Texas-Louisiana Cross-shelf Transport due to Submesoscale Eddies

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Goal
Study enhanced dispersion and cross-shelf transport due to baroclinic instabilities along river plume edge

Numerical Model
Regional Ocean Modeling System (ROMS) circulation model of the Texas-Louisiana shelf
Includes wind and rivers, nested in HYCOM Gulf model
Validation: (Zhang et al., 2012a,b)

Particle Tracker
TRACMASS, runs trajectories natively on staggered Arakawa C grid (Döös et al., 2013)
...wrapped in Python: TracPy
https://github.com/kthyng/tracpy

Drifter Simulations: From River Inputs
Drifters started every model output (4 hours), May-August
Run for 90 days
2007 and 2008
Started where Mississippi and Atchafalaya rivers are input
Each associated with part of the river volume transport inflow

Drifter Simulations: Uniformly Distributed
Started daily sets of drifters seeded 1 km apart in $x$ and $y$ which ran for 30 days
Surface-limited
2004-2010
Included diffusion to the particle trajectories with $A_H = 5 \text{ m}^2\text{s}^{-1}$
Used for mean separation distance calculation

Wind was similar in 2007 and 2008 but more river discharge in 2008

⇒ ... expect more instabilities on shelf in 2008

Submesoscale?
Loop Current Eddies are mesoscale $O(100\text{ s}) \text{ km}$
Shelf instabilities are $O(20 \text{ -- } 50) \text{ km}$
Sub-observational
$R_i \sim 2 \text{ -- } 10$

References

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Surface transport for drifters started in each month

Transport associated with drifters started in each month and run for 90 days shows largest cross-shelf transport in May and run through the summer.

Dispersion

Baroclinic instabilities, present in the summer, enhance dispersion. Data from LaCasce and Ohlmann (2003).

Conclusions

- More river input (2008), with similar winds, can lead to more effects from baroclinic instabilities
- River water input in May leads to eddies in June-July
- Baroclinic instabilities enhance lateral dispersion
- Baroclinic instabilities enhance cross-shelf transport

River connectivity over time

River water input throughout May shows spreading over shelf throughout July.