The Generation and Dissipation of a Solitonic Wave that Travels in the Reverse Direction to the Flow in the Saint John River Estuary, New Brunswick Canada

by

Nicole Delpeche

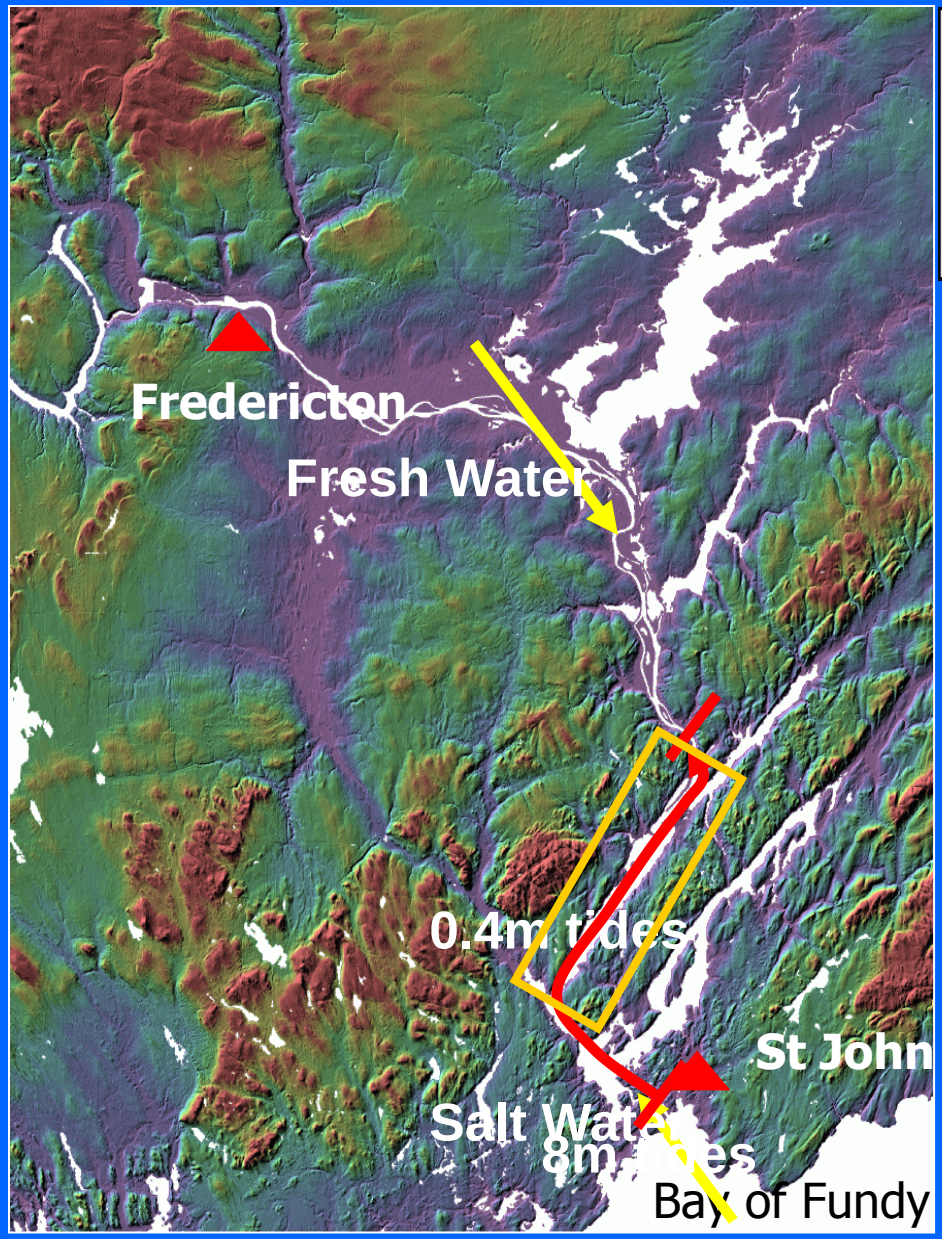
Collaborators: John Hughes Clarke and Susan Haigh

University of New Brunswick Canada (Ocean Mapping Group)

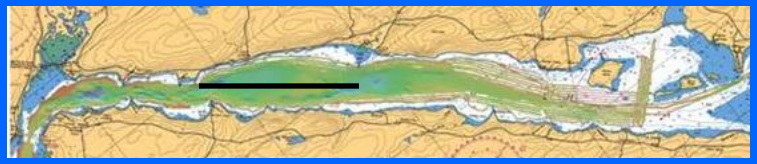
Waves Engineering Group

Institute of Cybernetics

Tallinn University of Technology

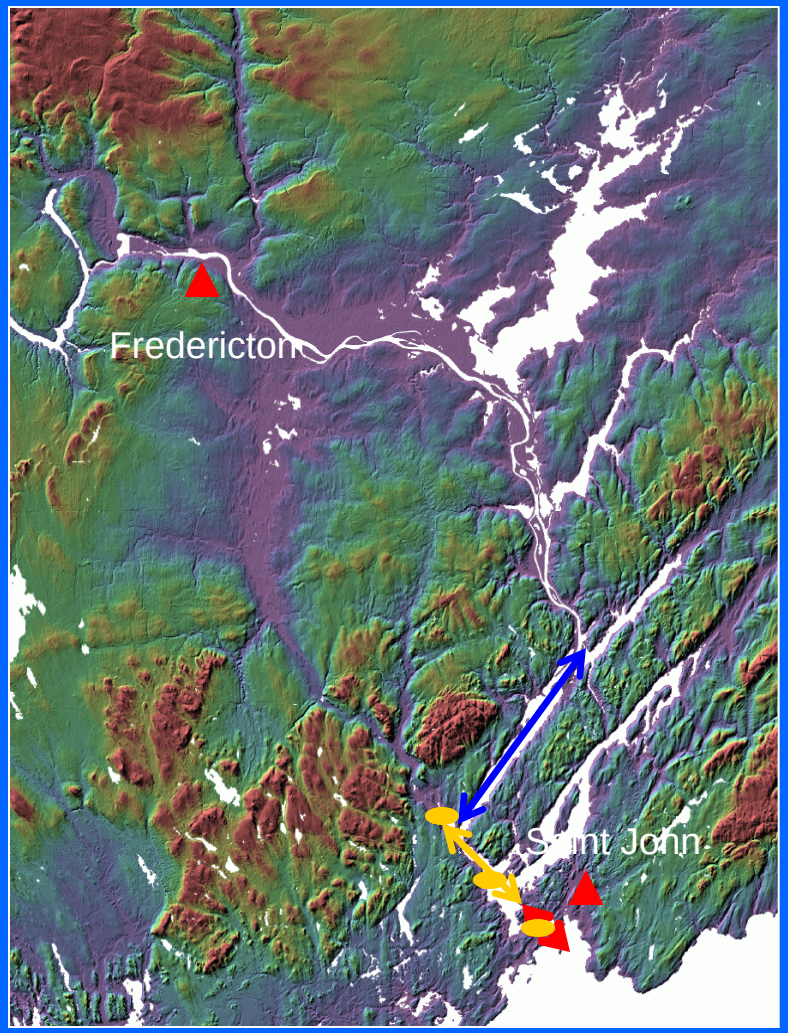

Fredericton
Fresh Water
0.4m tides
St John
Salt Wate
8m
Bay of Fundy

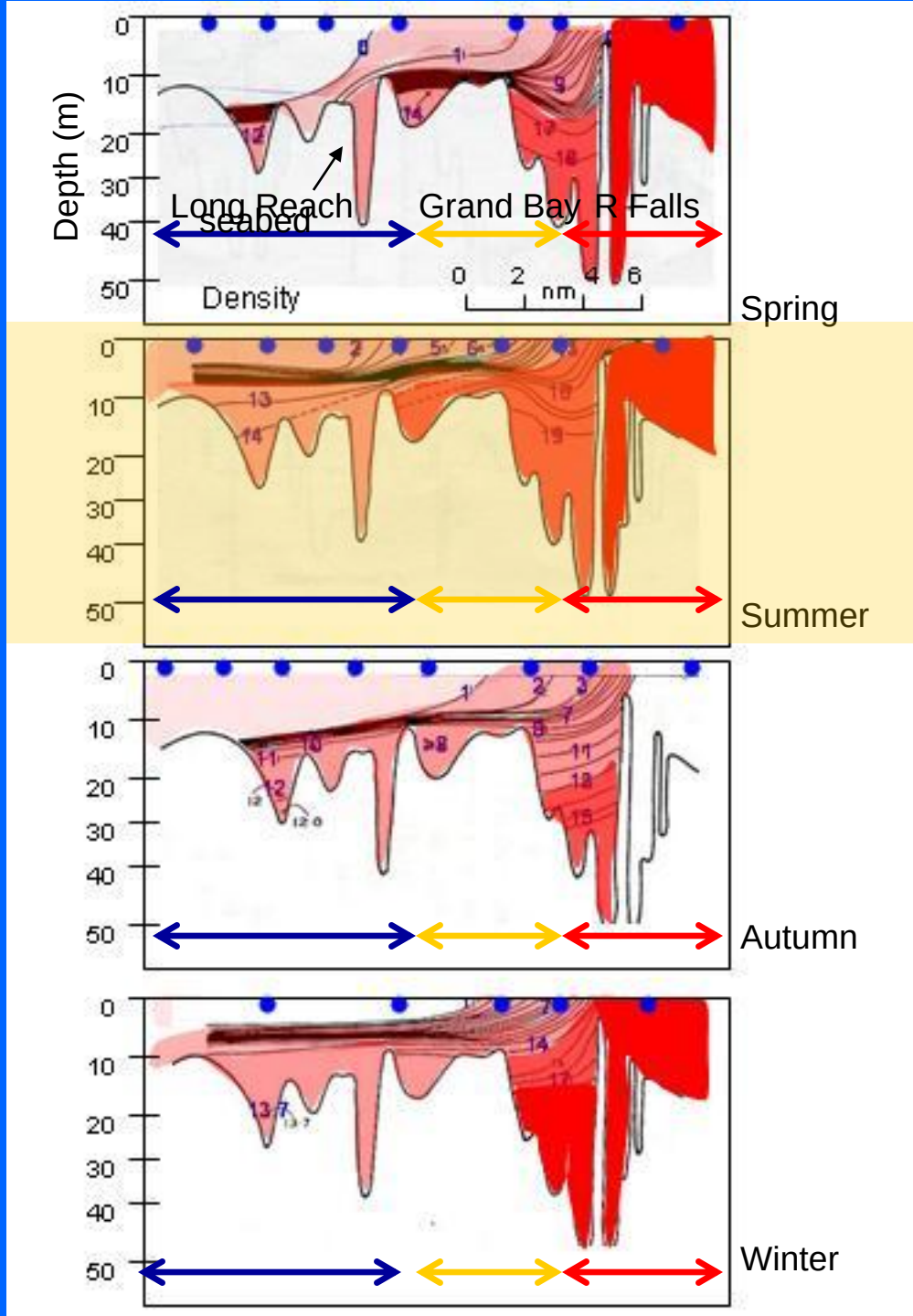

Nova Scotia
Atlantic Ocean



Previous Research

Trites, R.W. (1959)
Metcalfe, C. et al. (1976)



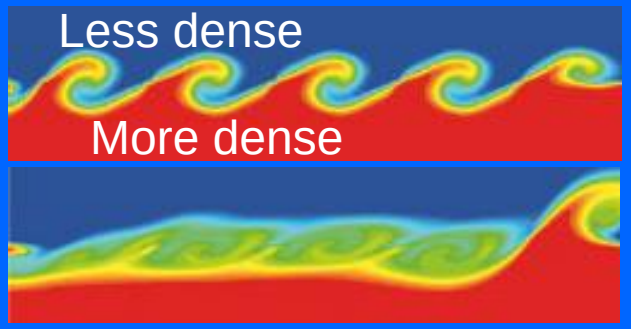


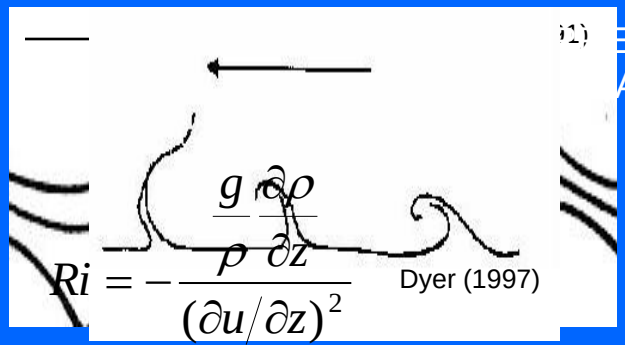
Interfacial Mixing

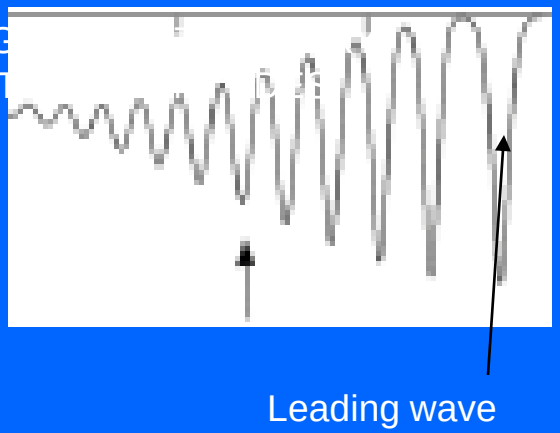
- Three known types of internal waves contributes to turbulent interfacial mixing
  - Kelvin-Helmholtz
  - Holmboe

SHEAR, STRATIFICATION

Kelvin-Helmholtz Holmboe Soliton wave packets



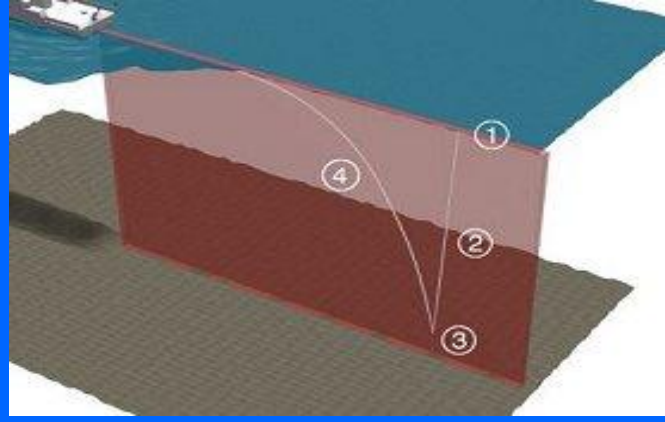





CTD
ADCP
200 kHz
echosounder

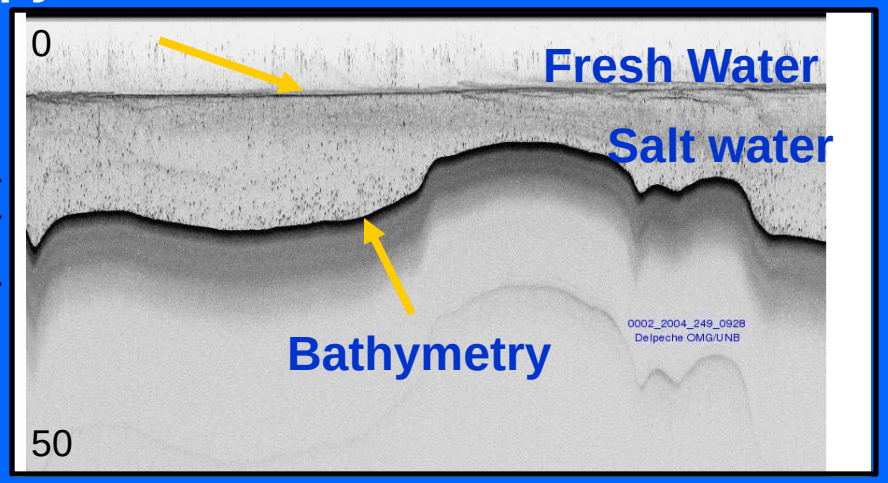
Survey Sensors

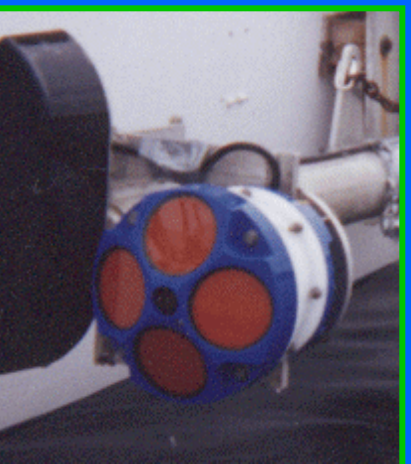
V. Resolution = 0.1m
H. Resolution = 400 m



V. Resolution = 0.07 m.
H. Resolution = 0.5 m

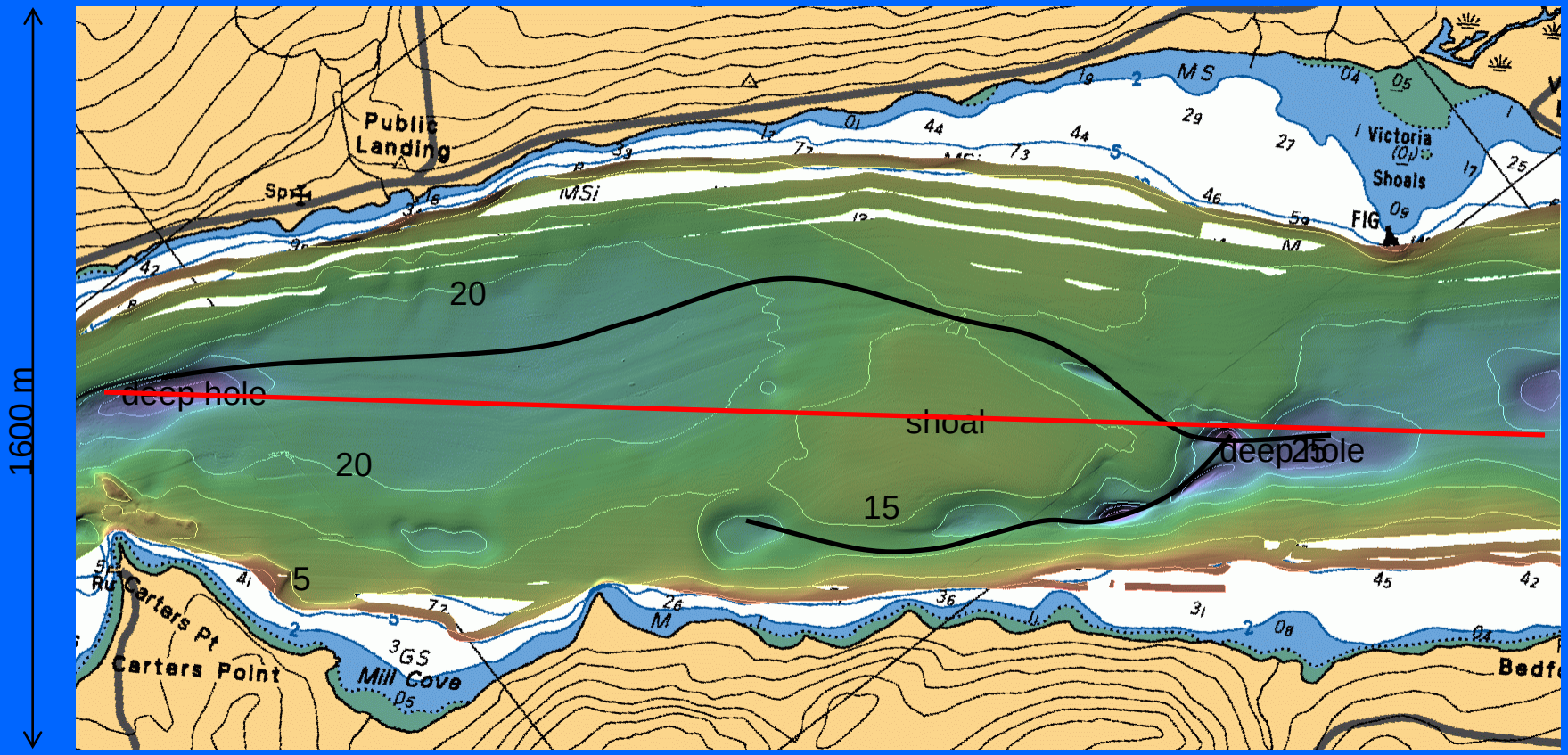
pycnocline





V. Resolution = 0.5 m
H. Resolution = 4 m

Bathymetry


1600 m
Public Landing
Spr
MSi
20
deep hole
20
shoal
deep hole
15
5
Carters Pt
Carters Point
Mill Cove
Victoria
Shoals
FIG
4500m

Density kg/m^3

1009 1008 1002
1012 1003 998

Velocity m/s

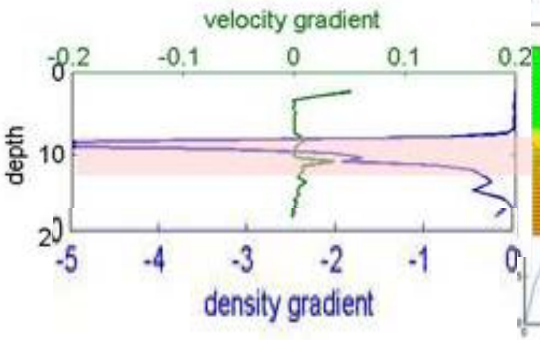
0.3 0.2 0.1
0.2 0.1 0

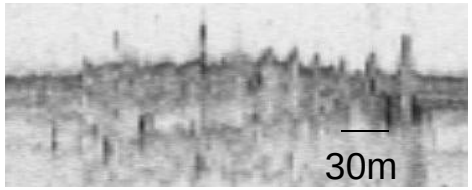
density

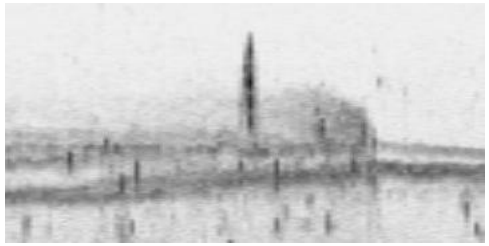
acoustic backscatter

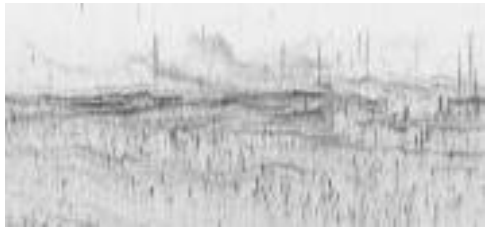
Gradient Richardson Number

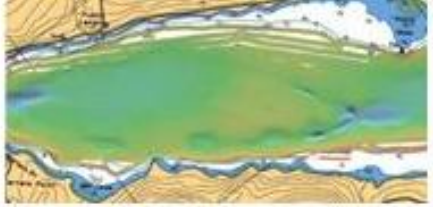
0<RI<1

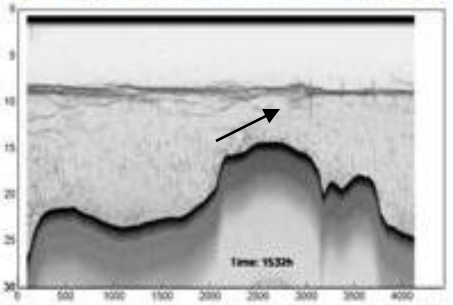



30m





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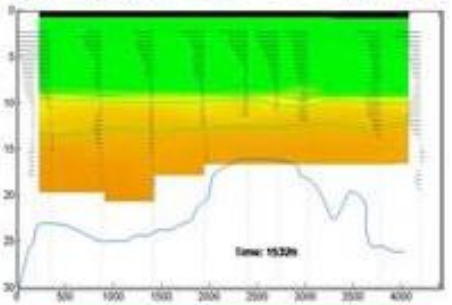
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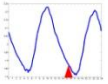

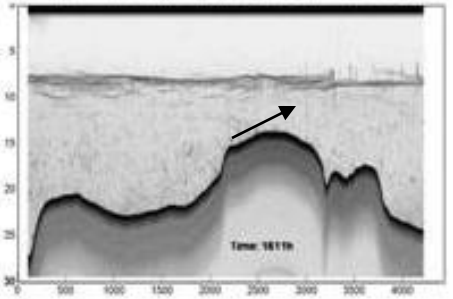
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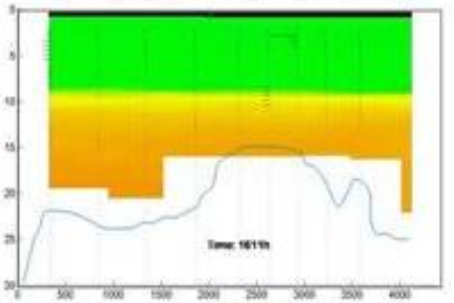
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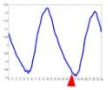

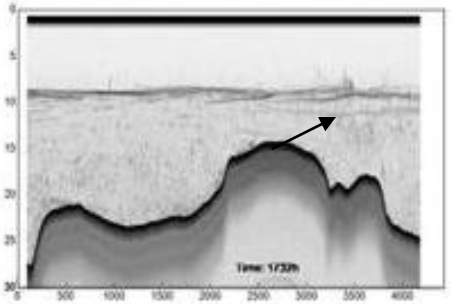
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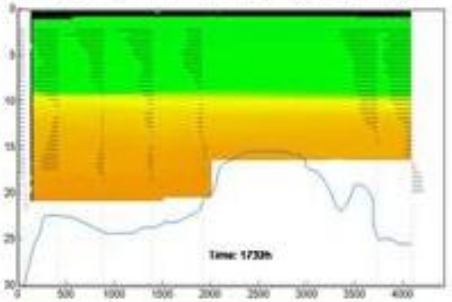
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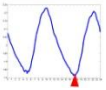

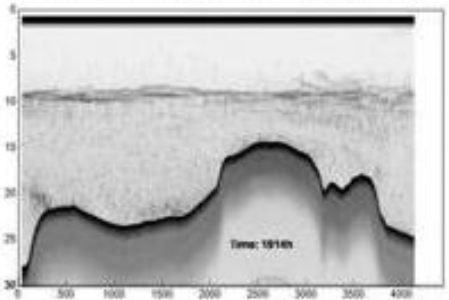
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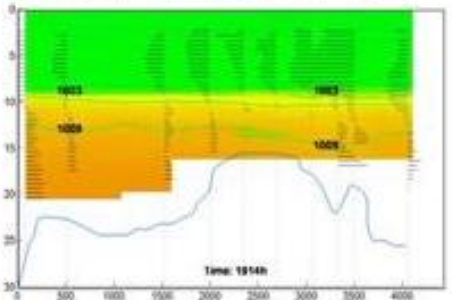
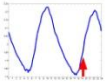
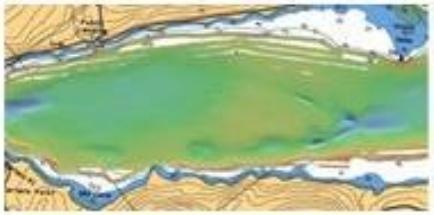
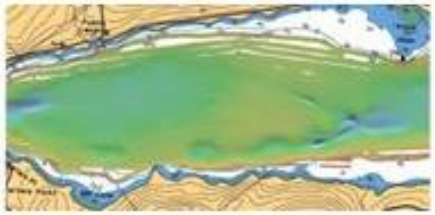

1003
1003
1009
1009
Time: 1914h



Mixing

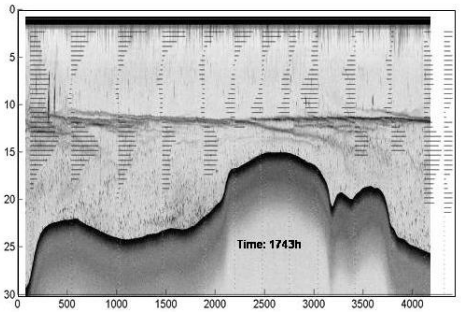
- Decrease in density observed at 500m (downstream of shoal) at high tide and at the 3000m marker (upstream of sill) at rising into high tide
- Gradient Richardson number calculated for $0<Ri<1$
- Mixing was found to be occuring at the 500m marker
- Internal wave observed to diminish at the 3000m marker at neap tides. When this occurred the decrease in density took place
- For spring tides the internal wave did not appear. The decrease in density at the 3000m marker did not occur

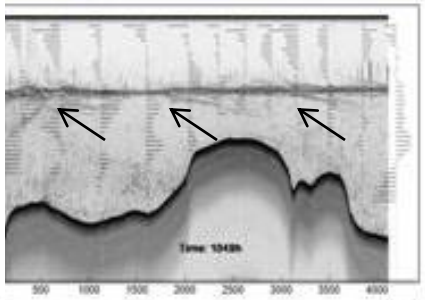


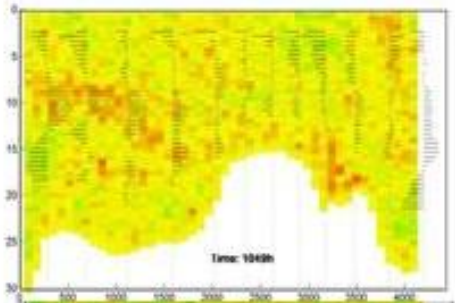


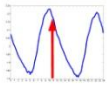
Velocity m/s

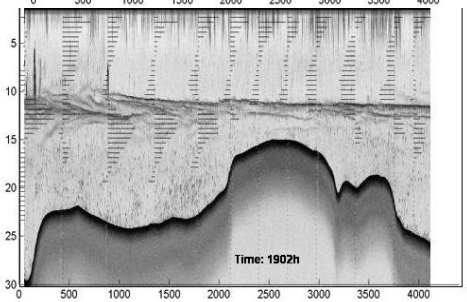
-0.2 to 0.5 - -0.1 to 0.1 - -0.2 to 0.6

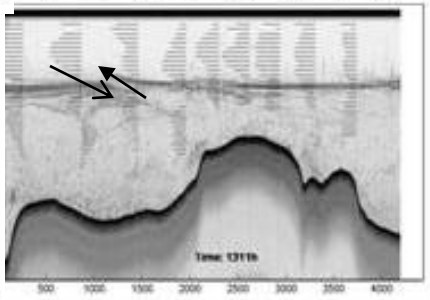


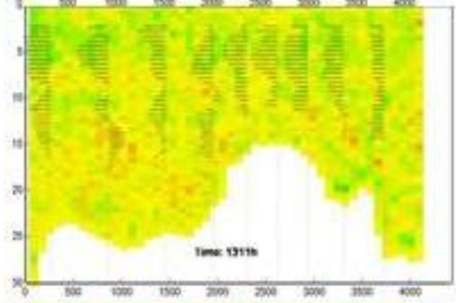




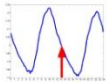


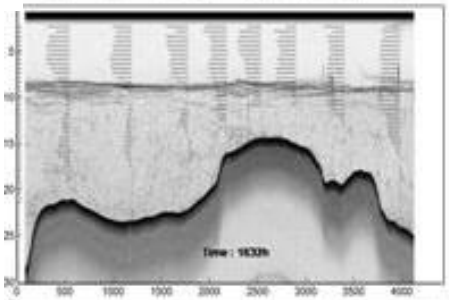


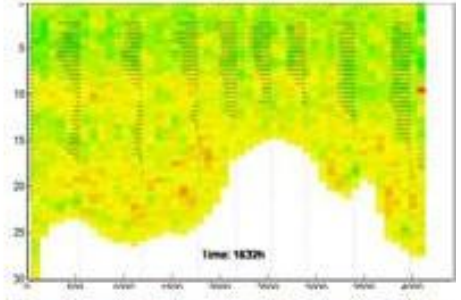


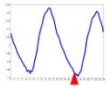


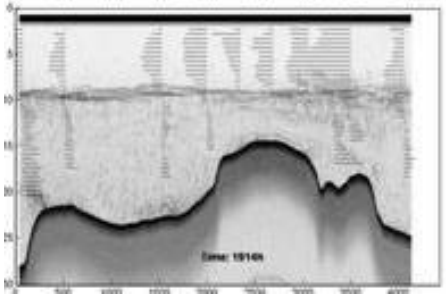
velocity

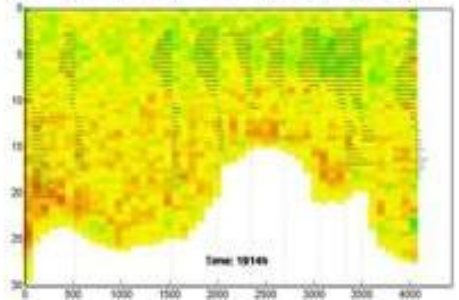


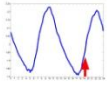


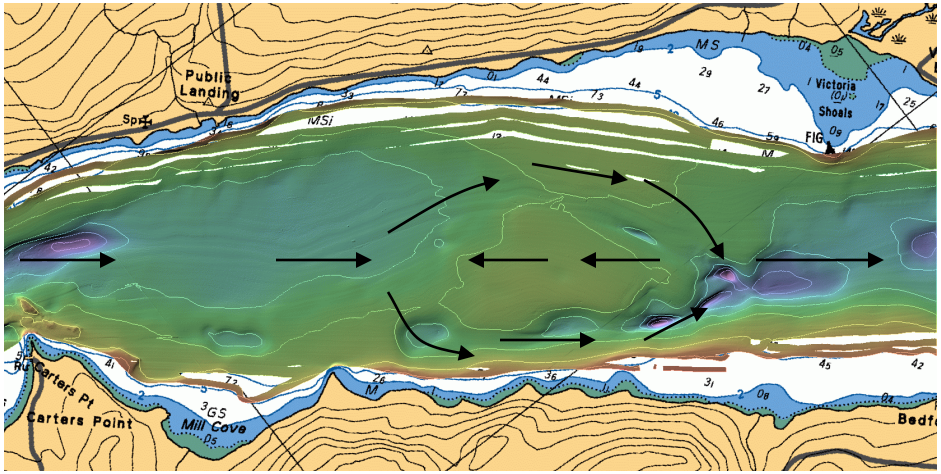


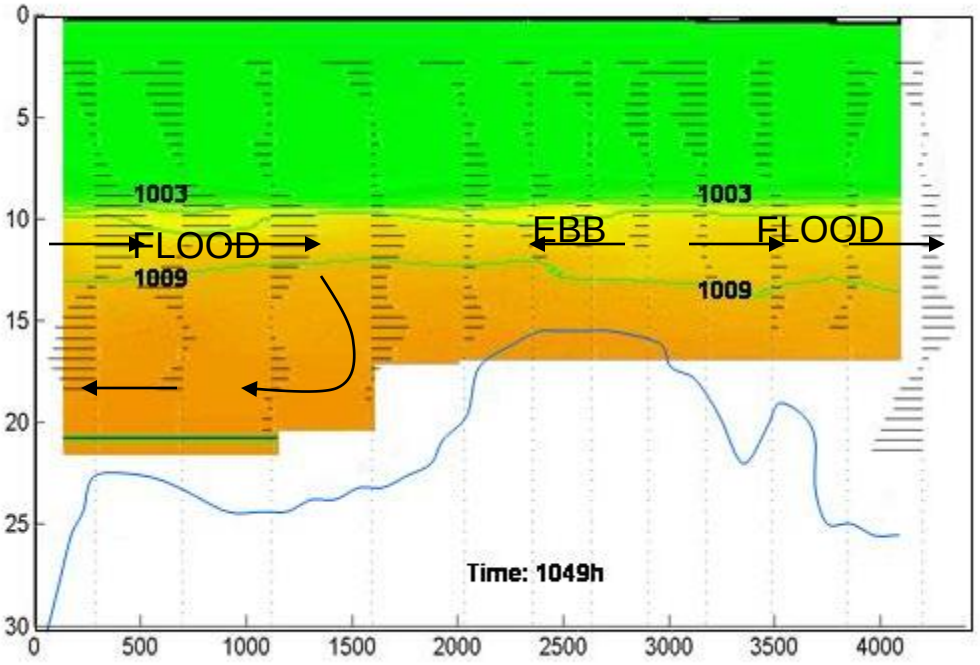









Public Landing
Victoria (O)
Shoals
Carters Pt
Carters Point
Mill Cove


1003
FLOOD
1009
EBB
1003
FLOOD
1009
Time: 1049h
0
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25
30
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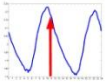
500
1000
1500
2000
2500
3000
3500
4000



Conclusion

- At neap tides the soliton wave packet that develops upstream of the shoal appears to contribute to the decrease in density observed upstream
- Two contrasting circulation pattern appears to develop downstream and upstream of the shoal. The circulation pattern appears to be influenced by the bathymetry of the area
- The over-riding phenomena observed from the acoustic backscatter images appears to be influenced by the less dense water riding on top of more dense water.

Questions