SHALLOW AND DEEP CURRENT VARIABILITY IN THE KUROSHIO EXTENSION

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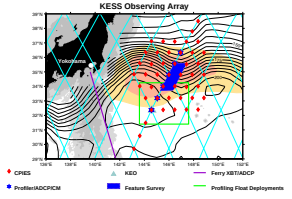
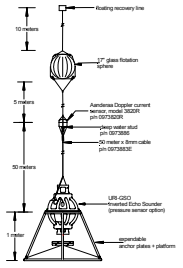
KUROSHIO EXTENSION SYSTEM STUDY



•GOAL – Identify dynamic and thermodynamic processes that govern meanders and eddies in the Kuroshio Extension and interactions with the recirculation gyre.
•OBSERVATIONS – Mesoscale-resolved 4D density and velocity fields
•CALCULATE – Dynamical balances and exchanges of heat, salt, momentum and potential vorticity.

CURRENT AND PRESSURE RECORDING INVERTED ECHO SOUNDER (CPIES)



On an acoustic-telemetry cruise, June-July 2005, we collected the first year of daily travel times, pressures and currents. The instruments remain on the sea floor collecting data.

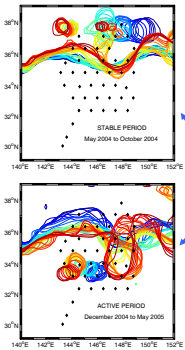
Look-up tables interpret the CPIES acoustic travel times as geopotential height, **φ**(p). 2-D arrays of CPIES estimate horizontal gradients of **φ** to calculate geostrophic velocities.

Velocity profiles are referenced by measured deep currents. Bottom pressures are leveled using time-mean near-bottom currents.

Upper streamfuntions (0 re 5000 dbar) and deep streamfunctions were mapped daily from these data by optimal interpolation.

TWO STATES OF VARIABILITY OBSERVED IN UPPER AND DEEP LEVELS

SEA SURFACE HEIGHT



Satellite altimetry shows the Kuroshio Extension alternates between relatively stable and vigorous meandering intervals on decadal time scales (see Qiu *et al.* OS52D-02).

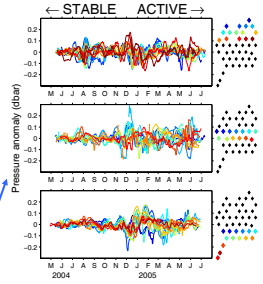
The KE transitioned between these two states in Fall 2004.

SSH fields for the stable period show two nearly stationary meanders and a westward-propagating warm core ring (WCR) in the KESS region.

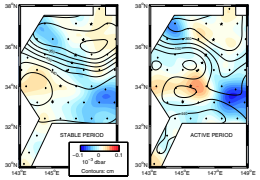
During the active period, a steep trough develops and a cold core ring (CCR) forms.

The deep level correspondingly changed. Bottom pressures transitioned from weak fluctuations to strong fluctuations.

PRESSURE ANOMALY



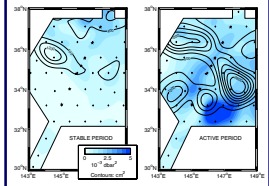
UPPER AND DEEP MEAN STREAMFUNCTIONS



UPPER STREAMFUNCTION: CONTOURS
STABLE period: well-defined KE front and recirculation gyre SW of a mean weak meander trough.
ACTIVE period: increased meandering produces weaker lateral gradients across the KE mean front. Both the trough and cold core ring are evident in the mean.

DEEP STREAMFUNCTION: COLORS
STABLE period: Anticyclonic circulation is deep expression of southern recirculation gyre. Weak cross-frontal flow under the trough.
ACTIVE period: Deep features are intensified.

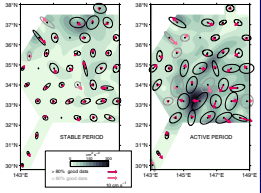
UPPER AND DEEP STREAMFUNCTION VARIANCE



UPPER VARIANCE: CONTOURS
STABLE period: high variance restricted to the KE frontal region and under the WCR.
ACTIVE period: high variance 32ºN- 37ºN

DEEP VARIANCE: COLORS
STABLE period: moderate variability occurs under the northern WCR, and low variability in the southern recirculation region.
ACTIVE period: higher variance everywhere, largest in the southern region under the upper layer trough and CCR.

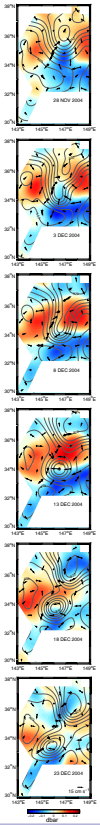
MEAN DEEP CURRENTS, ELLIPSES AND EKE



DEEP EKE: COLORS
STABLE period: weak variability in deep currents, concentrated in the north beneath the WCR.
ACTIVE period: large variability in currents throughout the KESS array, more than twice that of the STABLE period.

JET INTERACTION WITH DEEP EDDIES

Meander trough steepens during December 2004 and pinches off a cold core ring. Deep cyclones (C) and anti-cyclones (AC) move from northeast to southwest. Upper and deep layers interact and jointly intensify. Deep eddies play an important role in the pinch-off process.



•Pair of deep ACs (red) under meander crests; deep C (blue) under trough;
•Strong deep barotropic currents near trough cross the baroclinic front.

•Upper trough steepens and deep pressure cells intensify;
•Deep currents tend to constrict the neck of the trough.

•Trough steepens further; its axis rotates to NE/SW;
•Strong cross-frontal exchange along neck.

•Strong deep AC centered under neck – strengthens from stretching;
• Barotropic currents (20-30 cm/s) assist upper pinch-off ('self development').

•CCR pinch-off is nearly complete;
•Deep currents under KE trough are nearly aligned with upper front.

•Complex, but weaker deep eddy features continue to translate WSW;
•Deep currents (10-25 cm/s) are not aligned with any upper features.