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WEATHER CONDITION ASSOCIATED WITH INFLUENCE OF THE ANTARCTIC OZONE HOLE OVER SOUTH OF BRAZIL ON OCTOBER 21th, 2011

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Abstract: *An analysis of the weather condition is presented in this work, associated with the occurrence of the Influence of Antarctic Ozone Hole over southern Brazil on October 21th, 2011. In this date, there was a drop in ozone content of the 4.65% in relation to climatological average of the October at the data obtained through the Brewer Spectrophotometer MKIII 167 installed in South Space Observatory - OES/CRS/INPE – MCTI and instrument of satellite OMI of the NASA. The origin of the stratospheric polar air mass poor in ozone has been proven by the analysis of potential vorticity maps, retroactive trajectories and satellite images of the ozone content. The tropospheric weather condition in the South of Brazil, associated with the event was the occurrence of a wide area of atmospheric stability, without significant clouds, associated with the subtropical jet stream away from the Atlantic Ocean, superimposed by a wide area of the subsidence movement and occurrence of the an intense high-pressure post-front system.*

Keywords: Stratospheric Ozone, Tropospheric Weather Condition

Introduction

The passage of air masses originating from the Antarctic ozone hole (Farman *et al.*, 1985) on medium latitudes was first observed on the South of Brazil (29.4ºS; 53.8ºW) by Kirchhoff *et al.* (1996), being this type of phenomenon called 'influence of the Antarctic ozone hole, which has been frequently observed over South America (Perez *et al.*, 2000; Pinheiro *et al.*, 2012).

Peres *et al.*, 2012, observed that the event of the Influence of Antarctic Ozone Hole over southern Brazil on October 13th, 2010, occurred after the passage of a tropospheric frontal system.

This study aims to verify the weather condition of troposphere during the occurrence of of the Influence of Antarctic Ozone Hole over southern Brazil on October, 21th, 2011.

Material and Methods

Events of influence of the Antarctic ozone hole over the South of Brazil are identified through observation of falls below the limit climatological average less 1.5 standard deviation in total column ozone data obtained through the Brewer Spectrophotometer MKIII #167 installed on South Space Observatory – OES/CRS/INPE – MCTI (29,4º S; 53,8º W; 488,7 m), in São Martinho da Serra and by the satellite instrument IMO of the NASA, which are also used his images ozone content. In these days, the stratospheric origin of ozone-poor air masses is verified through the analysis of Potential Vorticity (Semane *et al.*, 2006) over isentropic surface of 620 K potential temperature, using daily parameters provided by NCEP/NCAR reanalysis, for the purpose of checking the dynamic pattern of the stratosphere. Retroactive trajectories of air masses were made by HYSPLIT model of the NOAA confirms the

polar source of ozone-poor air mass and your passing by the polar region. The identification of the tropospheric weather condition is carried out through the analysis of wind fields at 250 hPa and Vertical speed Omega in 500 hPa, sea level pressure and thickness between 1000 and 500 hPa and GOES 12 satellite images enhanced infrared, in order to identify any connection between the stratosphere and the troposphere during the occurrence of this event.

Results

The day October 21th, 2011, showed the value of total ozone column of 278.7 DU representing a decrease of 4.7% compared to the climatological average for the month of October which is 292.3 ± 9.9 DU. The stratospheric analysis shows, from the isentropic analysis, an increase of the values of absolute potential vorticity in the 620 K potential temperature level of day 21 (a) to day 22 (b) of the October, 2011, indicating that the origin of ozone-poor air mass that arrived southern Brazil was polar. Backward trajectory of air masses (c) and the satellite image IMO (d) complement the analysis, confirming the polar origin of the air mass and the existence of a connection between the polar region, where acted the Antarctic Ozone Hole and Southern Brazil, seen in Figure 1.

The tropospheric weather condition, seen in Figure 2, shows that over South of Brazil, acted a wide area of atmospheric stability, with the displacement of the

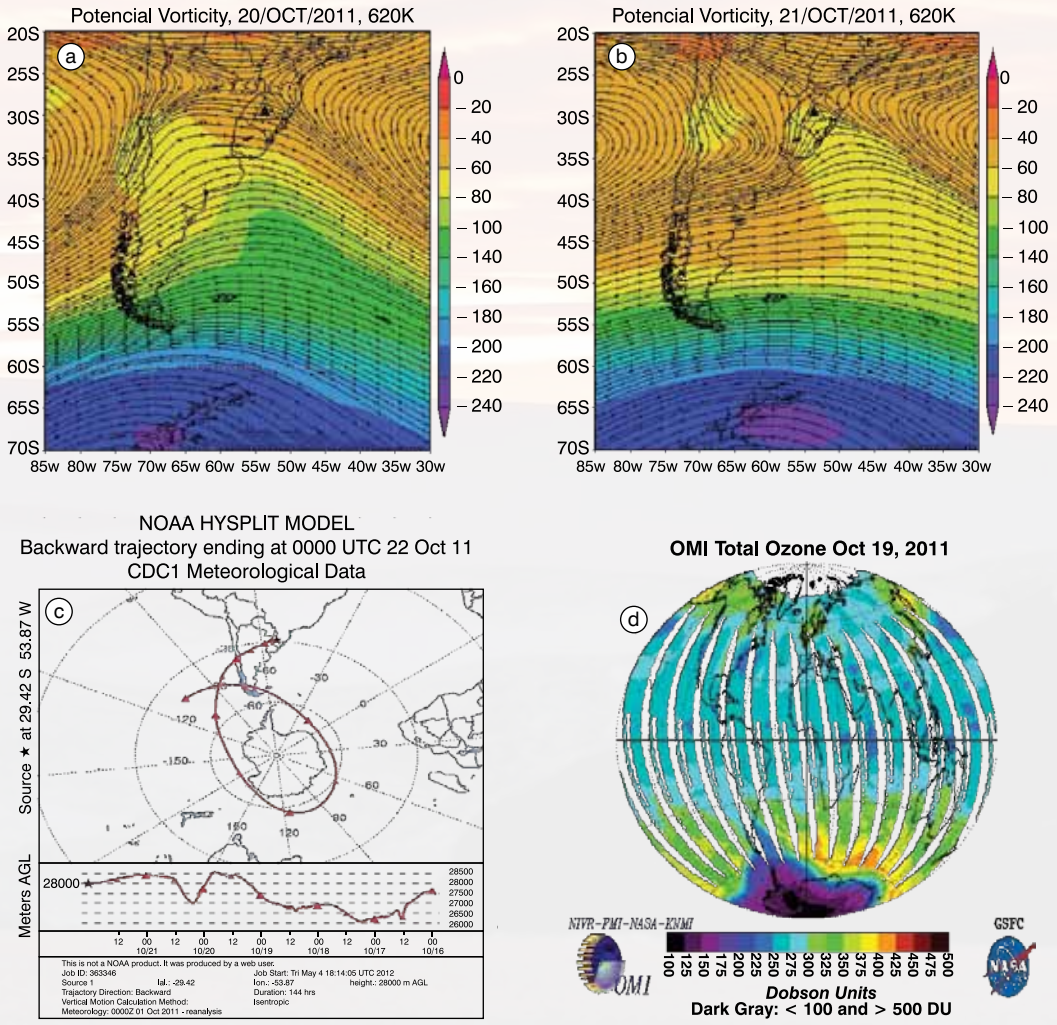

Figure 1. Potential Vorticity and Wind at 620K level for 20th (a) and 21th (b) of October, 2011. Air mass backward trajectory (c) and OMI image (d) for 22th and 19th, respectively.

subtropical jet stream toward the Atlantic Ocean, and the performance of their region of polar input and center of positive values of Omega in the wind field in 250 hPa and Vertical speed Omega in 500 hPa over South of Brazil in October 20Th, 2011 (a), characteristic by subsidence and intrusion of stratospheric air into the troposphere.

The performance of a high pressure post frontal system in the field pressure at sea level and thickness between the levels of 1000 and 500 hPa in October 21 (b), characteristic by the divergence of the air at low levels, inhibit cloudiness formation, as observed in the satellite image of the infrared highlighted of GOES 12 to 15 UTC in October 21 (c) 2011.

This pattern of atmospheric circulation, with the displacement of the subtropical jet stream from medium to low latitudes, may have aided in its southern sector, in stratospheric air intrusion into the troposphere and in the transport of ozone-poor air mass from Antarctic region to the South of Brazil, showing evidence of a connection between the stratosphere and the troposphere.

Discussion

Events of Influence of Antarctic Ozone Hole over middle latitudes is becoming more frequent (Kirchhoff *et al*., 1996;

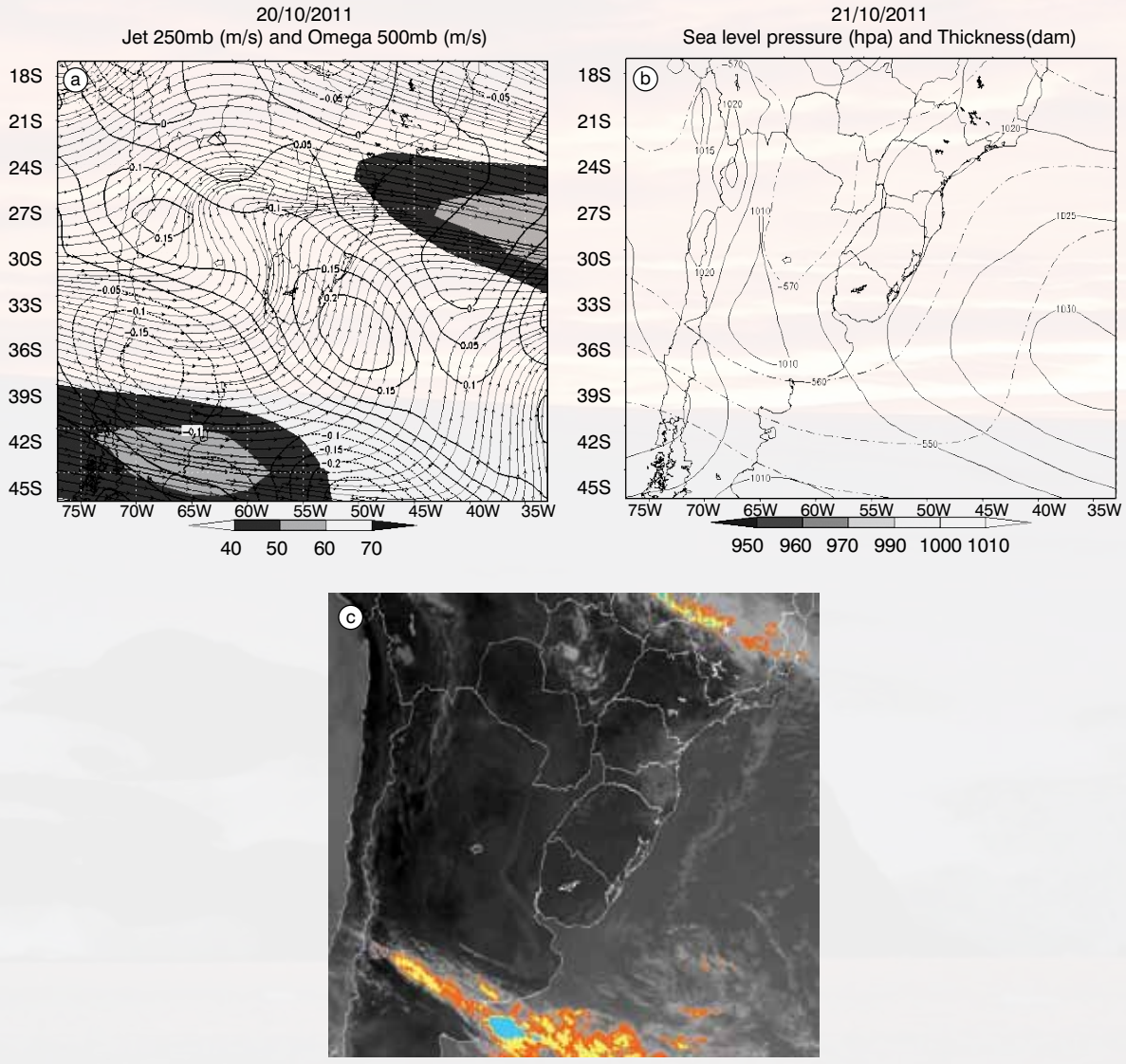

Figure 2. Field daily average at 250 hPa level and Omega at 500 hPa for October, 20th, 2011 (a), pressure at sea level and thickness between 1000 and 500 hPa (b), and enhance GOES 12 image satellite at 15:00 (c) for October, 21th, 2011.

Perez *et al.*, 2000; Pinheiro *et al.*, 2012, Peres *et al.*, 2012), as well as the identification of the existence of a connection between the transport of air masses in the stratosphere and the troposphere weather condition, mainly by the performance of the tropospheric jet stream, where its displacement influence the vertical distribution of ozone content (Bukin et al. 2011) and causes intrusion of stratospheric air into the troposphere (Stohl *et al.*, 2003). Moreover, on the South of Brazil, similar to the way the present study, this type of event has occurred after the passage of a frontal system (Peres *et al.*, 2012).

Conclusion

The occurrence of the event of influence of the Antarctic ozone hole over South of Brazil in October 21th, 2011 was confirmed by the drop in ozone content that reached 4.7 % relative the climatological average for the month of October and stratospheric isentropic analysis of potential vorticity, backward trajectory and ozone content of the satellite image showed that the ozone-poor air mass that arrived at South of Brazil was of polar origin at the Antarctic ozone hole.

The tropospheric weather condition shows that this event ocurred in conjunction with a wide area of atmospheric stability over South of Brazil associated with a post front condition, without significant cloud cover, occasioned by shift at the Atlantic Ocean of the subtropical jet stream and acting of a post frontal high-pressure system, characterized by the subsidence of air masses, inhibition of formation of cloud cover which may have favored the transport of stratospheric ozone-poor air mass.

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