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Quantifying the Impact of Internal Wave Activity on Multibeam Bathymetry

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RV Celtic Voyager



31.4m - 340 tonnes

- EM2040D
- EA60 38/200

RV Celtic Explorer



65.5m - 2425 tonnes

- EM2040S
- EM1002
- EM302
- EK60 18/38/120/200



The seasonal onset and decay of thermal stratification





Static Bias

Due to vertical displacement

Slowly Changing Bias

Primarily displacement, minor slope

Rapidly Changing Bias

Minor displacement, predominantly slope





4 consecutive lines – showing evolution of soliton packet, triggered from bank top



Initiation of Soliton Packet

This wave appears to have been triggered from the nose of a lateral intrusion along the thermocline. The nose was crossed at 02:26:40 (July 24th, JD205).

80-120m water depth



was steaming west at ~ 7.5 knots

the second se

Next line : 4.0 hours later



This occurred at 07:56:44 on July 24th (JD205) as the vessel was steaming back to the east at ~ 8 knots. About 3 hours later as we had to go to the west end of the line and return.





* Relative to oblique path length

Variation With Obliquity

Ratio of Oblique ray-trace distance through thermocline

A directional filter:

-- only acts on apparent wavelength, projected across track















2495 2500 2505 2520







WavePacket_CE1702_C - Line {0031}

 λ = 20 m, azi 070°



2495

1520

morphologic degadation

Conclusions:

Internal Wave Activity is a major concern for seasonally stratified shelf seas

(Celtic Sea – North Sea – Scotian Shelf – Grand Banks – Gulf of St. Lawrence)

- <u>5 km +</u> wavelength can be addressed by MVP
- <u>0.5 to 5 km</u> requires means of tracing thermocline acoustically -see Jose Cordero Ros – next presentation
- <u>< 0.5km</u> wavelength are tricky to identify but are the prime cause of <u>false morphology</u>

Numerical modeling of Internal Wave azimuth, wavelength, amplitude and layer thickness well describes observed relief.









in Ma

dz

Can infer Internal Wave Activity and Dimensions

- 1. Wavelength
- 2. Amplitude
- 3. Azimuth
- 4. Thickness

Recommendations:

Hydrographers need the tools/training to recognize these features



Oct Nov

Dec

Jan Feb

Month

Jul

Jun

Aug Sep

• Avoid the oceanographic conditions.

2018 operations April-May **BEFORE/DURING** thermocline development

Adapt survey to respond Marine Institute: 20% overlap CHS : 100% overlap

0 Mar Apr

4.5

40

60

Depth (m)