Haginoya, S., and Y. Kawabata, 2025: Re-Examination of Errors and Exclusion Range, and Gap-filling for Surface Flux Estimation using the Bowen Ratio Method. *J. Meteor. Soc. Japan*, **103**, <u>http://doi.org/10.2151/jmsj.2025-026</u>

Plain Language Summary: This paper presents a method for estimating turbulent fluxes using the Bowen ratio method. The Bowen ratio method has been widely used to estimate sensible and latent heat fluxes using time-averaged values, such as two-level air temperature and humidity measurements, net radiation, and soil heat flux. However, there exist conditions in which the Bowen ratio method is not applicable. We propose a data exclusion criterion for the Bowen ratio method, defining an exclusion range for the Bowen ratios (B) as $B_- < B < B_+$. To determine B_- and B_+ , we evaluated the flux difference between the Bowen ratio method and the eddy covariance method and suggested $B_- = -2.0$ and $B_+ = -0.6$. We also propose an interpolation method to handle missing data based on the exclusion criteria by interpolating B-factor ("B/(1 + B)" or "1/(1 + B)"). By implementing these approaches, we establish a comprehensive and practical framework for estimating turbulent fluxes with the Bowen ratio method. We expect that these results will enhance the accuracy and reliability of flux estimates in various environmental and climate studies.



Figure 1. (a) Original data. H(eddy) and H(Bowen) are the sensible heat fluxes measured by the eddy correlation and Bowen ratio methods, respectively. Many spike errors can be seen in H(Bowen). (b) Sum of the data to which the criterion is applied ("in" data) and the interpolated data ("int" data). Spike errors are removed. Red dashed line and equation are the regression line and function, respectively. R^2 is coefficient of determination.

- Optimization of data exclusion criteria: The exclusion criteria (B₋, B₊) were determined objectively using a variety of indicators. It is possible that these criteria may change due to site dependency. However, there is no dependence on temperature or height difference.
- Effectiveness of methods to fill in missing data: The B-factor interpolation method provided reasonable results for gap-filling of excluded data points, and interpolation of 6–12 data points are feasible and requires fewer input variables, making it a simpler and more practical alternative in field applications.