Boulder Fluid and Thermal Sciences Seminar Series

Tuesday, October 13, 2015
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center (DLC)
University of Colorado, Boulder

Two Oddities Related to the Transition in Atmospheric Turbulence Structure from External Forcing

James Brasseur, *University of Colorado, Boulder*

During the daytime, the surface of the earth bounds the lower troposphere, a highly turbulent flow region with three-dimensional eddies at the “microscale” (~10 m to ~1000 m) that is forced from below by solar heating and above by nonsteady quasi-two-dimensional turbulent winds at the “mesoscale” (~50 km - 1000 km). In this brief 30-minute presentation I shall describe two oddities we have discovered that result from this mesoscale forcing. The first results when extremely low levels of surface heating from the sun (e.g., in the morning) forces an otherwise “neutral” atmospheric boundary layer and causes a surprising and dramatic change in turbulence structure. The second results from nonsteady forcing of the atmospheric boundary layer from above by a change in direction of mesoscale winds, for example associated with the passage of a weather front. If the underlying boundary layer is near neutral, the change in the wind direction can also cause a sudden change in turbulence structure, but for a very different reason than that due to solar heating.

High-Accuracy Numerical Simulations of Concentration Polarization in Reverse Osmosis Systems

Claire Strebinger, *Colorado School of Mines*

Reverse osmosis (RO) membrane filtration systems have numerous applications in seawater desalination and advanced water treatment. However, fluid flow and mass transport in RO membrane filtration systems are difficult to simulate numerically due to the coupling between the transmembrane filtrate flow, pressure, and osmotic pressure. This coupling is challenging for real-world systems in which the local filtrate flow varies both spatially and temporally. Consequently, previous simulations tend to focus on two-dimensional steady cases. We present a new, high-accuracy numerical method specifically tailored to simulating RO. Using the method, we simulate the transient accumulation of rejected solutes at membrane surfaces and the resulting formation of concentration polarization layers. Specifically, we investigate polarization in plate and frame RO systems as a function of inlet Reynolds number, inlet solute concentration, and outlet transmembrane pressure. This talk will cover the numerical techniques used in our model and the unsteady results as they compare to current analytical and numerical models.