

Sea ice response from NEMO-LIM3 to two atmospheric forcings

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About karaoke

“Kara” – “Oke” is much enjoyable:

- It is cheaper than singing in a band
- It allows to assess your singing performances
- Different versions of the karaoke record help
 - track your systematic errors
 - improve your voice

➔ Karaoke drills you for “live” songs

About forced model runs

Forced model runs are much enjoyable:

- They are cheaper than coupled runs
- They allow to assess model performances
- Different versions of the forcing field help
 - track the model systematic errors
 - improve the model behaviour

➔ Forced runs drill the model for “life” runs

Outline

- Aims of the experiments
- Configurations
- Results
- Discussion

1. Aims of the experiments

- Current intense research about LIM3...
 - Snow representation, data assimilation, sea ice rheology, biogeochemistry, etc. See complete description on

www.climate.be/lim

- ... whose results need to be assessed...
- ... on a cheap basis



Sensitivity of NEMO-LIM3 to different atmospheric forcings?

2. Configurations

EXPERIMENTAL DESIGN

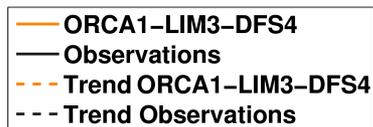
	DFS4	NCEP
<i>Model</i>	NEMO-LIM3 (www.nemo-ocen.eu, www.climate.be/lim)	
<i>Resolution</i>	Tripolar ORCA1 grid (1° resolution), 46 ocean levels	
<i>Temporal coverage</i>	50 years spinup; period of interest: 1979-2006	
<i>Melting Ice albedo</i>	Set to 0.50 during spinup; set to 0.53 afterwards.	
<i>Forcing Interpolation</i>	On-line (NEMO code)	
<i>Initial conditions</i>	Levitus (1998) climatologies	
<i>Wind forcing</i>	4-times daily (ERA40)	Daily (NCEP/NCAR)
<i>Air temperature forcing</i>	4-times daily (ERA40)	Daily (NCEP/NCAR)
<i>Humidity</i>	4-times daily (ERA40)	Monthly climatologies (Trenberth et al. 1989)
<i>Precipitation forcing</i>	Monthly climatologies (Large and Yeager, 2004)	Monthly climatologies (Large and Yeager, 2004)
<i>Radiation forcing</i>	Daily climatologies (Zhang et al. 2004)	Monthly climatologies of total cloudiness (Berliand and Strokina, 1980)

See Brodeau et al. (2009)

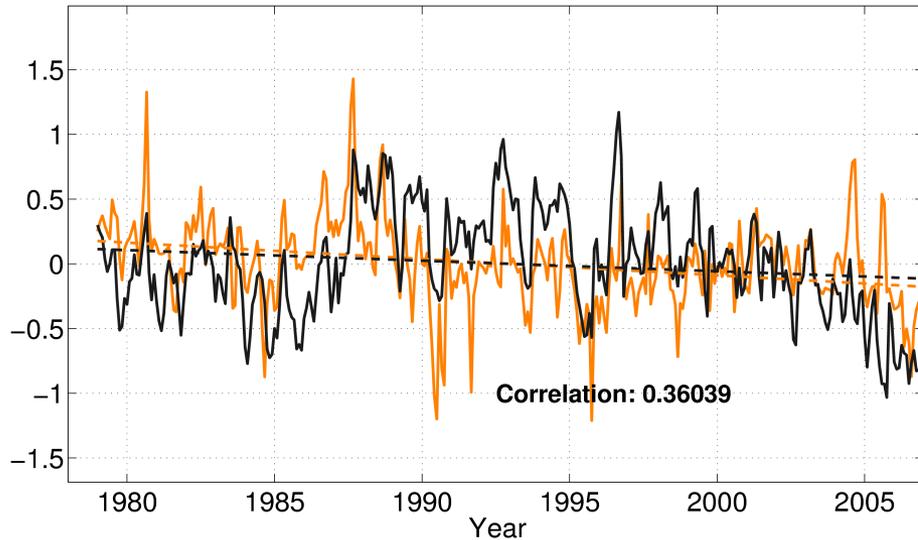
See Vancoppenolle et al. (2009)

3. Results

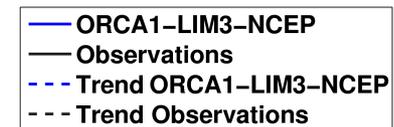
3.1 Northern Sea Ice Area monthly anomalies



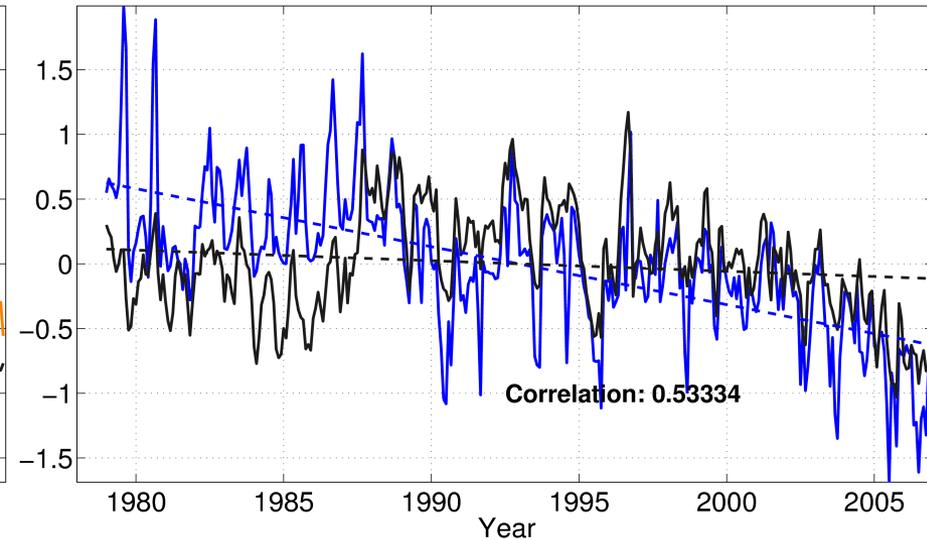
Monthly anomalies of Northern Sea Ice Area



DFS4



Monthly anomalies of Northern Sea Ice Area



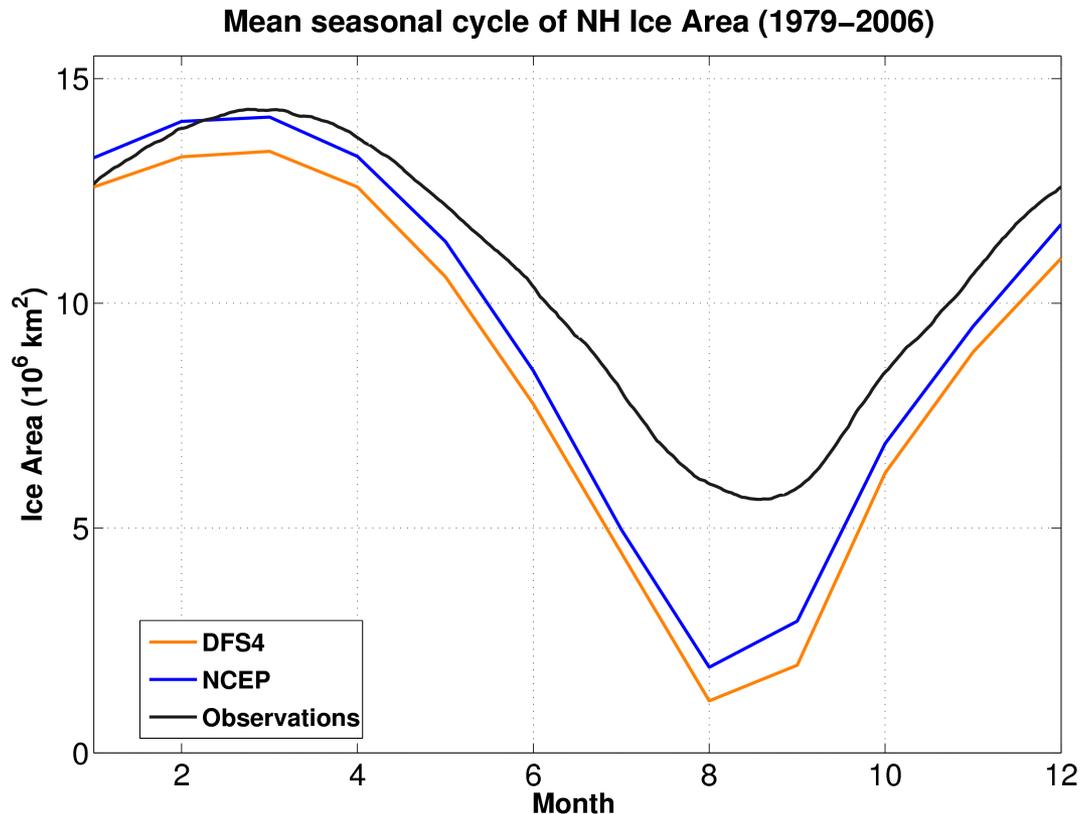
NCEP

Observations: Comiso, 2007

Correlation(**DFS4**,**NCEP**)=0.6884

3. Results

3.2 Northern Sea Ice Area mean seasonal cycle



- Winter area OK
- As ice is too thin (see next slide), ice area shrinks during summer
- Value for melting ice albedo?

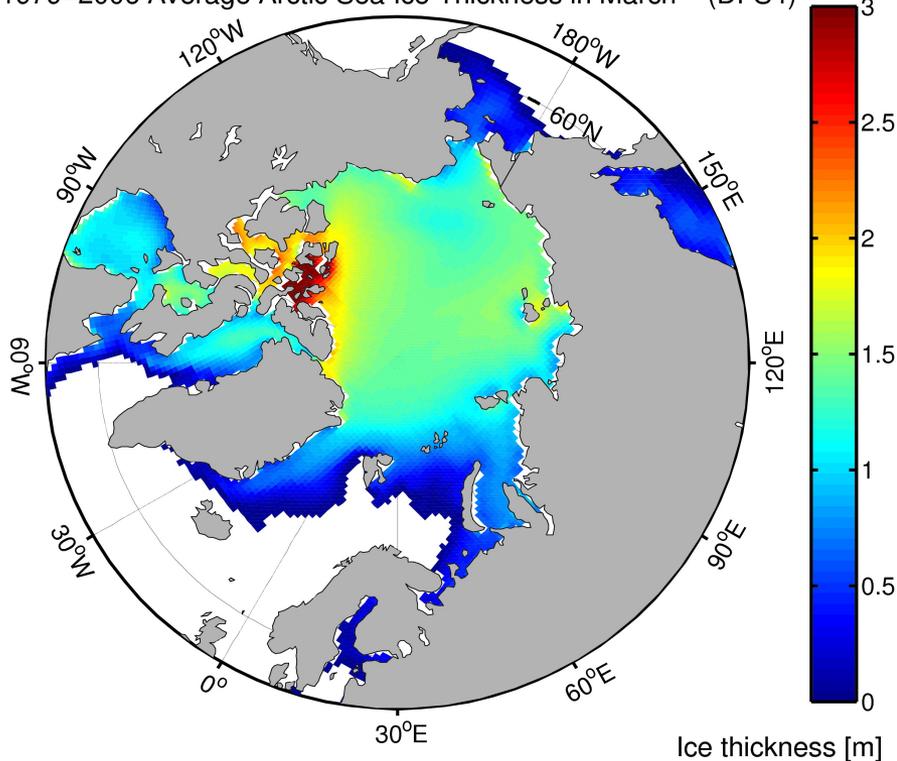
Observations: Comiso, 2007

3. Results

3.3 Average Winter Northern Sea Ice thickness

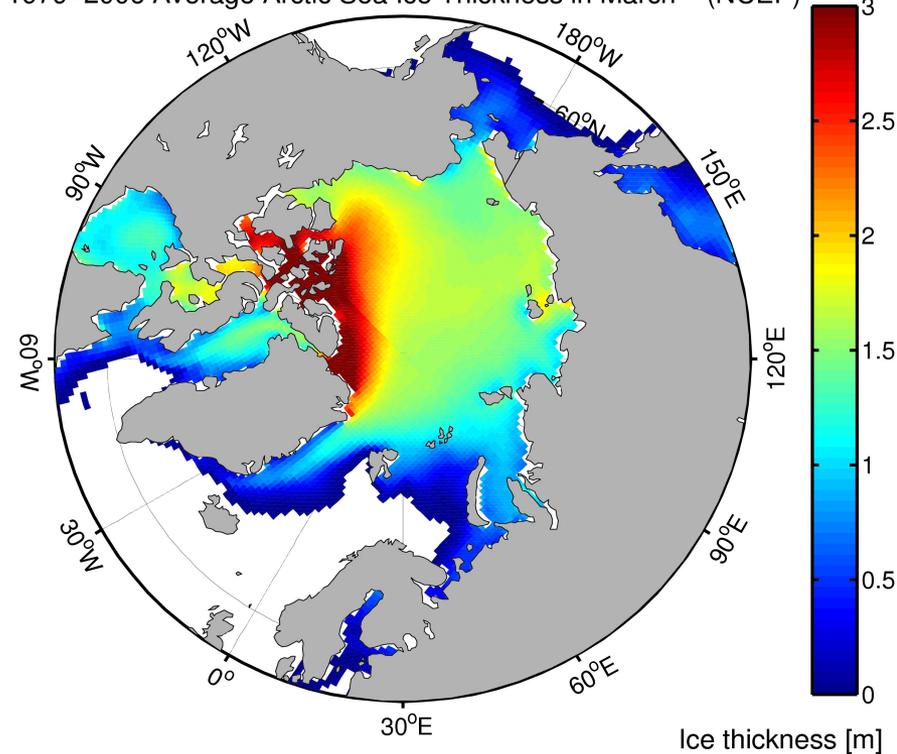
DFS4

1979–2006 Average Arctic Sea Ice Thickness in March (DFS4)



NCEP

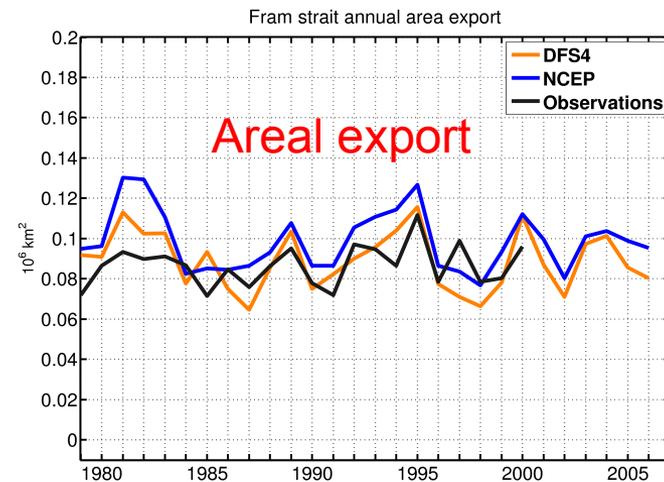
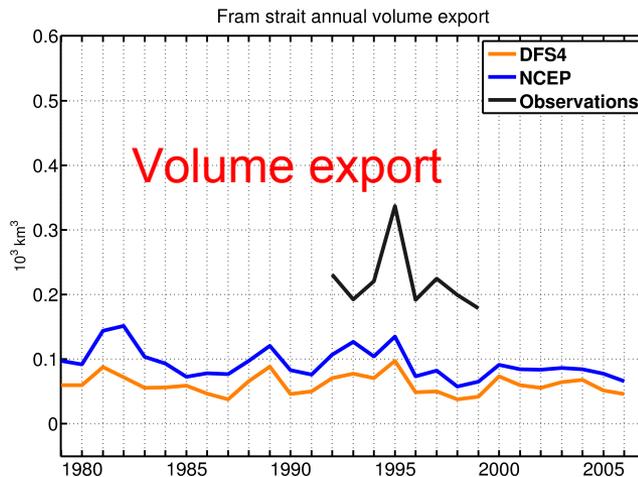
1979–2006 Average Arctic Sea Ice Thickness in March (NCEP)



Stronger thickness gradient for **NCEP**; due to higher wind speeds?

3. Results

3.4 Annual Fram Strait export

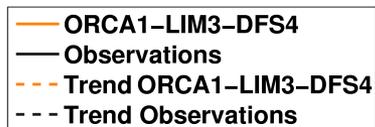


Observations: Kwok et al., 2004

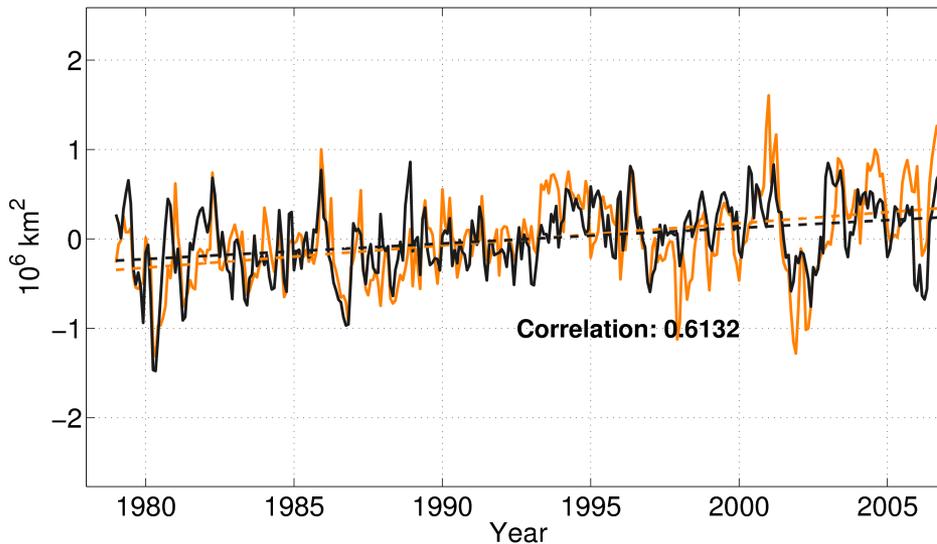
- Areal export is OK
- Volume export is not
- ➡ Sea ice is too thin inside the Arctic basin
- NCEP exports more ice than DFS4 (wind?)

3. Results

3.5 Southern Sea Ice Area monthly anomalies

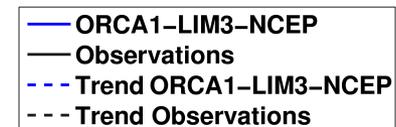


Monthly anomalies of Southern Sea Ice Area

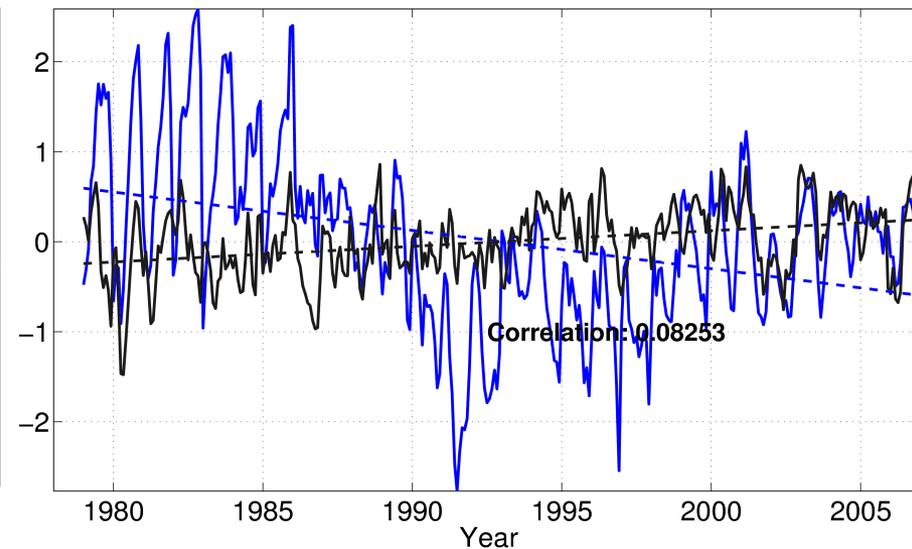


DFS4

Observations: Comiso, 2007



Monthly anomalies of Southern Sea Ice Area

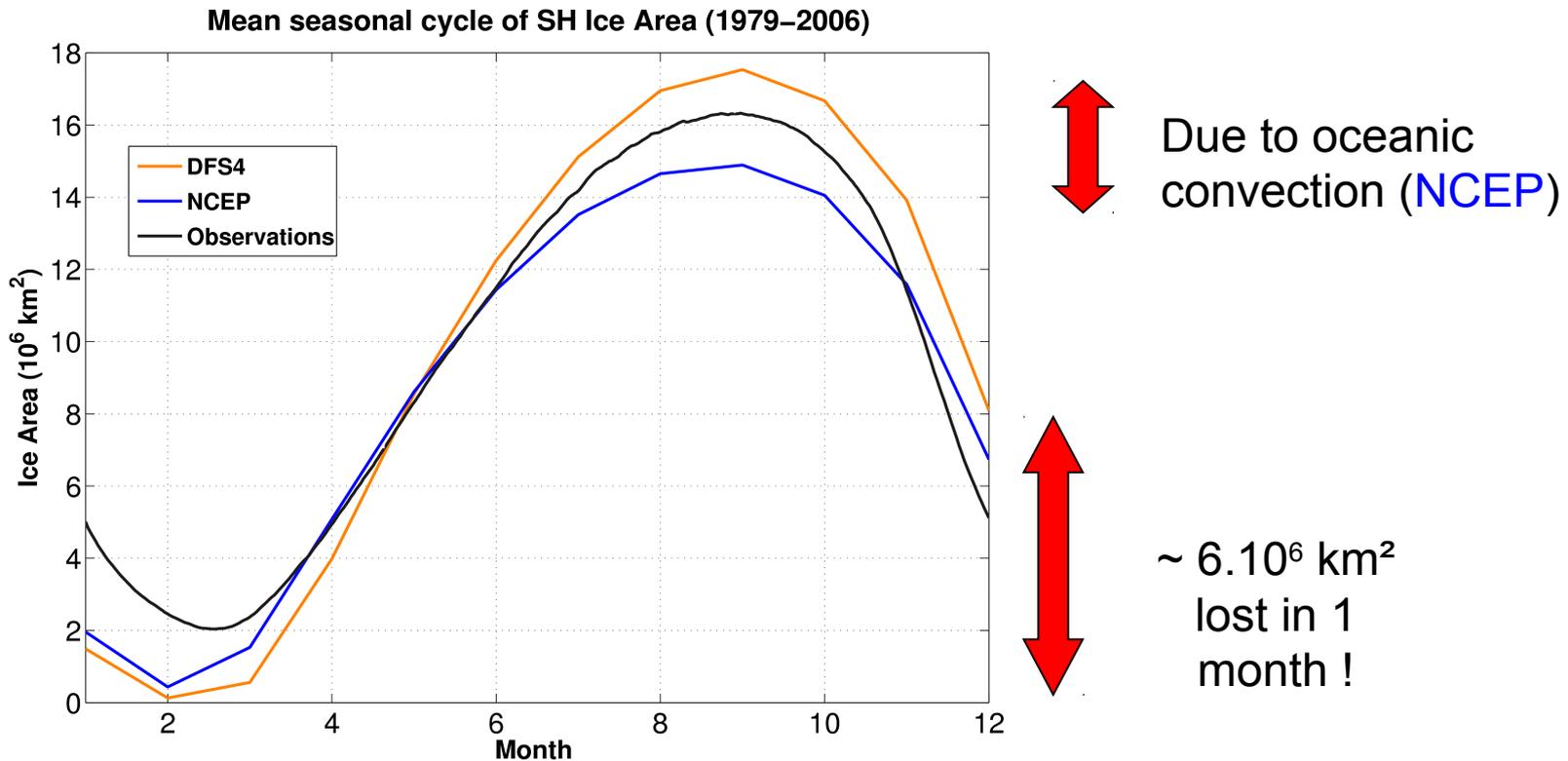


NCEP

NCEP unrealistic because of deep (wind driven?) oceanic convection

3. Results

3.6 Southern Sea Ice Area mean seasonal cycle



4. Discussion

- Don't forget that we used LIM3 in **forced** configurations.
- Wind seems to play a important role regarding ice thickness distribution in the northern Hemisphere → next step: compare the wind fields from the two forcings. No forcing definitely chosen yet; other metrics than simple correlation are going to be tested!
- Instabilities in the Southern Hemisphere (NCEP) have to be fixed.
- For both forcings, ice is too thin (which leads to drastic shrinking in summer ice area); we will have a particular look at the thermodynamics of the model sea ice to tackle this issue. Original melting ice albedo could be the reason for this underestimation.
- Effect of sea ice concentration and thickness initial conditions?
- ORCA1 resolution adapted to EC-Earth experiments → feel free to contact me later on.

References

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