On the Estimation of Overwater Bowen Ratio from Sea–Air Temperature Difference

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On the basis of thermodynamic considerations, a relationship between overwater Bowen ratio, *B,* and sea–air temperature difference, $(T_{sea} - T_{air})$, under unstable conditions has been formulated by Hsu (1998). The purpose of this note is to further support the proposed general form that $B = a(T_{sea} - T_{air})^b$, where a and b are to be determined from field experiments.

Datasets incorporated into this study as shown in Fig. 1 are based on Table 1 as provided by Yasuda (1975) from measurements made in the East China Sea during winter. Table 2 is based on Pond et al. (1971) from data collected during the Research Platform *FLIP* cruises off San Diego, California, and in the equatorial Atlantic Ocean. Figure 1 shows our results, where $(T_{sea} - T_{air})$ has extended to about 13°C and B to over 0.5. If one accepts the high correlation coefficient of 0.94 [i.e., the equation provided in Fig. 1 can directly account for

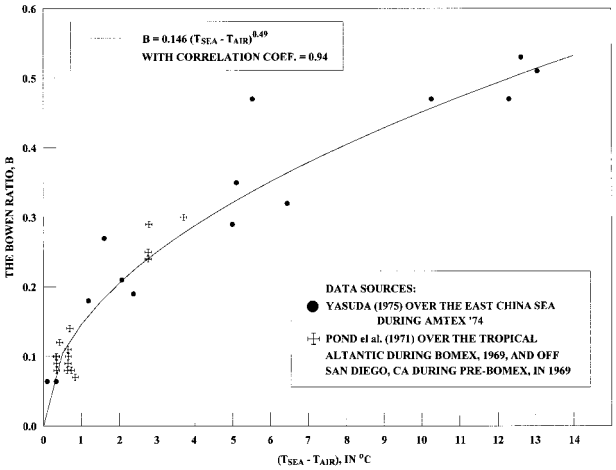

FIG. 1. A relationship between the Bowen ratio and sea–air temperature difference.

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TABLE 1. Daily mean values for parameters used to compute *B* in the East China Sea in Feb 1974 (based on Yasuda 1975, Tables 1 and 2).*

Date (Feb)	T_{air}	T_{sea}	H_s	H_l	$T_{sea} - T_{air}$	B
14	14.09	19.08	0.086	0.292	4.99	0.29
15	16.97	18.16	0.021	0.116	1.19	0.18
16	16.82	18.90	0.025	0.117	2.08	0.21
17	17.59	19.20	0.026	0.097	1.61	0.27
18	16.68	19.07	0.044	0.226	2.39	0.19
19	17.62	17.96	0.007	0.109	0.34	0.064
20	14.00	19.10	0.126	0.361	5.10	0.35
21	14.74	21.19	0.103	0.326	6.45	0.32
22	18.45	18.55	0.006	0.094	0.10	0.064
23	13.16	18.69	0.158	0.338	5.53	0.47
24	11.36	21.62	0.299	0.633	10.26	0.47
25	7.91	20.54	0.450	0.857	12.63	0.53
26	7.19	20.25	0.364	0.709	13.06	0.51
27	8.85	21.15	0.350	0.742	12.30	0.47

* T_{air}: air temperature (in °C); T_{sea}: sea surface temperature (in °C); H_s: sensible heat flux (in ly min^{-1}); H_l: latent heat flux (in ly min^{-1}); B: Bowen ratio $= H_s/H_l$.

TABLE 2. List of Bowen ratio vs $T_{sea} - T_{air}$ (in °C) for the equatorial Atlantic Ocean and off California (based on Pond et al. 1971, Table 1 and appendix).

Run	$T_{sea} - T_{air}$	B
OSU 1*		
2	2.78	0.25
3	2.78	0.24
4	2.80	0.29
5	3.71	0.30
6	0.63	0.08
7	0.65	0.11
8	0.65	0.09
8	0.70	0.14
9	0.33	0.10
10	0.43	0.12
11	0.35	0.10
12**	1.89	0.08
13	0.74	0.08
14	0.66	0.10
15	0.84	0.07
UBC 1***	0.43	0.12
2	0.35	0.09
3	0.35	0.10
4	0.35	0.10
5	0.35	0.08

* Oregon State University. The data were collected on the Research Platform *FLIP* during BOMEX.

** This value may be 0.89. Since this point was in question by the authors, it has been excluded from this analysis.

*** The University of British Columbia. The data were collected during a pre-BOMEX trial cruise near San Diego, CA.

$(0.94)^2 = 88\%$ of the variability in B], Fig. 1 may be useful from the tropical ocean to the cold air outbreak region such as over the East China Sea. The composite values of a ($=0.146$) and b ($=0.49$) are also provided in Fig. 1.

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