

INFLUENCE OF THE ANTARCTIC OZONE HOLE ON THE SOUTHERN REGION OF BRAZIL IN THE LAST 11 YEARS



Programa de Pós Graduação em
Meteorologia
UFSM

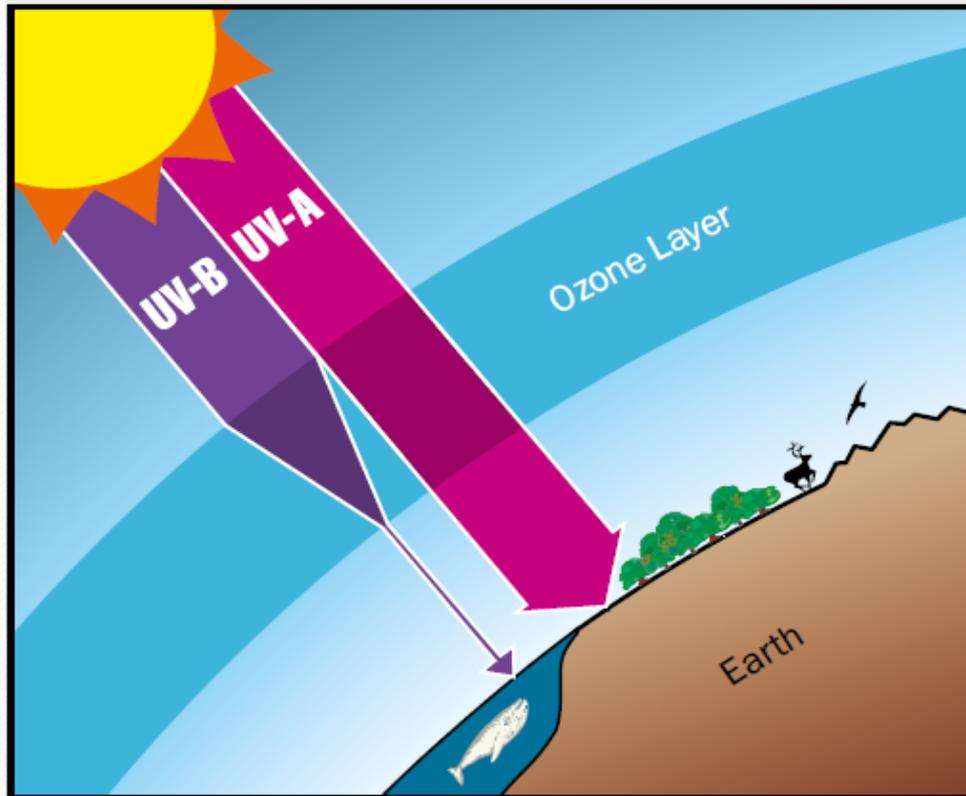


**Gabriela D. Bittencourt, Damaris K. Pinheiro,
José V. Bageston, Lucas V. Peres, Bibiana C. Lopes.**

São José dos Campos/SP, April 25th, 2018

INTRODUCTION

UV Protection by the Ozone Layer

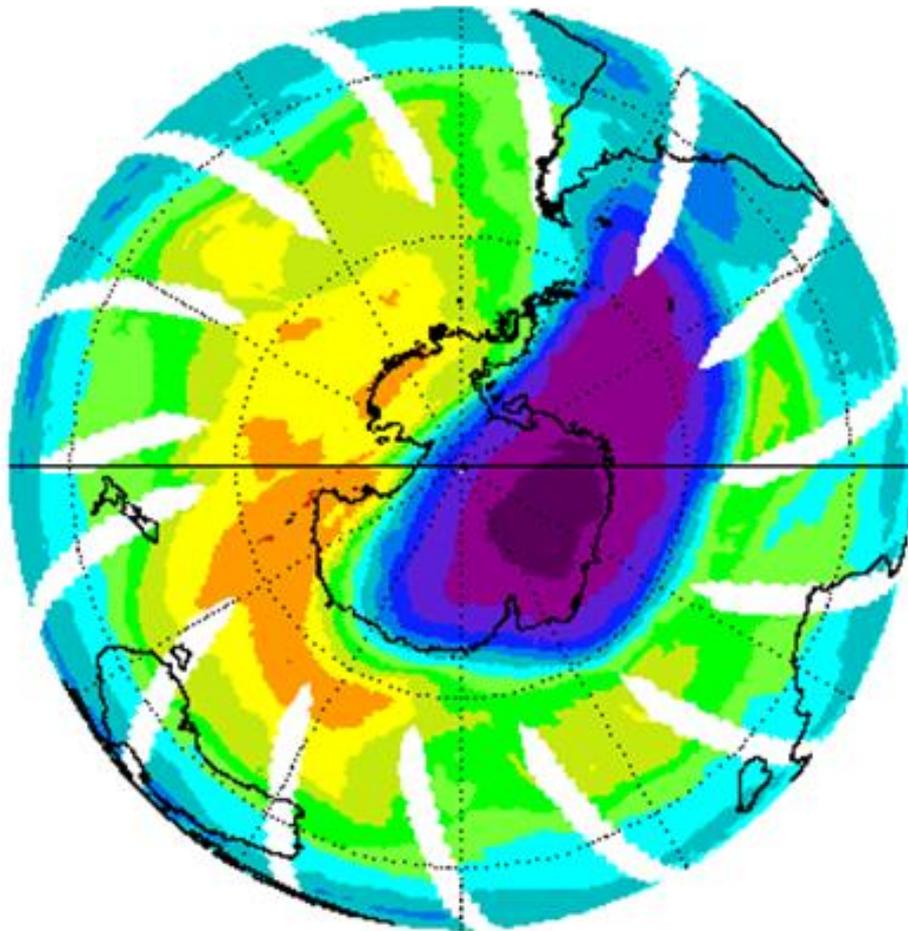


- Ozone is the main trace gas constituent of the stratosphere;
- Ozone Layer: Absorbs ultraviolet radiation (Salby, 1996 and Dobson, 1968);
- The Antarctic Ozone Hole (AOH) is a cyclical phenomenon that occurs during the spring and results in the temporary reduction of the total ozone content.

Fonte: WMO, 2014.

INTRODUCTION

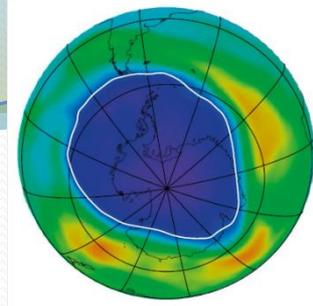
OMI Total Ozone for Oct 19, 2016



➤ The effects of this reduction in ozone content can influence mid-latitude regions in a phenomenon known as the **Secondary Effect Event of the Antarctic Ozone Hole'** (Kirchhoff et al., 1996).

➤ The **Potential Vorticity** variable is widely used in these studies because it plays an important role in the dynamics of large-scale air masses (Hoskins et al., 1985).

OBJECTIVE



- The main objective of this work is to analyze the stratospheric and tropospheric dynamics during the occurrence of AOH influence events between 2006 and 2016.

METHODOLOGY



- ❖ The data used for the period from 2006 to 2016, comprising the Southern region of Brazil.
- ❖ Two instruments for ozone measurements:
 - Brewer MKIII Spectrophotometer # 167, installed in São Martinho da Serra / RS.
 - OMI Satellite (Ozone Monitoring Instrument), available on NASA's website.
- ❖ Reanalysis Data (ECMWF) - Interim Daily.

IDENTIFICATION OF THE SECONDARY EFFECT EVENT OF AOH

- **Analysis of the average daily ozone data;**
- The average daily value of the total ozone column should be **less than the climatological average** of the month - 1.5 of its standard deviation ($\mu - 1,5\sigma$);

METHODOLOGY



- **Selected the days of possible occurrence of the event;**
- **Stratospheric analysis corresponds to the fields at different levels of potential temperature;**
- **The analysis of the tropospheric dynamics was done through meteorological fields in high and medium atmospheric and surface levels.**

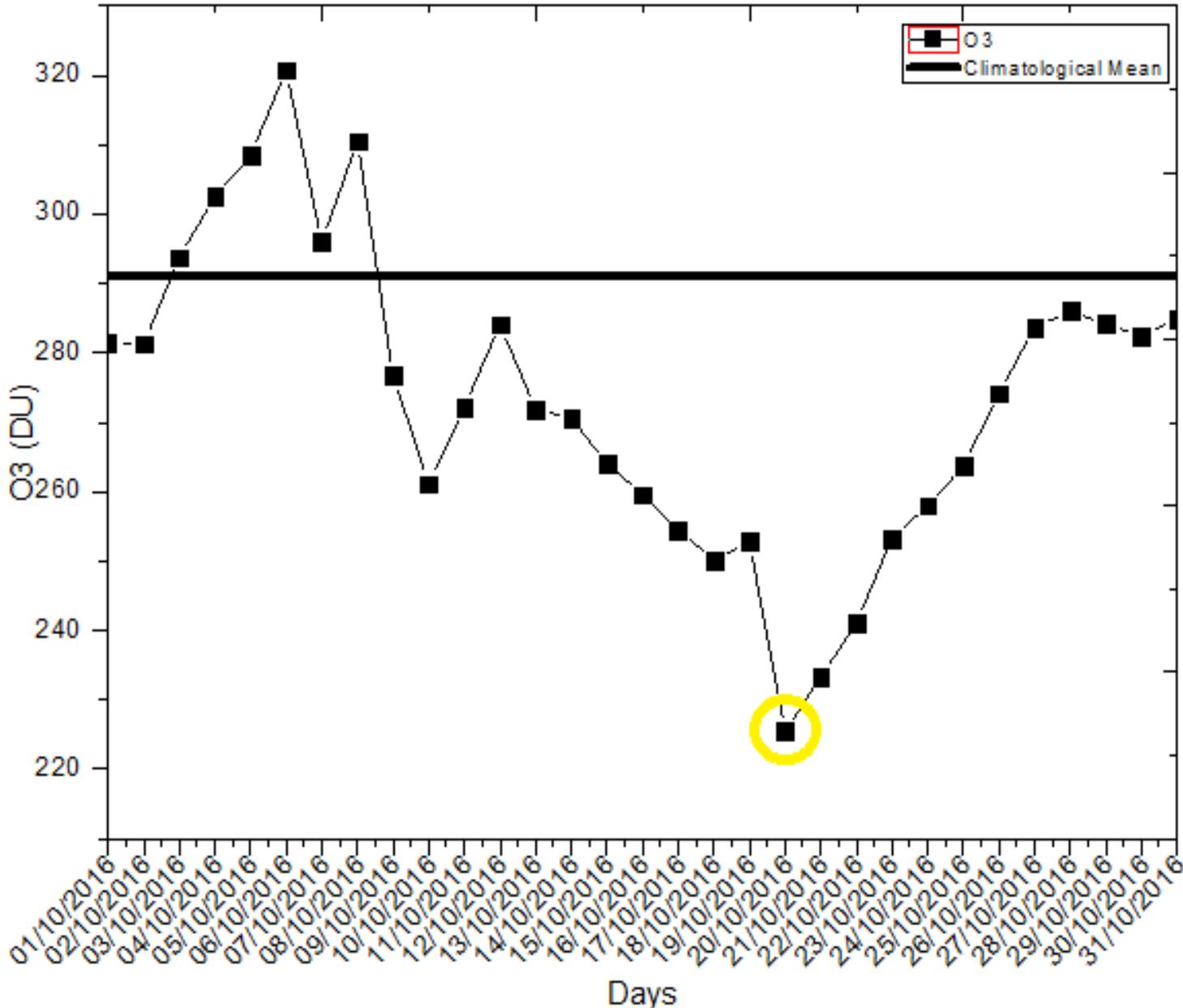
RESULTS

- ❖ **11 years of data analyzed through surface and satellite instruments;**
- ❖ **We identified 34 events of influence of the AOH that reached the southern region of Brazil;**
 - In total, 4015 days were available for analysis;
 - Of this total, 86 days had a value lower than the climatological average - 1.5 of their standard deviation;
 - The 86 days, 34 were characterized as events of secondary effect of the AOH on the southern region of Brazil;

EVENT DAY OCTOBER 20, 2016

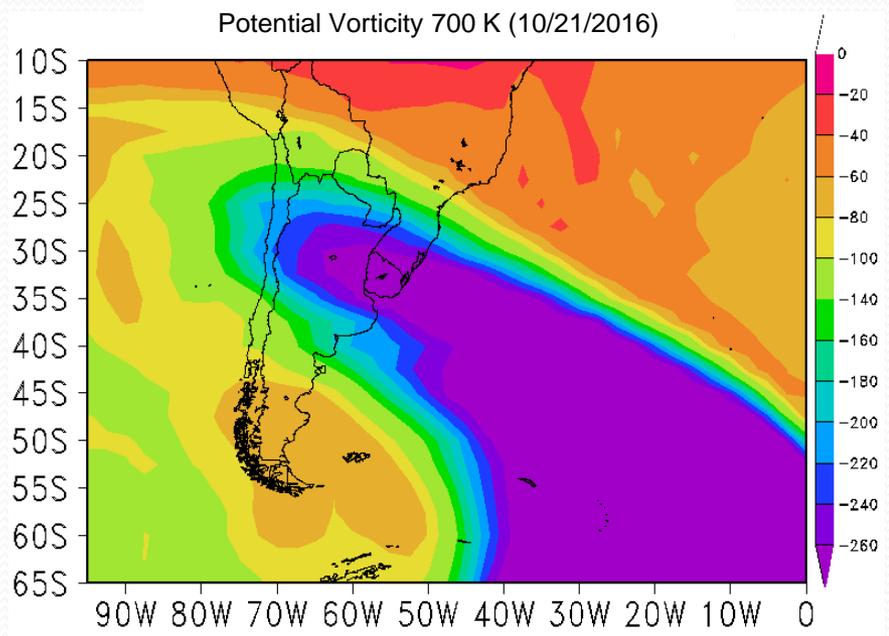
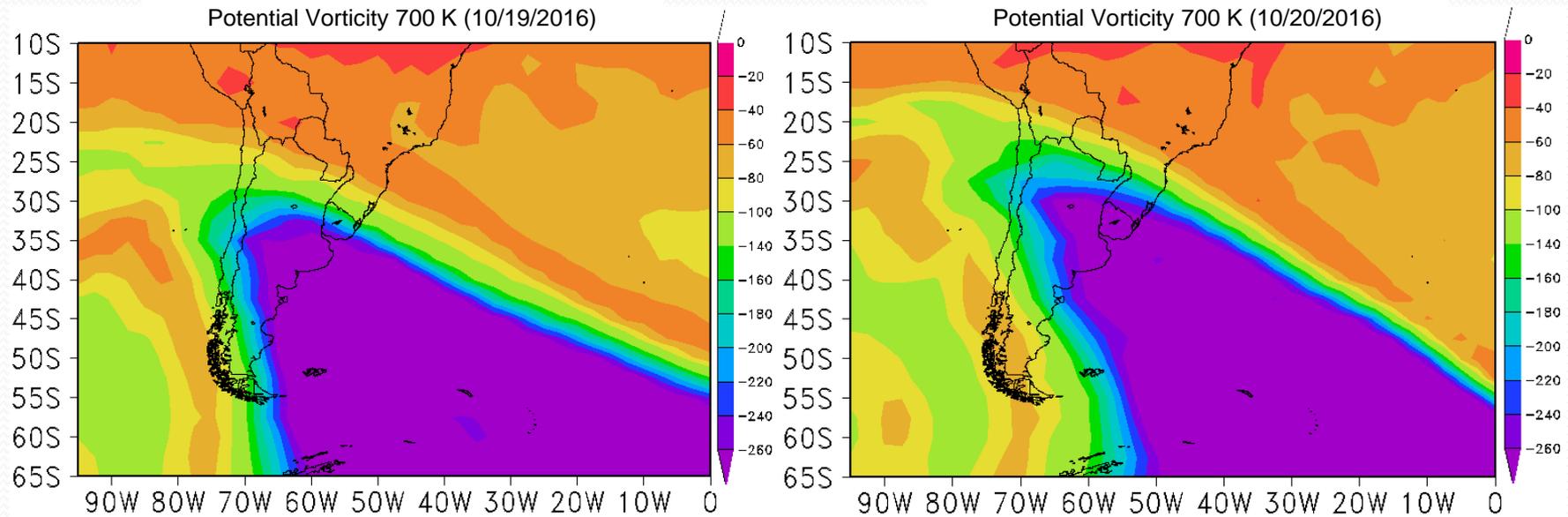
- ❖ **The event of 10/20/2016 was the second most intense event ever recorded in the last 25 years (BITTENCOURT et al., 2018);**
- ❖ **The Brewer Spectrophotometer recorded for the 10/20/16 a value of 225 DU on the region;**
 - The area of the AOH is defined as a region with values less than 220 UD (Hofmann et al., 1997).
- ❖ **Reduction of ~ 21% of the total ozone content, in relation to the climatological average on October;**

EVENT DAY OCTOBER 20, 2016



EVENT DAY OCTOBER 20, 2016

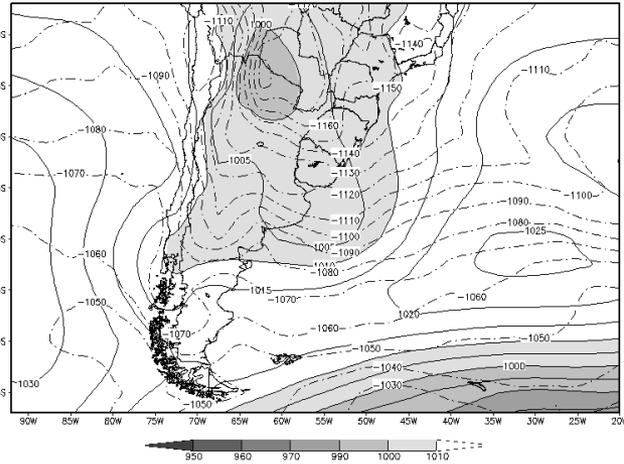
Level 700 K



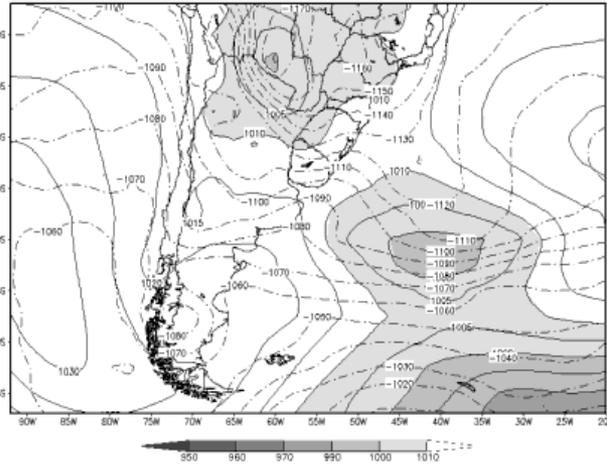
EVENT DAY OCTOBER 20, 2016

ANALYSIS OF TROPOSPHERIC DYNAMICS

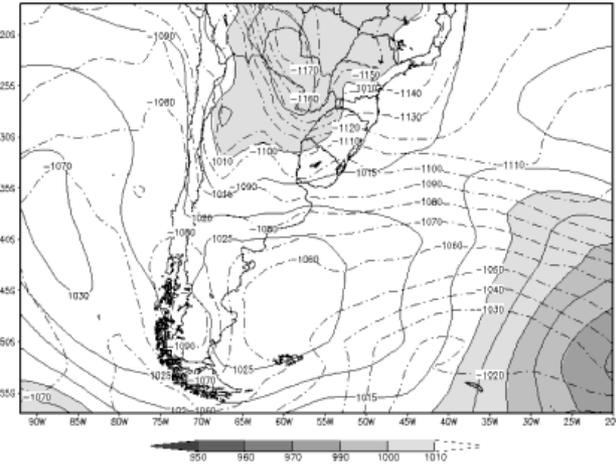
16/10/2016
Sea level pressure (hpa) and Thickness(dam)



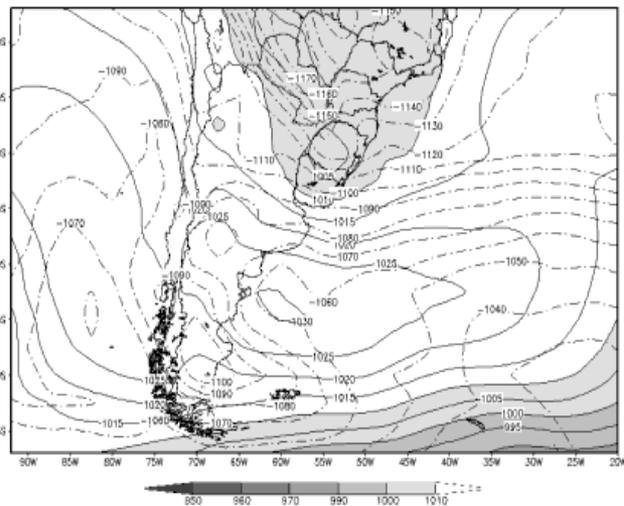
17/10/2016
Sea level pressure (hpa) and Thickness(dam)



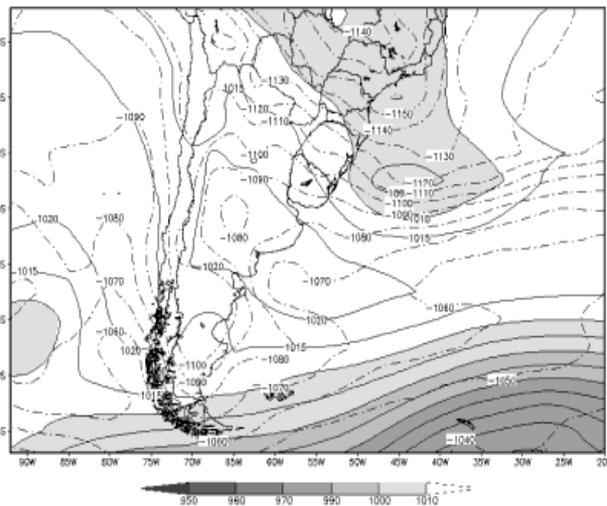
18/10/2016
Sea level pressure (hpa) and Thickness(dam)



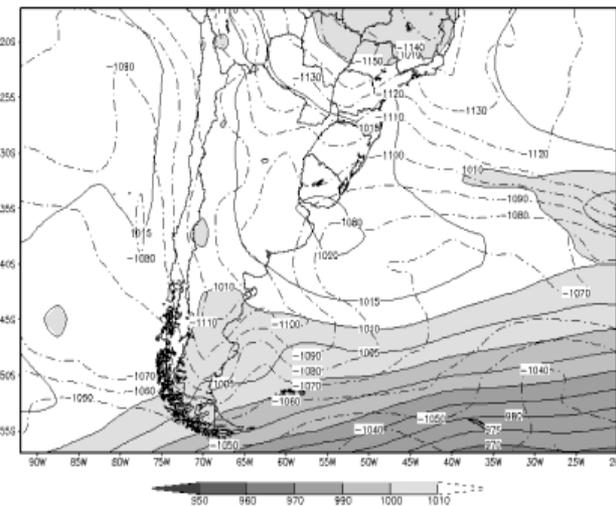
19/10/2016
Sea level pressure (hpa) and Thickness(dam)



20/10/2016
Sea level pressure (hpa) and Thickness(dam)

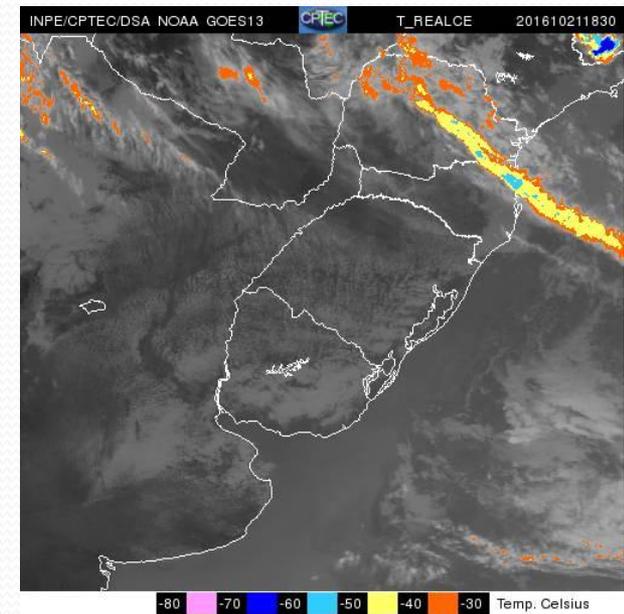
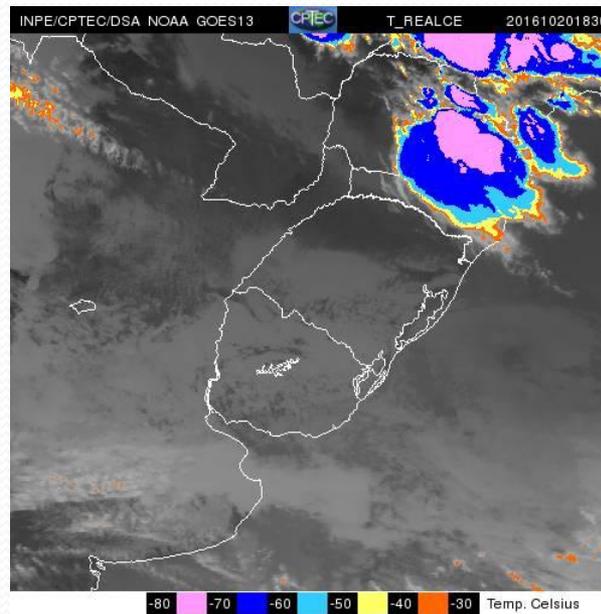
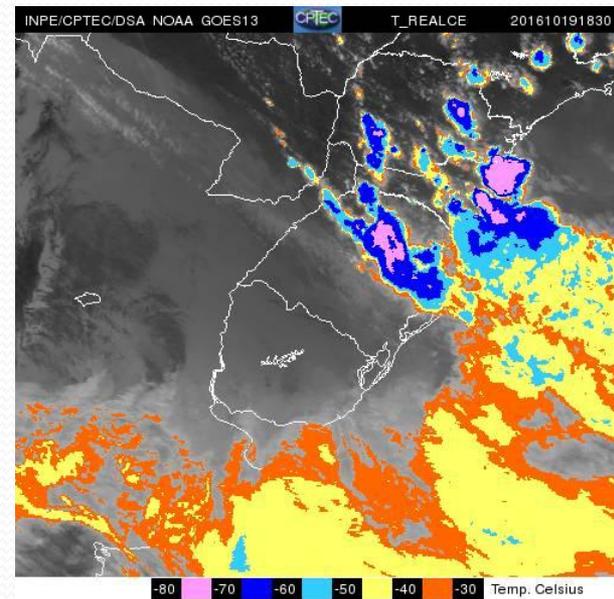


21/10/2016
Sea level pressure (hpa) and Thickness(dam)



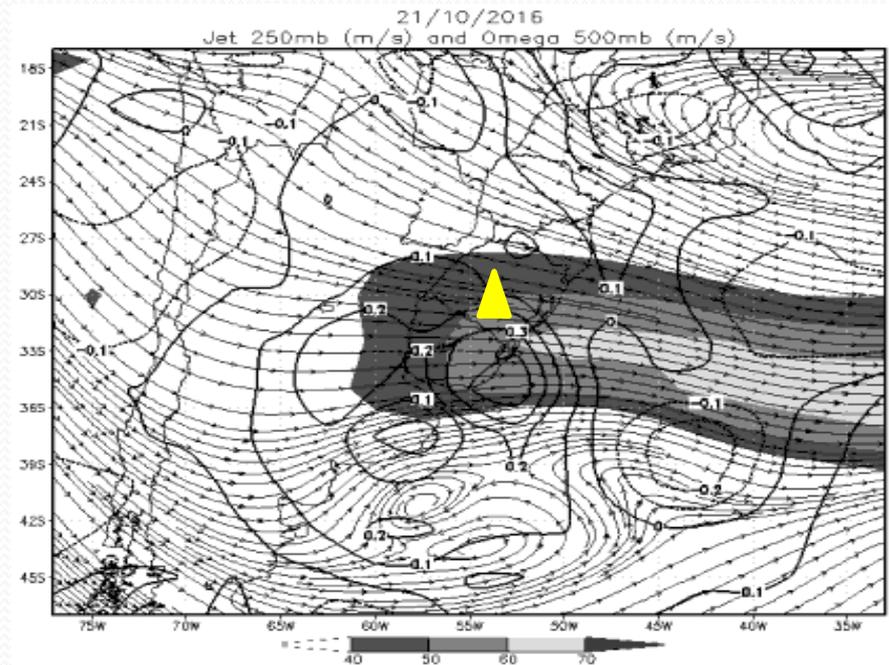
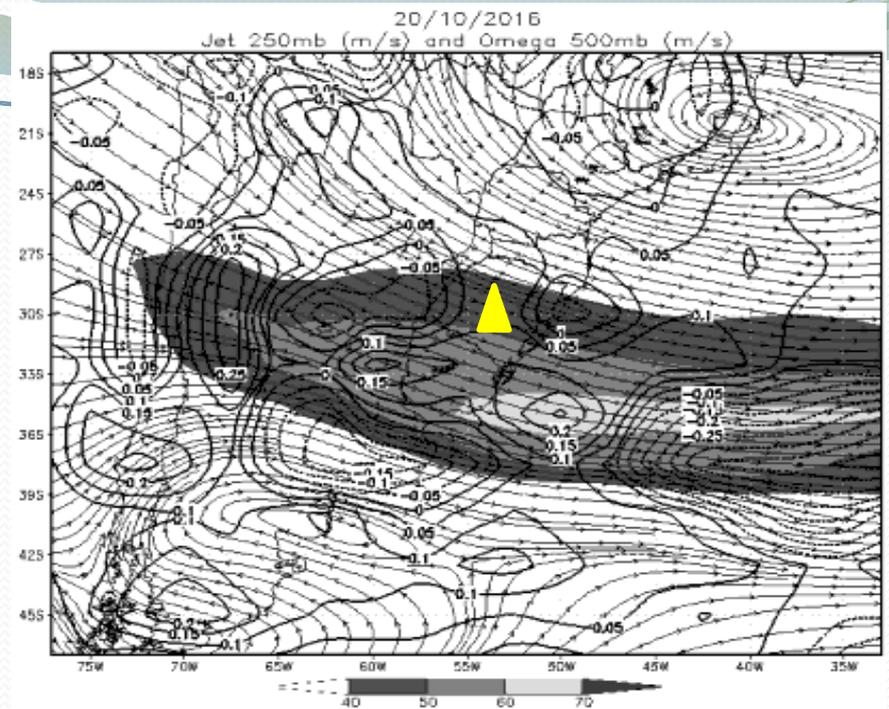
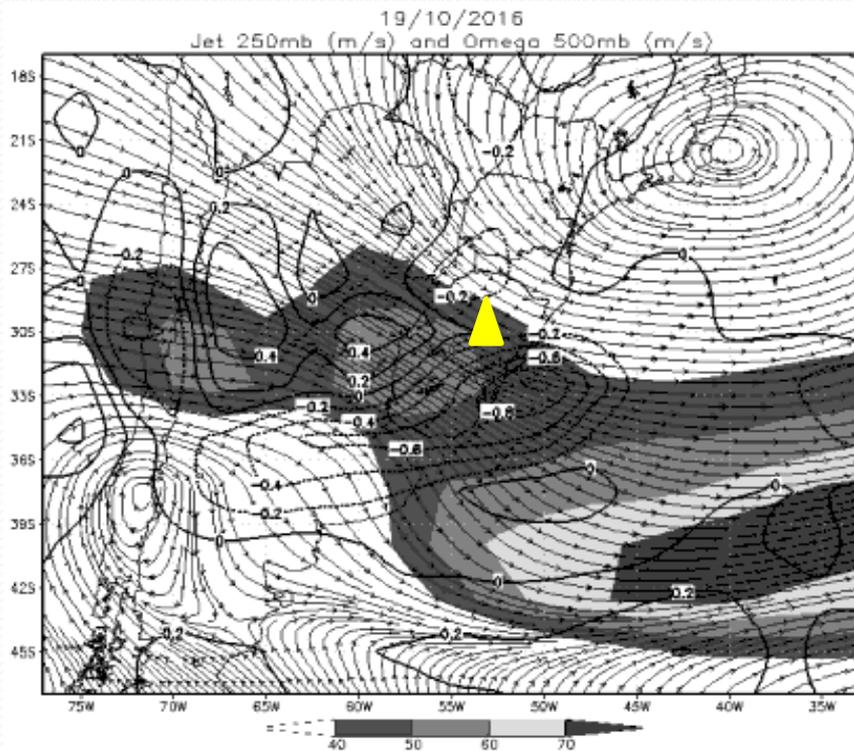
EVENT DAY OCTOBER 20, 2016

- On the surface, the arrival of a high-pressure system helps to stabilize the atmosphere, and the intrusion of the mass of O₃.



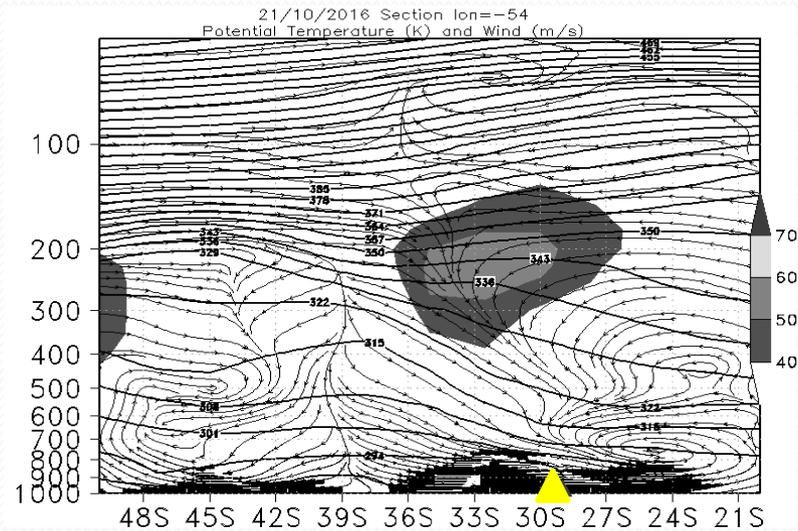
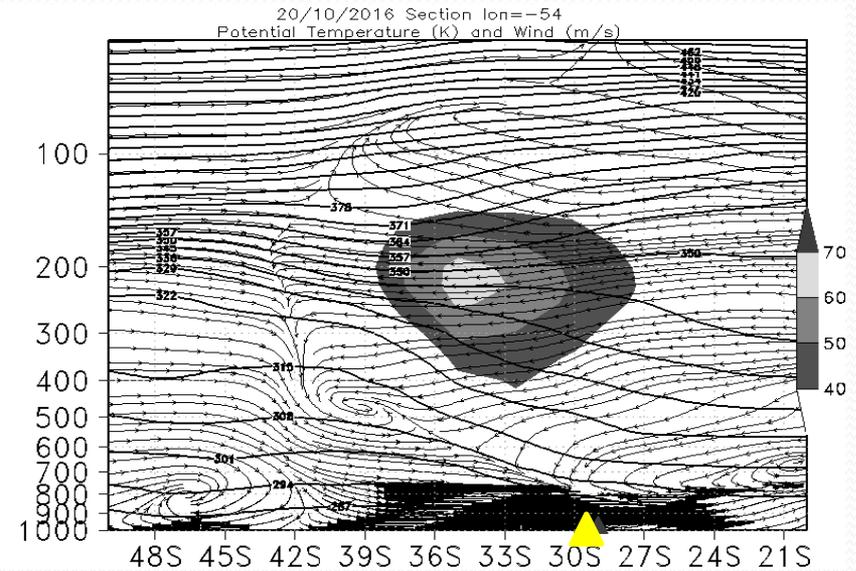
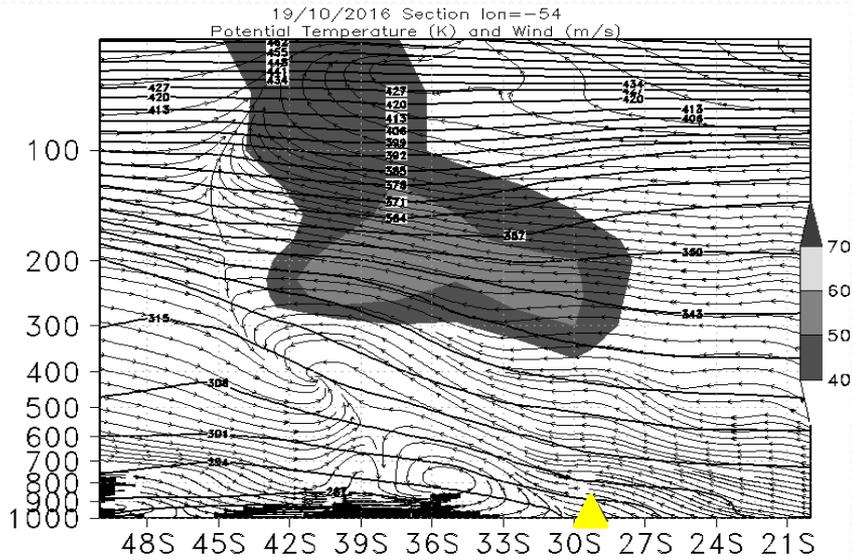
EVENT DAY OCTOBER 20, 2016

- Presence of the subtropical jet stream and center with negative values of Omega;



EVENT DAY OCTOBER 20, 2016

- ❖ Presence of the subtropical jet stream, at higher levels;



STATISTICAL ANALYSIS

✓ During the 11 years of analysis:

- 17.6% occurred in August (6 events);
- 32% in September (11 events); ←
- 38% in October (13 events); ←
- 11.7% in the month of November (4 events)

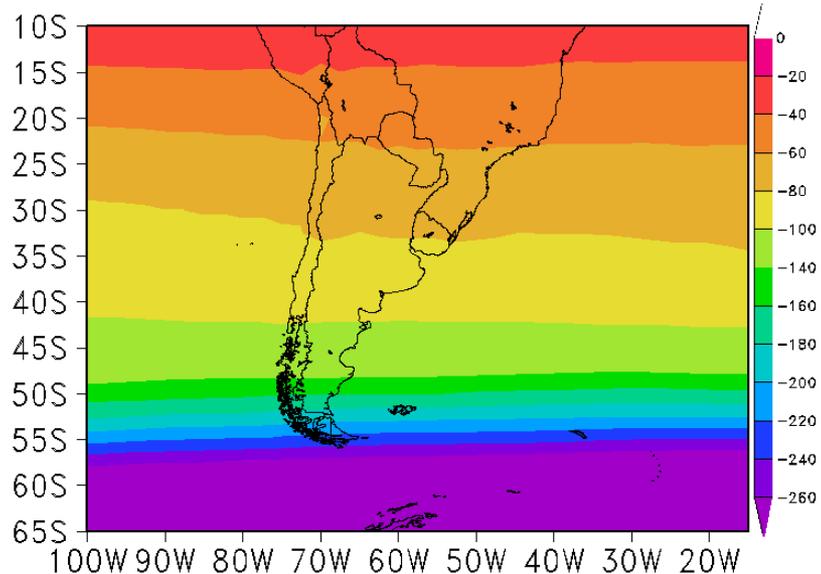
✓ In relation to the presence of the subtropical and / or polar jet stream, we have:

- of the 34 events, in 91% of the cases the jet stream was present;

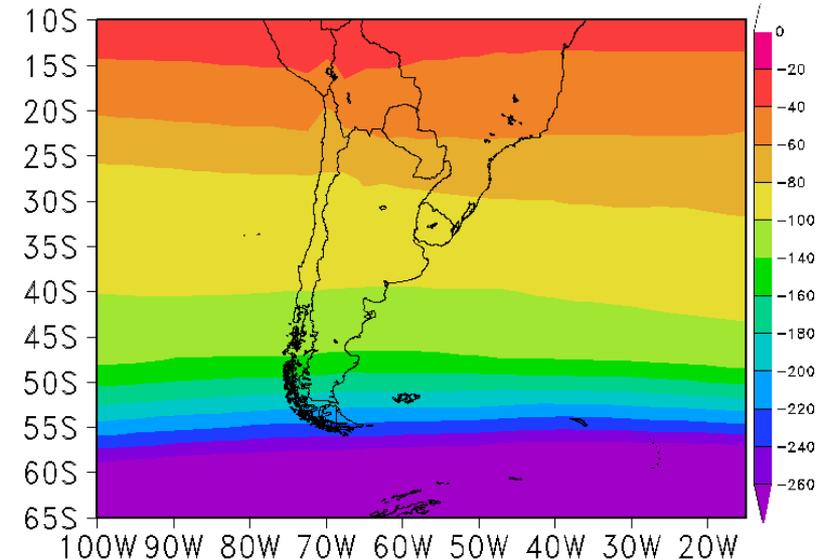
✓ In 68% of cases, the event occurred after the passage of a frontal system over the study region;

CLIMATOLOGY

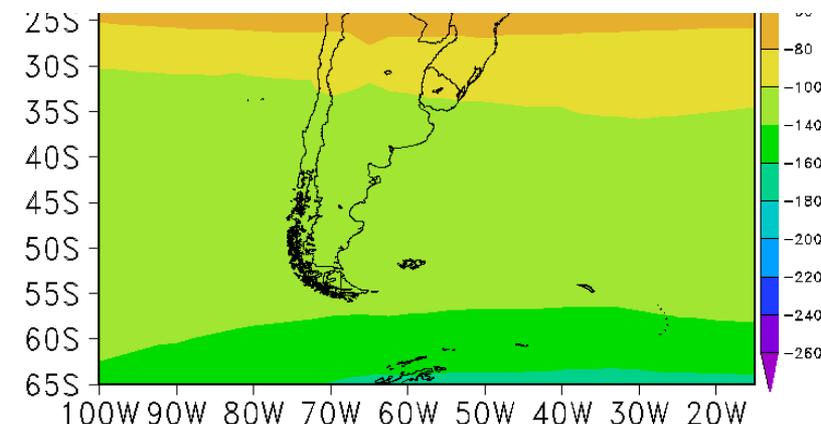
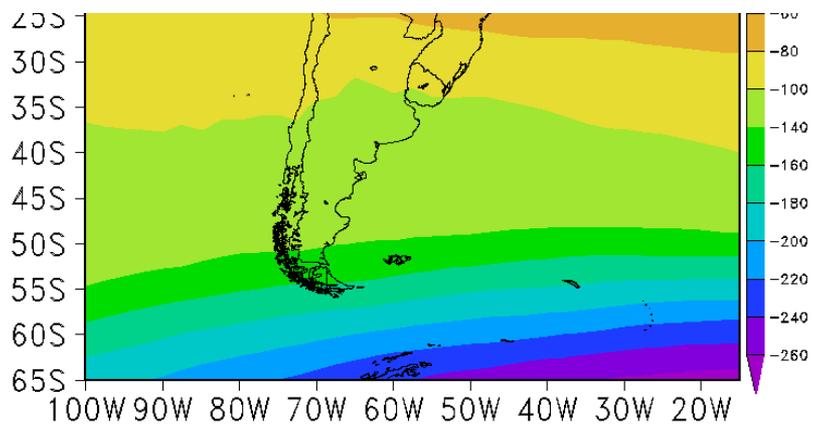
Potential Vorticity Climatology - August (2006 – 2016) 700 K



Potential Vorticity Climatology - September (2006 – 2016) 700 K

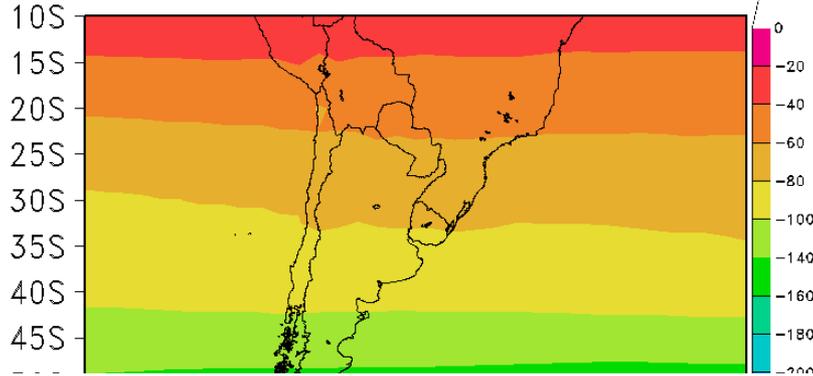


➤ For the fields of climatology from August to September, it is observed:
→ increase of APV in the months of August and September, close to 65° S;

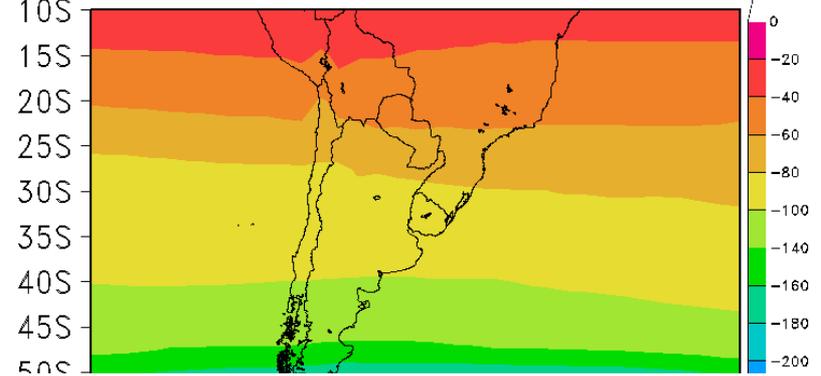


CLIMATOLOGY

Potential Vorticity Climatology - August (2006 – 2016) 700 K

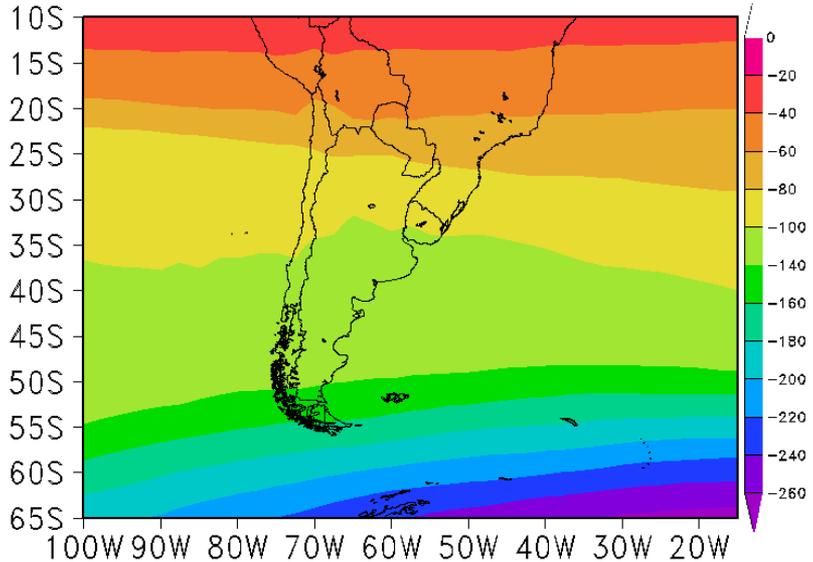


Potential Vorticity Climatology - September (2006 – 2016) 700 K

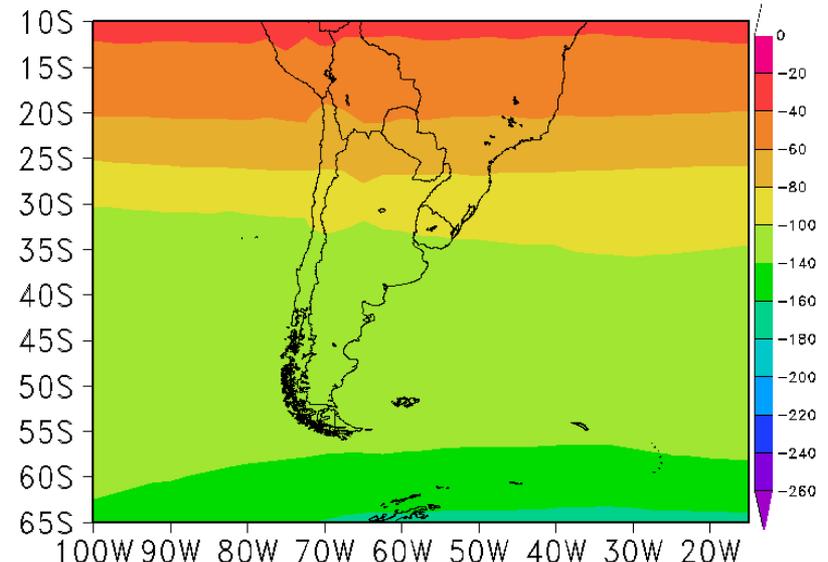


➤ In the months of October and November the opposite is observed, a decrease in VPA over the region;

Potential Vorticity Climatology - October (2006 – 2016) 700 K

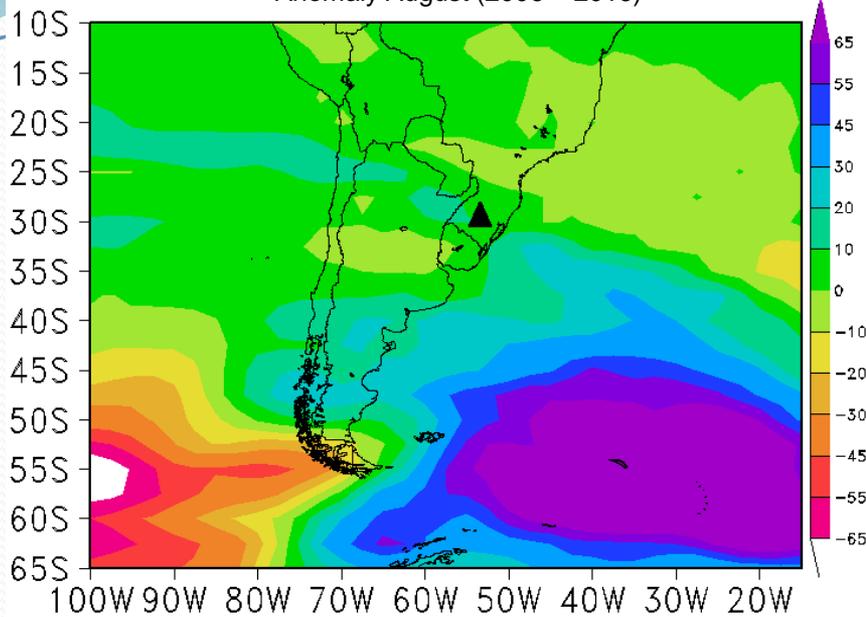


Potential Vorticity Climatology - November (2006 – 2016) 700 K

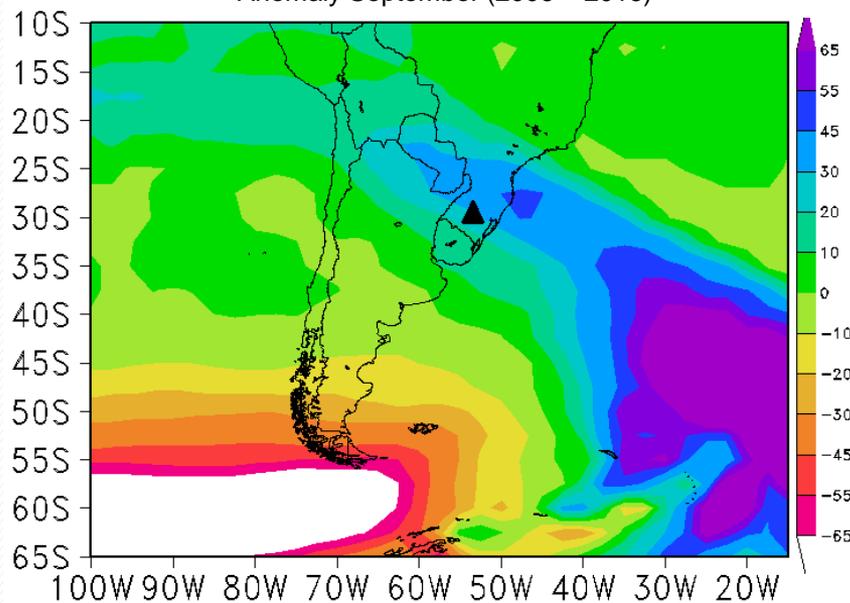


ANOMALY

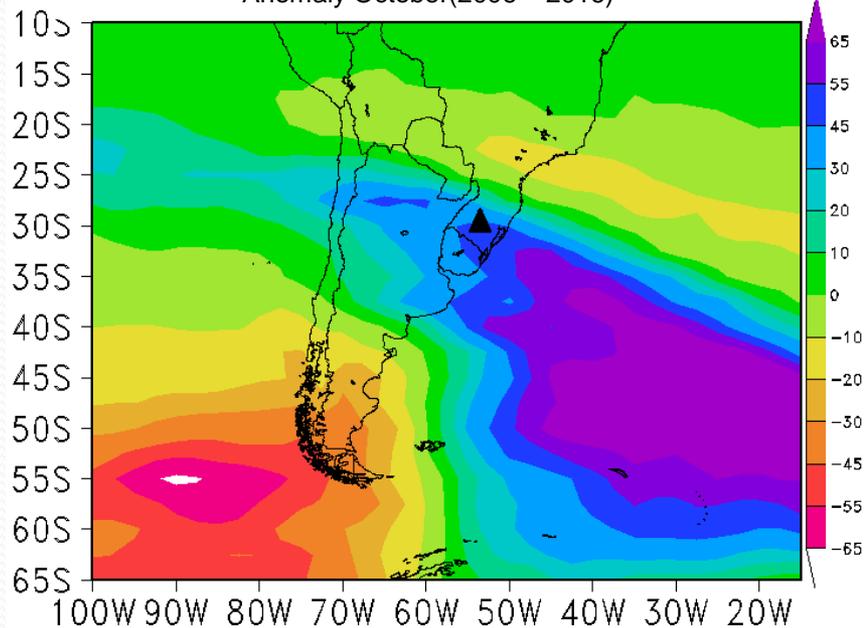
Anomaly August (2006 – 2016)



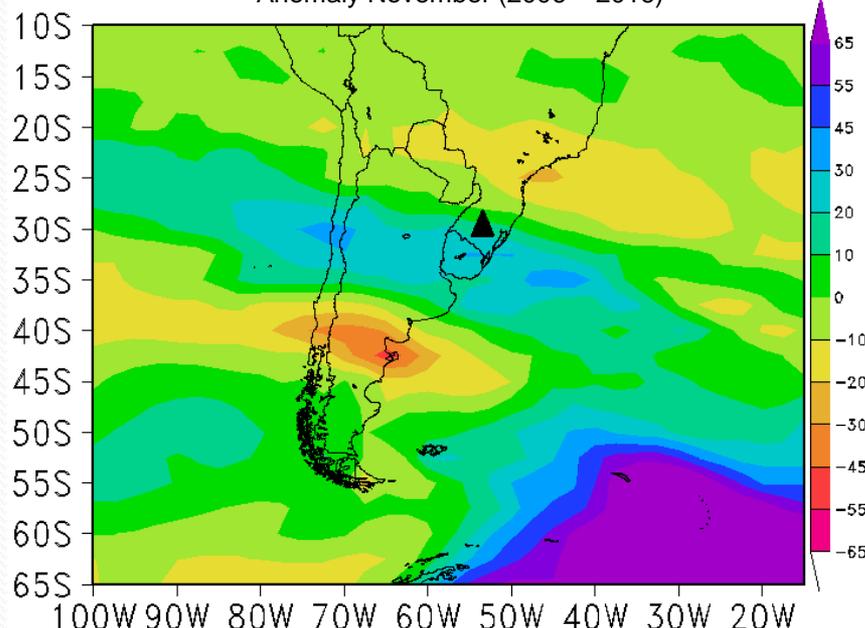
Anomaly September (2006 – 2016)



Anomaly October (2006 – 2016)

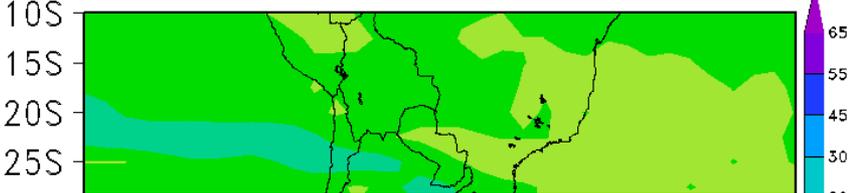


Anomaly November (2006 – 2016)

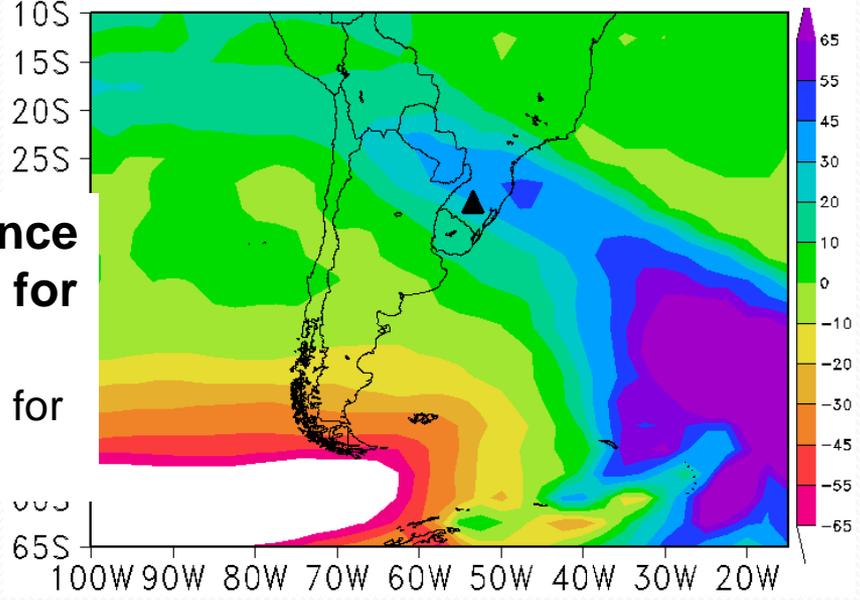


ANOMALY

Anomaly August (2006 – 2016)

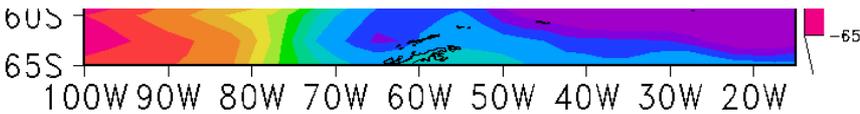


Anomaly September (2006 – 2016)

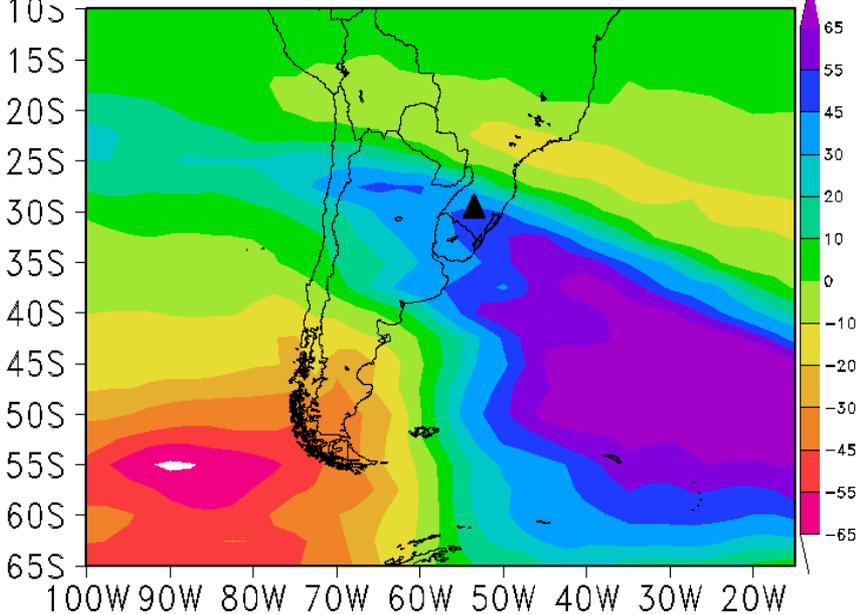


For the anomaly analyzes, the predominance of positive anomalies is observed, mainly for the months of September and October.

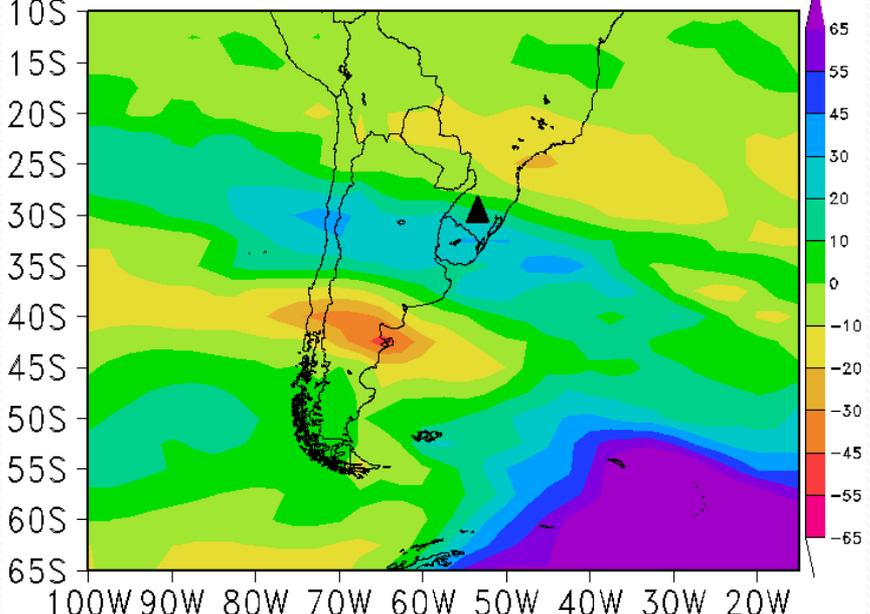
○ months with greater occurrence of events for the period analyzed;



Anomaly October (2006 – 2016)

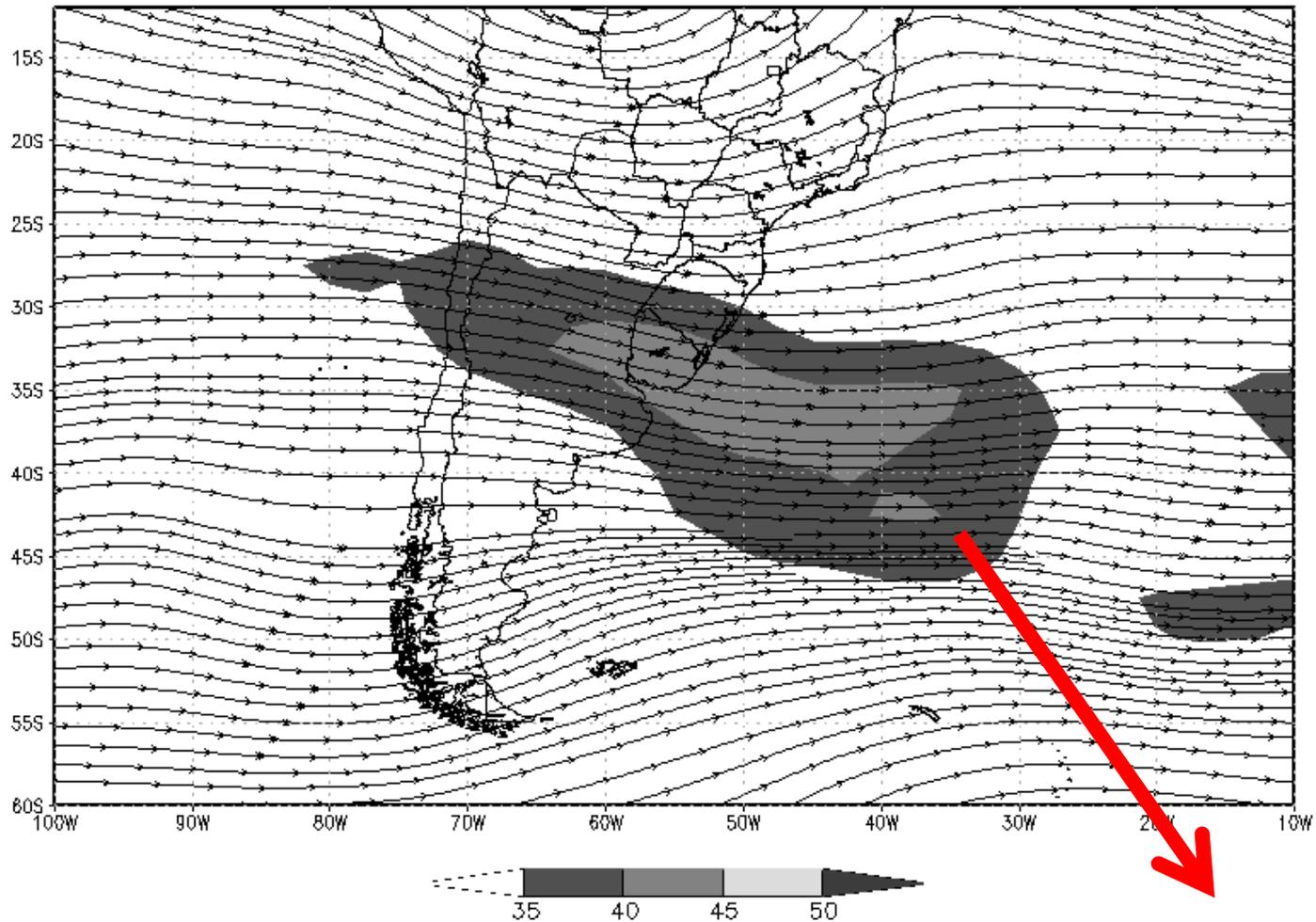


Anomaly November (2006 – 2016)



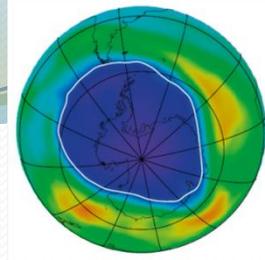
MEDIUM HORIZONTAL FIELD OF EVENTS

MEDIUM FIELD 34 EVENTS (2006 - 2016)
Jet 250 mb



SUBTROPICAL JET

CONCLUSIONS



- ✓ We identified 34 events of influence of the AOH on the Southern region of Brazil for the period of 11 years of data;
- ✓ The climatology of the stratospheric fields presented a increase of APV in the months of August and September;
- ✓ Prevalence of positive anomalies for the months of analysis, mainly in September and October over the study region;
- ✓ Of the 34 cases, 91% confirmed the presence of the jet stream, and 68% after the passage of frontal systems;