Shelfbreak Frontal Circulation near the Sable Gully of Nova Scotia

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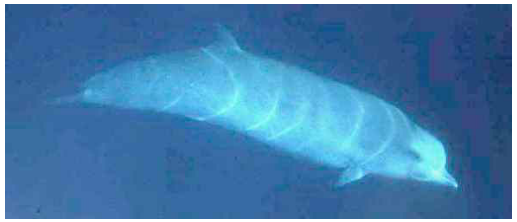
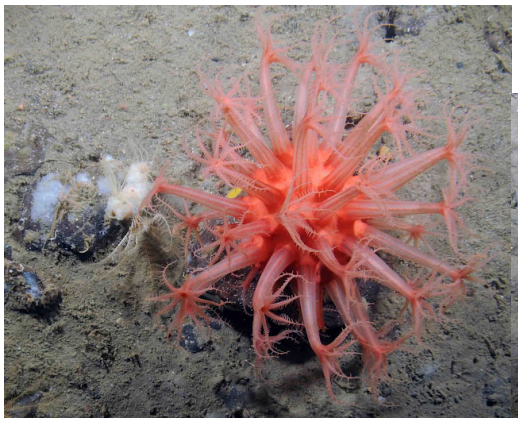
Motivation and Outline

Being the home of many marine species including the endangered Northern Bottlenose whale, the Gully was designated as a Marine Protected Area (MPA) in 2004. Better understanding of physical environmental condition in this MPA is needed for sustainable ecosystem management.





http://hudson0142011.blogspot.ca/2011_06_01_archive.html

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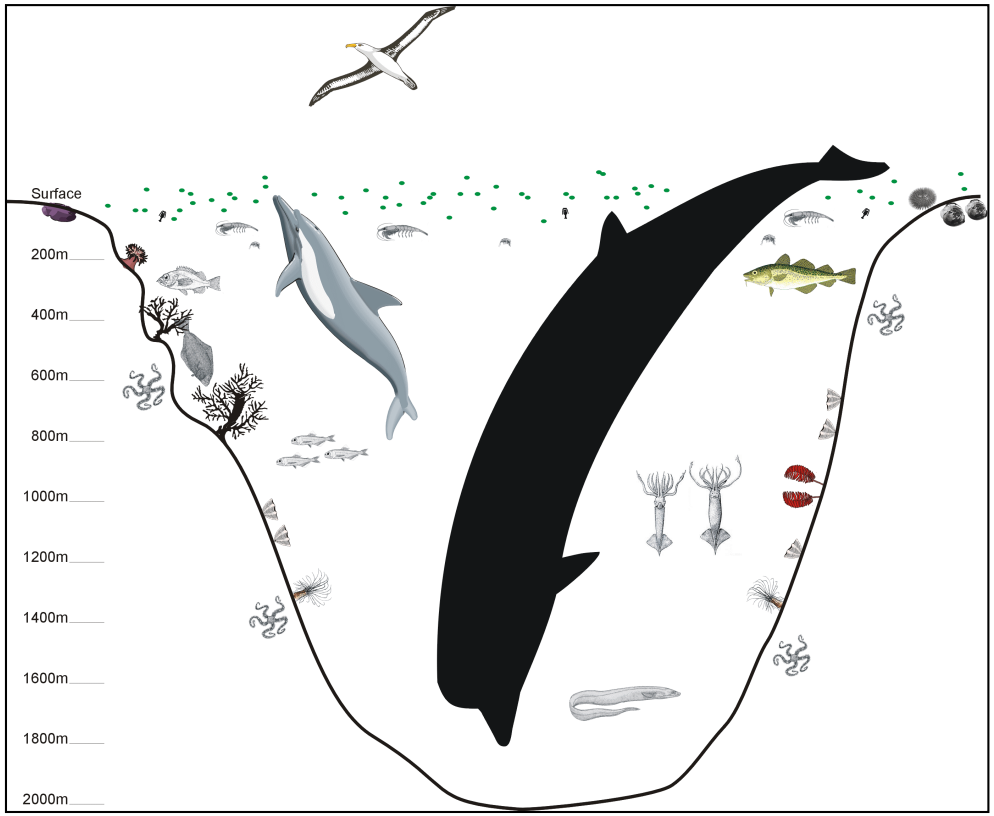
The Sable Gully, Marine Protected Area

- Where do the nutrients come from?
- What is the linkage between the Gully and the Scotian Shelf?
- Is it protect the Gully enough? Or we have to extent the MPA to include other areas on the Scotian Shelf as well.

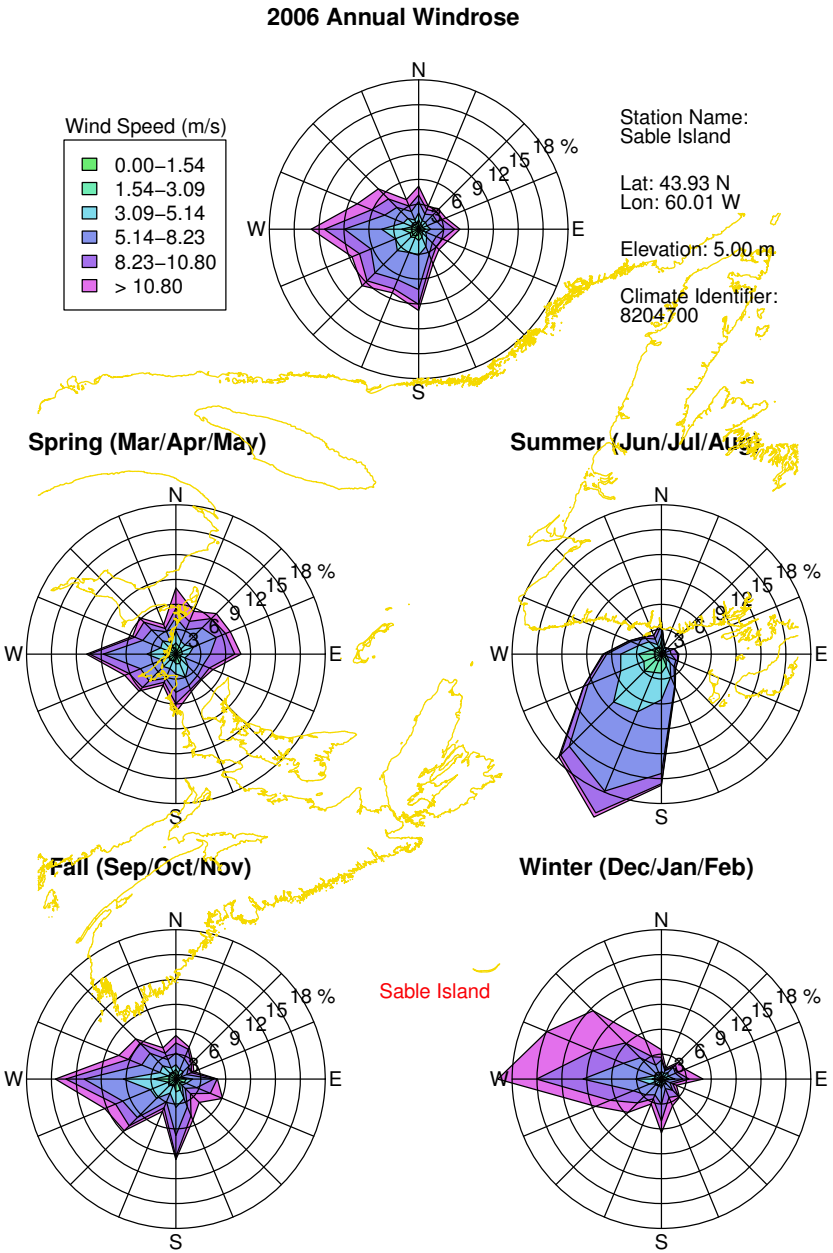


Rutherford and Breeze (2002)

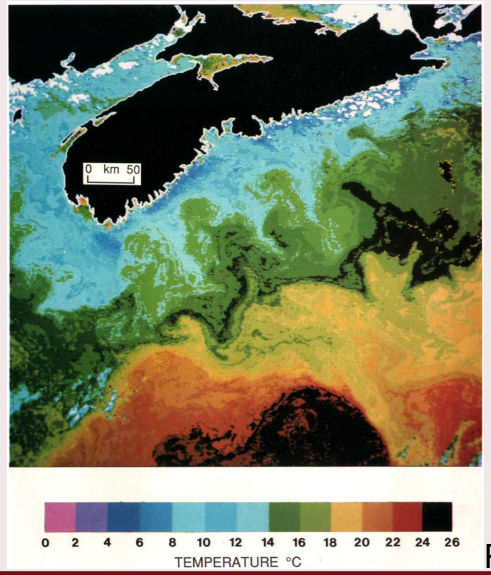
Understanding the circulation is the first step.

Oceanic Background: Circulation

http://www2.mar.dfo-mpo.gc.ca/science/ocean/woce/climatology/na_circ.jpg

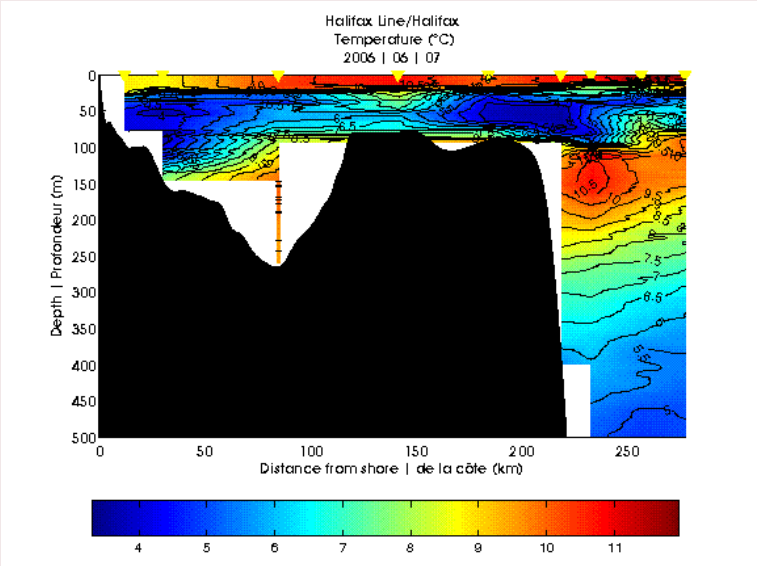


Coastal Upwelling



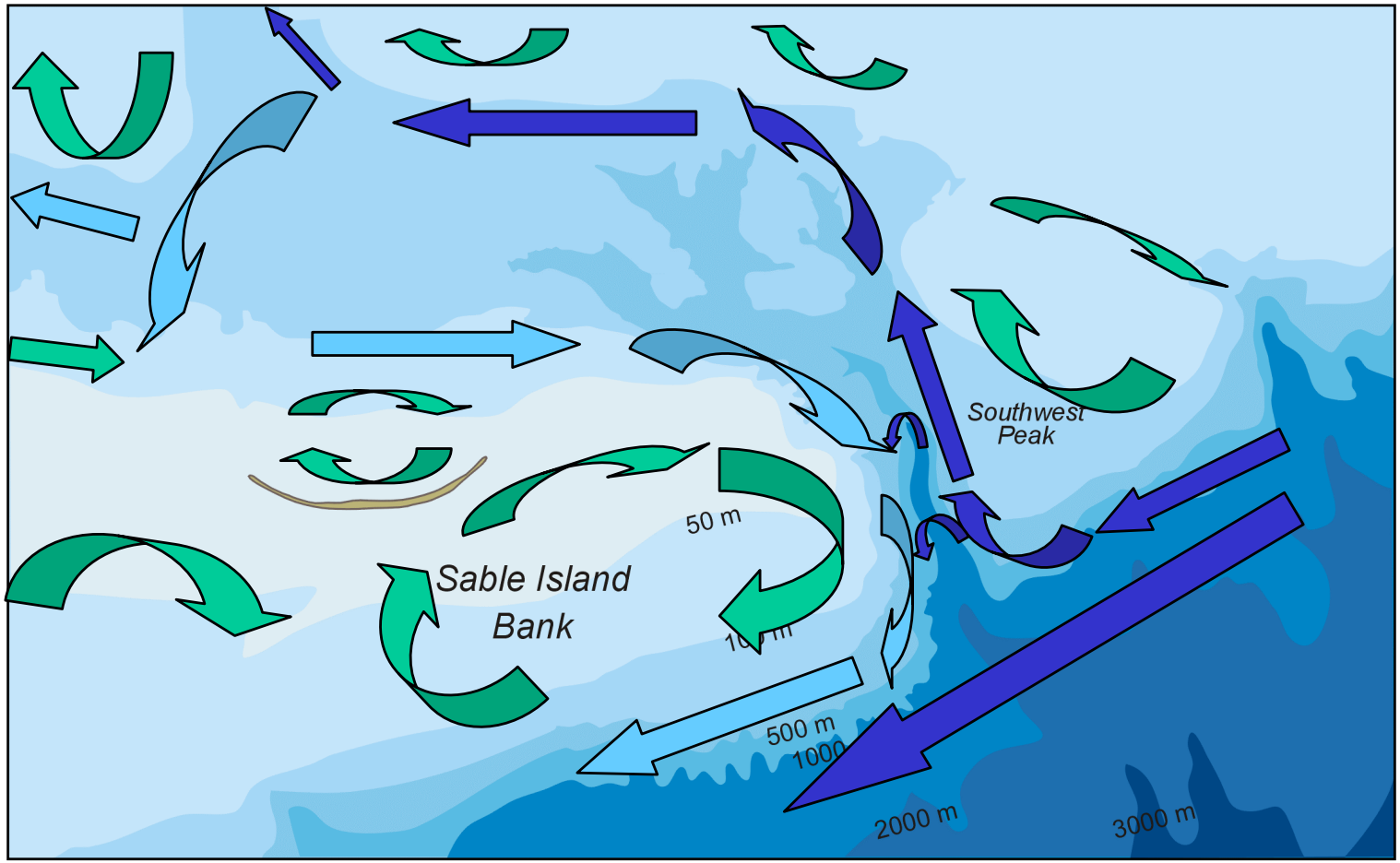
Petrie et al. (1987)

Cold Intermediate Water



www.meds-sdmm.dfo-mpo.gc.ca/alphapro/zmp/section/2006/HAL_2006_002_CTD_TES_TEMP.GIF

Oceanic Background: Circulation

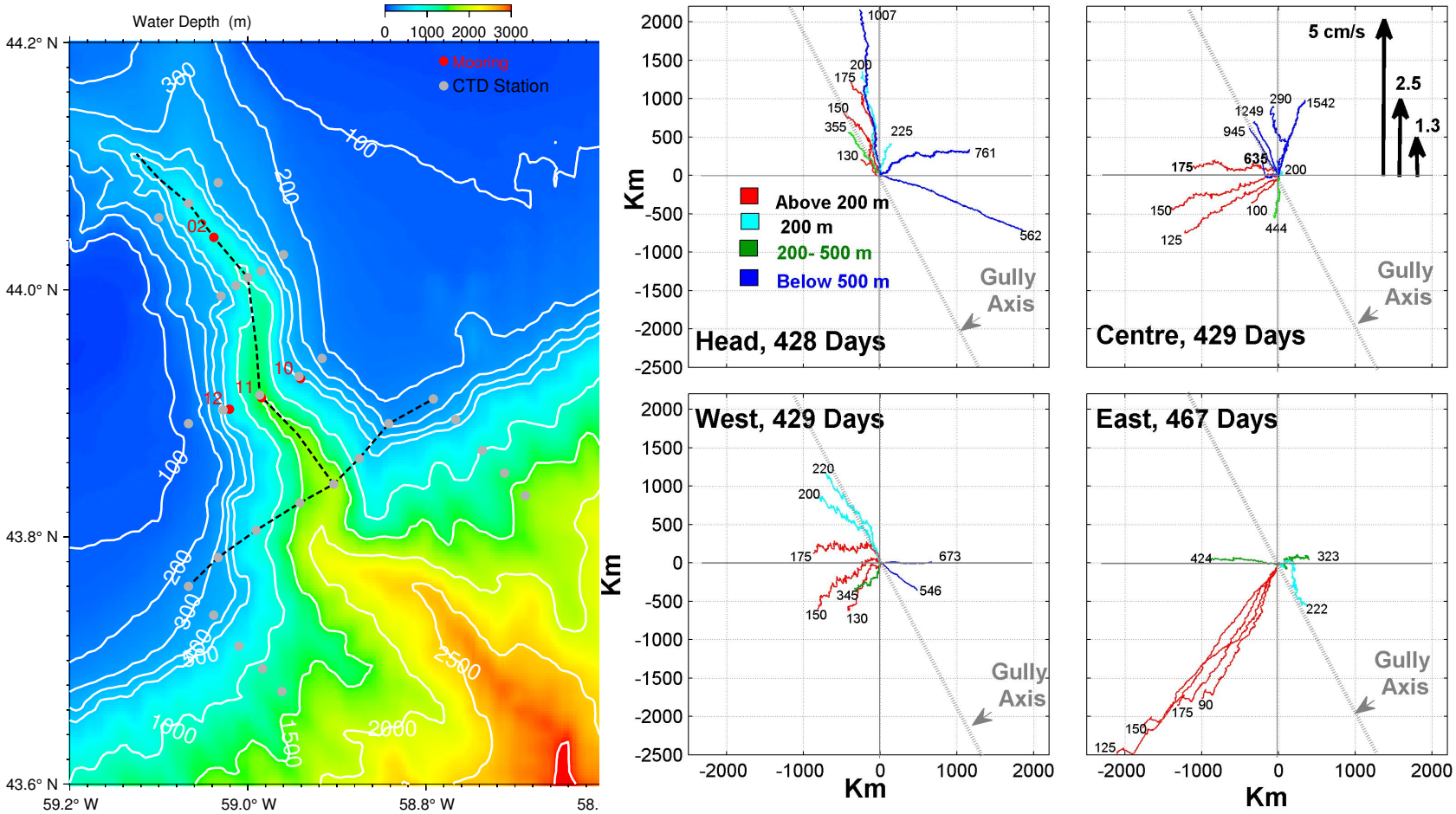


Rutherford and Breeze (2002)

Current Observations

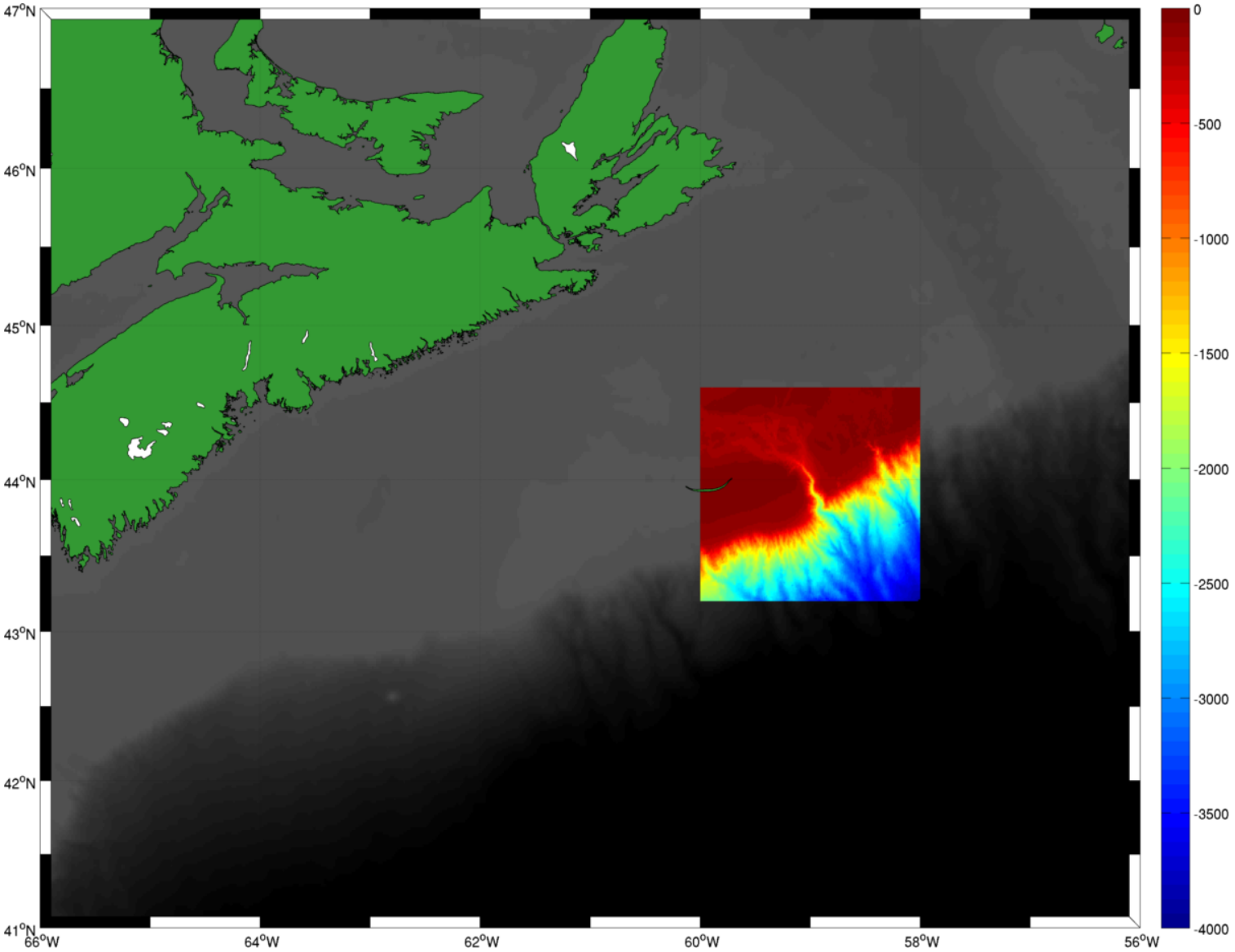
Four moorings deployed in the Gully from April 2006 to July 2007. (Greenan et al. 2010)

- Above rim, flow is generally southwest
- Below rim, along canyon flow is generally north
- Along sides, flow may be influenced by topography

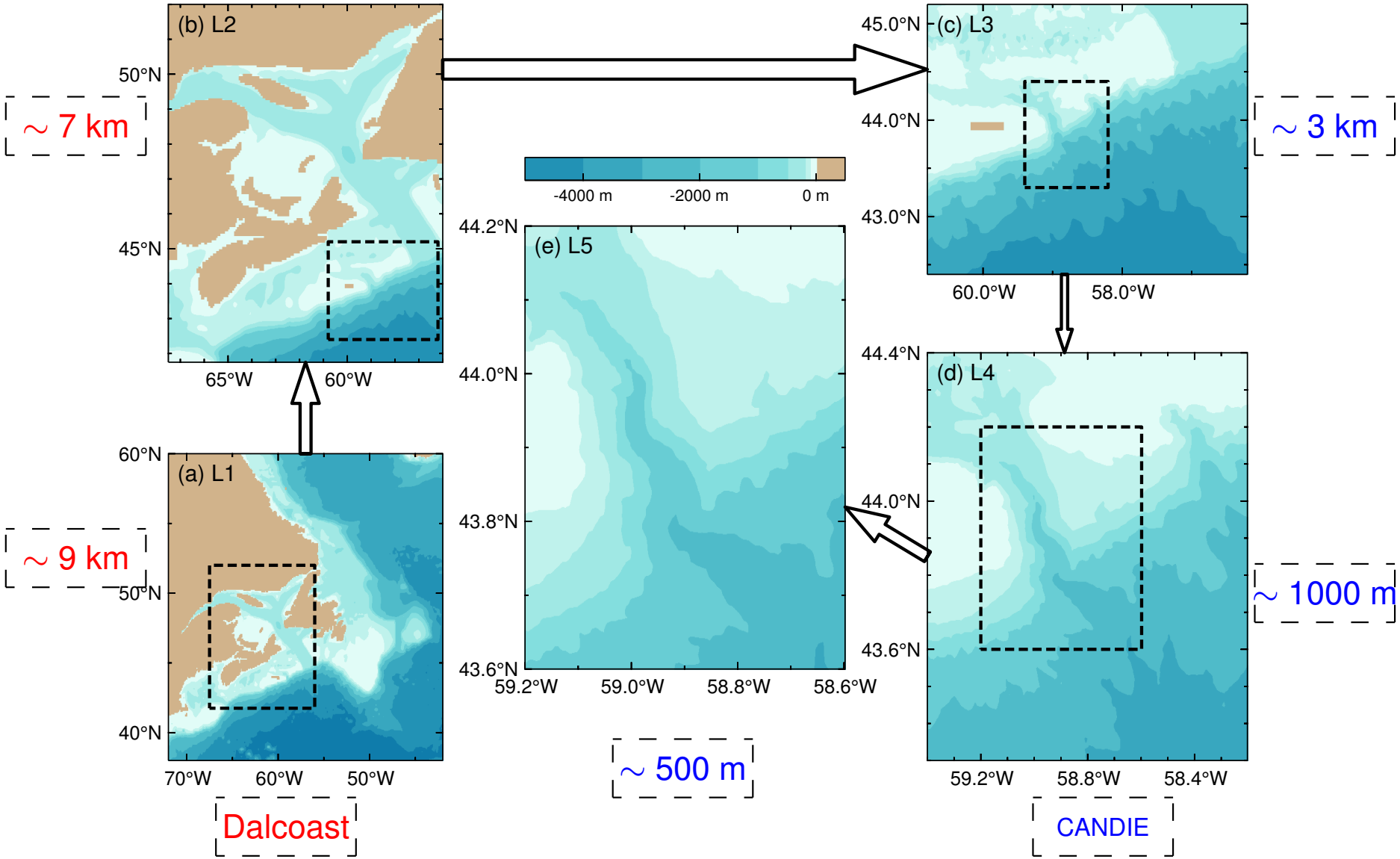


The Modelling Challenges

Multibeam bathymetry ($\sim$ 100m) from BIO

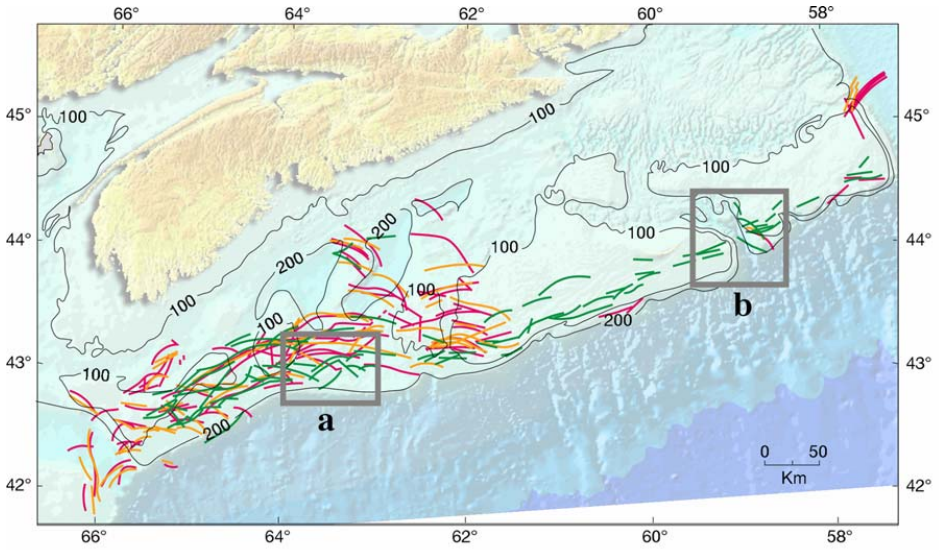


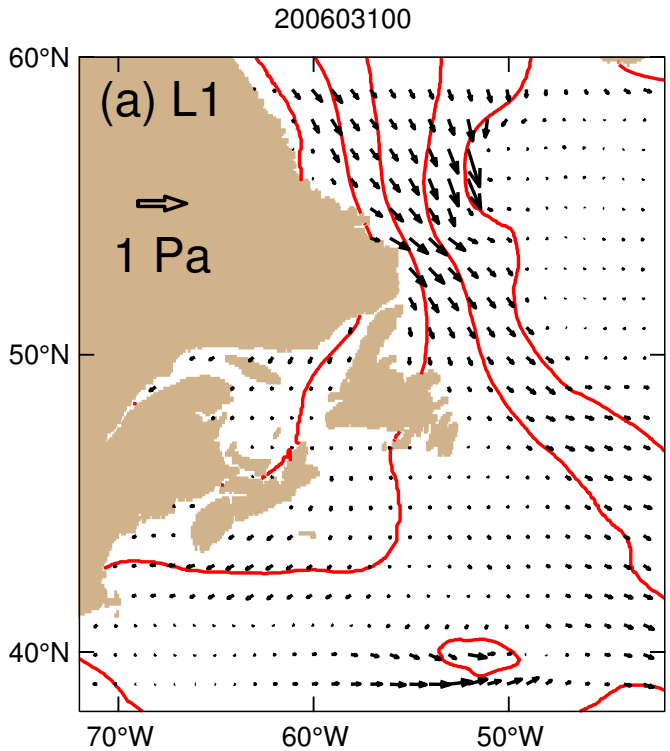
Multi-nested Coastal Ocean Circulation System for The Gully



Main Features of DalCoast-Gully:

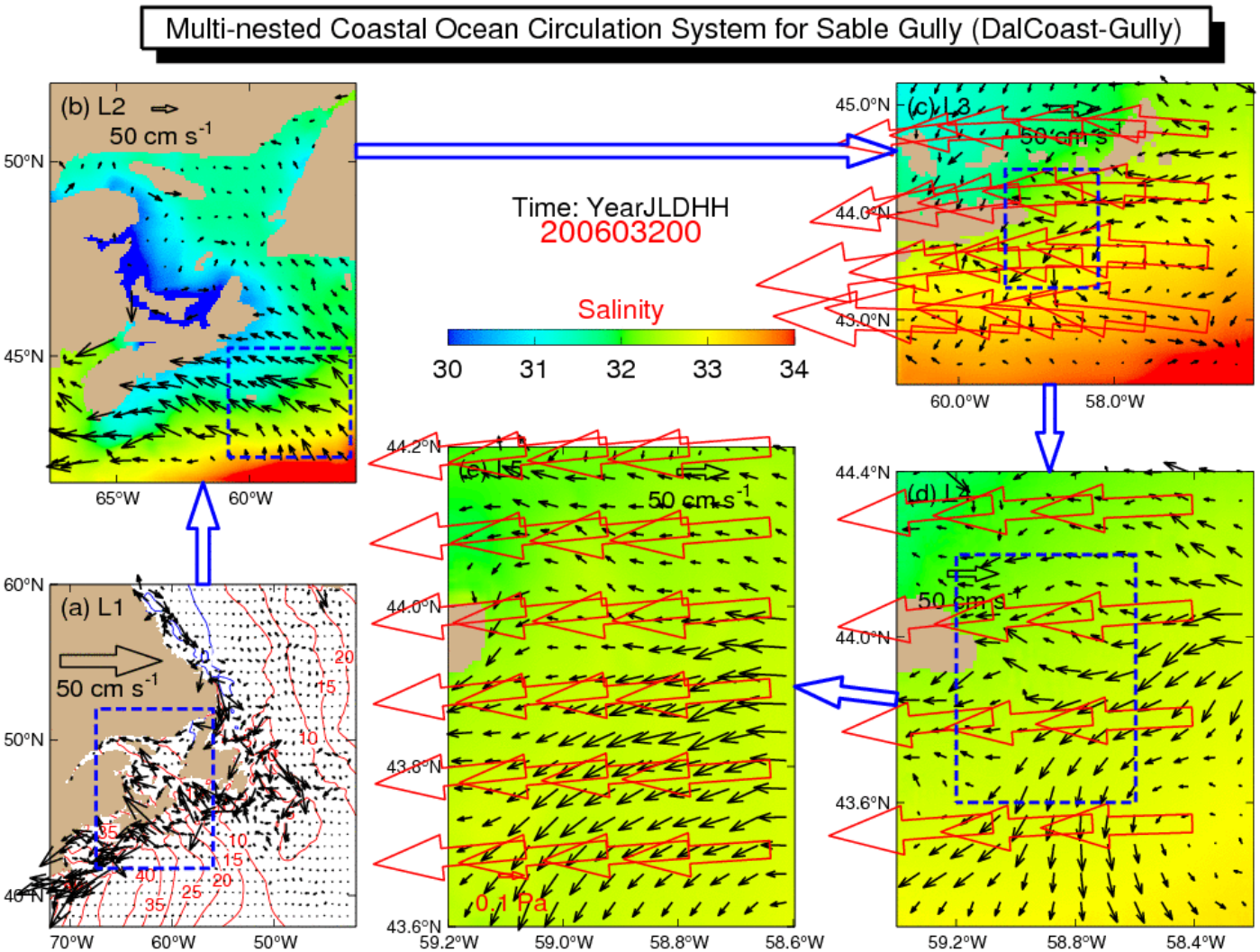
1) Five submodels with different horizontal resolutions
2) Based on Dalcoast (POM) and CANDIE
3) Driven by tides, wind and sea level pressure, air-sea fluxes of heat
4) One-way nesting



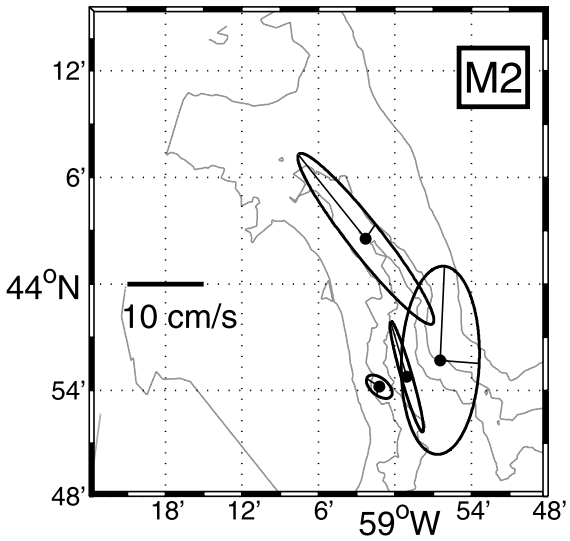


Sandstrom and Elliott (2011)

Preliminary Model Results

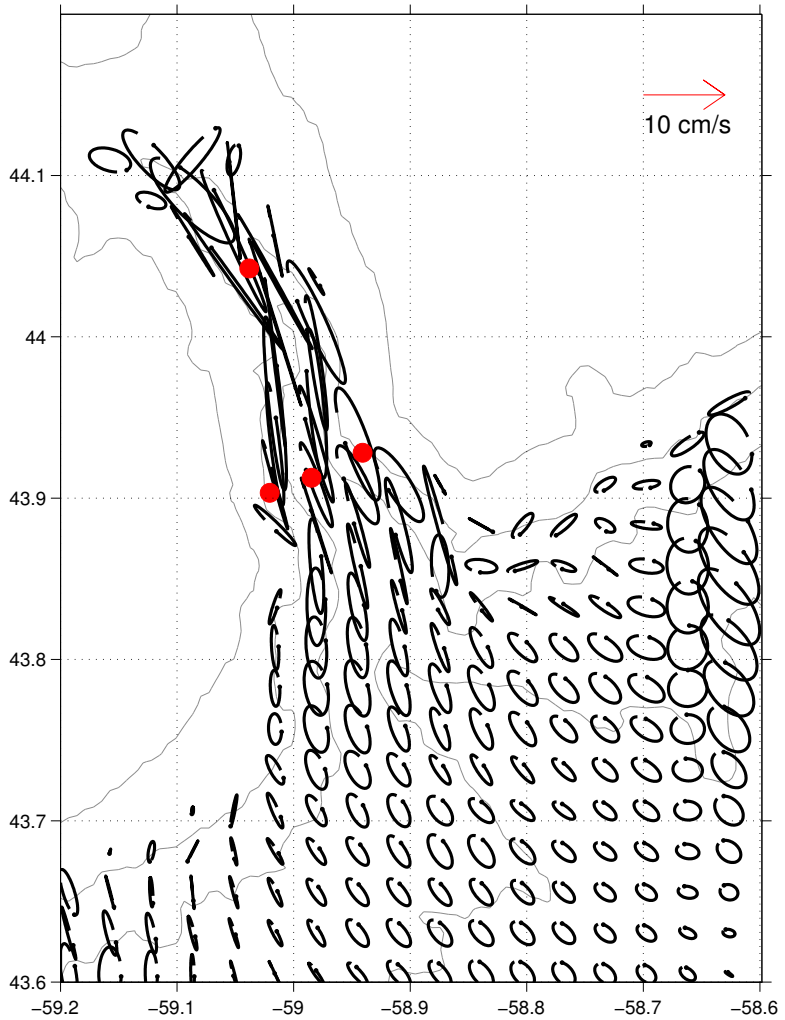


Tidal Current



Observation

(Swart et al. 2011)

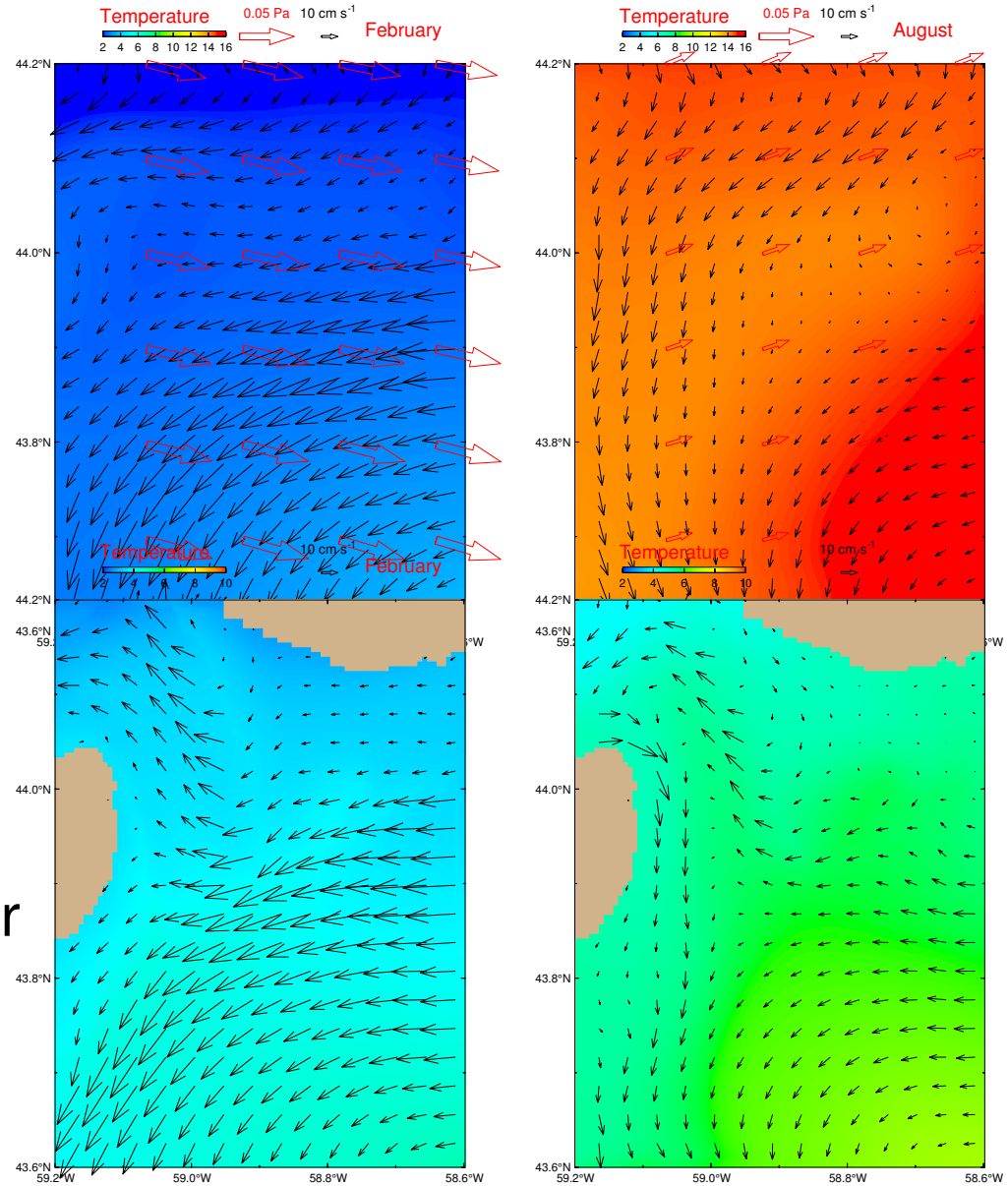


Model

Monthly Mean Temperature and Current

Surface

80 meter



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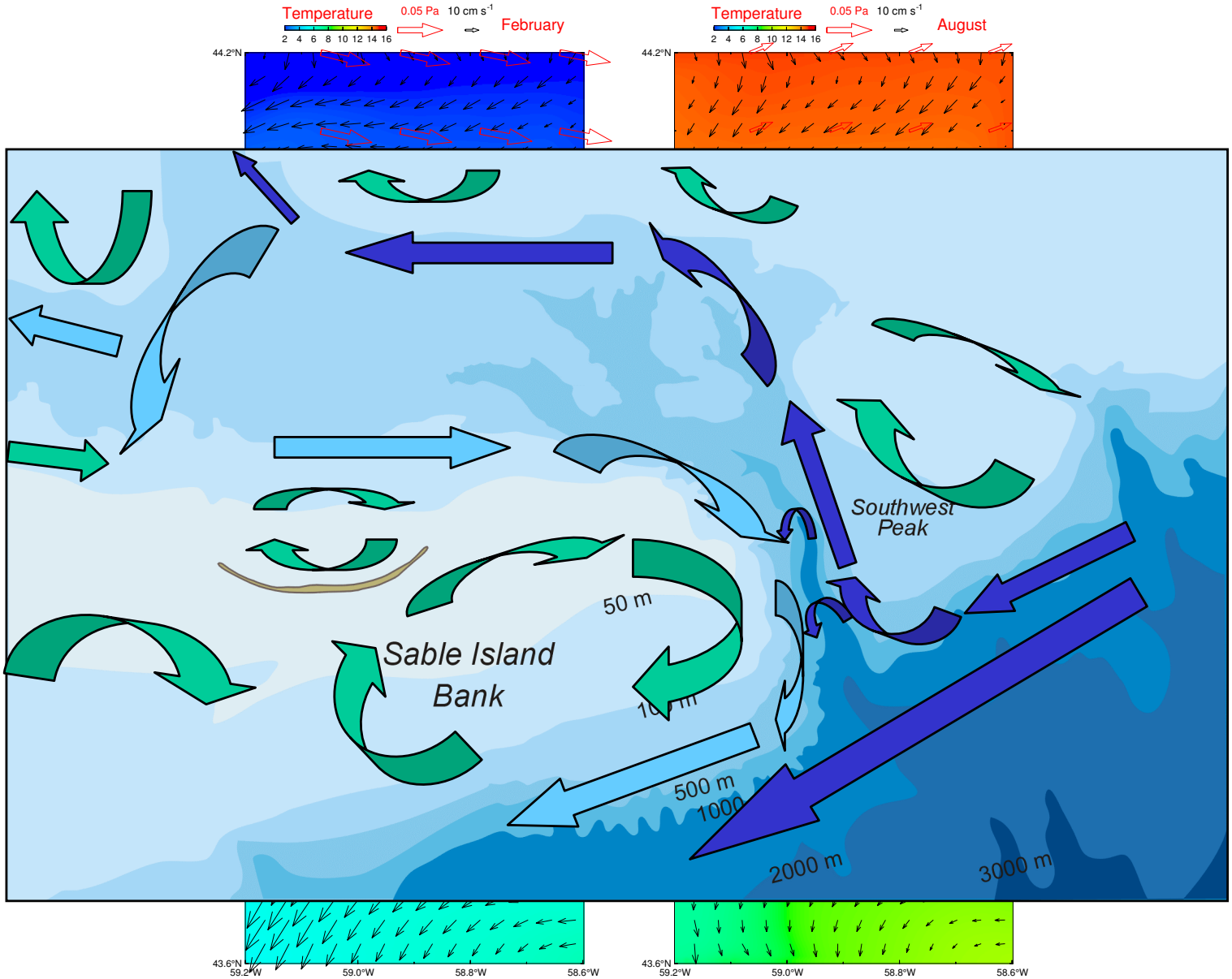
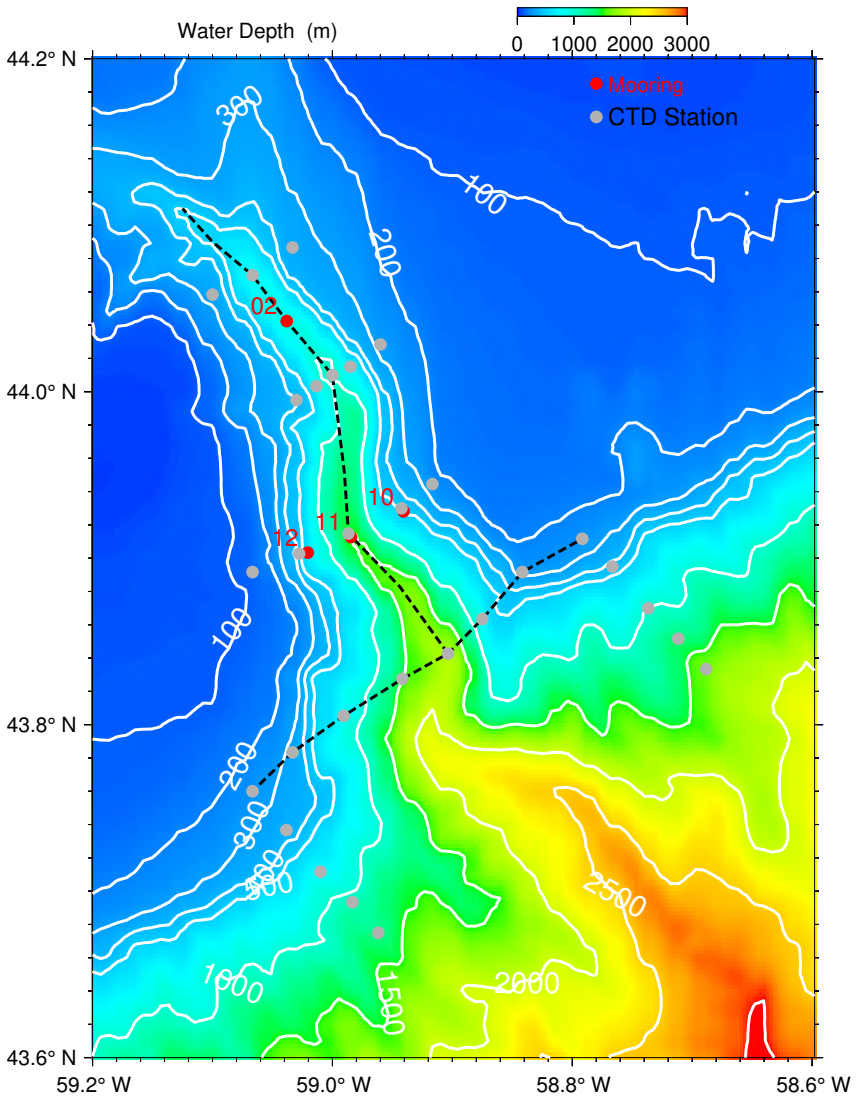
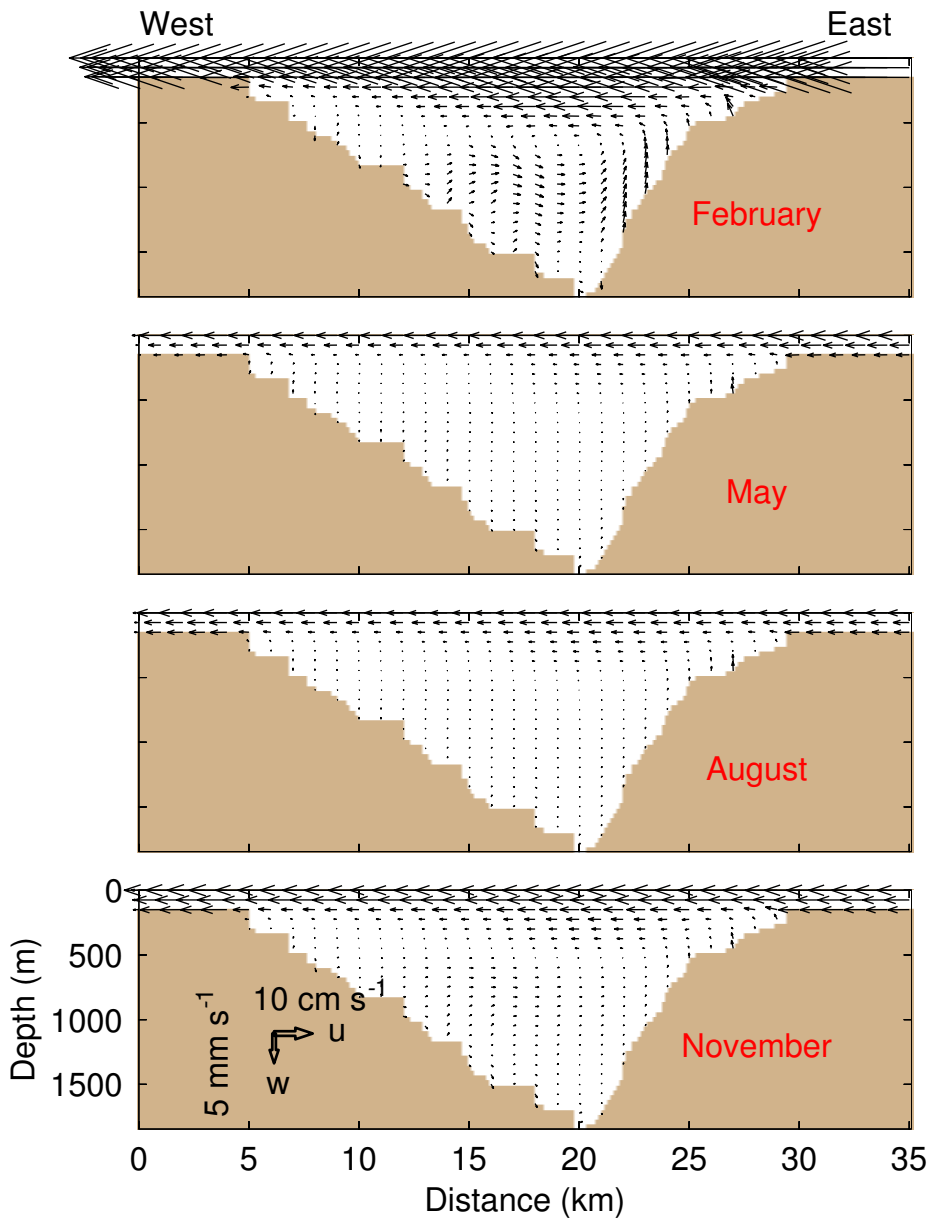
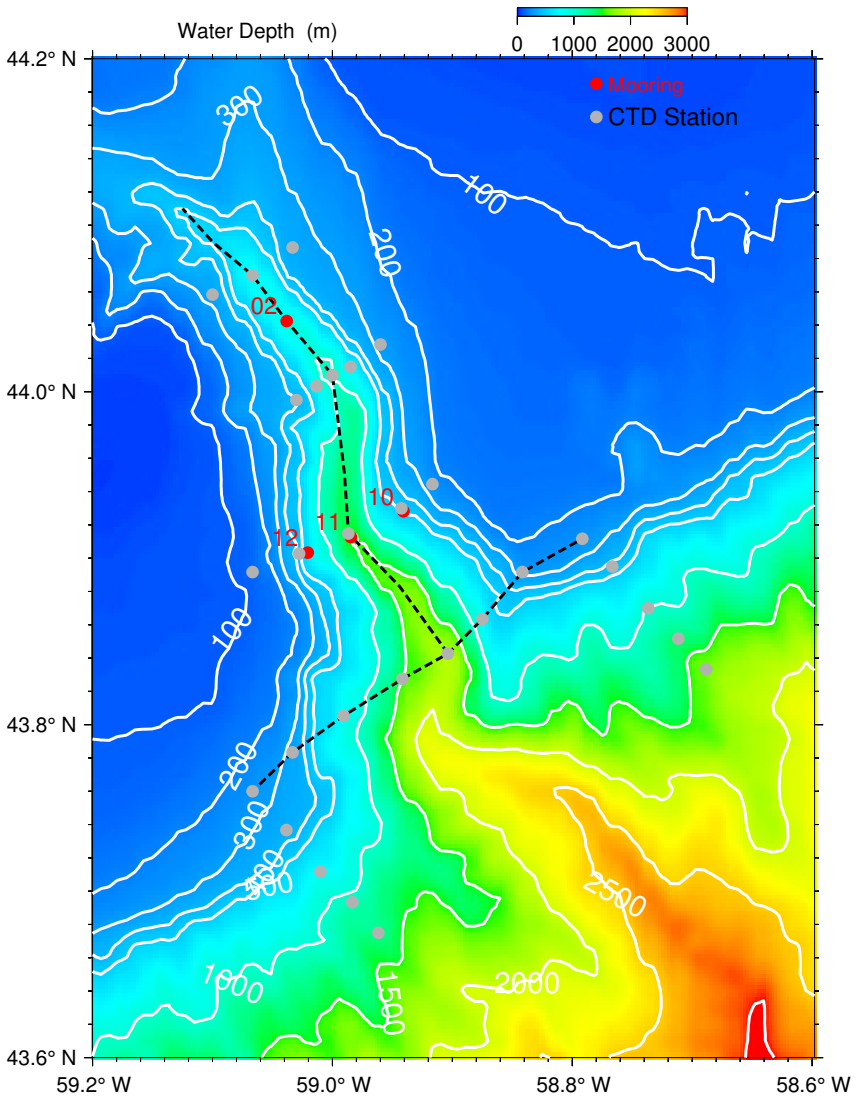


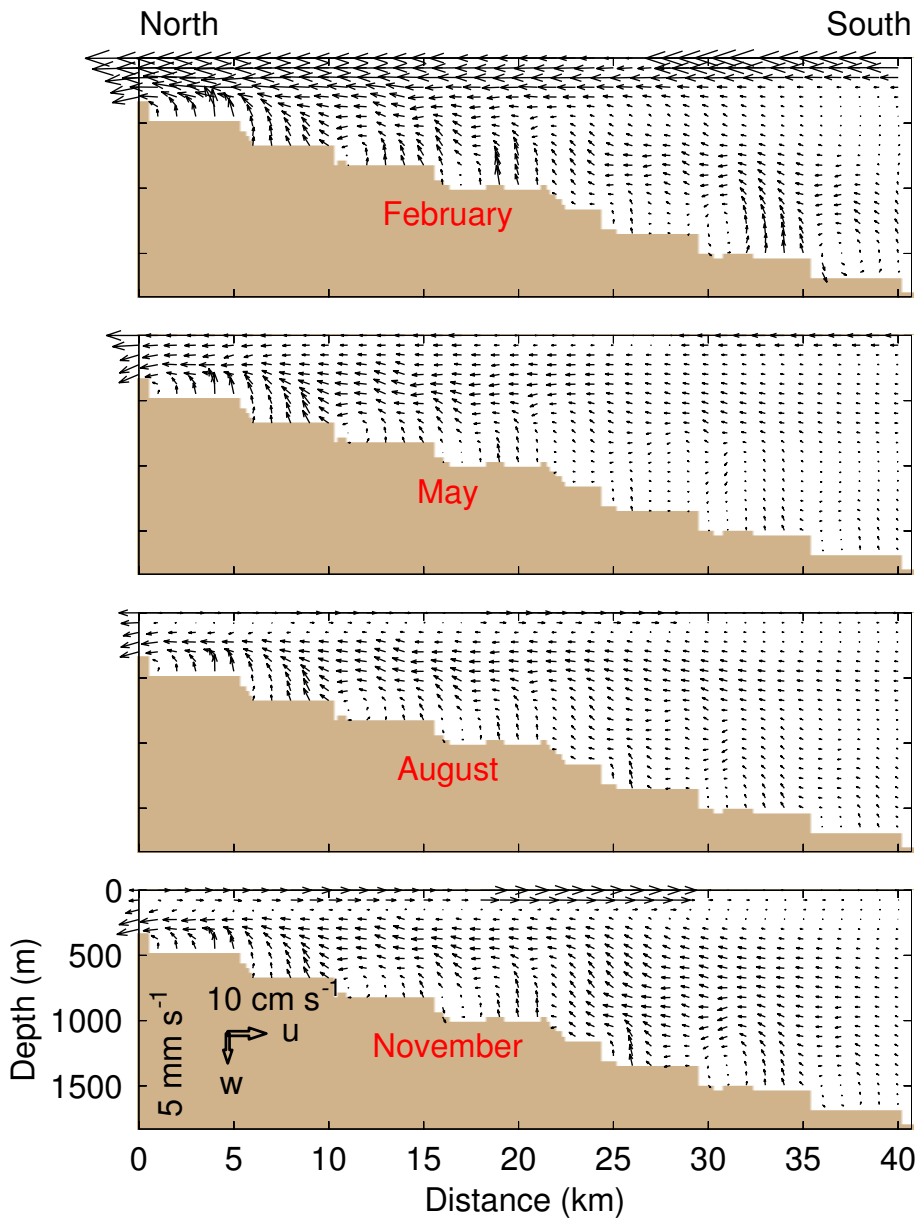
Monthly Mean, Vertical Section: Cross The Gully





Monthly Mean, Vertical Section: Along The Gully





Conclusions and Future Work

1) A multi-nested, 3D, baroclinic ocean circulation model for the Sable Gully was developed. The model is driven by tide, wind and surface heat fluxes.
2) The simulated tidal currents were compared with observations from four moorings deployed in the Gully.
3) The circulation in the Gully has a complex vertical structure and varies from season to season.
    - The model results show a shelfbreak jet flows from northeast to southwest throughout the year.
    - A persistent northward flow occurs in the deep layer of the Gully, indicating the cross shelf transport of deep ocean water onto the shelf.

Using the simulated flow field to conduct particle tracking experiments and examine the retention and connectivity in the Gully and Scotian Shelf.

Acknowledgements

Ocean Modelling Group at Dalhousie University

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