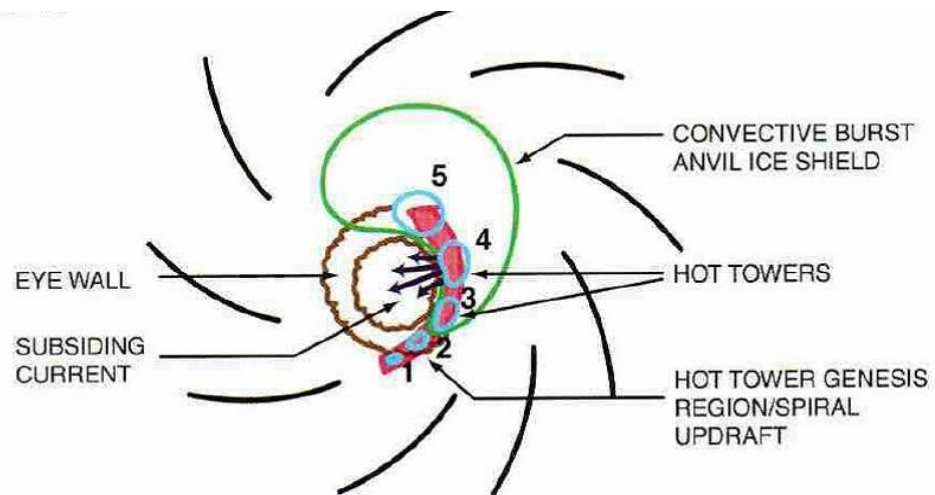
Source: Lapis

- **A recent survey of convective bursts:**
 - **80% of TCs have at least one "burst"**
 - **70% of TCs intensify after a "burst"**

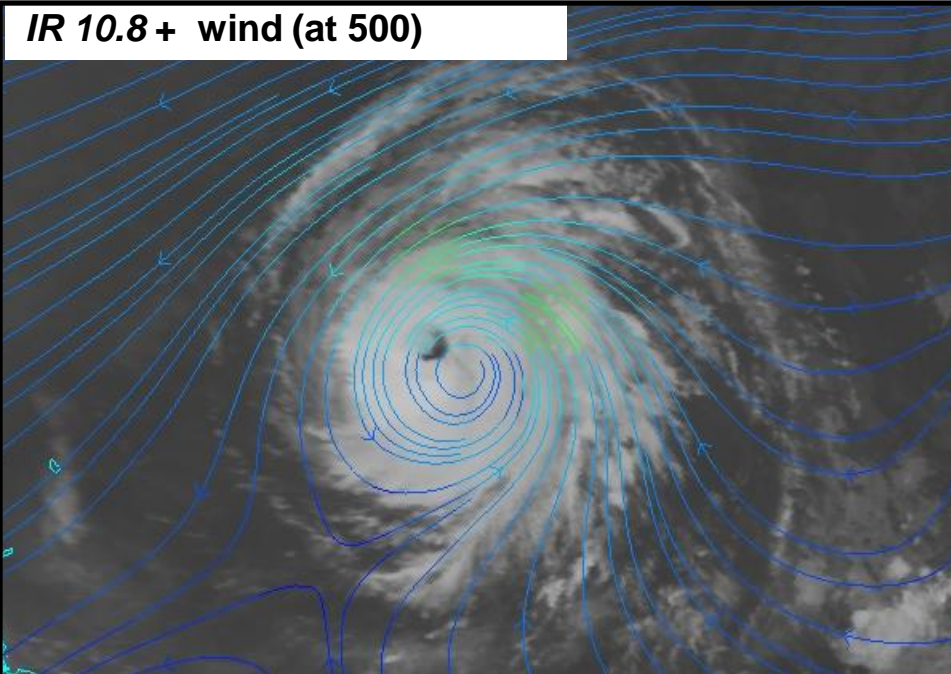
Convective Bursts:

- **Overshooting and diverging convection at upper levels drives asymmetric mesoscale descent (adiabatic warming) in the eye, which lowers the pressure, increasing the pressure gradient and tangential winds**

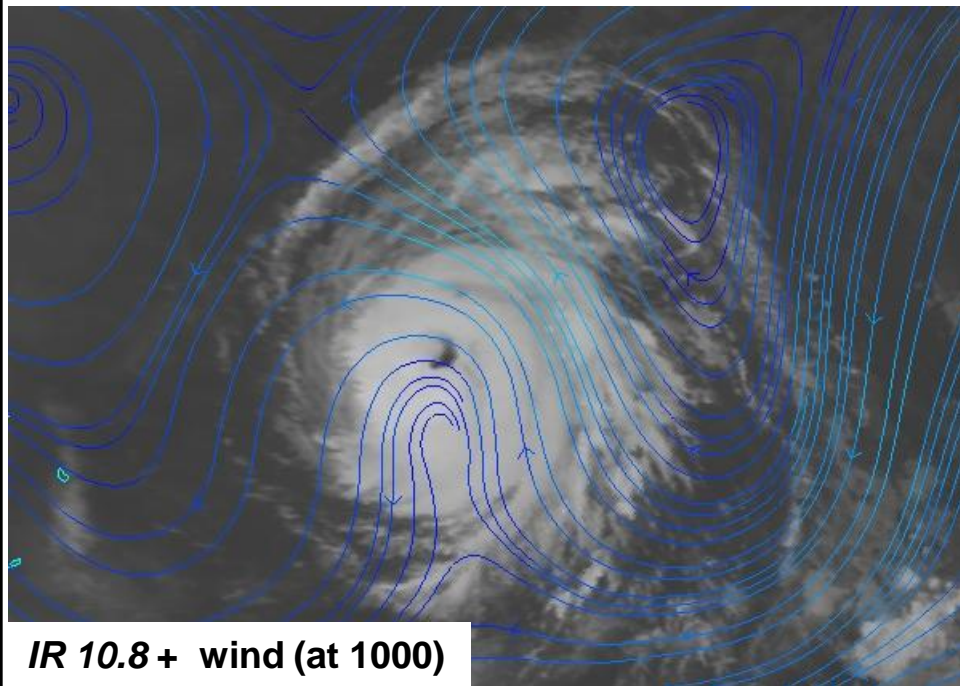
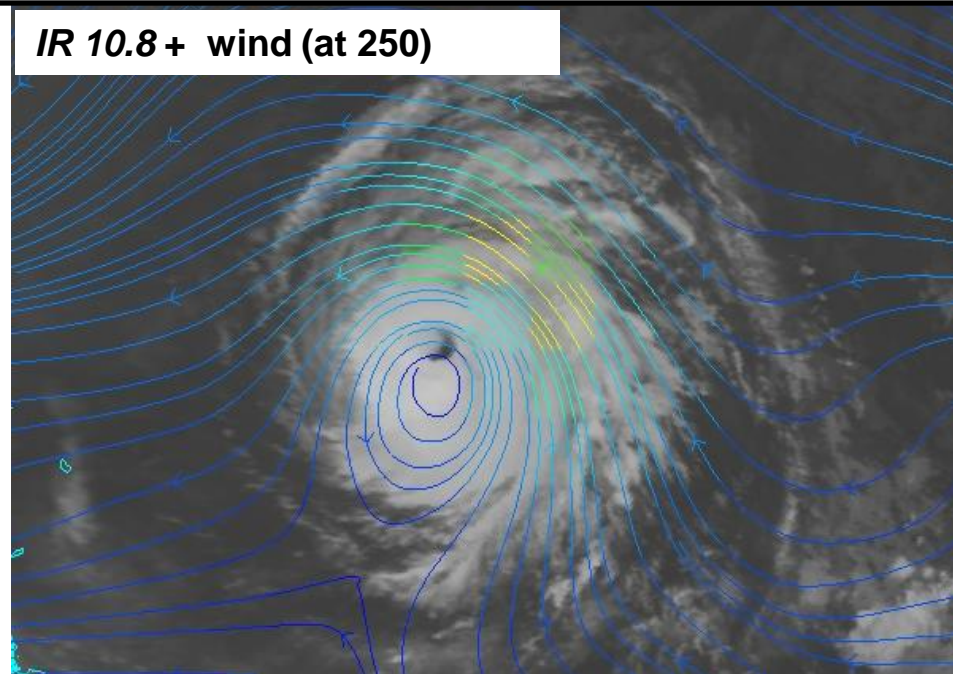
Conceptual Model of Convective Burst



IR 10.8 + wind (at 500)



IR 10.8 + wind (at 250)



Intensity change can be a slow and steady process or it can occur rapidly over the course of several hours

Forcing exists on multiple scales

- Seasonal (SST, relative humidity)
- Synoptic (wind shear)
- Mesoscale (convective features, MCV, eyewall cycles)
- Microscales (air-sea interface, water phase changes)

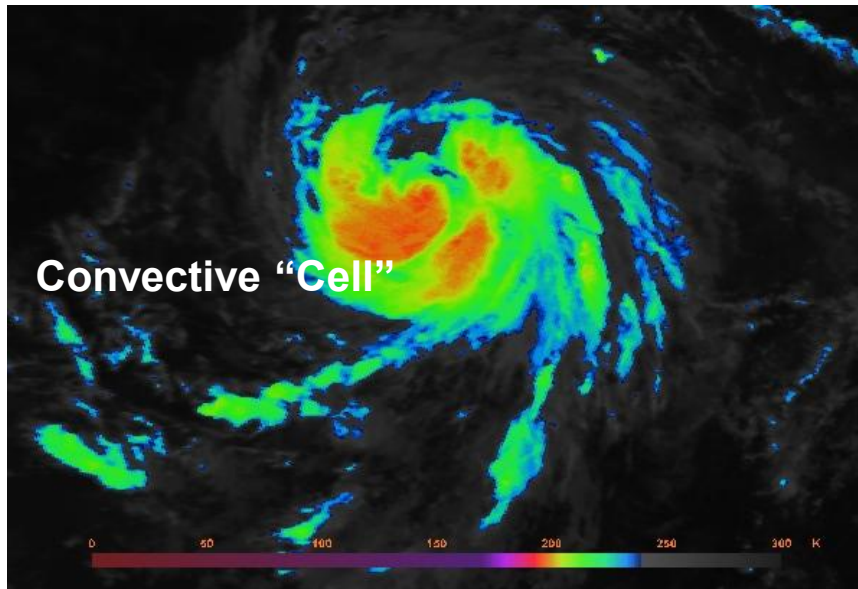
Complex interactions exist between the scales

Very difficult forecast problem!!!

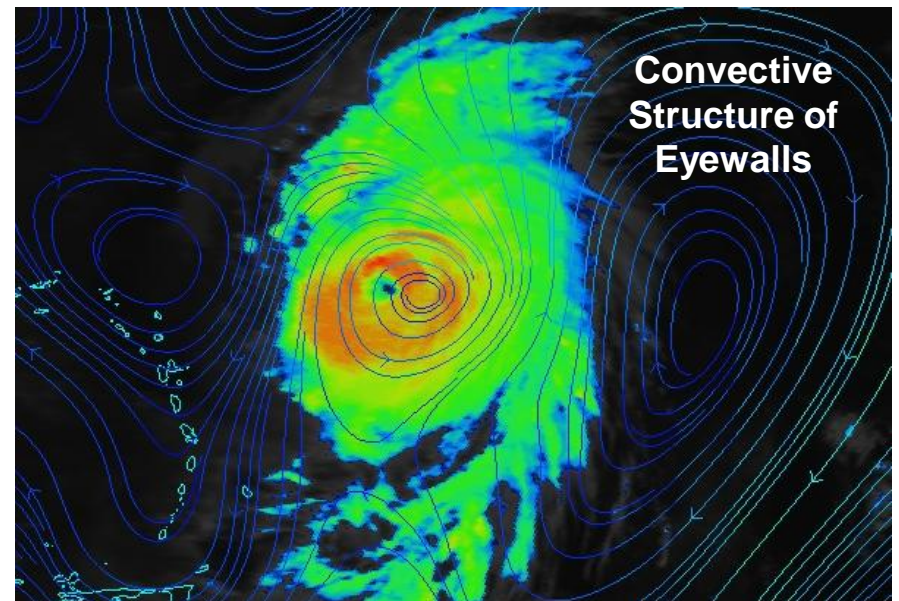
Tropical Cyclone Eyewalls

- Convection is rarely organized into a uniform ring of ascent

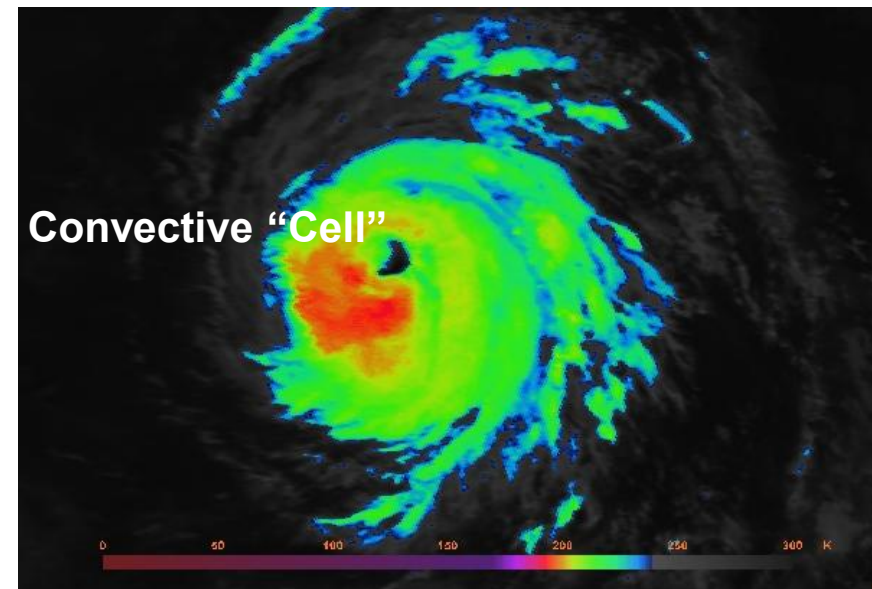
- Individual cells often develop, mature, and decay within 1 hour



- Convection is often organized into multiple distinct "cells" that rotate cyclonically around the eyewall

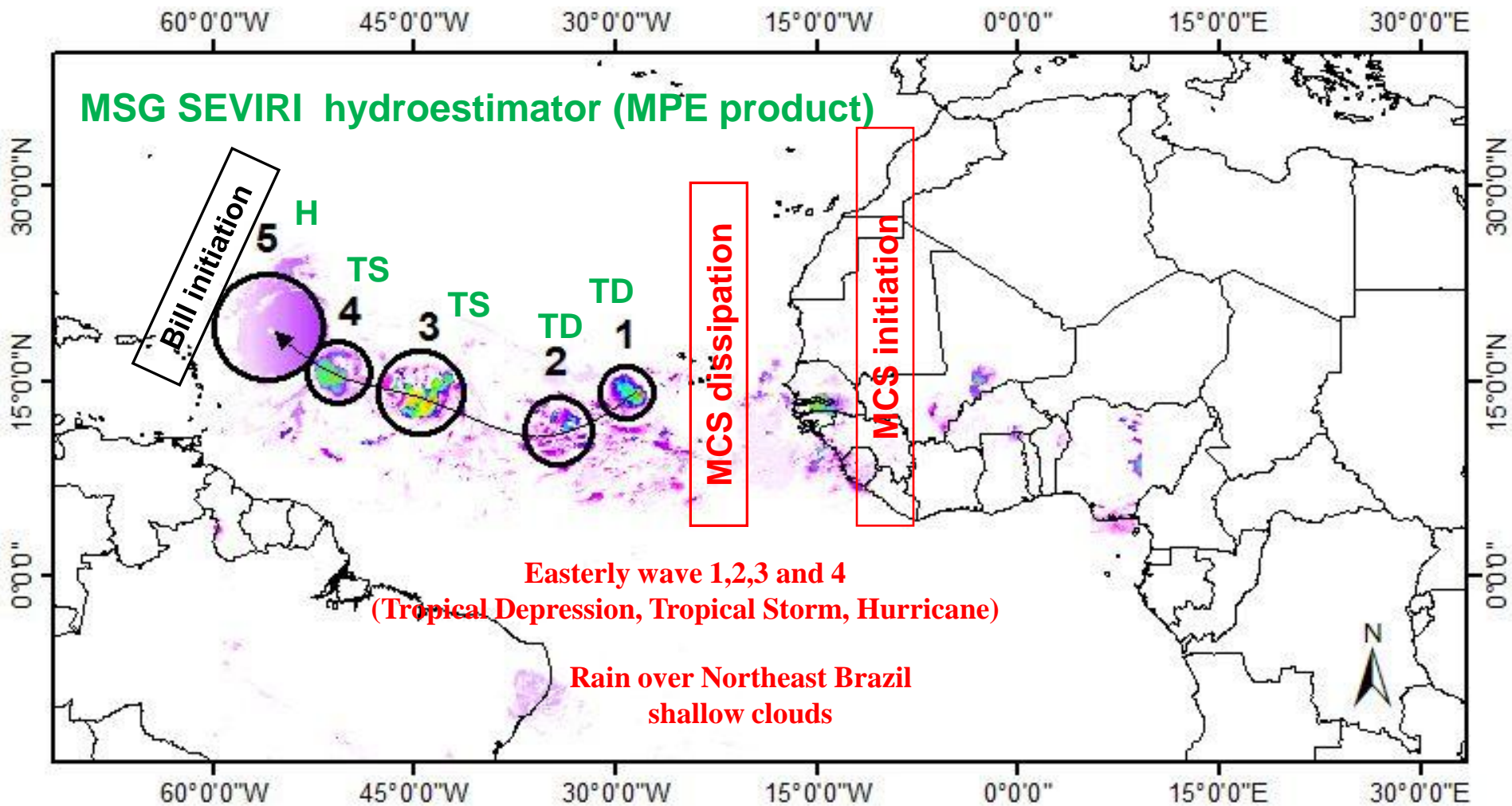


- Cells are the "detectable result" of strong updrafts **Source: Lapis**



Tropical Cyclone (TC) Bill (Rain Band)

MSG SEVIRI hydroestimator (MPE product)



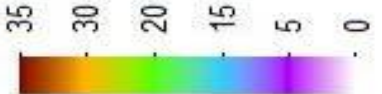
Source: Lapis

Tool: McIDAS-V

- 1-> Aug 14th 2009 at 1200 UTC
- 2-> Aug 15th 2009 at 1200 UTC
- 3-> Aug 16th 2009 at 1200 UTC
- 4-> Aug 17th 2009 at 1200 UTC
- 5-> Aug 18th 2009 at 1200 UTC

Chuva (mm)

Value



GAPS

- Majority of severe weather occurs in relation to organized mesoscale system
 - Mesoscale Convective Complexes → Flash floods, etc
- Presently observation networks do not adequately resolve the mesoscale with regular observations of both winds and thermodynamics in space and time
 - Surface observations
 - Rawinsonde networks
 - Geostationary and polar-orbiting satellites
- The greatest challenge for a weather forecaster is on the mesoscale
 - Anticipate mesoscale weather based on the synoptic observations
 - Adapt quickly to any evolving mesoscale observations
 - Be able to effectively disseminate information to the public in a near real time in order to save lives and property

References

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- Morrison, I., S. Businger, F. Marks, P. Dodge, and J. A. Businger, 2005: An observational case for prevalence of roll vortices in the hurricane boundary layer., *J. Atmos. Sci.*, 62, 2662-2673.**



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LABORATÓRIO DE ANÁLISE E PROCESSAMENTO DE IMAGENS DE SATÉLITES

Objetivos Projetos Contatos

• *Thank you for listening!*
• *Questions?*

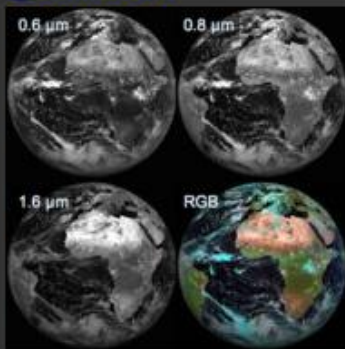
Menu Principal

- Home
- Equipe
- Pesquisas
- Publicações
- Softwares
- Contatos

Produtos

- Estação de Recepção

Links



Lápis



Qui, 24 de Setembro de 2009 11:08

O Laboratório de Análise e Processamento de Imagens de Satélites (LAPIS) da Universidade Federal de Alagoas (UFAL) realiza atividades de pesquisa, assistência tecnológica e treinamento de recursos humanos para a recepção, processamento, interpretação e integração de imagens dos satélites da série METEOSAT. Para atender a essa demanda, em 2007 a UFAL instalou e operacionalizou a terceira estação de recepção de imagens do satélite METEOSAT Segunda Geração (MSG) do Brasil. Como atividades de pesquisa e transferência de conhecimento, a equipe do LAPIS elabora aplicativos para tratamento de imagens, disponibiliza produtos meteorológicos e ambientais derivados do MSG para setores operacionais e oferece treinamento na área. Desenvolvidas inteiramente com ferramentas open-source e freeware.

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Eventos

- 2006
- 2007
- 2008
- 2009

