Boulder Fluid and Thermal Sciences Seminar Series

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

Spectroscopic measurements of tropospheric trace gases: Instrumentation and applications

Sean Coburn, *University of Colorado, Boulder*

The first part of this talk contains an overview of two projects focused on measurements of tropospheric trace gases in the marine boundary layer. Both studies rely on the Differential Optical Absorption Spectroscopy (DOAS) measurement technique and the development of low noise/high sensitivity instrumentation to detect halogen oxides and volatile organic compounds (VOCs) at volume mixing ratios <10 pptv. The first of these studies utilizes a ground-based passive remote sensing instrument that was developed for measuring bromine monoxide (BrO) and iodine monoxide (IO) in order to investigate the potential role of halogen species in atmospheric mercury oxidation at mid-latitudes. In the second of these studies, a cavity enhanced DOAS instrument was developed to measure glyoxal (the smallest alpha-dicarbonyl) fluxes over the open ocean to aid in our understanding of potential sources of VOCs in a pristine remote environment.
The second part of this talk details a project that is currently underway which seeks to expand the spectroscopic measurement applications of frequency comb instrumentation to open path field measurements of methane. The proposed project includes the development of a fieldable dual frequency comb instrument capable of measuring trace enhancements of methane (~1 ppbv on top of 2 ppmv background) which used in conjunction with atmospheric modeling and inversion techniques will allow the instrument to locate and size small methane leaks on oil and gas operation sites.

Biomass particle heat transfer in multi-phase flows: Converging experimental, DNS, and reactor-scale simulation models

Jack Ziegler*, National Renewable Energy Laboratory*

Modeling heat transfer in reacting-gas particle flows is important for understanding of biomass pyrolysis. In pyrolysis reactors, millions of ~1mm sized ground wood particles heat up quickly through convective heat transfer at the boundary layers at the particle surfaces. Modeling this correctly at the reactor-scale is a challenge due the irregular shapes of the particles, their low thermal conductivity, and vast number. At NREL we have taken a multi-scale approach involving: DNS of single particles with realistic geometry and a specially designed fixed bed heat-transfer experiment. Using a 1-D numerical model of the experiment, a minimization procedure was used to determine the heat transfer coefficients, particularly the particle Nusselt number[1]s dependence on the Reynolds number. Using these results, the experiment was simulated using a 2-D transient model with the MFIX software. The focus of the talk is the multi-scale nature of the problem and the challenges encountered.