Boulder Fluid Dynamics Seminar Series

Tuesday, October 29, 2013
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center (DLC)
University of Colorado at Boulder

Oh, the places your laser beam will go - Optical sensing in harsh, practical environments

Greg Rieker, *University of Colorado at Boulder*

Lasers provide the capability to non-intrusively probe environments that would be otherwise inaccessible to traditional sensors. I will describe the basics of laser absorption spectroscopy to measure physical properties of gas phase systems, and show two examples of my work with laser sensing in practical environments:
1) Measurements of temperature and water vapor concentration in a full-scale ground test scramjet combustor at the air force research laboratory and basic comparisons with CFD
2) Measurements of time-resolved greenhouse gas concentrations over a 2 km open path in the atmosphere above Boulder
My goal is to demonstrate what these techniques can and cannot do, in hopes of generating conversation between experimentalists and computationalists around measurement and analysis of fluids problems.

Asymptotically Reduced Models for Rapidly Rotating Convection in Planets and Stars

Michael Calkins, *University of Colorado at Boulder*

Buoyancy-driven flows are one of the most common sources of turbulence and magnetic field generation in planets and stars. Understanding these systems remains difficult, however, due to the vast range of spatial and temporal scales that characterize them. Numerical simulations of the full governing equations is of limited utility given the inability to access realistic parameter values (e.g. the Reynolds number) and flow regimes. An alternative modelling effort that helps to overcome these limitations is to develop simplified, or *reduced*, equation sets that focus only on the dynamical scales of interests. Development of reduced equations relies on the mathematical tools provided by multiscale asymptotics, whereby a small (or large) parameter that characterizes the dynamical processes of interest is identified, and the unknown quantities are expanded in a perturbation series about a basic state. In the case of the rotating convection, this basic state is a balance between the pressure and Coriolis forces in the governing equations, well-known as the geostrophic balance. I will discuss how we are using numerical simulations of the new *quasi-geostrophic* models for understanding convection in planetary atmospheres, oceans, liquid cores, and the convecting regions of stars.