Low level circulation associated with a Northwestern Argentina Low event

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RESUMO

Este trabalho tem como objetivo a analise de um caso de jato de baixos níveis na Região do Chaco, associado com a formação da Baixa do Noroeste Argentino. Através de simulações com o modelo Regional Eta/CPTEC são estudadas em detalhe os possíveis mecanismos que determinam a ocorrência do jato e, em particular, a interação com o aprofundamento da Baixa do Noroeste Argentino.

Os resultados mostram que o ciclo de vida do Jato de Baixos Níveis denota a superposição de oscilações locais com forçantes de escala sinótica. Este efeito apresenta deferências para as distintas latitudes, o que encoraja a realização de experimentos de campo.

The relevance of SALLJ (South American Low Level Jet) to South American climate has been emphasized in previous studies, which mainly concentrate on its larger scale structure and impact on regional circulation an precipitation. Less is known about its mesoscale structure and its response to different local-forcing mechanisms, possibly due to the lack of reliable data sets to address this kind of studies. This work focuses in the analysis of a Chaco low level jet (CJE) associated with a typical Northwestern Argentina Low (NAL) episode occurred on February 26, 2000. This kind of low level jet (LLJ) is of particular interest provided its unusual southward penetration, that leads to enhanced precipitation over La Plata basin. Central goals of this work are: to *study* in detail a particular CJE through a high resolution model simulation, in order to recognize possible forcing mechanisms; and to *understand* the interaction between the intensification of the Northwestern Argentina Low and the CJE formation. To accomplish this objective ETA/CPTEC regional model outputs were used in order to simulate both systems life cycle from 00 UTC February 25 to 00 UTC February 28. Model behavior and NAL characteristics are described in a related work (Seluchi et al., 2002-this same volume).

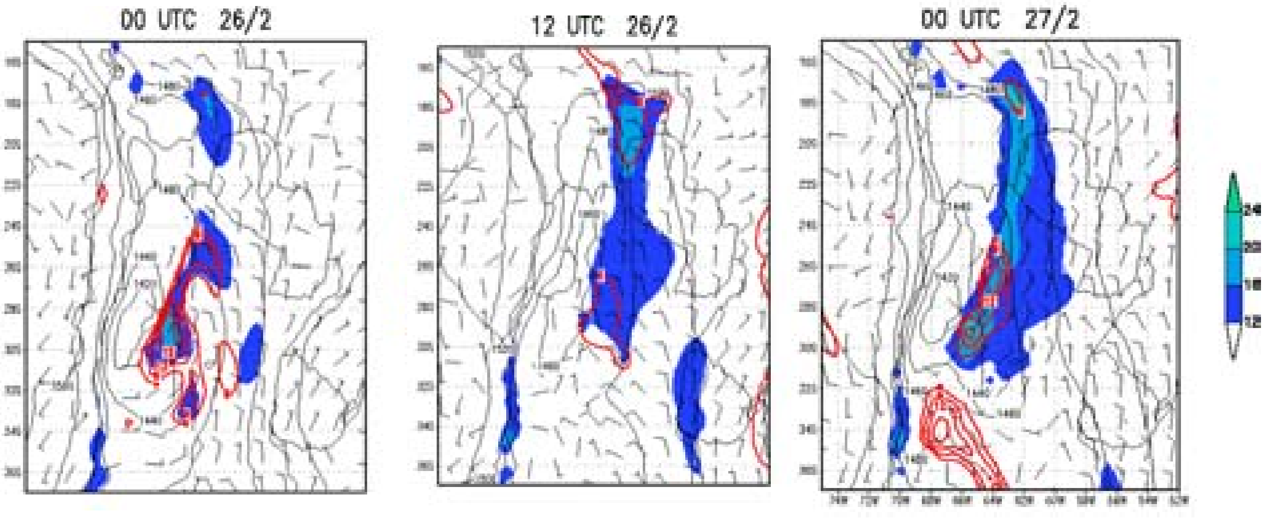

Figure 1: Forecasted evolution of the 850 hPa height (mgp-black contours) and wind (barbs). Shaded blue: wind magnitude above 12 ms^{-1}. Red contours: vertical wind shear between 850 and 700 hPa.

This episode can be categorized as a CJE from 12 UTC February 26 to 12 UTC February 27 (according to Nicolini and Saulo, 2000). Some distinct features of this low level jet can be identified with the aid of Figure 1. Assuming that Bonner criteria 1 is satisfied over the areas where shaded and red contours superimpose, there can be detected smaller LLJ areas immersed in a well organized northerly wind current that show a different diurnal cycle. From a detailed inspection of LLJ behavior at several points lying between 19°S - 30°S and 66°W-58°W it could be detected a planetary boundary layer (PBL) signal, that locally forces the LLJ, which exhibits a maximum between 06 and 12 UTC (approximately 02 and 08 local time) at lower latitudes and between 21 UTC and 03 UTC at higher latitudes. This behavior is consistent with the latitudinal dependence of the inertial frictional oscillation in the PBL. This signal, however, is clearer near the Andes than at points further east (i.e. around 500 km away). The response at the eastern points seems to be dominated by the synoptically driven low level jet, which is in geostrophic balance with the pressure field. Accordingly, a strong correlation between NAL and CJE should be found when the NAL is well stablished.

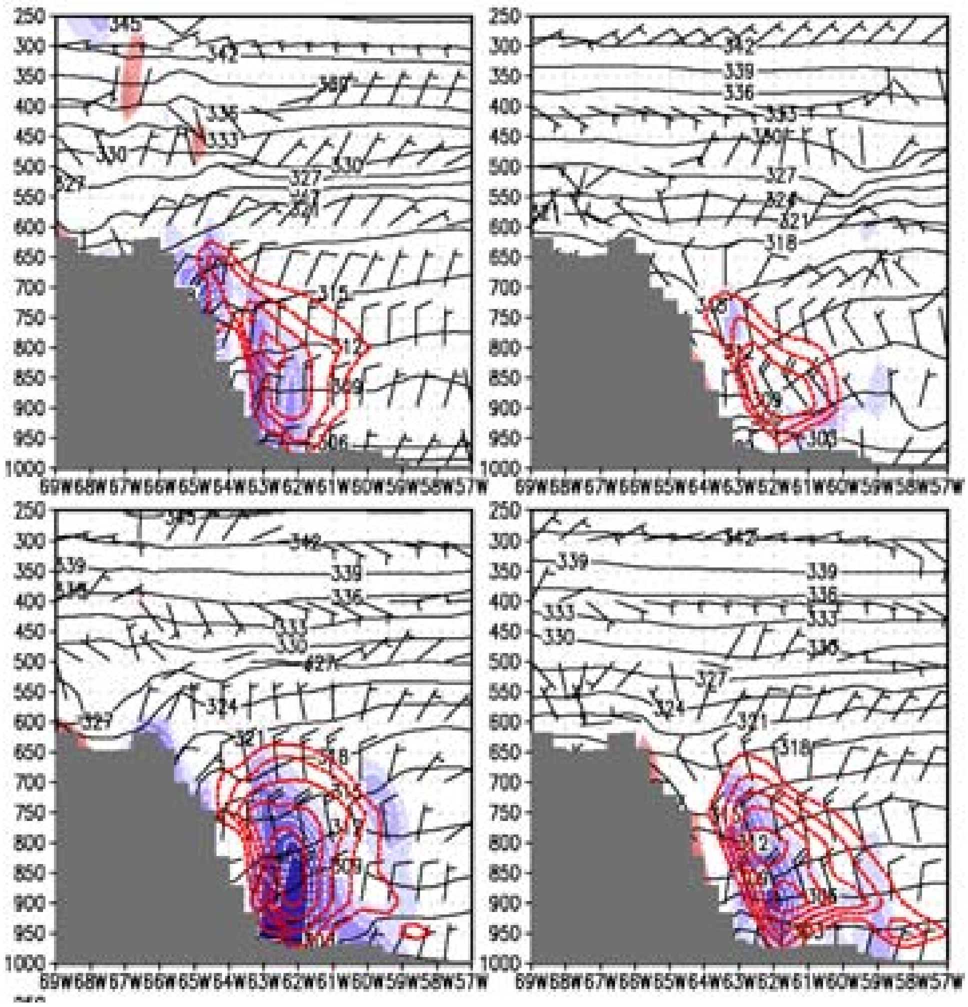

Figure 2: Vertical cross section at 19°S. Black contours: potential temperature (in K); red dashed: v-wind (ms^{-1}), shaded: geostrophic v-wind (ms^{-1}). Upper left: 00 UTC, February 26, upper right: 12 UTC, February 26; lower left: 00 UTC, February 27; lower right: 12 UTC, February 27.

Figure 2, shows the diurnal oscillation of the geostrophic and the real v-wind component. It can be seen that at relatively "warm hours", the geostrophic v-wind baroclinically generated near the andean slopes is stronger than the real v-wind, as expected. On the other hand, at 12 UTC, February 26, the wind is clearly supergeostrophic. However, this is not evident on February 27, when there is a strong geostrophic v-wind even at "cold" hours. This suggests a superimposed synoptic forcing upon local heating/cooling pattern.

As expected, the synoptic forcing is stronger at higher latitudes. Figure 3 shows the same cross section analyzed before, but at 25°S. At this latitude, the meridional northerly wind component is well organized even during the earlier stages, but its core is higher than at lower latitudes, suggesting that mechanisms different than

PBL or differential heating over elevated terrain should account for the wind field evolution that clearly depicts a sustained growth during both days.

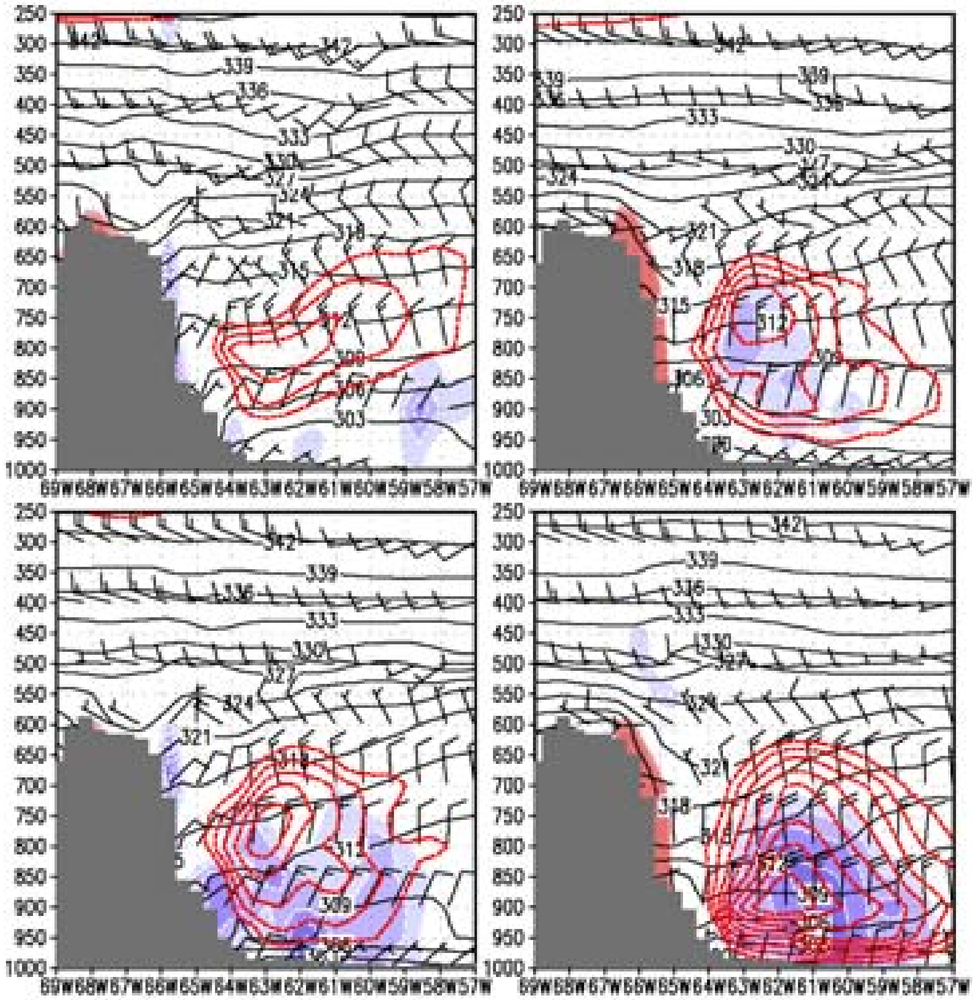

Figure 3: same as figure 2 but at 25°S.

This preliminary analysis clearly suggests the existence of different forcing mechanisms with particular timing and horizontal scale, that progressively lead to the formation of a Chaco jet event. The CJE becomes clearly determined when a well defined NAL organizes a strong northerly wind channel that starts at 15°S and reaches south of 30°S. It has also been detected the existence of a relationship between NAL's diurnal cycle and that of the low level jet, with a maximum jet lagging around 3 hours the minimum surface pressure attained by the NAL.

The characteristics of the low level jet life cycle denotes the superposition of local-diurnal oscillations with the larger scale environmental synoptic forcing. This behavior is different at particular locations, what might be of mayor interest for the design of a Field Experiment.

References:

Nicolini, M. and A. C. Saulo, 2000. Eta characterization of the 1997-1998 warm season Chaco jet cases. Preprints of the 6th International Conference on Southern Hemisphere Meteorology and Oceanography, Chile, 3-7 de abril de 2000, 330-331.

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