The state of the western North Pacific in the first 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 January to June 2003, computed with respect to JMA's 1971-2000 climatology. Both NOAA/AVHRR satellite data and *in situ* data are used for the area between 20ºN and 50ºN from 120ºE to 160ºE, and only *in situ* observations are used in the other regions.

SSTs were generally below normal in the seas north of 35ºN from the Kuril Islands to east of Japan throughout the period, except for June, and SST anomalies exceeding -1ºC were found between 35ºN and 40ºN from March to May. Figure 2 shows that negative SST anomalies east of Japan lasted from December 2002 to May 2003, with a magnitude of about -1ºC, which is comparable to values observed in 1996 (region 4). In June, SSTs rose considerably in the seas north of 35ºN around Japan (regions 1-4), and SST anomalies exceeding +2ºC were found in the northern part of the Japan Sea.

SST anomalies in the seas south of Japan (region 6 and 9) continued to be positive in the last few years.

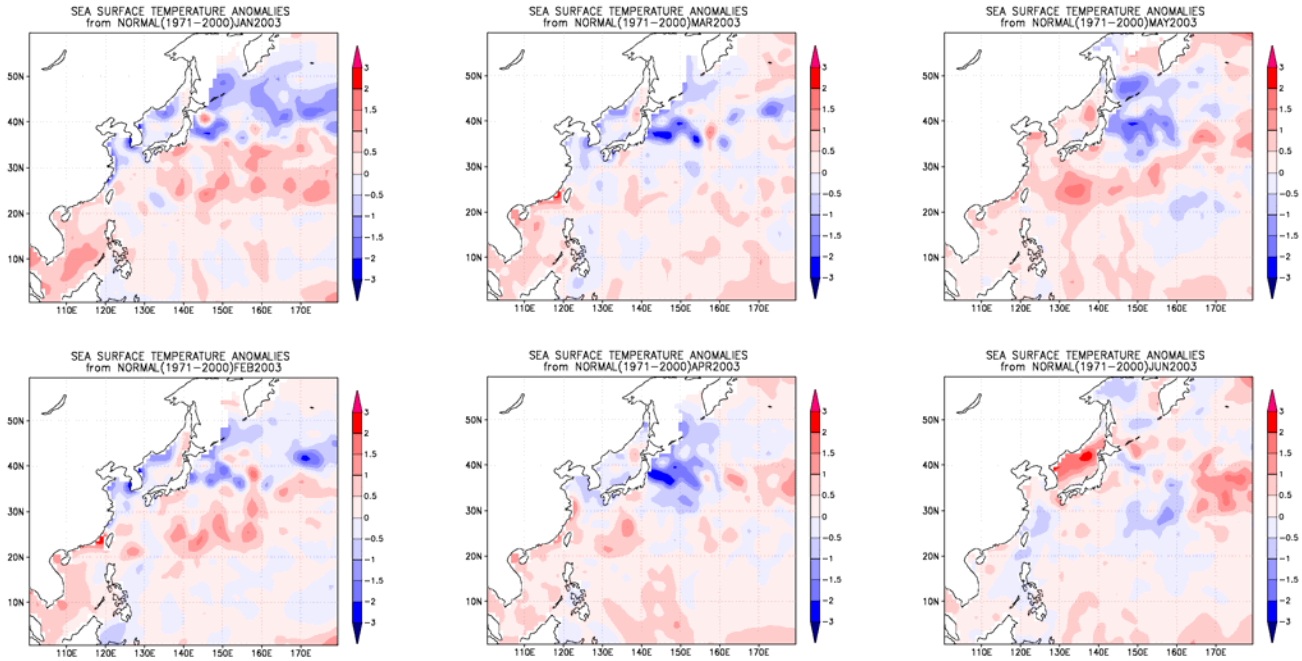

Fig. 1 Monthly mean sea surface temperature anomalies (ºC) in 2002: February, March and May (top row), and June, August and September (bottom row). Anomalies are departures from JMA's 1971-2000 climatology.

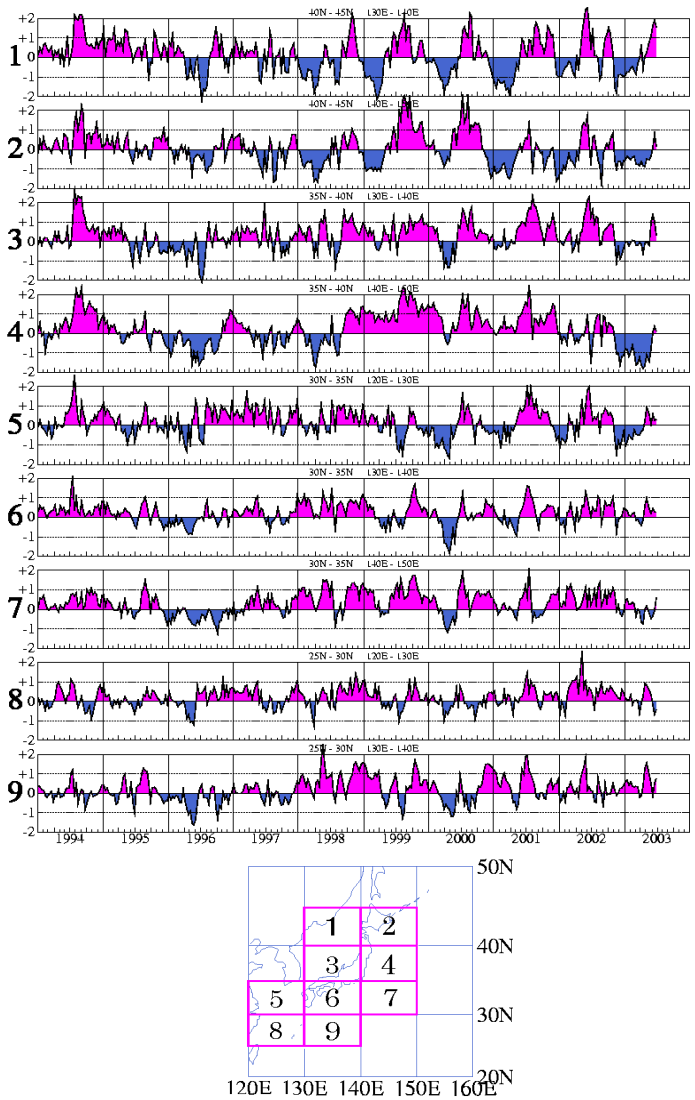

Fig. 2 Time series of the ten-day mean sea surface temperature anomalies (ºC), computed from JMA's 1971-2000 climatology for the areas shown in the bottom panel.

Kuroshio and Oyashio

A meander of the Kuroshio was found around 132ºE from January to March, and the Kuroshio flowed far off the coast between 132ºE and 135ºE from late February to March. The eastward propagation of the meander brought frequent small perturbations in the seas east of 135ºE after March. One of the perturbations developed into a meander around 140ºE in June, and the southernmost position of this meander was 32.5ºN, 140ºE in mid-June (Fig. 3).

Figure 4 shows subsurface temperature distributions at a depth of 100 m east of Japan for March and April 2003. These charts are based on JMA's Ocean Comprehensive Analysis System. The System includes objective analyses and a numerical ocean data assimilation model with 0.25×0.25 resolution adjacent to Japan, using Jason-1 altimeter observations and *in situ* water temperature data from ships and buoys.

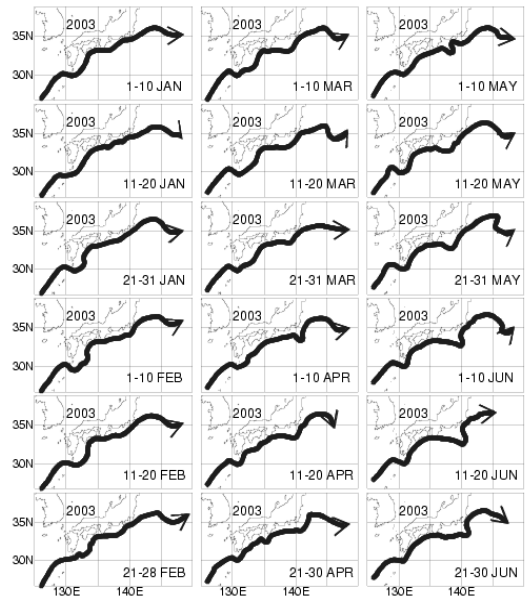

Fig. 3 Location of the Kuroshio axis from January to June 2003.

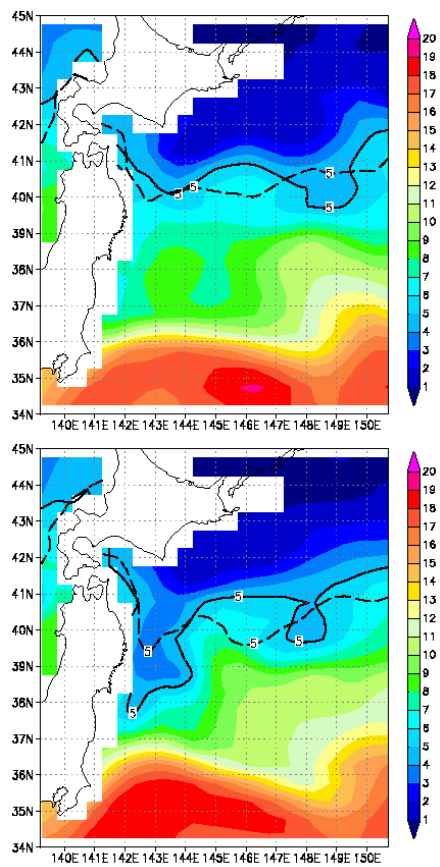

Fig. 4 Subsurface temperature (ºC) at a depth of 100 m east of Japan for March 2003 (top) and April 2003 (bottom). Solid lines denote 5ºC isotherm for 2003, and dashed lines are that of the normal (30-year averaged values from 1971 to 2000).

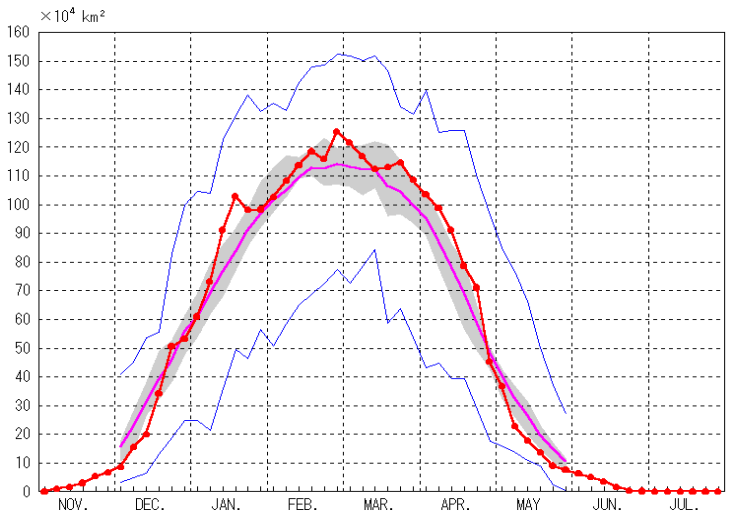

Fig. 5 Time series of sea ice area in the Sea of Okhotsk from November 2002 to July 2003.
time series of sea ice area; normal
near normal; maximum/minimum

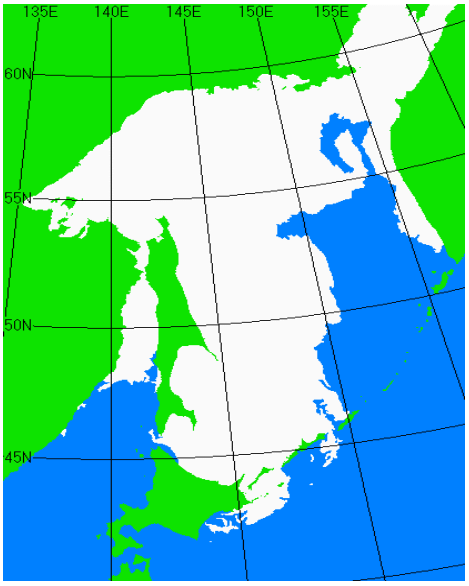

Fig. 6 Sea ice extent (white area) in the Sea of Okhotsk on February 28, 2003.

The southward extent of the Oyashio cold water (area where the temperature is colder than 5ºC in Fig. 4) was almost normal in March. But in April, the coastal branch of the Oyashio cold water extended southward considerably. It reached 37.5ºN, 142ºE in April, which was about 2º in latitude south of the normal position.

Sea ice in the Sea of Okhotsk

Sea ice conditions are analyzed based on visible and infrared satellite images. The extent of sea ice in the Sea of Okhotsk was near normal (30-year averaged values from 1971 to 2000) from November 2002 to July 2003, but was above normal in mid-January (Fig. 5). Sea ice area came to a maximum on February 28, and it was 125.49x10^4 km^2, larger than normal. This means 80% of the Sea of Okhotsk was covered with sea ice (Fig. 6). The area of sea ice was about 110% of normal, and in the southern part of the Sea of Okhotsk (south of 50ºN), was 130% of normal.

A considerable amount of sea ice flowed into the Pacific from early February, and the edge of sea ice extent reached around Cape Erimo in late February. Sea ice flowed into the Japan Sea through the Soya Strait from mid- to late February.