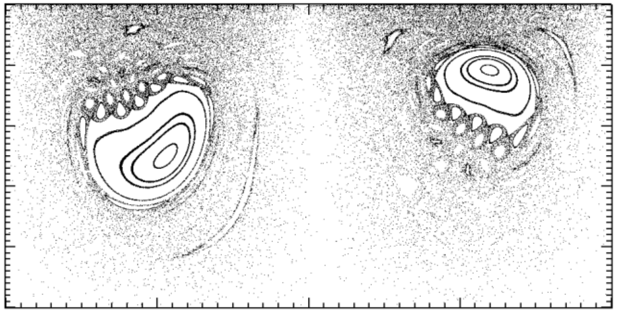
Future Directions

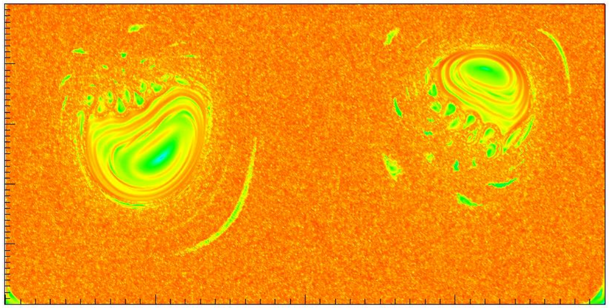
1) The rotating can and SQG models reveal fascinating Lagrangian structures (invariant tori and other transport barriers, resonant layers, manifolds) in 3D+1. We need to extend to more realistic settings. (with RSMAS and MURI team)

- Simulate the effects of background turbulence.
- Move to more complex time dependence
- Consider stratification
- More general SQG models: moments models, dynamically active boundaries, O(Ro) corrections into 3D GQ ellipsoids.

2) The MURI group as a whole has developed a variety of tools for potential use in computing Lagrangian structures in 3D+1. We need to decide which are best (most efficient, most transparent, best suited to data) by testing in our idealized setting (where truth is known). (MURI).

- FTLEs and FSLEs in 2D and 3D
- Ergodicity defect, CD
- Mesohyperbolicity
- Koopman operator
- Ergodic partition
- Old fashion tracer release

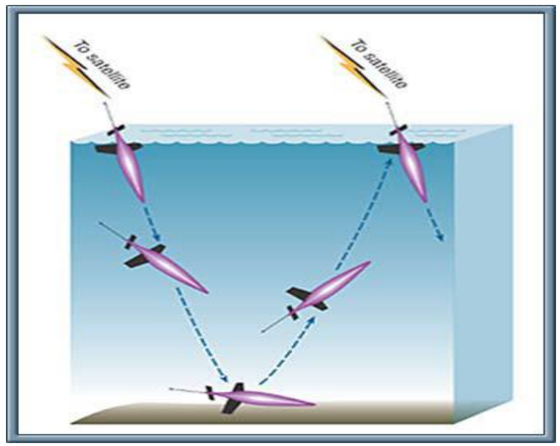




3) Consult with LDA group on models with known underlying Lagrangian structures. Use to

-Determine how these structures inform LDA.

-Provide model environments for vehicle control (UNC, Marquette, WHOI, UCSD…MURI team)



4) Use idealized models to determine when 2D analysis fails: when does the assumption of weak w get us into trouble: secularity, shear dispersion, etc… (overlap with U. Delaware).

Long Range

1) Carry out a field program (dye release?) to observe some of the features we have discovered, check predicted spectra, etc.
2) Carry out test missions with controlled vehicles and robots.

Theory/Simple Models Group: What we will talk about

Stefan and Cecily: weakly 3D model based on surface QG dynamics provides dynamically consistent velocity fields and allows us to explore the limitations of 2d analysis in a environment where we know the truth. In this model the differences between 2d and 3d emerge over long time scales. Similarly for work with Rodolph.

Larry, Irina, Tamay and Peng: looking at similar questions in a fully 3d model. Here the velocity field is described by a numerical model, but a great deal of insight from approximate analytical solutions and KAM-type theorems is useful. They have also provided velocity fields to Elaine, Chris et al. for testing of Lagrangian data assimilation.

Note: both of the above present good test beds because truth is known.

Irina: will describe work with Sherry and Larry on using measures of complexity (alternatives to FTLEs) to map out Lagrangian structures.

Marko and Igor: will describe other measures (mesohyperbolicity, the ergodic partition) that can map out Lagrangian structures and are promising for use in 3D+1.