

The state of the western North Pacific in the second half of 2003

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Mr. Toshiyuki Sakurai is a scientific officer of the Office of Marine Prediction at the Japan Meteorological Agency (JMA). He is working as a member of a group in charge of oceanic information in the western North Pacific. Using a new "Ocean Comprehensive Analysis System" (in operation since January 2001), this group produces surface and subsurface temperature, salinity and current maps with 0.25×0.25 resolution in waters adjacent to Japan. Monthly averaged fields obtained from the system are included in the "Monthly Ocean Report" published by JMA. Mr. Sakurai is now involved in developing a new daily analysis system for sea surface temperature in the global ocean, using in situ observations and data from several satellites with infrared and microwave sensors.



Sea surface temperature

Figure 1 shows monthly mean sea surface temperature (SST) anomalies in the western North Pacific from July to December 2003, computed with respect to JMA's 1971–2000 climatology. Both NOAA/AVHRR and *in situ* data are used for the area between 20°N and 50°N from 120°E to 160°E, and only *in situ* observations are used in the other areas.

SSTs were generally below normal around Japan in July, and in the seas north of 35°N around Japan in August and September. Negative SST anomalies exceeding -1°C were found in the southern part of the Japan Sea, east of Japan and west of the Korean Peninsula in July and August, and around the Kuril Islands in August. The negative anomalies around 37°N, 145°E persisted to December (region 4 of Fig. 2).

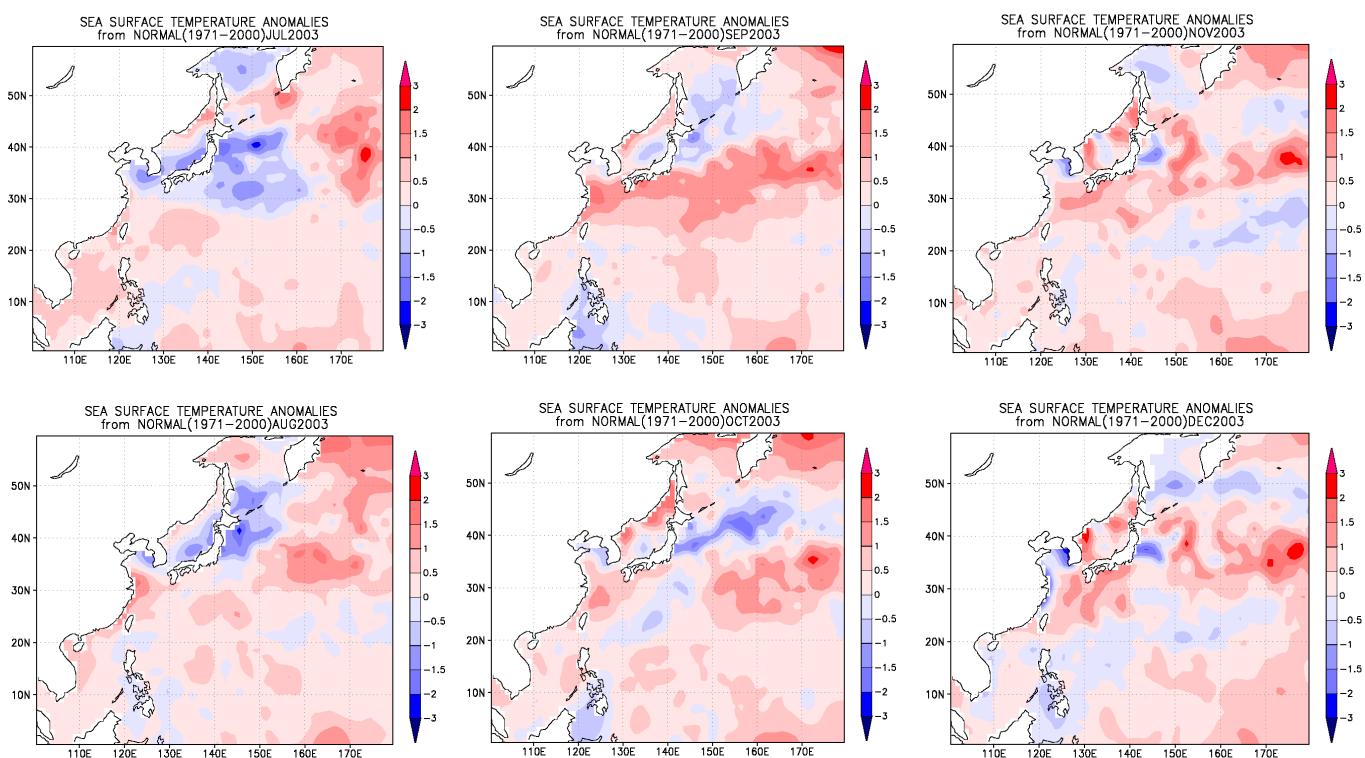


Fig. 1 Monthly mean sea surface temperature anomalies ($^{\circ}\text{C}$) in 2003: July, September and November (top row), and August, October and December (bottom row). Anomalies are departures from JMA's 1971–2000 climatology.

Positive SST anomalies exceeding $+1^{\circ}\text{C}$ were found around 40°N , 170°E in July, and in the seas between 150°E and the date line along 35°N from August to December. In addition, SSTs were more than 1°C above normal south of Japan in September, November and December, and in the northern part of the Japan Sea and east of the Korean Peninsula from October to December. The positive SST anomalies south of Japan (region 6, 9 of Fig. 2) have persisted for the last few years.

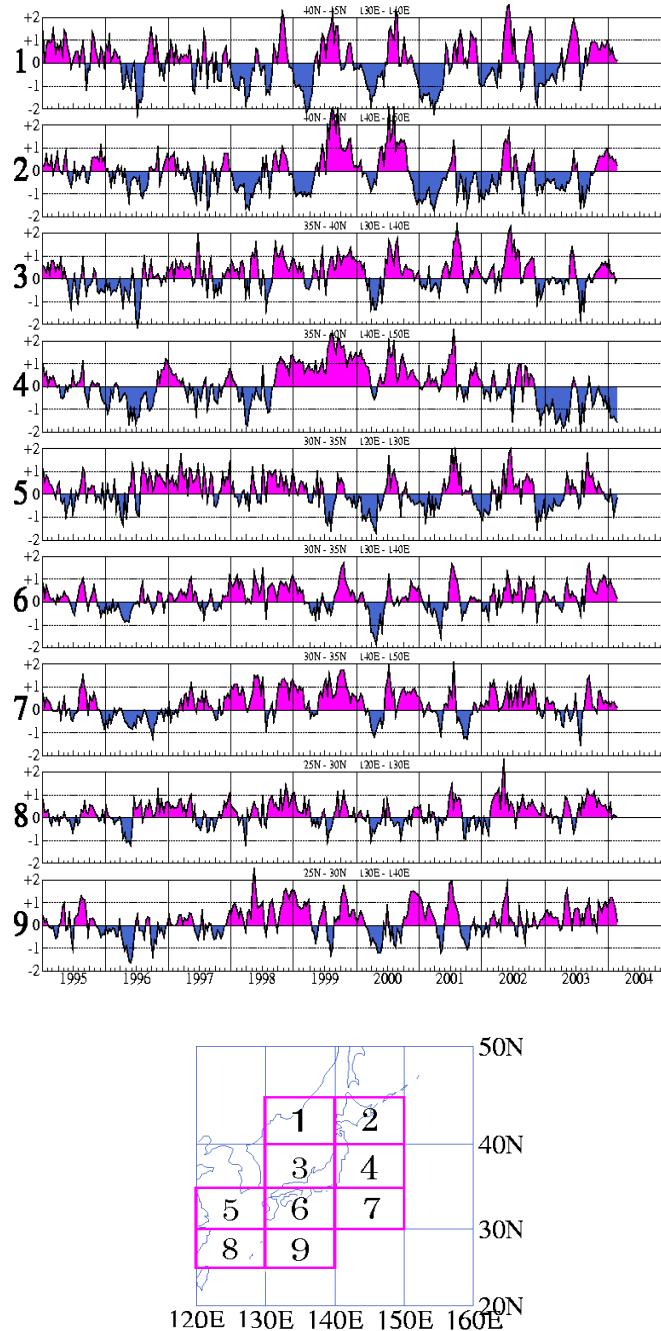


Fig. 2 Time series of the ten-day mean sea surface temperature anomalies ($^{\circ}\text{C}$), computed from JMA's 1971-2000 climatology (top panel) for the areas shown in the bottom panel.

Kuroshio

The Kuroshio took a non-large meandering path off Tokai from July to December. However, small perturbations propagated eastward off Tokai from late September to early October, and from late November to mid-December (Fig. 3).

After passing the Tokara Strait, the Kuroshio flowed along the southern coasts of Japan from July to early-November. A small meander of the Kuroshio was formed in the seas southeast of Kyushu from mid-November to December, and the Kuroshio flowed offshore between 30°N and 33°N (Fig. 3).

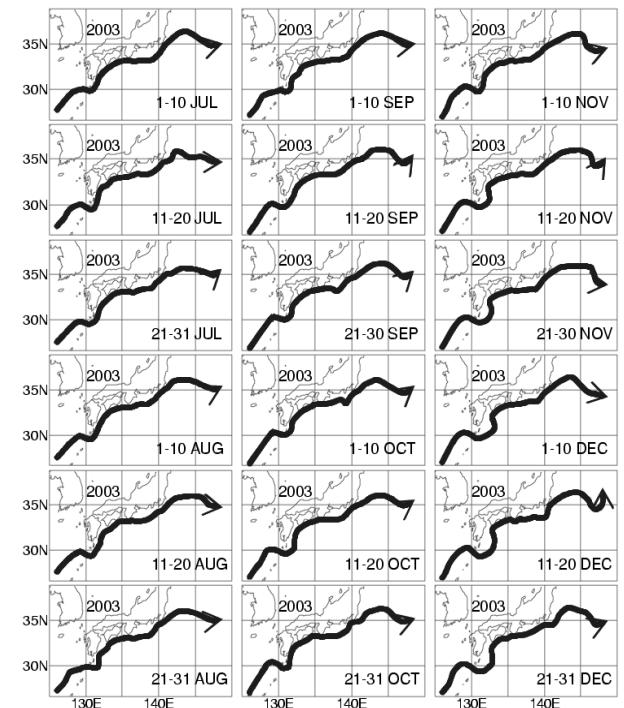


Fig. 3 Location of the Kuroshio axis from July to December 2003.

Carbon dioxide

JMA has been conducting observations for carbon dioxide (CO_2) in the surface seawater and overlying air in the western North Pacific, on board the R/V *Ryofu Maru* and R/V *Keifu Maru*.

Figure 4 illustrates the distribution of the difference in CO_2 partial pressure (ΔpCO_2) between the surface seawater and overlying air, denoted as ΔpCO_2 , observed in the western North Pacific in the four seasons of 2003. The ΔpCO_2 value represents the direction of CO_2 gas exchange across the air-sea interface, indicating the ocean to be a potential source (or sink) for atmospheric CO_2 in the case of positive (or negative) value of ΔpCO_2 .

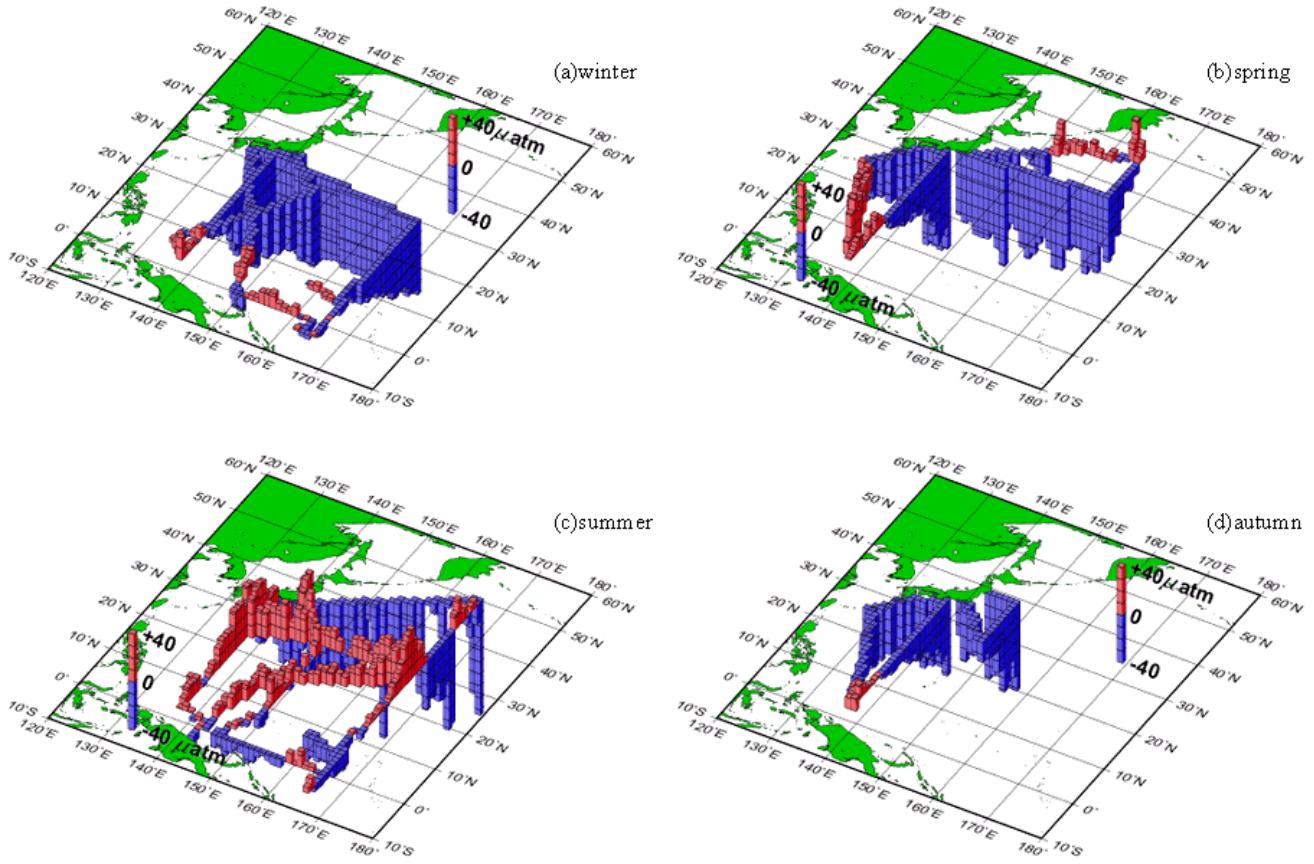


Fig. 4 Difference in the carbon dioxide partial pressure between ocean and atmosphere in the western North Pacific. Red/blue pillars show that oceanic pCO₂ is higher/lower than atmospheric pCO₂.

In the western subtropical Pacific, oceanic pCO₂ was lower than atmospheric pCO₂ in the winter, spring and autumn 2003, implying that the ocean acted as a sink for atmospheric CO₂, whereas this region changed to be a source in summer. In the western subarctic Pacific, a source area for atmospheric CO₂ was observed in the

spring and summer, and was smaller than that in this region in 2002. In the equatorial Pacific, pCO₂ was also smaller than that in 2002. The average of oceanic pCO₂ in this region in 2003 was lower than those in 1998-2002, and was at about the same level as that in 1997 during the El Niño event.