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An Observation Tower for Atmospheric Boundary Layer next to the Sea Surface in AMTEX

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Abstract

A sectional tower is made for the observation of transfer processes of energy and momentum on air-sea boundary surface according to the objectives of AMTEX and is used at Hentona site, Okinawa Island, during AMTEX. The easy construction and good exposure of instruments are described, showing its utilities.

1. Introduction

The objectives of AMTEX are described in the text of the Objectives of AMTEX, adopted by the First AMTEX Study Conference in November of 1971, as follows: AMTEX is planned as an experiment within the GARP subprogramme on air-surface interaction. Its aim is to clarify the transfer processes by which energy and momentum are supplied from the sea surface to the air and transported to the free atmosphere through the planetary boundary layer, especially in areas where the air-mass transformation is active (Japanese National Committee for GARP 1971).

One of scientific requirements for this project is to determine the surface fluxes of momentum, heat, and water vapour from the sea surface over the whole area and to extend the fundamental understanding of the physical mechanism of transfer processes in the surface boundary layer.

Therefore, it is necessary to get a convenient and stable platform carrying several sensitive instruments on it for accurate measurements at any time and any place.

2. Design of a sectional tower and its test experiment

A sectional tower is designed according to the three purposes: the first, obtainment of reliable data under the good exposure of instruments over the sea surface; the second, rejection to any trouble due to wavy motion of the observation platform; the third, escape from the heavy construction under the direction of a civil engineer. The tower is primitive and it consists of several small pieces, each of which weighs under 20 kg. It can be constructed easily in the shallow sea by a few persons without special technics, using a small boat.

A test experiment of this tower in Kagoshima Bay in October of 1972 is already reported by Takahashi (1973). Fragmental pieces of the tower are thrown into the sea and the tower is completed eight hours later in the sea, where the depth to the

bottom is about 4 m, 170 m apart from the beach.

Instruments used in this case are a supersonic anemomenter-thermometer, four cup anemometers, and four sets of dry and wet bulb of thermister thermometer. The heights of all instruments above the sea surface can be changed, if necessary. Electric signals from these instruments are transmitted to the recorders in a hut prepared on the beach, by the cable setted on the sea floor. It takes two days to complete the arrangements of instruments, cable connection, a hut, and recorders.

3. Observation Tower during AMTEX

According to the results of the test experiment in Kagoshima Bay in 1972 mentioned above, the structure of the tower is somewhat improved concerning three points, i. e. weight of each piece, directions of arms holding instruments, and the height of the top of the tower.

Every parts of the column are changed to be 50 cm uniformly, which make the framing work easy due to less weight of a piece and visible length measure.

Arms may be stretched to three different directions in order to get much better exposure to the prevailing wind and to be free from any influence of other instruments.

The height of the top of the tower above the mean sea level is 6 m in AMTEX '74 and is 8 m in AMTEX '75.

The tower is setted in the sea just before AMTEX '74 off Hentona beach of Okinawa Island (Fig. 1). After AMTEX '74 it has been taken to pieces and in a storage and

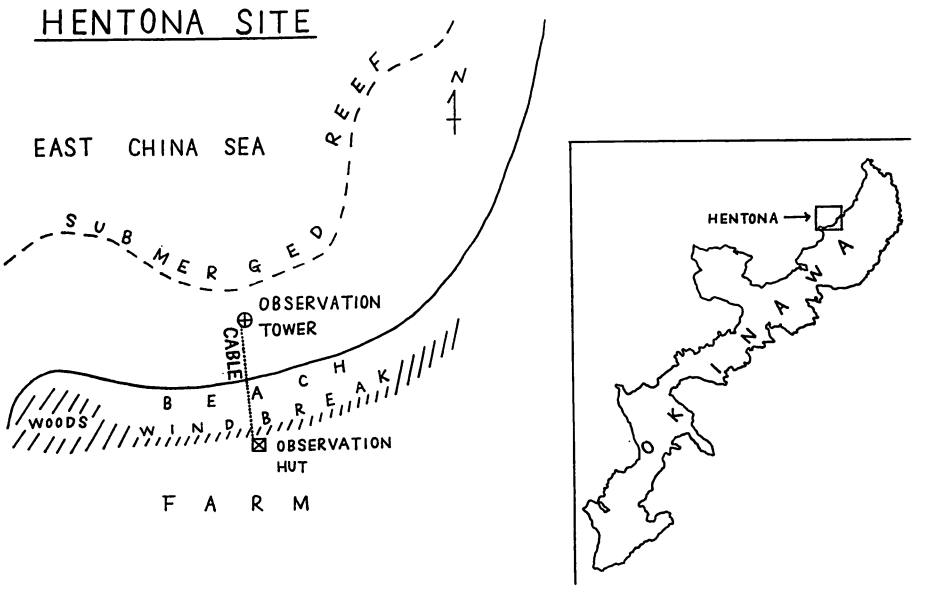


Fig. 1. Surroundings of Hentona site during AMTEX.

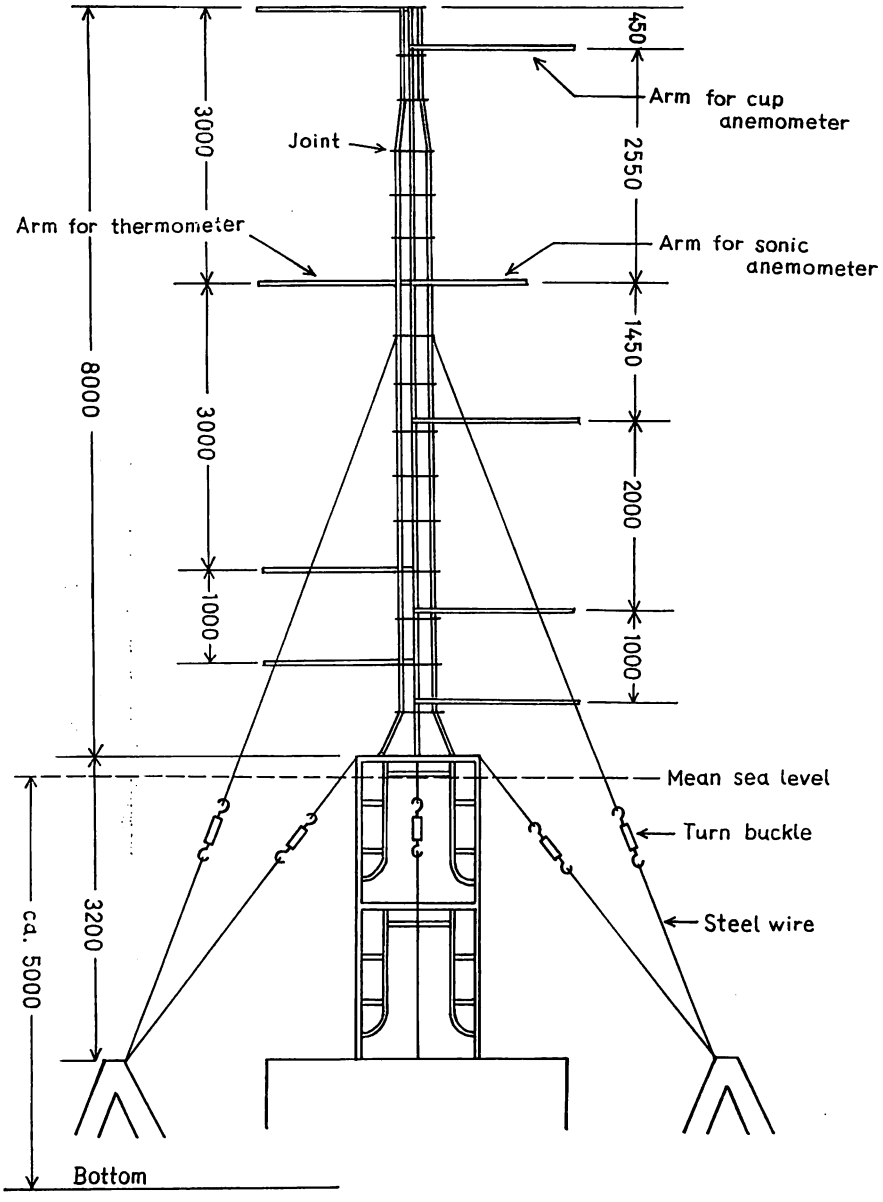
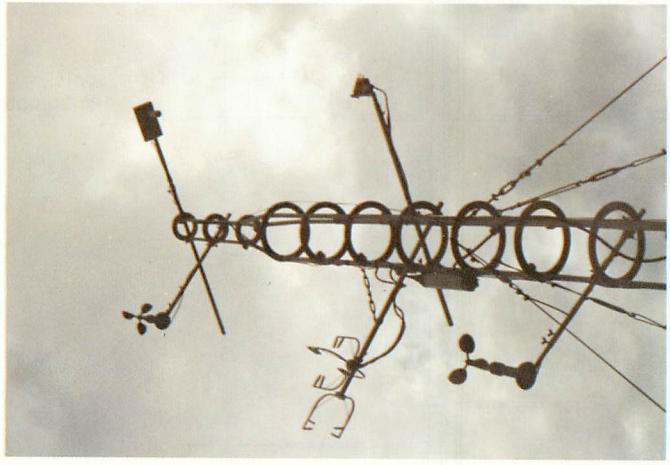


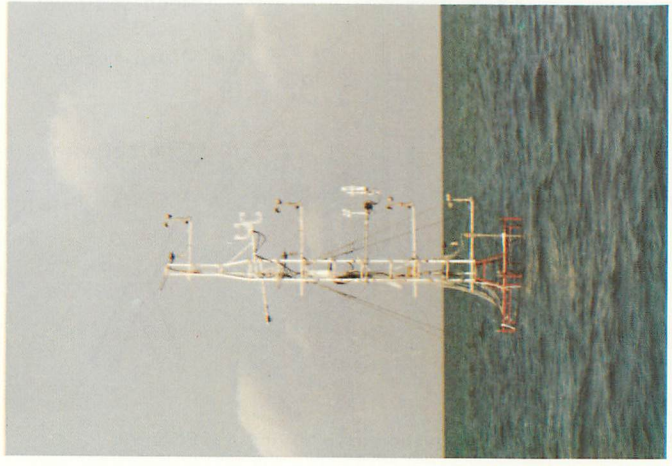
Fig. 2. Structure of the observation tower during AMTEX '75.

it is constructed again just before AMTEX '75 after a minor improvement of some pieces. Structure of the tower during AMTEX '75 is shown in Fig. 2.

According to Fig. 1, at Hentona site the sand beach of some 80 m wide stretches aproximately from ENE to WSW about 4 km long. To the south of the beach there is a windbreak consisting of many trees of ca 8 m height against northerly wind and further south rather even land without any hill. The tower is constructed on the sea



(b)



(a)

Fig. 3. Photograph of the tower with instruments.
(a) 6 m Tower during AMTEX '74, entire.
(b) 8 m Tower during AMTEX '75, upper part.

floor where the depth to the bottom is ca 5 m and is situated 250 m apart from a low water shore line.

Wind speed is measured by cup anemometers mounted at four heights. Temperature and vapour pressure are measured by sets of dry and wet bulb of thermister thermometer at three heights. Momentum flux and heat flux are measured directly by a sonic anemometer and a set of dry and wet bulb of thermocouple thermometer at the same level. Since all the instruments are mounted to the tower fixed to the sea floor, the observation level varies all the time according to the tide. Fig. 3 shows the tower with instruments.

Observation period is 16th–28th of February in 1974 and from 14th of February to 1st of March in 1975. A part of preliminary results of the experiments is reported by Takahashi (1975) and by Chaen (1976) also. Further results will be presented later.

4. Conclusion

A sectional tower is made and used during AMTEX at Hentona site. Comparing this procedare with observations by a floating bouy (Takahashi 1965; Takahashi and others 1970), it seems to have some advantage due to mainly easy construction. Practically this method is simple and its application may be rather wide, besides being not expensive. The authors wish to express their thanks to Mr. M. Nagata, Chief technician, University workshop, Kagoshima University, for his handicraft of the sectional tower.

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