Glider Adaptive Sampling and Control

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Central themes:

- Add automatic feedback control for robustness and automation in adaptive sampling.
- Take advantage of forecasts of currents to steer gliders efficiently.
- Use the glider network as a re-configurable, mobile sensor array.

Daily

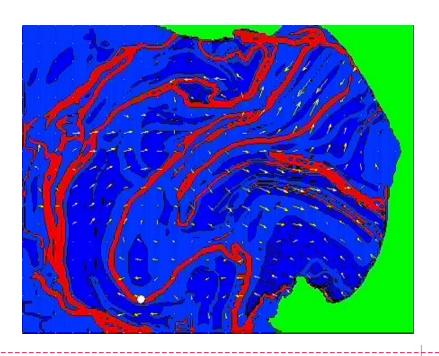
- 1. Forecasting with HOPS-ESSE and ROMS.
- 2. An integrated interpretation of the forecasts, forecast errors and dynamical hot spots (physical and/or coupled physical/biological).
- 3. Analysis of the circulation fields by Lagrangian Coherent Structures (LCS).
- 4. A collective decision by a Real Time Operations Committee ("War Room") as to what features and regions to be adaptively sampled the next day.
- 5. The implementation of optimal coordinated motion using feedback control.

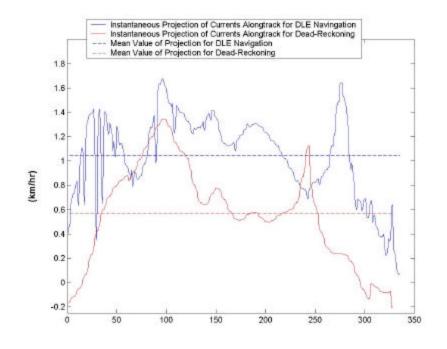
Every two hours

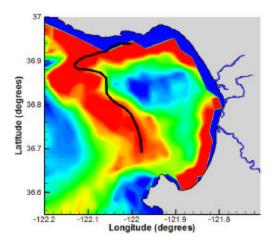




Analysis of Circulation Fields by Lagrangian Coherent Structures (LCS)







Comparison of navigating along LCS vs. dead reckoning to goal point.

Superposition of LCS on Temp field (ICON data)



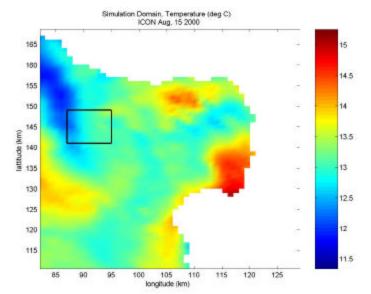


Optimal Coordinated Motion Using Feedback Control

Daily: Steps 1-4 of Adaptive Sampling Plan (glider allocation determined) Assign rule for - inter-vehicle spacing - pattern through front - trust in forecast vs observations Every two hours (Adaptive Sampling Feedback Control): Gliders surface, establish communication, report GPS and data. Automatically plan motion of glider network for next 2 hour cycle using method of virtual bodies and artificial potentials (VBAP). - Method yields smooth glider paths advected in forecast flow field. - Virtual body leads gradient climb, collective passes through fronts. - Artificial potentials maintain network configuration, attraction to goal points and LCS. 3. Recompute glider paths to account for dead reckoning. Discretize these paths and pass refined waypoints to gliders. Every few seconds: Gliders while underwater use dead reckoning and low-level control to effect waypoint tracking. Sampled data assimilated in model. Forecasts updated.







Optimal Coordinated Motion Using Feedback Control

Gradient descent by glider network to find feature despite error in prediction.

