Atmospheric carbon invasion in the meridional border of California Current surface water

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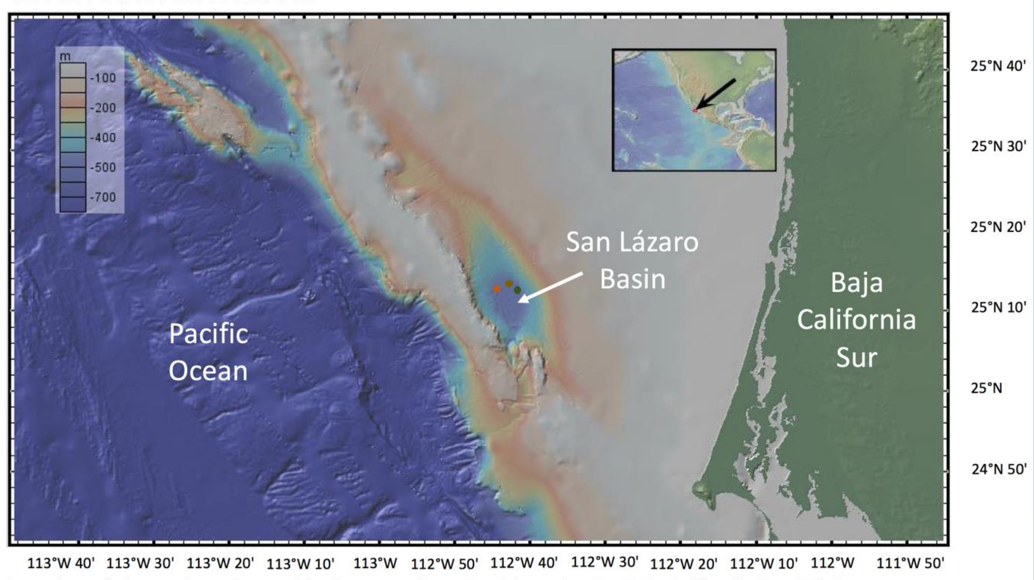
Introduction

San Lázaro basin (SLB) is located in the southern boundary of the California Current System (CCS) and its conditions allows for the well preserved laminated sediments of the sea floor.

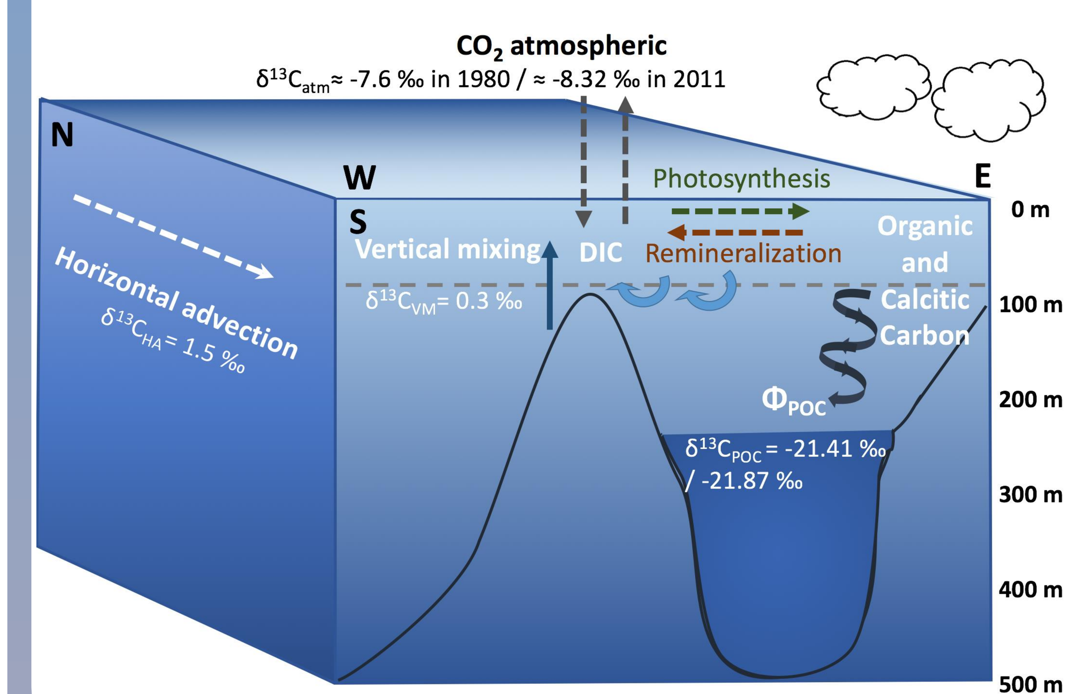
Cores retrieved from SLB



Location of the study region and bathymetry from San Lázaro basin, Baja California Sur, México

The carbon isotopic composition of the main processes in the study region and obtained from instrumental data and information from the laminated sediments in SLB.

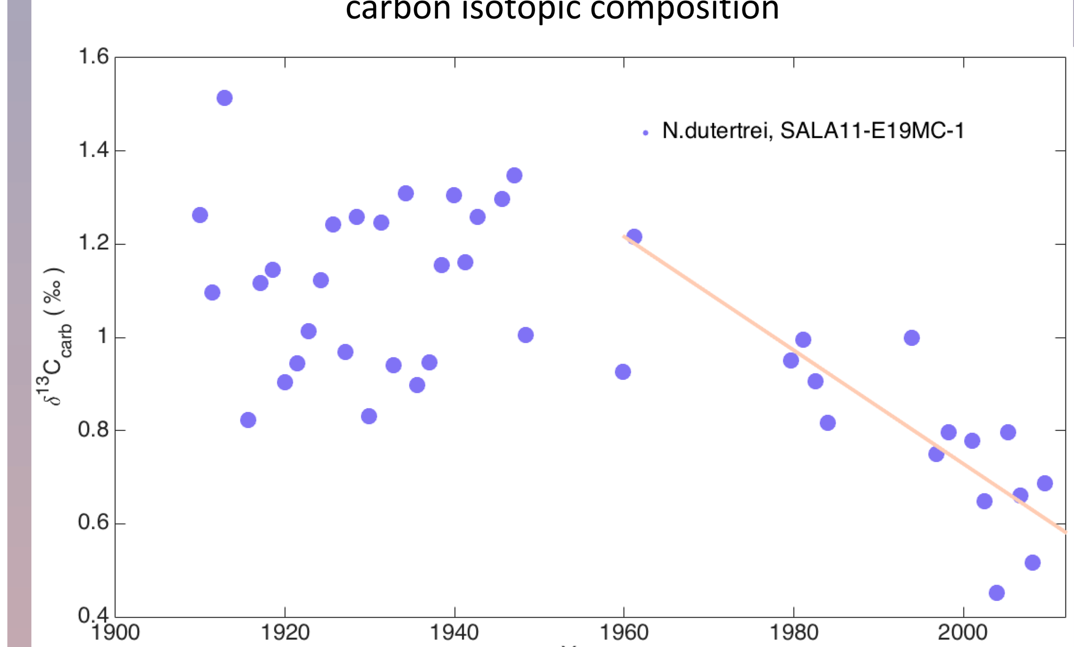
$$\delta^{13}C\,(‰) = \left(\frac{{}^{13}C/{}^{12}C_{Muestra}}{{}^{13}C/{}^{12}C_{Estándar}} - 1\right) \times 1000$$

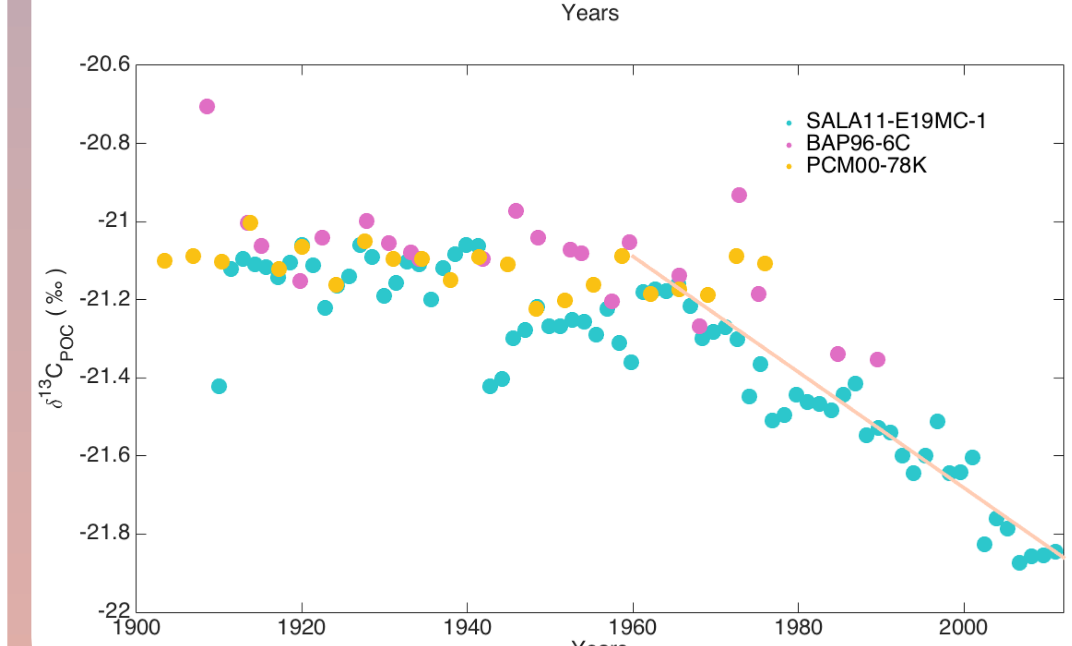


Main processes that affect the carbon cycle and their isotopic composition

Results

Time series for the last century of organic and inorganic carbon isotopic composition

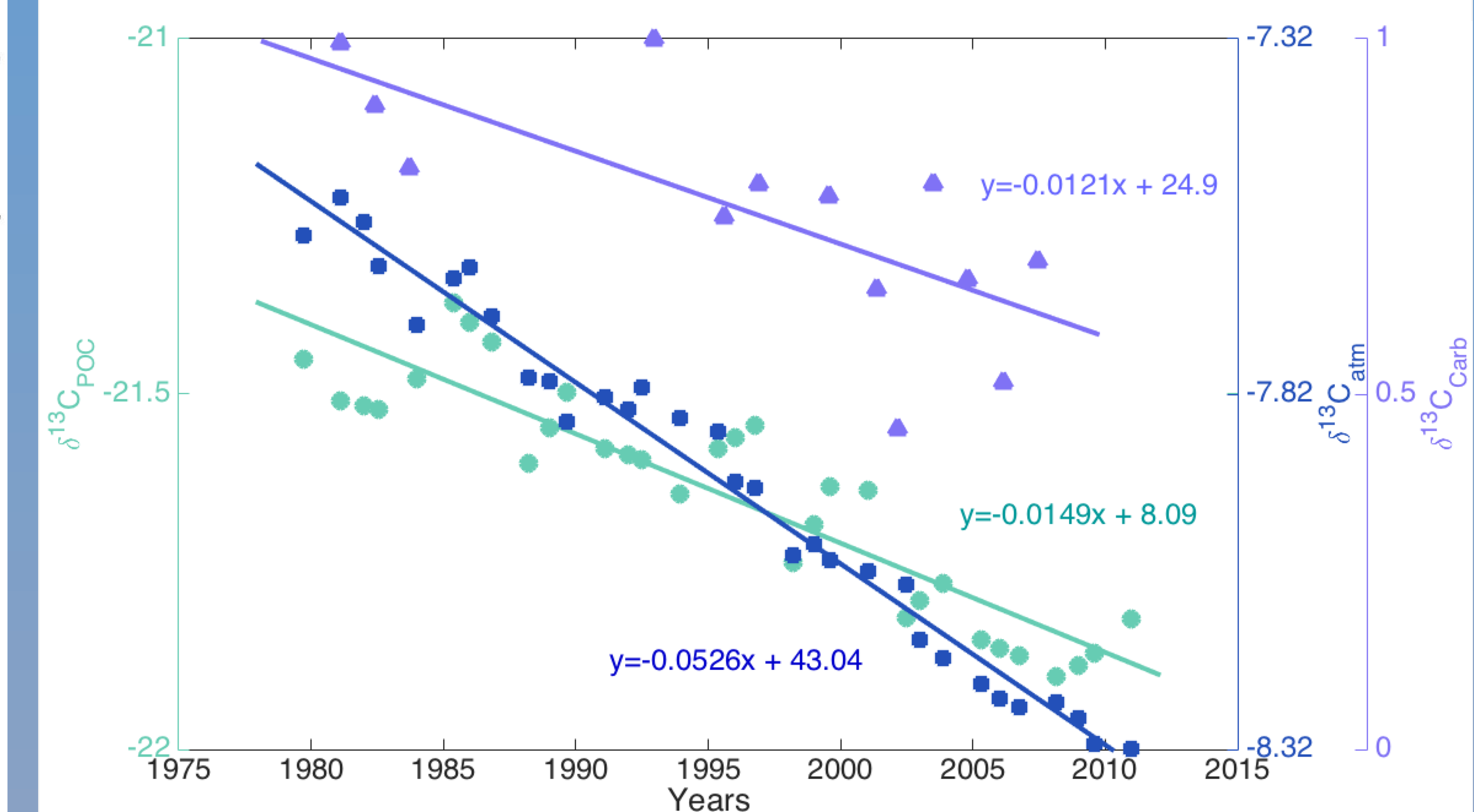




Discussions

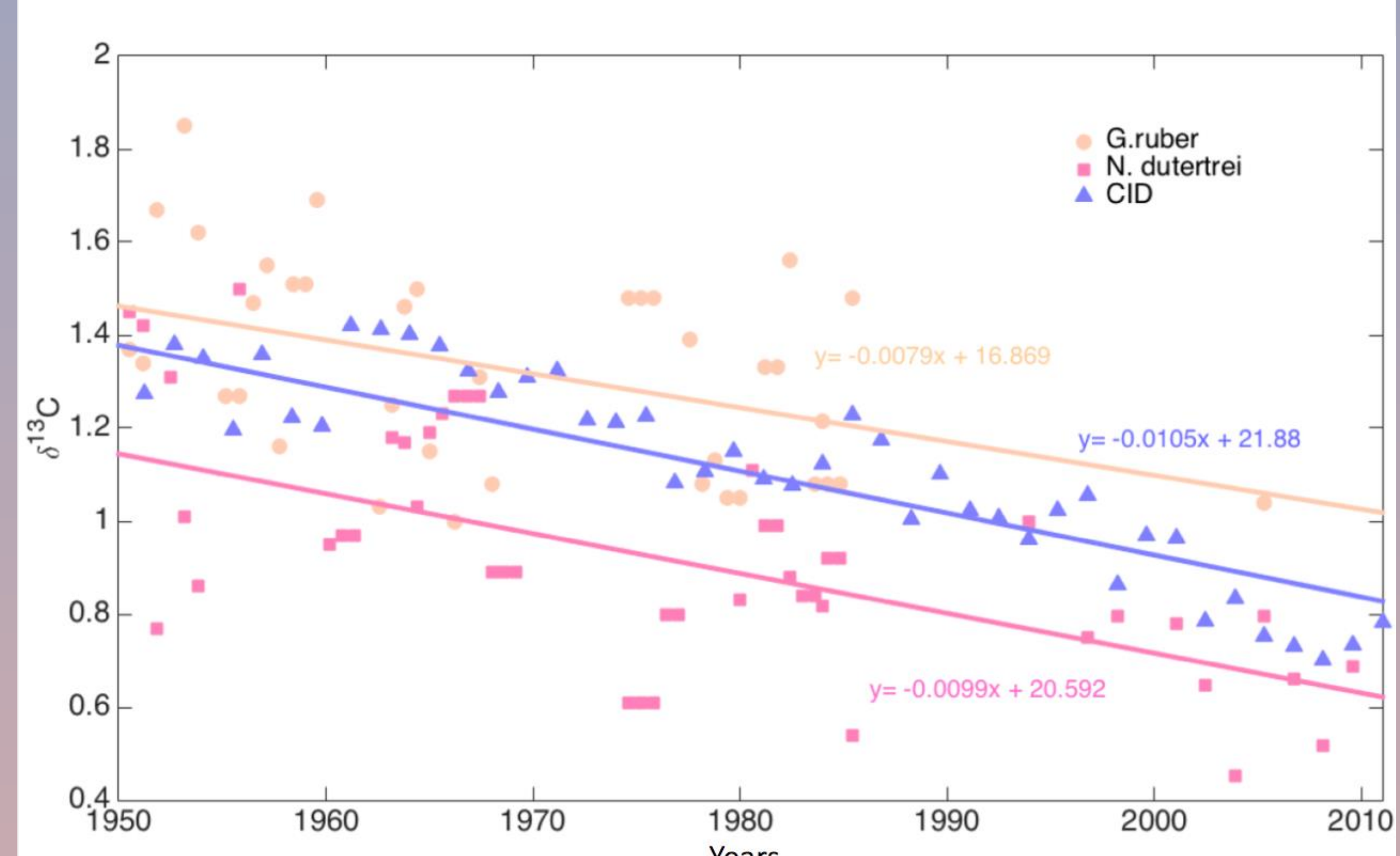
How much is the Suess Effect observed in an eastern boundary upwelling system as is the CC?

To know the origin and redistribution of the CO_2 in the ocean we use the stable carbon isotopic composition in two phases



The slopes of the carbon isotopic composition in the carbonates (carb) and in the particular organic carbon (POC) show a similar tendency to atmospheric carbon isotopic composition, that means the Suess Effect, but the differences between them mean the presence of other processes.

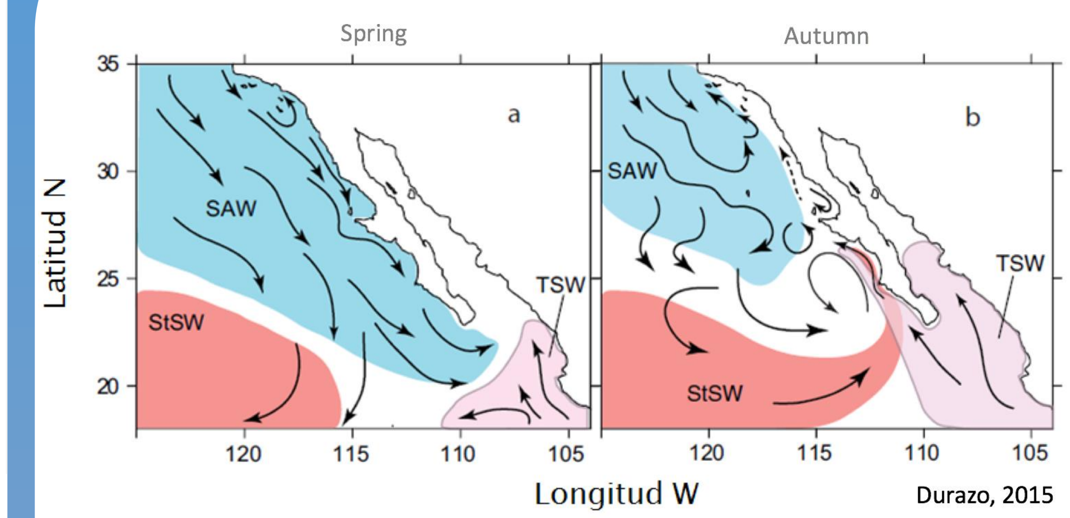
We calculated $\delta^{13}C$ of the mixed layer considering a constant fractionation fraction of 22.5 ‰, and compared it with two planktic foraminifera that live in different conditions.



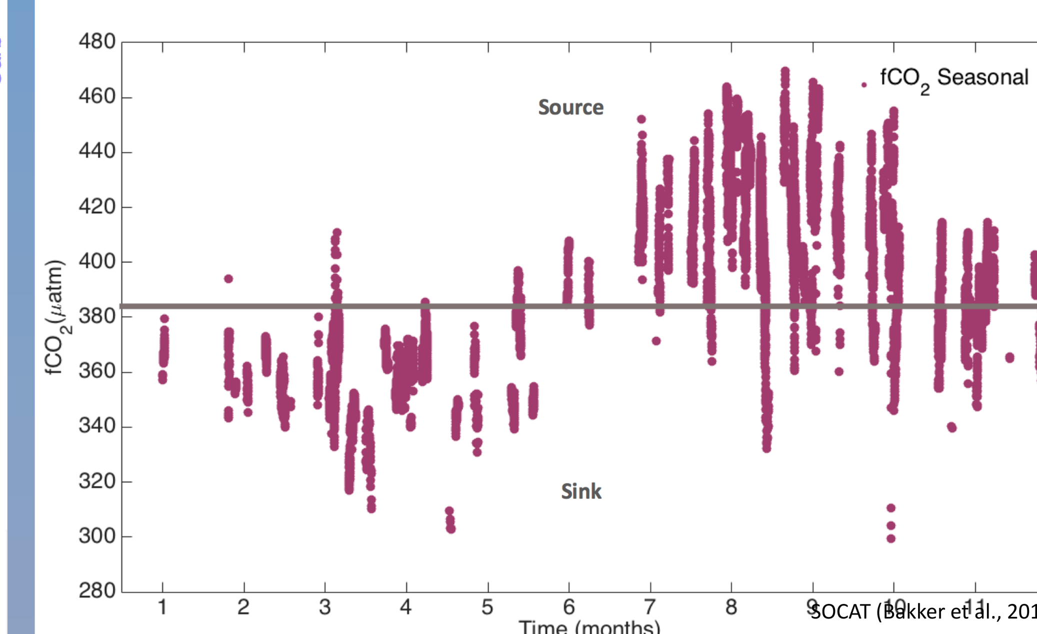
There are no significant differences in the slopes

The results obtained from the assumption of the constant fractionation in time generated from the observations (Rau et al., 2000) show that there is no change in fractionation, and therefore the change is in the isotopic composition of the dissolved inorganic carbon in the mixing layer, from which fractionate the planktic foraminifera and phytoplankton.

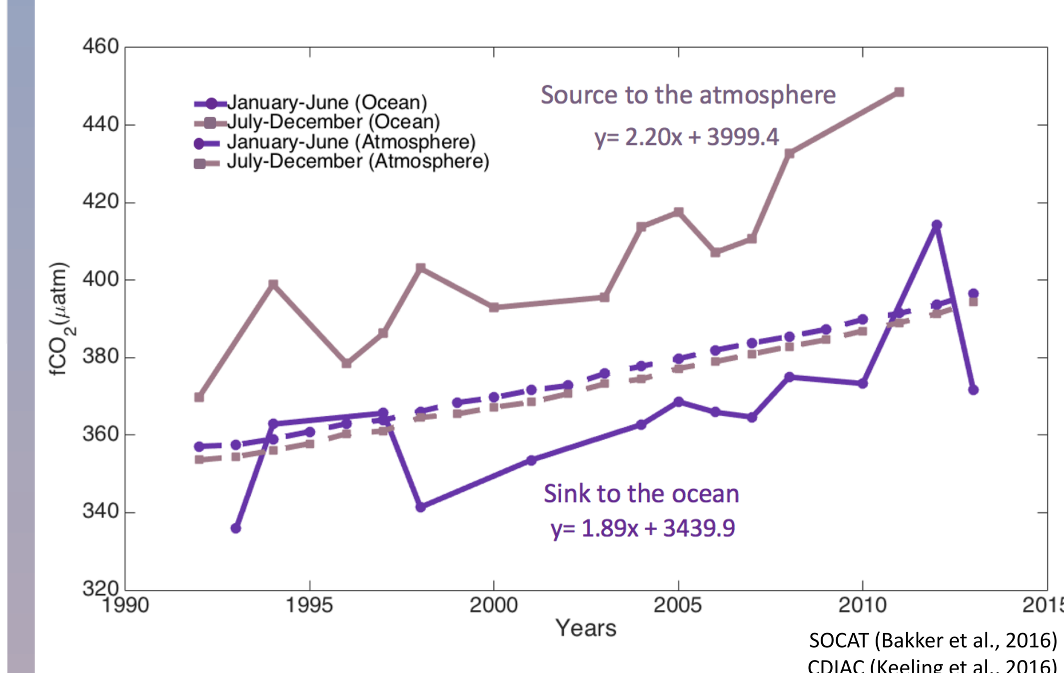
Instrumental data



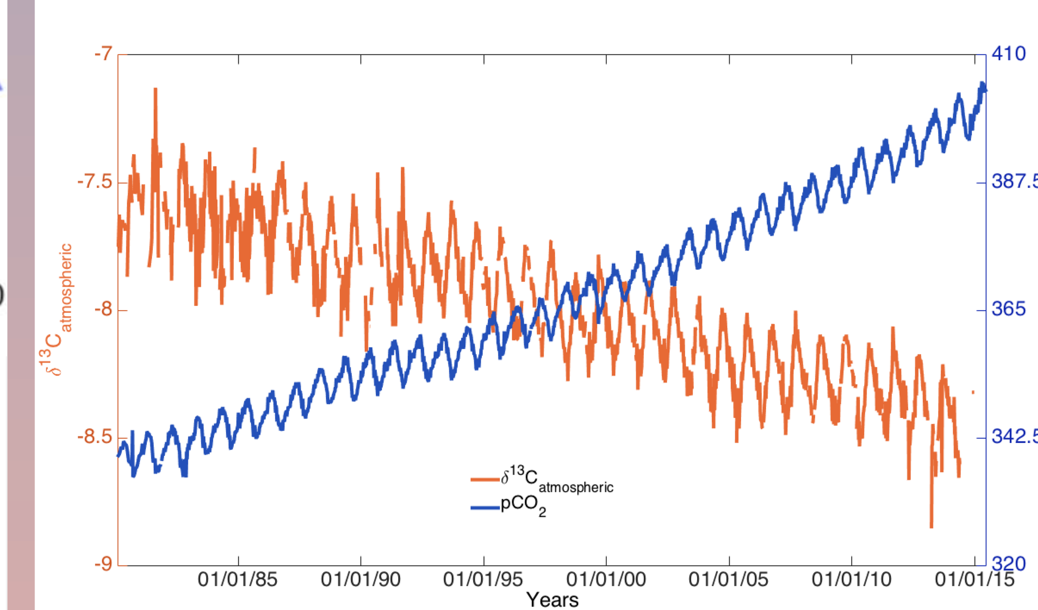
There is a clear seasonal variability in the CCS, and this pattern its observed in interdecadal and decadal scales. In the spring we can observe the lowest temperatures while in autumn the highest. The same behavior is observed in the ocean CO_2 fugacities.



Values above the line gray indicates the period when the CC is being a source to the atmosphere (from july to december). While values down the line indicates the period when is acting like a sink to the ocean, this period consider the months between january to june.



The time series of both periods indicates an increase in the fugacity of CO_2 in parallel to the increase in the pCO_2 in the atmosphere, regardless of whether it is acting as a source or sink.



The increase of $pCO2$ in the atmosphere is caused by the burning of fossil fuels that has a very light isotopic composition and when are released into the atmosphere causes a decrease in ^{13}C. This effect is known as Suess Effect

Conclusions

- **There are two periods with different behaviors in the CO_2 fugacity in the southern region of the California Current (CC), the months from January to June (sink), and the months from July to December (source). The time series of both periods show a tendency to increase towards the present.**
- **The slope of fugacity is higher from June to December than from January to June probably due to excess residual carbon during the summer probably is the result of an imbalance of the Redfield ratio between carbon and nitrate.**
- **The time series of the last thirty years for the $\delta^{13}C_{atm}$, $\delta^{13}C_{carb}$, $\delta^{13}C_{COP}$ reflect the Suess Effect. However, the slopes of the isotopic composition of both carbonate and POC are different from atmospheric due to the importance of vertical mixing in the CC.**

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