During this Master's thesis two main types of data have been used : in situ chemical and biological observations, arising from three oceanographic campaigns led in 2006, 2008 and 2009 at Drake Passage in the frame of the Drake project. The region which is located between the southern tip of South America and the northern Antarctic Peninsula, is the narrowest constriction of the Antarctic Circumpolar Current (ACC) in the Southern Ocean (SO). This is the largest current system in the world and plays a key role in connecting the three major ocean basins allowing exchanges of heat, salt, carbon and other chemical and biological properties. The main objective of this study was trying to identify a concurrent variability between air-sea CO2 fluxes and the ACC front locations, but also with the phytoplankton biomass over the 3-year Drake project. For this, Total Alkalinity (TA) and Dissolved Inorganic Carbon (DIC) measurements collected in 2006 and 2009 were used. They were firstly calibrated and associated partial pressure of CO2 data were computed at the LOCEAN laboratory, in Paris by using a MATLAB R version of the CO2SYS programme. A continuous surface fugacity of CO2 record was also used for the year 2008. Then, air-sea CO2 fluxes over Drake Passage were calculated for the three expeditions at the LEGOS laboratory, in Toulouse. Phytoplankton pigment samples collected in 2009 were then analysed at AWI, in Bremerhaven by using a High-Performance Liquid Chromatography (HPLC) system. The resulting pigment concentrations were ran through a MATLAB R version of the CHEMTAX R software in order to determine the different phytoplankton assemblages for the last Drake campaign. Remotely sensed data through ocean color satellite images were taken into consideration to assess an eventual concurrent variability of the biological activity. However, an important cloud cover observed for the 3-years does not allow any relevant comparison. From the obtained results, the strength of the wind appears to be the key element regarding the variability of the CO2 fluxes at the air-sea interface in 2009. The ACC fronts and associated branches play a role in the phytoplankton distribution over the Drake Passage such as it has been observed with the apparition of diatoms around the Polar Front. A potential weakening of the atmospheric CO2 storing capacity by the ocean was also detected between 2006 and 2009 attesting the hypothesis of the saturation of the Southern Ocean CO2 at Drake Passage.