Arctic sea ice drift modeled by NEMO-LIM3.6 at different resolutions

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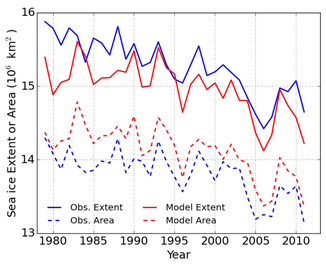
PRocess-based climate sIMulation: AdVances in high-resolution modelling and European climate Risk Assessment

1. Arctic sea ice loss from 1979 to 2011

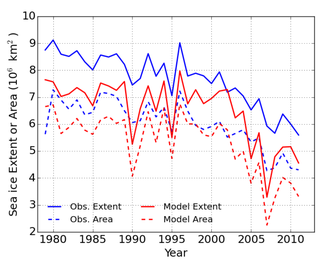
Observed by OSI SAF (SSMI, 10km)

Modeled by NEMO-LIM3.6 (ORCA2)

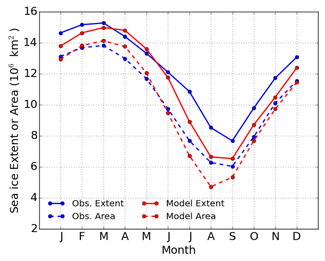
A) March (max extent)

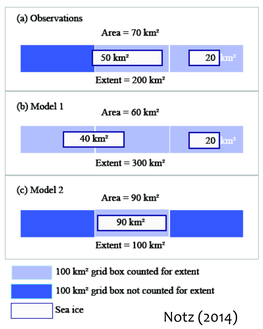


B) September (min extent)



C) Seasonal cycle



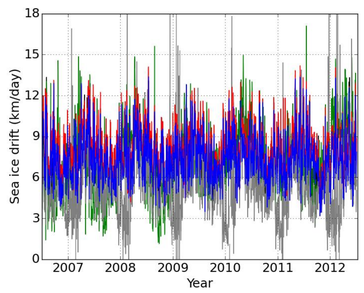


Notz (2014)

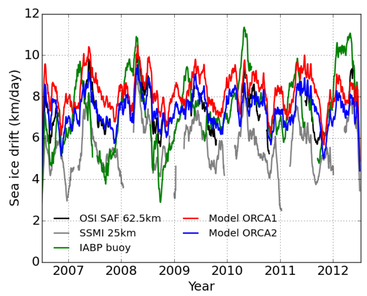
2. Sea ice drift from 2007 to 2012

Latitude ≥ 50°N, ice concentration ≥ 0.15

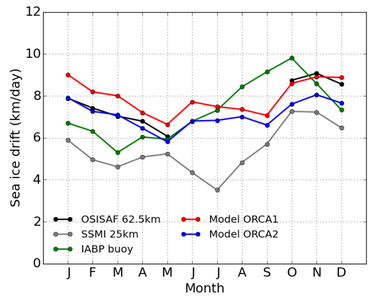
A) Raw data



B) Moving average (30 days)



C) Seasonal cycle



Modeled drift agrees well with OSI SAF observations

RMSE (km/day)	OSI SAF 62.5km	SSMI 25km	IABP buoy
ORCA1	1.8	3.0	2.7
ORCA2	1.5	2.2	2.3

3. Drivers of drift

Ice velocity is computed from momentum conservation:

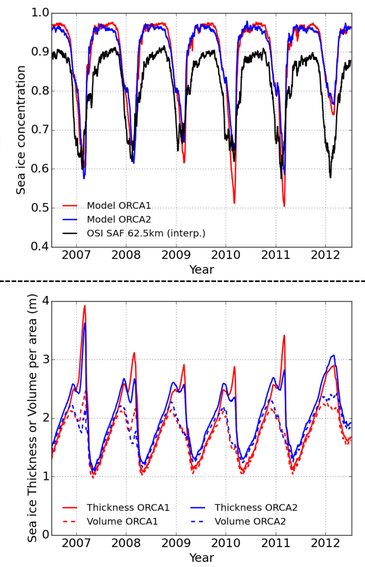
$$m\frac{\partial \boldsymbol{u}}{\partial t} = \nabla \cdot \boldsymbol{\sigma} + A(\boldsymbol{\tau}_a + \boldsymbol{\tau}_w) - mf\boldsymbol{k} \times \boldsymbol{u} - mg\nabla\eta$$

Ice internal stress — Acceleration — Wind stress — Ocean stress — Coriolis force — Ocean surface tilt

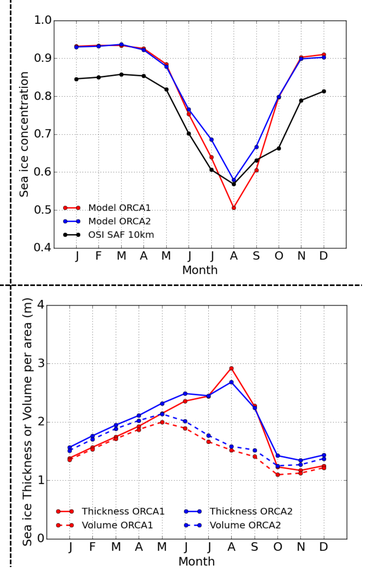
Sea ice concentration

Sea ice thickness

A) Time series 2007-2012



B) Seasonal cycle

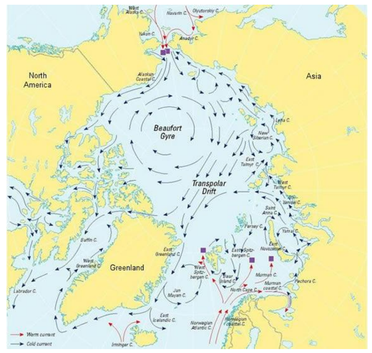


- Drift variability driven by concentration and thickness through mechanical strength; wind and ocean stresses also control ice drift
- What is the real contribution of the different drivers? See Olason & Notz (2014)
- Model overestimates concentration but matches drift: is thickness underestimated?
- Do we need to look at sea ice thickness or volume per area?

4. Spatial variability of drift

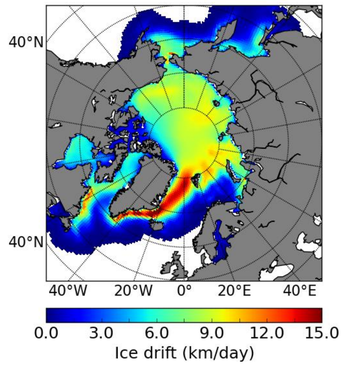
A) Arctic ocean circulation

Courtesy of AMAP



B) Modeled by NEMO-LIM3.6 (ORCA1)

Mean 2007-2012

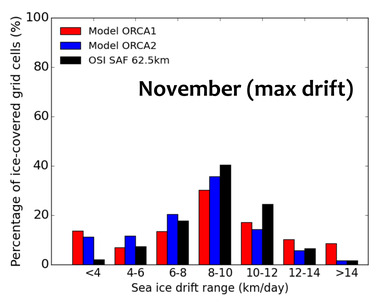


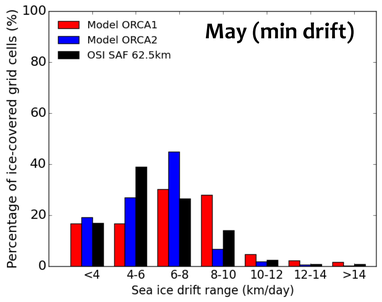
5. Frequency histograms

Mean 2007-2012

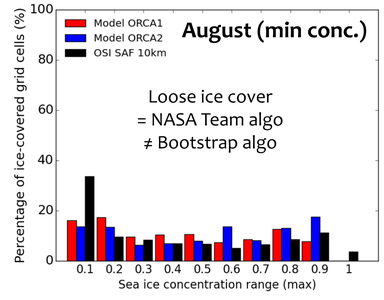
Inspired by Notz (2014)

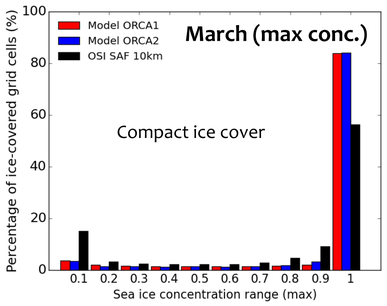
A) Sea ice drift





B) Sea ice concentration





6. Conclusions

- NEMO-LIM3.6 agrees well with OSI SAF observations in terms of Arctic sea ice extent, area and drift; differences in drift between obs. datasets
- Concentration and thickness drive drift; loose ice cover in summer
- Drift varies from one region to the other, higher at Fram Strait