andering eastward jet; one of the major functions of the meandering jet is to dissipate the PV anomaly so that the water can reenter the interior subtropical gyre. This dissipation process is characterized by instabilities of both baroclinic and barotropic origin which are manifested by vigorous meandering.

The flux of PV anomalies away from the detached jet erodes the ambient PV field in the interior, creating plateaus upon which nearly inertial recirculation gyres develop (Cessi et al. 1987; Jayne and Hogg 1999). Spall (1996) has shown that this process can lead to natural internal oscillations (*i.e.*, even without atmospheric coupling). Specifically, meandering of the jet causes PV fluxes that spin up the recirculation gyre. Moreover, the (slowly evolving) PV distribution across the jet determines its stability properties and its consequent intensity of meandering. A cyclic process arises because the low PV anomaly carried into a strong recirculation gyre from the deep western boundary current tends to reduce the instabilities, thus weakening the recirculation. The gyre retracts, which is followed by stronger instability and gyre spin-up again, with a decadal time scale. In addition, if there are other sources of variability in the PV anomaly distribution supplied by the western boundary current, due to changes in the thermohaline circulation for example, these will also lead to a modulation of the recirculation gyre.

In the Kuroshio Extension, the existence of a southern recirculation gyre is well demonstrated by lowered ADCP measurements from the WOCE P10 cruise across the Kuroshio Extension southeast of Japan (Figure 3). The volume transport of the eastward-flowing Kuroshio Extension, denoted in Figure 3 by the unshaded area, is about 140 Sv (Wijffels et al. 1998). This is three times as large as the maximum Sverdrup transport of about 45 Sv in the subtropical North Pacific (*e.g.*, Hautala et al. 1994; Huang and Qiu 1994). This inflated eastward transport is largely due to the existence of the southern recirculating flow. Though weak in its surface speed, the lowered ADCP measurements show that this westward recirculating flow has a strong *barotropic* component and has a total volume transport exceeding 90 Sv (Wijffels et al. 1998, their Figure 6).

That the recirculation gyre is an inseparable part of the Kuroshio Extension system is also seen from the T/P satellite altimetric measurements (SSH). Over the past 8 years, the Kuroshio Extension evolved gradually from an elongated state to a contracted one from late 1992 to 1996. This modal transition reversed after 1997 and the Kuroshio Extension re-

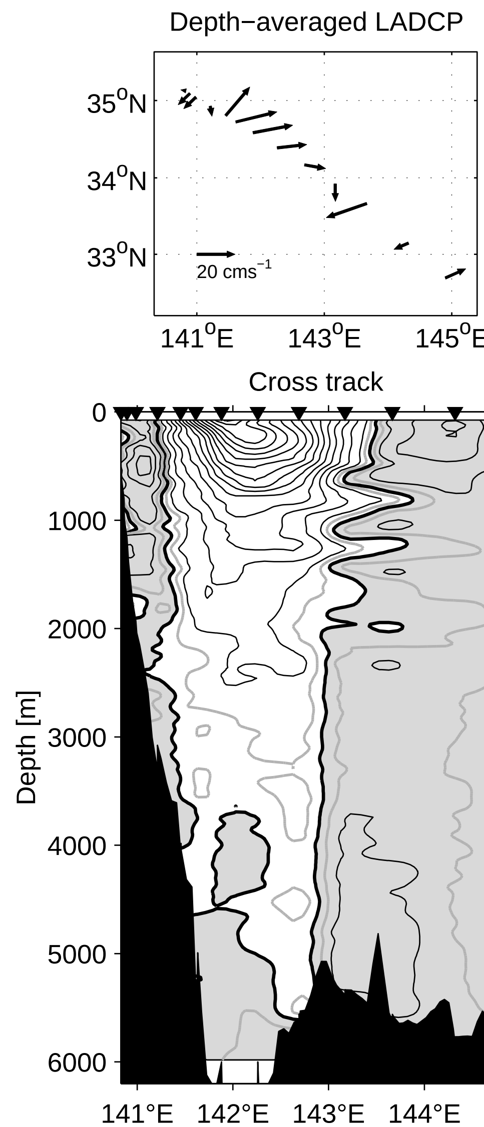

Figure 3: Lowered acoustic Doppler current profiler velocities from World Ocean Circulation Hydrographic Program section P10 where it crossed the Kuroshio Extension close to Japan (Wijffels et al. 1998). Velocities are positive to the northeast. Velocities are contoured at 10 cm s^{-1} intervals, with an additional gray contour at ± 5 cm s^{-1}. Shaded regions are negative. Note strong deep recirculation (shaded) south of the Kuroshio Extension.