High fidelity simulation of multiscale turbulent flows in the environment

ABSTRACT
The high fidelity simulation of flows around engineered devices that operate in the natural environment presents a tremendous challenge owing to the large range of length scales (mm to tens of meters) and time scales (sec to hours) in the flow variability. We will discuss two examples concerning flows in a stratified environment. The first concerns the stratified wake motivated by flying airplanes or underwater submersibles. A large eddy simulation (LES) with an immersed boundary method is employed to simulate the near wake and the results coupled with another domain in which the simulation is continued into the far wake. This technique enables a realistic picture of wake dynamics including turbulence, coherent vortices and radiated gravity waves. The second example concerns upper ocean turbulence in the Pacific Equatorial Ocean where the sea surface temperature determined by turbulent mixing crucially impacts the coupled ocean-atmosphere dynamics central to the El Nino/La Nina cycle. We utilize LES and of a subsurface jet driven by wind and modulated by diurnal heating as well as supporting DNS studies to show how coherent bursts of turbulence in the nominally stable undercurrent accomplish entrainment of the cold subsurface water into the mixed layer.

BIO
Sutanu Sarkar received his B. Tech from IIT Bombay, M. S. from Ohio State University and Ph. D. from Cornell University. After 4 years as a staff scientist at ICASE, NASA Langley Research Center, he joined UCSD where he is currently the Blasker Professor of Engineering and the Chair of the department of Mechanical and Aerospace Engineering. His current research interests are in the areas of simulation and modeling of turbulent flows, transport and mixing in the environment, and energy. He has received a NASA group achievement award (1994), the Bessel Award from the Humboldt Foundation (2001), and was elected Fellow, American Physical Society (2006), Associate Fellow, AIAA (2009) and Fellow, ASME (2010).