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SRG / NOAA
Introduction

A rapid extremely dry-to-extremely wet atmospheric pattern transition occurred in the Sao Paulo region during March 2015.

This work explores the global local patterns associated with extremely dry and extremely wet conditions in Sao Paulo using 2014-2015 reanalysis data.

It further elaborates on the extremely dry-to-extremely wet transition that occurred in February-March 2015, and looks into two specific heavy rainfall events in the region using GFS model data and observations.

The analysis was greatly enhanced by techniques learned during the International Desk training.
1. Introduction

GEOGRAPHY - LOCATION

Population

Social aspects

Cantareira reservoir supplies

~ 50% of water to population

Grafico do volume

Sabesp
Main reservoir < 10% capacity

Affects 10 million people

\[
\text{Índice 1} = \frac{\text{Volume armazenado}}{\text{Volume útil}} \times 100 = 19.7\%
\]
\[
\text{Índice 2} = \frac{\text{Volume armazenado}}{\text{Volume total}} \times 100 = 15.3\%
\]
\[
\text{Índice 3} = \frac{\text{Volume armazenado} - \text{Volume reserva técnica}}{\text{Volume útil}} \times 100 = -9.6\%
\]
Tools and Methods

• rainfall observations from INMET – conventional/automatic stations

• reanalysis data: winds, sst, pressure/geopotential data, composites
analysis of two cases

• Infrared satellite images

--Wingridds software for analyses and identification of some meteorological
predictor fields

-MJO index analysis:
Source (CPC)

- Wavelet analysis=> evolution of the amplitude and frequency of velocity
potential (large scale convection associated with MJO)
evolution of the amplitude and frequency of 500 hPa geopotential
Monthly Rainfall Anomalies (mm) - Rainy Seasons (JFM) of 2014 and 2015

Jan 2014
Feb 2014
Mar 2014
Jan 2015
Feb 2015
Mar 2015
## INMET MARCH MONTHLY RAINFALL RECORDS

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<th>Rank</th>
<th>Year</th>
<th>Precipitation (mm)</th>
<th>statistics</th>
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| 1    | 2006 | 607,9*             | average: 186 mm  
       |      |                    | Standard deviation: 95 mm  
       |      |                    | Mediana: 171 mm  
       |      |                    | highets: 607,9* mm (2006)  
       |      |                    | lowest: 38,5 mm (1975) |
| 2    | 1991 | 451,3              |            |
| 3    | 1996 | 396,8              |            |
| 4    | 2015 | 332,7              |            |
| 5    | 2002 | 326,5              |            |
Associated atmospheric and SSTs patterns

SSTs patterns (2014 and 2015) anomalies

FEB/MAR 2014

FEB/MAR 2015
SSTs and OLR patterns (2015 MINUS 2014)

SST dif
NINO 3.4 warming

OLR dif
MORE CONVECTION

Yellow (convection) blue (supressed)
DIFERENÇAS IN UPPER CIRCULATION (2015 minus 2014)
MJO OSCILLATION ACTIVATES BY THE END OF 2014

Data updated through 19 May 2015

Velocity potential – OMJ index
WAVELET ANALYSIS

(a) 

(b) 

MADDEN-JULIAN OSCILLATION INDEX 40W

Value


Parte real dos coeficientes da Ondelota

frequency

30 days

18 days

45 days

scale average 15-30 and 30-60 days

Average variance

CASE STUDIES

FIRST RAINFALL EVENTS AFTER THE DROUGHT
FIRST RAINFALL EVENTS AFTER THE DROUGHT

feb/15-19

SP

5 days rainfall (in mm)

mar/06-10

SP
Case 1: 85,3 mm at 02/16
Case 2: 69,2 mm at 03/07 and 77mm at 03/08

climatological precipitation of february: 235mm
climatological precipitation of march: 186mm
February 16 Wet event

INMETs Automatic weather station data

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- Dew points around 19ºC
- 52mm in 1hour
Case 1: 02/16 event
Analysis of predictors

Infrared satellite image convection pattern
Case 1: 02/16 event
Analysis of predictors  dynamics / Instability
Case 1: 02/16 event
Analysis of predictors Flux of moisture

Low level (975 - 850 hPa)
Flux of moisture= yellow lines
Magnitude of moisture flux= blue

SP
Case 1: 02/16 event
Analysis of predictors
Flux of moisture

Flux of moisture = yellow lines
Magnitude of moisture flux = blue

medium level (700 - 500 hPa)
Case 1: 02/16 event
Analysis of predictors Time section at SP station

Vertical velocity (blue)
Vorticity (yellow)
Relative humidity (purple)
INMETS Automatic weather station data 03/07 and 03/08

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Dew points around 19°C

60mm/2h
Case 1: 03/08 event
Analysis of predictors

Infrared satellite image convection pattern 14h-23hutc
Case 1: 03/08 event
Analysis of predictors

Infrared satellite image convection pattern 20h-02h utc

15/03/08
Case 2: 03/08 event
Analysis of predictors dynamics / Instability

GDI index = dashed; Low layer winds = black
High level winds = white
Divergence = dotted
Case 2: 03/08 event
Analysis of predictors **Flux of moisture**

**Low level (975 - 850 hPa)**
- Flux of moisture = yellow lines
- Magnitude of moisture flux = blue
Case 2: 03/08 event
Analysis of predictors **Flux of moisture**

Low level (975 - 850 hPa)
Flux of moisture = yellow lines
Magnitude of moisture flux = blue
Case 2: 03/08 event
Analysis of predictors Time section at SP station

Vertical velocity (blue)
Vorticity (yellow)
Relative humidity (purple)
CONCLUSIONS / SUMMARY

Synoptic systems structure:
- Subtropical upper level High displaced to the west and a Amplifying mid level trof/ low enhances / creates a large difluence/ divergence zone
- Broad confluence area: Low pressure close to the coast (a low with Subtropical characteristics developing over the Atlantic Coast and other low pressure in the continent). Combination or balance of flux of moisture advection from the Atlantic Ocean - southeast wind- and from the south Amazon basin –northwest wind
- Isentropic ascent just north of the station

• Predictors:
  - High dew points (close to the 19ºC)
  - Vorticity and vertical velocity appears ~ between low and medium level
  - High content of moisture (relative humidity almost saturated)
  - Gradient of flux of moisture detected in medium level
  - High values of GDI index

• Teleconnections
  • Warming of 3.4/4 Niño => Wawe train from the Pacific
    Slightly cold SST in niño 1.2