SEA LEVEL VARIABILITY IN THE KUROSHIO EXTENSION: STERIC AND NON-STERIC COMPONENTS

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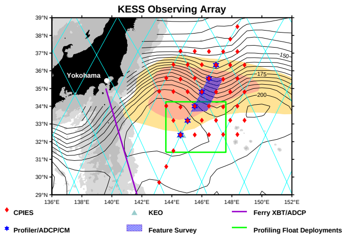
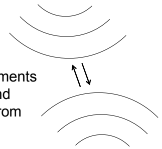
KUROSHIO EXTENSION SYSTEM STUDY



GOAL of KESS: Identify the dynamic and thermodynamic processes governing the variability of the Kuroshio Extension and the recirculation gyre and their interactions.
MEASURE: Time-varying density and velocity fields.
DETERMINE: Dynamical balances and exchanges of heat, salt, momentum and potential vorticity.

DATA COLLECTION *VIA* ACOUSTIC TELEMETRY



One year of daily measurements of travel time, pressure, and current were telemetered from the CPIES to the ship.

The CPIES remain on the sea floor for recovery later in 2006.

Geopotential height is determined from travel time via look-up tables.

SSH COMPRISES STERIC AND NON-STERIC PARTS

Sea Surface Height (η)

$$\eta = \Phi/g + P/\rho g$$

where

Φ = Geopotential Height (0 re 5000 dbar)

g = Gravity

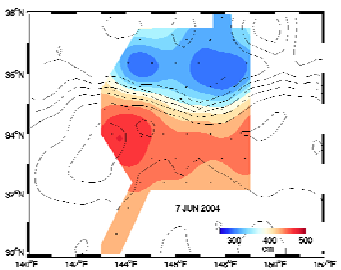
P = Bottom Pressure

ρ = Density

	Φ/g (m)	$P/\rho g$ (m)	η (m)	σ_η (std dev) (m)
Kuroshio Jet	1.3	0.5	1.7	0.2
Quiet Intervals	0.3	0.2	0.4	0.1
Meanders & Rings	1.0	0.3	1.2	0.15

Steric and non-steric parts have similar amplitudes but different processes and different spectra

SATELLITES MONITOR THE LARGE SCALE, SLOWLY CHANGING SSH FIELD

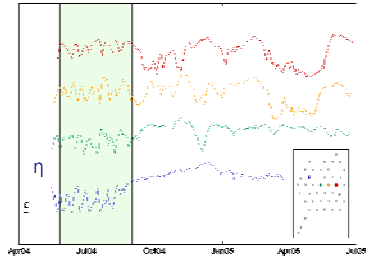


Good agreement is often observed between the *in situ* (color; red = high SSH, blue = low SSH) and AVISO merged satellite SSH (contours).

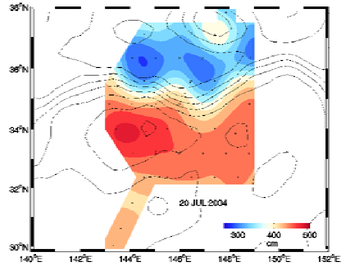
But problems (next panel) arise when satellite SSH is interpreted solely as steric signal…

PROBLEM 1: MESOSCALE FEATURES ALIAS SATELLITE SSH

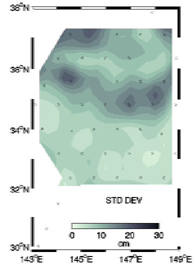
May to September 2004 a series of rapid, eastward propagating (25-30 km/d) meanders were observed by the CPIES.



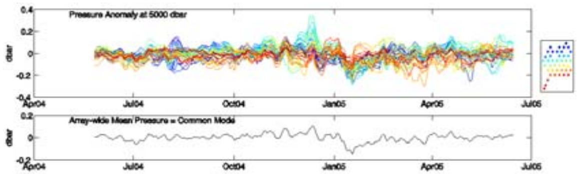
These short wavelength (160 km) meanders were not resolved by satellite SSH.

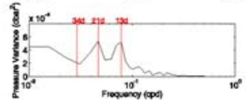


Largest differences between *in situ* and satellite SSH maps occurred along jet axis during this period.



PROBLEM 2: COMMON MODE OSCILLATIONS ALIAS SATELLITE SSH MAPS, CREATE 'TRACKINESS'





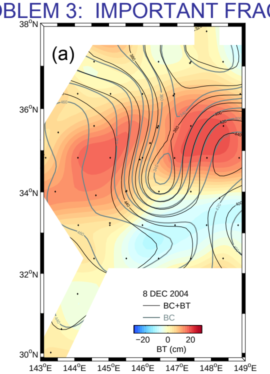
Bottom pressures at 42 sites exhibit common fluctuations P_{com}~0.035 dbar, likely driven by the atmosphere. Note this is NOT an isostatic response.

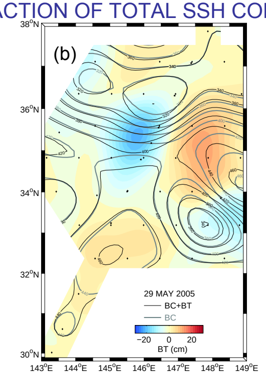
With periods of 2-20 days, these fluctuations alias the satellite SSH maps created from measurements with Nyquist period 20-34 days. The different elevations along neighboring or crossing groundtracks cause mapping errors.

Spectrum shows that more than half the ($P_{com}/\rho g$) variance,~ 1.7 cm, is aliased for ERS 17d sampling interval.

This should NOT be interpreted as steric signal.

PROBLEM 3: IMPORTANT FRACTION OF TOTAL SSH CONTRIBUTED BY NON-STERIC COMPONENT





Non-steric (deep barotropic) eddies contribute independently to local SSH with different (x,y,t) dependence than the steric (baroclinic) component.

Cases (a) and (b) show the joint baroclinic and barotropic features are more developed than just the baroclinic meanders.

Because satellite SSH is only a single measurement the barotropic and baroclinic contributions cannot be separated to identify their independent dynamical roles.

If SSH were interpreted solely as steric height or heat content, examples (a) and (b) would overestimate the baroclinic signal by ~25%.