THE INFLUENCE OF THE LOCAL CIRCULATION AND INERTIAL OSCILLATION ON THE DEVELOPMENT OF THE MCSs

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1. INTRODUCTION

The rainfall regime over the Plata Basin is strongly influenced by Mesoscale Convective Systems (MCSs) that develop during night time associated with the Low Level Jet (LLJ) to the east of Andes. As they are mesoscale systems, their predictability depends on the model resolution and ability in representing the main features associated with their development. Due to the lack of observed data on these regions, the studies have focused on the synoptic scale phenomena. However the influences of local scales, such as heating, mountain-valley circulation and secondary circulations, also play an important role in the genesis of MCSs.

2. OBJECTIVES

The objective of this study is to investigate the role of local and secondary circulations and the inertial oscillation on the development of MCSs that occur to the east of the Andes Cordillera.

3. METHODOLOGY

The Eta model (nonhydrostatic version) was integrated with 10 km and 38 vertical layers using Kain-Fritsch convection scheme. The initial and lateral boundary conditions were obtained from analyses of the NCEP (~35 km and 64 vertical layers). A composite of four cases of MCSs were chosen for the experiments (fig. 1). The model was integrated 72 hours prior to each MCSs. The first 24 hours of integration were discarded to avoid the adjustment period of the model. Due of local phenomena (local circulation and inertial oscillation) are embedded in the synoptic scale, it was not possible to analyze them directly in the dynamic fields of the model. The method used for the separation of these phenomena was the method of perturbations , described below:

$$VAR'(x,y,z,t) = VAR(x,y,z,t) - \overline{VAR}(x,y,z)$$, where

$$\overline{VAR}(x,y,z) = \sum_{t=t_i}^{t=tf} \frac{VAR(x,y,z,t)}{t_f - t_i}$$, ti=25 and tf=73

VAR are the variables used (temperature, zonal and meridional wind, omega)

To better represent the local circulation, the average of pertubations was calculated for the range of latitude of 25ºS to 23ºS given by:

$$\overline{VAR}'(x,z,t) = \sum_{y=y_i}^{y=y_f} \frac{VAR'(x,y,z,t)}{y_f - y_i}$$, yi=25ºS and yf=23ºS

$$\overline{VAR_{DIA}}(x,z) = \left(\frac{\sum_{t=t_{di1}}^{t=t_{df1}} \frac{\overline{VAR}'(x,z,t)}{t_{df1}-t_{di1}} + \sum_{t=t_{di2}}^{t=t_{df2}} \frac{\overline{VAR}'(x,z,t)}{t_{df2}-t_{di2}}}{2} \right)$$

tdi=17 GMT and tdf=19 GMT (period of maximum heating)

$$\overline{VAR_{NOITE}}(x,z) = \left(\frac{\sum_{t=t_{ni1}}^{t=t_{nf1}} \frac{\overline{VAR}'(x,z,t)}{t_{nf1}-t_{ni1}} + \sum_{t=t_{ni2}}^{t=t_{nf2}} \frac{\overline{VAR}'(x,z,t)}{t_{nf2}-t_{ni2}}}{2} \right)$$

tni=06 GMT and tnf=08 GMT (period of maximum cooling)

4. RESULTS

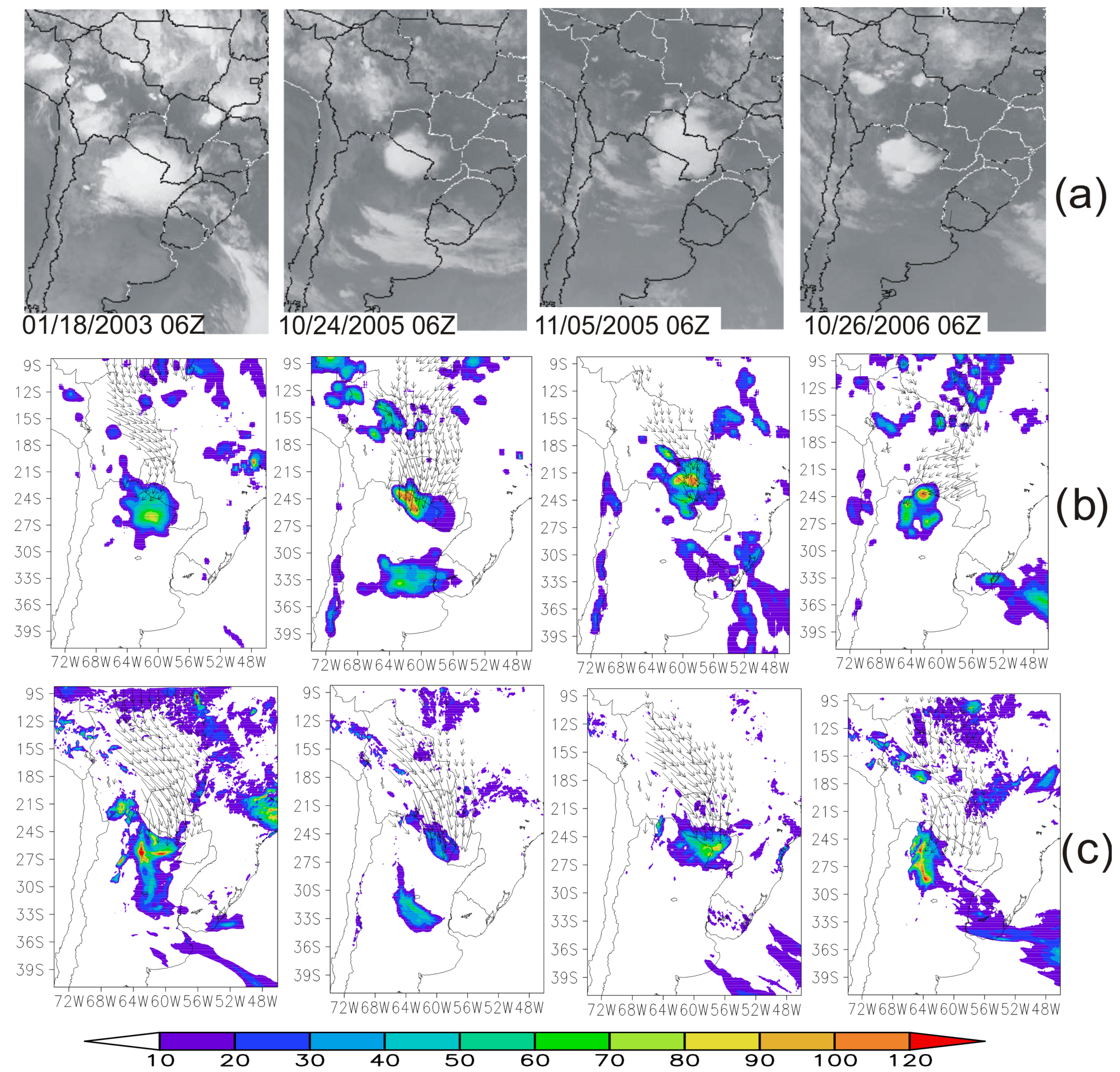

FIG.1: (a) Infrared satellite images at 06:00 GMT for cases of MCSs, (b) observed precipitation (mm/24h), (c) simulated precipitation (accumulated 48-72 hours). Wind vectors at 850 hPa (greater than 5 m/s).

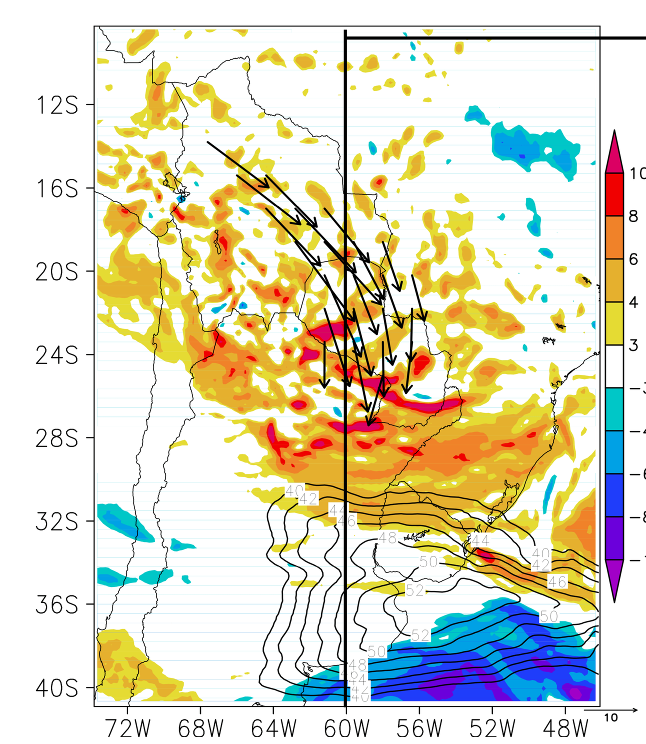

FIG.2: FCT - 66h of the composite cases for wind at 850hPa, Vorticity (shaded) and wind at 250hPa (contours) valid for 6 hours before the mature stage of systems.

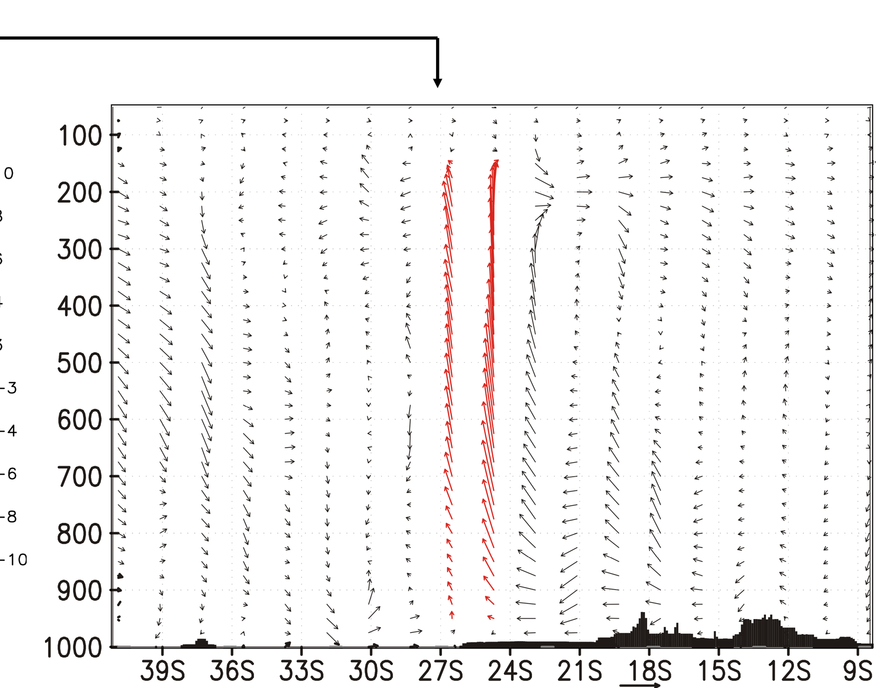

FIG.3: FCT-66h of the composite cases for vertical section (v, ω) at 60 W.

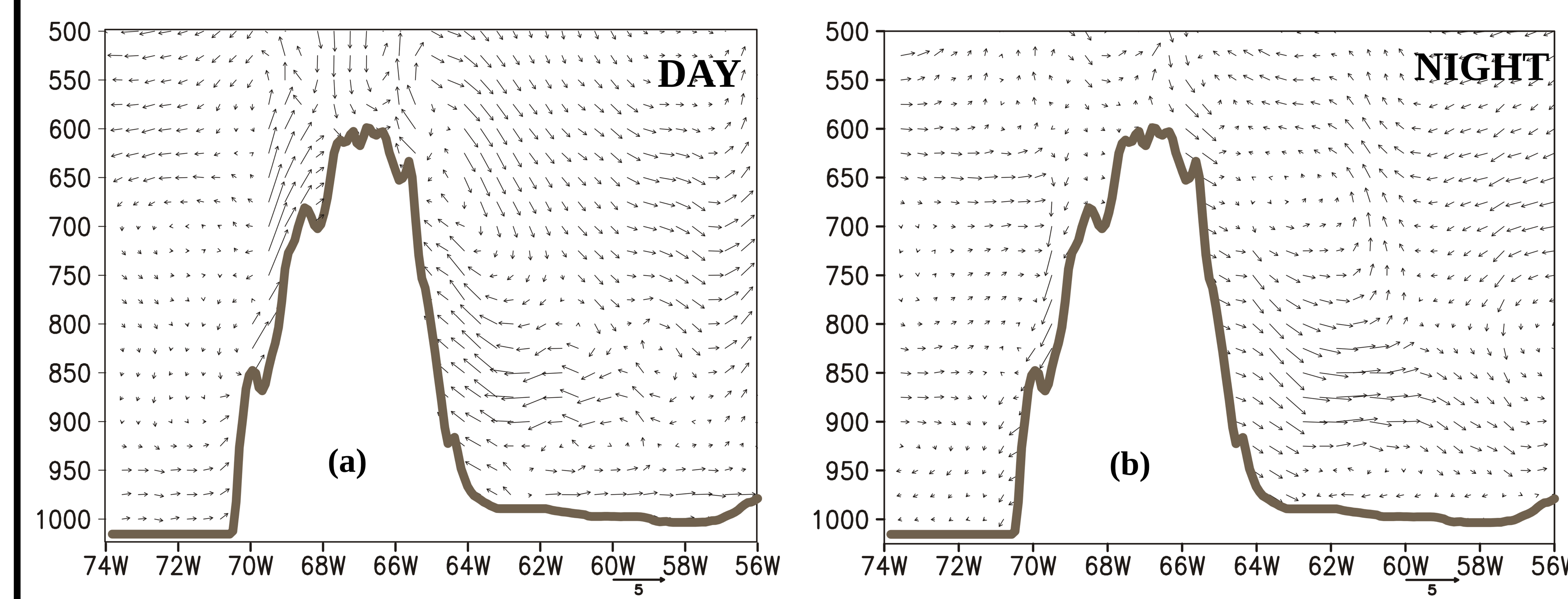

FIG.4: Average between the latitudes of 25 S and 23 S Vertical section (u, ω) , (a) during the day, (b) during the night.

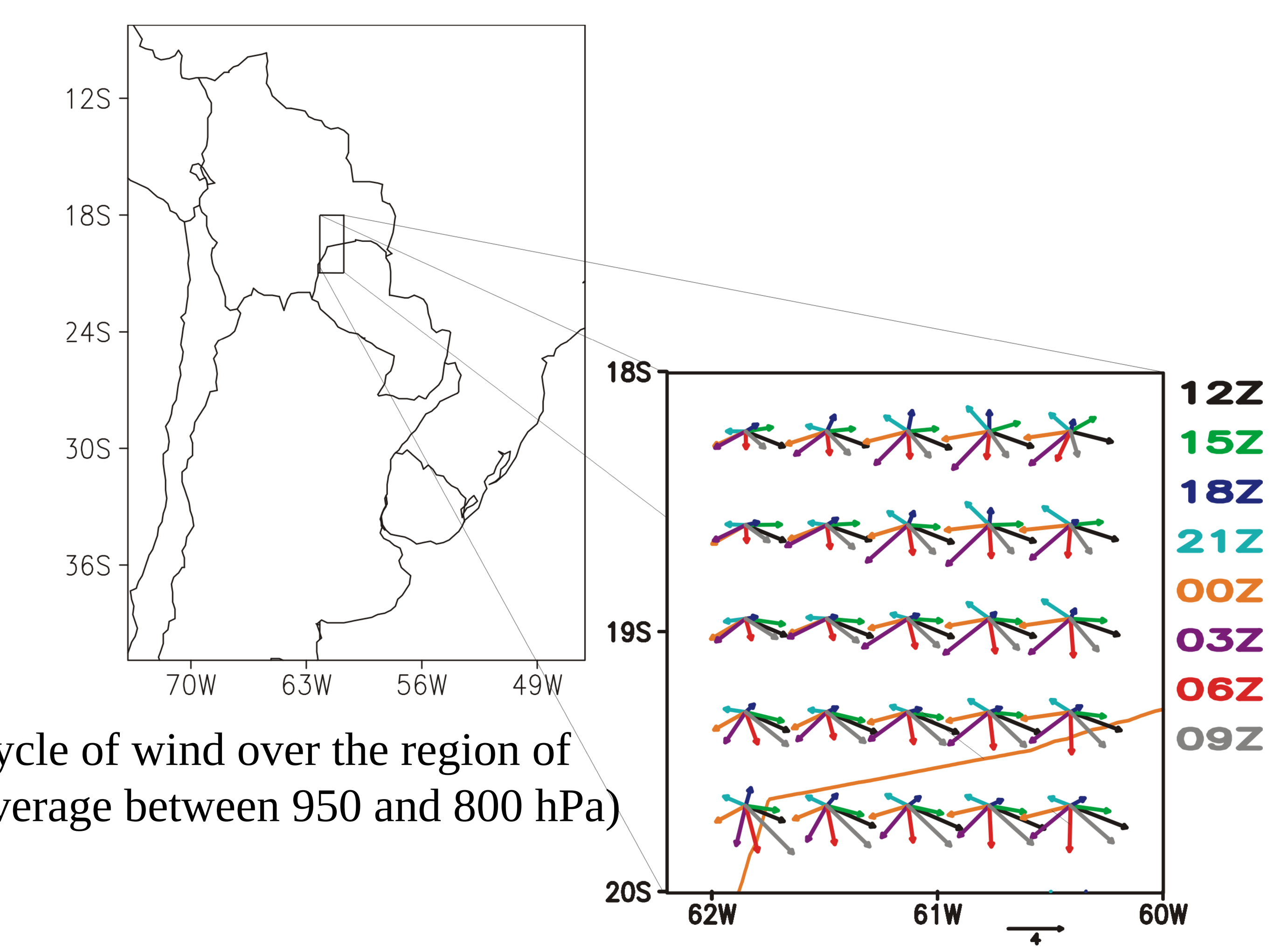

FIG.5: The diurnal cycle of wind over the region of ocorrence of LLJ (Average between 950 and 800 hPa)

5. CONCLUSIONS

The results showed that the Eta model was able to simulate, 72 hours in advance, the precipitation and the associated mechanisms of MCSs occurrence. Using the high resolution model results, the local circulation features contribution for the development of MCSs were identified. During the warming period, the circulation generated near the Andes acts to inhibit the formation of clouds over the valley and favor convection on the mountain side. During the cooling, the katabatic winds that blow from the mountain converge on the valley and act to trigger the first convective cells, playing a very important role in the genesis of MCSs, especially with regard to the nocturnal habits.The diurnal cycle and local circulation were also well represented by the model. The mountain-valley circulation to the east of Andes due to the differential heating and the inertial oscillation due to the Coriolis force which strengthened the LLJ, contributed to the development of convection associated with the MCSs.

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