Spatial variation of dissolved inorganic carbon derived from satellite data in the California Current System during spring (2003-2021)

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Introduction

- The development and application of methodologies that aid in the generation of marine carbon knowledge is essential to describe and understand the changes in the ocean through fluctuations in carbonate system variables.
- Satellite information is a crucial tool due to its spatio-temporal resolutions. However, it is a great challenge due to its limitations, for example, cloudiness that inhibits infrared measurements.
- Therefore, the objective of this work was to use satellite products of sea surface temperature (SST), salinity (SSS), and chlorophyll-a (CHL) for 15 years (2003-2018), in the spring, to determine the dissolved inorganic carbon (DIC) of the southern portion of the California Current System. And with this, to know the variation of DIC through time and contrast the results with in situ measurements.

Study area

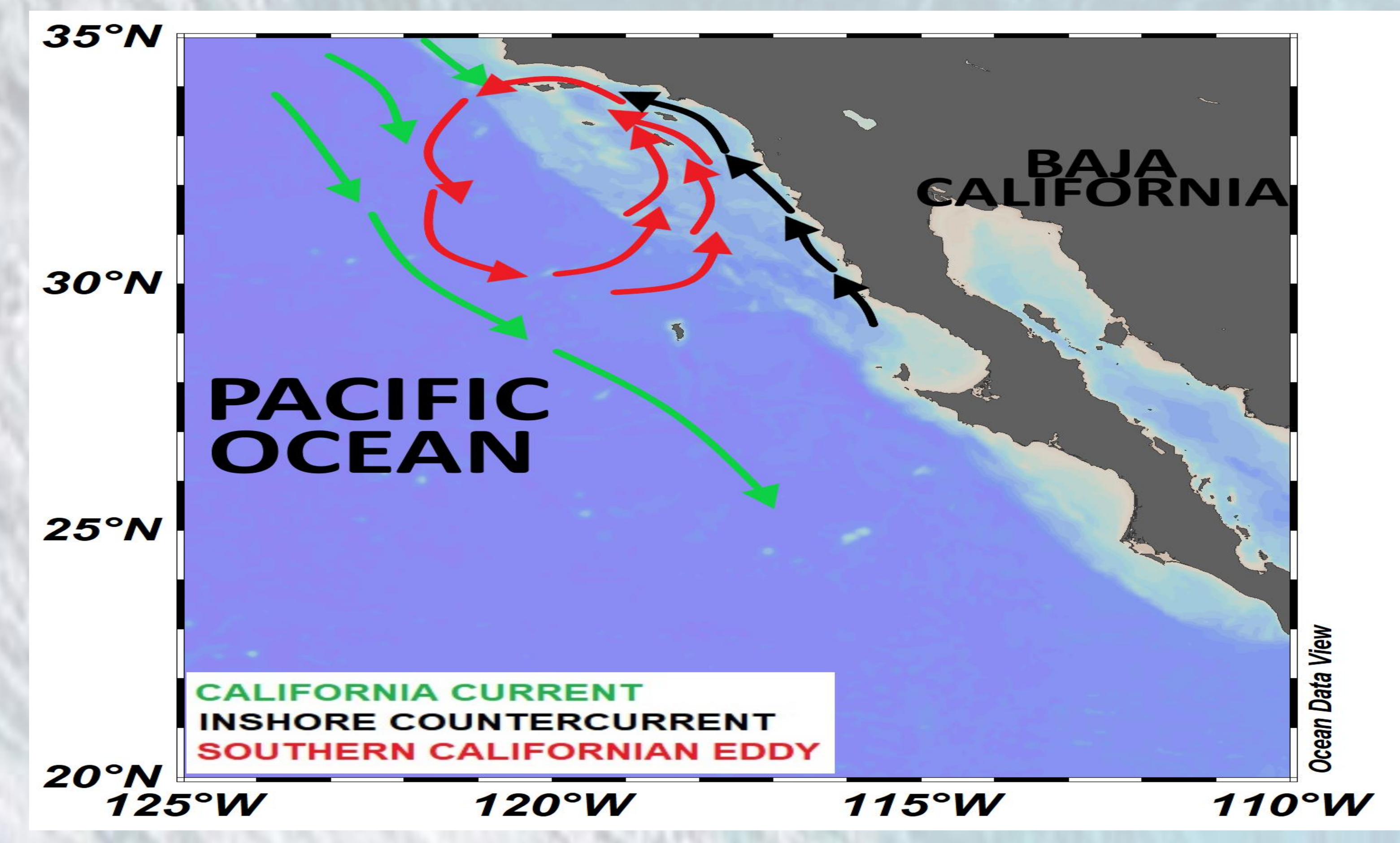

Fig. 1. The study area showing the southern portion of California Current System, and other features between 21-34° N latitude, around the Baja California Peninsula, Mexico.

Data and Methodology

- We used satellite data of SST and CHL from the Aqua-Modis sensor. The images were weekly composition from 2003 to 2018, only during spring (April to June), the pixel size was 4 x 4 km. Also, we used SSS, which was a product of Barcelona Expert Center (BEC); the resolution was 0.25 degrees.
- We estimated TA and DIC according to Sarma et al. (2006) methodology. With these two variables, we calculated pCO_2 in CO2SYS (Lewis and Wallace, 1998).
- We regressed pCO_2 measurements (from World Ocean Database (WOD), 1993-2018) and pCO_2 estimations to establish how well the both data fits.

Results and Discussion

- The spatial variability of SST (Fig. 2) and DIC (estimated) (Fig. 3) show their spatial distribution in the study area.
- The results are in agreement with in situ DIC measurements collected in various databases (WOD).
- This suggests that this methodology reproduces the DIC values measured in spring.
- A new adjustment would have to be made for autumn and winter to obtain both seasonal and interannual variability.

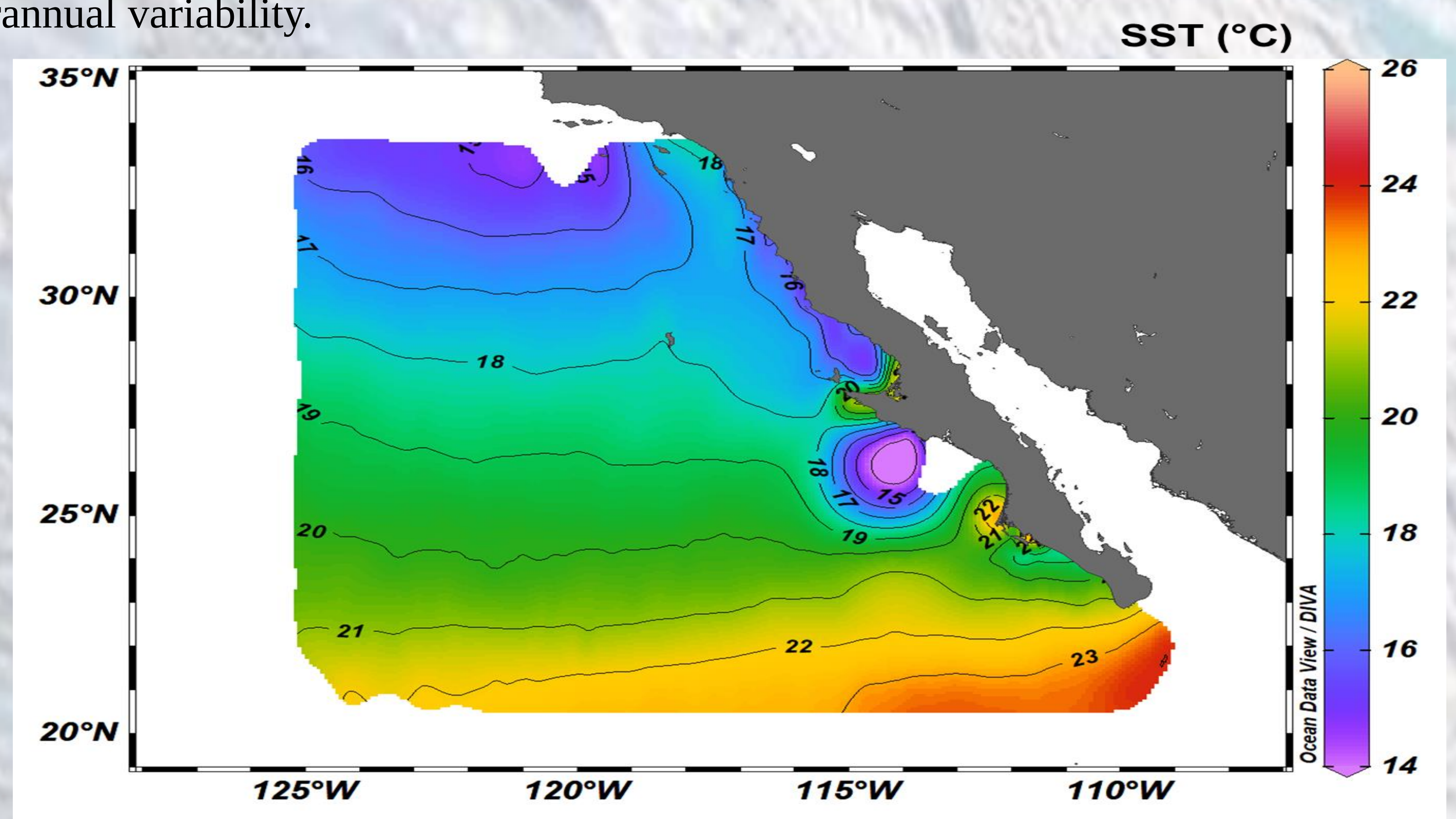

Fig. 2. Spatial distribution of sea surface temperature (SST; °C) during spring in the period 2003-2018

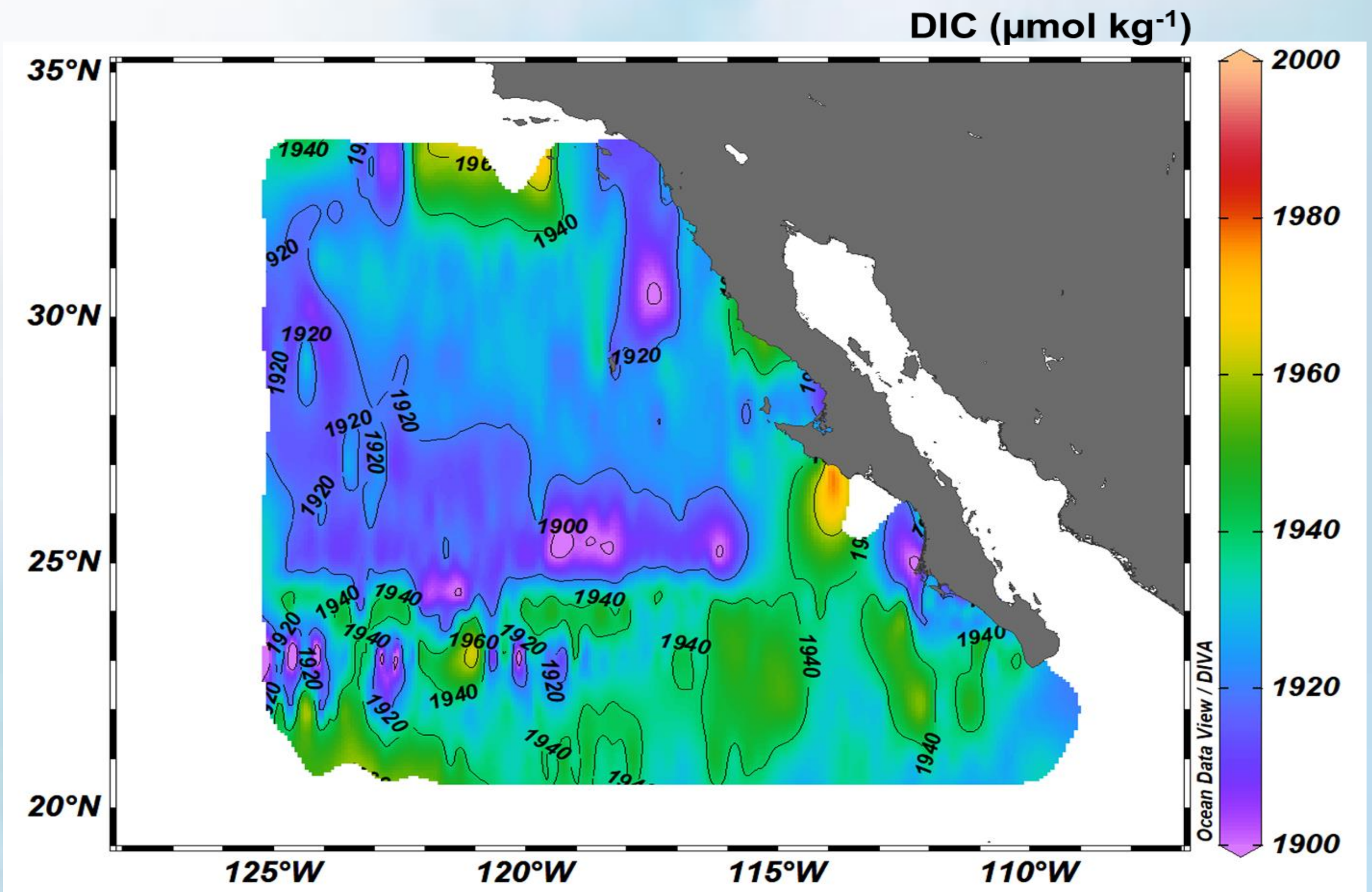

Fig. 3. Spatial distribution of dissolved inorganic carbon (DIC; μmol kg^{-1}) during spring in the period 2003-2018

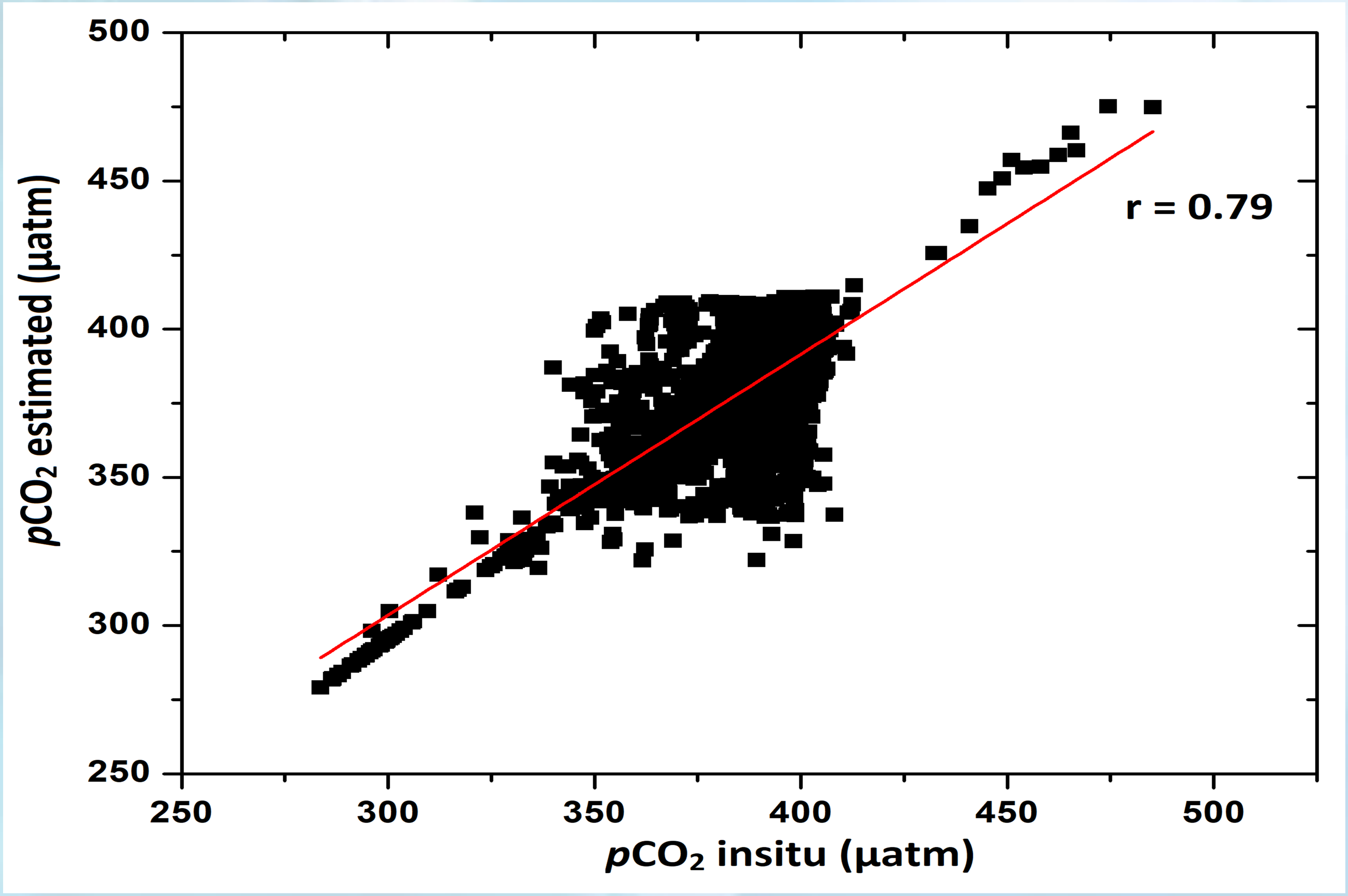

Fig. 4. Relationship between measured pCO_2 (underway) versus computed pCO_2 from DIC and TA.

- Finally, the measured and estimated pCO_2 values were regressed. The result showed a high correlation coefficient (0.79) (Figure 4), which supports that the calculated DIC values are within the range that has been described in the area.
- It should also be noted that variations may be due to uncertainties in the estimates as cited by Sarma et al. (2006), as well as the annual increase of 1.5 μatm (Takahashi et al., 2009).

Reference

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