

Title: Developing Bulk Turbulent Surface Flux Algorithms over Surfaces Consisting of Liquid or Frozen Water

Abstract:

Bulk flux algorithms predict the turbulent surface fluxes of momentum and sensible and latent heat (and even trace gases) from the bulk properties of the air and surface—namely, wind speed, air temperature and humidity, and surface temperature and salinity. Some algorithms also consider the morphological properties of the surface. Bulk flux algorithms find use for estimating the surface fluxes when they cannot be measured directly. More importantly, a form of bulk flux algorithm is always used in numerical weather prediction, global climate, and hurricane forecasting models, where it couples the atmosphere and the surface through flux boundary conditions. From thousands of hours of eddy-covariance measurements of the surface fluxes, I have developed bulk flux algorithms for various water and ice surfaces. My inventory of algorithms covers the open ocean; large lakes and reservoirs; sea ice in winter, when it is compact and snow-covered; sea ice in summer, when it is more open and includes melt ponds; and the marginal ice zone, which consists of ice floes and open water in comparable proportions. The winter sea ice algorithm is also appropriate for glaciers and extensive terrestrial snow fields. Developing bulk flux algorithms for such water and ice surfaces is possible because the surface temperature, a key variable in these algorithms, is straightforward to define and relatively easy to measure. In this talk, I will review the general theoretical foundation for bulk turbulent flux algorithms but will also highlight differences among the algorithms that I have developed. I will also discuss the measurements required for developing turbulent flux algorithms and focus on the lingering conceptual issues that keep flux algorithms a hot topic in micrometeorology.