5.12 Air-sea surface eddy flux measurement

(1) Personnel

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(2) Objective

To better understand the air-sea interaction, accurate measurements of surface heat and fresh water budgets are necessary as well as momentum exchange through the sea surface. In addition, the evaluation of surface flux of carbon dioxide is also indispensable for the study of global warming. Sea surface turbulent fluxes of momentum, sensible heat, latent heat, and carbon dioxide were measured by using the eddy correlation method that is thought to be most accurate and free from assumptions. These surface heat flux data are combined with radiation fluxes and water temperature profiles to derive the surface energy budget.

(3) Instruments and Methods

The surface turbulent flux measurement system (Fig. 1) consists of turbulence instruments (Kaijo Co., Ltd.) and ship motion sensors (Kanto Aircraft Instrument Co., Ltd.). The turbulence sensors include a three-dimensional sonic anemometer-thermometer (Kaijo, DA-600) and an infrared hygrometer (LICOR, LI-7500). The sonic anemometer measures three-dimensional wind components relative to the ship. The ship motion sensors include a two-axis inclinometer (Applied Geomechanics, MD-900-T), a three-axis accelerometer (Applied Signal Inc., QA-700-020), and a three-axis rate gyro (Systron Donner, QRS-0050-100). LI7500 is a CO_2/H_2O turbulence sensor that measures turbulent signals of carbon dioxide and water vapor simultaneously. These signals are sampled at 10 Hz by a PC-based data logging system (Labview, National Instruments Co., Ltd.). By obtaining the ship speed and heading information through the Mirai network system it yields the absolute wind components relative to the ground. Combining wind data with the turbulence data, turbulent fluxes and statistics are calculated in a real-time basis. These data are also saved in digital files every 0.1 second for raw data and every 1 minute for statistic data.

(4) Observation log

The observation was carried out throughout this cruise. Three-hourly 'flux-cruise', starting from 00, 03, 06, 09, 12, 15, 18 and 21LST, was applied steaming against the wind to reduce the ship effect during the stationary observation period at (8S,80E) (Leg1; 10:30 30 Sep 24:00 23 Oct, Leg2; 4:30 31 Oct 12:00 28 Nov.).

(5) Data Policy and citation

All data are archived at Okayama University, and will be open to public after quality checks and corrections. Corrected data will be submitted to JAMSTEC Marine-Earth Data and Information Department.

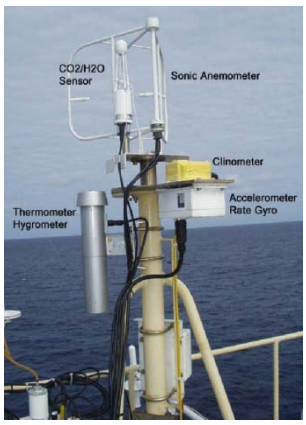

Fig. 5.12-1 Turbulent flux measurement system on the top deck of the foremast

Table 5.12-1 A part of the' flux-cruise' in the daytime are listed here for Leg-2 including human-checked air temperature, relative humidity, SST and weather conditions. All the times are Local Standard Time [UTC+5h]

Run No.	Day	Time(LST)	AT(degC)	RH(%)	SST(degC)	Remarks
1	2011/10/31	6:07	27.3	78	28.1	Cloudy
2		12:23	27.7	75	28.3	Fine
3		15:02	27.7	77	28.3	Cloudy
4		18:06	27.6	74	28.2	Cloudy
5	2011/11/1	6:05	27.6	72	28.1	Fine
6		9:12	27.7	73	28.2	Cloudy
7		12:18	27.8	73	28.3	Fine
8		15:06	27.8	73	28.5	Cloudy
9		18:06	27.5	76	28.4	Fine
10	2011/11/2	6:07	27.4	75	28.1	Cloudy
11		8:56	27.4	78	28.1	Fine
12		12:18	27.6	75	28.4	Fine
13		15:03	27.7	71	28.4	Fine
14		18:08	28	75	28.3	Fine
15	2011/11/3	6:03	27.5	73	28.2	Fine
16		9:03	27.5	71	28.2	Fine
17		12:19	27.7	73	28.4	Fine
18		14:58	27.7	74	28.5	Cloudy
19		18:07	27.5	77	28.3	
20	2011/11/4	6:06	27.2	77	28.1	Fine
21		9:03	27.7	77	28.2	Fine
22		12:21	27.7	70	28.3	Fine
23		14:58	27.7	73	28.4	Fine
24		18:06	27.6	76	28.3	Fine
25	2011/11/5	6:00	27.3	78	28.1	Fine
26		8:59	27.8	76	28.2	Fine
27		12:23	27.4	79	28.3	Fine
28		14:58	27.4	77	28.4	Fine
29		18:05	27.3	75	28.3	Fine
30	2011/11/6	6:43	27.3	80	28.2	Fine
31		8:59	27.5	79	28.2	Fine
32		12:20	27.3	78	28.3	Fine
33		14:55	27.6	74	28.4	Fine
34		18:04	27.5	78	28.3	Fine
35	2011/11/7	6:02	27.5	79	28.2	Fine
36		8:56	27.5	81	28.3	Fine
37		12:19	26.3	81	28.4	Fine
38		14:52	26.4	83	28.5	Fine
39		18:03	26.7	80	28.4	Fine
40	2011/11/8	6:14	27.2	82	28.3	Fine
41		8:58	27.6	79	28.3	Fine
42		12:24	27.7	75	28.3	Fine
43		14:55	27.3	77	28.4	Fine
44		18:03	27.5	78	28.3	Fine
45	2011/11/9	6:05	27.3	71	28.2	Fine
46		8:59	27.6	72	28.2	Fine
47		12:26	27.5	74	28.3	Fine
48		14:52	27.5	68	28.4	Fine
49		18:02	27.2	72	28.3	Fine
50	2011/11/10	6:03	26.8	73	28.1	Fine
51		8:58	27.5	72	28.1	Fine
52	2011/11/11	8:53	27.5	74	28.1	Fine
53		12:21	27.4	73	28.2	Rain
54		14:55	27.2	78	28.2	Fine
55		18:09	27.3	75	28.1	Fine
56	2011/11/12	8:55	27.5	77	27.9	Fine
57		12:26	27.3	77	28.2	Cloudy
58		14:51	27.3	77	28.2	Fine
59		18:00	26.2	80	28	Cloudy
60	2011/11/13	6:04	26.6	83	27.8	Cloudy
61	2011/11/13	8:54	27.2	81	27.9	Cloudy
62		12:24	27.5	82	28.1	Cloudy
63		14:55	27.7	75	28.3	Fine
64		18:03	27.4	77	28.1	Fine
65	2011/11/14	6:09	27.5	77	27.8	Fine
66		8:54	27.6	81	27.9	Fine
67		12:19	26.3	83	28	Fine
68		14:54	26.5	85	28	Cloudy
69		18:06	27	80	28	Cloudy
70	2011/11/15	6:20	27.3	78	27.9	Fine
71		9:00	27.5	78	27.9	Cloudy
72		12:20	27.4	76	28.1	Fine
73		14:54	27.6	76	28.1	Fine
74		18:09	27.2	79	28	Cloudy
75	2011/11/16	6:17	27.4	76	27.9	Fine
76		8:58	27.6	78	27.9	Fine
77		12:18	27.6	78	28	Fine
78		14:52	27.6	79	28.1	Cloudy
79		18:07	27.4	79	28	Fine
80	2011/11/17	8:52	27.5	80	27.9	Fine
81		12:18	27.4	79	28	Fine
82		14:55	27.3	80	28.2	Fine
83		18:01	27.1	83	28	Fine
84	2011/11/18	6:02	27.3	80	27.9	Fine
85		9:02	27.8	78	27.9	Fine
86		12:20	27.6	80	28.1	Rain
87		14:55	27.7	77	28.1	Fine
88		18:06	27.4	82	28.1	Cloudy
89	2011/11/19	6:03	27.4	75	27.9	Cloudy
90		8:58	27.1	77	27.9	Fine
91		12:26	27.8	75	28	Cloudy
92		14:56	27.1	83	28	Cloudy
93		18:04	26.9	81	28	Fine
94	2011/11/20	8:56	27.6	77	27.9	Fine
95		12:20	27.7	72	28.2	Fine
96		14:51	27.7	73	28.1	Fine
97		18:05	27.4	74	28.1	Fine
98	2011/11/21	6:03	26.8	70	27.9	Fine
99		8:51	27.2	75	27.9	Fine
100		12:19	27.2	73	28.1	Fine
101		18:01	27.3	76	28	Fine
102	2011/11/22	6:04	26.8	77	27.8	Fine
103		8:53	27.1	75	27.9	Fine
104		12:18	27.4	75	28.1	Fine
105		14:52	27.4	75	28.4	Fine
106		18:02	27.3	77	28.2	Fine
107	2011/11/23	6:04	26.8	76	27.8	Fine
108		8:49	27.2	75	27.9	Fine
109		12:19	27.4	76	28.1	Fine
110		14:52	27.6	76	28.2	Fine
111		18:02	27.3	76	28.1	Fine
112	2011/11/24	6:30	26.9	81	27.9	Rain
113		8:59	27.6	76	27.9	Cloudy
114		12:29	25.3	84	28	Cloudy
115		14:52	27.7	75	28	Fine
116		18:08	27.4	77	27.9	Cloudy
117	2011/11/25	9:56	26.5	85	27.9	Cloudy
118		12:26	27	80	28	Cloudy
119		14:55	26.5	84	27.9	Cloudy
120		18:02	26.3	83	27.9	Cloudy

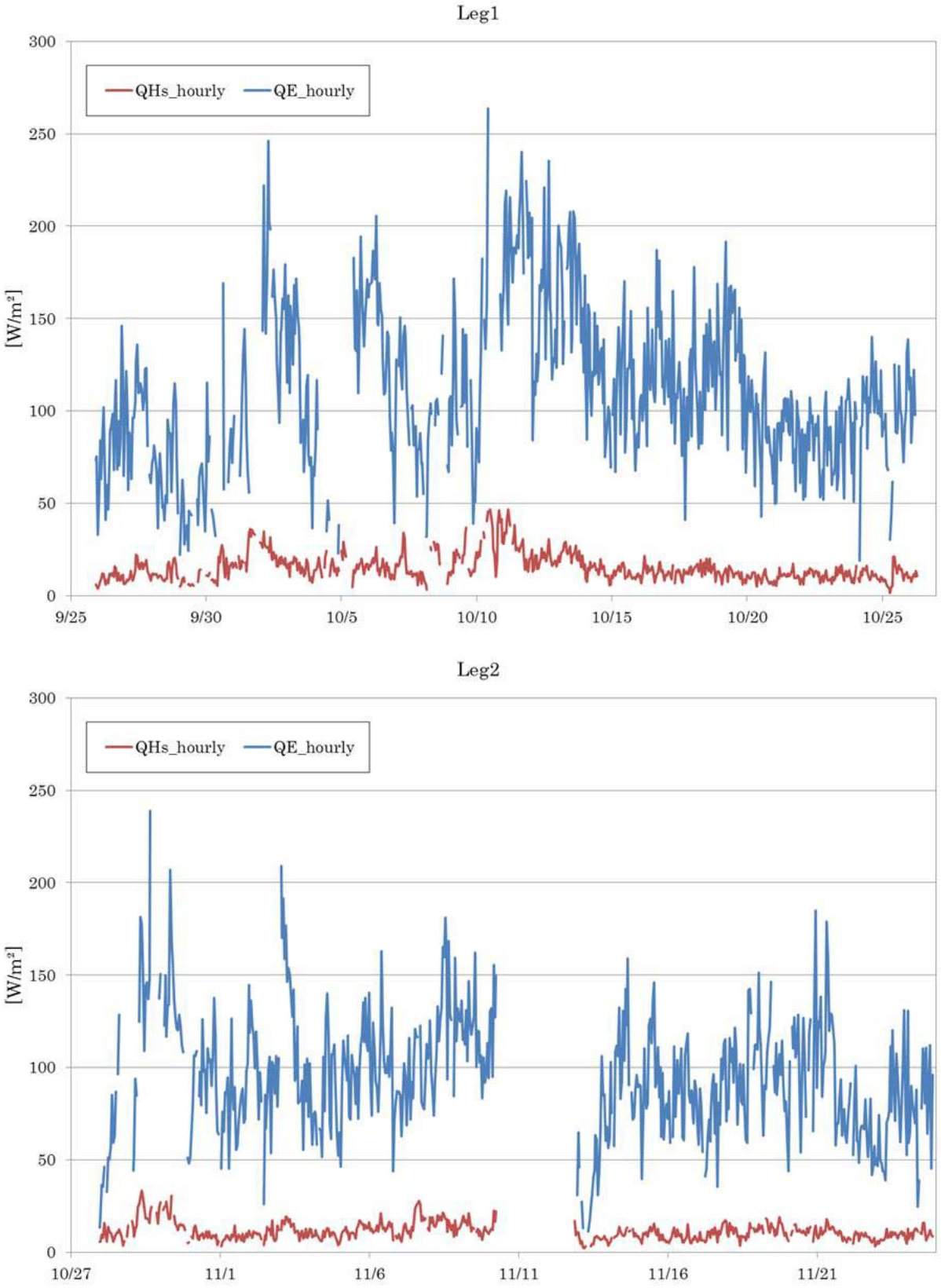

Fig. 5.12-1. Preliminary results of eddy fluxes of sensible heat (QHs), latent heat (QE) calculated with eddy-covariance method. Water vapor corrections were not applied to the sensible heat flux.