Modeling recurrent larval transport routes in the Northern Gulf of California during February, exemplified with *Merluccius productus* larvae

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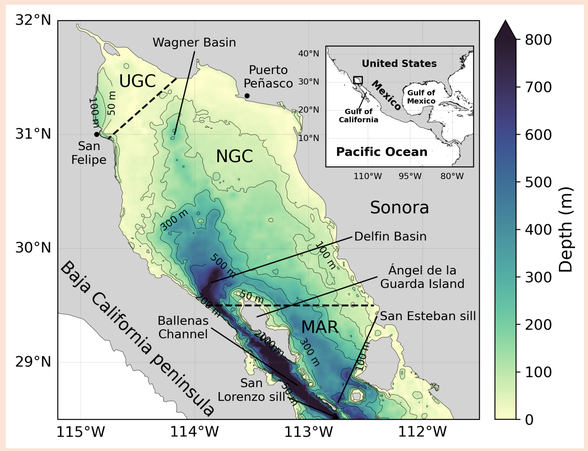
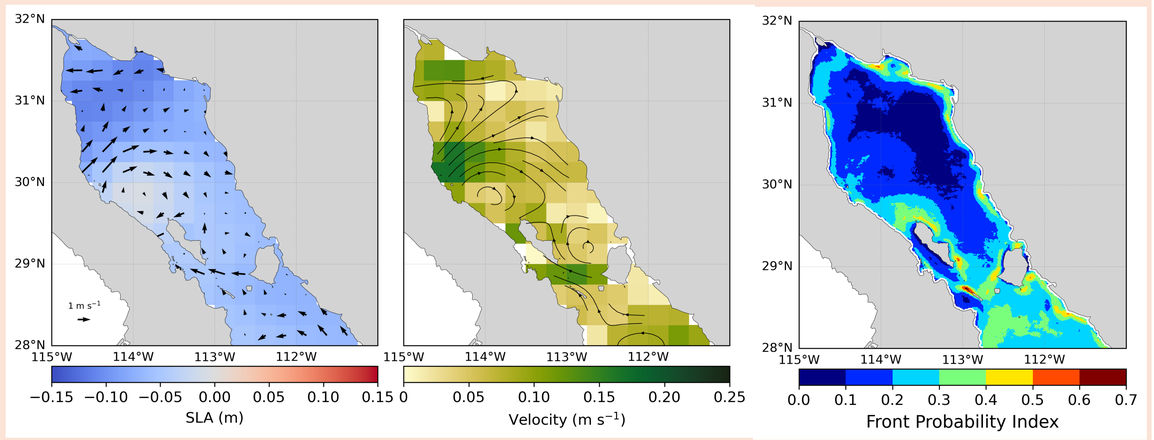
Background & Objective

The Northern Gulf of California exhibits seasonally reversible circulation influencing larval transport.

Identify recurrent February transport routes and connectivity (2006 vs 2024).

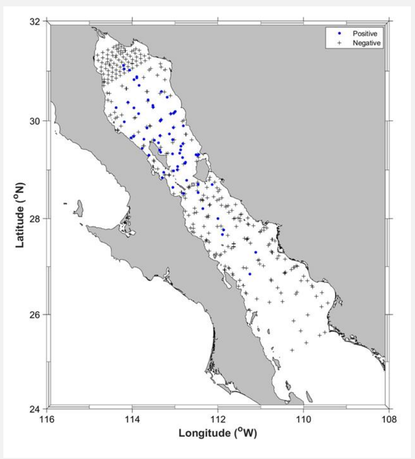


- Anticyclonic circulation dominates the region.
- Southward coastal flow drives transport.
- Coastal velocity maxima.
- High frontal probability along coasts and archipelago.

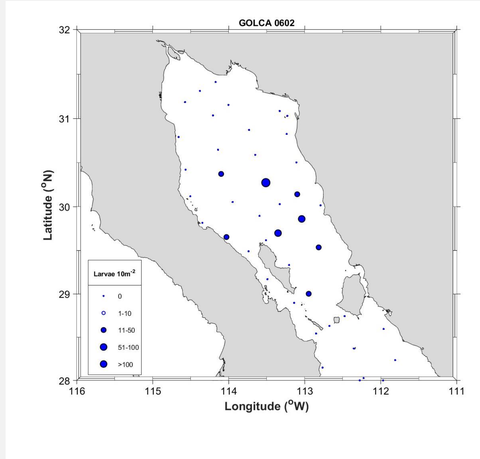


Results

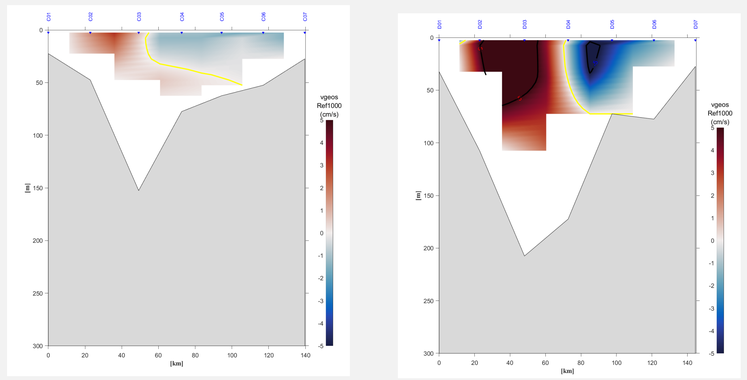
- Larval occurrences define key source locations for simulations.
- Release points represent areas of biological relevance.



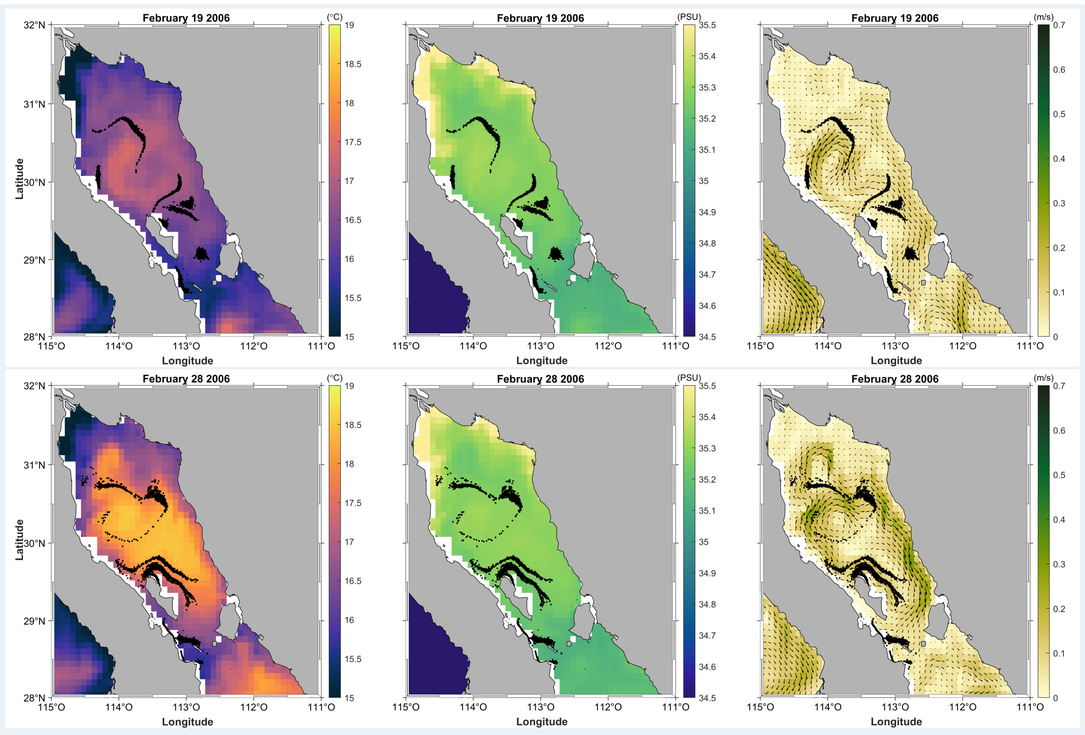
- Larval abundance is spatially heterogeneous across the Northern Gulf.
- Higher concentrations are observed in central and southern regions.
- Discrete sampling stations define biologically relevant source areas.



- Surface-intensified velocity gradients.
- Frontal zones associated with strong shear.
- Mesoscale circulation structures present.

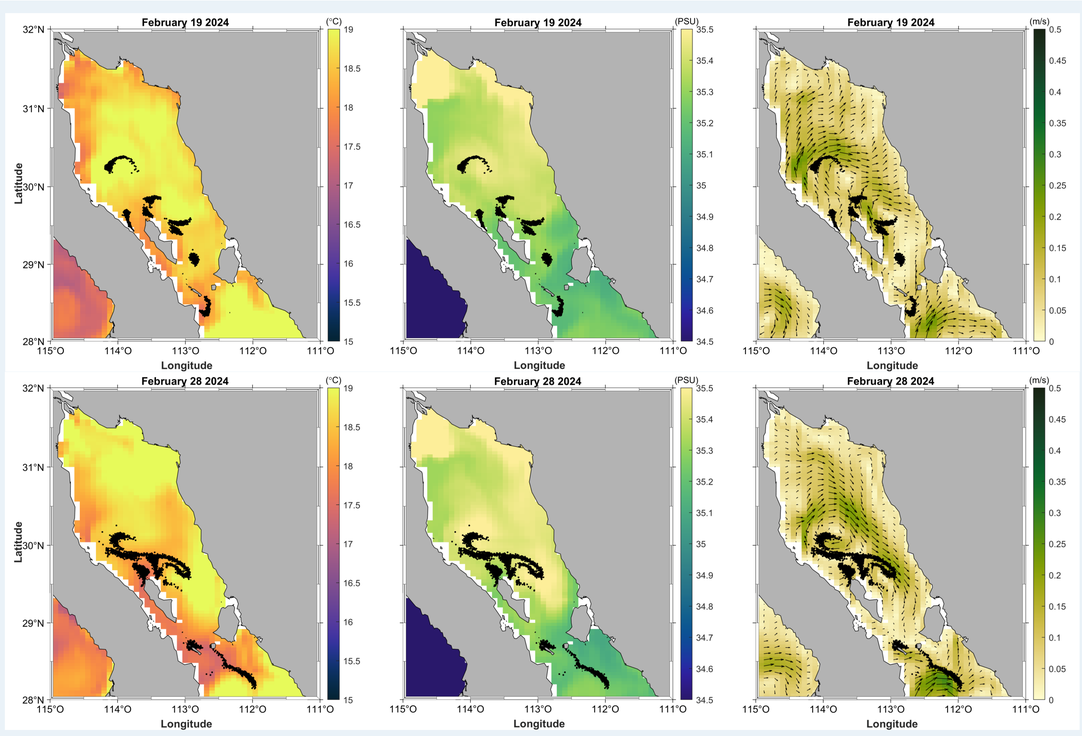


2006



- Environmental and circulation patterns show strong similarity between 2006 and 2024.
- Persistent mesoscale structures drive comparable transport pathways.

2024



- Trajectories indicate consistent retention and advection mechanisms.
- Interannual variability does not significantly modify dominant circulation patterns.

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Conclusions

- Recurrent mesoscale circulation patterns control larval transport during February.
- The anticyclonic structure promotes retention and limits long-distance dispersal.
- The Midriff Archipelago acts as a key boundary for larval connectivity.
- *Merluccius productus* larvae are likely recruited near their spawning areas.
- Lagrangian modeling is a powerful tool to support fisheries management and ecosystem conservation.