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# An Application of Lagrangian Coherent Structures to Harmful Algal Blooms

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*Karenia brevis* is present in low concentrations in vast areas of the Gulf of Mexico (GoM). This toxic dinoflagellate sporadically develops blooms anywhere in the GoM, except in the southern portion of West Florida Shelf (WFS). There, these harmful algal blooms (HABs) are recurrent events whose frequency and intensity are increasing. HABs on the WFS are usually only evident once they have achieved high concentrations that can be detected by observation of discolored water, which may be apparent in satellite imagery; by ecological problems such as fish kills; or human health problems. Because the early development stages of HABs are usually not detected, there is limited understanding of the environmental conditions that lead to their development.

Analysis of simulated surface ocean currents reveals the presence of a persistent large-scale *Lagrangian coherent structure* (LCS) on the southern portion of the WFS. A LCS can be regarded as a distinguished material line which divides immiscible fluid regions with distinct advection properties. Consistent with satellite-tracked drifter trajectories, this LCS on the WFS constitutes a cross-shelf barrier for the lateral transport of passive tracers. We hypothesize that such a LCS provides favorable conditions for the development of HABs. LCSs are also employed to trace the early location of an observed HAB on the WFS. Using a simplified population dynamics model we infer the factors that could possibly lead to the development of this HAB. The population dynamics model determines nitrogen in two components, nutrients and phytoplankton, which are assumed to be passively advected by simulated surface ocean currents. Two nutrient sources are inferred for the HAB whose evolution is found to be strongly tied to the simulated LCSs. These nutrient sources are found to be located near shore and likely due to land runoff.