A Distribution of Surface-Water Masses in the Lungga Estuary, the Solomon Islands

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Abstract

Surface-oceanographic observations were carried out in the Lungga estuary, Guadalcanal Island, the Solomon Islands on December 7, 1982, to investigate the distribution and mixing condition of river and sea waters. A characteristic of river-water dispersion in a small estuary was observed based on the distributions of water temperature and salinity. The degree of mixing condition between river and sea waters is estimated by means of the temperature-salinity relation. The percentage of the sea water having a salinity of 36.0‰ to the fresh water, which is named the sea-water ratio increases linearly with distance from the river mouth to offshore along the axis of dispersion.

Introduction

Estuaries and coastal seas are known as high biological production areas, and at the same time, are areas becoming polluted by human activities. As a basis for studying these subjects, it is necessary to investigate the mixing conditions between river and sea waters and water circulation in estuaries. In the second scientific survey of the South Pacific organized by the Kagoshima University Research Center for the South Pacific in 1982, physical and chemical oceanographic surveys were made at the Rewa estuary in Fiji on November 29 and at the Lungga estuary in the Solomon Islands on December 7, 1982 (CHAEN, ZANN, IKEDA and KAWAGUCHI, 1983).

In this report, the results of observations made in the Lungga estuary are presented; including the surface-horizontal distributions of water temperature, salinity, and dissolved oxygen, as well as the mixing conditions between river and sea water is estimated by means of temperature-salinity relations. The results in the Rewa estuary will be published in the near future.

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Method of Observation

Many small rivers run into Iron Bottom Sound at the northern side of Guadalcanal Island. The Lungga estuary shown in Fig. 1 is located about 10 km east of Honiara, capital of the Solomon Islands. The seashore near the Lungga estuary is a sandy beach with coconut palms, and mangroves and creeks enclosed within the beach. The Lungga estuary has no large barrier reef which becomes exposed to the air at low weters. The river is about 100 m wide and about 1 m deep at the mouth.

A total of seventeen stations and one station was established in an area about 0.4 km^2 and about 1 km upstream from the river mouth, respectively (Fig. 1). The time of observation was from 10 : 00 a. m. to 11 : 30 a. m. immediately after high water as shown in Fig. 2, according to the tide table for Auki, Malaita Island, the Solomon Islands by the MARITIME SAFETY AGENCY of JAPAN (1982). At the time of the observation the sky was clear with a NE wind to 3 m/sec as observed on board the Kagoshima Maru anchored at Honiara harbor.

The temperature measurements and water samplings were taken on board a small boat sailed by a native of the Solomon Islands. Each observation point was positioned by sighting distinct marks on the beach. The surface-water temperature was measured with a mercury thermometer in a water bucket, and the salinity for the same bucket

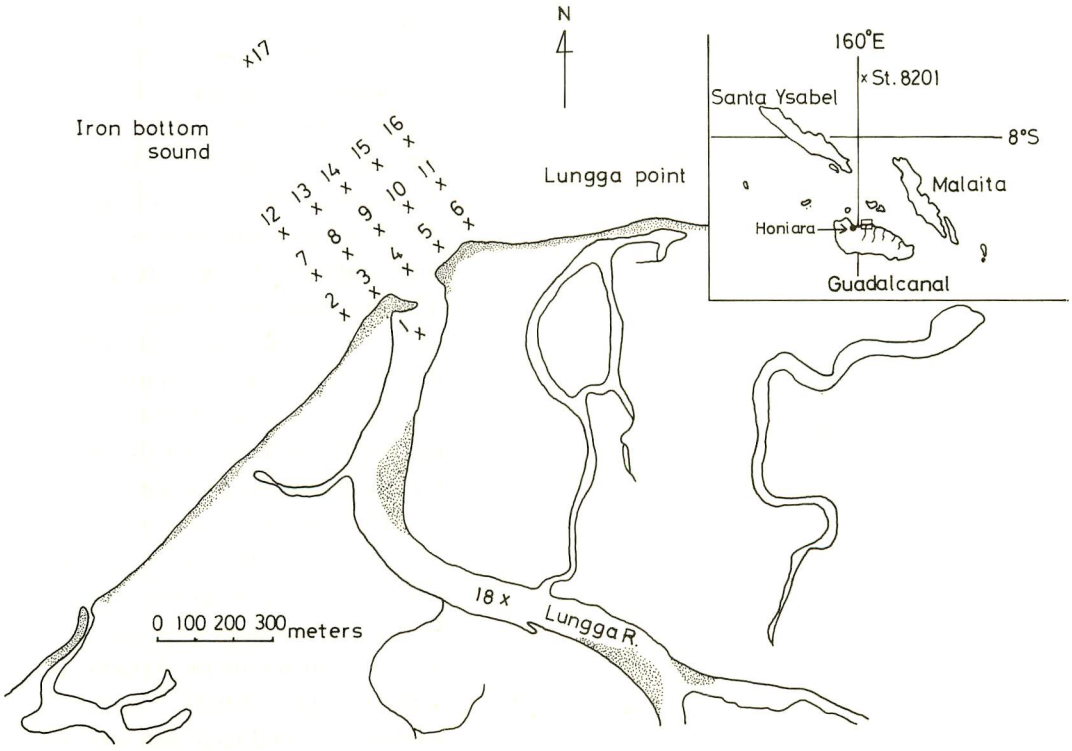

Fig. 1. Map showing the observation stations in the Lungga estuary, Guadalcanal Island, the Solomon Islands.

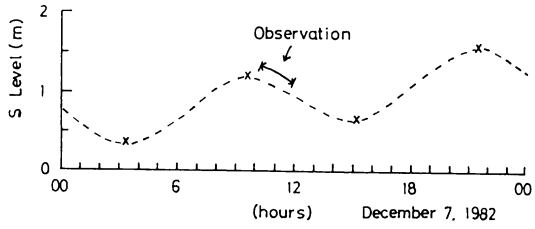

Fig. 2. Sea-level change at Auki, Malaita Island, the Solomon Islands on December 7, 1982.

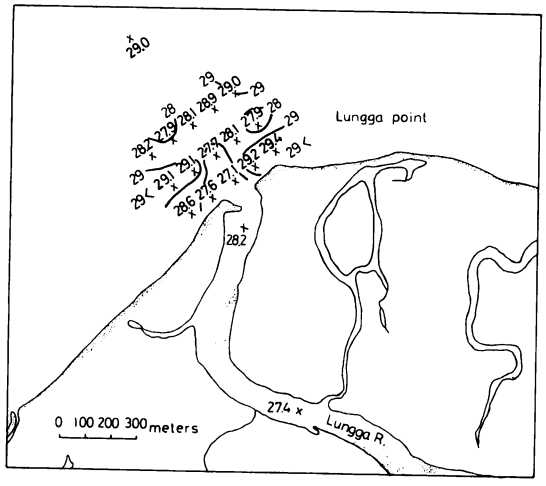

Fig. 3. Horizontal distribution of surface-water temperature (°C).

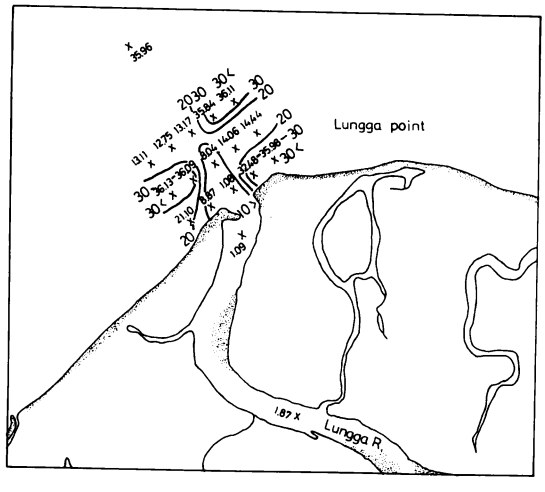

Fig. 4. Horizontal distribution of surface salinity (‰).

of water was measured with an inductive salinometer in the laboratory at the Kagoshima University. The dissolved oxygen level was measured with a YSI model 58 Dissolved Oxygen Meter on board the small boat.

Results and Discussion

The surface-horizontal distributions of water temperature, salinity, and dissolved oxygen are shown in Fig. 3, 4, and 5, respectively. The surface-water temperature was 27-28°C in the river and about 29°C in the sea water, and the surface salinity was 1.0-2.0‰ in the river and 35.8-36.1‰ in the sea water. The situation of river-water dispersion was observed based on the distributions of water temperature and salinity. The river water disperses to offshore with separating two parts. There was no dispersion of river water closely along the shoreline as already pointed out by TAKAHASHI (1974). The dissolved oxygen was 6.0 ml/L in the river and 6.2-6.3 ml/L in the sea water. It is difficult, therefore, to distinguish between river and sea water based on the distribution of dissolved oxygen.

To estimate the mixing conditions between the river and sea waters, the temperature-salinity (T-S) relation was used as in the study at the Nagura estuary, Ryukyu Islands (CHAEN, 1982). The T-S relations in eighteen stations are plotted in Fig. 6. The T-S diagram at St. 8201 (Lat. 6°59'S, Long. 160°

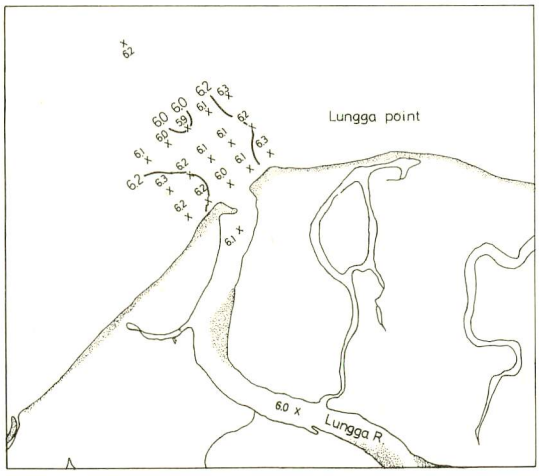

Fig. 5. Horizontal distribution of surface-dissolved oxygen (ml/L).

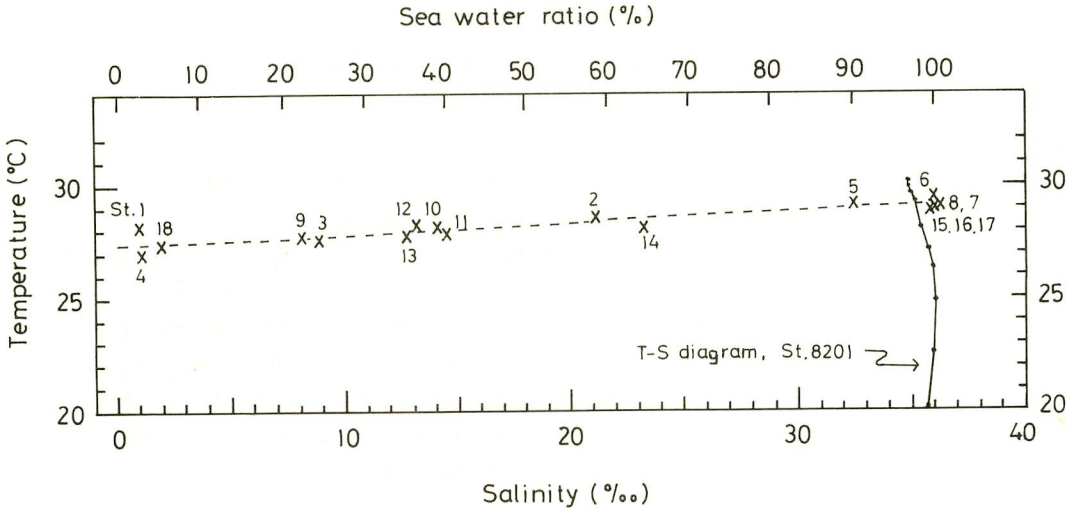

Fig. 6. Temperature-salinity relations in eighteen stations and St. 8201.

08'E) about 2.5° in latitude north of Guadalcanal Island (see inset map of Fig. 1) is shown as a reference of oceanic waters. Salinity in the surface water near the Lungga estuary is about 1.0‰ higher than that in St. 8201. The T-S relations in the eighteen stations distribute on the line between the points which represent the river and sea waters. Sea water in St. 6, 7, 8, 15, 16, and 17 has a salinity of 36.0‰ which is defined as 100% sea water. River waters should be 0‰ in salinity, that is, 0% sea water.

Dividing the line between the points of 100% and 0% sea waters into 100 segments, we obtaine the degree of mixing between the river and sea waters with the percentage of 100% sea water to the fresh water, which is named the sea-water ratio. For instance, the water at St. 11 has a 40% sea-water ratio, which means the water consists of 40% sea water and 60% river water. The water at St. 5 near the river mouth consists of 90% sea water and 10% river water. The sea-water ratio increases

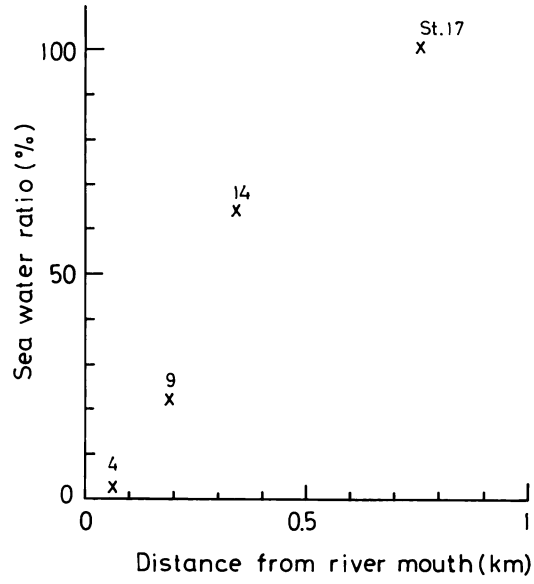

Fig. 7. Relation between the sea-water ratio and distance from river mouth.

linearly with distance from the river mouth along the line of St. 4, 9, 14, and 17, which is at right angles to the coast line near the river mouth (Fig. 7).

The observed distributions of water temperature and salinity show the situations of the dispersion of river water at the time of observation. The river-water dispersion in estuaries varies in time and space with changing tides, coastal currents and wind conditions. In this investigation, the area of observation was small for the investigation of the dispersion of river water even if the tidal condition was immediately after high water. To advance the investigation of estuarine circulation, direct-current observations by means of mooring current meters will be necessary in at least one station offshore near the river mouth.

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