# Effects of river streamflow on summer-winter dynamics of pH/$pCO_2$ in a Patagonia highly stratified fjord

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## Introduction

Patagonian fjords are characterized by subantarctic surface water receiving high volume of freshwater from rivers and glacial discharge. The interplay between continental and marine influences affect the chemical stoichiometry, and finally affect the plankton community in an "uncertain way" that make a difficult task the modelling efforts. In addition, fjords will face major changes in the carbonate chemistry speciation which most probably will trigger changes in carbon budgets, impacting primary productivity and the entire biogeochemistry of this cold and rainy region. In order to investigate the summer-winter pH/$pCO_2$ dynamics related to freshwater streamflow seasonal changes, we analysed the first high frequency of *in situ* pH and $pCO_2$ time series, daily river streamflow, monthly sampling of pH, total alkalinity of Reloncavi fjord between January (summer) to October (early spring) 2015.

## Methods

In order to investigate the summer-winter pH/$pCO_2$ dynamics related to freshwater streamflow, we analysed high temporal resolution observations of *in situ* pH and $pCO_2$ (SAMI, at 3.5 m), daily river streamflow, bimonthly sampling of pH, total alkalinity (AT) at the middle section of Reloncavi fjord between January to July 2015 (Vergara et al #57).

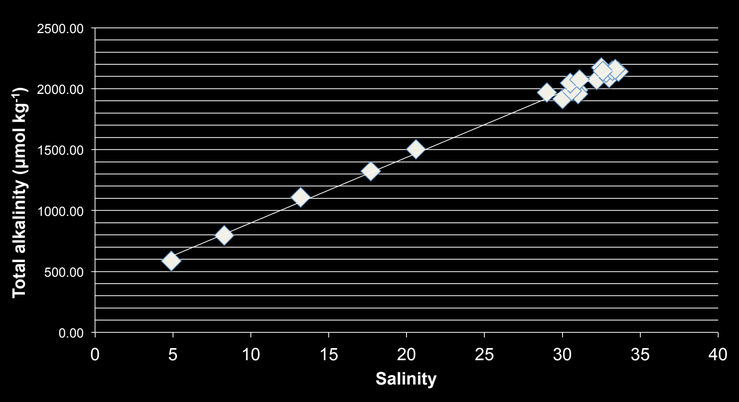


Figure 2: The observed total alkalinity (TA) and its relationship with salinity during the all period and the top 15 m surface layer showed a significant linear relationship, and the zero salinity intercept of the regression was 360 µmol $kg^{-1}$.

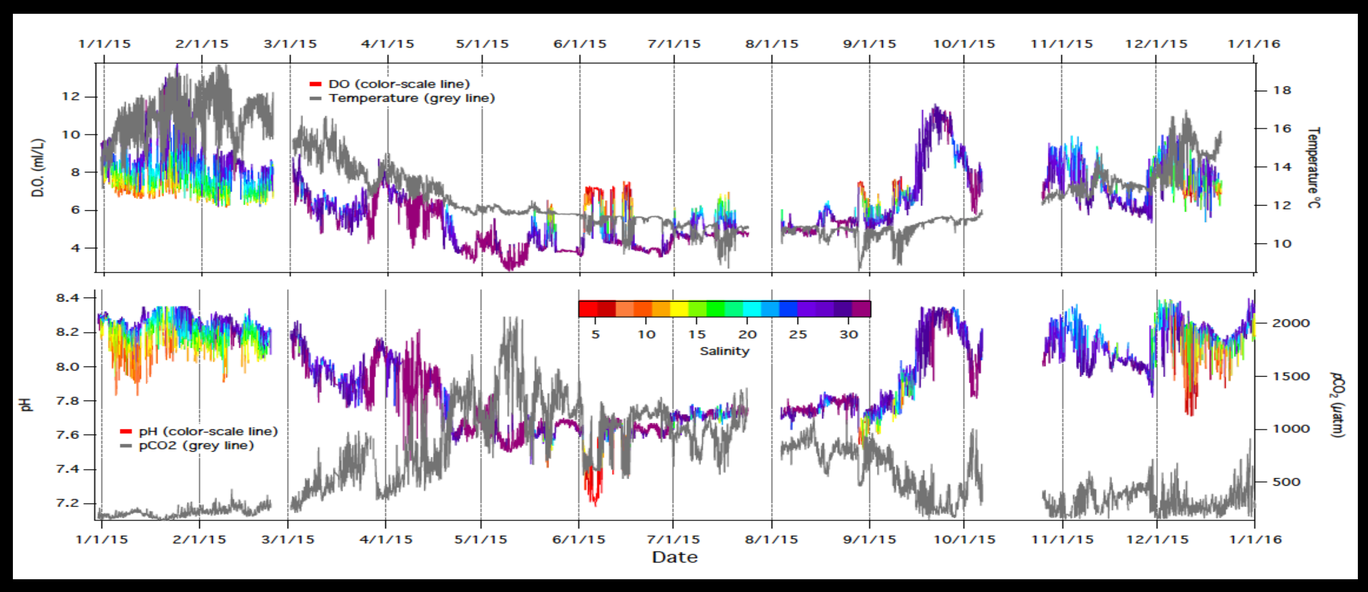


Figure 1: During austral summer, data showed the lowest $pCO_2$ and highest pH values, coincident with the low freshwater inputs (218 – 307 $m^3$ $s^{-1}$), high phytoplankton biomass (2 - 4 mg $m^{-3}$) and high dissolved oxygen (>6 mg L-1). In austral winter we observed that increased $pCO_2$ and a decreased of pH was associated to high freshwater inputs (1049 – 1402 m $s^{-1}$) of and low phytoplankton biomass (<0.5 mg $m^{-3}$). Summer-winter pH/$pCO_2$ variability showed that riverine freshwater inputs and phytoplankton biomass affected the chemistry features of the fjord, indicating that increased/decreased freshwater inputs play a role enhancing the shift from $CO_2$ sink in summer-autumn (high primary production) to a $CO_2$ source in winter (high community respiration and $CO_2$- rich oceanic water advection).

## Results

Strong summer-winter variability showed that the influence of freshwater layer affected the $pCO_2$ and pH dynamics of the surface water of the fjord. During summer months, data showed the lowest $pCO_2$ (mean=200 µatm) and highest pH values (8.0 – 8.2), coincident with high variabilty in salinity (5 – 30 psu). In contrast, we observed that increased winter freshwater inputs decreased pH (down to 7.6), $A_T$ (<1000 µmol $kg^{-1}$), and increased $pCO_2$ (>800 µatm). From autumn to winter salinity increased up to 32.5 psu, indicating strong oceanic water influence in the middle section of the fjord. The surface water shows a winter undersaturation of Aragonite ($\Omega < 1$), contrasting with oversaturated levels of warmer waters of summer period (Vergara et al, Poster #57) .