Upper-lower layer coupling in Loop Current Eddies Ekman and Franklin
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1. Dynamics of the Loop Current Experiment

**Goals:** Increase dynamical understanding of Loop Current, eddy-shedding mechanisms, and genesis of lower-layer flows.

**Elements:** Moored arrays of current and temperature and bottom-mounted pressure equipped inverted echo sounders (PIES) together with remote-sensing and numerical-modeling approaches.

**Deployment:** April 2009

**Rotation:** July & November 2010

**Recovery:** November 2011

Here we show results from the first 15 months: May 2009 to July 2010.

2. Circulation dominated by interaction between the Loop Current and Eddies Ekman and Franklin

Temperature and velocity measurements from the nine tall moorings resolve the full water column structure.

Meanders (~ 7 day period) along the Loop Current periphery precede Loop Current Eddy formation.

Upper-layer Loop Current flows are not visually coherent with lower-layer flows.

Upper-layer and lower-layer coupling revealed from mapped bottom pressure (shaded color contours) and currents (gray vectors) as well as measured deep currents (black vectors).

3. Upper and Deep Statistics

Principal axes of the standard deviation ellipses and the mean vectors are not aligned with those of the upper layer (~200 m depth).

In lower layer, mean circulation shows an west-east pattern of anticyclonic-cyclone pair.

Deep eddy kinetic energy is high along the northeastern periphery of the mean Loop Current position.

4. Loop Current Eddies Ekman and Franklin

**Eddy Ekman**

Initial detachment (June-July) occurs when a trough forms in the southeast edge of the Loop Current. The trough expands and ultimately causes detachment.

Separation occurs when a frontal cyclone along the northern Loop Current strengthens and moves southward.

A northward shift (meander crest) of the Loop Current, lower-layer thickness decreases, and deep anticyclonic vorticity develops to conserve potential vorticity. With favorable vertical offset, a lower-layer anticyclone leads a meander crest, upper-layer and lower-layer eddies grow.

**Eddy Franklin**

Joint development also occurs when a southward shift (meander trough) increases lower-layer thickness and generates a deep cyclone that leads the upper trough.

Eddy Franklin underwent five detachment/reattachment cycles until final separation in late September 2010.

Similar to Eddy Ekman, a growing and southward propagating meander along the west Florida slope initiates the first detachment.

A deep anticyclone is offset from an upper crest, a deep cyclone offset from upper trough and deep anticyclone offset from upper crest.

A strong deep cyclone with swift speed in excess of 20 cm/s develops leading an upper trough, the pair jointly intensify, move south and Eddy Franklin detaches from the Loop Current.

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