

Faculty of Science

Modeling of the sea ice and the ocean in the Nares Strait

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February 8th, 2011

Outline

- Purpose, motivation and setup
- Ice cover and flux
- North Water Polynya
- Ocean





Purpose

 One step towards an update of the operational system at dmi

- Flow (ocean and ice)
 through the Nares Strait
 limited described by models
- Challenging area for models
- One of the main sources for export of sea ice and fresh water from the Arctic
- Main focus of this talk is a validation with a 3 year hindcast





Domain

- Grid size 4-10 km
- 110x180x22 grid points
- Minimum 8 grid points across the strait
- Flow of sea ice and water is generally towards south
- Local winds are important



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Overview Coupled model

- HYCOM: hybrid vertical Layered ocean model
- CICE: dynamic (EVP) and thermodynamic sea ice model
- Lateral boundary conditions:
 - Salt
 - Temperature
 - Currents (baroclinic and barotropic)
 - Barotropic pressure
 - Sea ice volume and energy
- Bathymetry: Etopo 1



Simulation

	Hind cast
Purpose	Test of timing of events and validation of model setup
Lateral boundary	15km HYCOM+EVP sea ice (Nansen center)
Atmospheric forcing	HIRLAM 5km
Period	September 2005 – August 2008





Variation of the relative ice cover 2006–03–01

- March 2006 August 2007
- Full ice cover in winter
- •Baffin Bay and Nares Strait ice free/ almost ice free





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0.5

Ice flux – satellite observations

- 1996 2002
- 3 day drift averages
- Annual area ice Flux:
 15 45x10³km²y⁻¹
- 06/07: 80x10³km²y⁻¹
- Assumes 4m thick ice
- Source: Ron Kwok (2005+2010)







	Area flux 10x ³ km²/year	Volume flux Km ³ /year
2006	14	20
2007	69	120

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App. 80% of what is measur	ed
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Modeled sea ice cover compared to satellite images



North Water Polynya

- Latent heat polynya: Sea ice is advected away from the coast and new ice is formed due to latent heat
- Inuit's know the place as a dangerous but great place to hunt
- Earlier spring bloom, large biological activty





Early opening 2006



Summer opening 2006 ice cover model (M) and satelite (S)



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SST model (M) and satelite (s)





M 9/6

M 19/6

M 29/6 S 19/6 S 29/6



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Summer opening 29/6 2006



- Heat flux keeps polynya open
- No sign of upwelling



°C

T/S profiles





Database source: Kliem and Greenberg (2003)

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General ocean flow

- Ssh Gradient in the Nares Strait
- Current from Greenland and round
- General flow is southward







- Expected volume flux 0.5 1 Sv
- Fresh water flux
- 25 msv
 (Münchow, Rabe + others)

	Volume Flux (Sv)	Freshwate r flux (mSv)
2006	0,6	12
2007	0,9	18
2008	1,3	29





Conclusions

- General ice cover agrees reasonably
 well
- Modeled ice cover is slightly higher in winter and slightly lower in summer
- Large variation of the sea ice flux. Slightly less than measured by satellite images
- Volume ice flux is lower than expected due to too thin ice
- Ice flux is Connected to the formation of the ice bridge





Conclusions

- Modeled ice bridge is not as stable as the observed
- North Water Polynya in February opens at the same time as the measurements
- Heat flux from the atmosphere keeps polynya open in summer
- Reasonable oceanic transport



Thank you for your attention Questions?