# The State of the Western North Pacific in the Second Half of 2012

*by Shiro Ishizaki*

***Sea surface temperature***

Figure 1 shows the monthly mean sea surface temperature (SST) anomalies in the western North Pacific from July to December 2012, computed with respect to JMA's (Japan Meteorological Agency) 1971–2000 climatology. Monthly mean SSTs are calculated from JMA's MGDSST (**M**erged satellite and *in-situ* data **G**lobal **D**aily **SST**), which is based on NOAA/AVHRR data, MetOp/AVHRR data, and *in-situ* observations for the period since 1985. Time series of 10-day mean SST anomalies are presented in Figure 2 for 9 regions indicated in the bottom panel. In July, SSTs were above normal around 40ºN and east of 150ºE. The positive SST anomalies extended westward, and anomalies exceeding +1ºC prevailed east of 135ºE in September. These anomalies shrunk after September and were observed only east of 160ºE in December. From August to September, SSTs were above normal in the eastern part of the Sea of Japan and in the seas east of Japan. In particular, positive anomalies exceeding +2ºC were observed in September (regions 1, 2, 3 and 4 in Fig. 2), and the averaged SST in region 2 was the highest recorded since 1985. From October to December, SSTs were below normal in the seas south of Japan (regions 6 and 9 in Fig. 2).

***Kuroshio path***

Figure 3 shows time series of the location of the Kuroshio path. D uring the reviewed period, the Kuroshio took a non-large-meandering path off the coast to the south of Honshu Island (between 135ºE and 140ºE). East of 135 ºE, several small perturbations propagated eastward along it. Corresponding to the passage of each perturbation, the latitude of the current's axis over the Izu Ridge (around 140ºE) moved north and south. In December, the Kuroshio flowed south of Hachijo Island (33ºN, 140ºE).

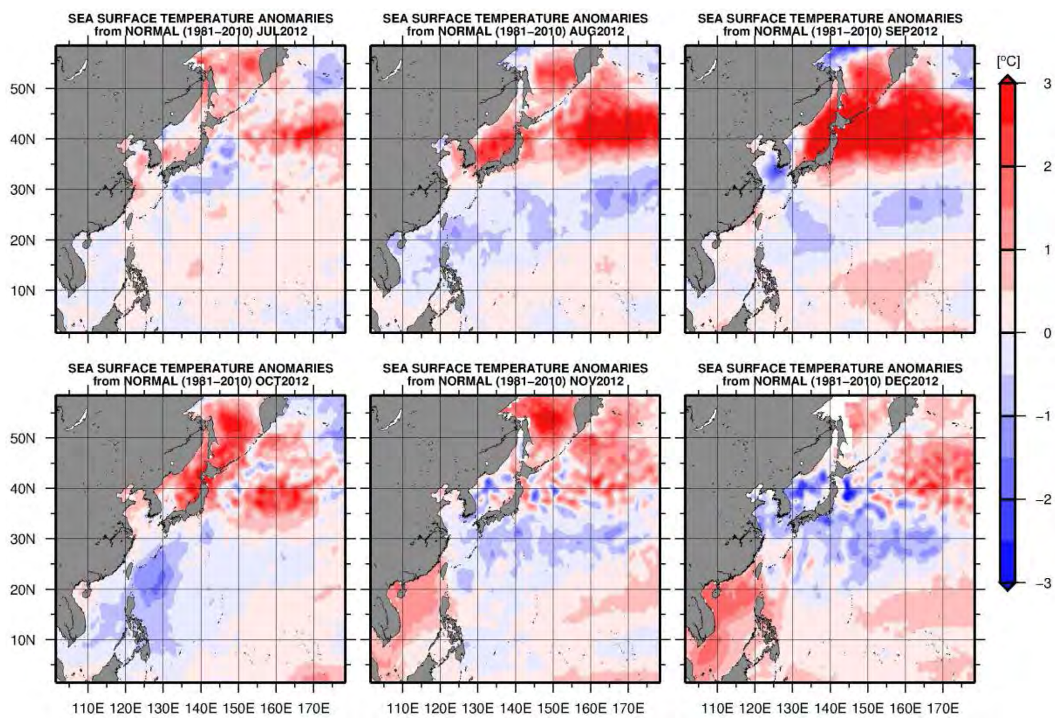


*Fig. 1 Monthly mean SST anomalies (°C) from July to December 2012. Anomalies are deviations from JMA's 1971–2000 climatology.*

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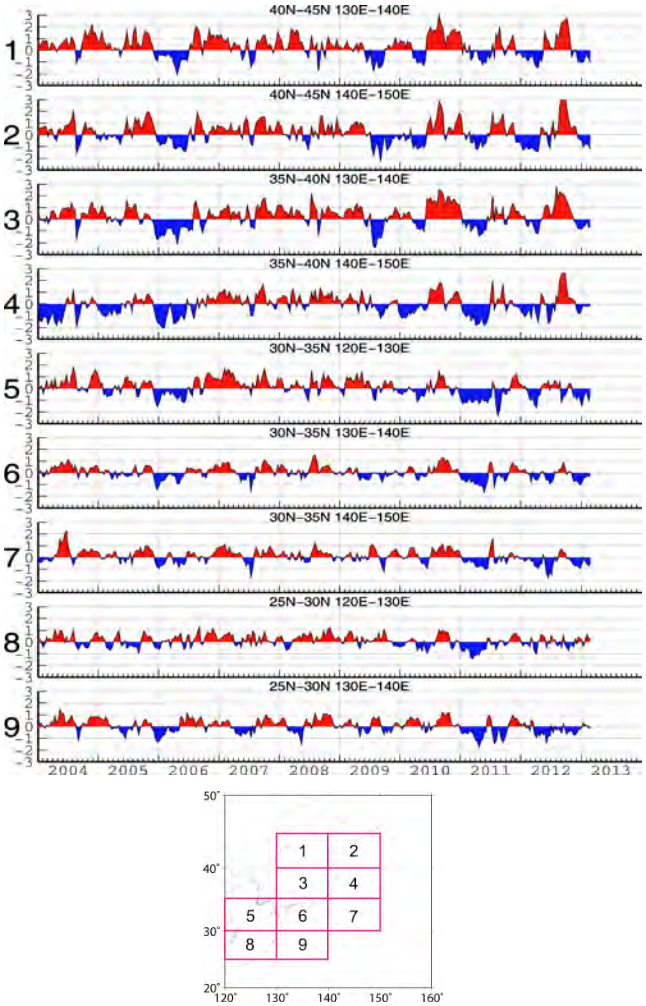


*Fig. 2* *Time series of 10-day mean SST anomalies (°C) averaged for the sub-areas shown in the bottom panel. Anomalies are deviations from JMA's 1971–2000 climatology.*

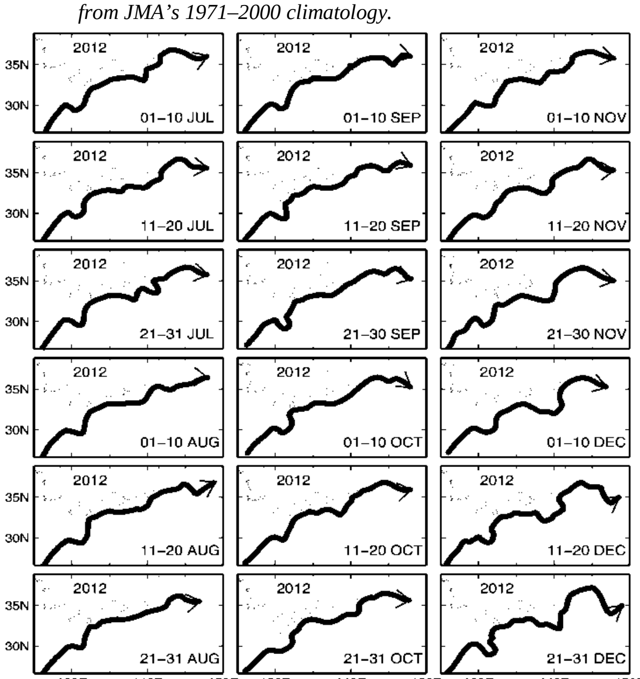


*Fig. 3* *Location of the Kuroshio path from July to December 2012.*

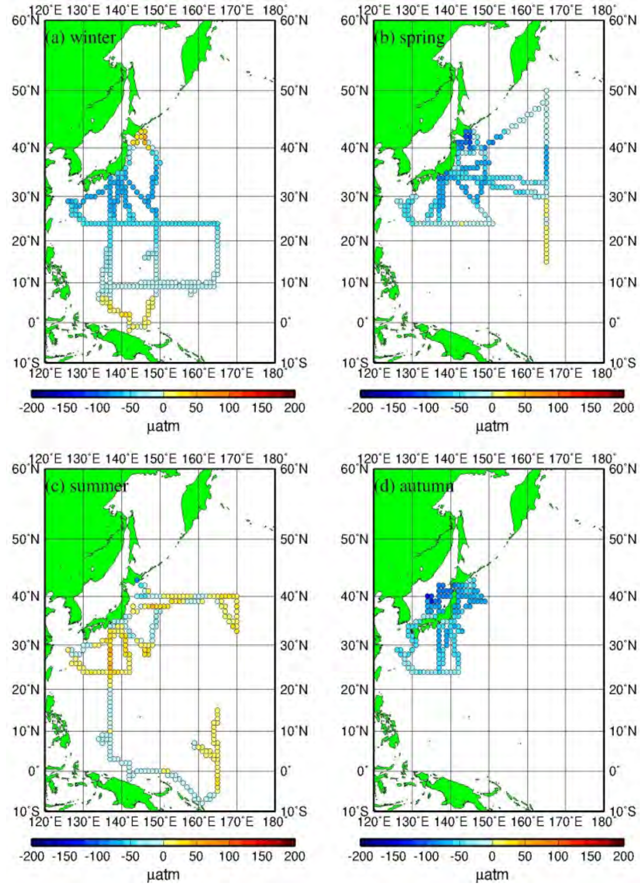


*Fig. 4* *Difference in $CO_2$ partial pressure between the ocean and the atmosphere in the western North Pacific in 2012: (a) winter (January–March), (b) spring (April–June), (c) summer (July–September) and (d) autumn (October –December).*

### *Carbon dioxide*

JMA has been conducting observations for carbon dioxide ($CO_2$) in the ocean and atmosphere 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 ($pCO_2$) between the surface seawater and the overlying air (denoted as $\Delta pCO_2$) observed in the western North Pacific for each season of 2012. The sign of $\Delta pCO_2$ determines the direction of $CO_2$ gas exchange across the air–sea interface, indicating that the ocean is a source (or sink) for atmospheric $CO_2$ in the case of positive (or negative) values of $\Delta pCO_2$.

In the winter of 2012, the ocean widely acted as a $CO_2$ sink in subtropical regions and as a source in subarctic regions north of 40ºN and in equatorial regions. In the spring, it acted as a sink in the region between 24ºN and 50ºN. Late in June and in the summer, the ocean turned into a $CO_2$ source due to thermodynamically increased $pCO_2$ in seasonally warmed seawater in subtropical regions south of 30ºN. In the autumn, subtropical regions north of 24ºN, and the Sea of Japan acted as a $CO_2$ sink.