



# MEOPAR

MARINE ENVIRONMENTAL OBSERVATION  
PREDICTION & RESPONSE NETWORK

## PREDICTION CORE

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MEETING THE CHALLENGES OF OUR CHANGING OCEAN



## Research Project & Personnel (*Research Plan* January 2013)

Researchers	Multi-Sector	Multi-Discipline
<b>Rene Laprise</b>	UQAM	Downscaling from large to small spatial scales
<b>Jinyu Sheng</b>	Dalhousie	Coastal observing, Prediction
<b>Youyu Lu</b>	DFO, Dalhousie	Support for the NEMO model
<b>Ron Pelot</b>	Dalhousie	Risk assessment, Visualization models
<b>Jim Christian</b>	UVic	Global biogeochemical modelling
<b>Stephanie Chang</b>	UBC	Socioeconomic indicators

### Issues:

- Respond to needs of multiple projects including provisions of services related to coupled & ocean modelling, downscaling, biogeochemical modelling & assimilation, assessing & visualizing risk, definition of socioeconomic indicators, and transfer of model technologies to operations
- Core's activities will lead to efficient use of resources, and transfer of knowledge among Network Investigators & HQP
- Will interact strongly with Theme 1 & 2 projects, Observation Core
- Will be expanded to provide services to Open Calls as common needs become clearly defined



## Milestones/deliverables (first 3 years, Lu ,Laprise, Christian)

- **Year 1:**
  - Create a regional ocean and sea-ice model that can be used as a reference for NEMO model users in various themes of MEOPAR (Lu)
- **Year 2:**
  - Develop a basin-scale NEMO for coupled regional climate downscaling (Lu)
  - Porting of the GEM/NEMO code from EC computer in Dorval to CLUMEQ-II computer used by ESCER/UQAM (Laprise)
  - Develop global NEMO-based biogeochemical models (Christian)
- **Year 3:**
  - Assess the performance of basin-scale NEMO model in hindcasting of ocean & sea-ice variability, both in stand-alone & in coupled CRCM modes at various scales (Lu)
  - Regional climate simulation of CRCM5 coupled with NEMO, driven by atm. reanalyses and prescribed ocean transports over a coastal regional of Canada completed (Laprise)
  - Global biogeochemical simulations for downscaling; high-resolution Arctic regional simulations (Christian)



# Downscaling from large to small spatial scales

R Laprise, P Lucas-Picher, UQAM

## Activities:

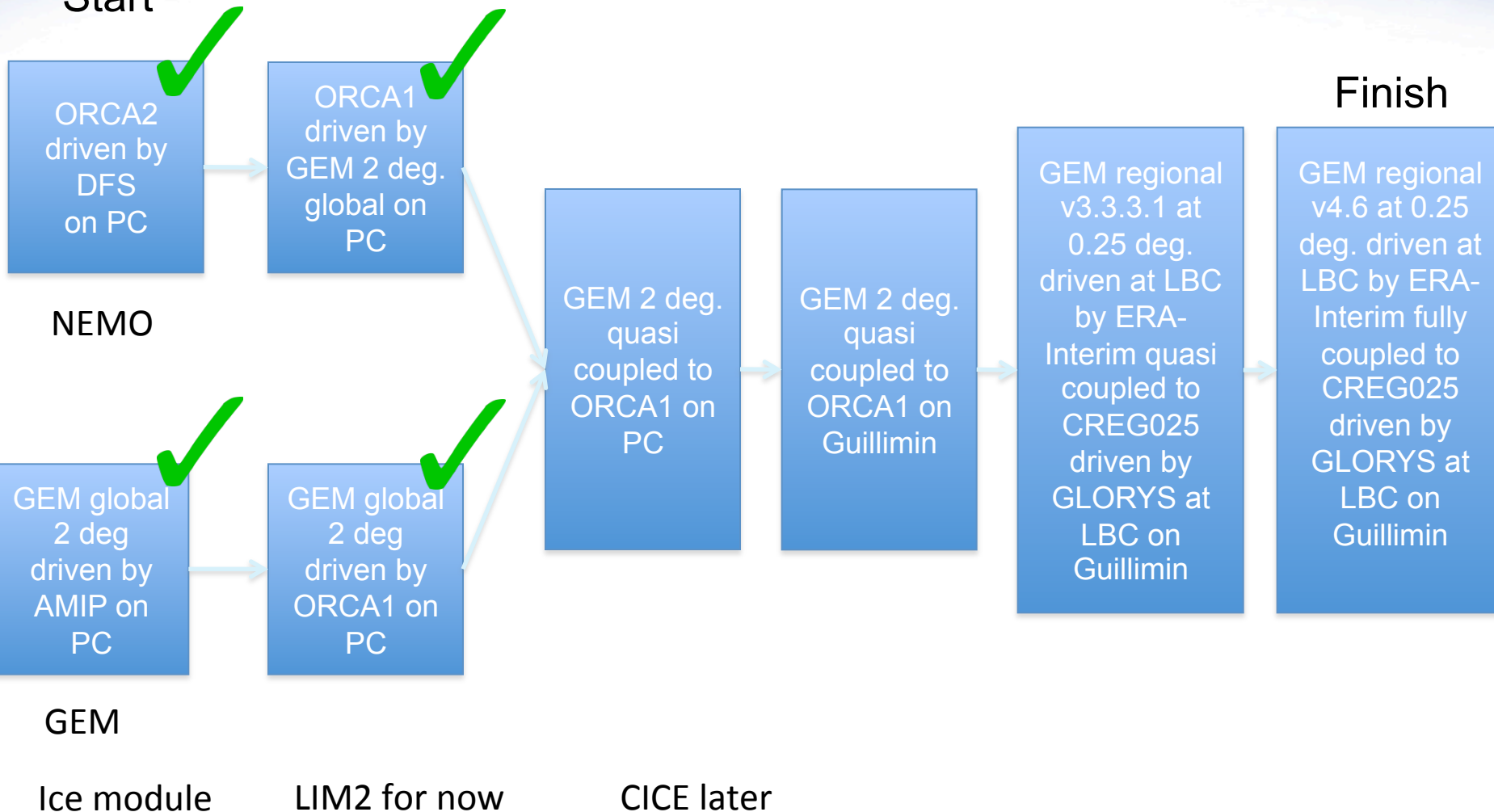
- **Late 2013:**
  - Running GEM global 2 deg. with observed SST (AMIP) on PC
  - Running NEMO ORCA2 with DFS4.3 on PC
- **Early 2014:**
  - Running NEMO ORCA1 with GEM (7 variables: TT, HU, UU, VV, FB, FI, PR) on PC
  - Running GEM global 2 deg. with NEMO ORCA1 (SST and SIF) on PC





# Plans & Progresses with NEMO & GEM

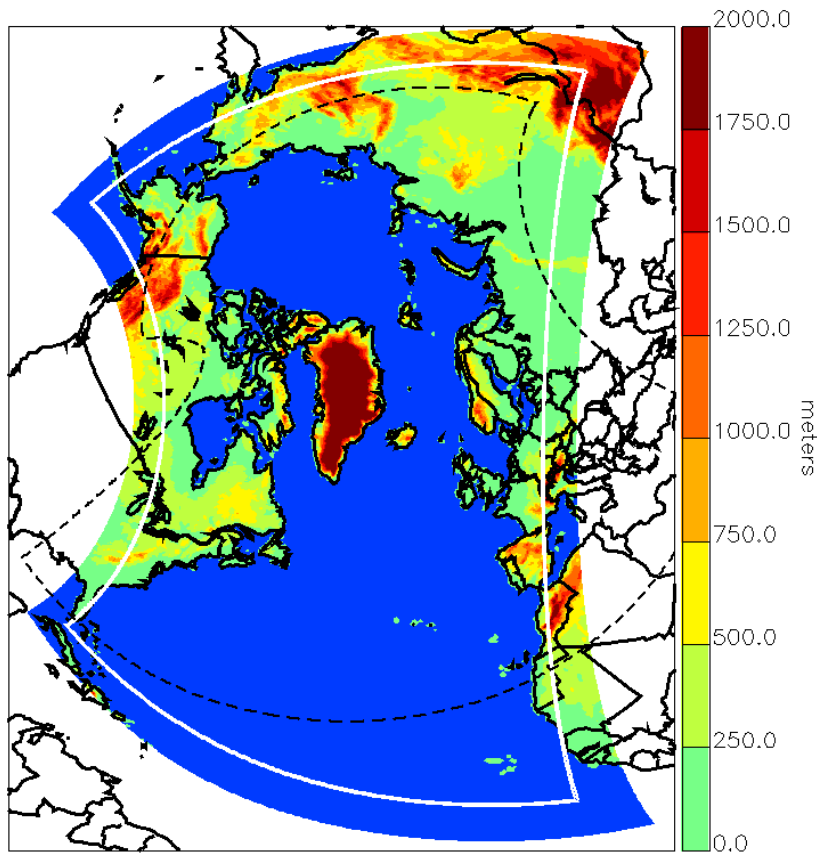
Start



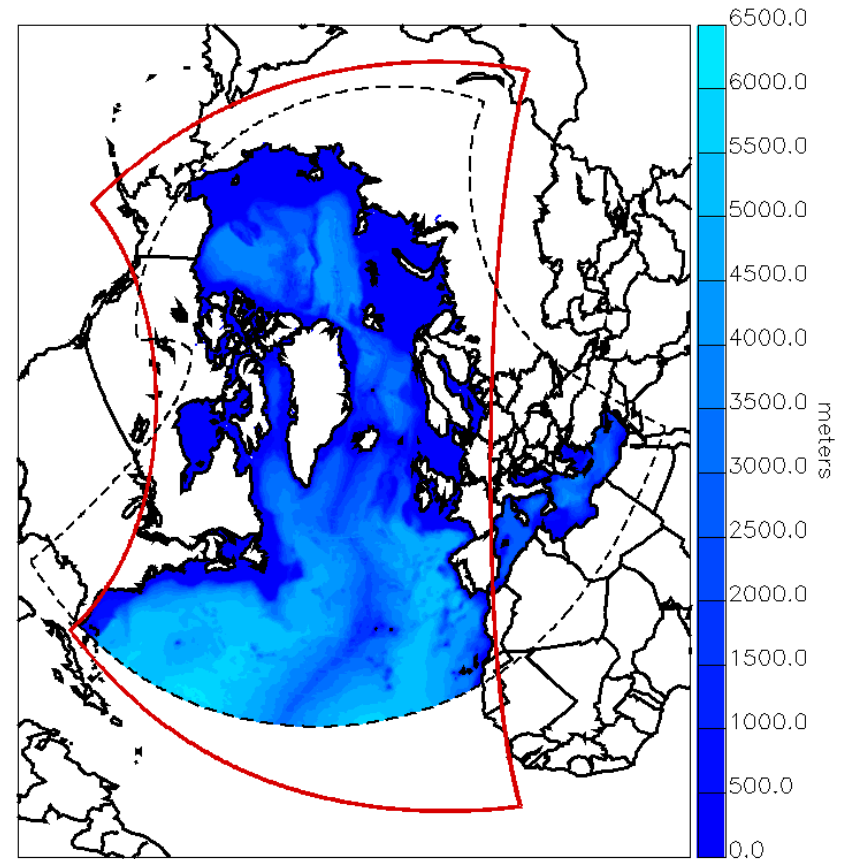


## GEM & NEMO Regional Domains

Topo & land/sea mask of CRCM (color);  
Domains of free CRCM (white line) &  
CREG025 (black dashed line)



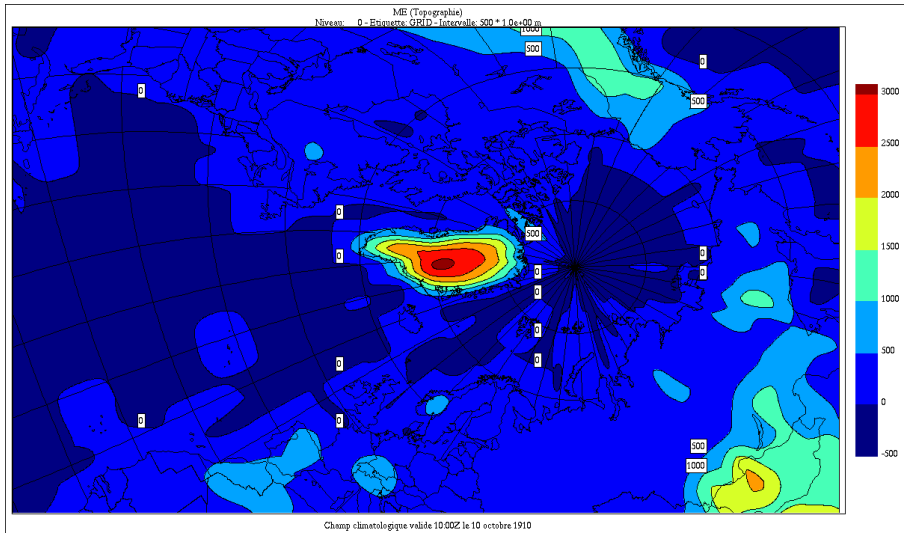
Bathymetry of CREG025 (blue scale);  
Domains of free CRCM (red line) & CREG025  
(black dashed line)



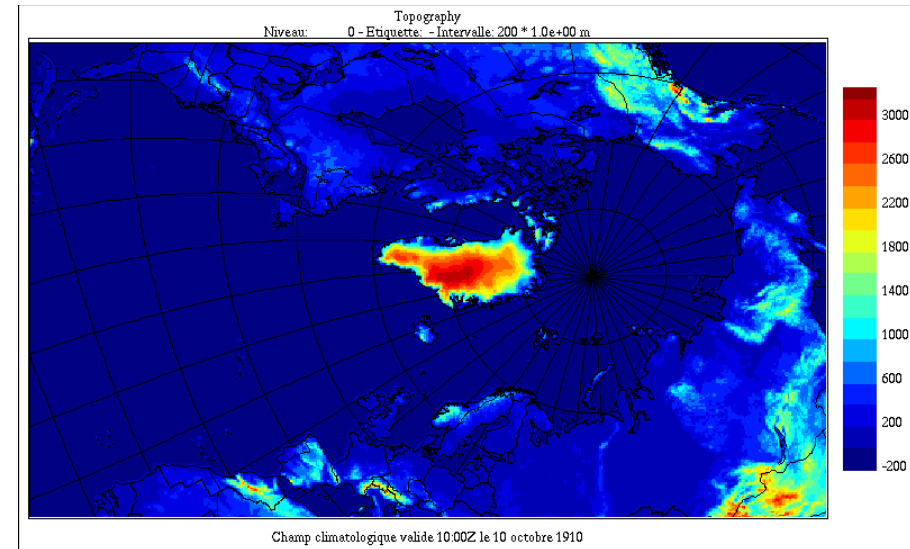


# GEM Regional Domains

**Research RPN LAM GEM domain  
(1382x812 @ 0.09 deg.)**



**UQAM CRCM domain  
(470x280 @ 0.25 deg.)**



Simulation of 1979-2012 is carried out with UQAM GEM with lateral boundary condition from ERA-Interim.

Using 16x10=160 cpus, we achieved 2 model years per computational day (34 years in 21 days)



# Support for the NEMO model

Y Lu, J-P Paquin, M. Casey, Dal (with DFO-EC CONCEPTS team)

## Activities:

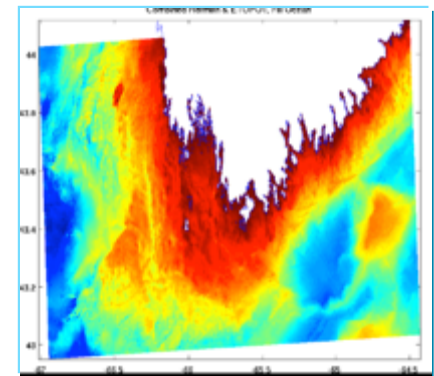
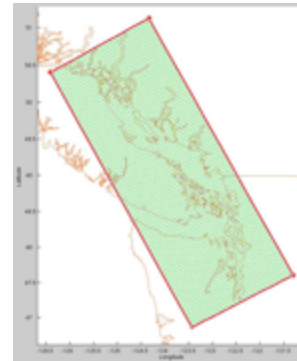
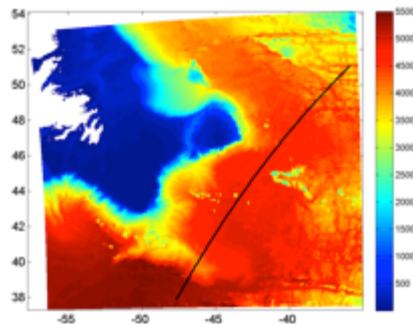
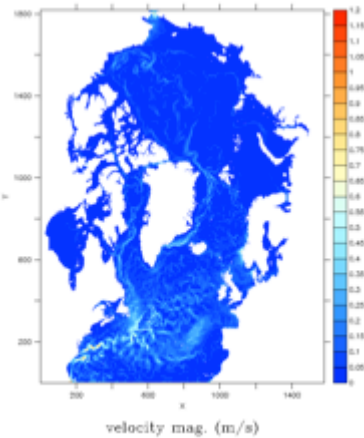
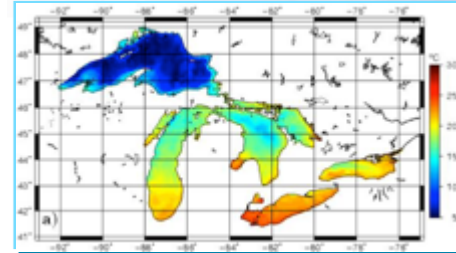
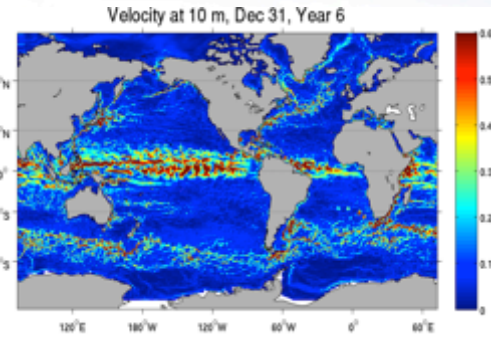
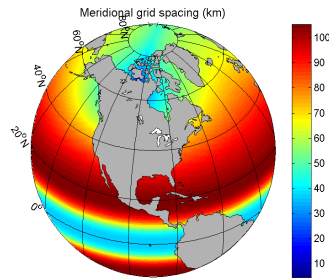
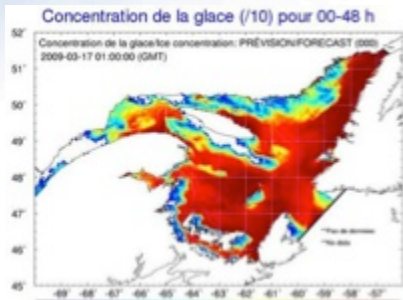
- Provided reference NEMO (CREGo25), NEMO codes from CONCEPTS, software tools (for generating model grids, initial and boundary conditions) to other MEOPAR groups
- Contributed to development of high-resolution coastal models for Strait of Georgia (UBC) & southwest Nova Scotia (Dal), and Scotian Shelf model (Dal)
- Interaction with UQAM group on support of basin-scale NEMO for coupled climate downscaling
- Prepared long simulation with CREGo25
- Evaluation of basin-scale NEMO; study on relations between Greenland Tip Jet & watermass formation in Irminger Sea
- Trajectory modelling with the Ariane software
- Active interaction/collaboration with CONCEPTS

## Outcome:

- Reference and new configurations of NEMO models
- Software for model configuration & analysis
- Validation package including trajectory modelling
- Initial results on variation of watermass formation in Irminger Sea
- HPQ training



# Ocean-Ice Models based on NEMO (CONCEPTS + MEOPAR)



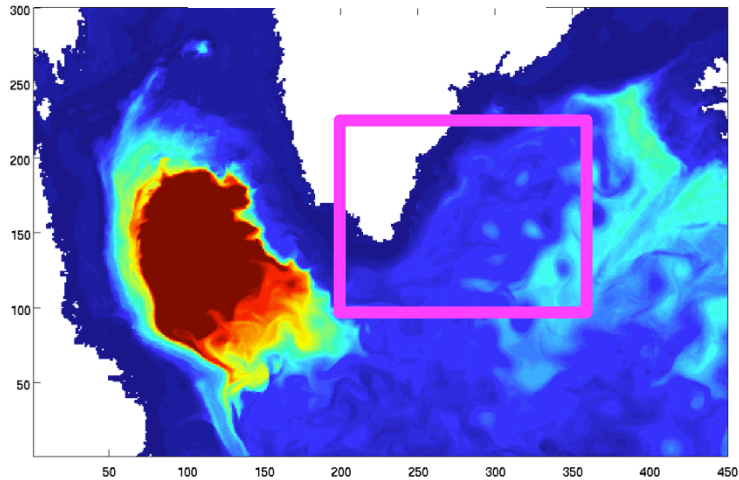
- Gulf of St. Lawrence, 5 km => 1 km
  - Global at  $1^\circ$ ,  $1/4^\circ$
  - Great Lakes at 2 km
  - N Atlantic/Arctic  $1/12^\circ$ ,  $1/4^\circ$
- => to add N Pacific

- Newfoundland Shelf at  $1/36^\circ$
- Scotian Shelf/Gulf of Maine at  $1/36^\circ$
- NW Pacific at  $1/36^\circ$  (planned)
- Strait of Georgia 0.5 km
- SE Scotian Shelf 0.5 km

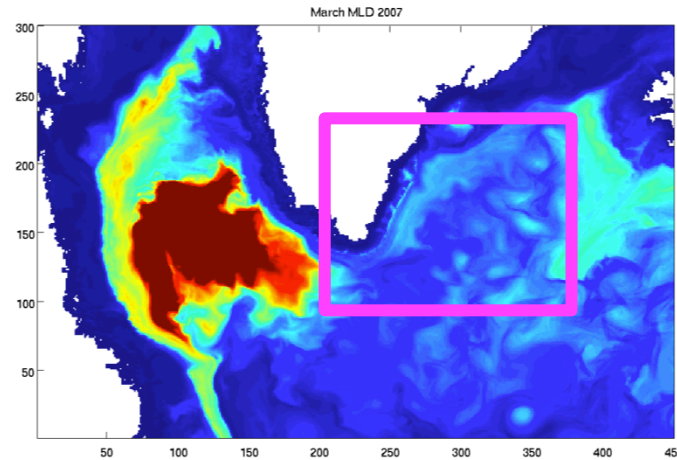


# Mixed Layer Depth (March), Focus on Irminger Sea

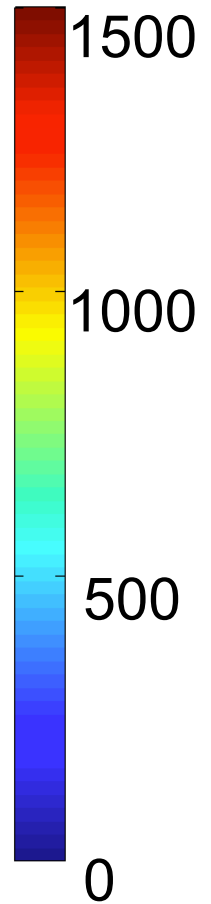
2004



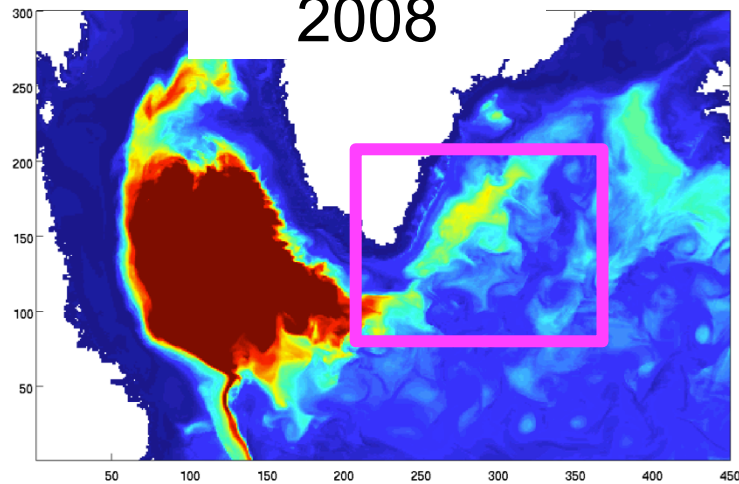
2007



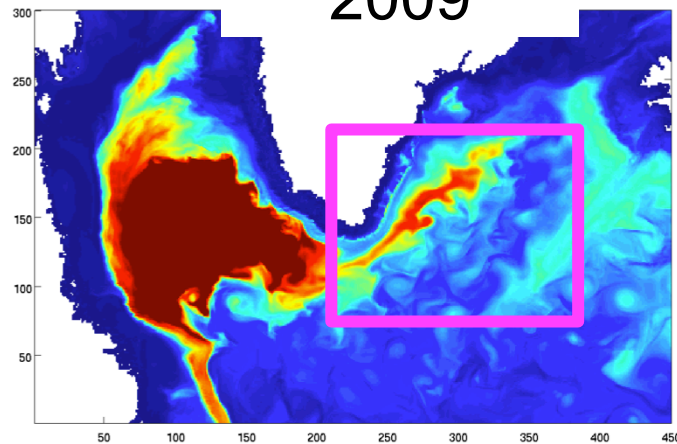
(m)



2008



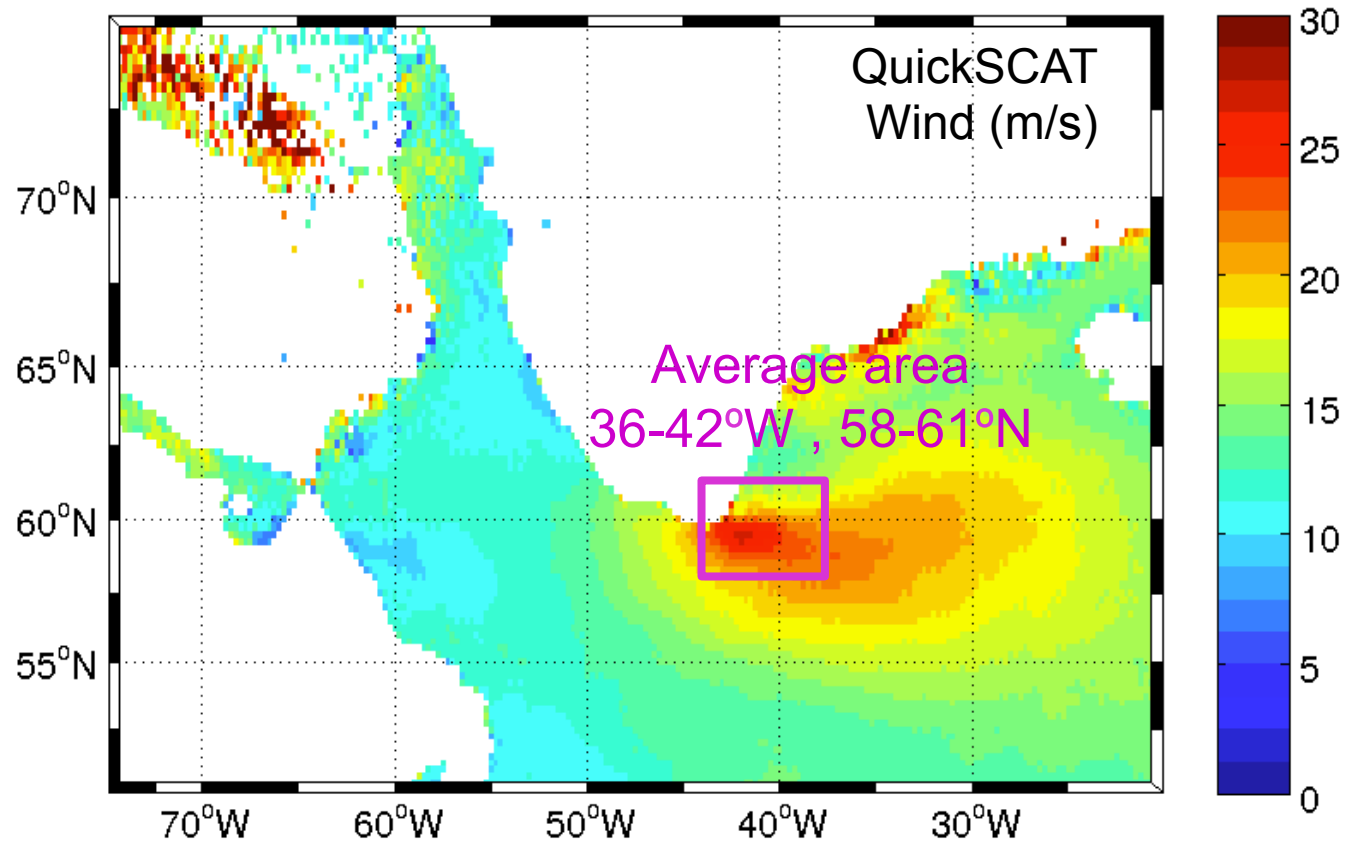
2009





# Explore Link between MLD & Greenland Tip Jets

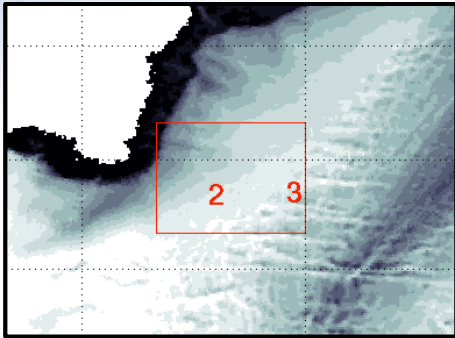
## Composite of West Tip Jets (2002-2009)





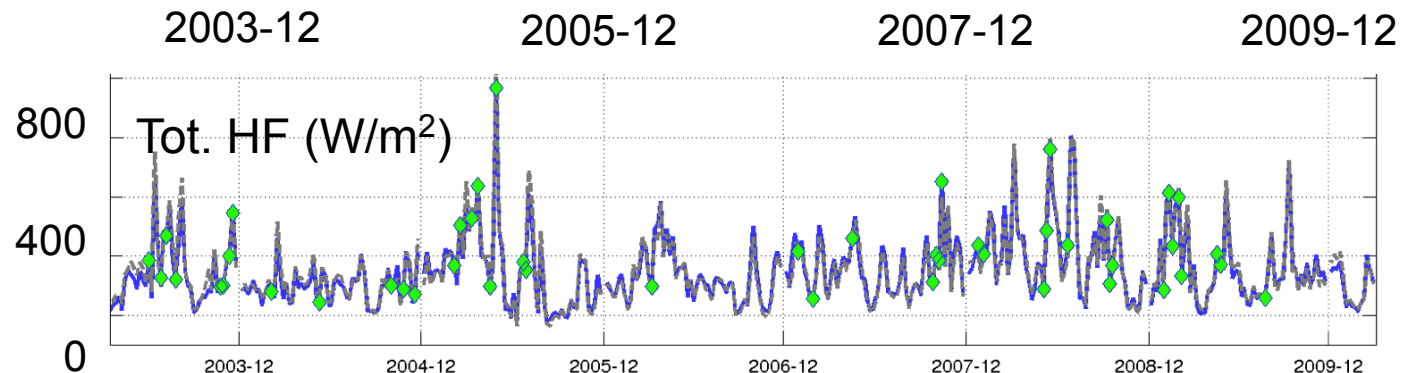
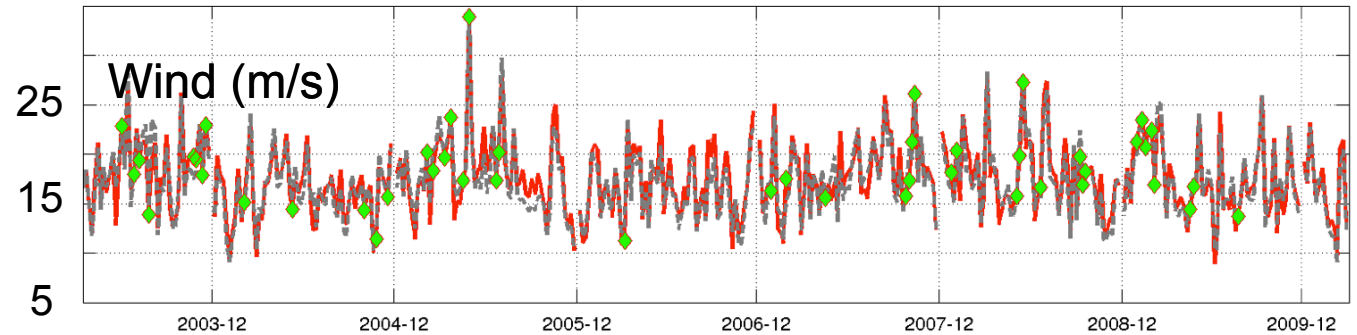
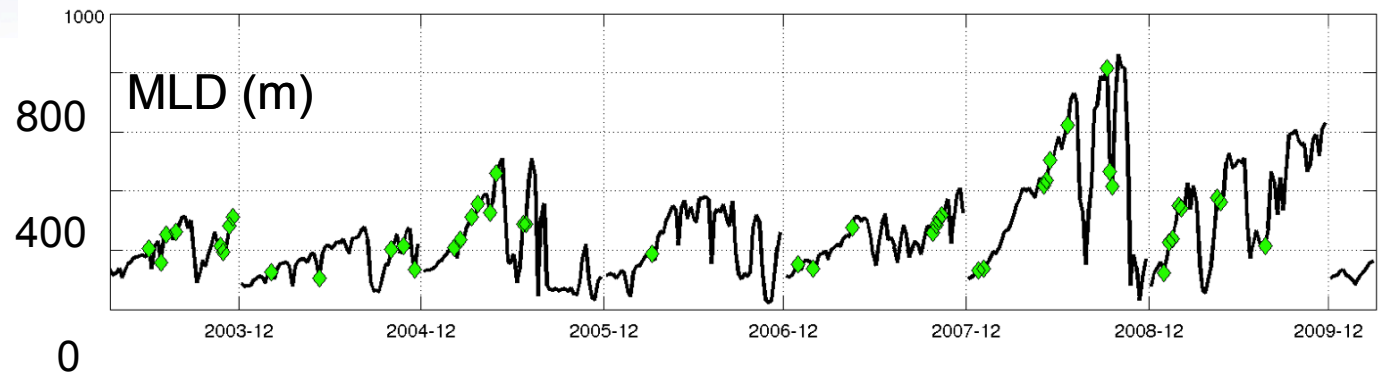


# Explore Link among MLD, Wind & Surface Heat Flux



CREG12  
2-day avg

— — — OA flux



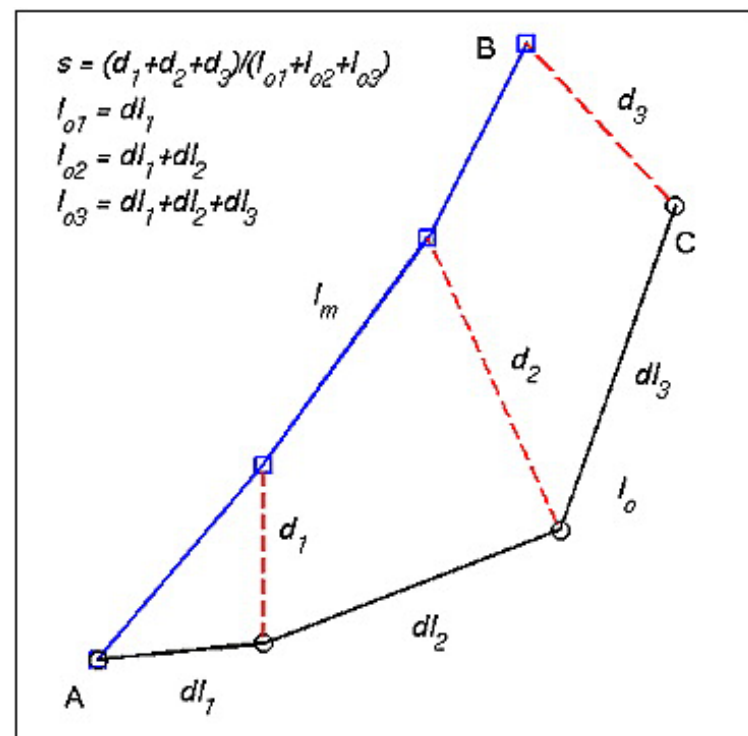




# Application of Ariane Particle-Tracking Program

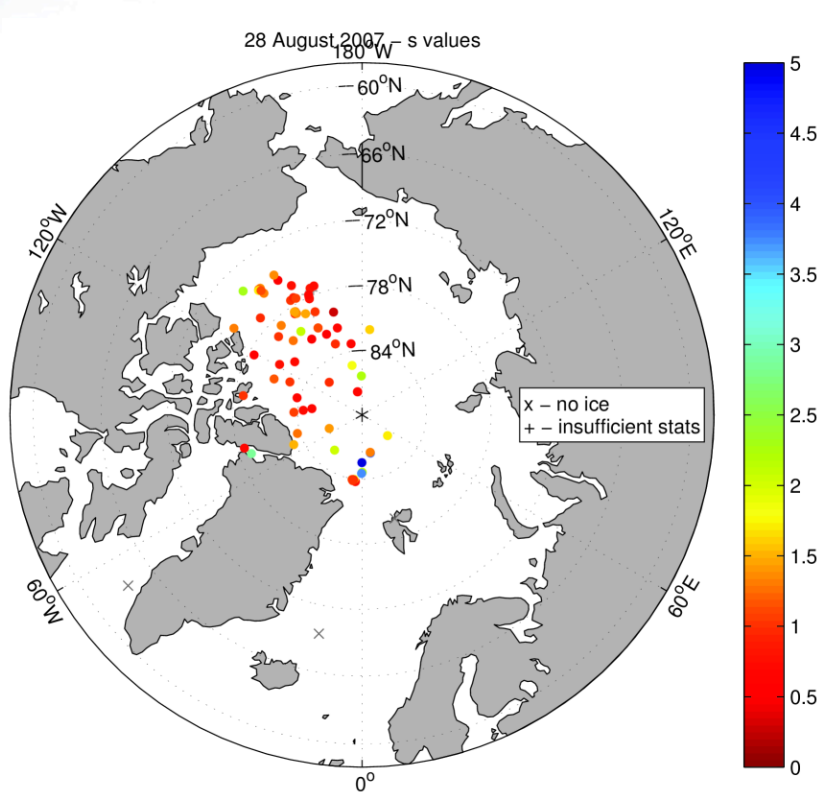
A statistical measure:

- based on Liu & Weisberg (2011)
- calculate  $s$  statistic for each drifter
- $d_i$  = distance between observed ( $l_o$ ) & modelled ( $l_m$ ) positions after a set period of time
- 2-day segments
- $s > 5$  in movie set to 5
- $s=0$  is "perfect"; lower is better

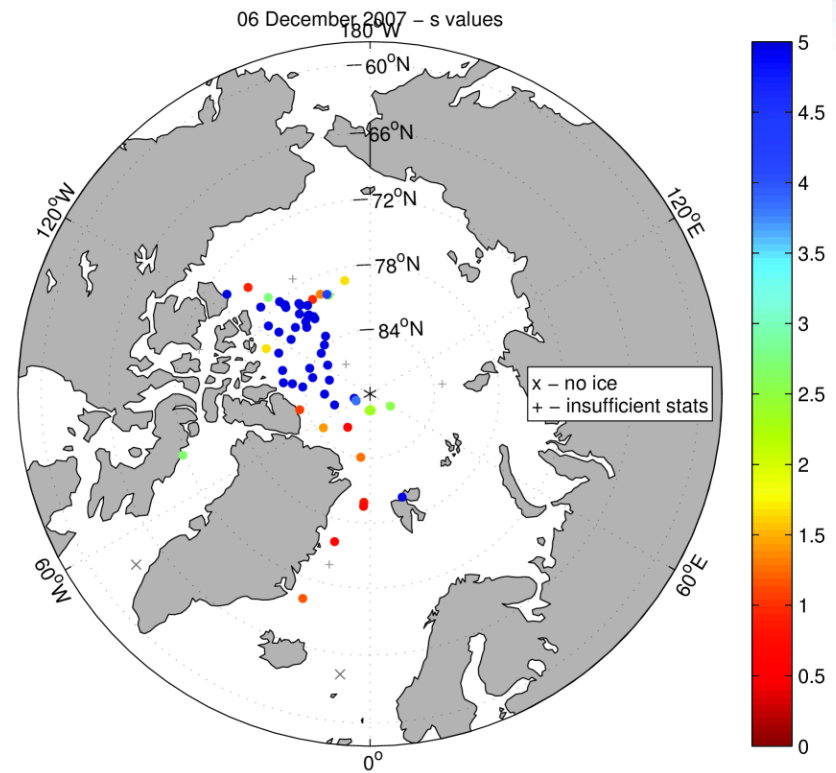




# Comparison of Sea-Ice Drift: CREG12 vs obs from International Arctic Buoy Program (IABP)



Not bad



Not as good

NB: "Snapshot" in time; each dot is based on 10 days of statistics for one drifter.



Questions?



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