Belgium-French Modelling and Observing Activities in the Southern Ocean sea ice zone

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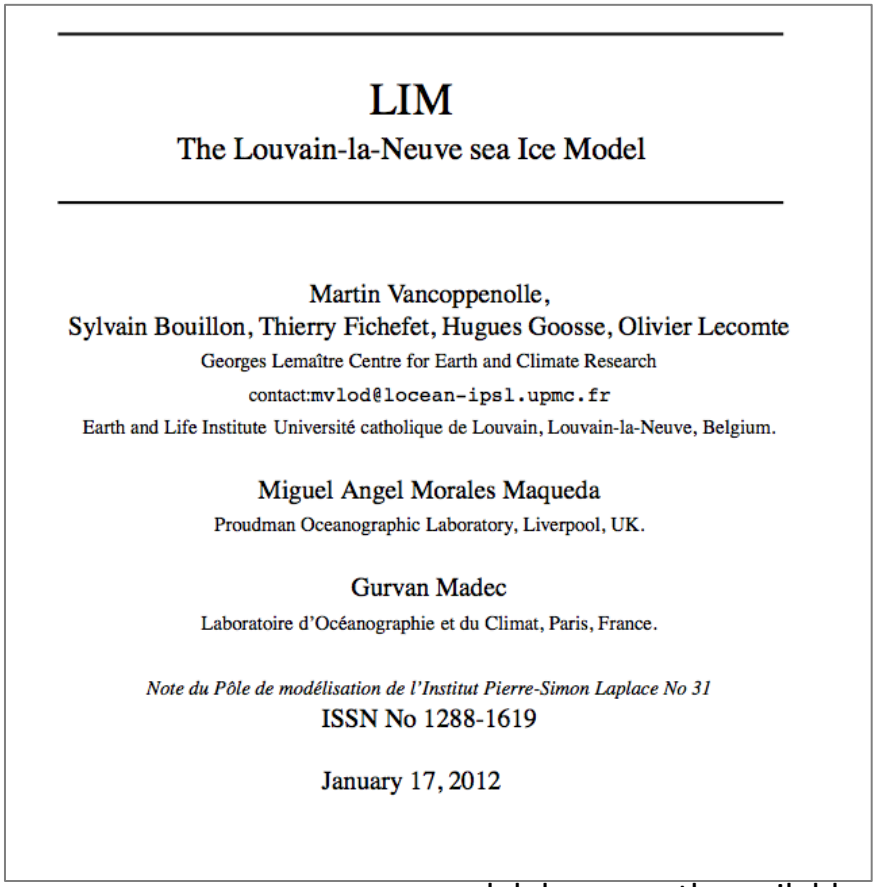
Ocean-Sea Ice Model Development

- **NEMO** = **N**ucleus for **E**uropean **M**odel of the **O**cean
  (UK+France+Italy+Belgium)

  LIM = **L**ouvain-la-Neuve sea **I**ce **M**odel

- **Forced** ice-ocean configurations
  - global 2°, 1°, 0.5°, ...
  - regional configurations (including Antarctic)

- **Coupling** with climate models: EC-Earth and IPSL-CM



LIM

The Louvain-la-Neuve sea Ice Model

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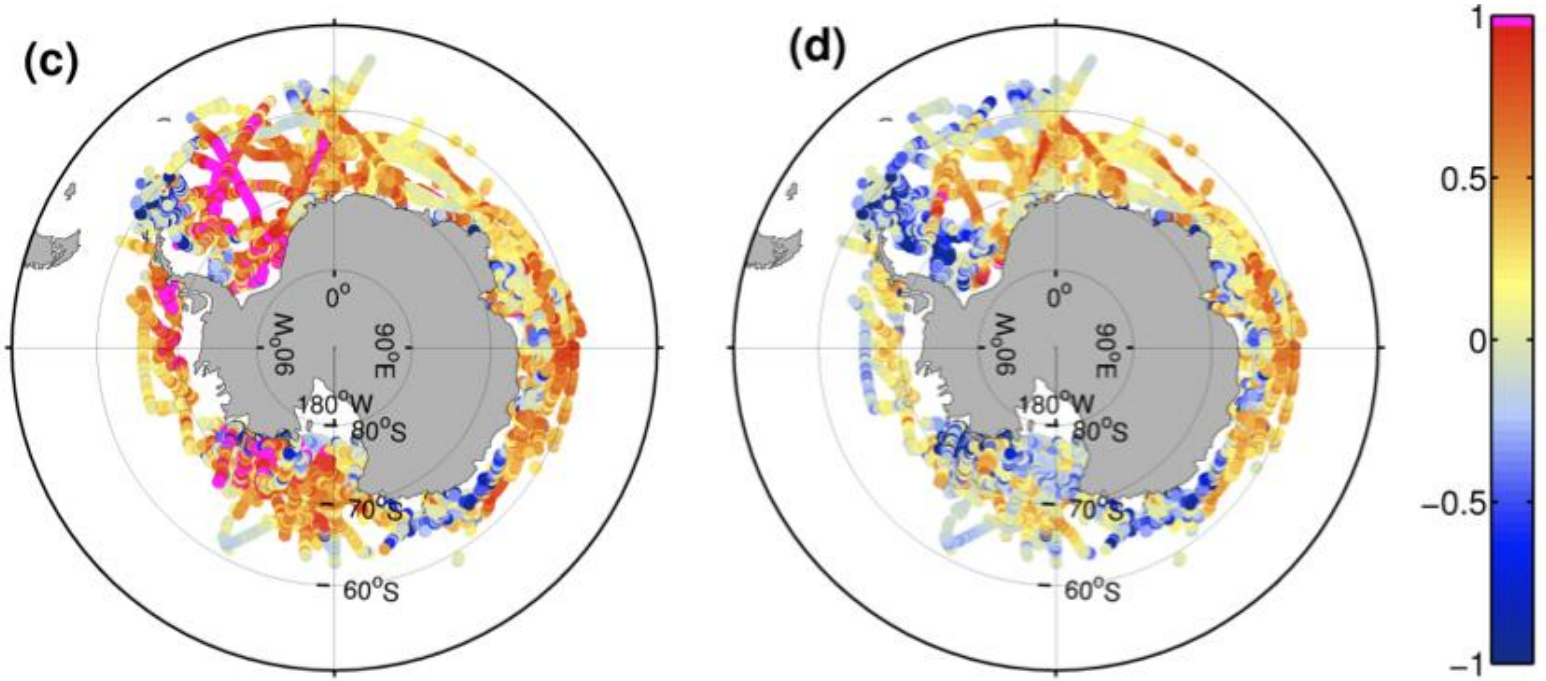
model doc recently available

http://www.nemo-ocean.eu/

http://www.elic.ucl.ac.be/repomodx/lim/

Forced 1° NEMO-LIM configuration (ORCA1): Comparison with aspect



LIM2

Mono-category VP
Semtner 3-layer

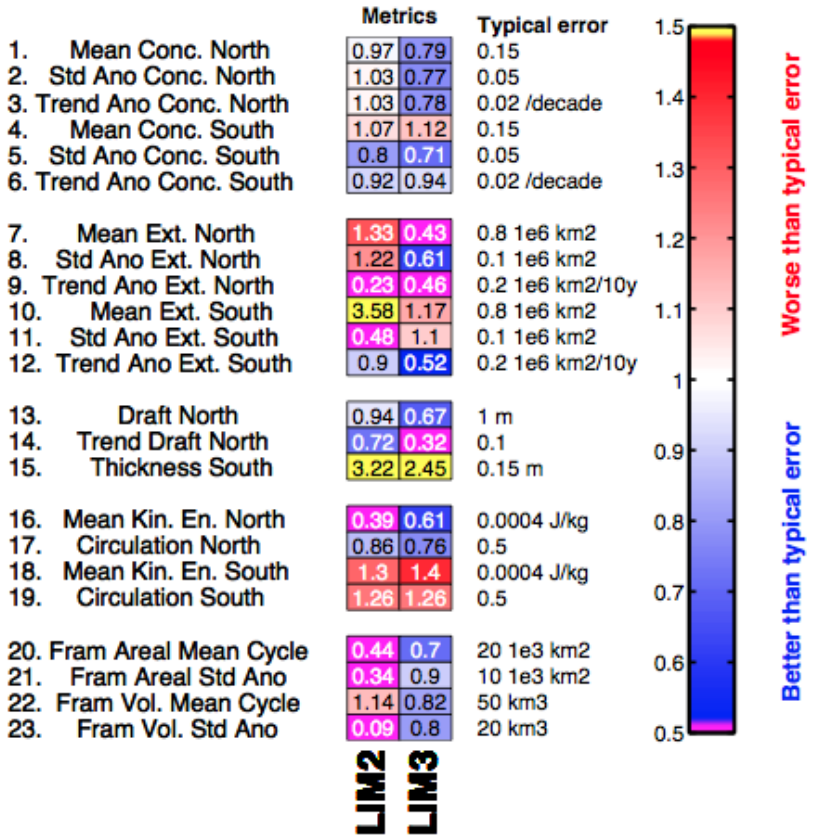
LIM3

Multi-category EVP
Halo-thermodynamic N-layer

Massonnet et al., 2011

Model evaluation: Arctic vs Antarctic

- Both model versions show less skill in the Southern Ocean
- Ocean model resolution and forcing field quality are limiting factors
- Still hard to understand problems from wrong ice physics



Massonnet et al., 2011

EnKF ice concentration assimilation

Assimilation of ice concentration in LIM2 improves winter and summer ice extent, which substantially changes thickness (improvements and deteriorations)

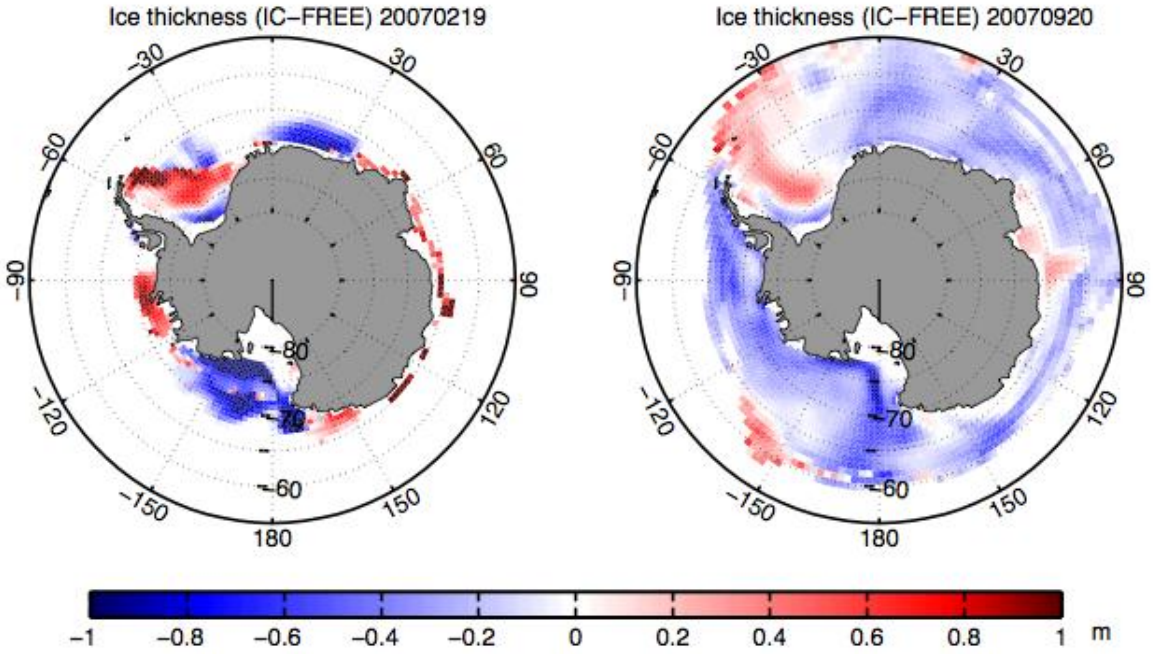
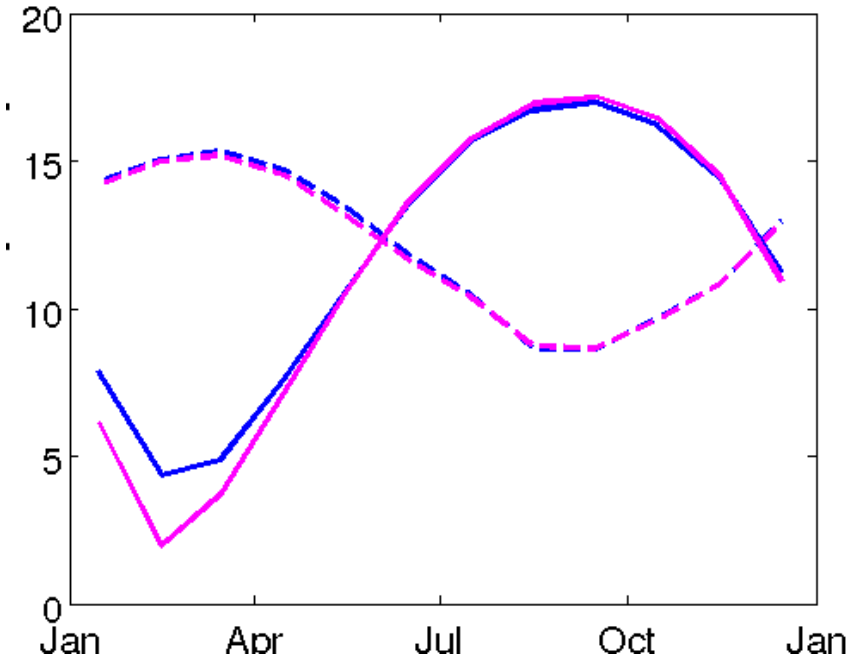


Fig. 10. Sea-ice thickness differences at the time of minimum **(a)** and the maximum **(b)** in 2007. Colors show the sea-ice thickness differences between FREE and IC.

Mathiot et al., GMDD 2012

Ongoing 3D developments

- Snow component (O. Lecomte)
  - snow thd (evap, radiation) + meltwater + blowing snow
- Elasto-brittle rheology (S. Bouillon)
  - good physics but currently stochastic model
- Ice-ocean interactions (A. Barthélémy)
  - subgrid-scale representation of brine plumes and ocean heat flux
- Pancake ice formation (M. Vancoppenolle)
  - see Wednesday

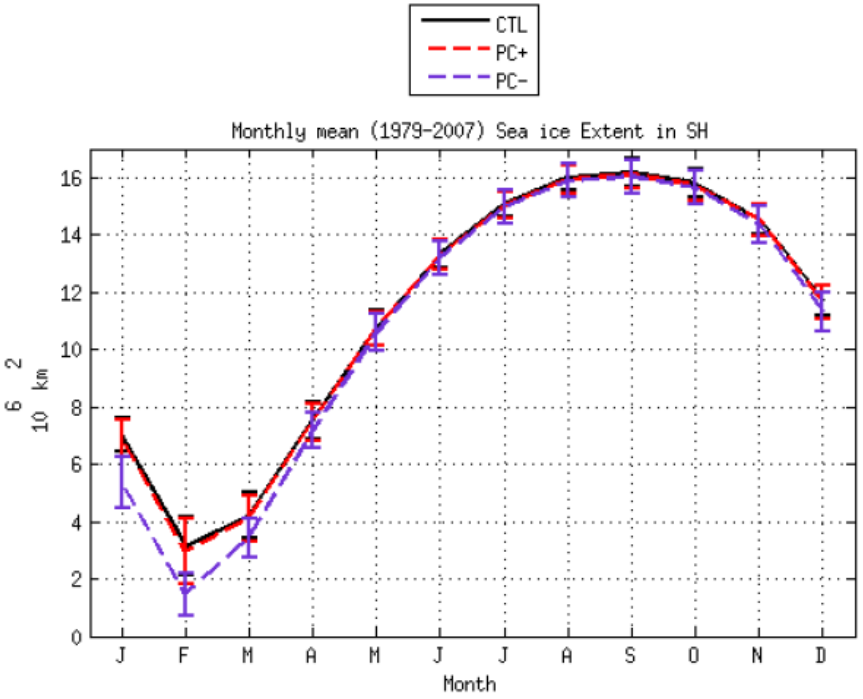


BLUE = CONTROL

PINK = New snow radiation scheme turned off

Ongoing climate configuration work

- Coupling multi-cats models with atmospheric models
- All atmospheric models are not able to see multi-surfaces
- Development of a flux redistributor
- CMIP5 analyses next year



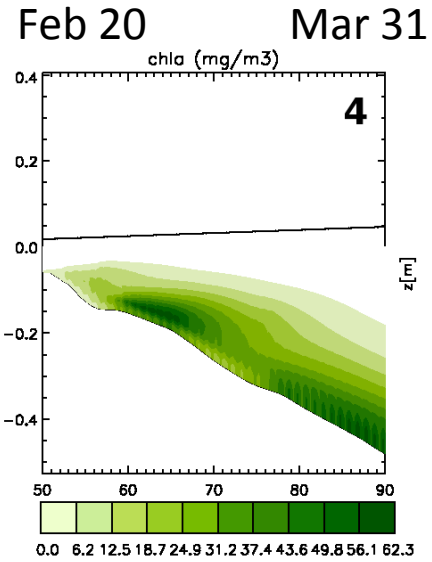
black = control case with 1 flux per category
red = with the flux redistributor
purple = without the flux redistributor

Gaelle Vergé-Deprez et al., ongoing work

Ongoing 1d sea ice model work

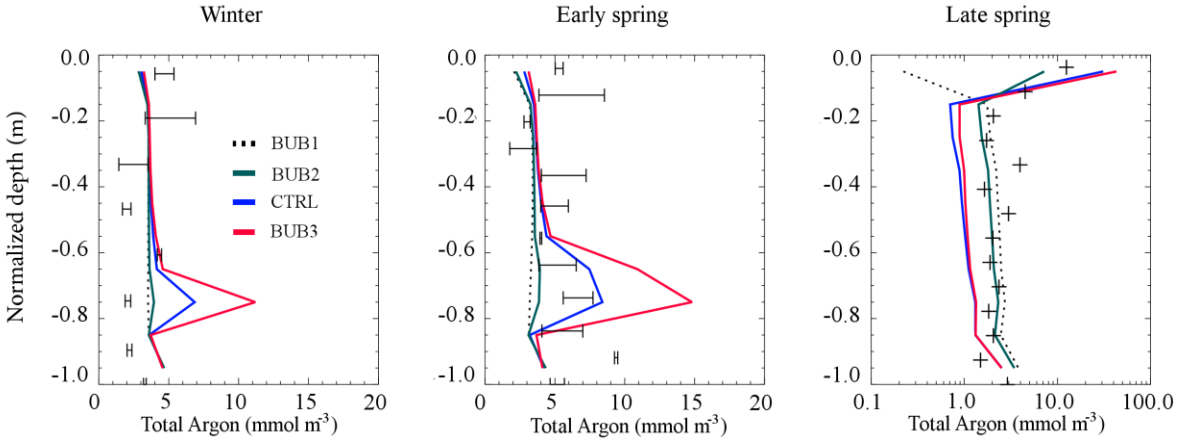
- Biogeochemistry
  (see Thursday)

Simulation of Cape Darnely sattellite-observed bloom (Jan Lieser et al.)



- Gas exchange: Ar, O2 and CO2
  (see Thursday)

Simulation of Ar in landfast sea ice



Moreau et al., in prep

YROSIAE – Belgian Antarctic field project

- Ongoing field program at Scott Base (Nov 2011-Dec 2012)
- Yearlong study of the biogeochemico-physical features of landfast Antarctic sea ice
- J-L Tison, P Langhorne, Bruno Delille, Fred Vivier, M Vancoppenolle, GS Dieckmann, et al.
- Direct connexion with the model development

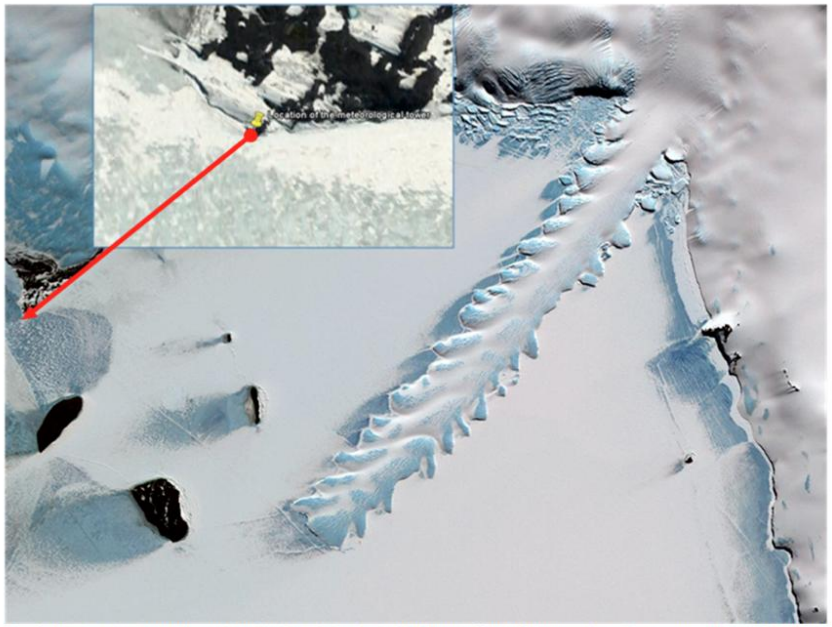


Fig 1. Erebus ice tongue and Dellbridge Islands in McMurdo Sound, Antarctica. The meteorological tower will be installed on the southern tip of the Cape Evans (indicated by the red arrow). The cape is surrounded by first year land fast sea ice.

- Ice cores
- Meteorological tower for radiation, heat, CO2 and DMS budget
- Sediment traps
- From growth onset to the end of the melt season

Air-ice exchanges	**Meteorological tower**		
		Air-ice CO_2 exchange measured by eddy-covariance, using a closed path CO_2 analyzer and 3D sonic anemometer	Continuous
		Air-ice DMS exchange using the gradient flux method	discrete sampling
		Short wave and long wave radiation	Continuous
		Atmosphere, sea ice, underlying water temperature (IMB)	Continuous
Snow and sea ice physical and biogeochemical processes ice-ocean exchanges	**Main discrete weekly sampling** - snow - ice (full profile at resolution ranging from 5 to 20 cm) - brines - underlying water at 0, 1 and 30 m depth		Sample collection will be carried out in trace clean condition
	Physics	Salinity	
		Temperature	
		^{18}O	
		Fabrics	
	Gases	Total gas content	
		O_2	
		Ar	
		N_2	
		pCO_2	
		DMS, DMSP, DMSO	
		CH_4	
		N_2O	(liquid phase only)
	Biology and Biogeochemistry	Chl a	
		TEP	
		Primary production derived from O2:Ar and N:Ar	
		Nutrients	
		Fe	
		$\delta^{13}C$, $\delta^{30}Si$, $\delta^{15}N$	
		$CaCO_3$ content	
		DIC	(liquid phase only)
		Talk	(liquid phase only)
		pH	(liquid phase only)
Biogeochemcial processes	**In situ incubation**		
		POC	
		PON	
		$bSiO_2$	
		^{13}C	
		^{15}N	
		^{30}Si	
		PDMPO spiking	
Ice-ocean exchanges	**Sediment trap**		
		POC	
		PON	
		PIC	
		$bSiO_2$	
		TEP	
		$\delta^{13}C$, $\delta^{30}Si$, $\delta^{15}N$	

Table 1 List of parameters to be measured during the field survey.

French observations are not yet well connected into the sea ice network

- Measurements are done every year on landfast sea ice in Dumont D'Urville on behalf of the French Polar Institute
- They are not yet part of the international programmes (eg AFIN)
- Yeah, we'll try to fix that in the next few years
- Lots of elephant seal data are taken, including data from the sea ice zone, but nobody is looking at them with a sea ice perspective yet

private message for Steve

Belgium

France