

EC-Earth meeting, ECMWF
3-4th February 2014



Overview of current and future developments with LIM

François Massonnet



A. Barthélemy • S. Bouillon • T. Fichefet • H. Goosse
O. Lecomte • S. Moreau • A. Pestiaux • J. Raulier
R. Stevens • M. Vancoppenolle • G. Vergé-Dépré

Slide presented Dec. 11th, 2009
ECMWF, EC-Earth meeting

Who's who?

- Louvain-la-Neuve sea Ice Model (LIM)³
- Large scale dynamic-thermodynamic sea ice model ~~[Fichefet and Maqueda, 1997]~~ [Vancoppenolle et al., 2009]
- Coupling with Océan PARallélisé [Goosse and Fichefet, 1999; Timmerman et al., 2005]
- Current developments
 - Rheology & sea ice physics
 - Assimilation (EnKF)
 - Finite element version
 - ...
- COMBINE project

Sea ice modelling: where is LIM?

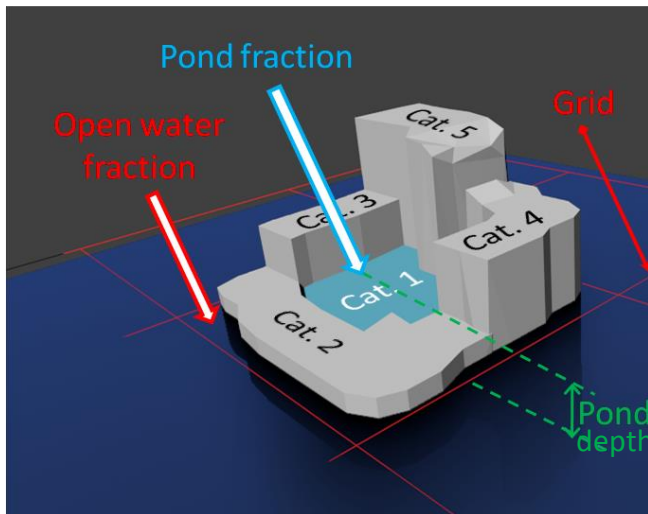
LIM in EC-Earth: where are we?

Sea ice modelling: where is LIM?

LIM in EC-Earth: where are we?

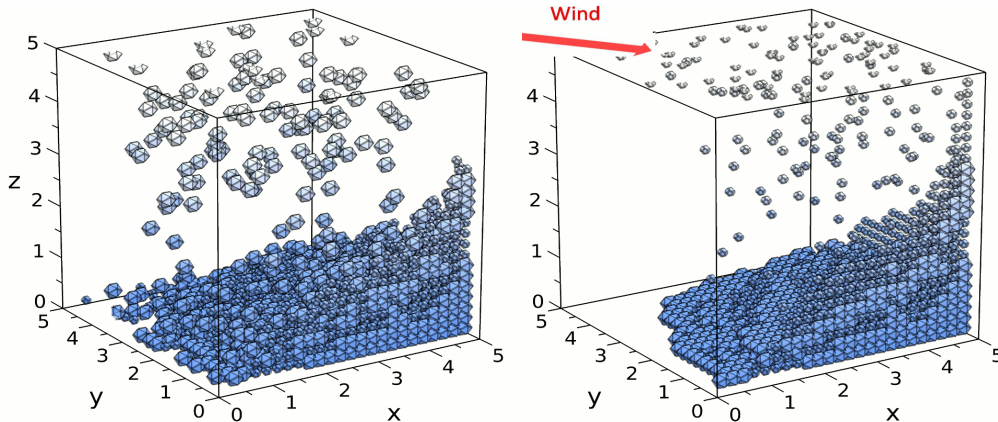
A comprehensive snow model on sea ice

Snow • Rheology • Ocean-sea ice interactions •
Biogeochemistry • Parameter estimation • State estimation



Inclusion of detailed melt pond scheme (Flocco et al., 2007) and blowing snow scheme

[Lecomte et al., 2014, in prep.]



Multi-layer snow on sea ice model

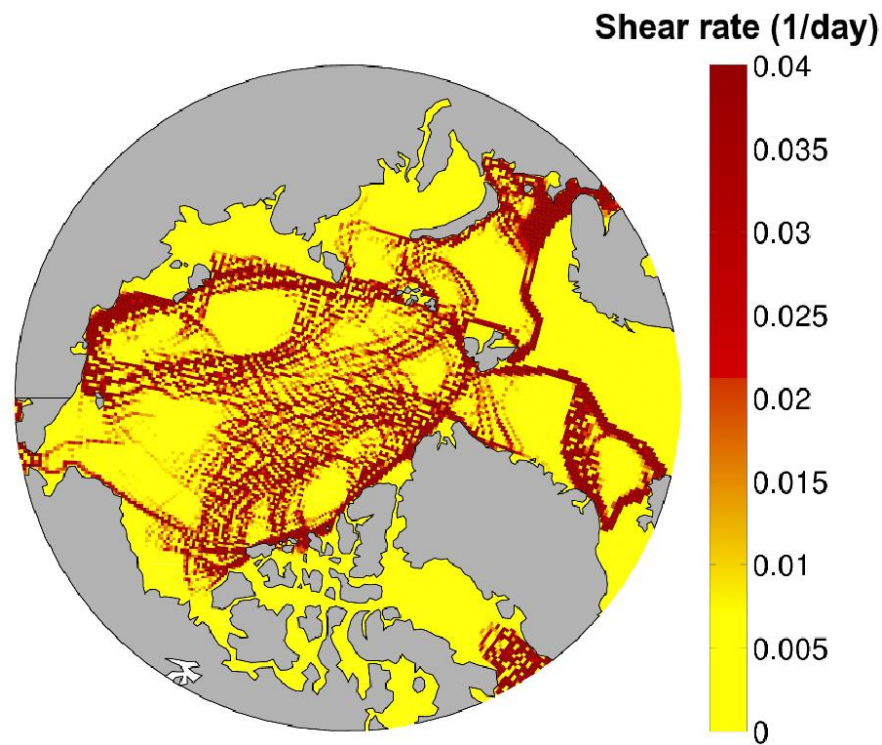
[Lecomte et al., 2013, JAMES]

Available: Sept. 2014
In ref. version: 2015

A more realistic rheology for the sea ice pack

Snow • Rheology • Ocean-sea ice interactions •
Biogeochemistry • Parameter estimation • State estimation

Elasto-brittle rheology in LIM
Follow-up of the EMBRACE project

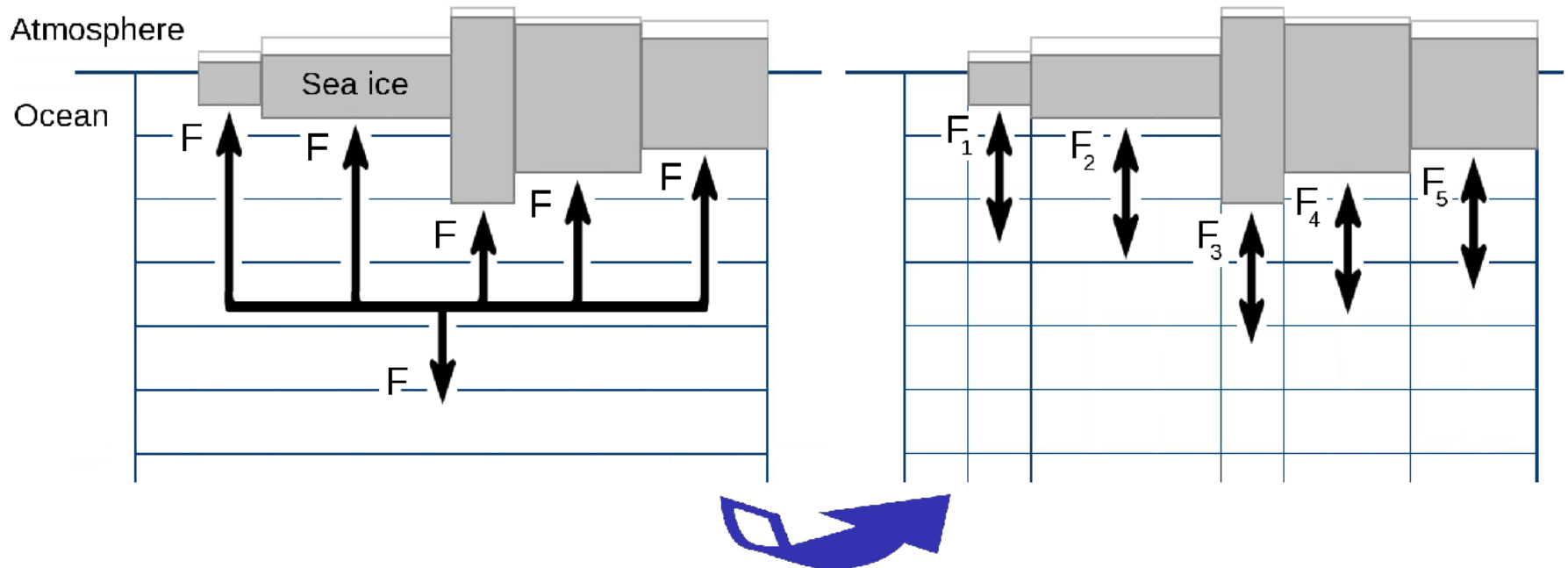


[J. Raulier PhD thesis, started Sept. 2013]

Refining the ocean-sea ice interactions

Snow • Rheology • Ocean-sea ice interactions •
Biogeochemistry • Parameter estimation • State estimation

Parameterization of brine rejection into the ocean



Making sea ice an active player of biogeochemical cycles

Snow • Rheology • Ocean-sea ice interactions •
Biogeochemistry • Parameter estimation • State estimation

More tracers in sea ice
e.g. dissolved inorganic carbon

Primary production in sea ice

CO₂ fluxes through sea ice

Objective calibration of sea ice parameters

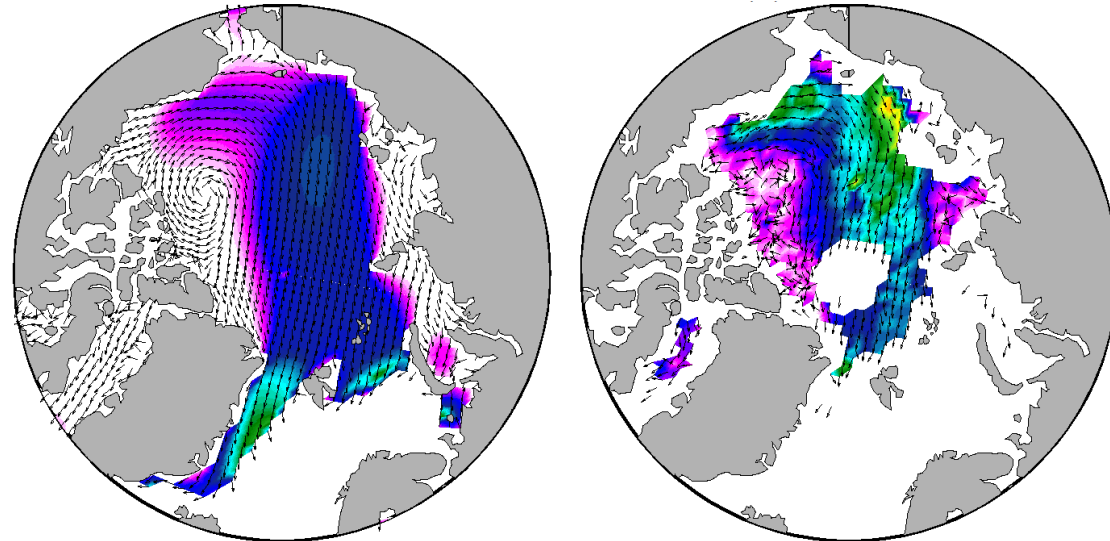
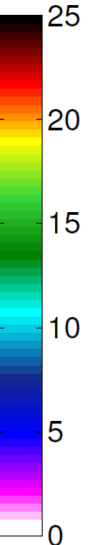
Snow • Rheology • Ocean-sea ice interactions •
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Sea ice drift, 12→14 April 2012

LIM3
reference parameters

OBS

km/day



[Massonnet et al., 2013, submitted]

Objective calibration of sea ice parameters

Snow • Rheology • Ocean-sea ice interactions •
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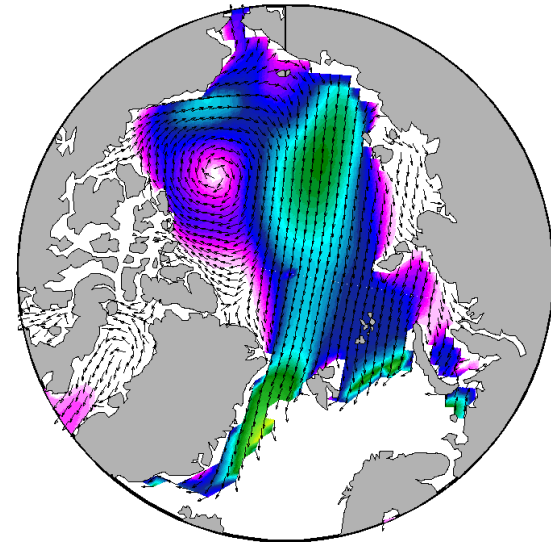
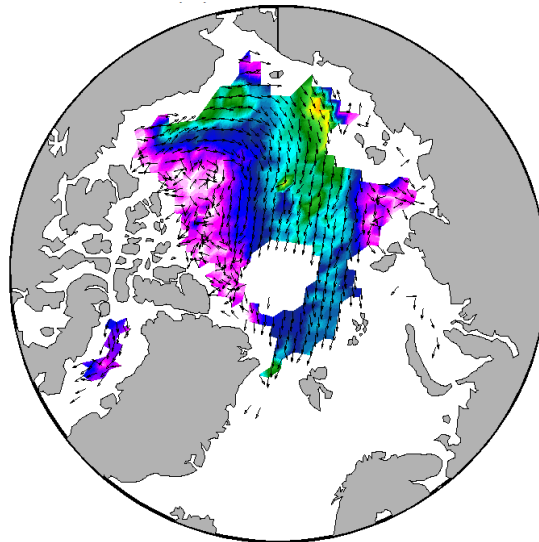
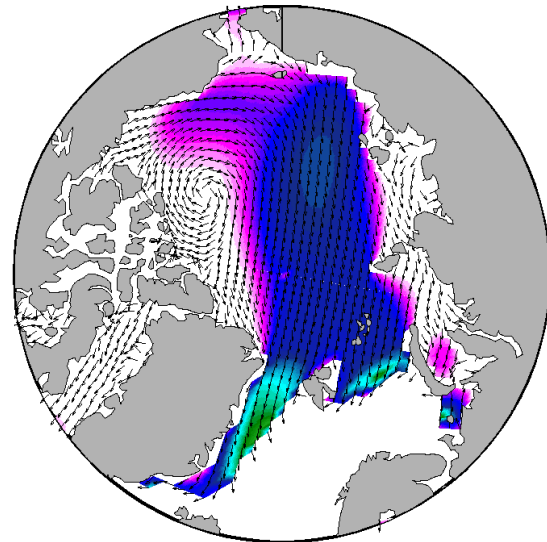
Sea ice drift, 12→14 April 2012

LIM3
reference parameters

OBS

LIM3
2 parameters estimated

km/day

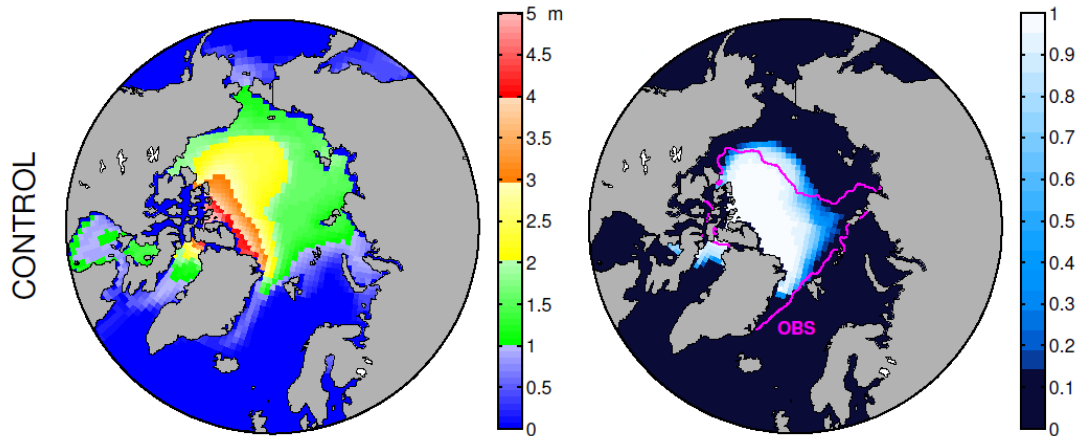


Data assimilation: LIM is ready for seasonal-to-decadal prediction

Snow • Rheology • Ocean-sea ice interactions •
Biogeochemistry • Parameter estimation • State estimation

March 2007 sea ice thickness

September 2007 sea ice concentration



[Massonnet et al., 2014, submitted]

Available: August 2014

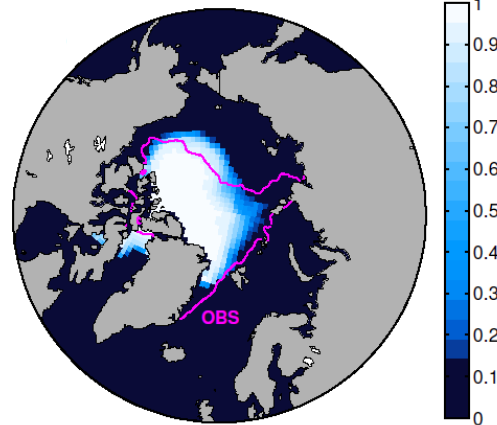
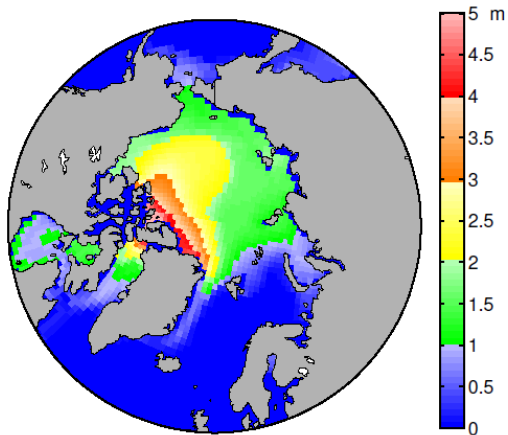
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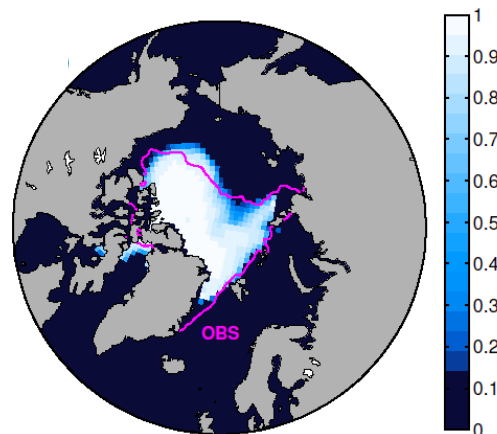
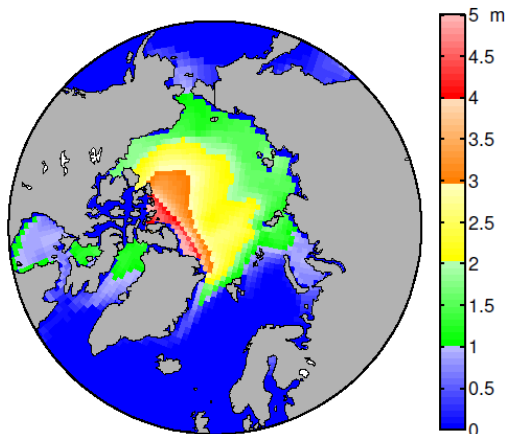
March 2007 sea ice thickness

September 2007 sea ice concentration

CONTROL



INITIALIZED



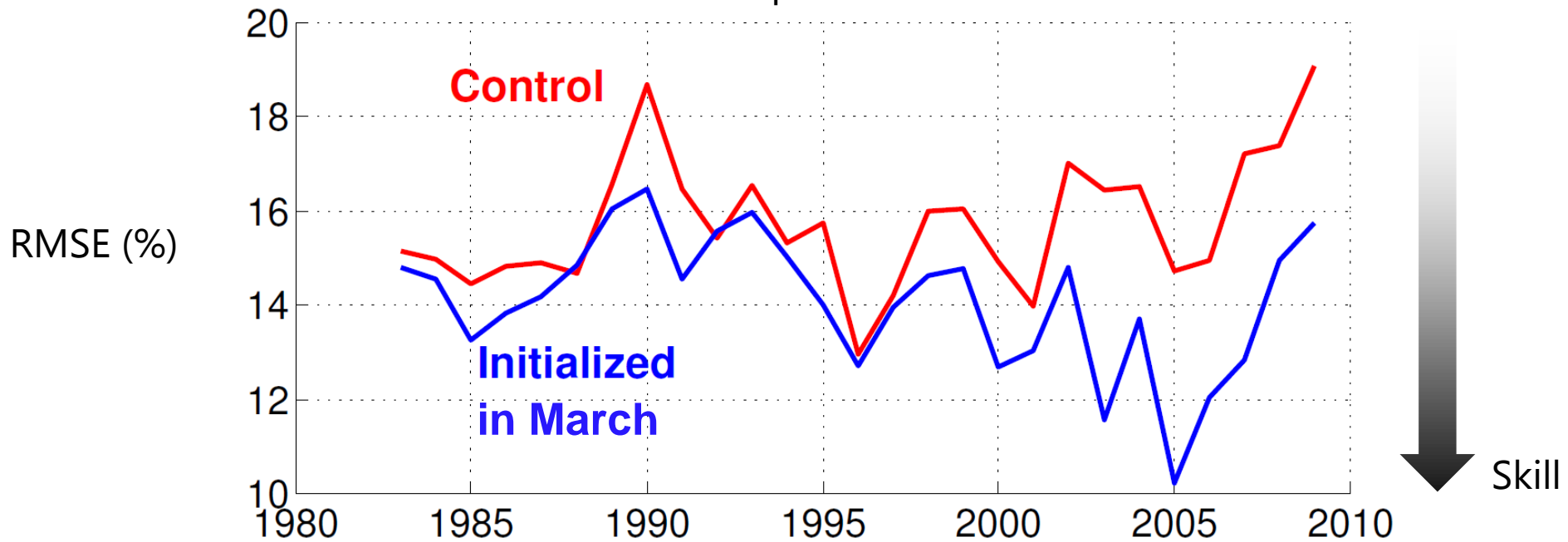
[Massonnet et al., 2014, submitted]

Available: August 2014

Sea ice data assimilation for better seasonal-to-decadal predictions

Snow • Rheology • Ocean-sea ice interactions •
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RMSE September Arctic sea ice concentration
with respect to observations



Sea ice modelling: where is LIM?

LIM is at the forefront of research

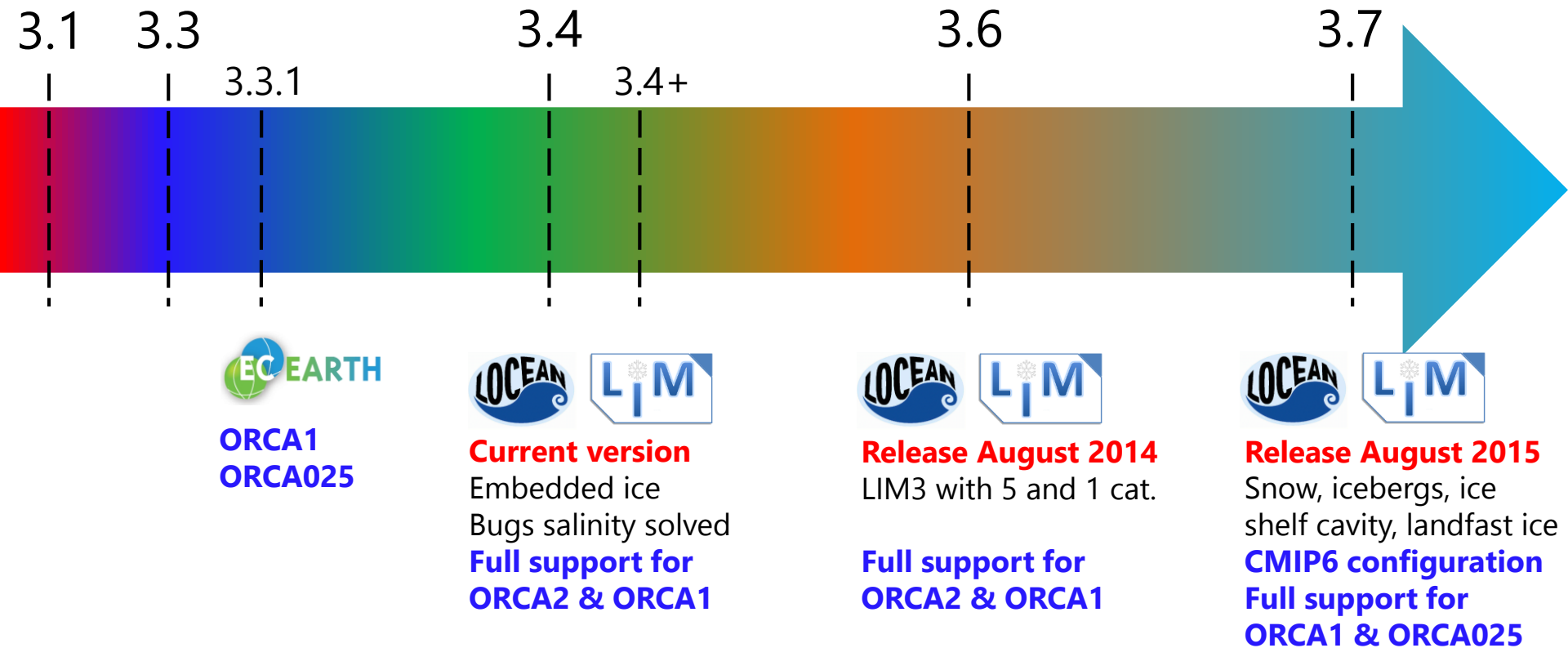
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Sea ice modelling: where is LIM?
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LIM in EC-Earth: where are we?

It is important to keep
our agendas synchronized

NEMO versions



High resolution (ORCA025, **under development**) → **NEMO DRAKKAR**

Issues are likely more
methodological than physical

EC-Earth often runs NEMO/LIM in
configurations that have not yet been tested!

LIM3 – 1 ice category never validated

LIM3 – ORCA025 never validated, not supported currently

LIM3 – ORCA025: how did you adapt the sea ice namelist?

Sustained collaborations imply more than plug-and-play

Deep problems cannot be solved by e-mails

- When stuck, make an effort to organize a visit to Paris
- Get involved: participate to NEMO Developers/Users Meeting
- Invite NEMO to EC-Earth meetings

The free use of NEMO and LIM implies duties

Please share both negative *and positive* results



Sea ice modelling: where is LIM?
LIM is at the forefront of research

LIM in EC-Earth: where are we?

Better communication is necessary



Thank you

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Issues are likely more methodological than physical

From the EC-Earth development portal

