



## **Kuroshio Extension meanders and abyssal eddies**

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As part of the Kuroshio Extension System Study, a mesoscale resolving-array of current- and pressure-gauge-equipped inverted echo sounders was moored on the ocean floor beneath the Kuroshio Extension with the goal to identify and understand processes governing the variability of and the interaction between the Kuroshio Extension and its southern recirculation gyre. The array, centered near 35N, 146E, encompasses the region of high eddy kinetic energy determined from satellite altimetry and the grid of measurements at about 80 km spacing provides quantitative mapping of the upper and deep circulation in a 600 by 600 km region. Mid-experiment telemetry in June 2005 retrieved 14 months of records from 42 instruments.

The instrumentation and array design allow us to produce daily maps of steric height at 100 dbar, absolutely referenced by the observed deep pressure and deep currents. Round-trip acoustic travel time, measured by the inverted echo sounder, estimated geopotential height referenced to 5000 dbar utilizing empirical relationships established with historical hydrography. Bottom pressures were leveled by adjusting all records to the same 5000 dbar geopotential surface by assuming near-bottom currents and bottom pressures are in geostrophic balance. Deep pressure records combined with estimated horizontal geopotential gradients yield referenced geostrophic velocities. Additionally, the array allows us to decompose absolute sea surface height into baroclinic and barotropic contributions. The baroclinic component, the geopotential divided by gravity, represents the steric-height contribution to sea surface height. Here we define the barotropic component as bottom pressure divided by gravity and density, and represents the mass contribution to sea surface height.

The Kuroshio Extension transitioned from a stable period, June to November 2004, to an energetic meandering period. During the stable period, a broad region of anti-cyclonic circulation existed beneath the stable strong recirculation gyre. During the

energetic period, deep anticyclones and cyclones traversed through the region and intensified beneath the large-amplitude meanders. Deep eddy velocities were found in excess of 30 cm/s, much larger than the typical 7 cm/s deep mean currents. The deep eddy velocities often exhibit a component normal to the upper baroclinic front and this causes substantial cross-frontal exchange of properties and vertical motion along sloping isopycnals. Strong barotropic eddies transited quickly through the array and contribute a sizeable fraction to the overall sea surface height variability. Daily maps of sea surface height show energetic processes not apparent in merged satellite sea surface height products. Short wavelength (160 km) meanders passed rapidly (25-30 km/d) along the northern edge of the Kuroshio Extension.