Inhomogeneous geographical distribution of pelagic salmon lice

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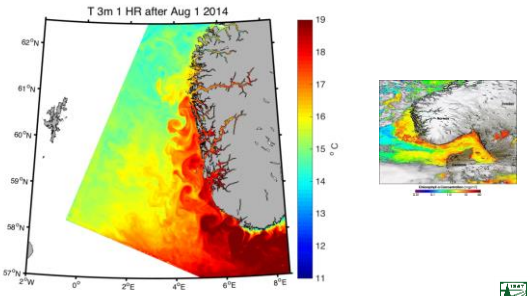
Outline

- Particle distribution in the sea is naturally inhomogeneous.
- Salmon lice will concentrate in narrow streaks.
- Examples of the potential consequences – “the lice gun”.

The coastal ocean dynamics includes eddies, whirls and filaments on numerous scales

http://oceancolor.gsfc.nasa.gov/cms/,
Bering and Chukchi seas captured by VIIRS on August 30, 2016

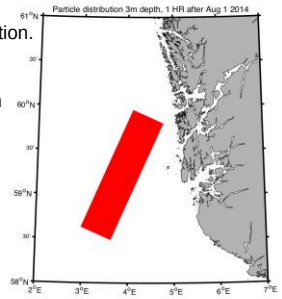
The current model system NorKyst800 confirms the variability observed by satellites



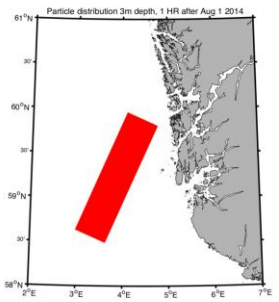
How will passive particles drifting at a fixed depth (3m) be distributed?

15 days simulation.

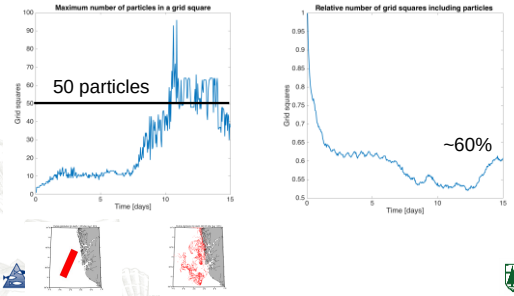
Initial particle distribution with one in each 800m x 800m grid square.



Hourly distribution of passive particles at 3m depth between August 1 and 15, 2014.

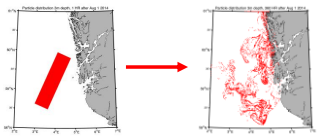


Horizontally passive particles will gain an inhomogeneous distribution



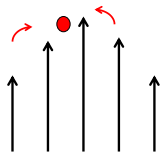
Conclusion 1:

In the layered and rotating ocean, particles will have a patchy distribution with maximum values of particles in the patches much larger than the spatially averaged value during a 15 days drift period.



Aggregation of particles in “jet currents”

Conservation properties under ageostrophic 2D flow will lead to a concentration of particles in jets.

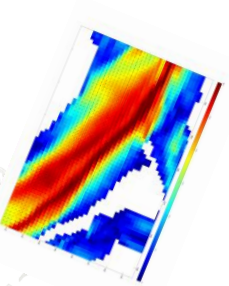


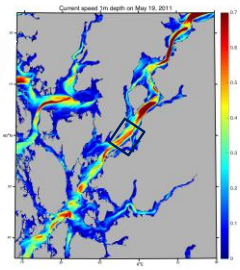
Under strong forcing (e.g. winds/post wind) such currents are generated in Norwegian fjords

Drifter observations from Sandnesfjord (SE Norway) confirm the narrow jet-current.

Up-fjord surface flow after a day of southerly wind at the coast

Model results from Hardangerfjord (W Norway) confirm the narrow jet-current.





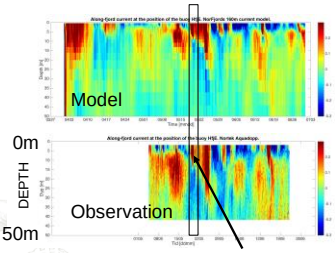
May 19, 6HR. 1 m depth. NorFjords, 160m resolution.

Conclusion 2:

Strong currents in stratified fjords tend to be narrow (“jet-like”).

Example of particle dispersion from May 17-21, 2011 in the Hardangerfjord.

Verticle profiles of current compare well between the current model and the observations.



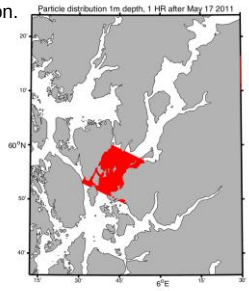
Strong wind = **strong inflow**

The “lice gun”:
Particles are aggregated in the jet stream.

5 days simulation.

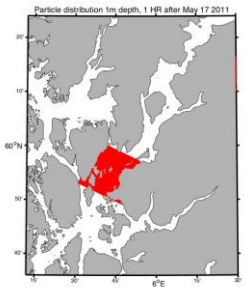
Initial particle distribution with one in each 160m x 160m grid square.

Wind episode force water into the fjord.

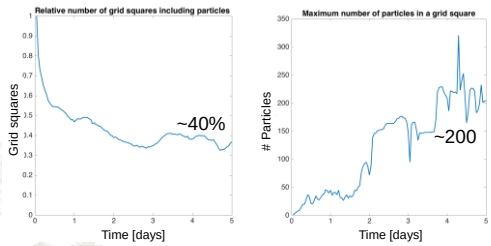


The “lice gun”:
Particles are aggregated in the jet stream.

Hourly updates of particle positions for 120hr.



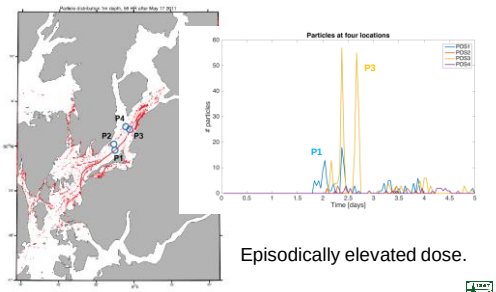
Horizontally passive particles will gain an inhomogeneous distribution



Area reduced to 40%. Max number increased to 200.

Consequences of the “lice gun”

Farms or wild fish being “hit” by this streak of copepodids will experience an elevated infection pressure



Episodically elevated dose.

Conclusions

- Distribution of plankton in the sea is not homogeneous.
- Lice copepodids can episodically gather in narrow streaks potentially leading to larger infection for fish being ”hit”.
- Larger infections are happening in episodes –mean values in time and space will underestimate infection.
- Models describing the variable current are capable of capturing these phenomenas.
- This knowledge can lead to an optimal localization of fish farms in order to reduce the overall infection pressure and transmission of diseases.