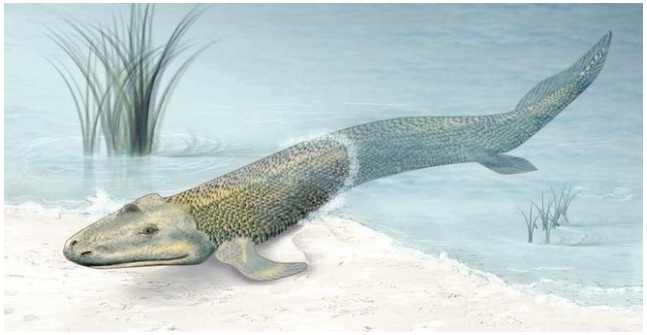
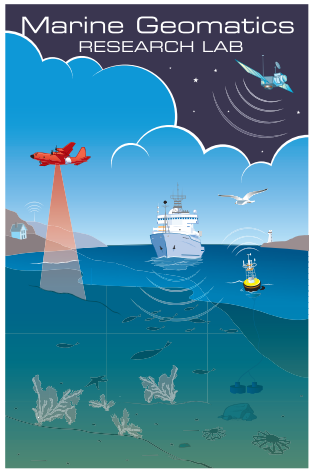
De la cartographie de notre planète bleue à l'aide de cartes papier numériques…



…à une meilleure connaissance des milieux marins à l'aide d'approches géographiques

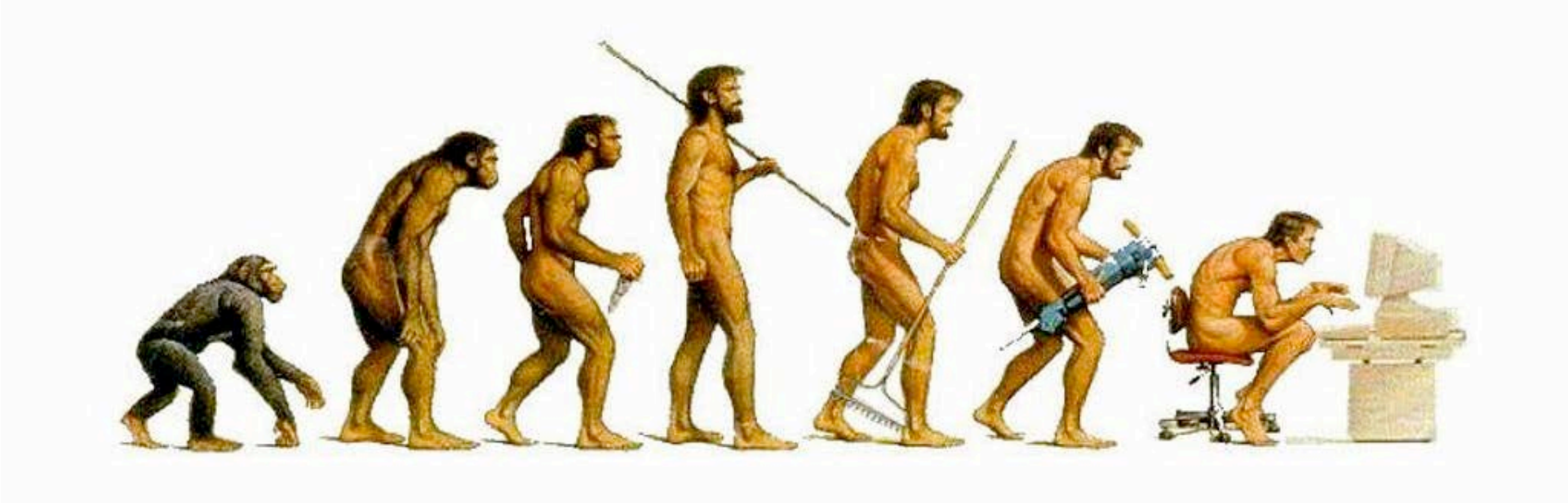


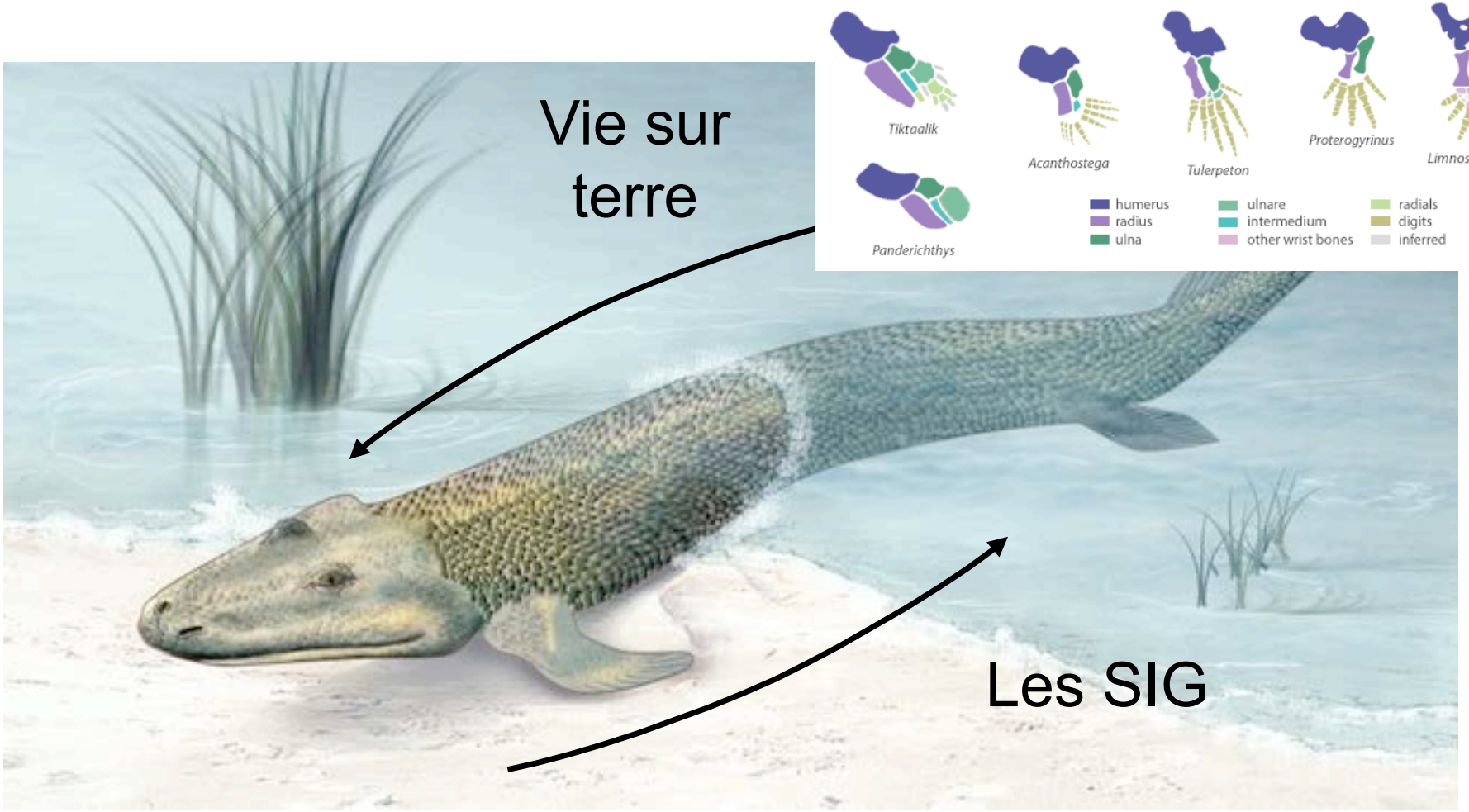
Rodolphe Devillers

Département of géographie
Université Memorial de Terre-Neuve, Canada

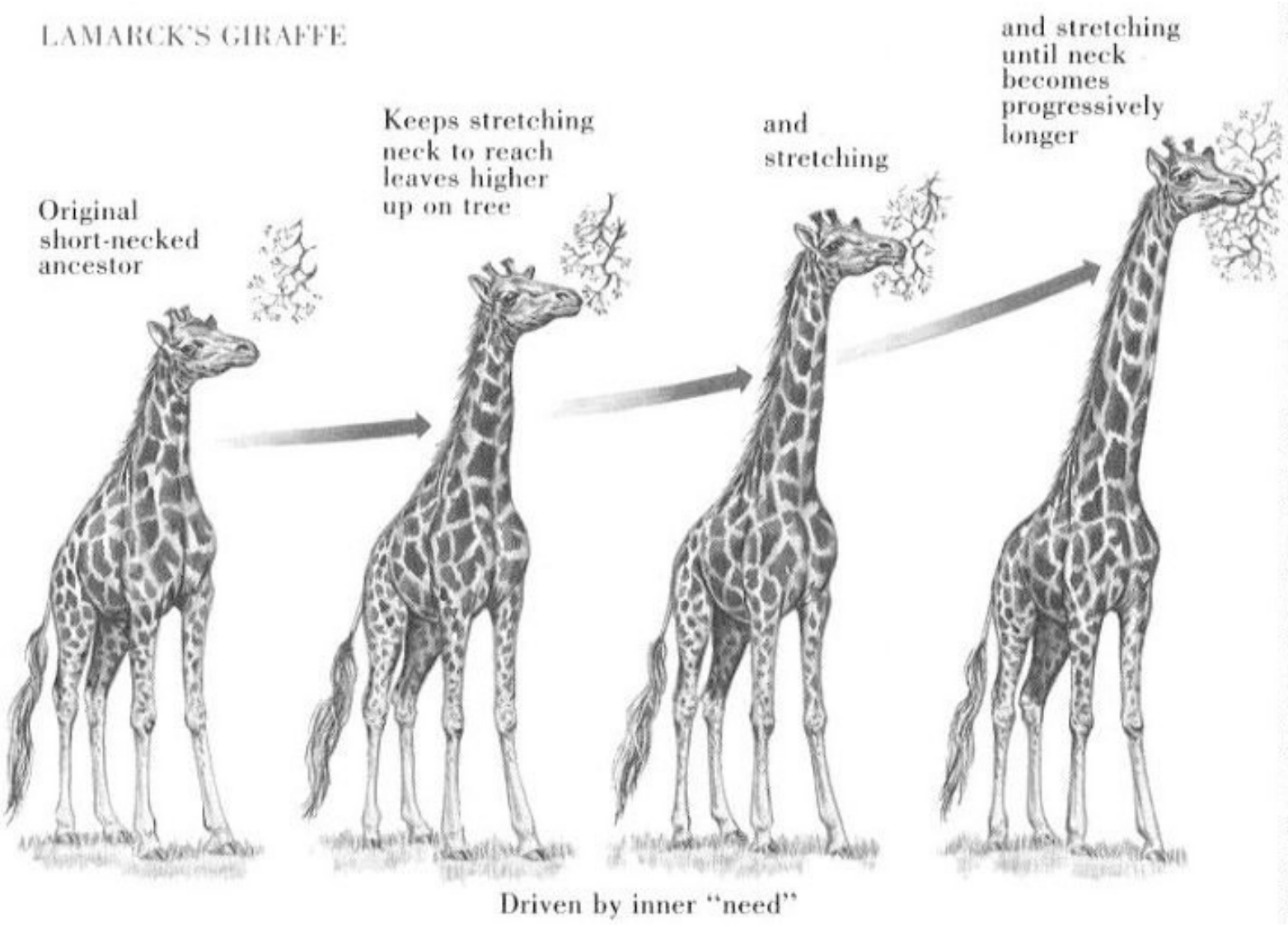
SAGEO 2013
Brest, France - 24 septembre 2013

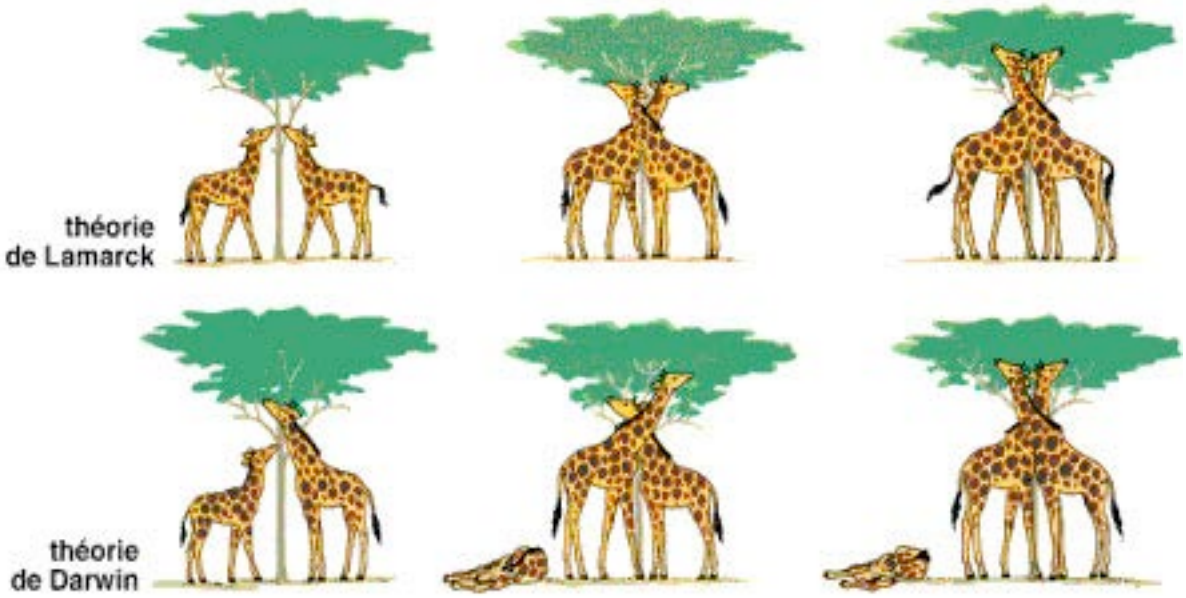
MEMORIAL UNIVERSITY

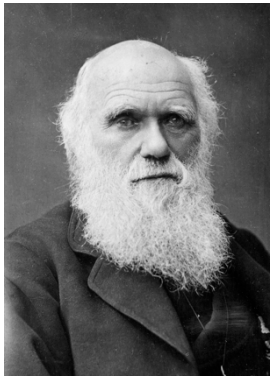




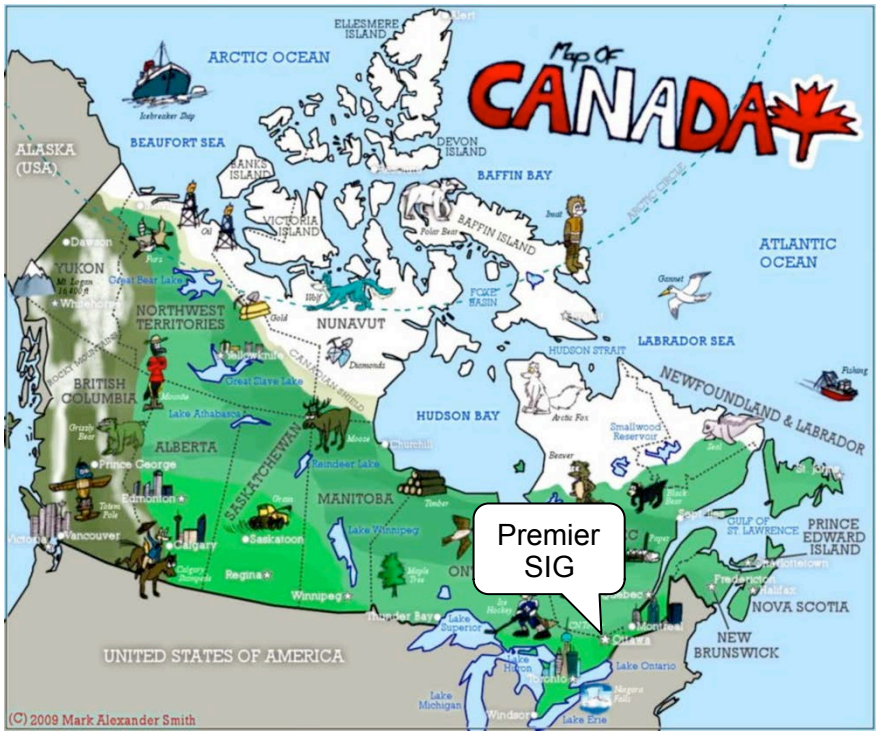
Tiktaalik roseae

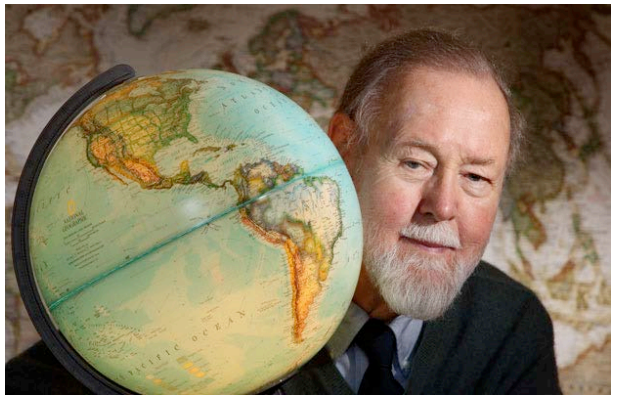

LAMARCK'S GIRAFFE
Original short-necked ancestor
Keeps stretching neck to reach leaves higher up on tree
and stretching
and stretching until neck becomes progressively longer
Driven by inner "need"

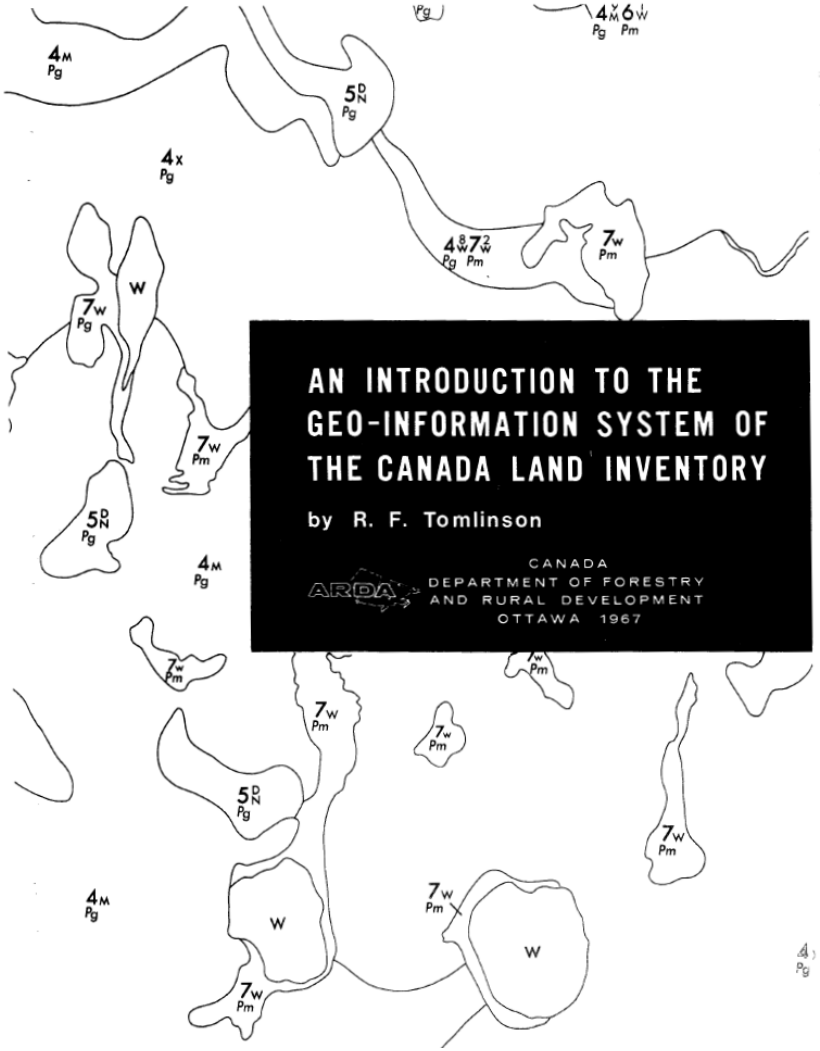




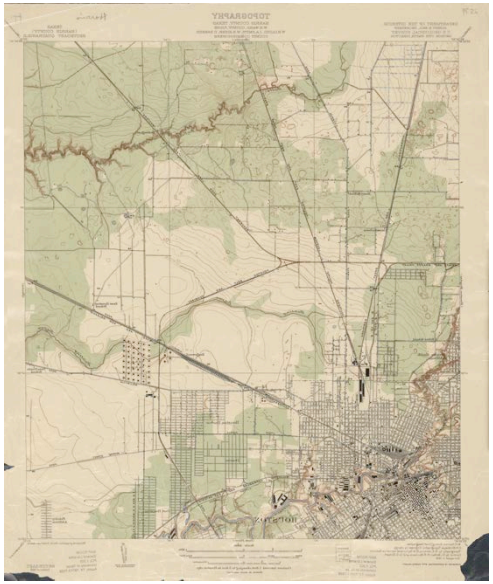
Question: Est-ce que les SIG vont s'adapter au milieu marin suivant la théorie de Lamarck ou de Darwin? (ou une autre?)


Map of CANADA
ARCTIC OCEAN
ELLESMERE ISLAND
BEAUFORT SEA
DEVON ISLAND
BANKS ISLAND
BAFFIN BAY
ALASKA (USA)
VICTORIA ISLAND
BAFFIN ISLAND
ATLANTIC OCEAN
YUKON
NORTHWEST TERRITORIES
NUNAVUT
LABRADOR SEA
HUDSON STRAIT
BRITISH COLUMBIA
NEWFOUNDLAND & LABRADOR
HUDSON BAY
ALBERTA
SASKATCHEWAN
MANITOBA
PRINCE EDWARD ISLAND
NOVA SCOTIA
NEW BRUNSWICK
UNITED STATES OF AMERICA
Premier SIG
(C) 2009 Mark Alexander Smith

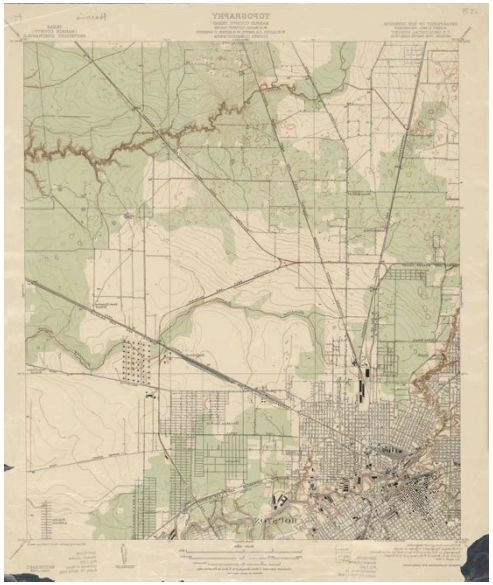



AN INTRODUCTION TO THE GEO-INFORMATION SYSTEM OF THE CANADA LAND INVENTORY
by R. F. Tomlinson
CANADA
DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT
OTTAWA 1967
ARDA

De la carte papier…



…à une copie numérique




Vallée
de
Sainte-Anne
Kerlinou
Le Nevent
Keropars
Route de Sainte-Anne
Le Rest
Sentier de Sainte-Anne à Saint-Renan
Sainte-Anne-du-Porzic
Coat Salou
Moulin du Nevent
Route de Sainte-Anne
Route de Sainte-Anne
Route de Sainte-Anne
Coquiller
Rue Joseph Fourier
Rue Claude Chappe
Avenue La Pérouse
Avenue Louis Rossel
Avenue Graham Bell
ENIB
- École
Nationale
d'Ingénieurs
de Brest
Avenue du Technopole
Avenue du Technopole
Avenue du Technopole
Avenue Alexis de Rochon
Parvis Blaise Pascal
Technopôle
Pointe
du Diable
Ifremer
Rue Dumont d'Urville
IUEM
Rue René Descartes
Avenue Alexis de Rochon
Technopole Brest Iroise
Goaremm Glaz
Rue de Kerbaleac'h
Kerézoun
Route de Kerezoun
Kerbaleac'h
Route de Mescleuziou
Kernevent
Sainte-Anne-du-Portzic-Dellec
Chemin de l'Ifremer
Mescleuziou
Le Petit Dellec
Pointe du Diable
Pointe du Diable
Le Dellec
100 m

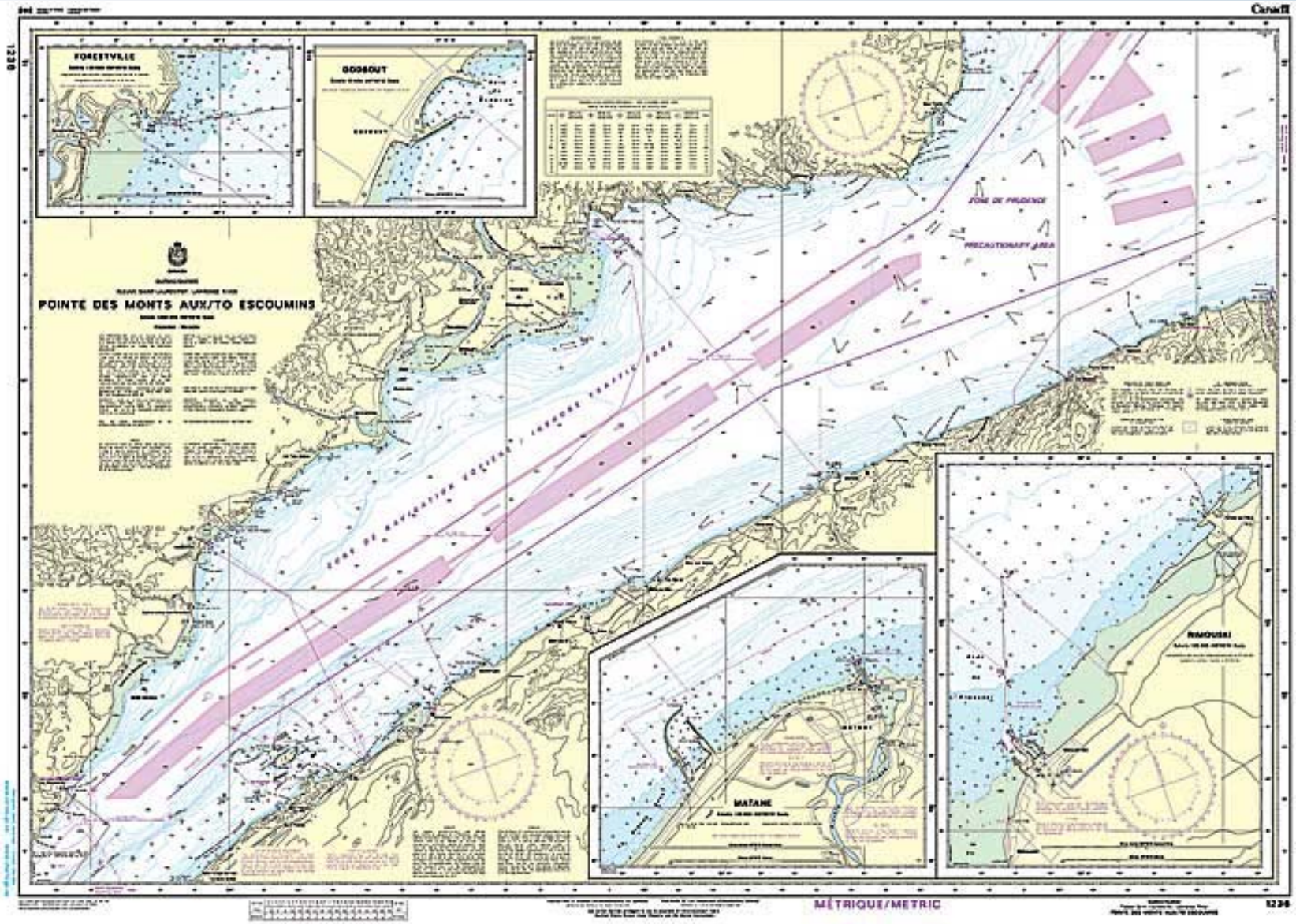
Les océans c'est:

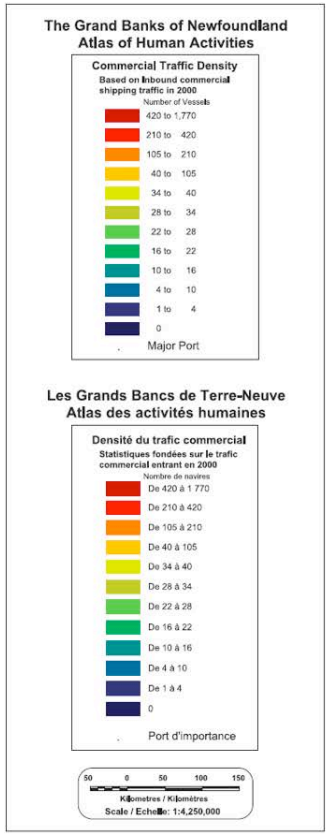
- 71% de la surface de la planète
- 97% de l'eau sur la terre
- 90% de la biomasse terrestre
- 90% des transports de marchandise

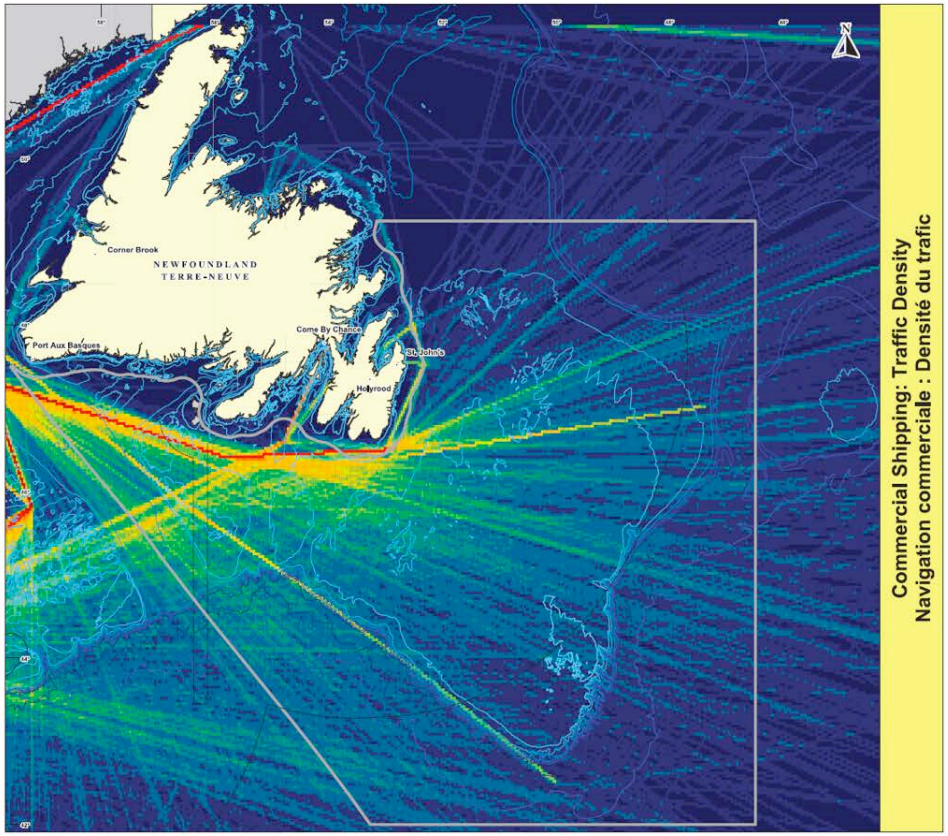
… mais 5% ou moins des chercheurs en géomatique?

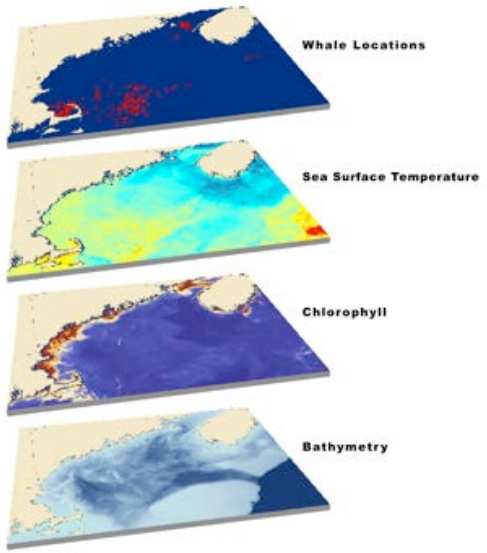

blirk.net

Vesconte Maggiolo (1541)


FORESTVILLE
GODBOUT
POINTE DES MONTS AUX/TO ESCOUMINS
ZONE DE PRUDENCE
PRECAUTIONARY AREA
MATANE
RIMOUSKI
MÉTRIQUE/METRIC


The Grand Banks of Newfoundland
Atlas of Human Activities
Commercial Traffic Density
Based on inbound commercial shipping traffic in 2000
Number of Vessels
420 to 1,770
210 to 420
105 to 210
40 to 105
34 to 40
28 to 34
22 to 28
16 to 22
10 to 16
4 to 10
1 to 4
0
Major Port
Les Grands Bancs de Terre-Neuve
Atlas des activités humaines
Densité du trafic commercial
Statistiques fondées sur le trafic commercial entrant en 2000
Nombre de navires
De 420 à 1 770
De 210 à 420
De 105 à 210
De 40 à 105
De 34 à 40
De 28 à 34
De 22 à 28
De 16 à 22
De 10 à 16
De 4 à 10
De 1 à 4
0
Port d'importance
50 0 50 100 150
Kilometres / Kilomètres
Scale / Echelle: 1:4,250,000


NEWFOUNDLAND
TERRE-NEUVE
Corner Brook
Port Aux Basques
Come By Chance
St. John's
Holyrood
Commercial Shipping: Traffic Density
Navigation commerciale : Densité du trafic


Whale Locations
Sea Surface Temperature
Chlorophyll
Bathymetry

Common Marine Data Types

Marine Points

Instantaneous Points

Feature Points
ID
X,Y
Z
Examples: marker buoy, transponder, other fixed, geography

Instant (Subtype)
ID
X,Y
Z or ΔZ
$m_1...m_2$
t
Examples: CTD, XBT, SVP casts at ΔZ, fish density, tide gauge, etc., at surface or a single Z

Location Series (Subtype)
ID
ΔX,Y
ΔZ
$m_1...m_2$
$t_1...t_2$
Examples: telemetry, bird/mammal sighting, ship mounted ADCP

Time Series Point

Time Series
ID
X,Y
Z or ΔZ
$m_1...m_2$
$t_1...t_{infinity}$
Examples: current meter, moored ADCP at ΔZ, obs. buoy, hydrophone, OBS at single Z

Survey (Subtype)
Examples: aerial coastal survey, lidar, SCUBA/free swim obs.

Sounding (Subtype)
Examples: single beam bathy

Marine Lines

Profile Line
ID
X,Y
M_1, M_2
$Z_1, Z_2...$
Examples: for abstracting data from, building profile from, measuring change along... seismic reflection, bathy profile, cross section, sed. transport line

Time Duration Line (Track)
ID
$X_1,Y_1, X_2, Y_2...$
M_1, M_2
$Z_1, Z_2...$
$m_1, m_2...$
$t_1, t_2...$
Examples: transit ship track, ROV or sub track, algal bloom trawl, ADCP tracks, ARGO drifter

Feature Line
ID
$X_1,Y_1, X_2, Y_2...$
M_1, M_2
Examples: cable, pipeline, sea wall, ocean front, EEZ or legal boundaries NOT enclosing an area

Shoreline
shoreline type, VDatum

Marine Areas

Feature Area
ID
$X_1,Y_1,X_2,Y_2...X_1,Y_1$
Z
m
Examples: Marine boundaries (e.g., sanctuary, MPA), habitats, patches, lava flows, clipping, masking

Time Duration Area
ID
$X_1,Y_1,X_2,Y_2...X_1,Y_1$
Z
m
$t_1...t_n$
Examples: No-take zones, oil spills, harmful algal bloom

Marine Rasters/Grids/Meshes

Regularly Interpolated Surfaces
row_1 $col_1...row_n$ col_n
$Z_{r,c1}...Z_{r,cn}$
multipoint
Examples: multibeam bathy, sidescan, lidar, SST, climatology, scientific mesh, "re-analyzed" products (images such as GeoTIFF, BIL, etc.)

Irregularly Interpolated Surfaces
row_1 $col_1...row_n$ col_n
$Z_{r,c1}...Z_{r,cn}$
multipoint
Examples: TINs, bathymetry, sidescan, lidar, scientific mesh for finite element model, etc.

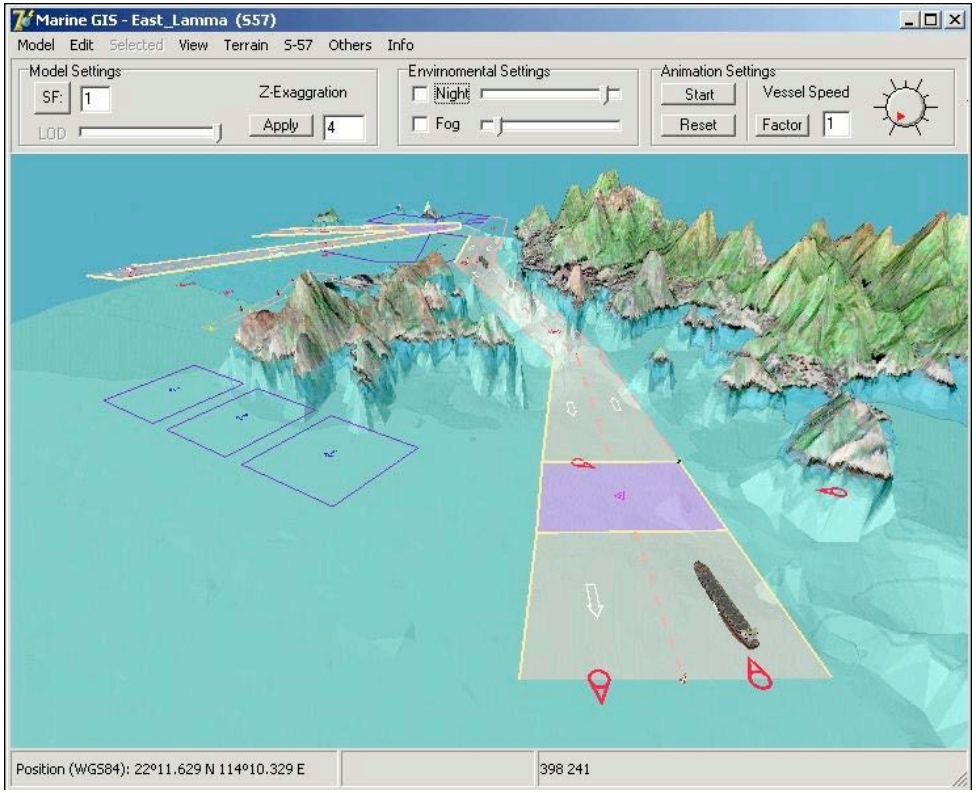
Mesh Volume
ID
X_1,Y_1,Z_1,X_2,Y_2,Z_2
$...X_1,Y_1,Z_1$
m or $m_1...m_n$
t or $t_1...t_n$
ncols,nrows,nlayers in scientific mesh, multipatch
Examples: model of plume, front, warm core, trawl abundance

Derived or Placeholder

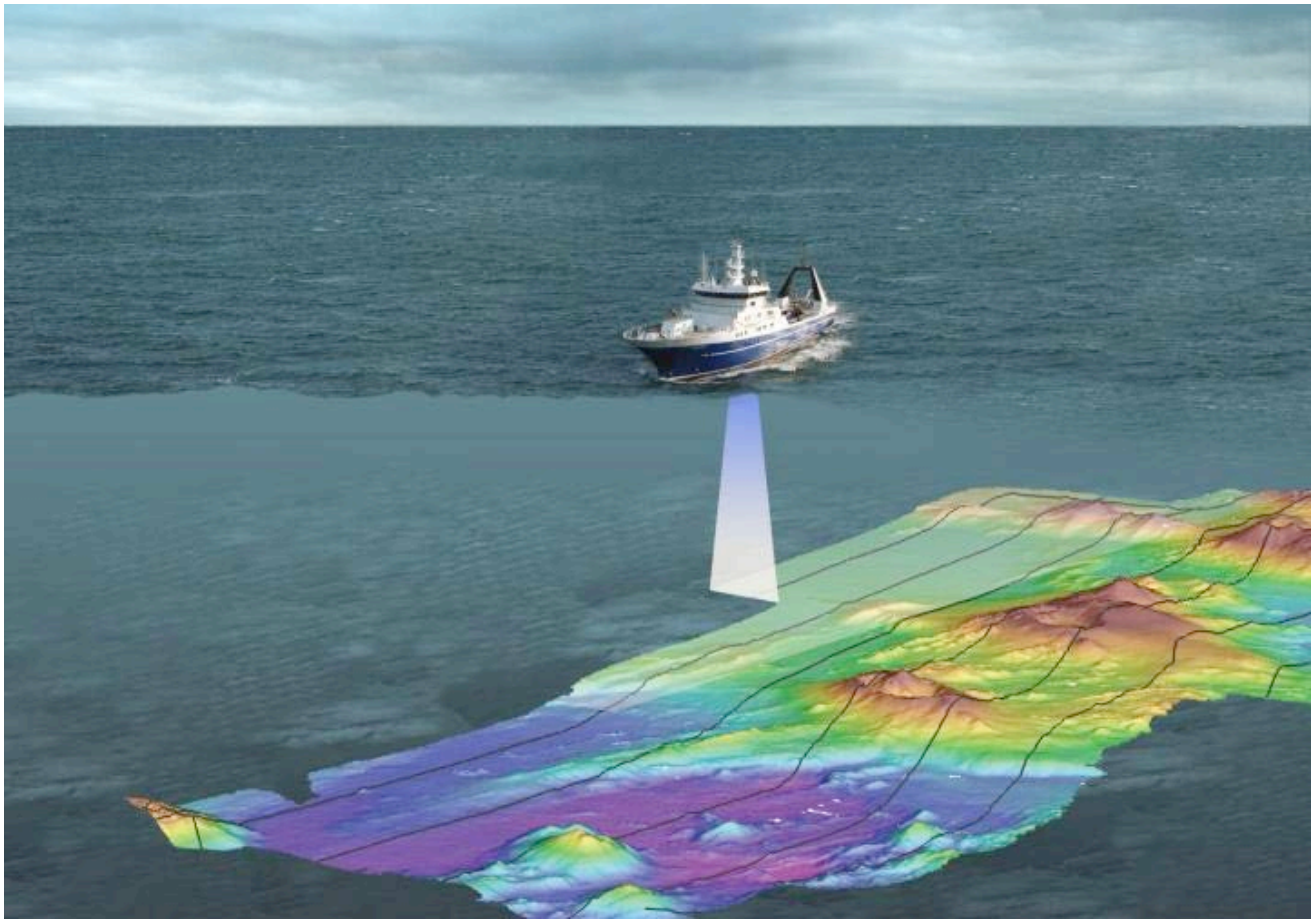
Animations, Movies, Video
X_1,Y_1,Z_1,X_2,Y_2,Z_2
$...X_1,Y_1,Z_1$
$t_1...t_n$
Examples: U/W video footage, outputs from atm. or circulation models that are animated & georegistered so other data may be overlain

ACRONYMS—definitions

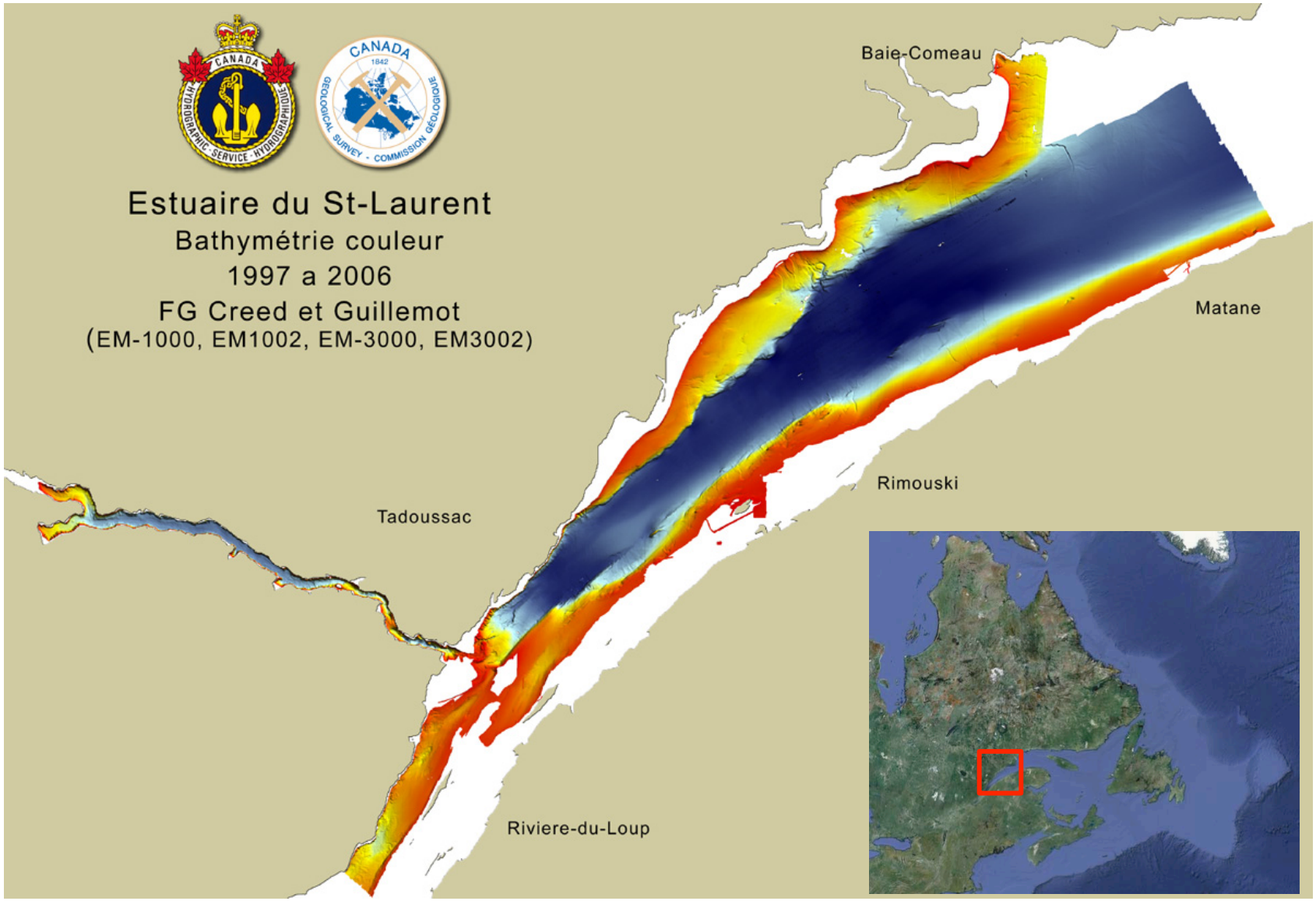
ADCP—acoustic doppler current profiler
ARGO—array for real-time geostrophic oceanography
BIL—band interleaved by line (for remotely sensed images or grids)
CTD—conductivity, temperature, depth
EEZ—exclusive economic zone
GeoTIFF—georeferenced tagged image file format
LIDAR—light detection and ranging
MPA—marine protected area
OBS—ocean bottom seismometer
ROV—remotely-operated vehicle
SCUBA—self-contained underwater breathing apparatus
SST—sea surface temperature
SVP—sound velocity profile
TIN—triangulated irregular network
U/W—underwater (also often refers to "underway")
VDatum—vertical datum
XBT—expendable bathythermograph

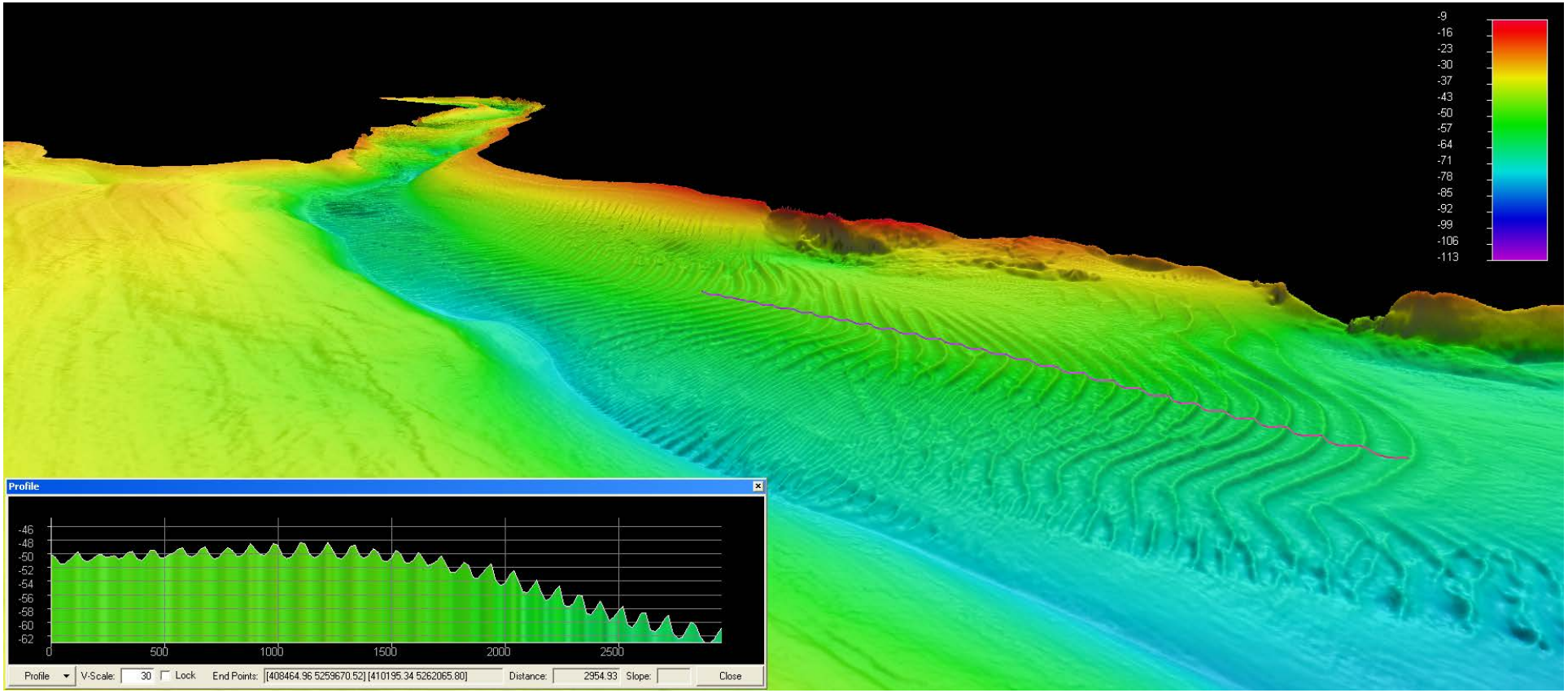


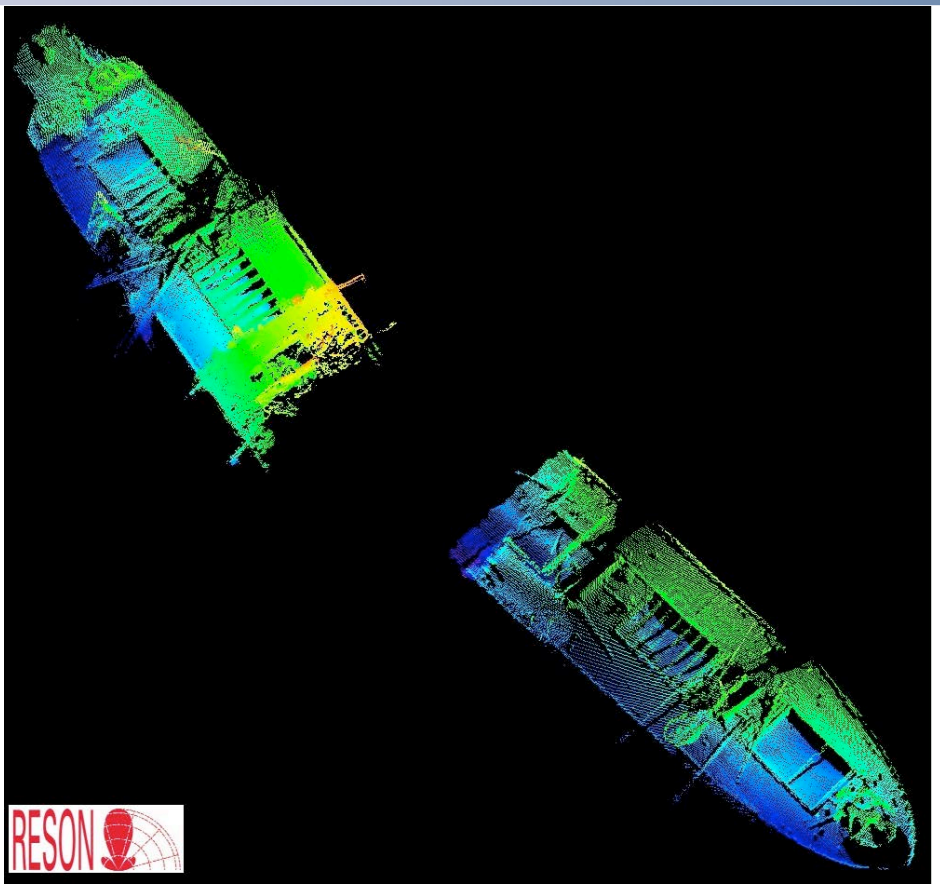

blirk.net

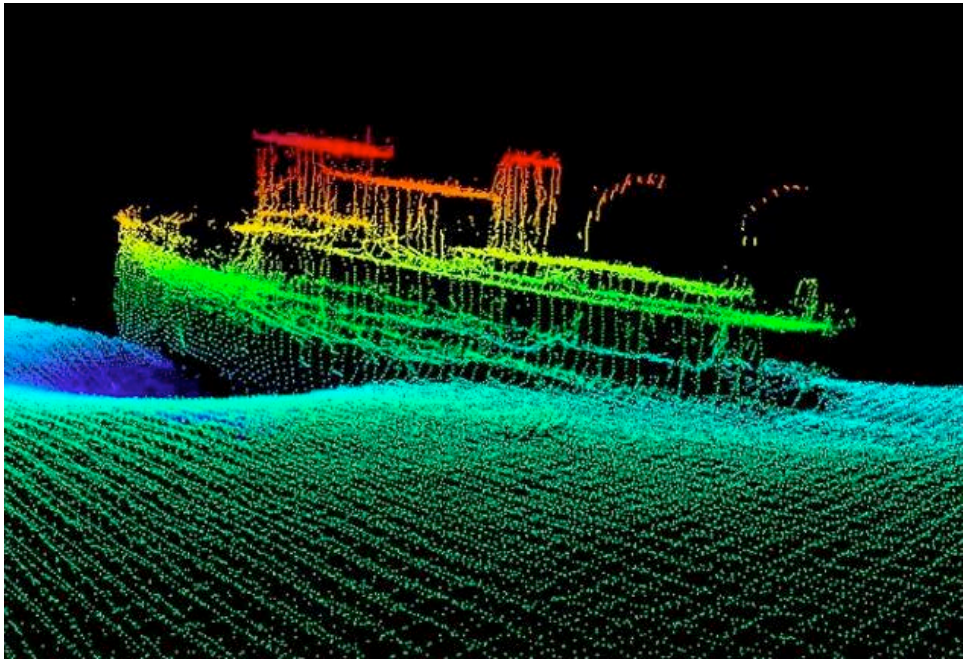


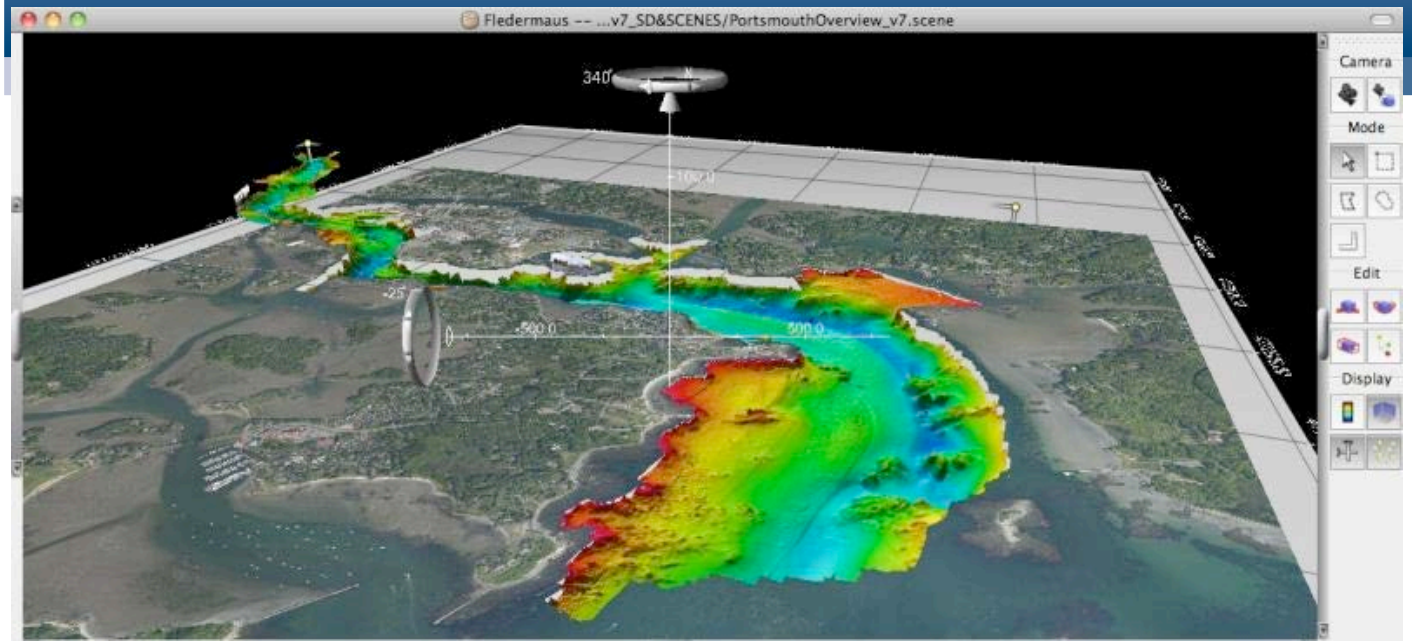

N
Québec


Estuaire du St-Laurent
Bathymétrie couleur
1997 a 2006
FG Creed et Guillemot
(EM-1000, EM1002, EM-3000, EM3002)
Baie-Comeau
Matane
Rimouski
Tadoussac
Riviere-du-Loup


-9
-16
-23
-30
-37
-43
-50
-57
-64
-71
-78
-85
-92
-99
-106
-113
Profile
-46
-48
-50
-52
-54
-56
-58
-60
-62
0
500
1000
1500
2000
2500
Profile
V-Scale:
30
Lock
End Points:
[408464.96 5259670.52] [410195.34 5262065.80]
Distance:
2954.93
Slope:
Close


RESON

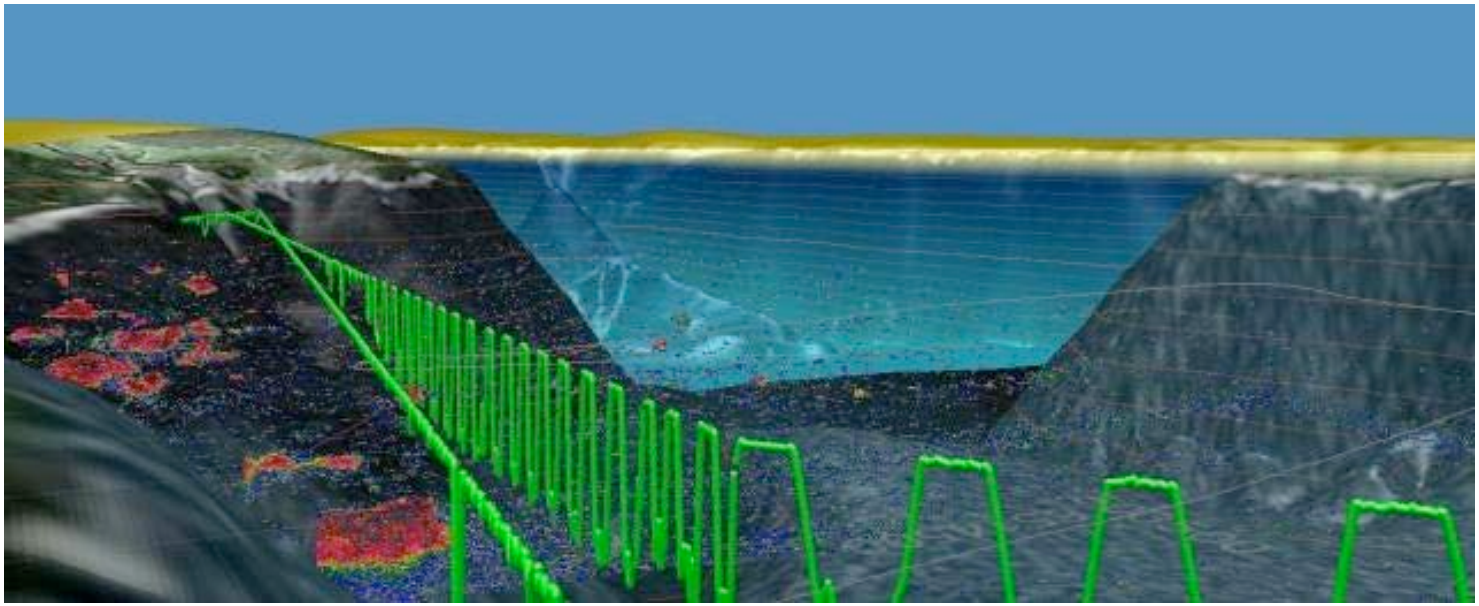


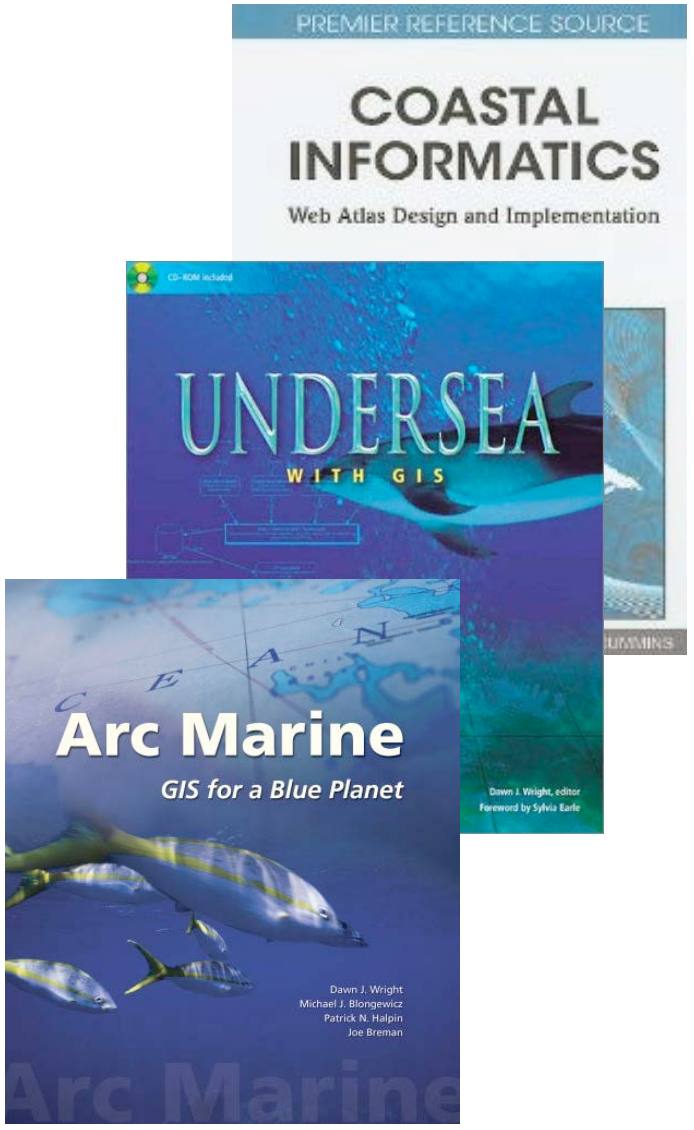


En support à la théorie de Darwin

Fledermaus

Eonfusion



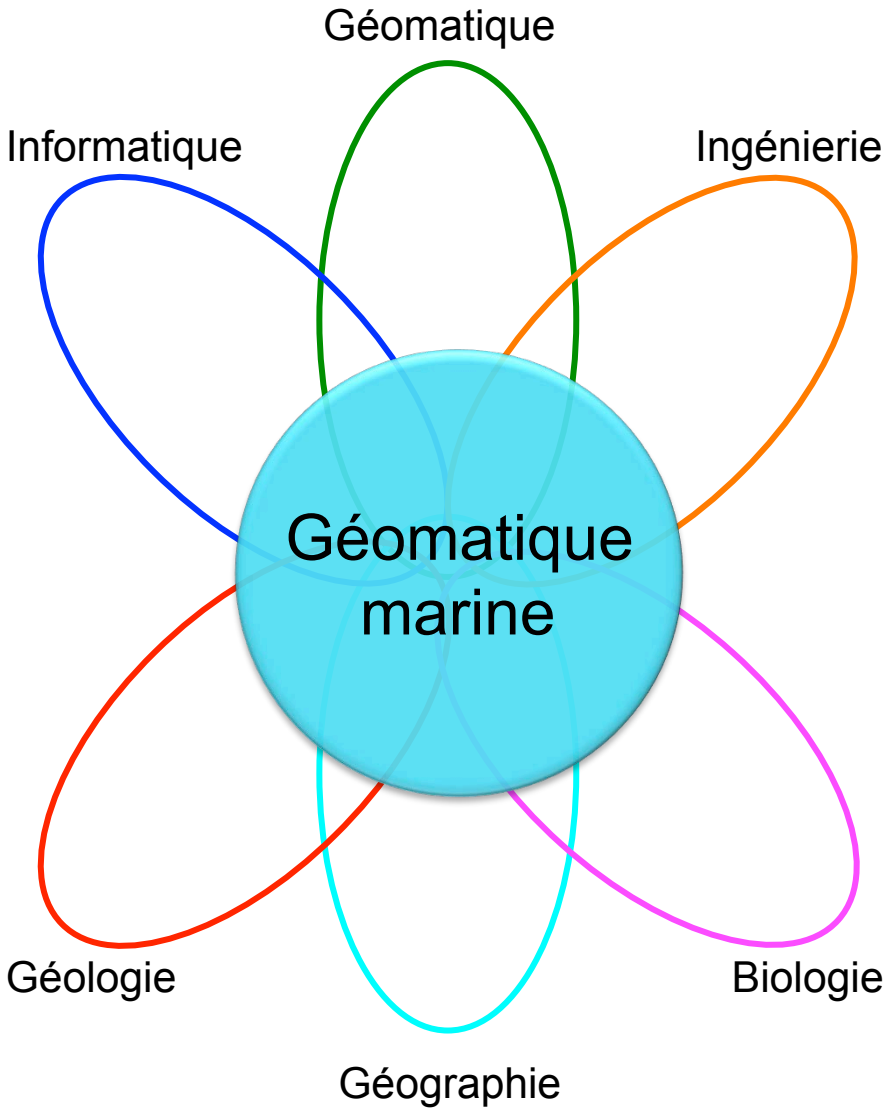


esri

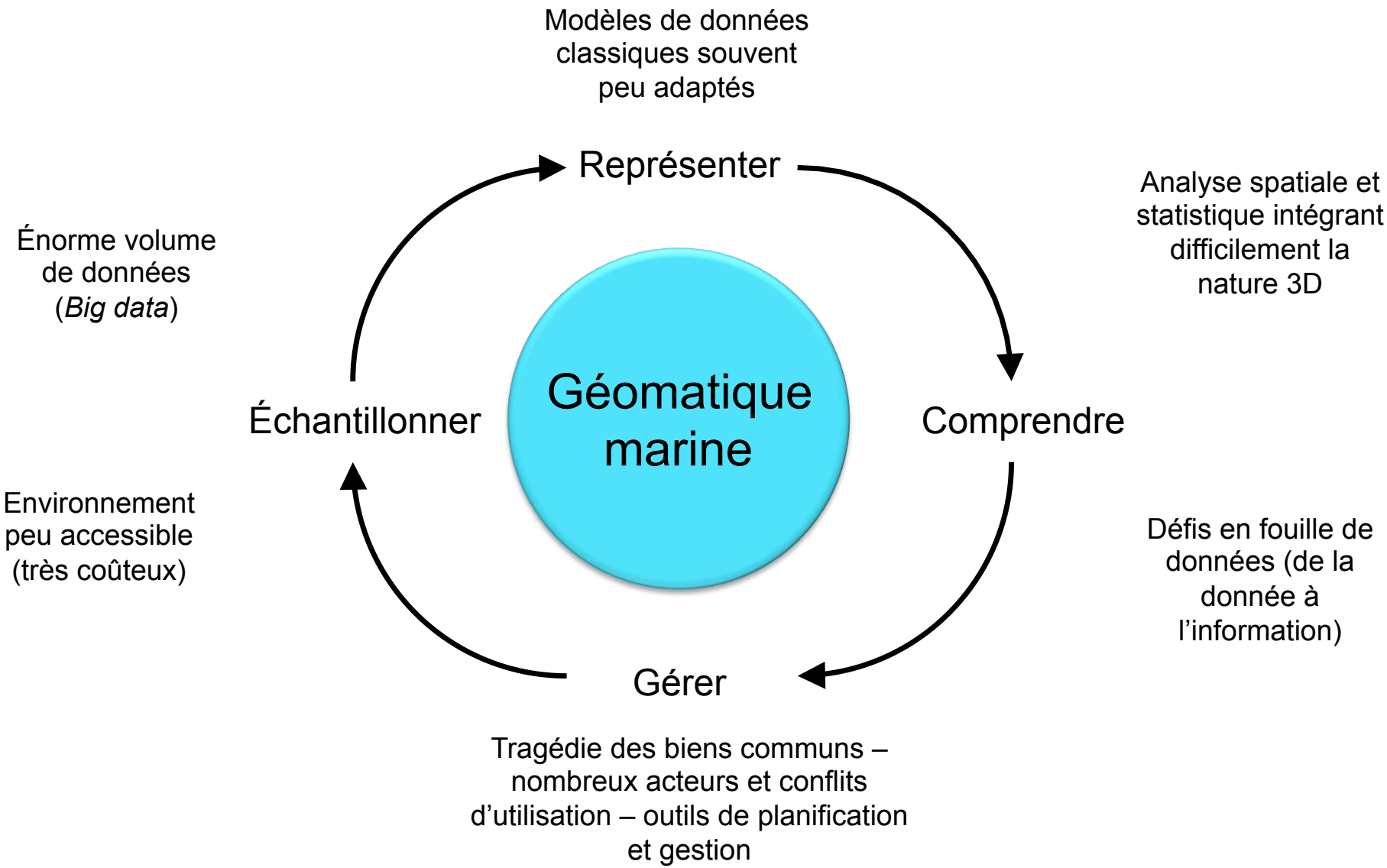
En support à la théorie de Lamarck

Géomatique marine

http://www.marinegis.com



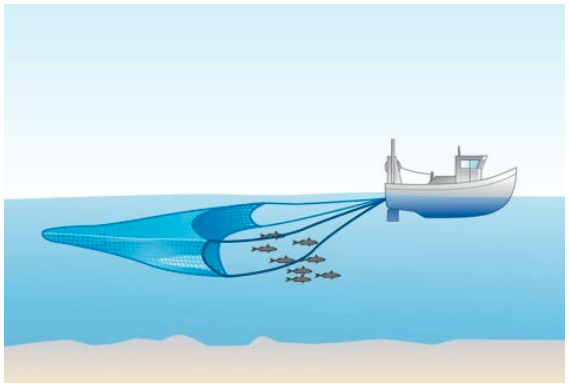
Nombreux défis en géomatique marine

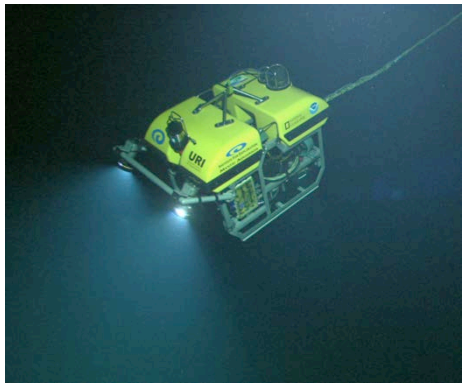


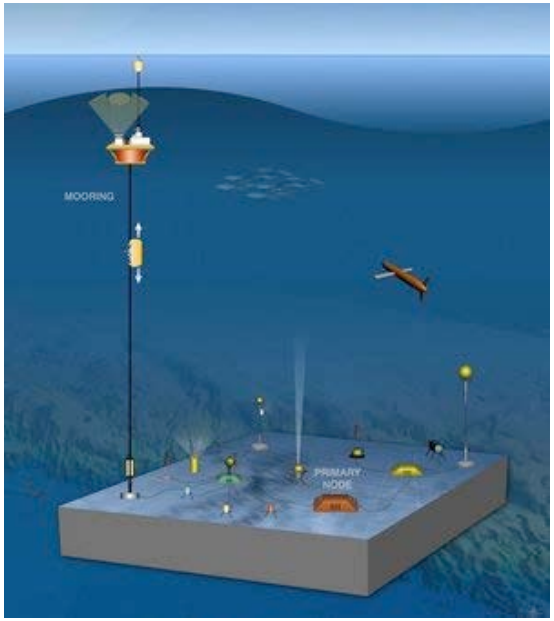
Échantillonnage

Sur terre (ex. foresterie)

En mer

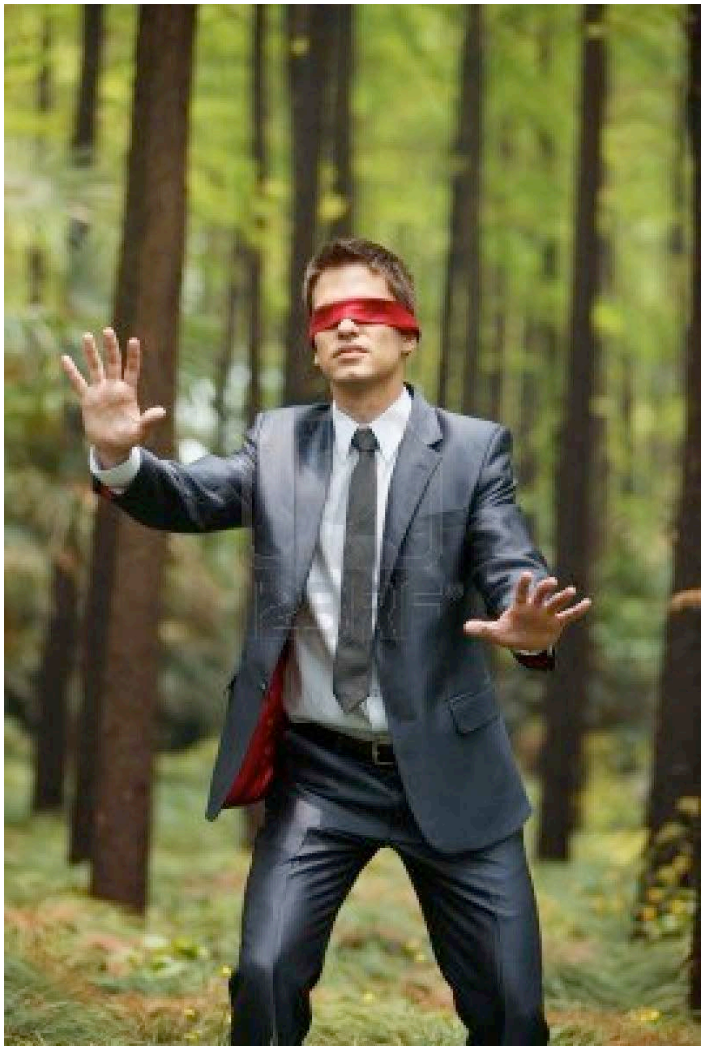




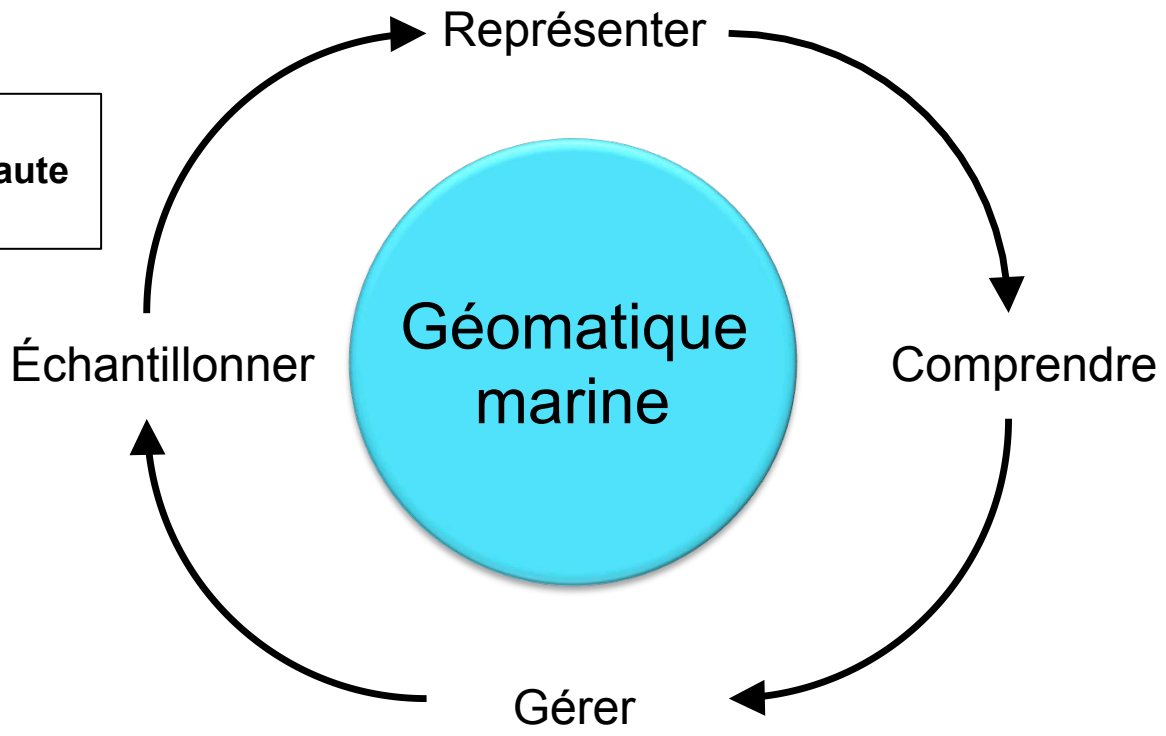


Échantillonnage

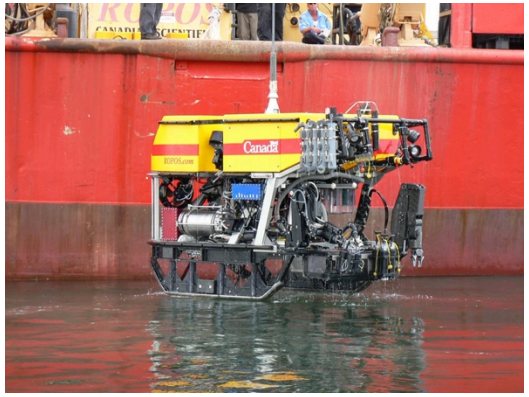
En gros, échantillonner en milieu marin serait comme échantillonner une forêt d'arbres qui bougent avec les yeux bandés!



Données bathymétriques haute résolution

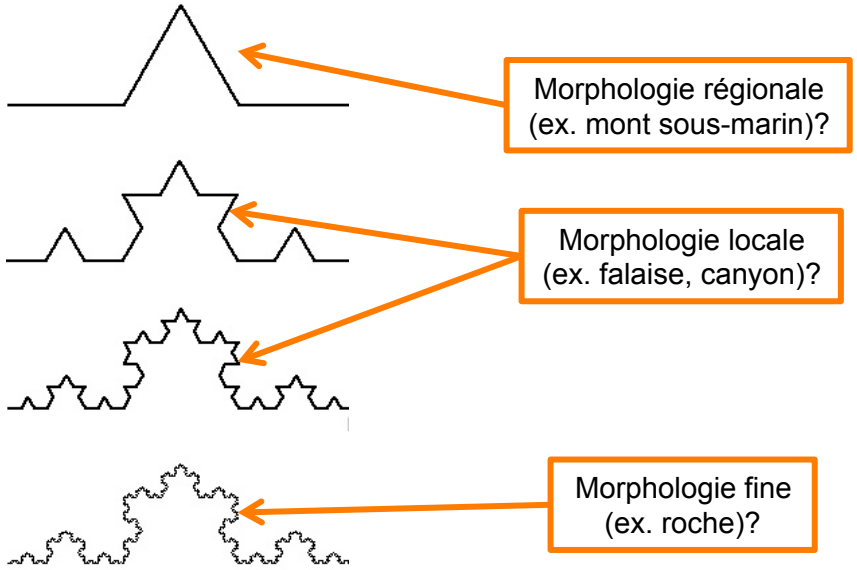


Échelle vs écologie marine



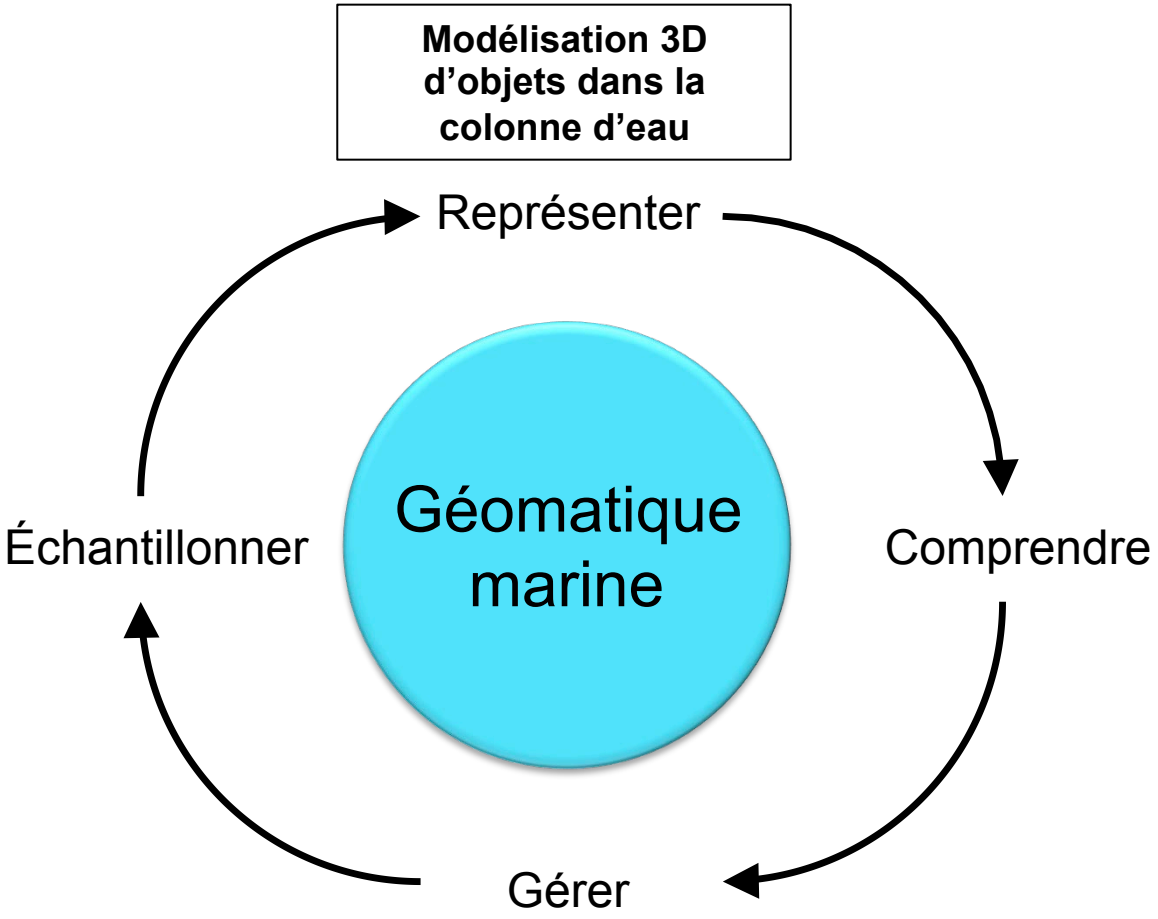
Acquisition de données bathymétriques à haute résolution

Géomorphométrie

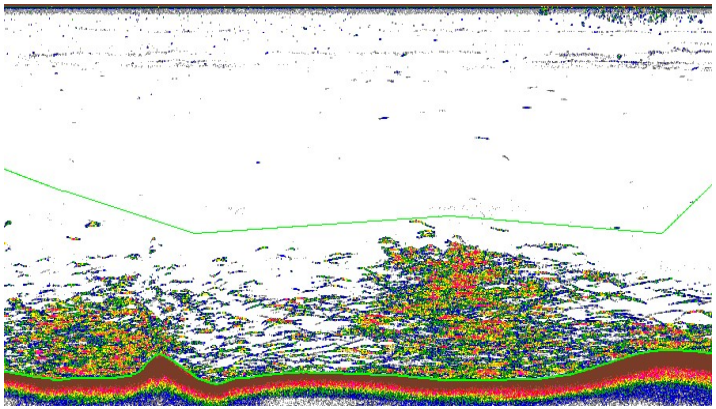


Comprendre l'impact de l'échelle d'observation sur la distribution des populations

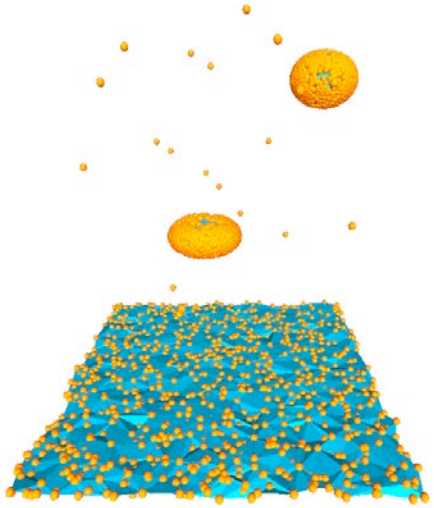
Lecours *et al*. 2013. *GeoHab Syposium.*


Modélisation 3D d'objets dans la colonne d'eau
Représenter
Comprendre
Gérer
Échantillonner
Géomatique marine

Modèles de données marins 3D

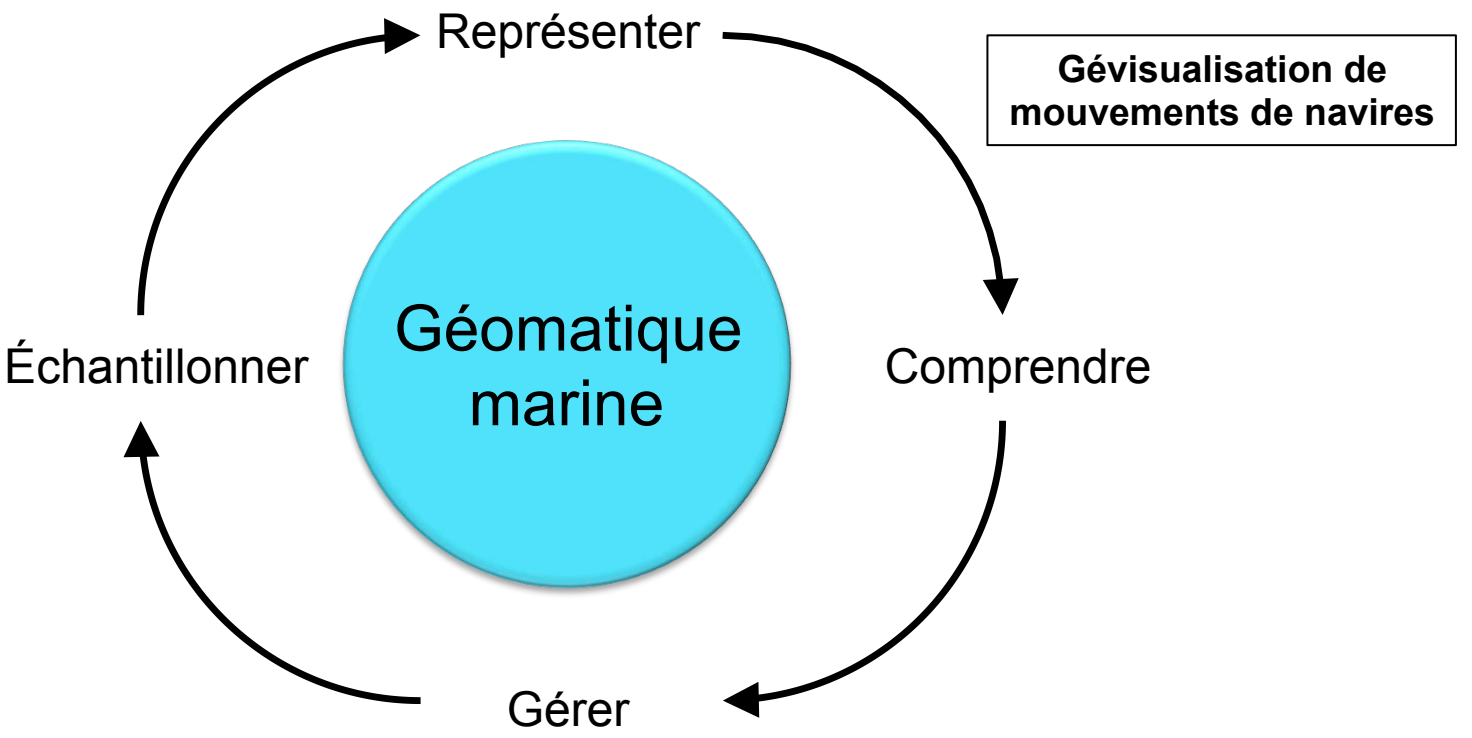


Profils acoustiques de pêcherie

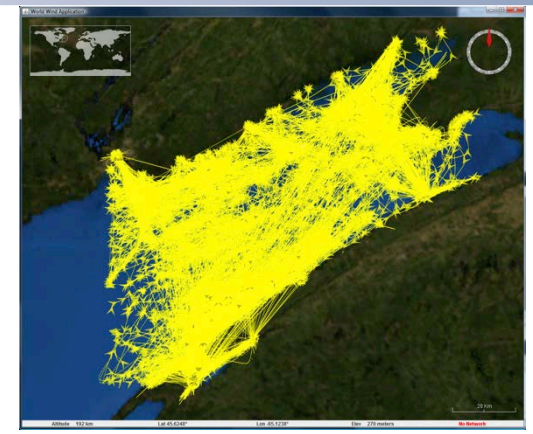


Modélisation 3D
d'agrégations de poisson

Carette *et al*. 2008. *Geomatica,* 62(4): 361-374

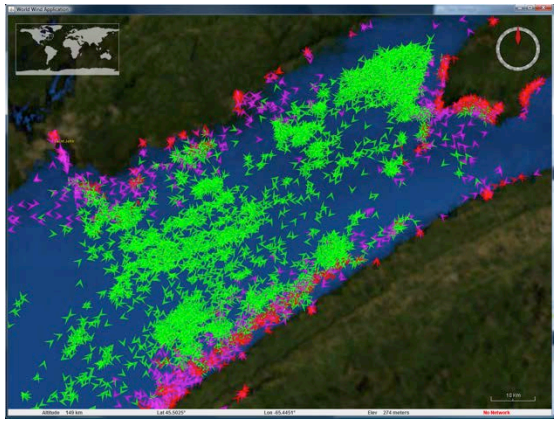

Représenter
Gévisualisation de mouvements de navires
Géomatique marine
Comprendre
Gérer
Échantillonner

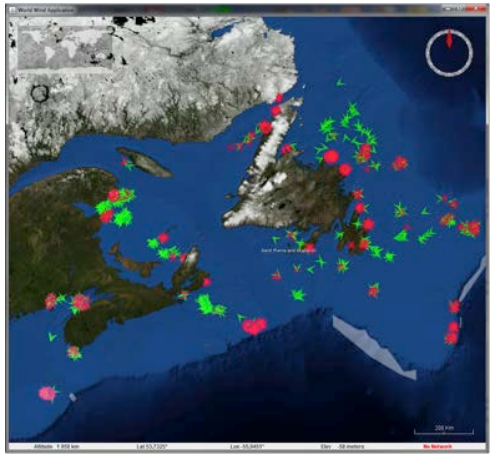
Analyse de mouvement



Larges jeux de données marins

Analyse de trajectoires, filtrage / classification de données + ontologies

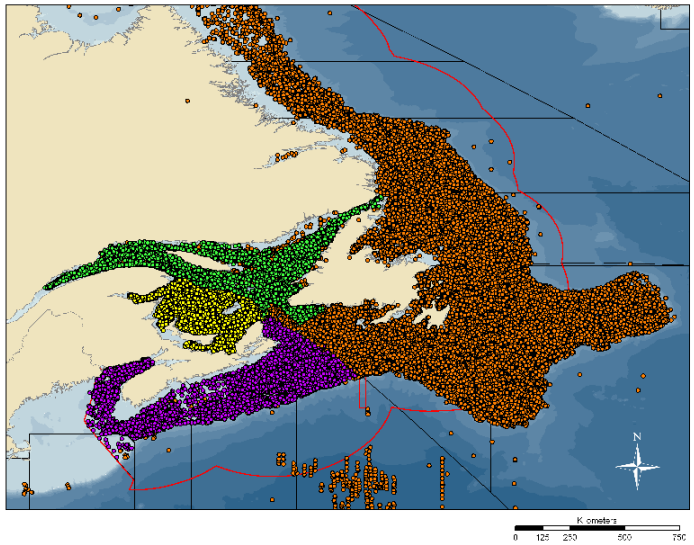




Identification de types de mouvement et d'événements

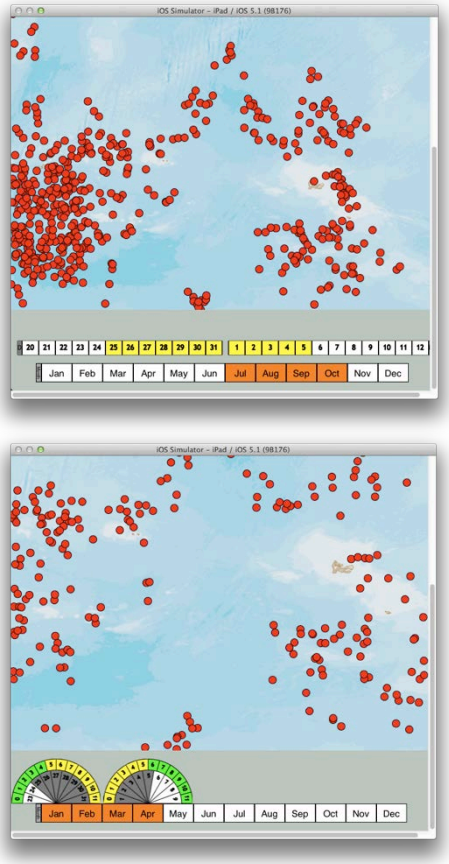
Vandecasteele *et al*. (soumis). *Marine Geodesy.*
Enguehard *et al*. 2013. *Journal of Coastal Conservation,* 17(1): 105-119.
Enguehard *et al*. 2012. *Information Visualization*, 12(1): 65-84.

Outils de navigation temporelle



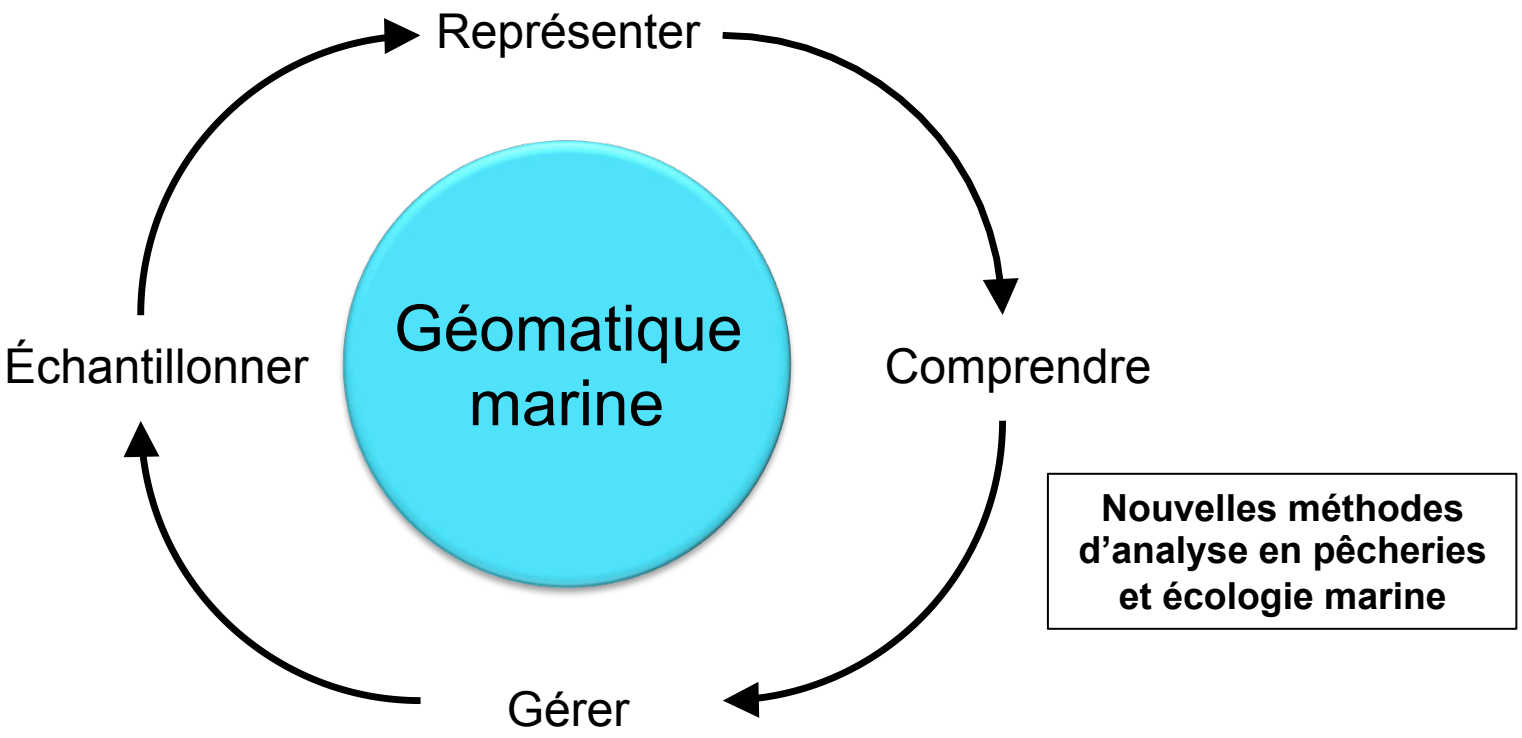
Visualisation de larges jeux de données marins spatio-temporels

Sélection d'objets à différentes granularités temporelles

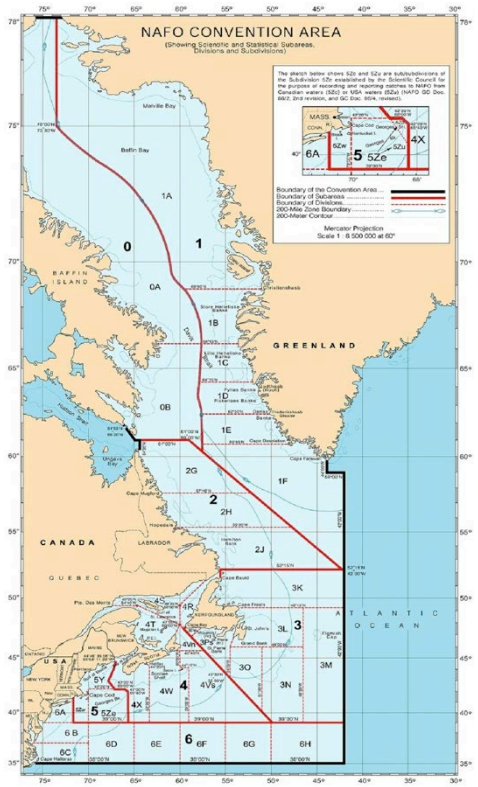


Sélection et zoom temporel sur écrans tactiles

Lee *et al*. (soumis). *International Journal of Geographical Information Science*.


Représenter
Comprendre
Gérer
Échantillonner
Géomatique marine
Nouvelles méthodes d'analyse en pêcheries et écologie marine

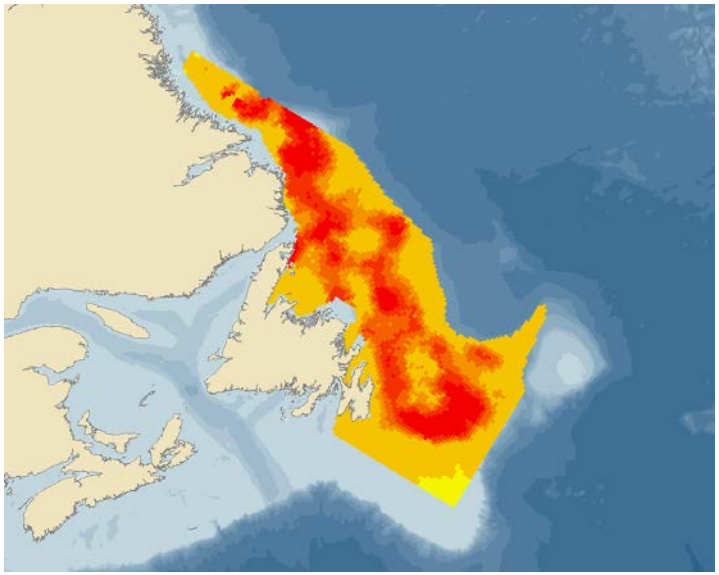
Statistiques et analyse spatiale en pêcherie



Analyses des populations de poisson par zone de gestion / statistique globales

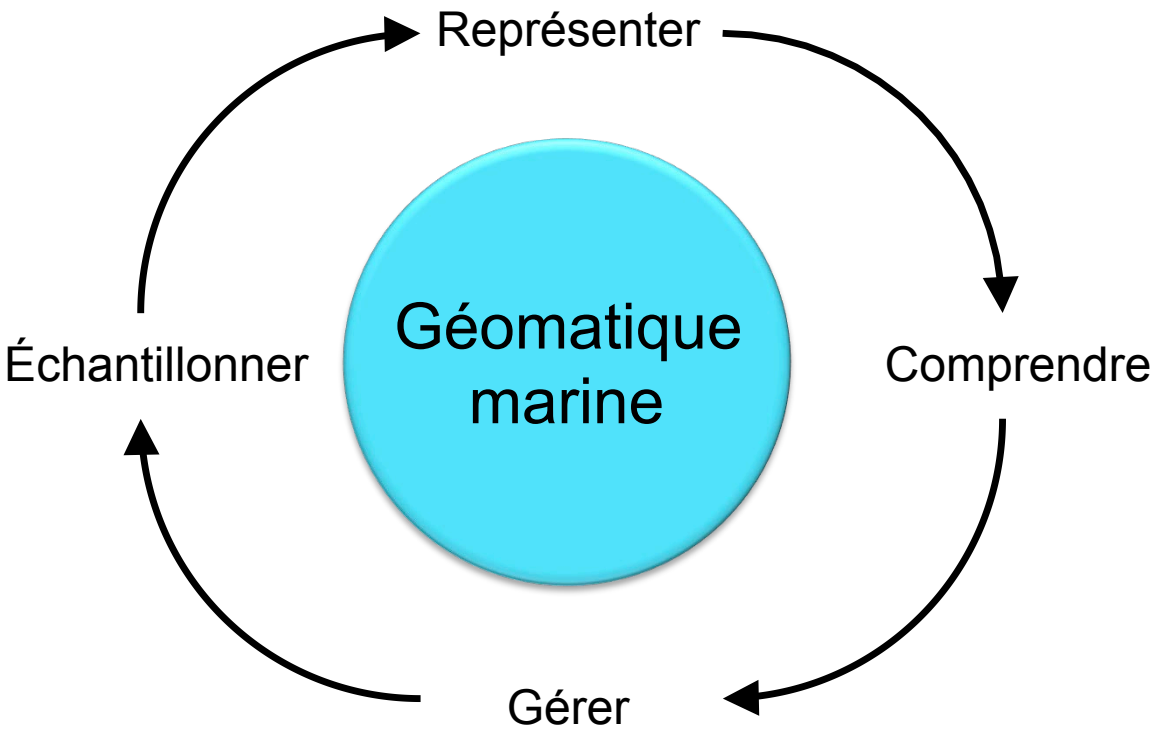
Statistiques et analyses spatiales

- Régressions géographiquement pondérée (GWR)
- Analyses de forme
- Fouille de données



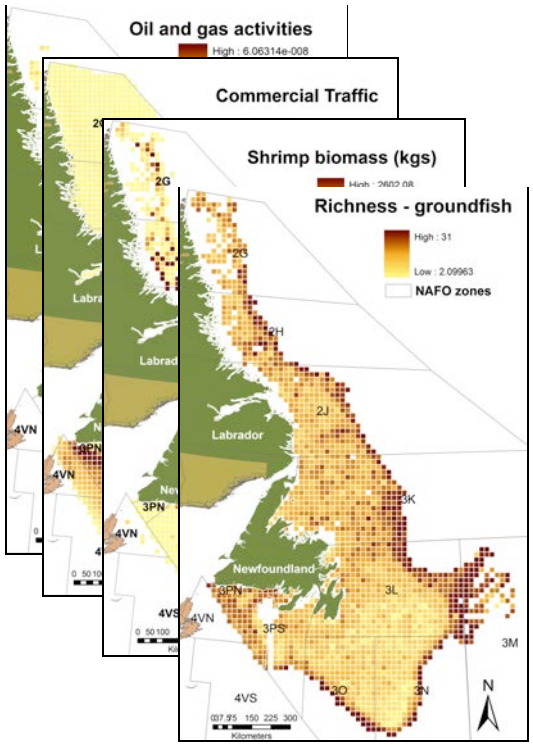
Meilleure compréhension de la dynamique des écosystèmes marins

Windle *et al*. (soumis). *Ecological Applications.*
Windle *et al*. 2012. *Marine Ecology Progress Series,* 469: 263-278.
Windle *et al*. 2010. *ICES Journal of Marine Science*, 67(1): 145-154.



Analyse multicritère en support à la conservation marine

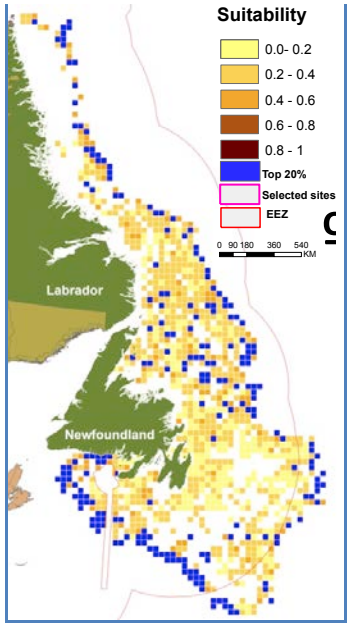
Nouvelle approche multicritère



Nombreux critères à considérer en conservation marine

Ordered Weighted Average (OWA)

Scénarios en fonction du niveau de risque voulu



Identification des endroits minimisant les conflits entre utilisateurs du milieu marin

Agapito *et al*. 2013. ICCB'13 Conference

5 défis pour la communauté géomatique

1. Repenser le fonctionnement des SIG de la base pour supporter du vrai 3D permettant des relations spatiales plus complexes
2. Rapprocher les « deux solitudes »: la recherche en télédétection marine et celle en SIG
3. Ne plus penser « données » mais « connaissances »
4. Effacer les frontières disciplinaires et s'intéresser aux domaines d'application pour les faire penser géographiquement
5. Mieux intégrer les aspects sociaux dans les processus de gestion

…et le numéro complémentaire (IGN©), le:

6. Mieux capturer les processus dynamiques du milieu marin

Questions?

rdeville@mun.ca

http://www.marinegis.com