CPTEC
Centro de Previsão de Tempo e Estudos Climáticos

MINISTÉRIO DA CIÊNCIA E TECNOLOGIA
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Energetic of South America Low Level Jets

Sergio Henrique S. Ferreira

Manoel Alonso Gan

Dirceu Luis Herdies

WWW.CPTEC.INPE.BR

Introdution

➢**SALLJ main Region and characteristic:**

The wind at the Andes Oriental border has a maximum velocity at 900-850 hPa. Mean velocity is around 9m/s, but maximum velocity can be reach more than 20 m/s.

➢**There are many proposed theories to explain the LLJ mechanism Examples:**

a) Inertial oscillation due to frictional decoupling at night;

b) Baroclinicity produced by the inclined boundary layer over the slope terrain

c) Large scale baroclinicity, interaction with upper-level jets

➢ **The objective of this work is use the Energetic Analysis to study the formation, intensification and dissipation of LLJ events.**

The reanalysis Data

- **A reanalysis field from National Center for Environment Prediction (NCEP) with inclusion of South American Low Level Jets Experiment (SALLJEX-2003)**

RGDAS: resolution ~100 km

Obs.: Quality of this reanalysis were studied by Herdies et al. (2007). The estimation of Low Level Jets was better with inclusion of radiosonde SALLJEX data in Data Assimilation System

HERDIES, D. L.; KOUSKY, V.E.; EBISUZAKI, W. The impact of High-Resolution SALLJEX Data on Global NCEP Analyses. Journal of Climate, v.20, p.5765-5782, 2007.

The energetic formulation

- **Based in the Orlansk and Katizsfey, 1991.**

ORLASK, I.; KATZFEY, J. The Life Cycle of a Cyclone Wave in Southern Hemisphere. Journal o f The Atmospheric Sciences, v.48, p.1972-1998. 1991.

- **The kinetic energy is derived mutiplying the momentum equation by wind vector**

$$\frac{dK}{dt} = \frac{\partial K}{\partial t} + \overset{\mathrm{r}}{V}.\nabla K + \omega \frac{\partial K}{\partial P} = -\overset{\mathrm{r}}{V}\nabla\Phi + diss$$

$$K = \frac{1}{2}\left|\overset{\mathrm{r}}{V^2}\right|$$

> Than this equation is partitioned applying

$$\overset{\mathrm{r}}{V} = \overset{\mathrm{r}}{V}_m + \overset{\mathrm{r}}{V}'$$

$$\Phi = \Phi_m + \Phi'$$

The energetic formulation (continuation)

The main results is the tendency of eddy flow kinetic energy

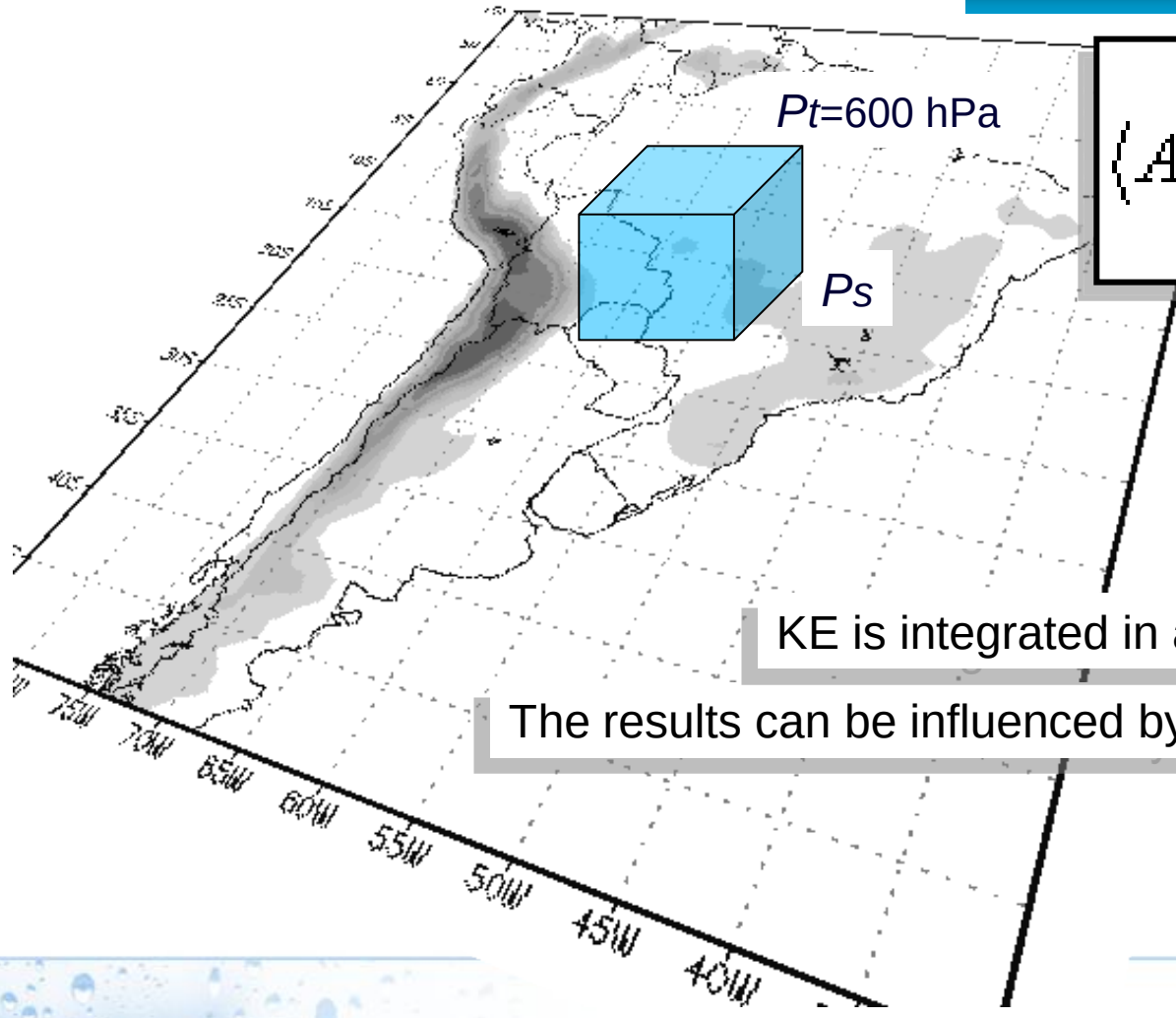
$$\frac{\partial K'}{\partial t} = \underbrace{-\nabla.\vec{V}K'}_{\mathbf{I}} \underbrace{-\nabla.\vec{V}'_a\Phi'}_{\mathbf{II}} \underbrace{-\omega'\alpha'}_{\mathbf{III}} \underbrace{-\left(\vec{V}'.\left(\vec{V}'_3.\nabla_3\right)\vec{V}_m + \vec{V}'.\left(\vec{V}'_3.\nabla_3\right)\vec{V}'\right)}_{\mathbf{IV}} \underbrace{-\frac{\partial}{\partial p}\omega K'}_{\mathbf{V}} \underbrace{-\frac{\partial}{\partial p}\omega'\Phi' + RES}_{\mathbf{VI}}$$

I	KFC	Kinetic Energy Convergence fluxes. It is responsible for displacing the energy maximum
II *	AFC	Ageostrophic Flux Convergence. represents the radiative energy transport, and is associated with the dispersive nature of the waves.
III *	BRC	Baroclinic convertion
IV *	BRT	Barotropic convertion: Represent the reynolds and mean stresses.
V	VA	Vertical advection
VI	EF	energy flux

Time evolution of Kinetic Terms

The vertical average for each KE term

$$\langle A \rangle = \frac{1}{(P_s - P_t)} \int_{Pt}^{P_s} A \, dp$$



KE is integrated in a volume for each time Step

The results can be influenced by position of integration box.

Conceptual models

Conceptual models of LLJ is important to determined the difference kind of events and choose the appropriate location for integration box

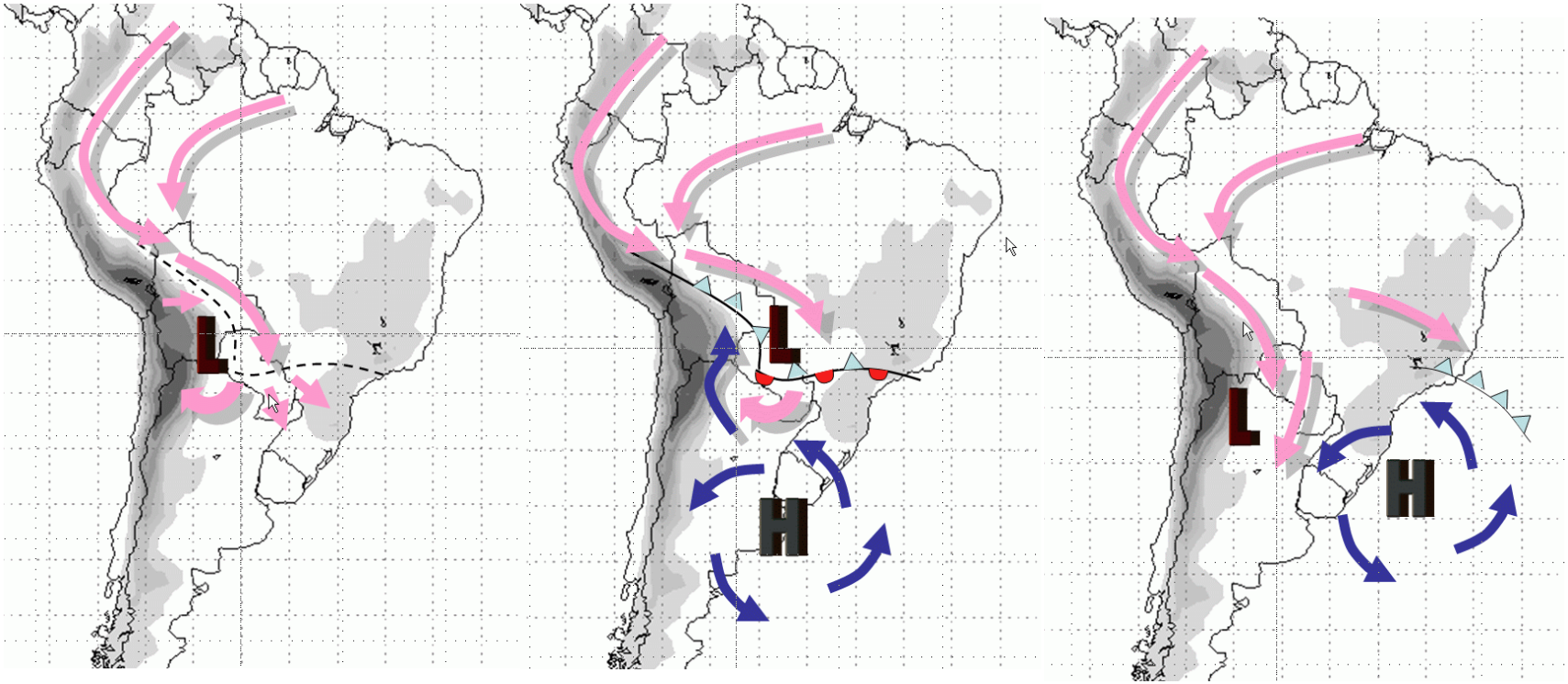
Winds, sea level pressure and geopotencial height from reanalysis fields and from observed data, including NOAA P3 airplane data, were analyzed.

We observed similarity characteristics with Hobbs at al.(1996) conceptual models for North America

HOBBS,P.V.; LOCATELLI, J.D.; MARTIN,J.E. A New Conceptual model for cyclones generated in the lee of Rocky Mountains. Bulletin of the American Meteorological Society, v.77, n.6 p.1169-1178, 1996

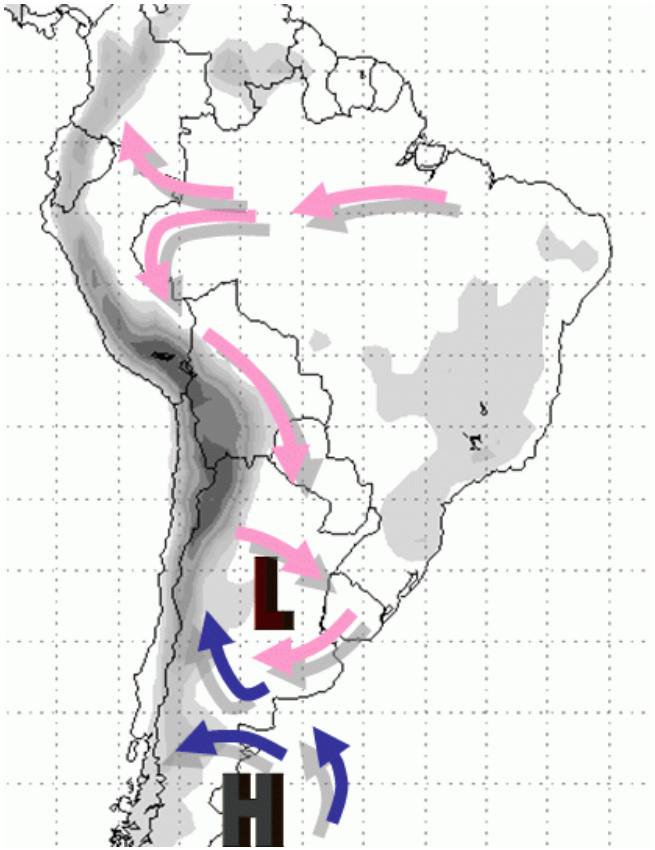
Conceptual models for type 1

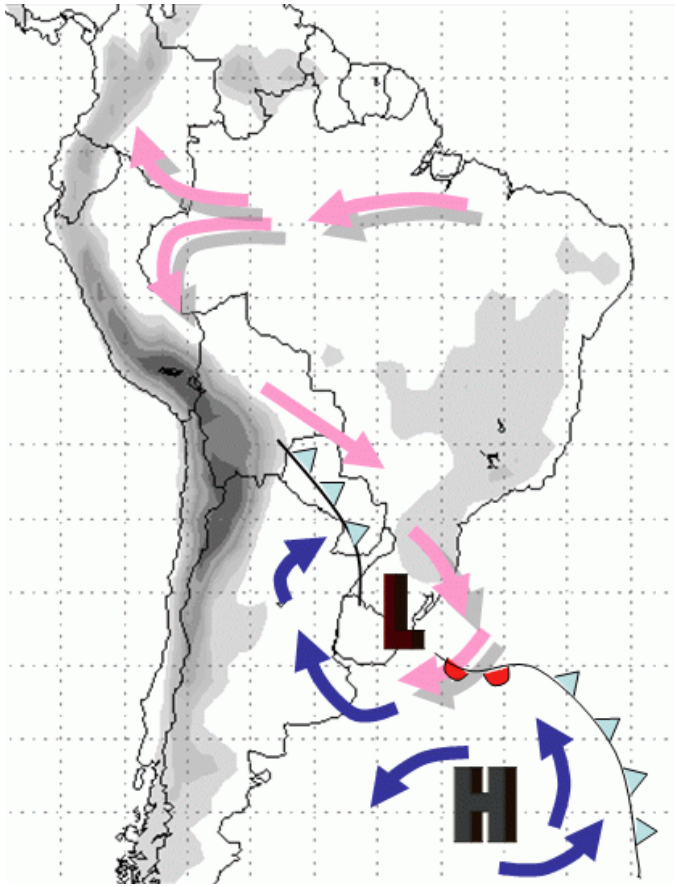
Cold anticyclonic propagates through Argentina Northeastward



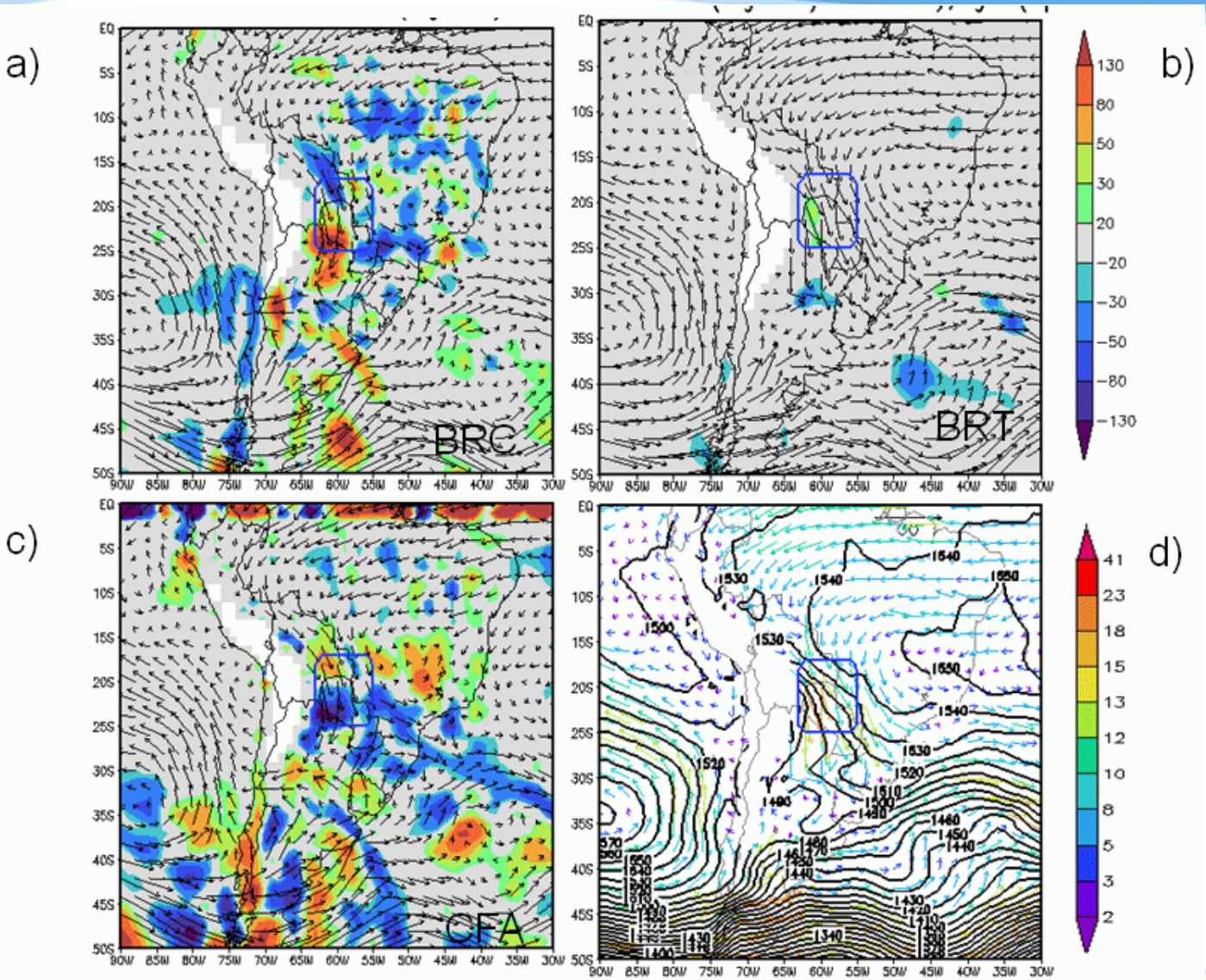
Conceptual models type 2

Cold anticyclonic propagates zonally

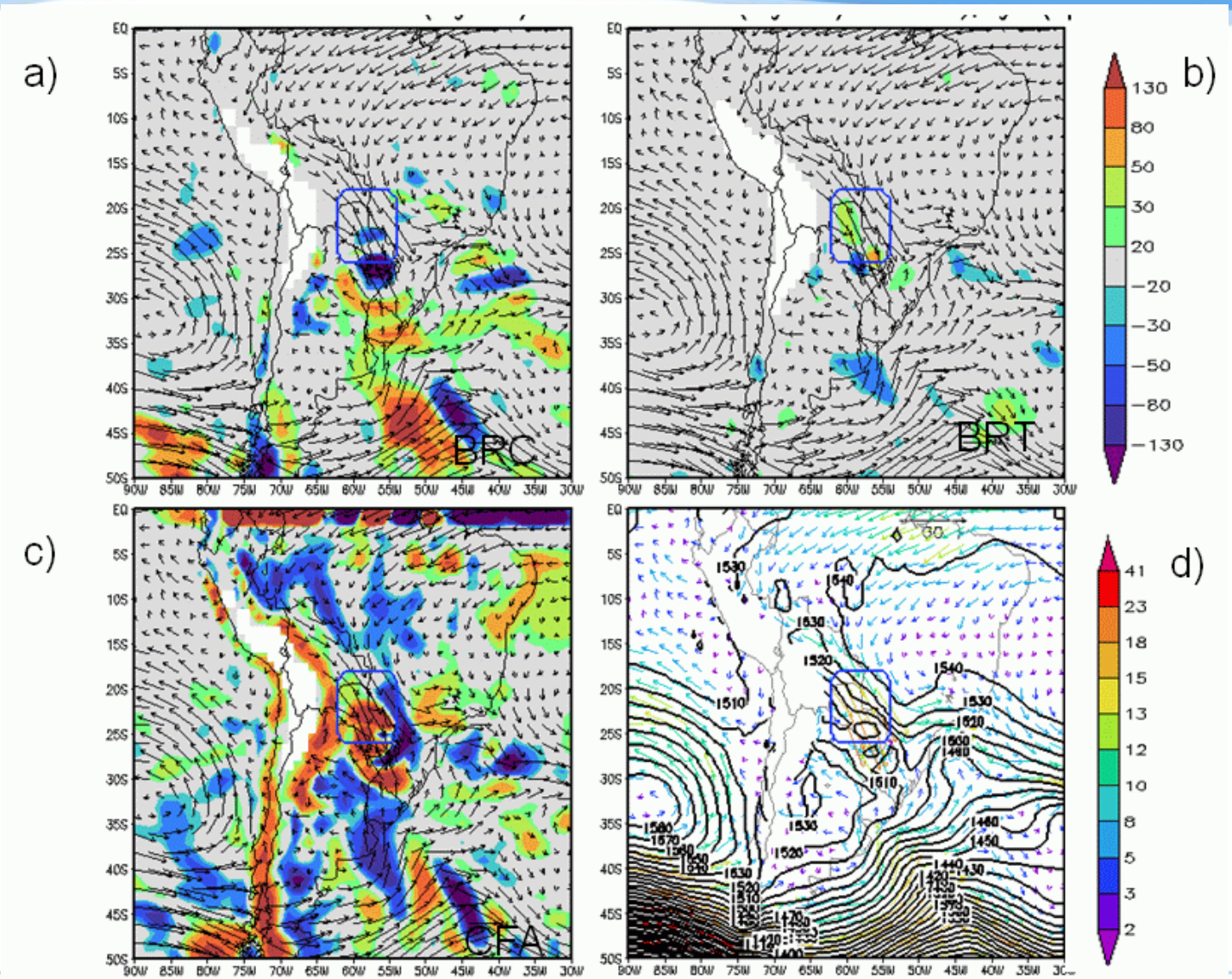




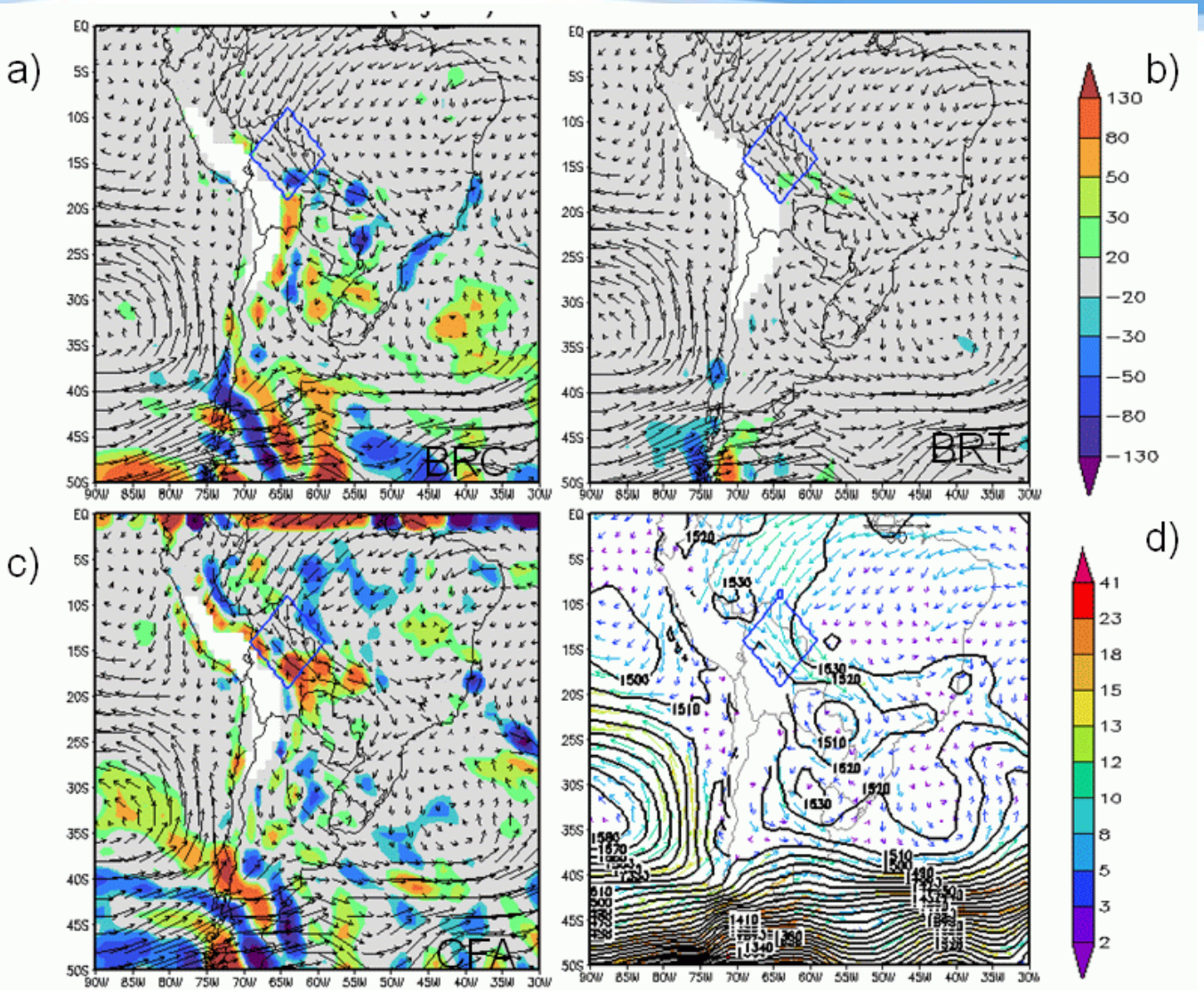
SALLJ events - type 1 2003-01-11 00Z



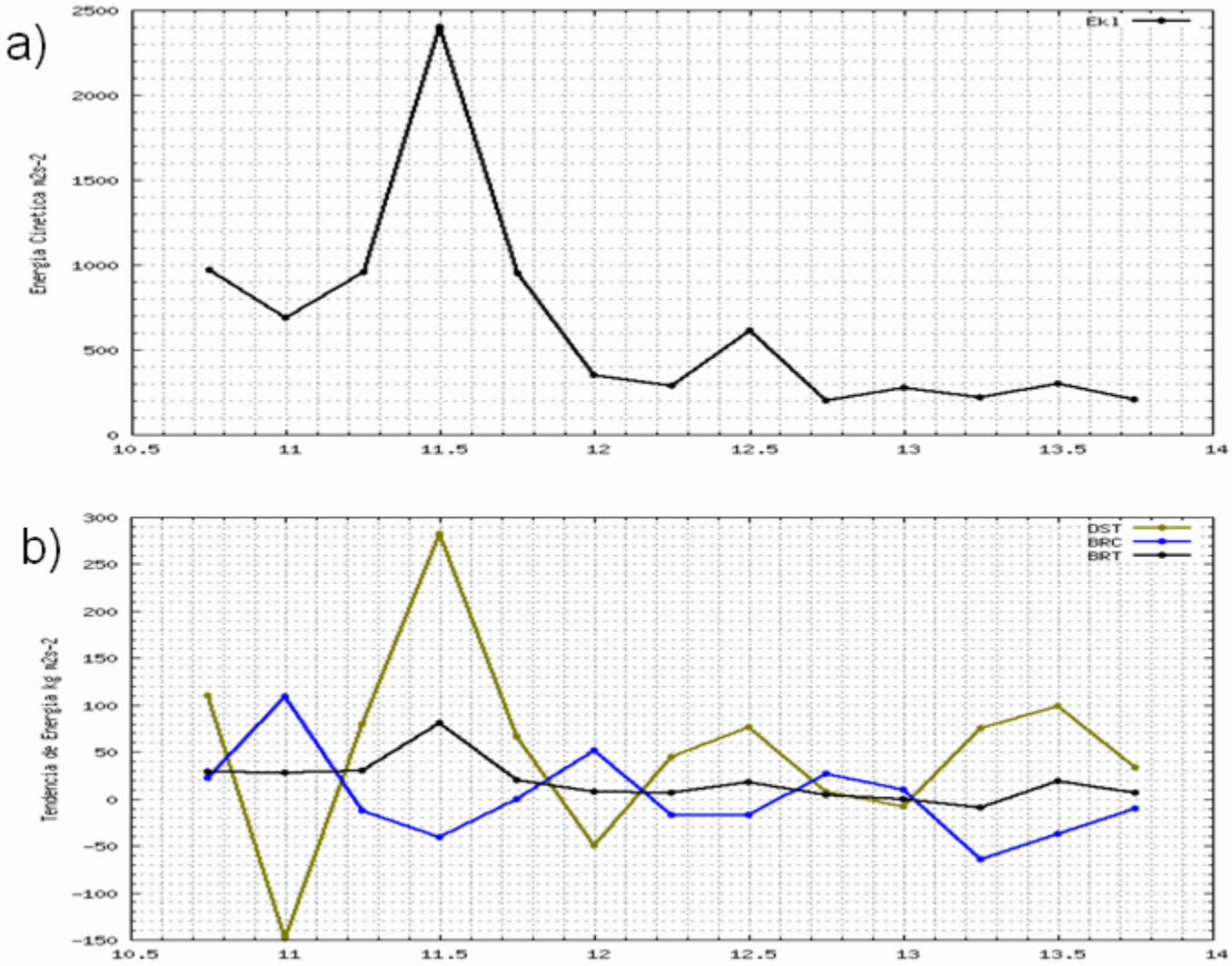
SALLJ events case type 1 2003-01-11 12Z



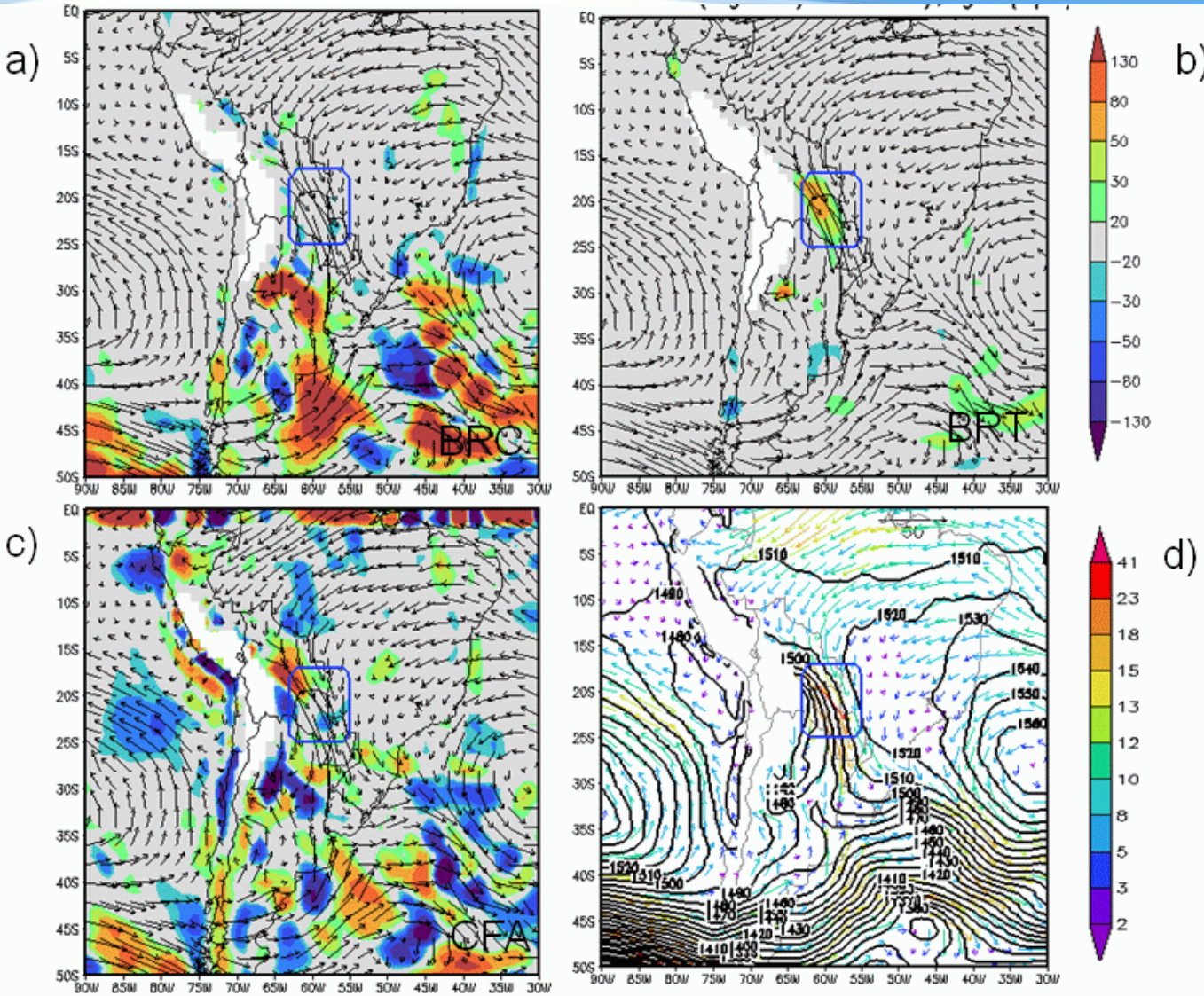
SALLJ events case type 1 2003-01-12 12Z



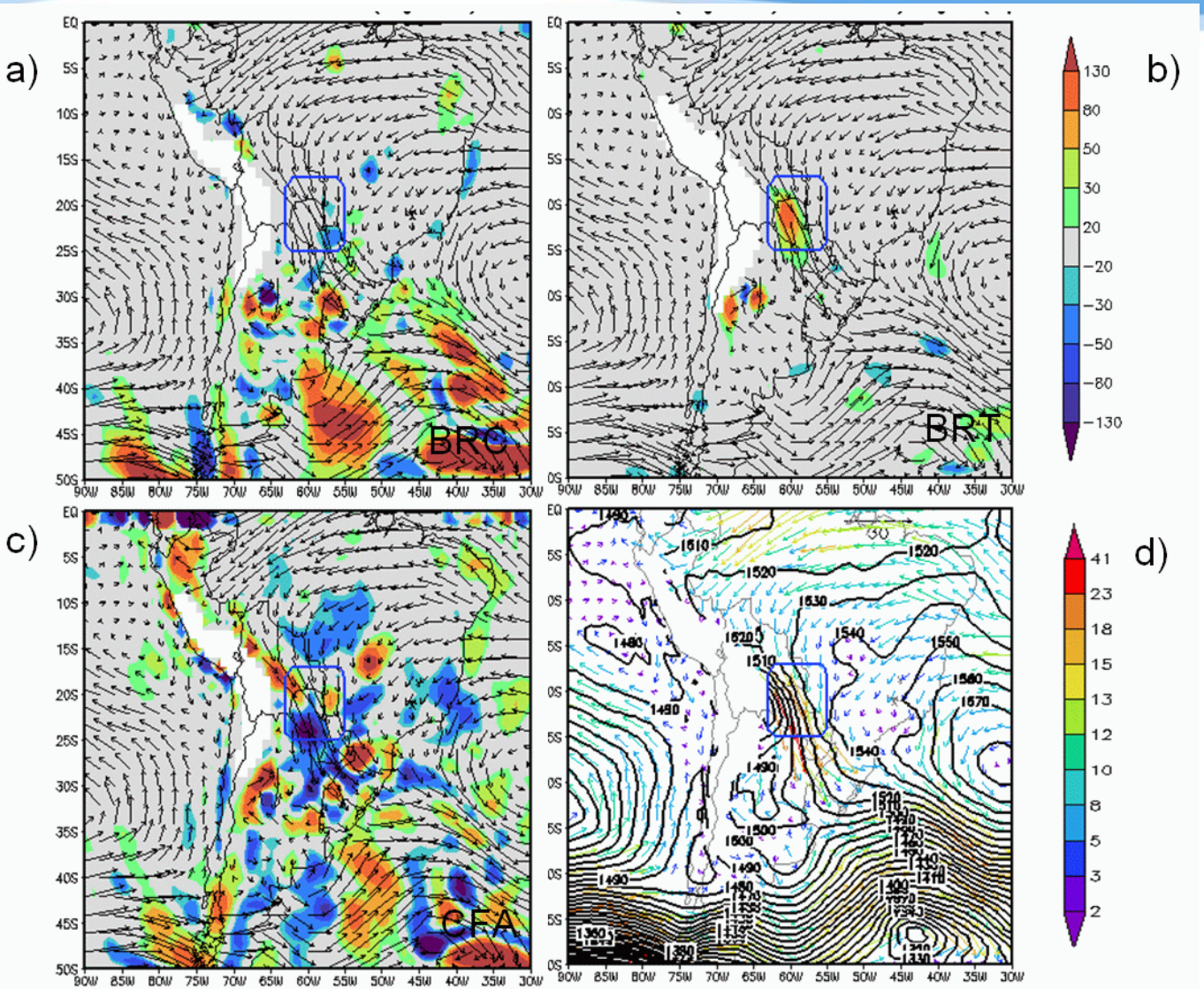
SALLJ events case type 1 from jan.10th to 14th



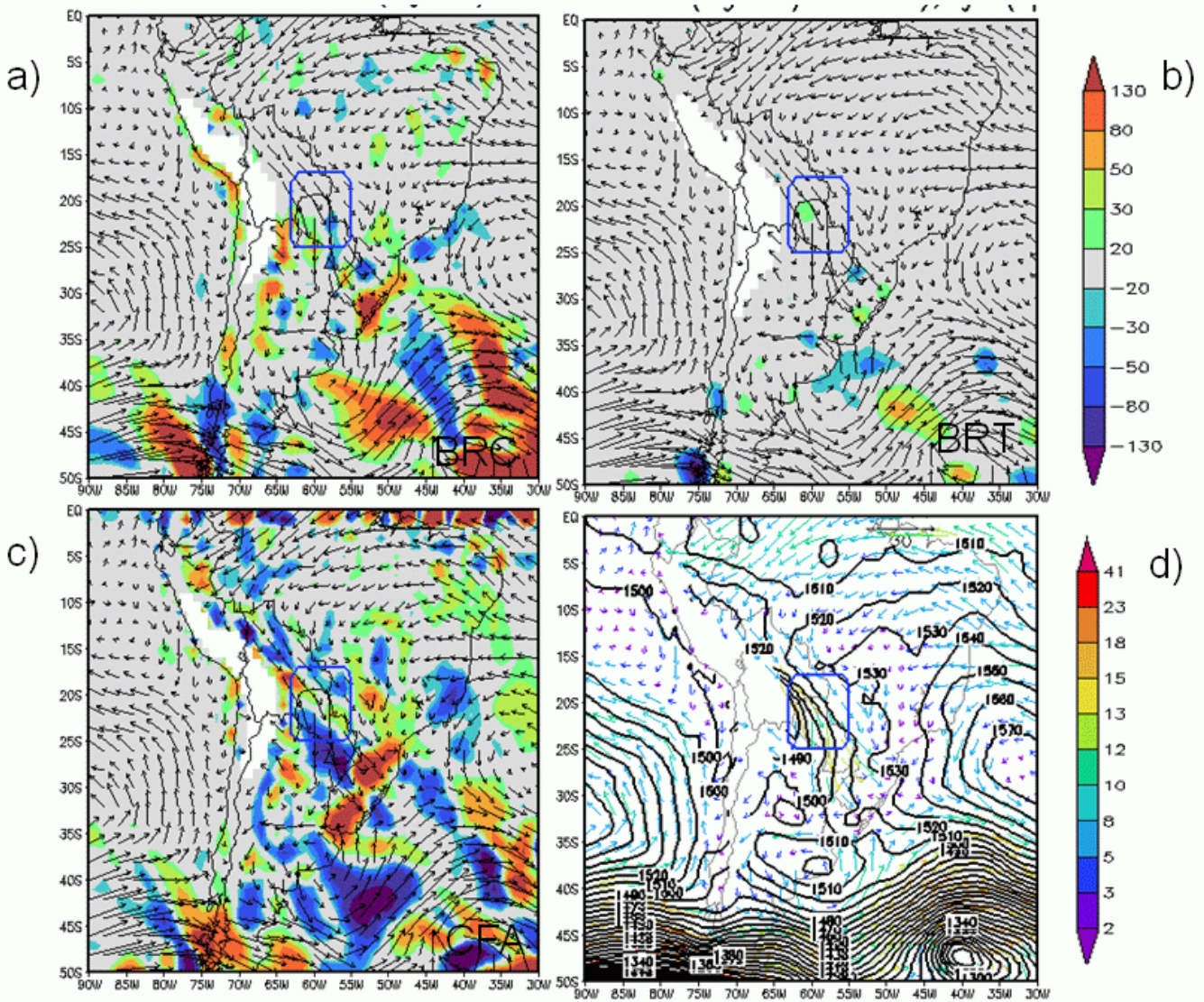
SALLJ events case type 2 2003-02-07 06Z



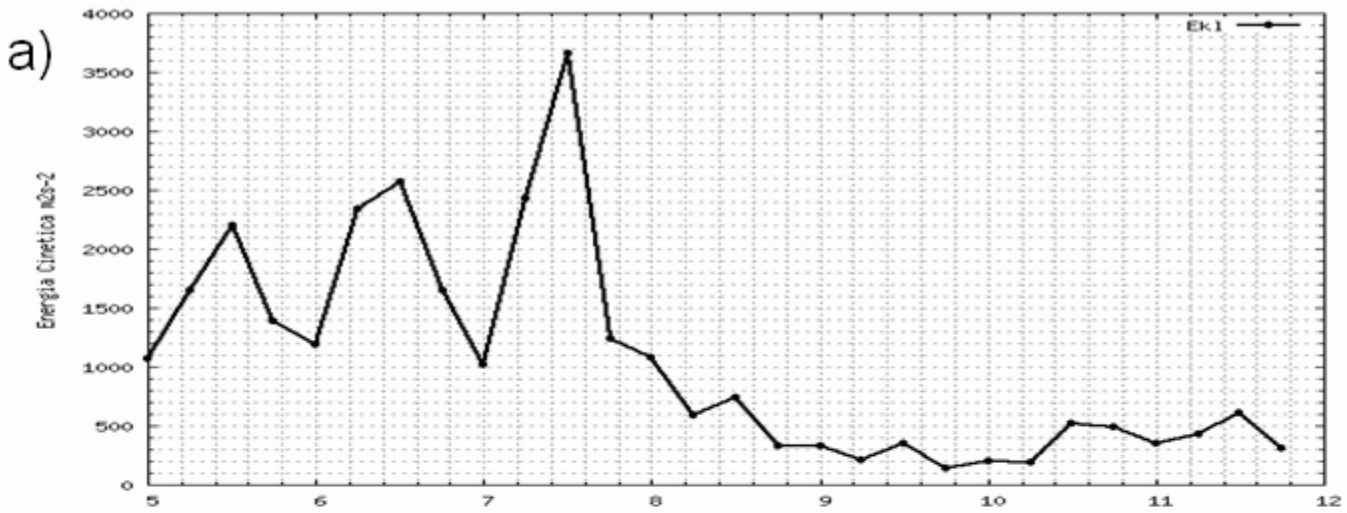
SALLJ events - type 2 2003-02-07 12Z

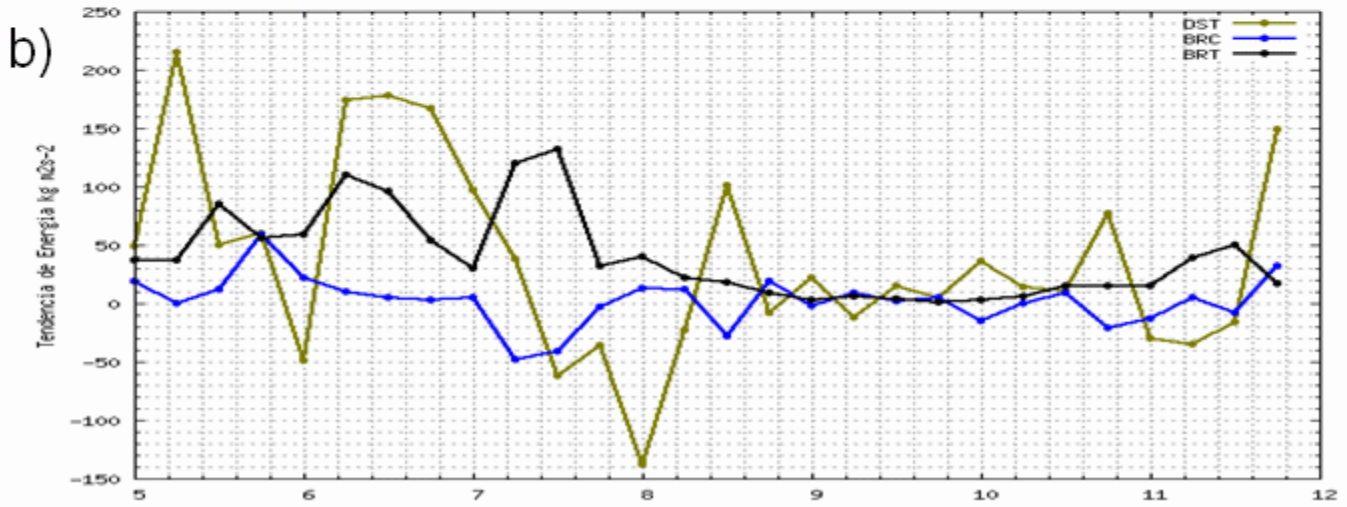


Conceptual models Case 2



Conceptual models Case 2





Conclusion

1) ACF is the most dominant term; It is modulated by agesostrophic wind diurnal oscillation, probably associated with frictional forces. It use to be negative in LLJ exit, because ageostrophic flux divergence in this area.

2) BRC -> Negative BRC conversion indicates downward warm flows at entrance of LLJ, reducing the LLJ KE.
Positive BRC conversion indicates upward warm air flows at exit of LLJ, increasing the intensity of the LLJ KE.

4) BRC and AFC has opposite contribution

5) BRT is always positive and more effective in the LLJ case 2 and it is associate with horizontal

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Thank you

sergio.ferreira@cptec.inpe.br

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