Regional pollution due to biomass burning in South America

Ulke[1], Ana G., Longo, K. M., Freitas S. R., Hierro R.F.

[1]Depto. de Cs. de la Atmósfera y los Océanos, Fac. de Cs. Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina
e-mail: ulke@at.fcen.uba.ar

Abstract

The present study analyses a low level jet event that occurred in conjunction with biomass burning and focuses on the impact on southeastern South America. The aerosol transport is analyzed using outputs of the CATT-BRAMS modeling system. The relationships between the low level jet and the smoke plume pattern and concentrations are shown.

1. Introduction

Biomass burning includes the human-initiated burning of vegetation for land clearing and land-use change as well as natural, lightning-induced fires. It is a major contribution to the trace gases and aerosol burden in South America (Artaxo et al, 2005). It takes place from August to October affecting several ecosystems. The influence on the Earth's atmosphere, climate and environment has short- and long-term impacts. Biomass burning particulates can also affect human health. The South American Low Level Jet (SALLJ) is a wind maximum that occurs east of the Andes as a result of the interaction of the trade winds, the mountain range, the South Atlantic Subtropical anticyclone and the northwestern Argentinean low. This pole-ward current is an important agent to transport and mix water vapor and biogeochemical substances (Vera et al, 2006).

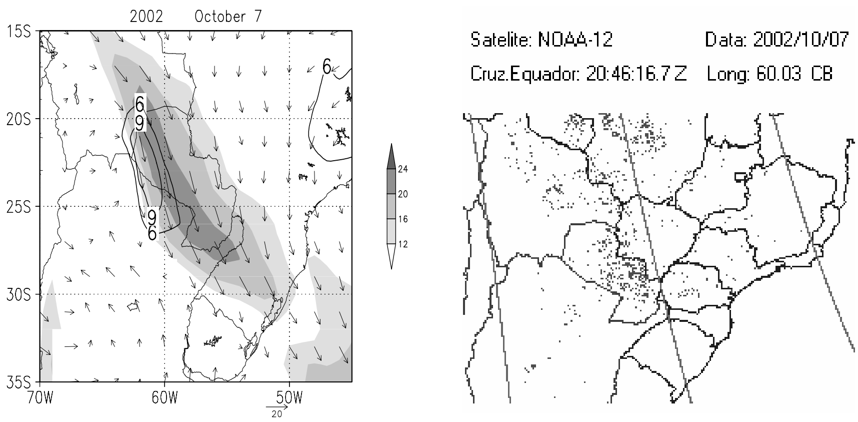
2. Data and methodology

The low-level jet event was diagnosed applying modified Bonner's (1968) first criterion to the analyses of the Global Data Assimilation System

(GDAS) of the National Centers for Environmental Prediction (NCEP). The outputs of the CATT-BRAMS modeling system (Freitas et al, 2005) are used to study the transport of aerosols. The main circulation features and the resulting plume pattern and concentration behavior are analyzed.

3. Results and discussion

The low level jet event took place on 07 October 2002, and covered central Bolivia, Paraguay and Southeastern Brazil (Figure 1 a)).



a) b)

Figure 1. a) Horizontal wind (*vector*); wind speed (*shaded*: ms^{-1}) at 850 hPa and 850-700 hPa wind shear (*contours*) composite fields (four synoptic hours). b) NOAA-12 AVHRR satellite hotspots (from http://www.cptec.inpe.br/queimadas/)

Intense biomass burning occurred simultaneously as depicted by the fire focus shown in Figure 1 b), with 312 spots in Bolivia, 716 in Paraguay, 1454 in Brazil and 86 in Argentina.

The mean fields of PM2.5 concentrations (μgm^{-3}) and wind speed at about 1400 m obtained with CATT-BRAMS during the hours in which the LLJ occurred are illustrated in Figure 2 a). Figure 2 b) presents the composite fields of columnar AOT (aerosol optical thickness). In this particular event the cold front oriented NW-SE, had its southernmost edge over the continent from 25° S to 35°S (see Figs. 1 a) and 2 a)).

The smoke plume exit to the Atlantic Ocean is in the Rio Grande do Sul state. As Buenos Aires had a post-frontal location was not affected by the smoke plume, contrarily to the case study in Longo et al. (2005). The highest PM2.5 concentrations at the level where the LLJ had its maximum strength occurred east of Bolivia and a relative minimum is observed in coincidence with the location of the jet core. The columnar AOT shows its highest values to the left side of the LLJ core, slightly to the south of the stronger particulate matter concentrations. There is an important zone affected by AOT values higher than 2.5, which is consistent with the aerosol load due to biomass burning activities.

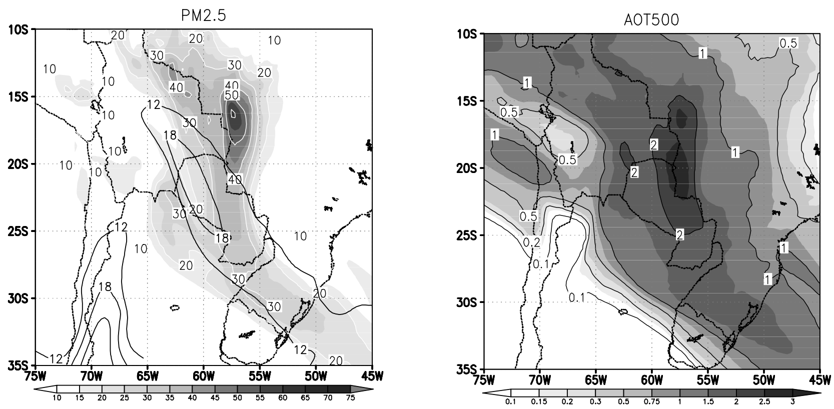


Figure 2. a) PM2.5 concentration (*shaded* in μgm^{-3}) wind speed (*contour*: stronger than 12 ms^{-1}) at 1400 m mean fields. b) Columnar AOT.

4. Conclusions

In this particular event of SALLJ and biomass burning, the plume originated over South America at about 10º S and, deflected by the Andes barrier, proceeded southward, reaching latitudes not far from 30º S due to the approach of a cold front that confined the polluted air mass to southeastern Brazil and the Atlantic Ocean.

5. Acknowledgements

This research was partially funded by UBACyT X170.

6. References

Artaxo. P et al, 2005: Química atmosférica na Amazonia: A floresta a as emissoes de queimadas controlando a composicao da atmosfera amazonica, *Acta Amazonica*, **35**, 2, 186-196.

Bonner, W D, 1968: Climatology of the low level jet, *Mon. Wea. Rev.*,**119**, 1575-1589.

Freitas, S R, K M Longo, M A F Silva Dias, P L Silva Dias, R Chatfield, E Prins, P Artaxo, G A Grell and Recuero, F S, 2005: Monitoring the transport of biomass burning emissions in South America, *Env. Fluid Mechanics*, **5**, 135-167.

Longo, K, Freitas, S R, Ulke, A G and Hierro, R F, 2006: Transport of biomass burning products in Southeastern South America and its relationship with the South American Low Level Jet East of the Andes, *8th International Conference on Southern Hemisphere Meteorology and Oceanography (8ICSHMO),* Foz do Iguaçu, Brazil, 24 to 28 April, 2006, American Meteorological Society, CD de la Conferencia, 121-129.

Vera and collaborators, 2006: The South American Low Level Jet Experiment, Bulletin of the American Meteorological Society, 63-77.