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The Information Science & Technology Center

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Colorado State University's
Information Science and Technology Center (ISTeC)
presents <u>two</u> lectures by

Dr. Edgar L Andreas

Senior Research Scientist
NorthWest Research Associates
Lebanon, New Hampshire

ISTeC Distinguished Lecture

In conjunction with the
Electrical and Computer Engineering Department,
Computer Science Department, and Interdisciplinary Water Resources Seminar Series

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

Monday, April 21, 2014
Reception with refreshments: 10:30 am
Lecture: 11:00 am – 12:00 noon
Location: Morgan Library, Event Hall

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Electrical and Computer Engineering Department, Computer Science Department, and Interdisciplinary Water Resources Special Seminar *Sponsored by ISTeC*

"Aerodynamic and Scalar Roughness over Snow and Sea Ice"

Monday, April 21, 2014
Lecture: 4:00 – 5:00 pm
Location: LSC 222

ISTeC (Information Science and Technology Center) is a university-wide organization for promoting, facilitating, and enhancing CSU's research, education, and outreach activities pertaining to the design and innovative application of computer, communication, and information systems. For more information please see ISTeC.ColoState.EDU.

Abstracts:

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

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.

Aerodynamic and Scalar Roughness over Snow and Sea Ice

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.

Speaker Biography:

Dr. Edgar L Andreas received his Ph.D. in 1977 from Oregon State University in physical oceanography. From 1978 through 2006, he was a Research Physicist with the U.S. Army's Cold Regions Research and Engineering Laboratory in Hanover, NH. He is currently a Senior Research Scientist with NorthWest Research Associates and has his office in Lebanon, NH. In 1986 and 1987, he spent a year with the NOAA/ERL Wave Propagation Laboratory in Boulder, CO (now NOAA's Earth System Research Laboratory), on a fellowship from the National Research Council. He has four primary research areas, all tied together by his fundamental interest in turbulent transfer processes in the atmospheric boundary layer. These four areas are 1) air-sea interaction and the effects of sea spray on air-sea heat, moisture, and momentum transfer in high winds; 2) polar meteorology and air-sea-ice interaction; 3) scintillation and electro-optical propagation in the atmospheric boundary layer; and 4) fundamental turbulence issues such as Monin-Obukhov similarity theory, fluid dynamics, time series and spectral analysis, and measurement physics. Dr. Andreas has done theoretical work, experimental work, and modeling in all four areas. He is the lead or sole author of 83 papers published in refereed journals and has edited or co-edited three books. He is a Life Member of the American Geophysical Union and a Fellow of both the American Meteorological Society and the Royal Meteorological Society.

To arrange a meeting with the speaker, please contact Steven Fassnacht, Steven.Fassnacht@ColoState.EDU 970-491-5454