

TracPy: Wrapping the FORTRAN Lagrangian trajectory model TRACMASS

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July 10, 2014

Outline

1 What is it and why do we care about it?

2 Numerical Approach

3 Wrapper

4 Uses of TracPy

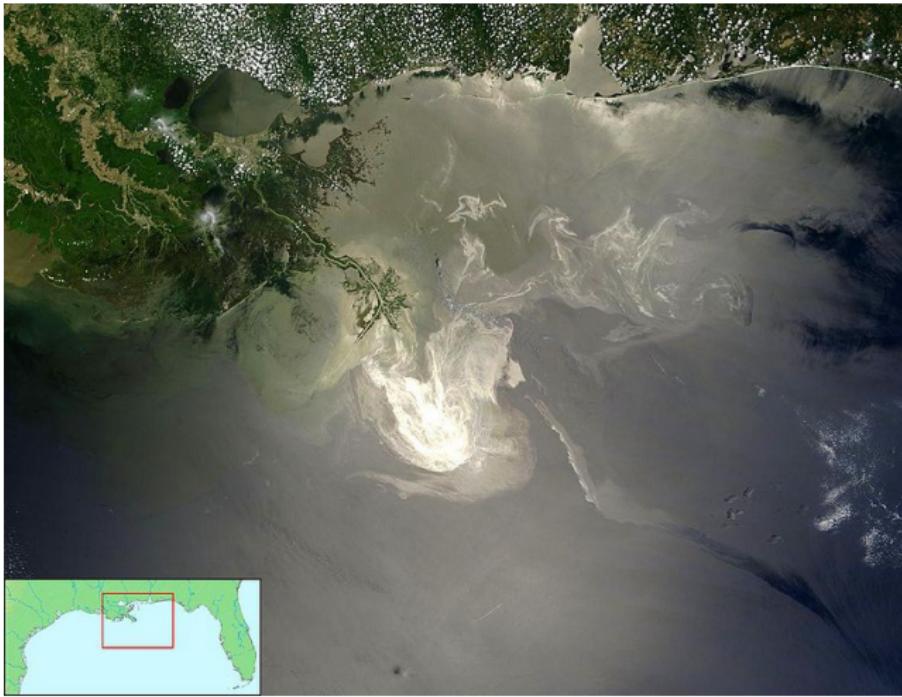
5 Summary

Drifter Trajectories

Drug Package Origination

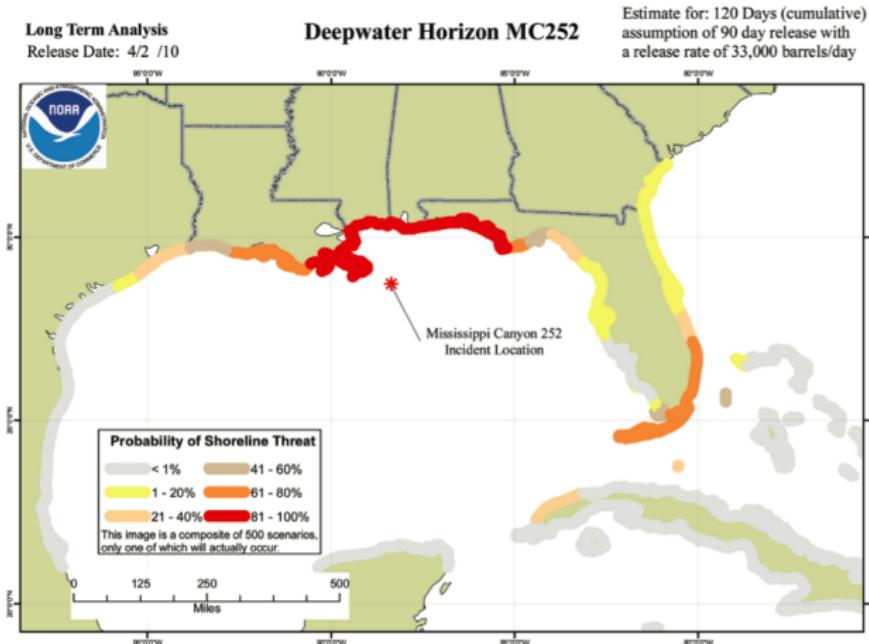


Oil spill transport



NASA's Terra Satellite

Oil spill transport



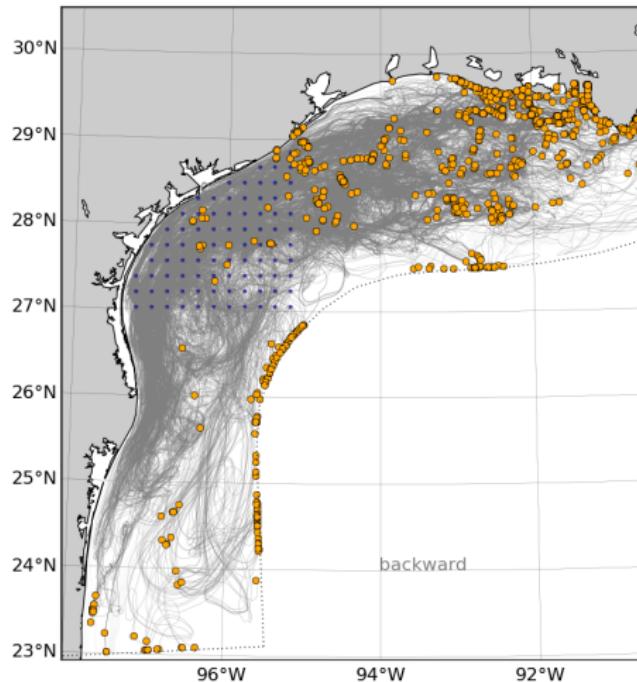
Barker, C. H., 2005, AGU Monograph: *Monitoring and Modeling the Deepwater Horizon Oil Spill: A Record-Breaking Enterprise*

Harmful Algal Bloom Events in Texas Waters



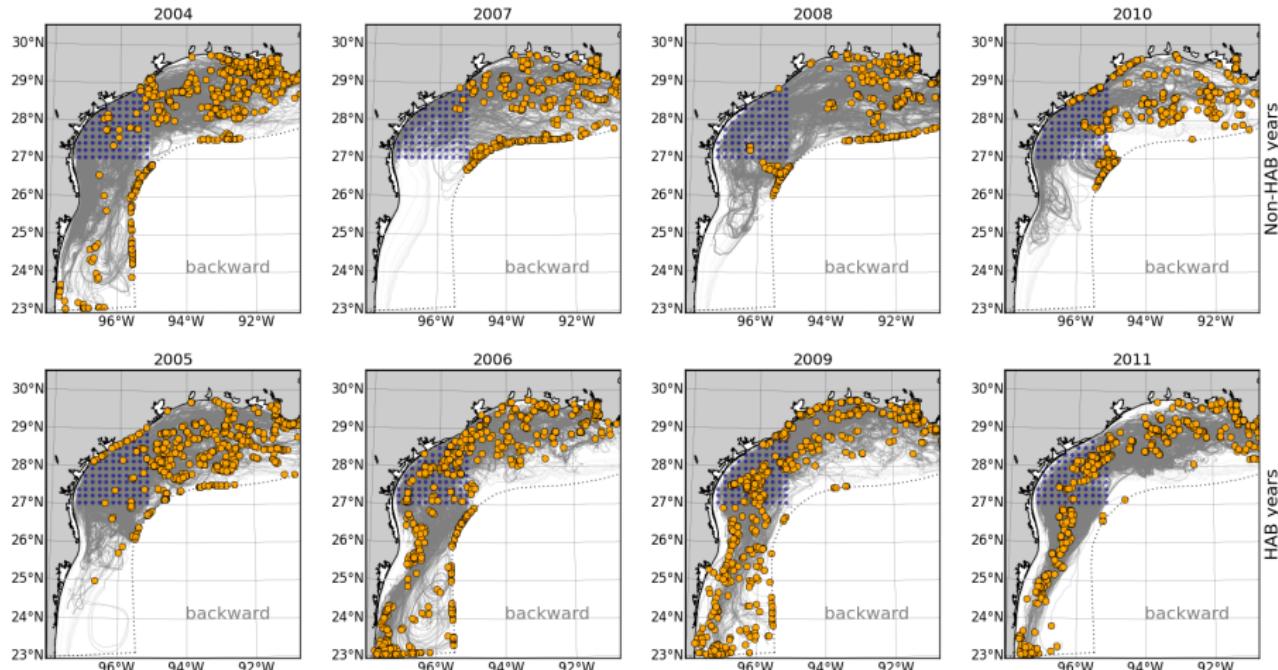
Photo: Texas Parks and Wildlife Department

Lagrangian Approach to Understanding HABs



Thyng, K.M, et al, L&O:FE 2013

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Thyng, K.M, et al, L&O:FE 2013

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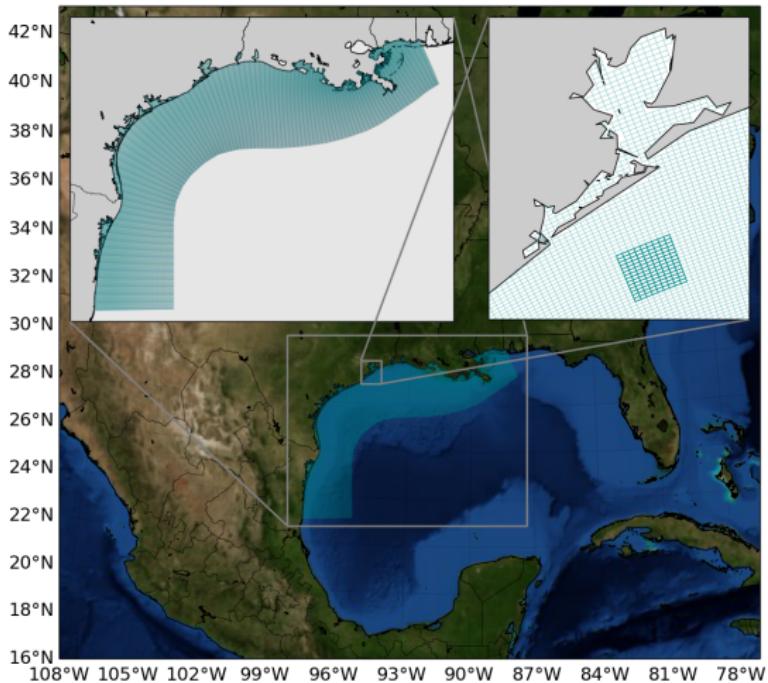
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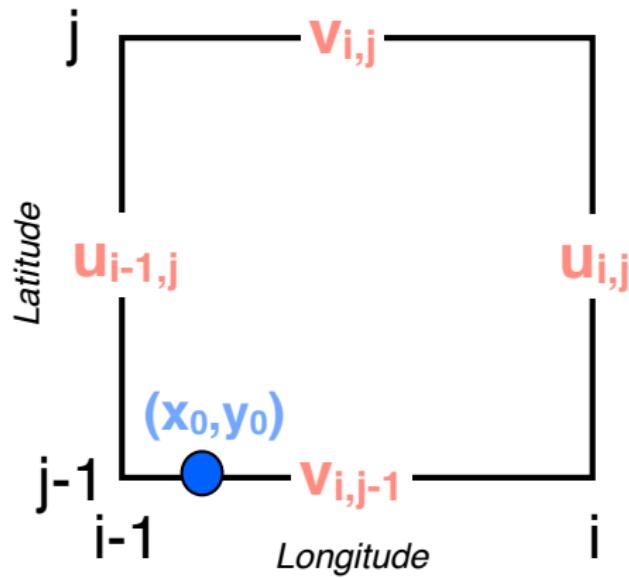
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Numerical Domain



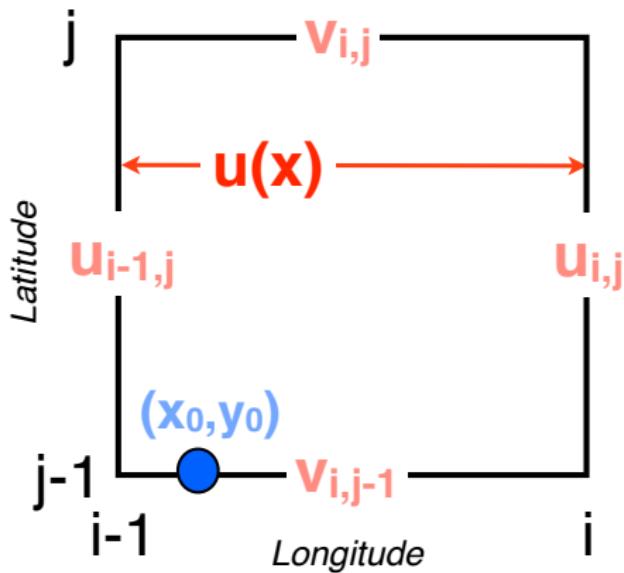
Surface Salinity



Horizontal velocities on a staggered Arakawa C grid

After TRACMASS documentation. <http://www.tracmass.org>, <http://doos.misu.su.se/tracmass/>

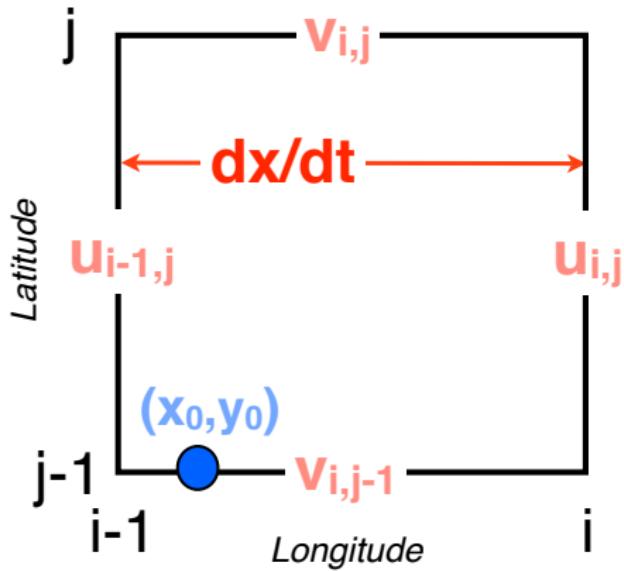
Lagrangian Trajectory Model



Linearly interpolate u in x to find $u(x)$ across cell

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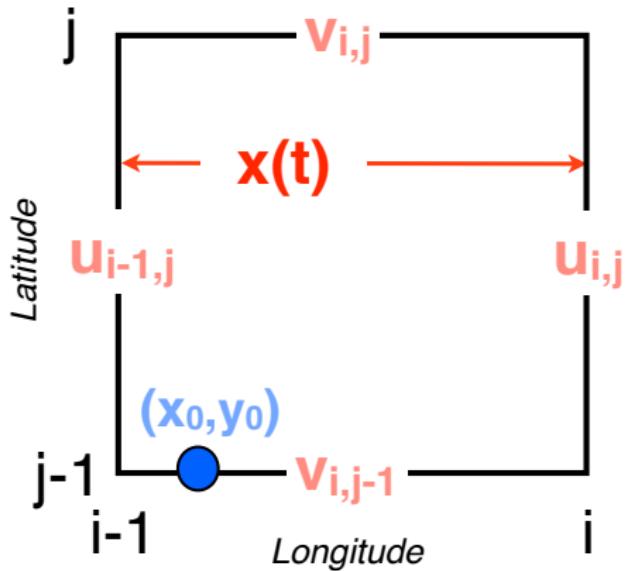
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$$u = \frac{dx}{dt}$$

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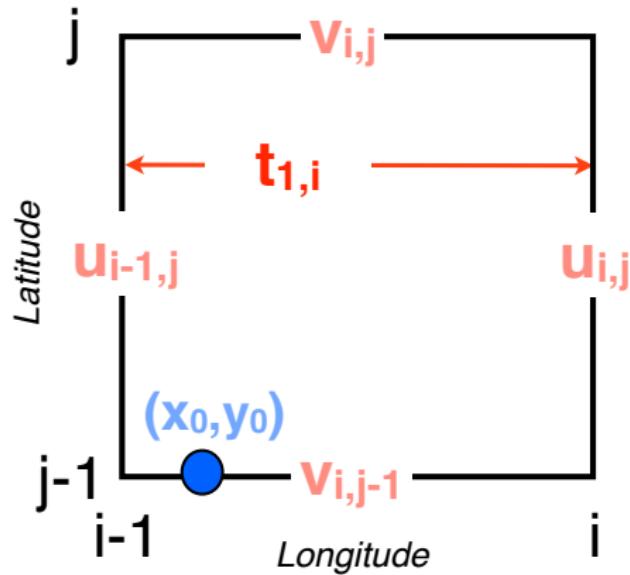
Lagrangian Trajectory Model



$\frac{dx}{dt}$ can be analytically solved for $x(t)$

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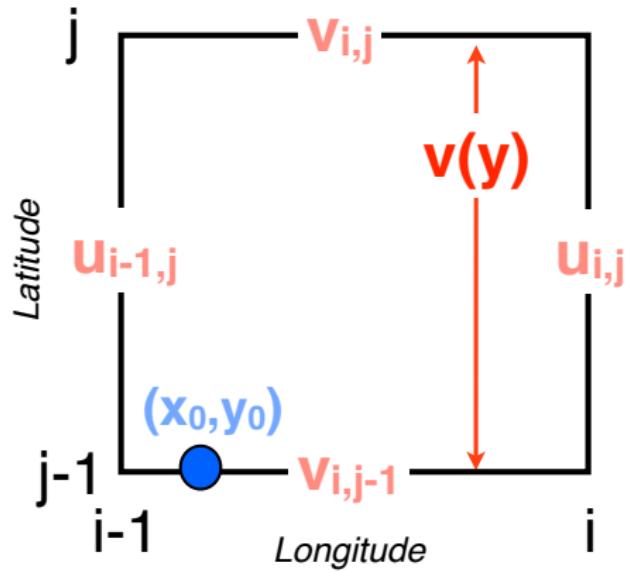
Lagrangian Trajectory Model



Solve for the time t when drifter would hit x wall

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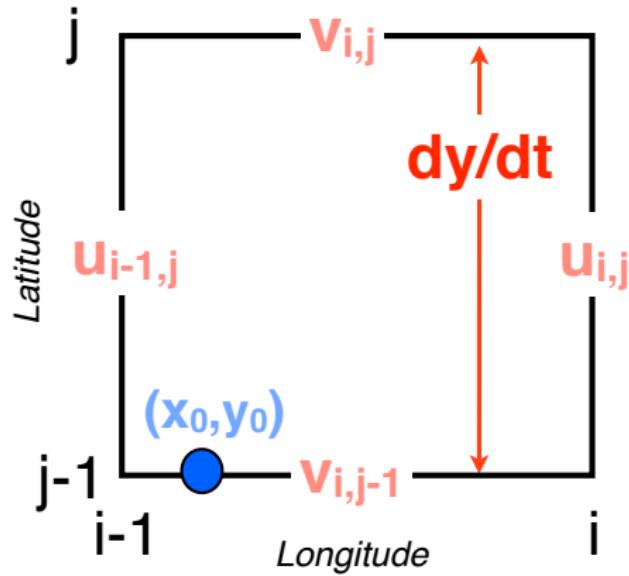
Lagrangian Trajectory Model



Same process in y and z directions

After TRACMASS documentation. <http://www.tracmass.org>, <http://doos.misu.su.se/tracmass/>

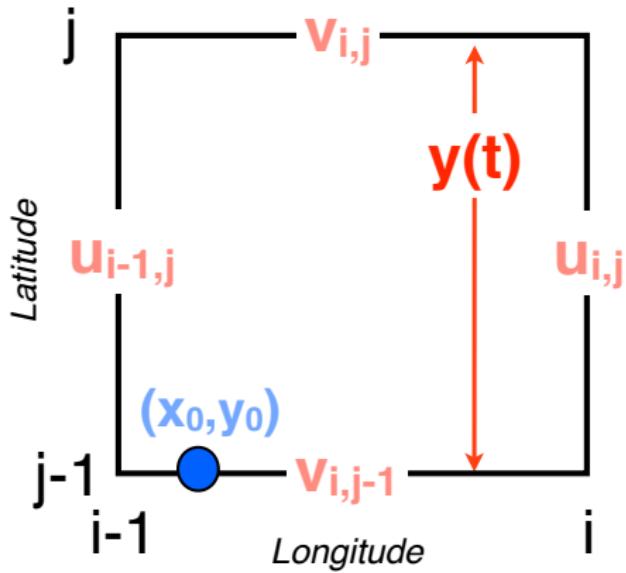
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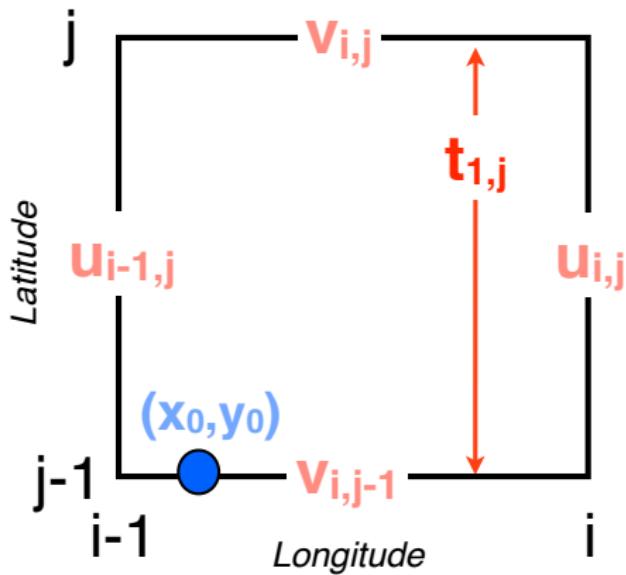
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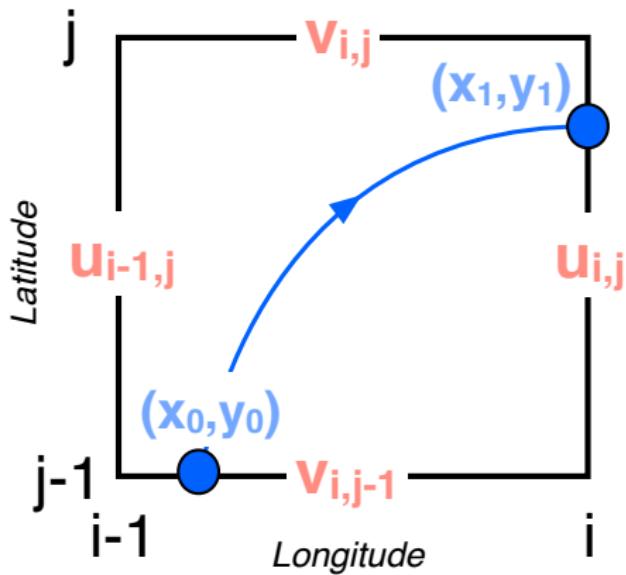
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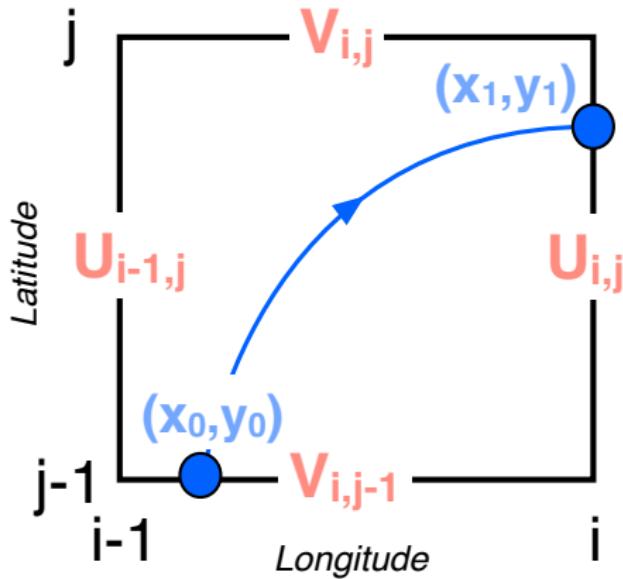
Lagrangian Trajectory Model



Minimum overall time is used to calculate position

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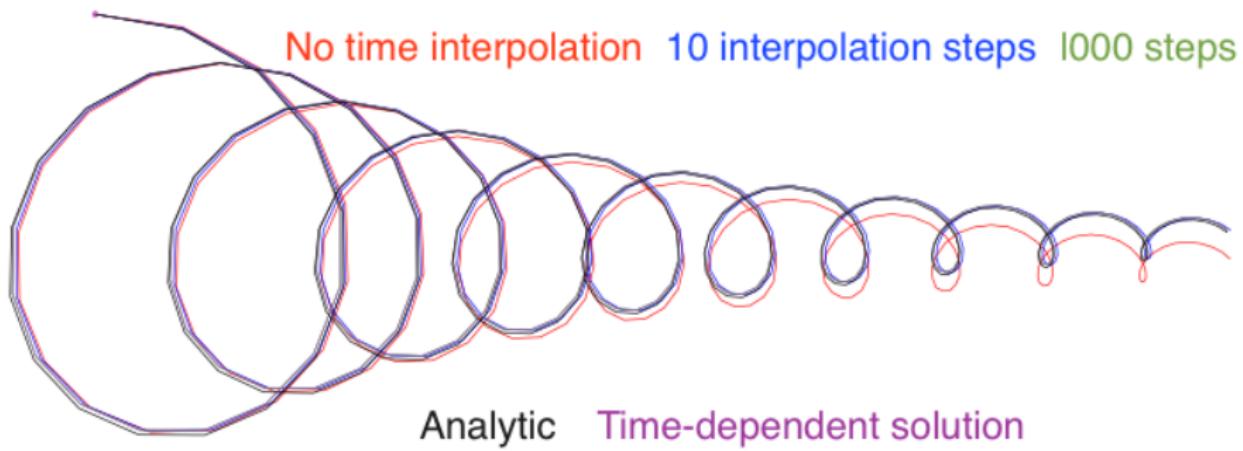
Lagrangian Trajectory Model



Instead of velocities, use fluxes to allow for differences in grid sizing

After TRACMASS documentation. <http://www.tracmass.org>, <http://doos.misu.su.se/tracmass/>

TRACMASS validation



Drifter Trajectories

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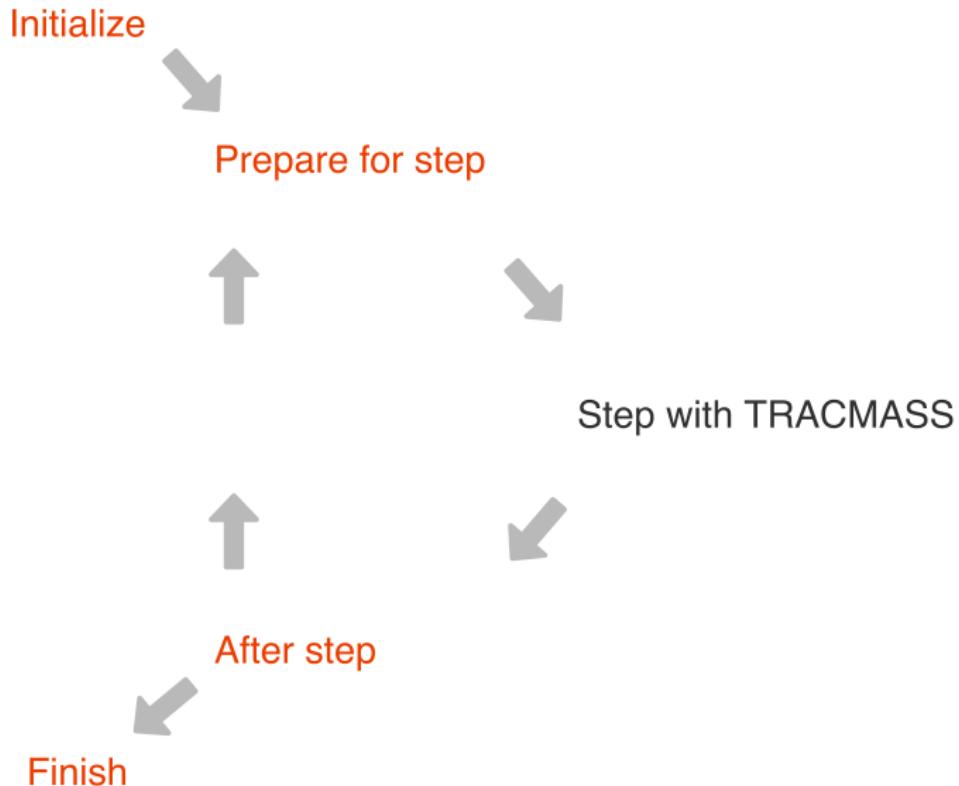
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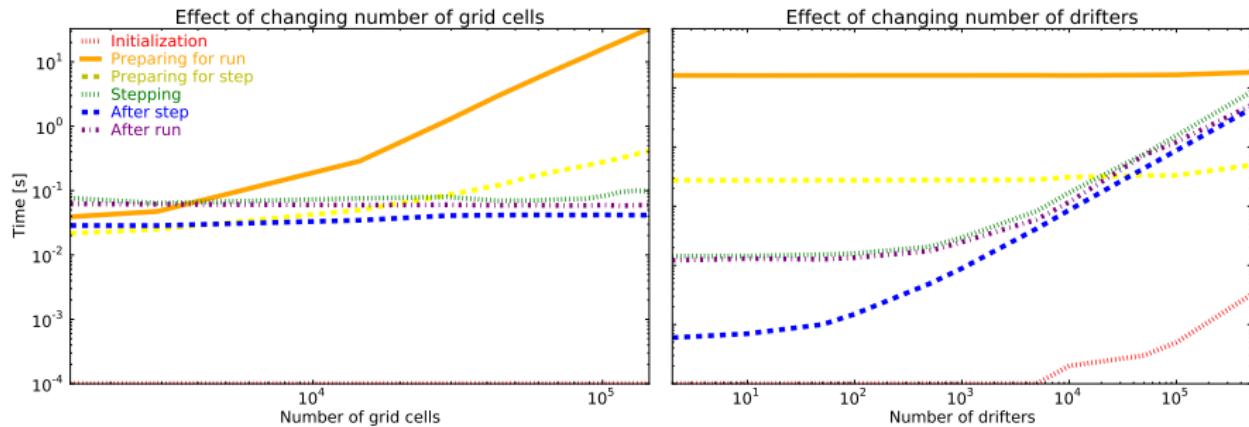
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TracPy



TracPy performance

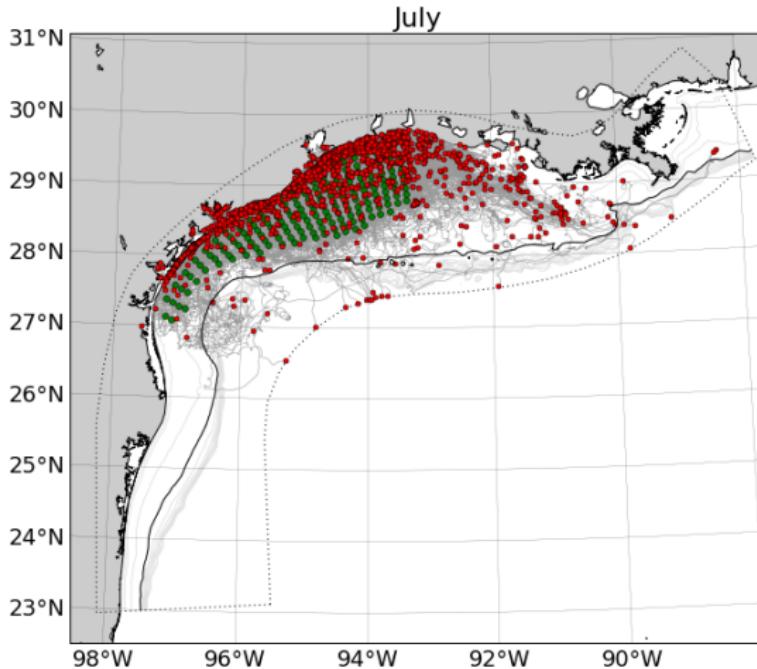


netCDF performance

	netCDF3	netCDF4C	% decrease
Simulation run time (s)	1038	1038	0
File save time (s)	3527	131	96
File size (GB)	3.6	2.1	42

Parallelization

Aggregated drifters starting on Texas shelf, 2004-2011



Processor 1
Processor 2
Processor 3
Processor 4

Set 1 }
Set 2 }
Set 3 }
Set 4 }

Future work

- Integration into NOAA's GNOME oil tracking system
- Improve grid read in speed and memory required
- Append output to track file instead of storing for full run
- Possibly rearrange drifter arrangement in output file to reduce nan storage
- Storage could be updated to full netCDF4 format.
- The modularity of the TracPy class should be improved.

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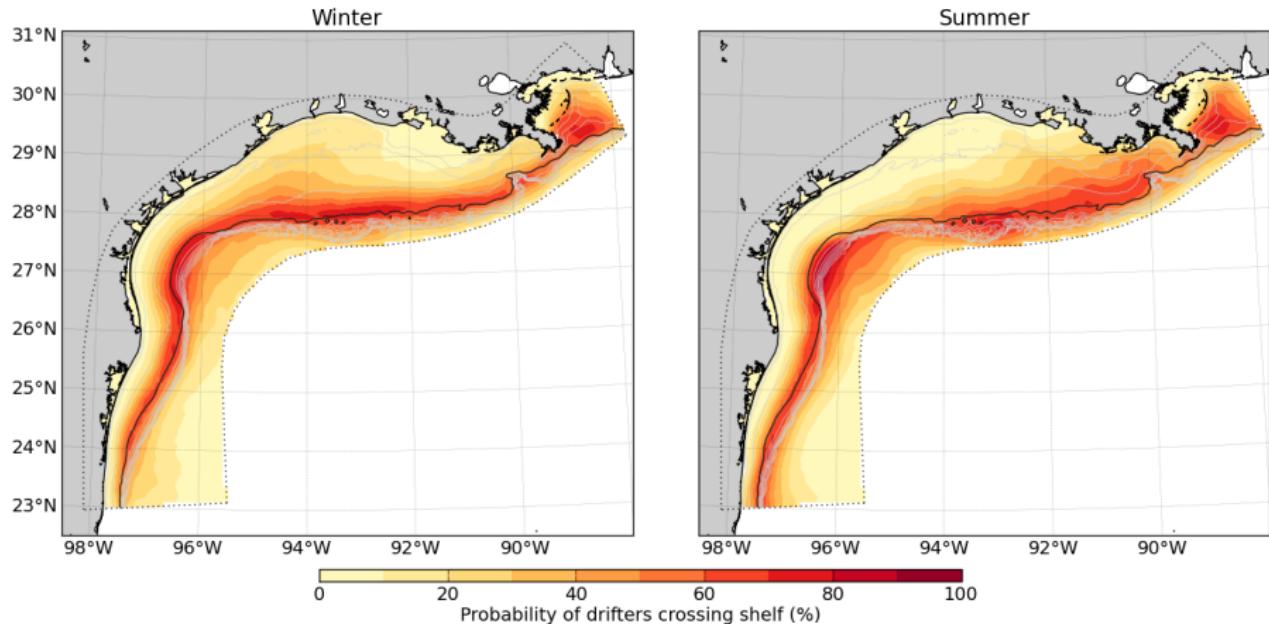
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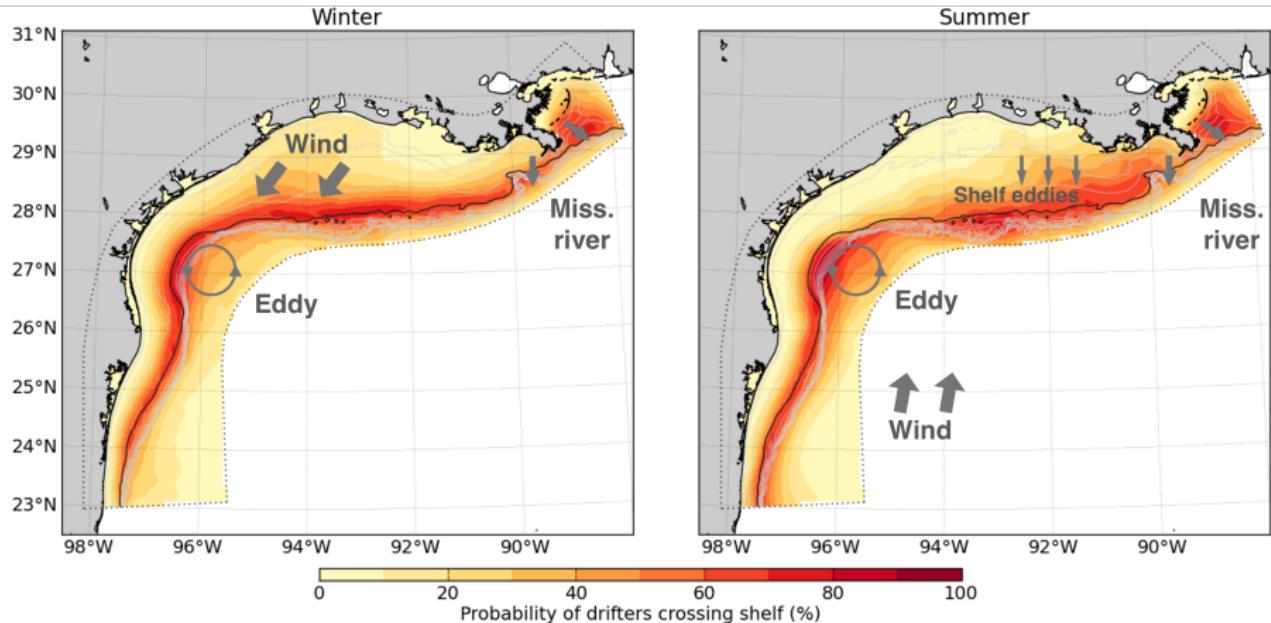
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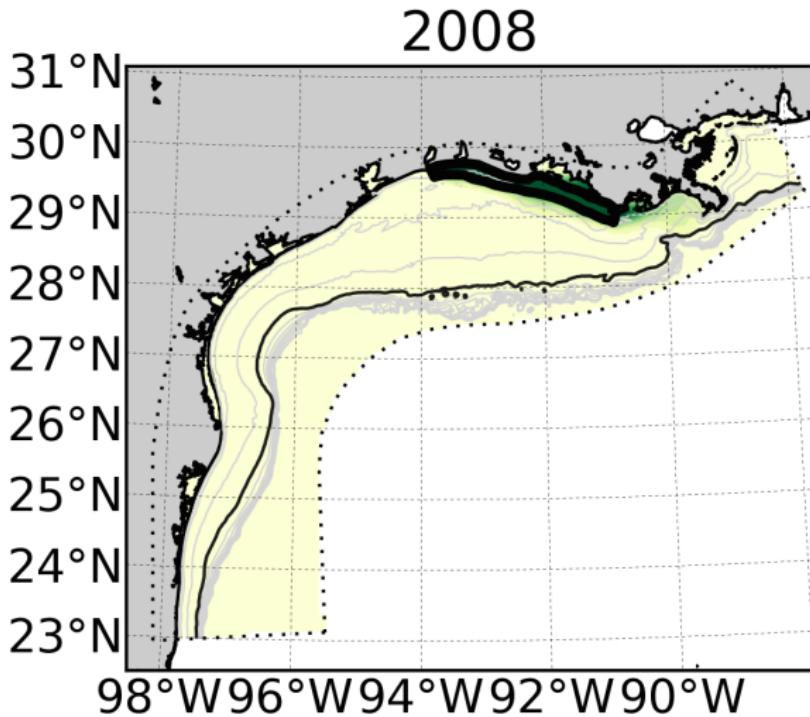
Cross-shelf transport



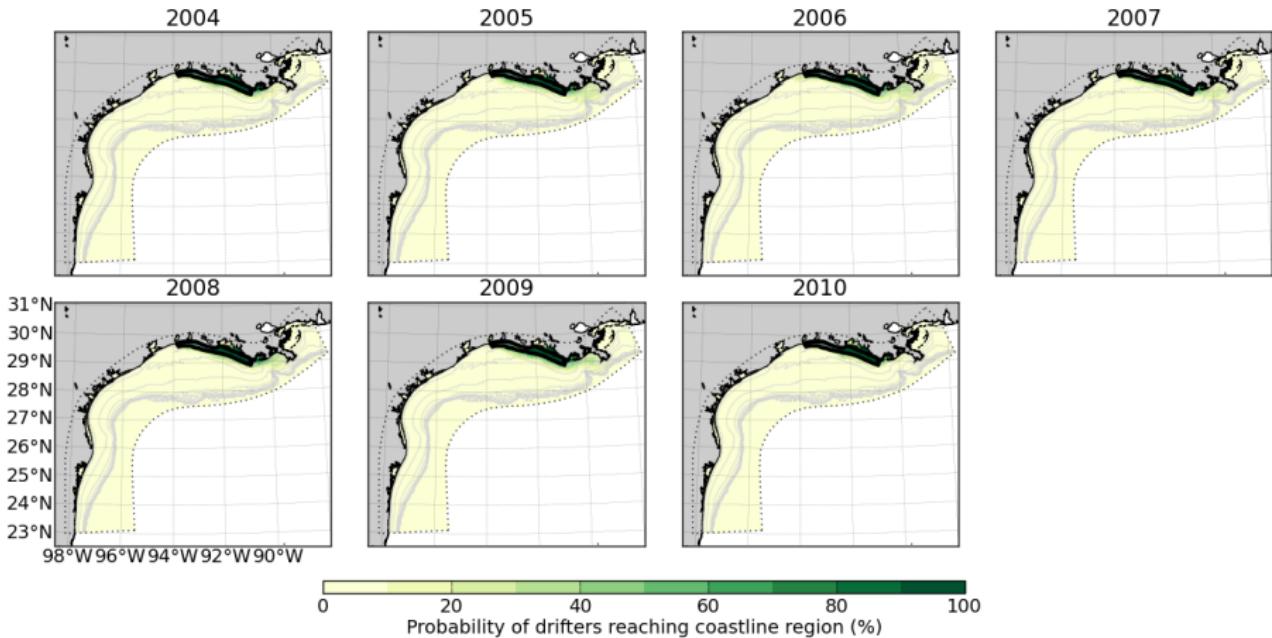
Cross-shelf transport



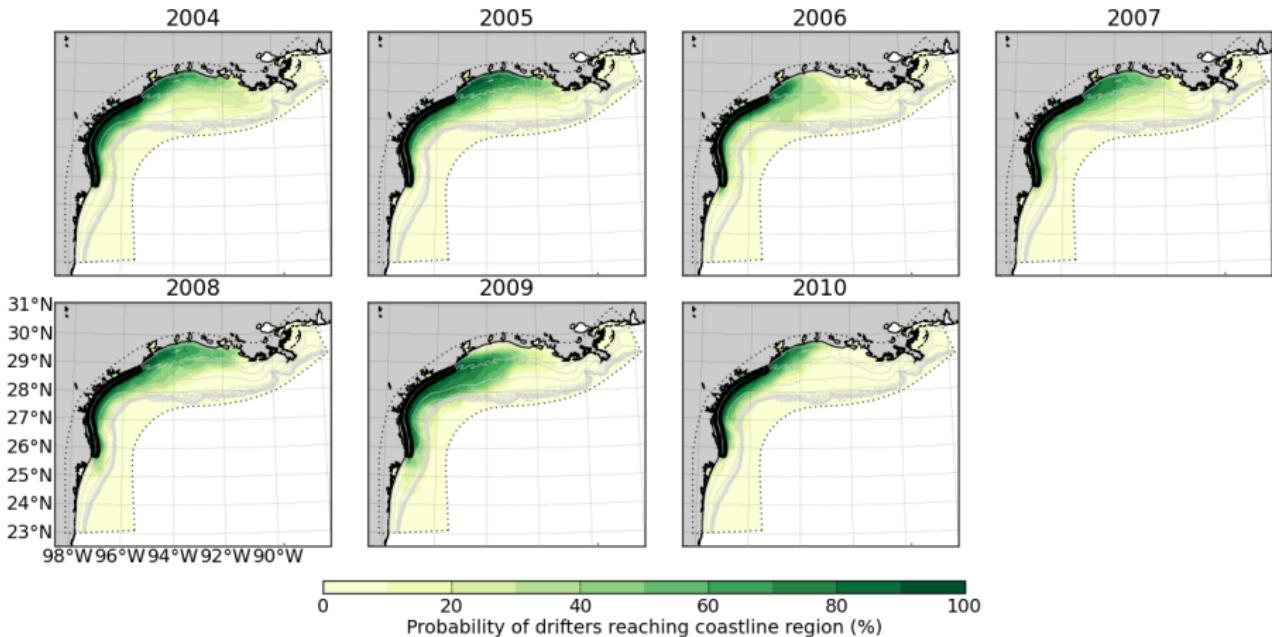
Coastline connectivity: Chenier Plain



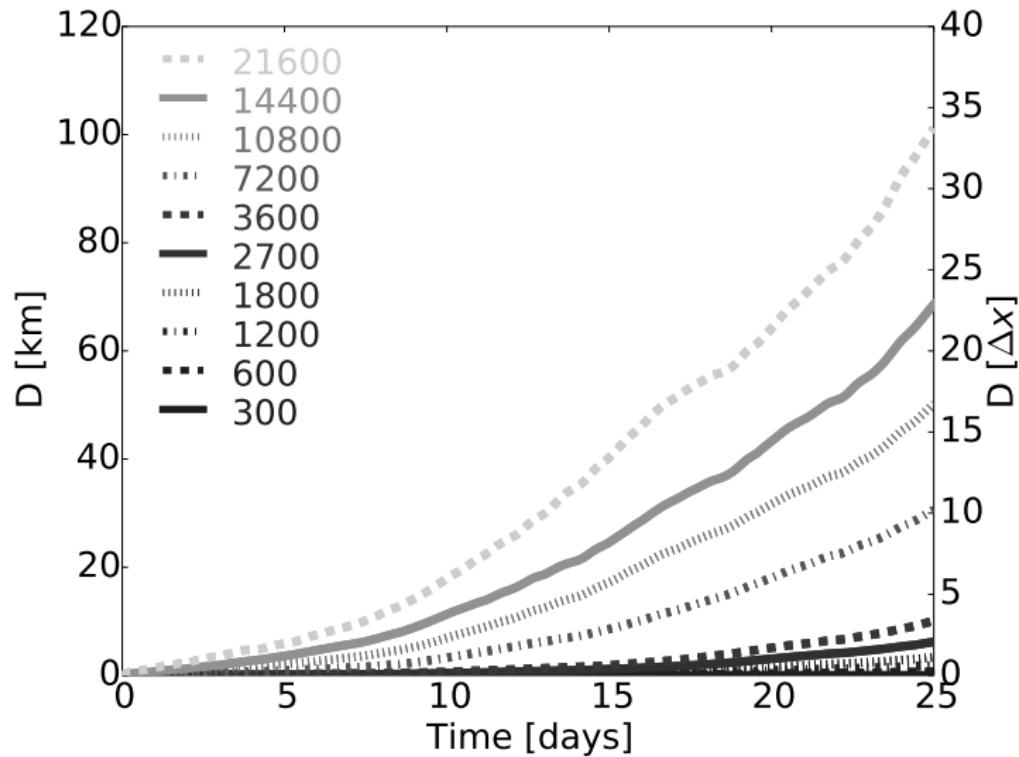
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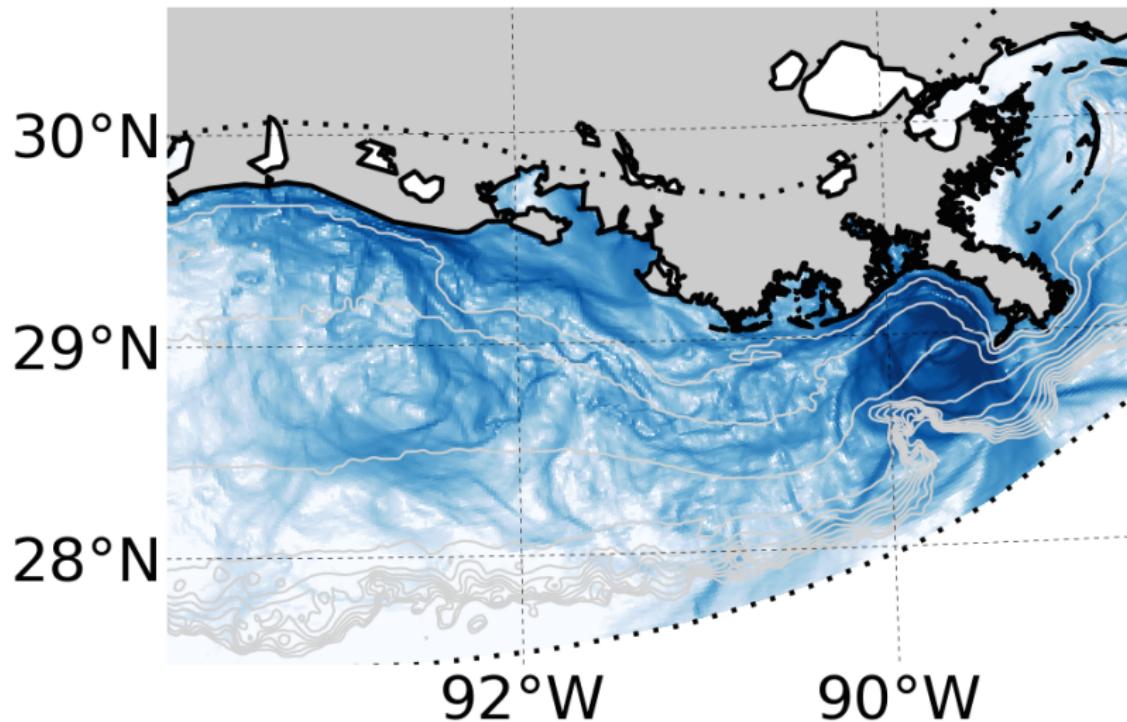
Coastline connectivity: South Texas



Error due to temporal sampling



River tracks



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Summary

- Simulated drifter tracks improve understanding of transport processes
- Many coastal concerns are transport-based
- TracPy wraps trajectory model TRACMASS
- Code has been used for several applications so far
- Improved understanding can help address coastal issues

Thank you!

