

Horizontal distribution of temperature at 400 m
(or 500 m) and 1000 m depth in seas south of
Honshu, Japan, and the western North Pacific Ocean
from 1934 to 1943 and from 1954 to 1980

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Abstract

A rather stable meander of the Kuroshio flow path surrounding the cold water region south of Tokaido, continuing over several years, has been seen several times since 1934, that is, 1934 to 1943, 1953 to 1955, 1959 to 1963, and 1975 to 1980. The first and the last of these were very similar in their behavior and duration.

The study of the Kuroshio south of Honshu, Japan, seems to have been confined to the mechanisms of the generation and decay of the cold water region, but they have not yet been thoroughly investigated.

Among many methods of studying the events, one of the simplest and clearest for understanding the variabilities of oceanographic conditions including the generation and decay of the cold water region is to see the historical thermal maps at some depths below the surface mixed layer in which seasonal variability is remarkable.

The results shown here have been obtained by the Oceanography Division of the Meteorological Research Institute in the course of studying the development and decay of the cold water region south of Tokaido generated in 1975, by the aid of the Working Group on the Kuroshio called "Kuroshio Kondankai", which was established by the late Professor Kozo Yoshida, University of Tokyo, in February 1976, half a year after the development of the Kuroshio meander in 1975. Thereafter, meetings have been held

about once a month, and the project "Large-scale meander of the Kuroshio and the associated cold water mass" planned by the group was carried out, financially supported by the Scientific Grant defrayed by the Ministry of Education.

On the other hand, the Science and Technology Agency supported the "Cooperative Study of the Kuroshio and Adjacent Regions" abbreviated CSK, from 1965 to 1969, which had been advanced by the Intergovernmental Oceanographic Commission (IOC) since 1962. They also began, in 1976, to conduct a six-year research programme of the Kuroshio, "the Kuroshio Exploitation and Utilization Research", abbreviated KER. The purposes of KER are the exploitation and utilization of the Kuroshio energy and productivity, the study of the ability of the Kuroshio to clean up the marine environment, the dynamical explanation of the variability of the Kuroshio, and so forth.

Besides participation in these projects, the Oceanography Division of the Meteorological Research Institute has proceeded their researches on the Kuroshio meander entitled "A study of the generation and decay of the cold water region south of Tokaido" and "A study of the mechanism of the decay of the cold water region south of Tokaido". In order to investigate into this mechanism, they observed the precise thermal structure in the cold water region south of Tokaido and in the warm water regions south of Shikoku and of Lake of Hamanako across the Kuroshio. With the aid of other available data, they have arrived at the conclusions that the warm water regions revealed slightly different features from each other, that a well developed thermocline, a thickness of which developed about 200 m in vertical, having nearly constant temperature and salinity, was observed in the warm water regions south of Shikoku and of Lake Hamanako, that the thermocline in the former was higher in temperature and shallower in location than in the latter, that a solitary cold eddy was observed just south of the warm water region south of shikoku, and so on. They also have

satisfactorily explained the behavior of the warm water regions concerning the generation and decay of the cold water region south of Tokaido.

In addition to these newly observed data, they analysed the historically obtained data since 1954 south of Honshu, the CSK data from 1965 to 1969 and the Issei Kansoku (i.e., simultaneous observations) data, prompted by the Hydrographic Office of the Japanese Navy, from 1936 to 1942 in the western North Pacific around Japan. Worth of special mention are the observations in the summer of 1939, which were performed with the mesh size of latitude 1° x longitude 1.5° over a large area north of 8° N and west of 165.5° E, setting 14 vessels in motion for 40 days. Though the observation region in the summer of 1940 was somewhat reduced in area compared to that in the previous year, i.e., north of 20° N and west of 145° E, the mesh size was refined to $40'$ x $40'$.

These figures suggest that the warm water region was laid along the Kuroshio flow path in the east-west direction during the time when there was no Kuroshio meander, but they seemed to prolong rather north-south direction during the time when there was the Kuroshio meander. These imply that an important controlling factor of the Kuroshio meander may be the behavior of the warm water region south of the Kuroshio.

In spite of the large gap in data from 1944 to 1953, during and after World War II, the remarkable periods of the Kuroshio meander were all included in our analyses.

In the first section, it is shown why we select thermal maps at the depths of 400 and 1000 m layer to show the variation of the oceanographic conditions. In the second section are shown thermal maps at 400 and 1000 m south of Honshu, Japan, from 1954 to 1980. In the third section are shown the thermal maps at 400 m depth south of Honshu from 1934 to 1943 and those at 500 and 1000 m depths in the western North Pacific Ocean from 1936 to 1942. In the figures dots represent the observation stations. Observed

months and years are also cited.

Of these maps, those at 400 m level from 1976 to 1979 are also shown in the reports "The Kuroshio meander and cold water mass" issued by the Kuroshio Working Group (1978, 1980).

Data used in the report are available in "Hydrographic Bulletin" and "Data Report of Hydrographic Observations" issued by the Japan Maritime Safety Agency, and "The Results of Marine Meteorological and Oceanographical Observations" by the Japan Meteorological Agency.