Boulder Fluid Dynamics Seminar Series

Tuesday, July 15, 2014
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center (DLC)
University of Colorado at Boulder

Hurricane Sandy at Ultra-Fine resolution

Mel Shapiro, *National Center for Atmospheric Research*

A team of researchers from the National Center for Atmospheric Research (NCAR), the National Center for Supercomputing Applications (NCSA), and Cray Inc., simulated the evolution of hurricane Sandy as it approached and made landfall, with catastrophic impacts over the northeastern United States. The simulation was performed on the Blue Waters Cray supercomputer at NCSA, using the NCAR/WRF-ARW regional prediction system. The simulation was comprised of previously unsurpassed ~4 billion computation grid points, with a horizontal grid resolution of 500 m with 150 vertical levels. The simulation is part of NCAR's research agenda to advance knowledge and predictive skill of high-impact weather hazards and the transition of research-to-operational services. It illustrates the importance and benefits of advances in super-computer capacity and visualization systems for Earth-system research and weather prediction. The NCAR VAPOR visualization system was used to create animations, tracking the storm's progress, enabling analysis of flow trajectories and associated dynamical processes during the life cycle of Hurricane Sandy. Technical details of the simulation are described in the SC2013 article "Petascale WRF Simulation of Hurricane Sandy: Deployment of NCSA's Cray XE6 Blue Waters."

Energy cascades in geophysical turbulence: a variation on a statistical mechanics argument by Kraichnan

Corentin Herbert, *National Center for Atmospheric Research*

Geophysical flows, such as the atmosphere and the ocean of the Earth, exhibit continuous energy spectra associated with coexisting motions over a broad range of length scales. On the one hand, long-lived coherent structures appear at the large scales, similarly to 2D turbulence. On the other hand, the three-dimensional character of the system becomes important at smaller scales. To understand how these different kinds of motions are maintained, a first step is to understand in an idealized framework how the energy is transferred across scales in turbulent fluids subjected to rotation and density stratification. These two ingredients break isotropy, and the standard 3D Kolmogorov cascade scenario is no longer valid. Numerical simulations show that the energy can be transferred downscale or upscale depending on the Froude and Rossby numbers. In this talk, I will adapt a theoretical argument from statistical mechanics, originally used by Kraichnan for 2D and 3D homogeneous isotropic turbulence, to discuss the energy cascade phenomenologies in rotating and stratified turbulence. will be given to emphasize the importance of including phase coherence in simulations for design purposes.