Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Measurement of High Reynolds Number Near-Field Turbulent Sphere Wakes under Stratified Conditions[1] KENNETH KALUMUCK, ALAN BRANDT, KIRK DECKER, KARA SHIPLEY, Johns Hopkins University Applied Physics Laboratory — To characterize the near-field of a stratified wake at Reynolds numbers, Re = 2 x 10^5 - 10^6, experiments were conducted with a large diameter (0.5 m) sphere towed through a thermally stratified fresh water lake. Stratification produced BV frequencies, N, up to 0.07/s (42 cph) resulting in Froude numbers F = U/ND $\geq$ 15. The submerged sphere and associated instrumentation including two Acoustic Doppler Velocimeters (ADVs) and an array of fast response thermistors were affixed to a common frame towed over a range of speeds. Three components of the instantaneous wake velocities were obtained simultaneously at two cross-wake locations with the ADVs while density fluctuations were inferred from temperature measurements made by the thermistors. These measurements were used to determine the mean, rms, and spectra of all three components of the turbulent velocity field and density fluctuations at multiple locations. The turbulence power spectra follow the expected -5/3 slope with wavenumber. Existing stratified near-field wake data for spheres are for Re =10^4 and less, and only a very limited set of data under unstratified conditions exists at these large values of Re. Those data are primarily measurements of the sphere drag, surface pressure distribution, and separation rather than in wake turbulence. Advances in CFD modeling have enabled simulations at these high Reynolds numbers without quantitative data available for validation.

[1]Sponsored by ONR Turbulence and Wakes program.

Kenneth Kalumuck
Johns Hopkins University Applied Physics Laboratory

Date submitted: 31 Jul 2015 Electronic form version 1.4