AN INTEGRATED SYSTEM FOR ANALYSIS OF ENVIRONMENTAL DISASTERS AND RISK ASSESSMENT

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Motivation

In response to catastrophic occurrences frequently observed in densely populated regions in Brazil, researchers from The Institute of Geosciences (IGEO) at The Federal University of Rio de Janeiro (Universidade Federal do Rio de Janeiro, UFRJ) are working towards an integrated system for the analysis of environmental disasters, and vulnerability and risk assessments (The SAnDRA Project).

General Mission

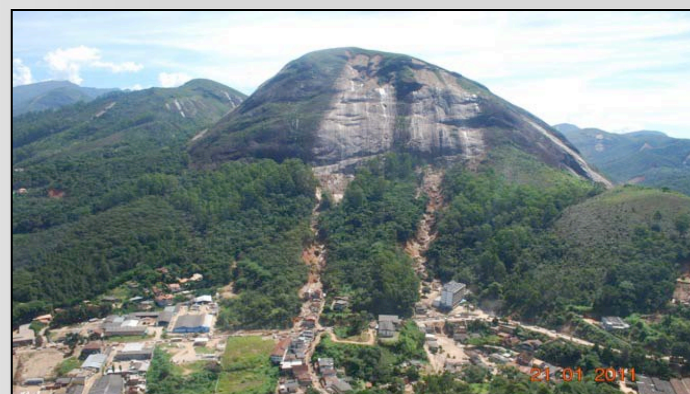
The integrated modeling approach aims the development of a system for decision-making regarding environmental disasters caused by extreme events via coordinated projects, research and activities of the Departments of Geography, Geology and Meteorology at IGEO-UFRJ.

LANDSLIDE OCCURRENCES ARE MOSTLY DRIVEN BY EXTREME METEOROLOGICAL EVENTS IN BRAZIL

Caraguatatuba, SP (1967)

Cubatão, SP (1985)

Timbé do Sul, SC (1995)



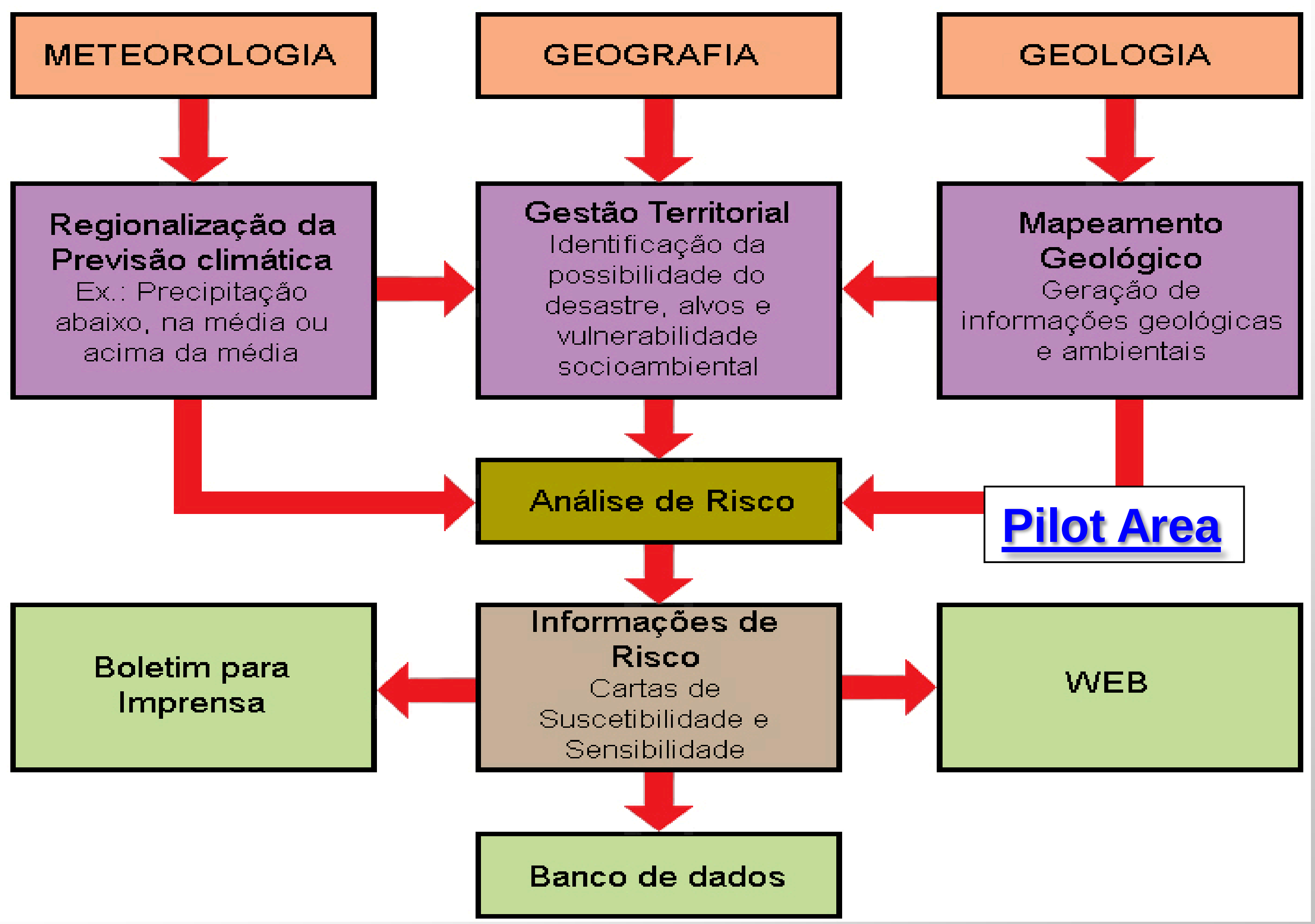
Nova Friburgo, RJ (2011)

Landslide occurrences are mostly driven by extreme meteorological events in Brazil

Deposition of mud above 2 meters

Rio Vieira (Teresópolis), RJ (2011)

Flux of Information

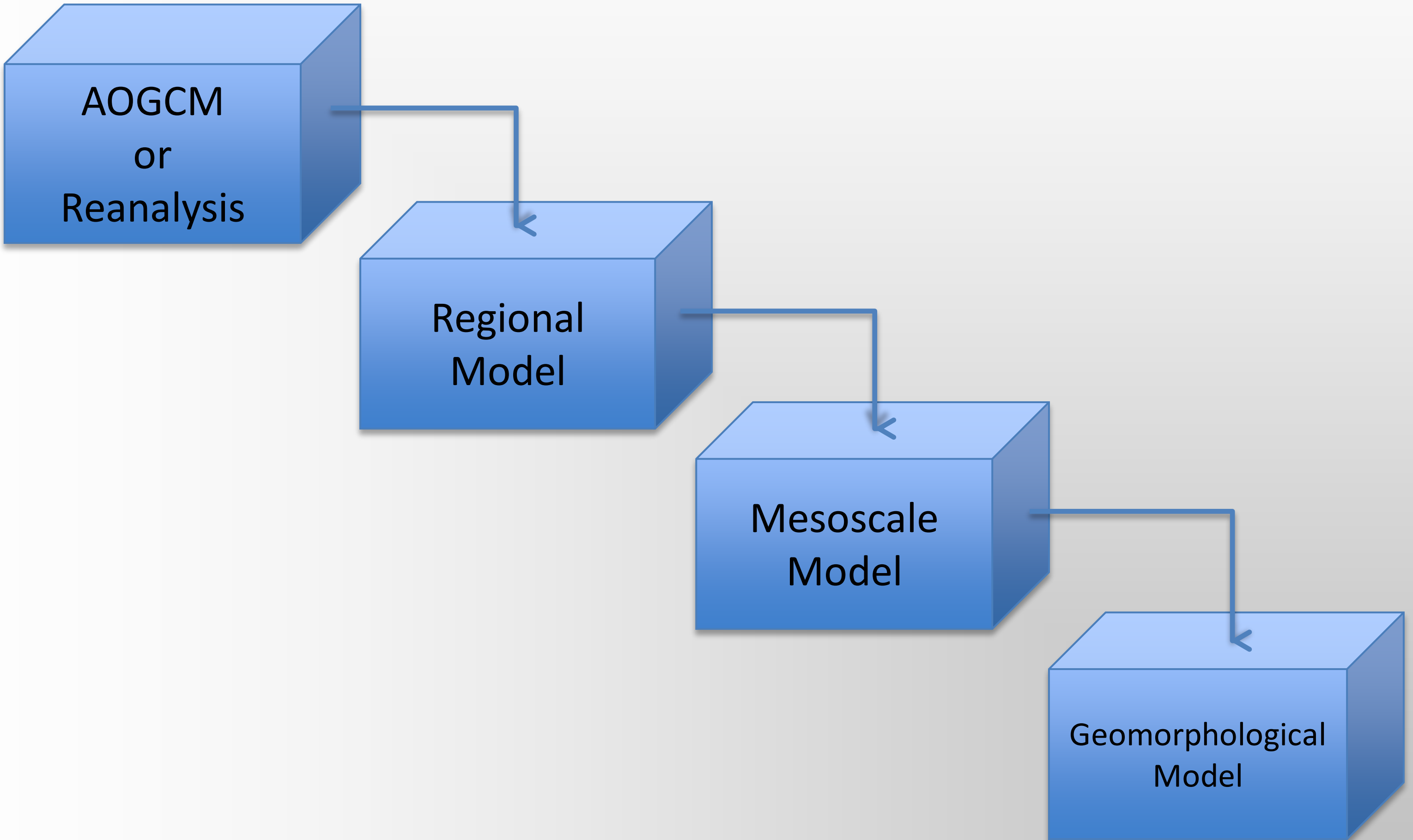


TEAM EXPERTISE

PhD: 31; MSc: 6

Weather and Climate Modeling, Geomorphology, Mesoscale Meteorology, Micrometeorology, Hydrometeorology, Geographic Information System (GIS), Cartography, Geography, Paleoecology, Paleoclimatology, Geotechnical Engineering, Geology and Environmental Engineering, Geophysics, Hydrogeology, Computational Intelligence, Oceanography.

Multi-scale Approach
Deterministic Models



MODELING COMPONENT

FAPERJ 09/2011

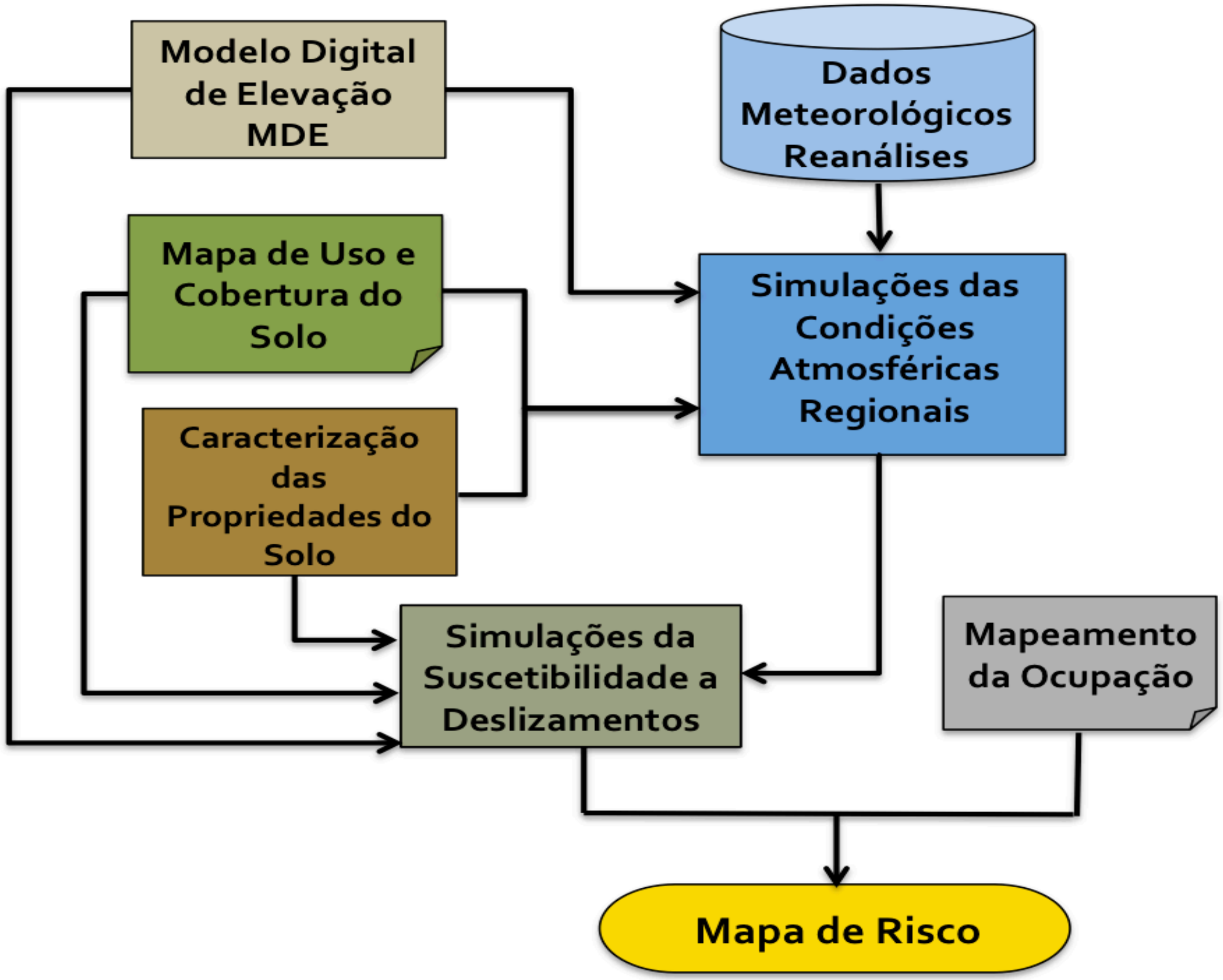
PREVER Project

- ✓ Mathematical Modeling Applied to Risk Assessment over Catastrophic Landslide Areas of the State of Rio de Janeiro

The Prever Project

Meteorological, geological and geographical datasets will be integrated into mathematical models in order to make predictions of natural disasters.

PREVER

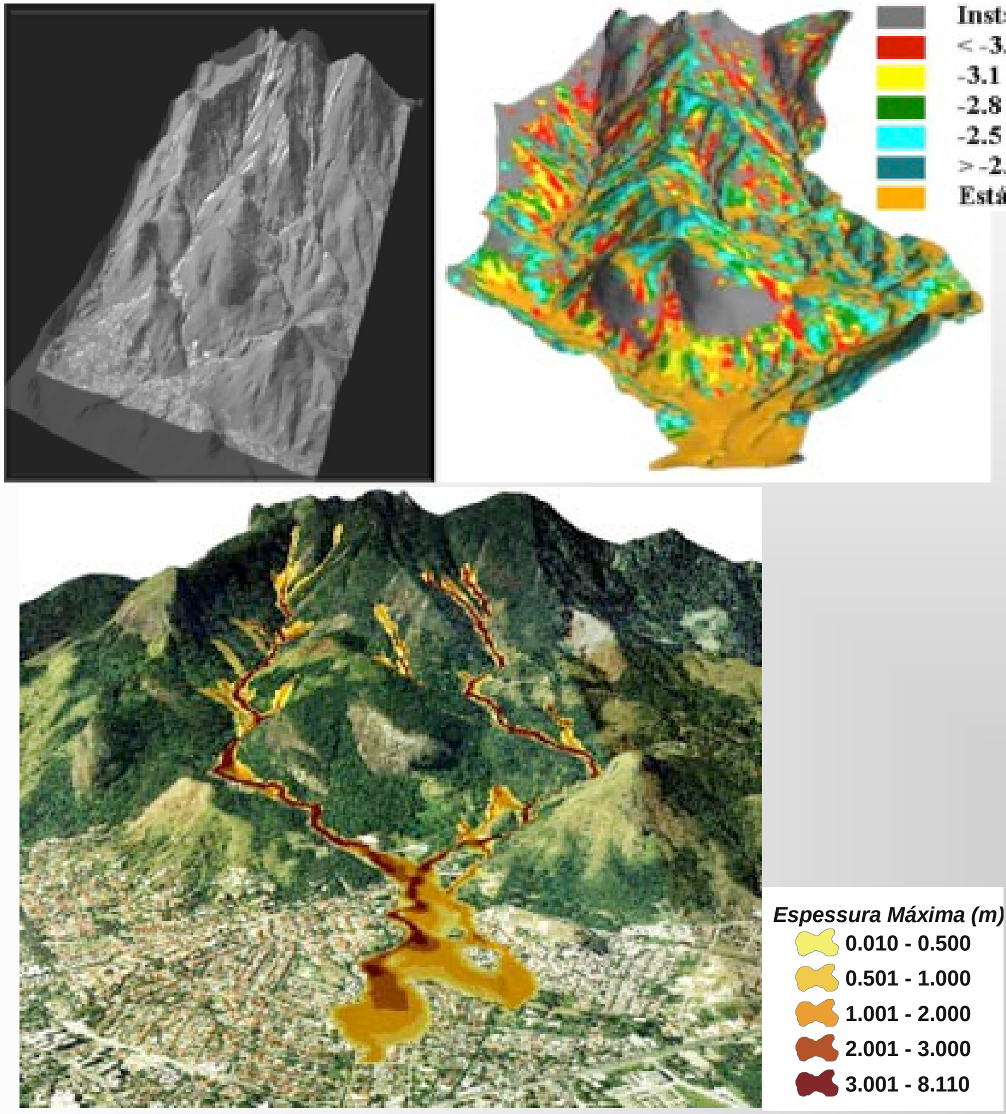

Modelo Digital de Elevação MDE
Dados Meteorológicos Reanálises
Mapa de Uso e Cobertura do Solo
Simulações das Condições Atmosféricas Regionais
Caracterização das Propriedades do Solo
Simulações da Suscetibilidade a Deslizamentos
Mapeamento da Ocupação
Mapa de Risco

Modeling Systems

The landslide modeling will apply physically based numerical models that include advanced hydrology and slope stability, among other combinations.

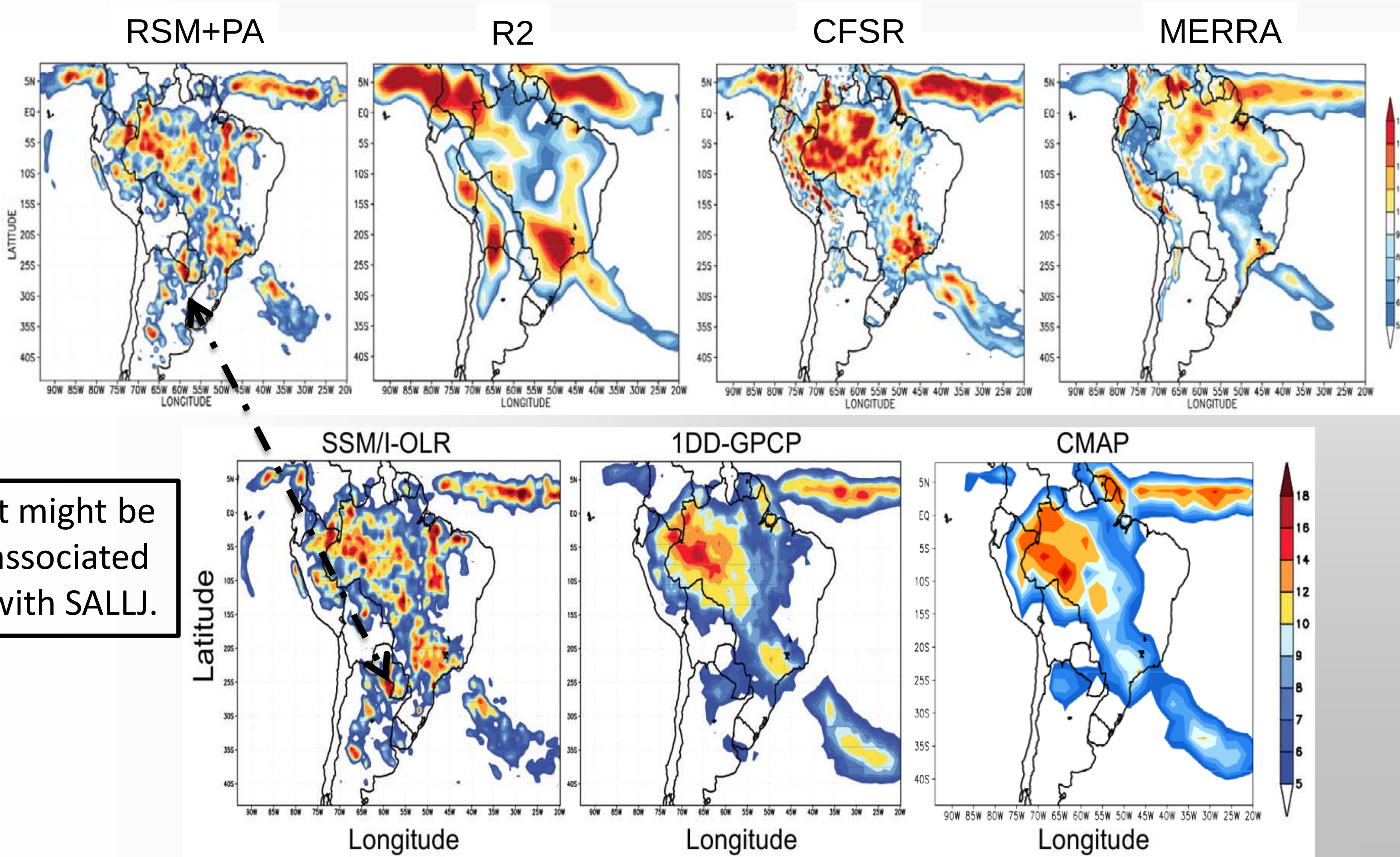
Predictions of areas susceptible to mass movements will be made through the combination of prediction models of mass movements (*e.g.*, SHALSTAB and TRIGRS models for shallow landslides) with a propagation model for debris flow (model FLO-2D).

Modeling Systems



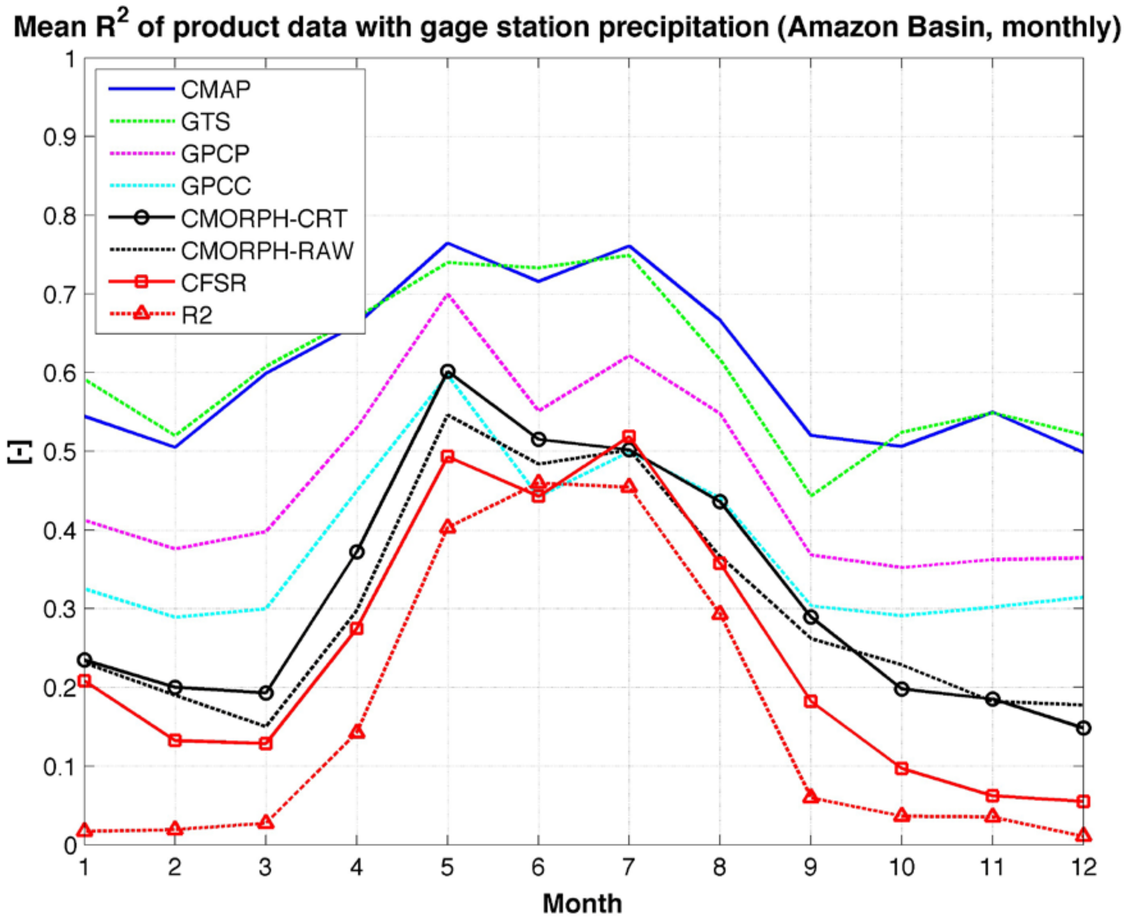
Forecasts of occurrence of landslides, and extent and thickness of the deposits of debris flow.

Precipitation (mm/d)
LBA Wet Season Campaign: January 1999

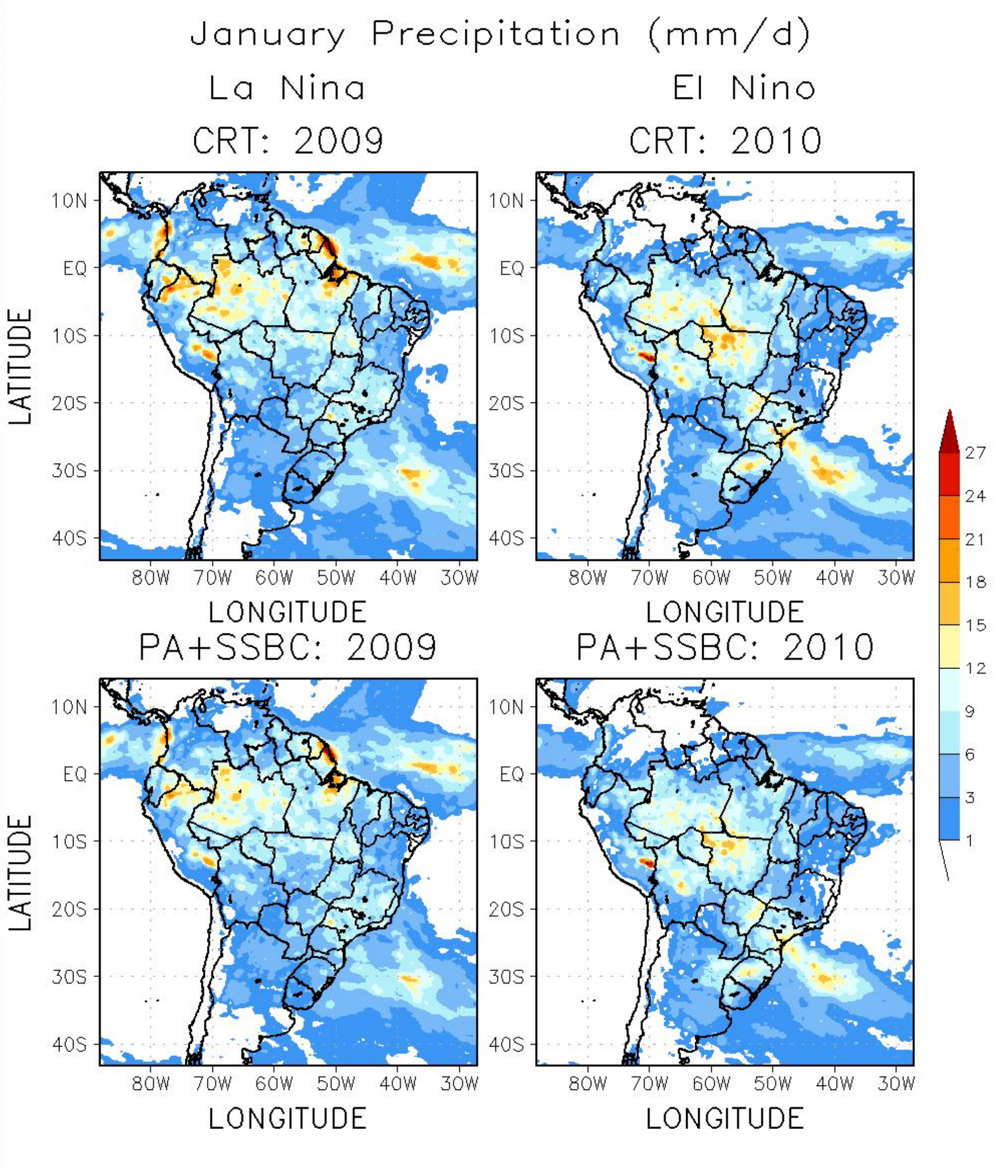


It might be associated with SALLJ.

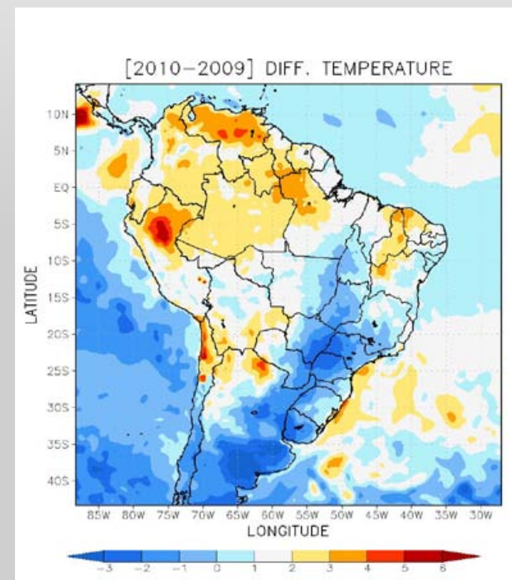
Global Reanalysis	Res.	Description	Reference
NCEP-DOE R2	~200 km	28 sigma-layers; coupled to the OSU1 LSM; R2 provides 6-hly boundary conditions to the RSM experiments.	Kanamitsu *et al.* 2002
NCEP Climate Forecast System Reanalysis (CFSR)	~38 km	64 layers; 4-layer Noah LSM; coupled to ocean.	Saha *et al.* 2010
Satellite-based Products	**Res.**	**Description**	**Reference**
CMAP	2.5°	Standard version (satellite and gauge), monthly means of precipitation	Xie and Arkin 1997
1DD-GPCP	1°	One-degree daily precipitation from version 1.1	Huffman *et al.* 2001
CMORPH (RAW/CRT)	25 km	From satellite; 3-hly precipitation assimilated by RSM/Gauge-corrected	Joyce *et al.* 2004
Station dataset	**Res.**	**Description**	**Reference**
GTS	0.5°	Daily precipitation analyses from global gauges	WMO
GPCC V6.0	0.5°	Monthly land-surface precipitation from gauges built on GTS-based and historic data	Schneider *et al.* 2011



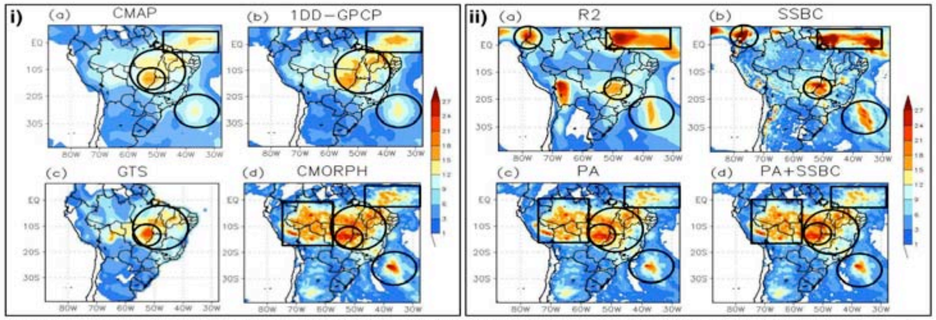
Comparisons with station data from Brando *et al.*, PNAS 2010.



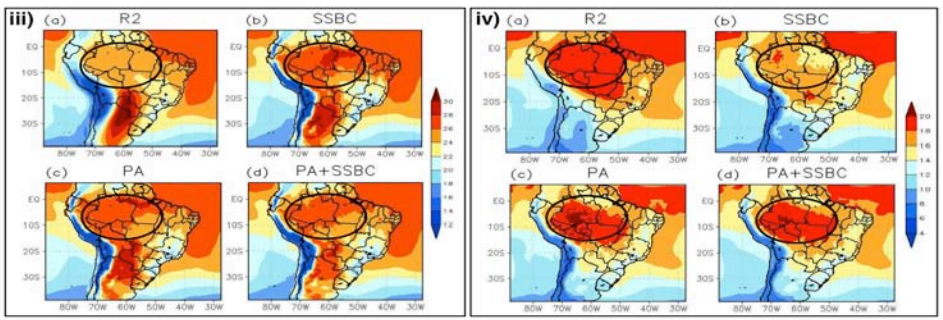
Dynamical downscaling assimilating satellite-based data (CMORPH_CRT) into a numerical modeling system (RSM+PA+SSBC).



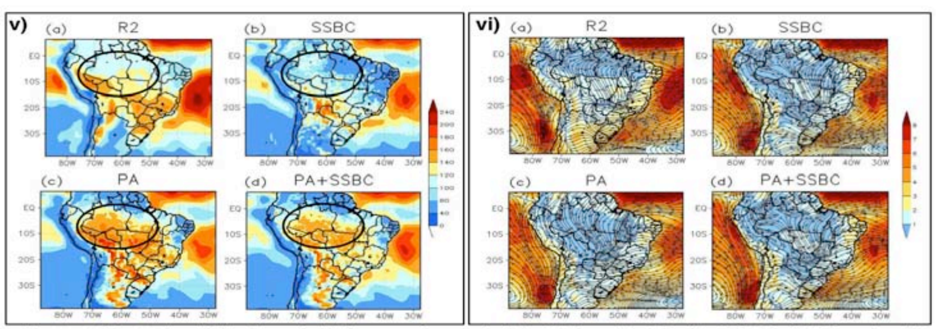
Neutral Conditions: 2004



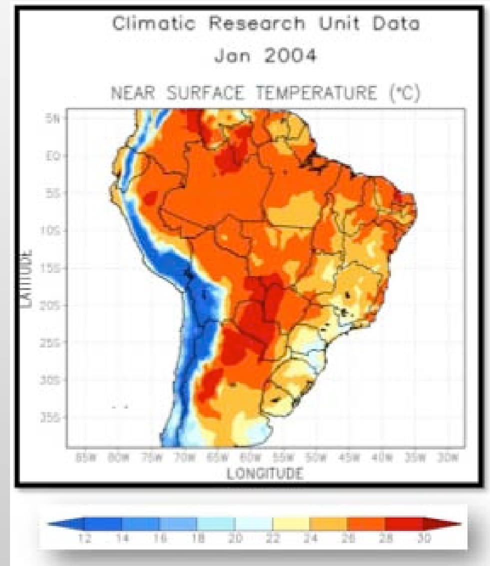
i) Precipitation analysis (mm/day) for: (a) CMAP; (b) 1DD-GPCP; (c) GTS; CMORPH V1.0; and
ii) Precipitation (mm/day) for: (a) R2; (b) SSBC; (c) PA only; PA+SSBC. Displayed: January 2004.



iii) Near-surface temperature (°C) and iv) Near-surface specific humidity (g/kg) for: (a) R2; (b) SSBC; (c) PA only; PA+SSBC. Displayed: January 2004.



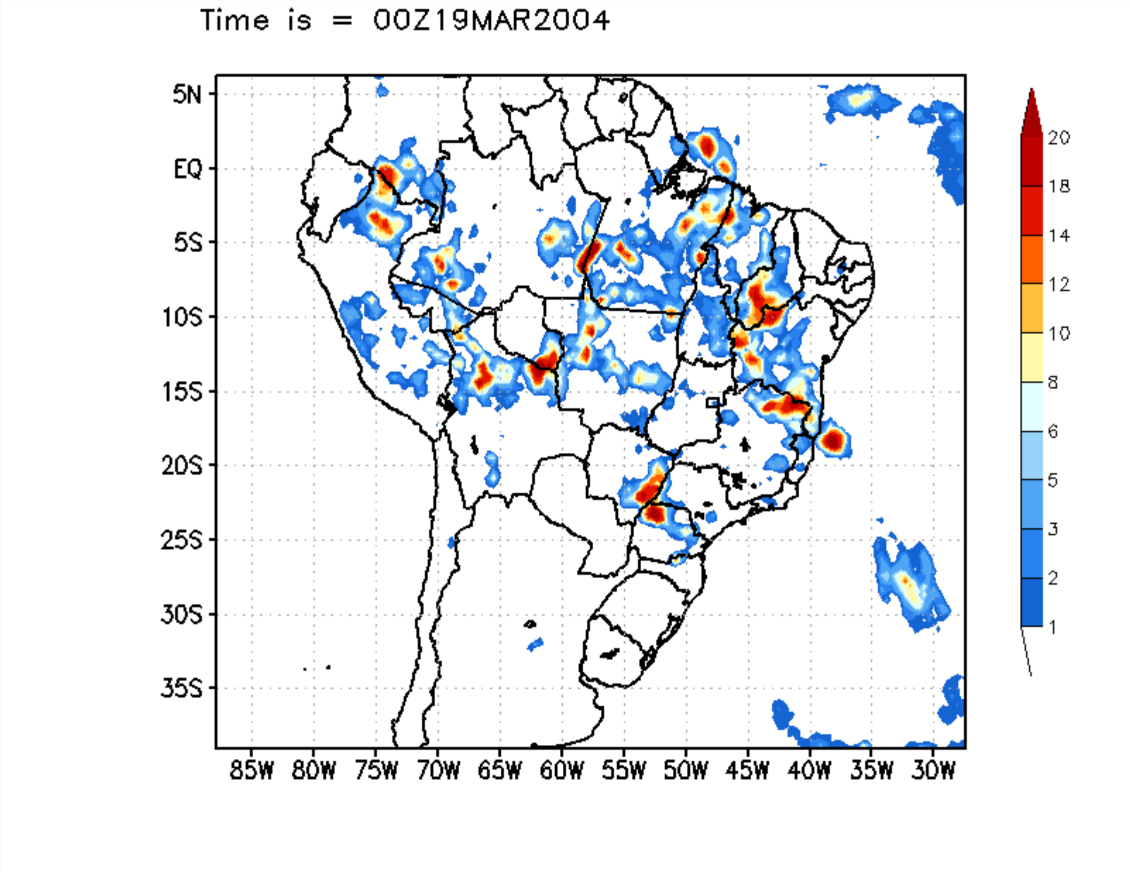
v) Latent Heat Flux (W/m²) and vi) Near-surface wind (m/s) for: (a) R2; (b) SSBC; (c) PA only; (d) PA+SSBC. Displayed: January 2004.



Poster WE10

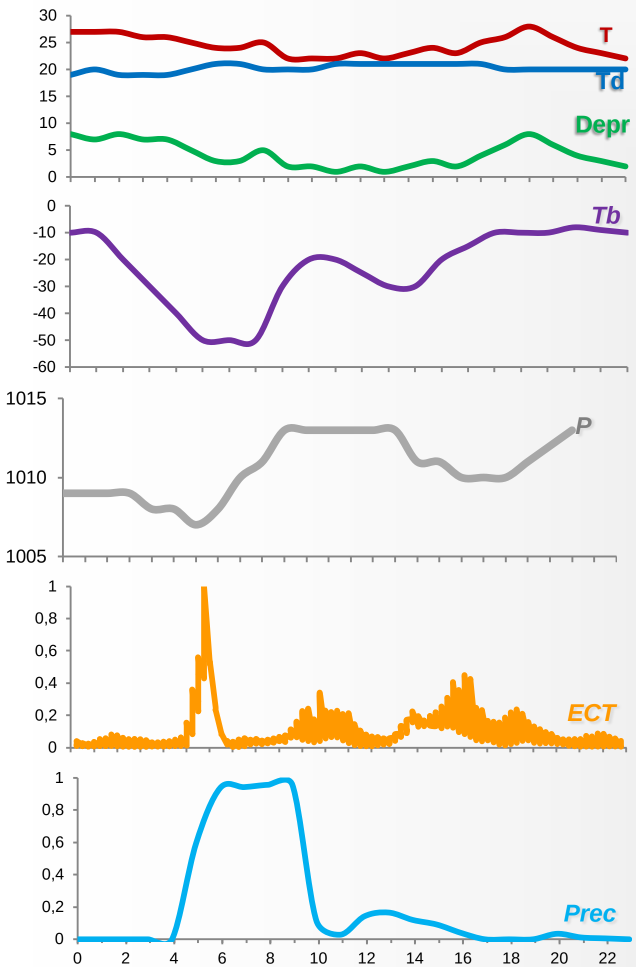
Extreme Event: Catarina, March 2004 Precipitation (mm/3hr)

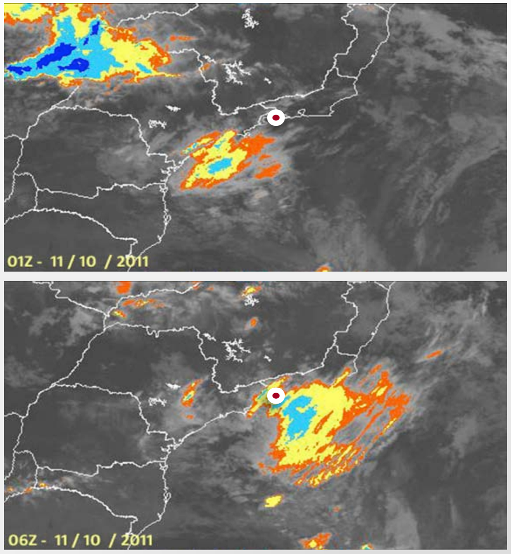
Regional Spectral Model (RSM) ~ 40 km



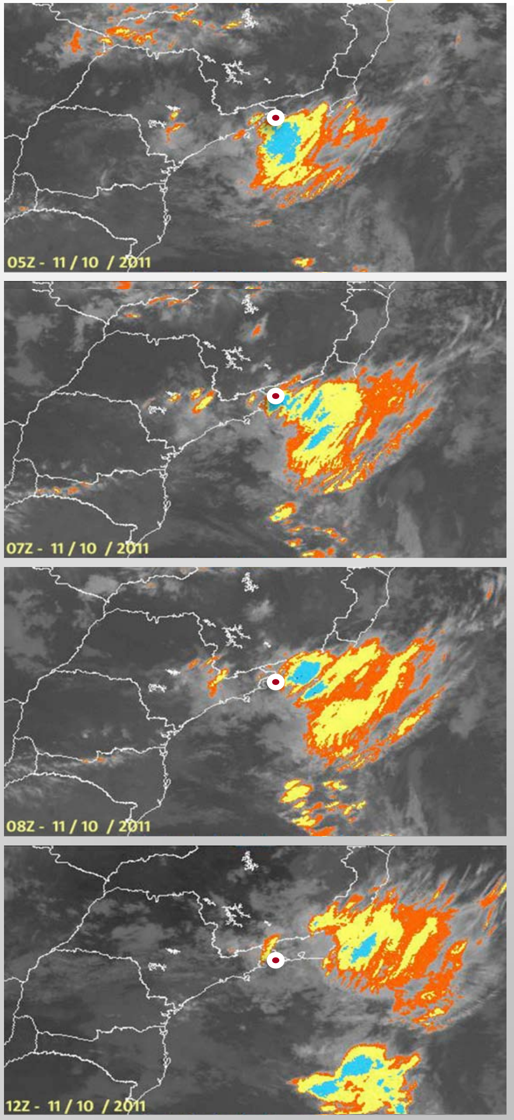
Modified Scale-Selective Bias Correction (Kanamitsu et al., JGR 2010) & Precipitation Assimilation (PA; Nunes and Roads, JHM 2007)

Severe Weather Event : Oct. 11th, 2011





Adaptive modeling based on neural network methodology for the nowcasting of severe weather events.



HYBRID PROFESSIONALS???

Meteorologist?

Geologist?

Geographer?

???????

Concluding Remarks

All proposed modeling experiments, as well as essential datasets, will be used in the refinement of the modeling systems, providing better predictions and projections to model areas susceptible to landslides.

This combined modeling effort will also contribute to the understanding of regional climate variability and change; and will support better mitigation and adaptation decisions at local scales.

An interdisciplinary approach will emerge together with new research initiatives and trained specialists.

Acknowledgments

- CMAP data were provided by the NOAA Office of Oceanic and Atmospheric Research Earth System Research Laboratory Physical Sciences Division at: *http://www.esrl.noaa.gov/psd/*;
- 1DD data were provided by the NASA/Goddard Space Flight Center's Laboratory for Atmospheres, which develops and computes the 1DD as a contribution to the Global Precipitation Climatology Project (GPCP) - GEWEX;

- NOAA/NCEP/National Weather Service provided the R2 and CFSR data sets;
- MERRA data sets were obtained from the Modeling and Assimilation Data and Information Services Center (MDISC), managed by the NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC).

We thank to all those who contributed to make the “**S**istema de **An**álise de **D**esastres e **R**iscos **A**mbientais”

(**SAnDRA**) project possible.

PILOT AREA

The State of Rio de Janeiro's mountain region (slopes) and surroundings.