Spatio-temporal variability of sea surface pCO_2 and nutrient in the tropical Pacific from 1981 to 2015

Yasunaka, S., S. Kouketsu, A. Murata (JAMSTEC, Japan), P. Strutton (Univ. of Tasmania, Australia), A. Sutton (NOAA, USA), S. Nakaoka (NIES, Japan), Y. Nojiri (Hirosaki Univ., Japan)
E-mail: yasunaka@jamstec.go.jp

* Deep Sea Research II (in press)

1. Background

Ocean physical observations:
- can represent intra-seasonal to interannual variability by TAO/TRITON array, satellite altimeter, and Argo floats (Gasparin et al. 2015),
- has clarified spatio-temporal variability of T, S, SSH etc (e.g. Casey and Adamec 2002; Trenberth et al. 2002; Qu et al. 2014).

How about pCO_2 and nutrient observations?
- Previous studies mainly focused on time series analysis just along the equator or spatial distribution within specific years (e.g. Feely et al. 1995, 1997, 2002; Takahashi et al. 2003; Strutton et al. 2008; Sutton et al. 2014).

This study:
- presents the current and historical state of the observing system for pCO_2 and nutrient observations, and characterize the spatio-temporal variabilities captured by those observations.

2. Data

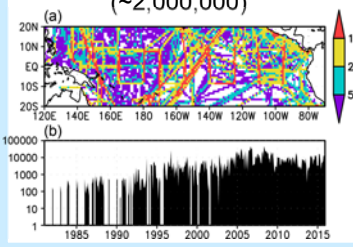
a. pCO_2

SOCATv4
(Bakker et al. 2016)

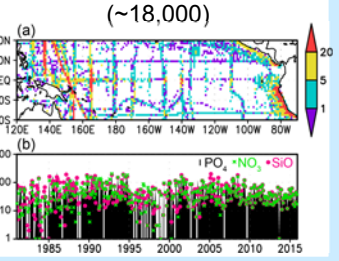
b. Nutrient

WOD2013 (Boyer et al. 2013)
GLODAPv2 (Key et al. 2015)
NIES Ship-of-opportunity data
(Yasunaka et al. 2013)

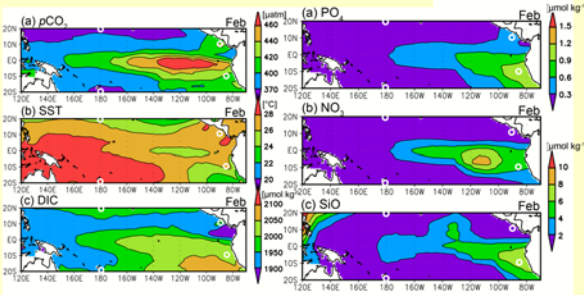
Number of CO_2 data (~2,000,000)



Number of nutrient data (~18,000)



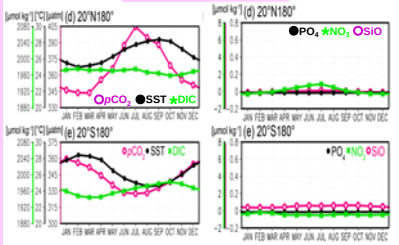
3. Long-term mean states



High pCO_2 & nutrients, low SST in the cold tongue region

3. Long-term mean states

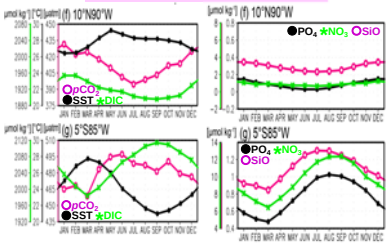
a. Subtropics



pCO_2: in-phase with SST

DIC & nutrients: weak variation

b. Upwelling region



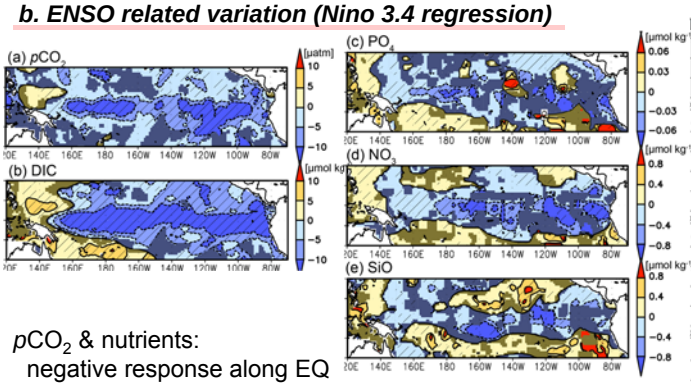
pCO_2: out-of-phase with SST, in-phase with DIC & nutrients

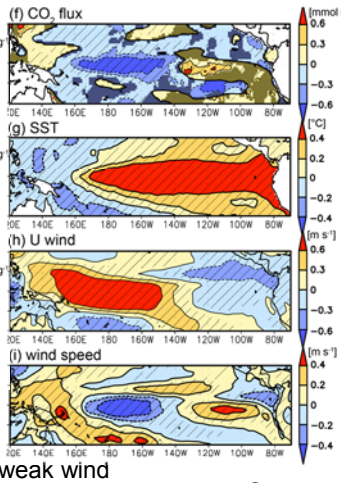
4. Interannual variability

a. Decorrelation scale & S/N ratio

pCO_2: zonal 17°, meridional 7°, 2-month & S/N ratio 4
Nutrients: similar to pCO_2 but noisy

b. ENSO related variation (Nino 3.4 regression)

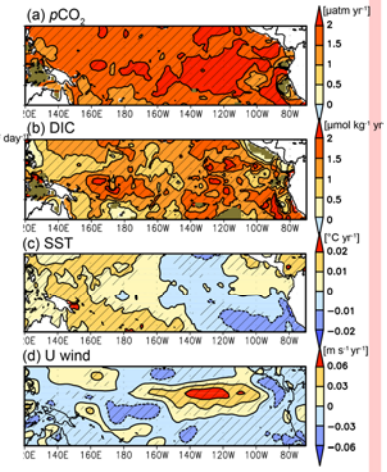




pCO_2 & nutrients:
negative response along EQ
← DIC & nutrient rich subsurface water

CO_2 flux:
in central EQ, CO_2 release suppression ← pCO_2 deduction & weak wind
in east EQ, CO_2 release enhancement ← pCO_2 deduction but strong wind

c. Long-term trend



Area mean:
ocean pCO_2 trend:
1.84 ± 0.07 µatm/yr
> atmospheric pCO_2 trend:
1.66 ± 0.01 µatm/yr

Strong positive pCO_2 & DIC trend along EQ
← PDO-like change