A Description of the Thermal Low characteristics using SALLJEX special observations

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Motivation

A low pressure system is commonly observed over Northwestern Argentina near the Andean slopes, at the southern portion of the Chaco low. The center is located approximately at 67ºW, 30ºS. This system is locally known as the Northwestern Argentinean Low (NAL)

•Previous studies characterized the NAL as a thermal-orographic system, being much more frequent during summer than in winter (Lichtenstein, 1980).

• Contrasting with the Chaco low, the NAL exhibits an intermittent behavior, with a mean duration typical of a midlatitude synoptic wave.

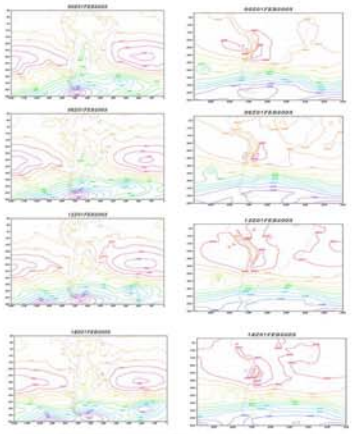
•Seluchi et al. (2003) showed that the summer NAL has a significant diurnal cycle and its existence is mostly explained by the sustained surface warming that results from the previous days circulation, characterized by clear skies that favor the positive radiative surface balance over the region.

•Several studies identified the relationship between the deepening of this low pressure system and the intensification of the northerly low level jet. For this reason, special attention was given to this thermal low during SALLJEX, with a NOAA-P3 flight mission (February 1st, 2003) dedicated to the observation of this feature.

•This work compiles all the data provided through the enhanced upper air observations and the NOAA-P3 profiles, in order to describe the three dimensional structure of the NAL episode that started by January 29, 2003 and ended by February 3, 2003.

NAL Evolution

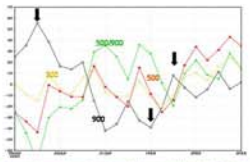
- Initiation: January 30
  - Strong Heat wave affected Central Argentina, with record maximum surface temperatures: 44.4ºC over Mendoza (32º 53' S; 68º 49' W)
- Deepening: February 1st and 2st
  - The system reached its minimum surface pressure



Temporal evolution of the sea level pressure (left,in hPa) and the 500–1000 hPa thickness (right, in gpm), and during February 1st.

- February 3rd: MCS over northeastern Argentina at the exit region of the low level jet
- Decay phase: February 4th
  - Chaco LLJ (wind maxima of 50 knots over Bolivia and Paraguay) and MCS over central and eastern Argentina

Thermal character

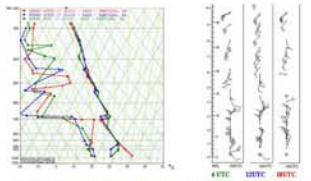


Area average temporal evolution (over NAL region) of the 500–900-hPa thickness (green), and the geopotential heights at the 500-hPa (red), the 300-hPa (yellow), and the 900-hPa (black) levels. Magnitudes (in gpm) are relative to a reference value for each level/variable.

Seluchi et al. (2003) ➡ the evolution of this NAL is mostly controlled by processes in the 900/500 layer

Radiosonde Observations

- Cerne et al. (work in progress) ➡ have analyzed the circulation previous to this NAL events and distinguished a dominant subsidence motion over the region south of 20ºS which also favored the sustained warming that leads to the formation of the NAL.
- The subsidence is seen in the special radiosonde observation at Santiago del Estero which is very close to the low pressure center

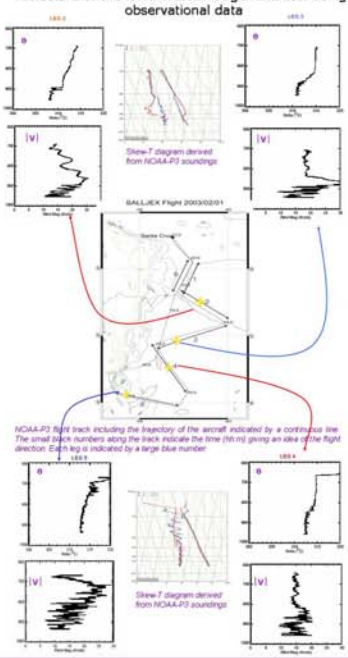


Skew-T diagram and wind barbs at Santiago del Estero, Argentina (27º 46'S, 64º 16'W) corresponding to February 1st 6:00, 12:00 and 18:00 UTC.

- The skew-T shows a strong surface warming (reaching above 40ºC at 3 PM local time) and a very deep mixed layer, reaching up to 700 hPa, where the subsidence inversion avoids further penetration of the mixing.
- Northerly winds dominate the circulation at Santiago del Estero on Februay 1 st.

The February 1st flight

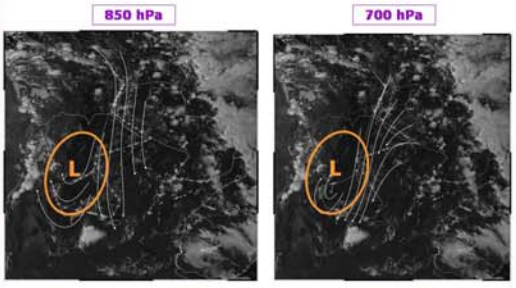
This is the first opportunity to describe the three-dimensional structure of the Northwestern Argentina Low using observational data



NOAA-P3 flight track including the trajectory of the aircraft indicated by a continuous line. The small black numbers along the track indicate the time (hh:mi) giving an idea of the flight direction. Each leg is indicated by a large blue number.

The vertical stratification indicates that:

- this system is surrounded by very deep mixing layers that reach up to 670 hPa. over the warmer surfaces.
- the depth of the mixing layers shows an increase towards the low level pressure center.
- this rather unique stratification of the system has been identified for the first time and is in qualitative agreement with previous studies, but more abrupt.
- very weak circulation is detected near the core, but over leg 2 and even at leg 3 northerlies were observed, with maximum wind intensities occurring at higher altitudes following the aircraft track.



Streamlines derived from NOAA-P3 soundings plotted over the visible GOES image corresponding to 19:45 UTC.

The circulation measured with the P3, confirmed that the thermal low exhibits a closed circulation, even at 700 hPa.

References

Lichtenstein, E. R., 1980: La Depresión del Noroeste Argentino (The Northwestern Argentina Low). Ph.D. dissertation, University of Buenos Aires, 223 pp.

Seluchi, M., C. Saulo, M. Nicolini and P. Satyamuyty, 2003: The Northwestern Argentinean Low: a study of two typical events, *Mon. Wea. Rev.*,**131**, 2361-2378.

Aknowledgments: SALLJEX special observations were supported with NSF (USA), NOAA (USA) and ANPCyT (Argentina - PICT 07-06671) grants. This research is partially supported by UBACyT (Argentina) X155