

# ANALYSIS OF THE FLUCTUATING FACTORS OF THE PARTIAL PRESSURE OF CO<sub>2</sub> IN SEAWATER IN THE YATSUSHIRO SEA CONSIDERING INFLUENCED BY STRATIFICATION

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## Introduction

In recent years, *blue carbon*, which is the carbon fixed by marine ecosystems has attracted attention as new climate change mitigation measures. Especially, a coastal area where vegetation exists is considered to be an important places for carbon fixation functions. In estimating the amount of blue carbon, fluctuating of the **partial pressure of CO<sub>2</sub> in seawater (pCO<sub>2</sub>)** is important.

However, pCO<sub>2</sub> in the coastal area is affected by physical processes such as flow, and biological processes such as photosynthesis by flora and calcification by corals, and fluctuates greatly in space and time. Furthermore, Tada *et al.* (2018) created a model of pCO<sub>2</sub> and showed that it was necessary to consider the difference in the fluctuating of pCO<sub>2</sub> with and without stratification in detail (Figure 1.). Therefore, in order to improve the estimation accuracy related to blue carbon, study about the effect of stratification on pCO<sub>2</sub> is needed.

This study carried out field survey on pCO<sub>2</sub> dynamics in the Yatsushiro Sea and tried to reveal the details of the effect of stratification on pCO<sub>2</sub>. Incidentally, the bay is a characteristic coastal area where both seagrass and coral inhabit.

## Survey

The survey point was selected near the mouth of the Kumagawa River, which accounts for about 60% of the river basin area flowing into the Yatsushiro Sea, because of the strong stratification (Figure 2.). The survey contents and the survey dates are shown in Table 1. and Table 2.

Table 1. Survey contents.

Survey content	Measured item	Time step / Measured depth
Water quality measure	Temperature, salinity, chlorophyll <i>a</i> , etc.	<ul style="list-style-type: none"> <li>• Every 20 minutes</li> <li>• Vertical distribution from sea bed to surface</li> </ul>
Water sampling	<b>Dissolved inorganic carbon (DIC), total alkalinity (TA)</b>	<ul style="list-style-type: none"> <li>• 5 times (at high tide, at 1.5 hours after high tide, at maximum ebb tide, at 1.5 hours before low tide, and at low tide)</li> <li>• 6 layers (at depth of 0, 3, 6, 9, 12, 15m)</li> </ul>

Table 2. Survey dates.

Survey date	Period	Tide	Survey time
2019/Aug./2	Strong stratification period	Spring tide	During the half tide period from 9:00 (high tide) to 15:00 (low tide)
2018/Aug./26	Weak stratification period		
2018/Dec./7	Well mixed period		

## Conclusions

- ✓ Field surveys of pCO<sub>2</sub> was conducted in the Yatsushiro Sea, and its fluctuation factors were considered.
- ✓ It was revealed that in the strong stratification period, the vertical mixing was suppressed by the stratification and the effect of phytoplankton photosynthesis was concentrated on the surface and pCO<sub>2</sub> decreased.
- ✓ In strong stratification period, it was suggested that pCO<sub>2</sub> fluctuated due to the effect of calcification.

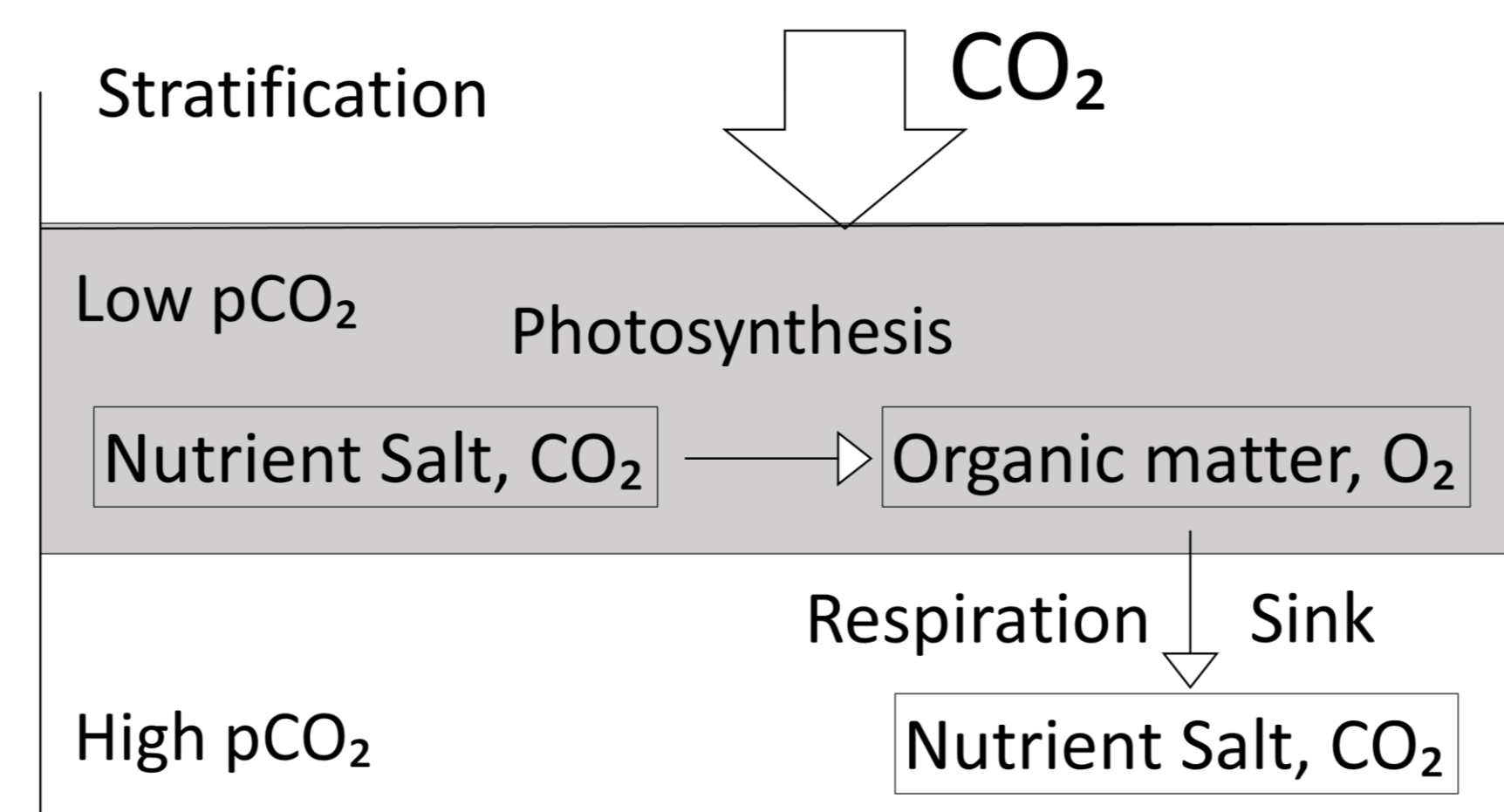


Figure 1. Fluctuating of pCO<sub>2</sub> during the stratification period.

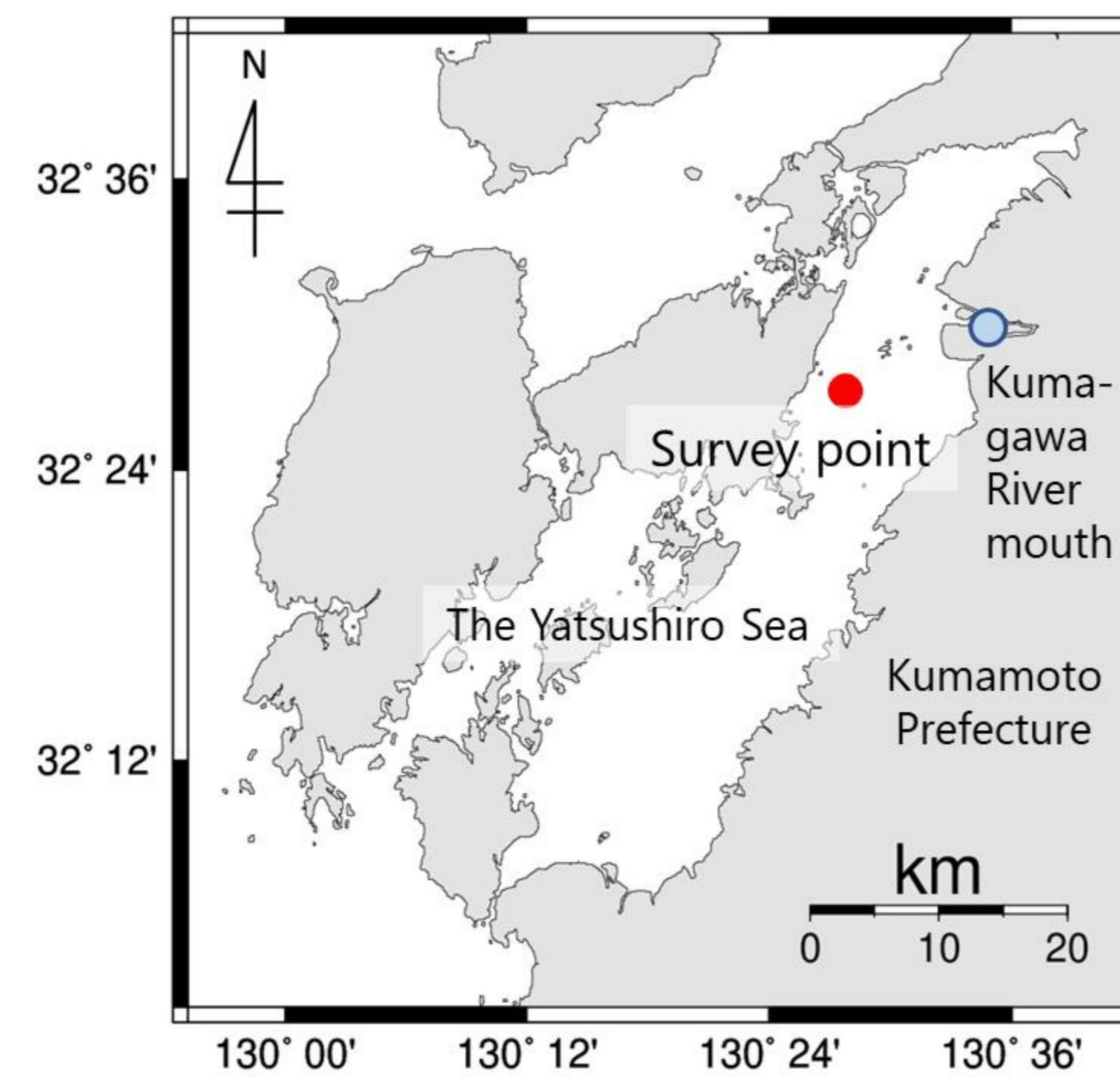


Figure 2. The survey point.

## Calculation of pCO<sub>2</sub> and the effect of biological processes

- ◆ pCO<sub>2</sub> was calculated from water temperature, salinity, DIC, and TA.
- ◆ **ΔDIC (the fluctuating value due to photosynthesis and respiration)** and **ΔTA (the fluctuating value due to calcification)** were calculated as the differences between the observed DIC and TA and the estimated values (Figure 3.).

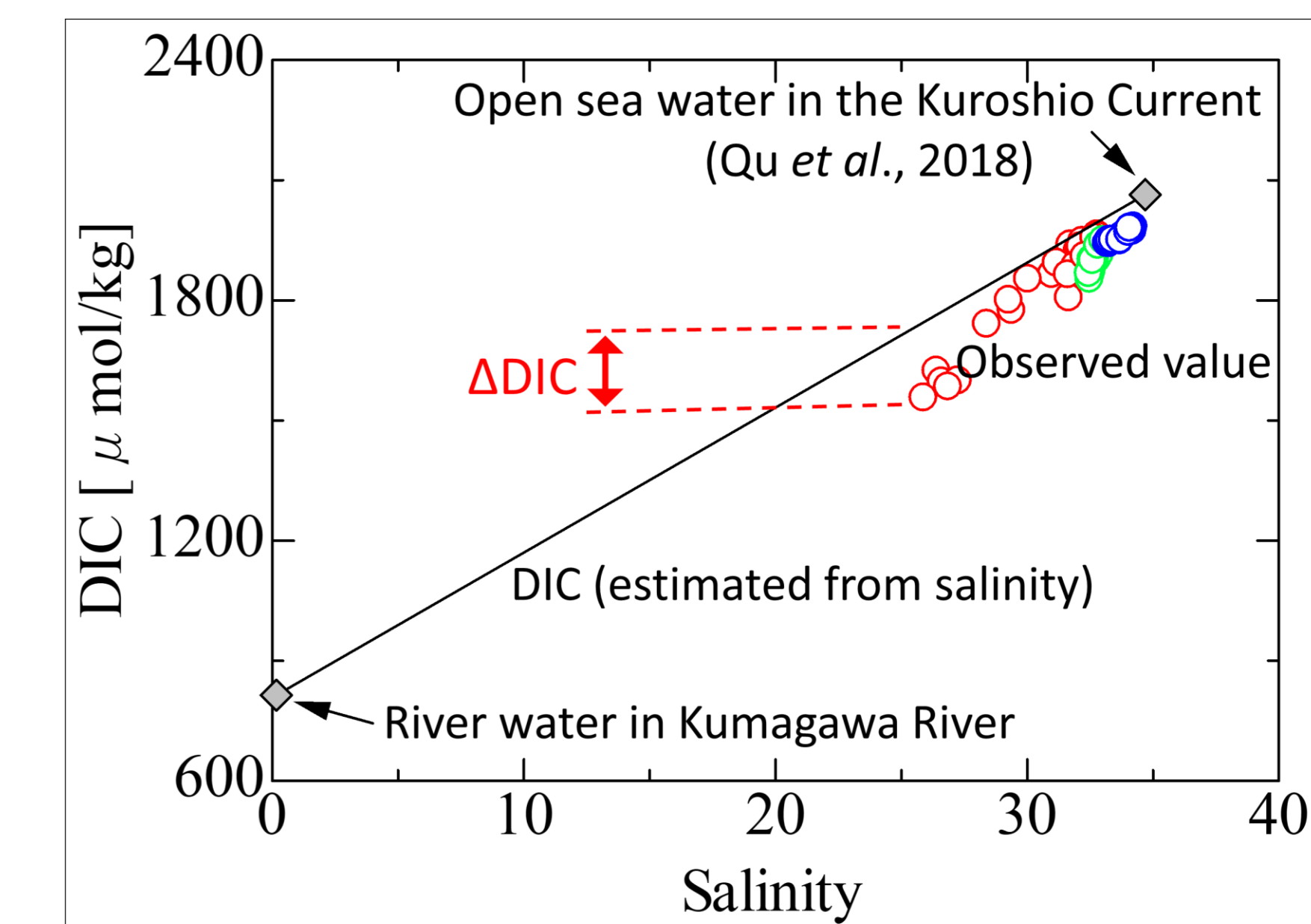


Figure 3. Calculation of ΔDIC (The same applies in calculation of ΔTA).

## Result

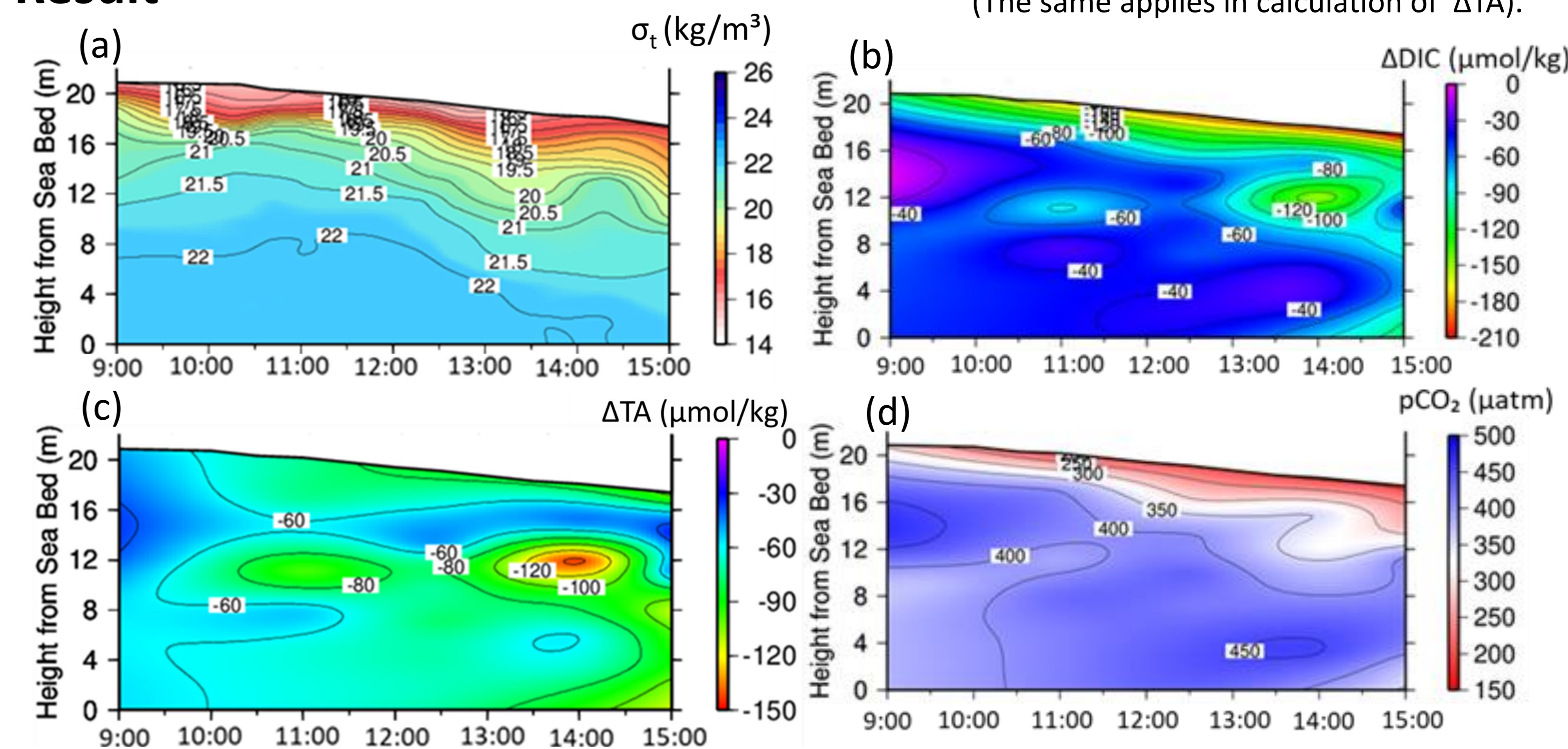


Figure 4. Contours figures of  $\sigma_t$  (a),  $\Delta$ DIC (b),  $\Delta$ TA (c), and pCO<sub>2</sub> (d) in the strong stratification period (2019/Aug./2).

Figure 4. shows the contour figures in the strong stratification period (2019/Aug./2).

- Regarding ΔDIC, large negative values was observed near the surface. Moreover, the distributions of the maximum values of ΔDIC and chlorophyll *a* generally corresponded.
- ΔTA showed different values at every depths in the strong stratification period. In contrast, it was about -60 μmol/kg in both of the weak stratification period and the well mixed period.
- From the distribution of pCO<sub>2</sub>, it was confirmed that in the surface, although water temperature was high, DIC decreased due to concentration of photosynthesis caused by stratification, and pCO<sub>2</sub> decreased.