Title: Aerodynamic and Scalar Roughness over Snow and Sea Ice

Abstract:
In Monin-Obukhov similarity theory, the aerodynamic roughness, z0, is the artificial height above the surface at which the wind speed profile in the atmospheric surface layer extrapolates downward to zero wind speed (assuming no-slip boundary conditions). Likewise, the scalar roughnesses for the surface-layer profiles of temperature (zT) and specific humidity (zQ) are the artificial heights at which these profiles extrapolate downward to the surface temperature and surface humidity. Besides their role in establishing the surface-layer wind speed, temperature, and humidity profiles, roughness lengths are often the cornerstone of so-called bulk turbulent flux algorithms, which are used in models, among other applications, to couple the surface and the atmosphere through the surface fluxes of momentum and sensible and latent heat. In this talk, I will review the theory and measurement of the aerodynamic and scalar roughness lengths over snow and sea ice. The data consist of thousands of hours of eddy-covariance flux measurements over both Arctic and Antarctic sea ice. In winter, sea ice is horizontal and snow-covered and, therefore, is similar to extensive snow-covered surfaces on land. As a result, what we learn about the roughness of winter sea ice should apply to any extensive snow fields. Although z0, zT, and zQ are not true physical quantities, I will describe recent efforts that link z0 to the physical roughness of sea ice, a quantity that can conceivably be measured from satellites. I will also highlight some of the misconceptions that exist about parameterizing roughness lengths.