Influence of the Antarctic Ozone Hole on South of Brazil in the XXI Century

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ABSTRACT: **The Antarctic Ozone Hole is a cyclical phenomenon which occurs over the Antarctic region from August to November each year. The polar vortex turns it into a restricted characteristic dynamics for this region. However, when the polar vortex begins to weaken in October, air masses with low ozone concentration could escape and reach regions of lower latitudes. This study presents a retrospective of the influence of the Antarctic Ozone Hole on the South of Brazil in the years from 2001 to 2008. To verify the events of influence, it was used data of ozone total column from Brewer Spectrophotometer installed at the Southern Space Observatory - OES/CRS/CIE/INPE - MCT (29.42 ° S, 53.87 ° W), in São Martinho da Serra, RS, Brazil. In addition to Brewer data, it was analyzed potential vorticity maps using GrADS (Grid Analysis and Display System) generated with the NCEP data reprocessed, and backward trajectories of air masses, using the HYSPLIT model of NOAA. Ozone total column for the days with lower ozone was compared with the climatological average of twenty years for October. For statistical reasons, it was analyzed only the days with ozone total column lower than climatological average minus 1.5 times the standard deviation. Considering only the days with decreased ozone, increased absolute potential vorticity and backward trajectories indicating the origin of polar air masses, it was observed 11 events in the period from 2001 to 2008. The year of 2002 was the only one which not showed influences of the Antarctic Ozone Hole. On average, ozone total column over Southern Space Observatory decreased in these days about 10.9 ± 1.4% when compared with climatological means. As a historical analysis, it was observed that all the years of the 21st century had days with secondary effects of the Antarctic Ozone Hole in the period 2001 to 2008 on the South of Brazil, with the sole exception of 2002.**

INTRODUCTION:

In the Antarctic continent, a significant decrease in total ozone content has been detected from August to November each year. This decrease is known as the Antarctic ozone hole [1, 2]. The atmosphere in the southern hemisphere at high latitudes, has undergone marked changes over the past recent decades. According to Angell [3] a record of evidence is the physical size of the ozone hole reached during the spring of 2000. Because of the polar vortex, this is restricted to the region. However, when the polar vortex begins to weaken in late September and October, masses of ozone-poor air can escape and reach regions of lower latitudes. These events are called side effects of the Antarctic Ozone Hole [4].

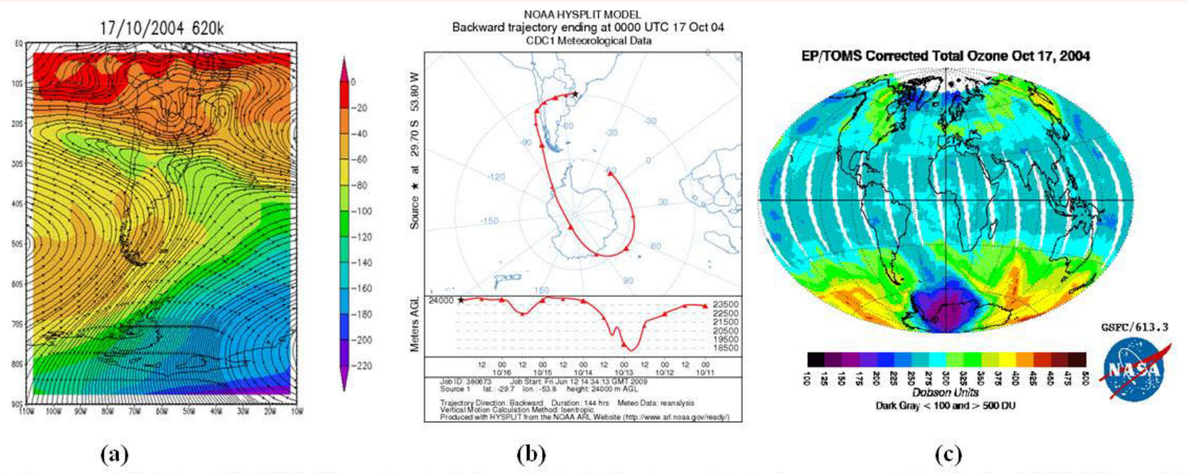
OBJETIVE:

This study presents a retrospective of the influence of the Antarctic Ozone Hole on the South of Brazil in the years from 2001 to 2008.

MATERIALS AND METHODS:

To verify the events of influence, it was used data of ozone total column from Brewer MKIII Spectrophotometer #167 (Figure 1) installed at the Southern Space Observatory - OES/CRS/CIE/INPE - MCT (29.42 ° S, 53.87 ° W), in São Martinho da Serra, Brazil. Besides the data of Brewer, we analyzed data from the TOMS instrument (Total Ozone Mapping Spectrometer), which measures the total column ozone at two specific wavelengths, 317.5 and 331.2 nm aboard NASA satellite, and IMO instrument, which replaced the TOMS in 2006. The proof of the side effects of the ozone hole over the Antarctic region south of Brazil may be made through the analysis of potential vorticity (PV) on isentropic surfaces. For the analysis of isentropic maps were generated using GrADS, with reprocessed data from NCEP, and retrospective analysis of atmospheric trajectories of air masses are produced using the HYSPLIT model (Hybrid Single-Particle Lagrangian Integrated Trajectory) developed by NOAA and Australia's Bureau of Meteorology. Ozone total column for the days with lower ozone was compared with the climatological average of twenty years for October. For statistical reasons, it was analyzed only the days with ozone total column lower than climatological average minus 1.5 times the standard deviation.

Fig.1: Brewer Spectrophotometer installed at the Southern Space Observatory.



(a) (b) (c)

Fig.2: Day event October 17, 2004. Map of potential vorticity (a) backward trajectory generated with the HYSPLIT model (b) and image generated using data from TOMS spectrophotometer (c).

RESULTS:

We analyzed data from the days when there were events side effects of Antarctic ozone hole over the south of Brazil in October 2001 to 2008. We compared the total ozone of the day it happened to fall to the climatological average of twenty years of October, which is averaging 292.62 UD. As shown in Figure 2, the day October 17, 2004, where they are represented an increase of absolute potential vorticity, the trajectories of air masses retroactive poor in Antarctic ozone and the generated image data Spectrophotometer TOMS. Considering only the days with decreased ozone, increased absolute potential vorticity and backward trajectories indicating the origin of polar air masses, it was observed 11 events in the period from 2001 to 2008. The year of 2002 was the only one which not showed influences of the Antarctic Ozone Hole. On average, ozone total column over Southern Space Observatory decreased in these days about 10.9 ± 1.4% when compared with climatological means. In table 1, has the days and years that were side effects of the ozone hole with the value of total ozone with their respective reduction of the ozone.

Table 1: Days and years that were side effects of the ozone hole with the corresponding reduction of ozone.

Effects of Days Secondary	Ozone (DU)	Reduction (%)
28/10/2001	264,2	9,7
16/10/2003	254,4	13,1
16/10/2004	253,8	13,3
17/10/2004	258,3	11,7
12/10/2005	266,3	9,0
14/10/2006	263,92	9,8
15/10/2006	262,99	10,1
27/10/2006	261,9	10,5
28/10/2006	259,13	11,4
29/10/2006	263,33	10
7/10/2007	257,67	11,9

CONCLUSION:

As a historical analysis, it was observed that all the years of the 21st century had days with secondary effects of the Antarctic Ozone Hole in the period 2001 to 2008 on the South of Brazil, with the sole exception of 2002. the period 2001 to 2008 events were analyzed side effects, a total of 11 events with average decreases of 10.9 ± 1.4%.

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BIBLIOGRAPHY:

[1] FARMAN, J. C.; GARDINER, B. G. and SHANKLIN, J. D. Large losses of total ozone in Antarctica reveal seasonal ClOx/NOx interaction. Nature, v. 315, p. 207-210, 1985.
[2] SOLOMON, S. Stratospheric ozone depletion: a review of concepts and history. Reviews of Geophysics, v. 37, n. 3, p. 275-316, 1999.
[3] ANGELL, J. K. et al., Southern hemisphere winter summary 2000. National Oceanic and Atmospheric Administration (NOAA)/Climate Prediction Center(CPC), Washington, DC, 2000.
[4] KIRCHHOFF, V. W. J. H.; SCHUCH, N. J.; PINHEIRO, D. K.; HARRIS, J. M. Evidence for an ozone hole perturbation at 30° south. Atmospheric Environment, v. 33, N° 9, p. 1481-1488, 1996.