SUBTROPICAL CYCLONE OVER THE SOUTH ATLANTIC

Lívia Dutra, Rosmeri Porfírio da Rocha, Ricardo de Camargo and Jean Peres
University of São Paulo, Brazil
Institute of Astronomy, Geophysics and Atmospheric Sciences
Department of Atmospheric Sciences

Introduction

→ In the first week of March 2010, a surface cyclone developed on the eastern coast of Brazil (at ~ 19ºS). This system was named *Anita* and was responsible for intense rain and strong winds that affected some coastal regions of Brazil. The Anita system showed an anomalous movement to the southwest, reaching the vicinity of the southern coast of Brazil at March 9, where it merged with another cyclonic system and started to move to the southeast. Initially, the Anita cyclone had subtropical characteristics (Guishard, 2006) and later underwent extratropical transition.

Objectives

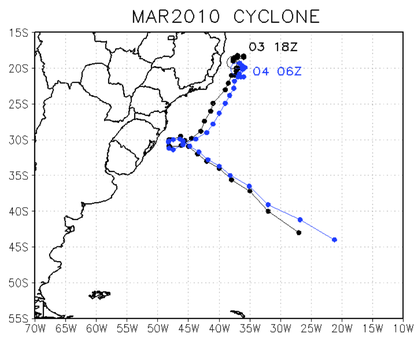
→ Investigate the synoptic, dynamic and thermodynamic processes related to this cyclonic disturbance.

Data resources

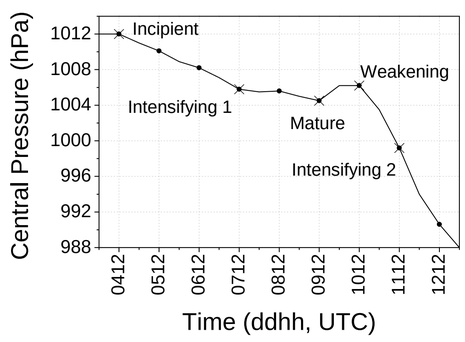
→ NCEP FNL (final) Operational Model Global Tropospheric Analyses;

→ NCEP/NCAR Reanalysis 1.

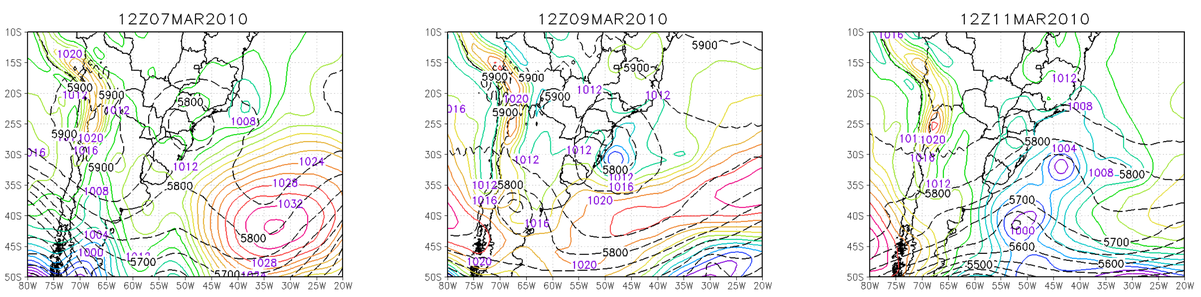
Synoptic Analysis



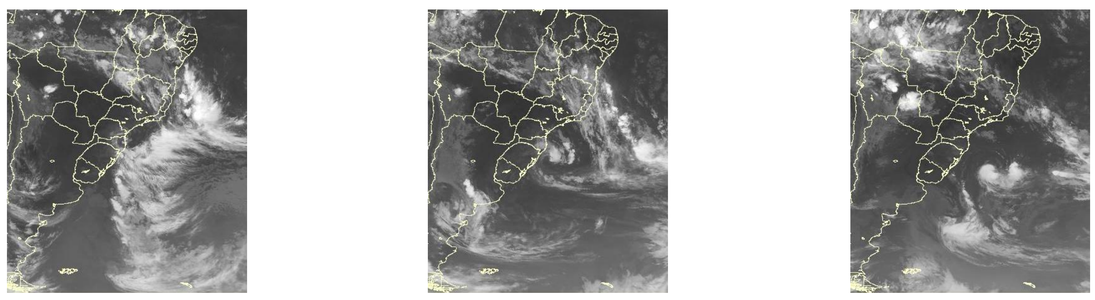
→ Surface cyclone trajectory as obtained by the visual inspection of the MSLP (black) and by the vorticity tracking algorithm (blue; Reboita et al., 2010).



→ 5 different stages of Anita´s life cycle were selected.



→ MSLP (hPa, colored lines) and 500hPa geopotential height (gpm, dashed lines).



→ GOES-12 infrared satellite imagery from INPE/CPTEC/DSA

Methods

→ Vorticity and heat budgets

$$\frac{\partial \varsigma}{\partial t} = -\vec{V}_H \cdot \vec{\nabla}_p \varsigma - \omega \frac{\partial \varsigma}{\partial p} - v\beta - (\varsigma + f)\vec{\nabla}_p \cdot \vec{V}_H + \frac{\partial \omega}{\partial y}\frac{\partial u}{\partial p} - \frac{\partial \omega}{\partial x}\frac{\partial v}{\partial p} + residue \quad (1)$$

$$\frac{\partial T}{\partial t} = -\vec{V}_H \cdot \vec{\nabla}_p T \underbrace{- \omega \frac{\partial T}{\partial p} + \omega \frac{RT}{c_p p}}_{Sw} + residue \quad (2)$$

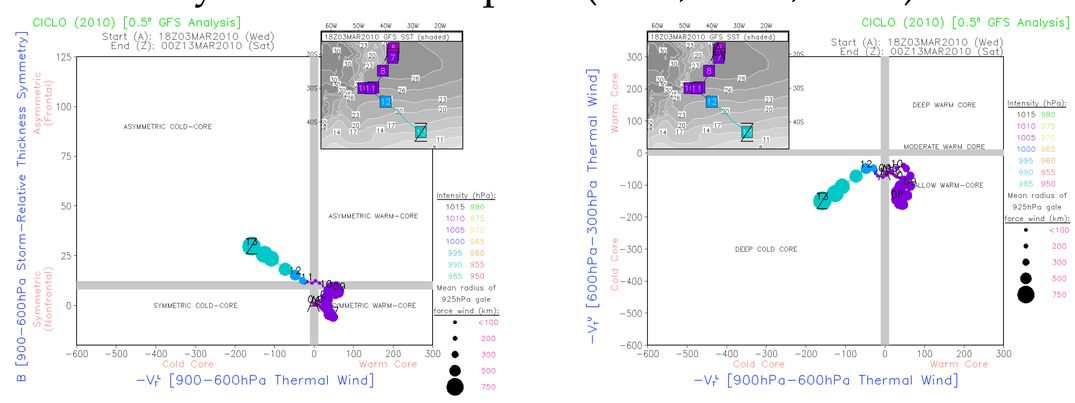
→ Quasi-lagrangian description

✓ equations terms were averaged over a 10º radial column centered on the surface low

→ Spatial distribution of the terms in different pressure levels

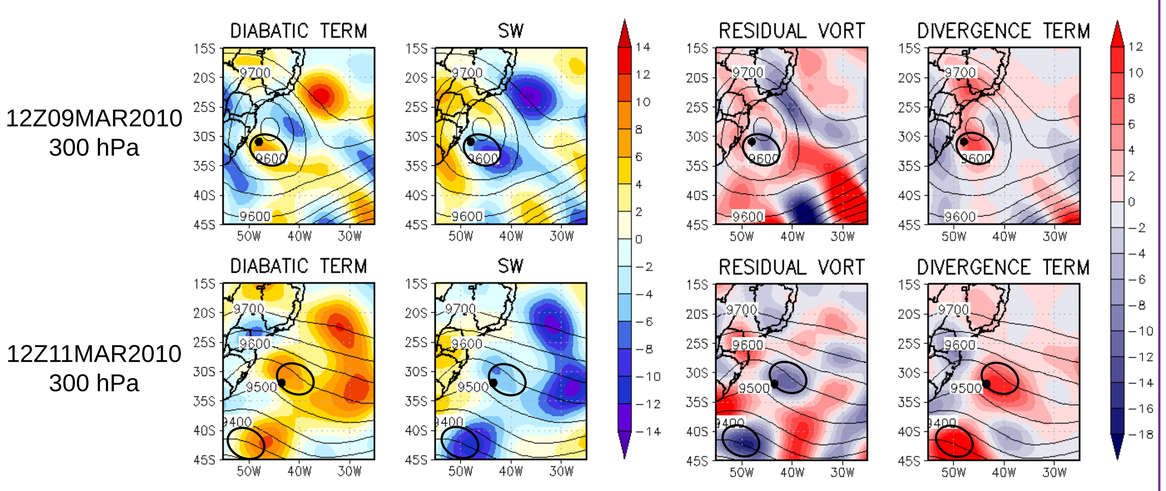
✓ 925, 500 and 300 hPa

Cyclone Phase Space (CPS; Hart, 2003)



→ Up to 00Z11MAR: hybrid structure, followed by an extratropical transition.

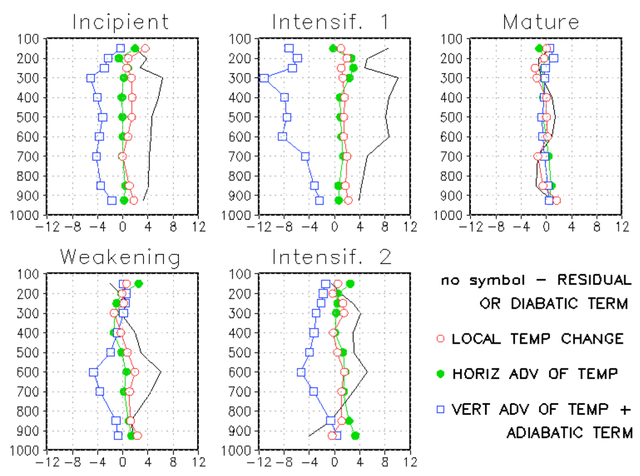
Spatial distribution of the vorticity and heat budget terms



Some regions in the upper troposphere: the convective processes could explain the observed vorticity imbalances.

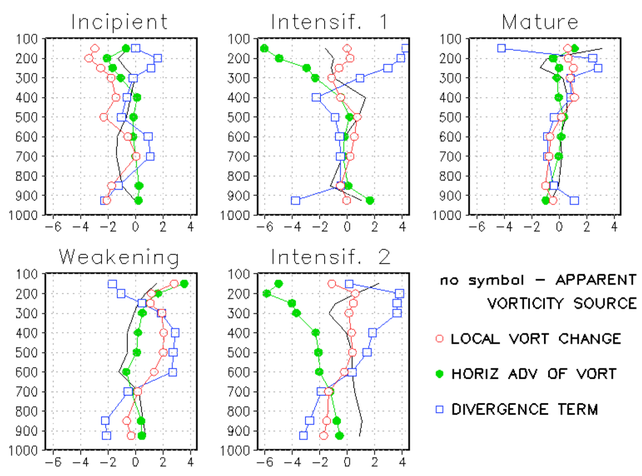
Other regions and levels: it is suggested that convection influences the local variations of vorticity in a more distributed way in the atmospheric column

Quasi-lagrangian description



→ In the middle and upper troposphere, the diabatic term counterbalances the temperature changes caused by Sw;

→ The process mentioned above is not verified at low levels.



→ Maximum horizontal advection of cyclonic vorticity at higher levels;

→ Lowest values of the terms in the mature stage throughout the troposphere.

References

GUISHARD, M. P., 2006: Atlantic Subtropical Storms: Climatology and Characteristics. Dept. of Meteorology. PhD Thesis, Penn. State Univ., State College, PA, 158pp.

HART, R. E., 2003: A cyclone phase space derived from thermal wind and thermal asymmetry. Mon. Wea. Rev., 131, 585-616.

REBOITA, M. S.; da ROCHA, R. P.; AMBRIZZI, T.; SUGAHARA, S., 2010: South Atlantic Ocean Cyclogenesis Climatology Simulated by Regional Climate Model (RegCM3). Climate Dynamics, 10.1007/s00382-009-0668-7.

Acknowledgments

→ The authors would like to thank CAPES, FAPESP, WCRP and USP Graduate Studies financial assistance.