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Using Ocean & Ice-sheet models to inform observations

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Overview

Using ice & ocean models to inform observations

Limits to using models to inform observations
- Uncertainties

Multi-model multi-institutional comparison projects
- MISOMIP
- ISMIP6
- OIE

A request

Closing thoughts

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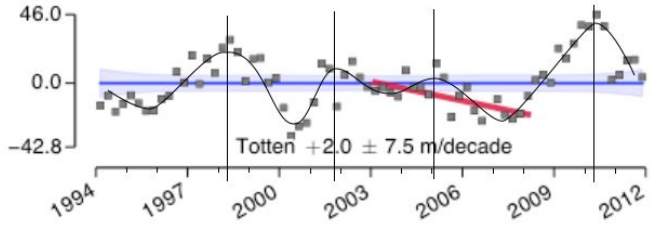
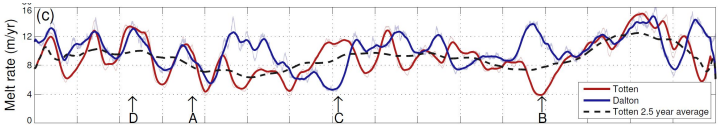
Using ice & ocean models to inform observations

- Multi-modal variability
- Longer observations require to detect and attribute change
- Minimum observation length



Paolo et al., 2015



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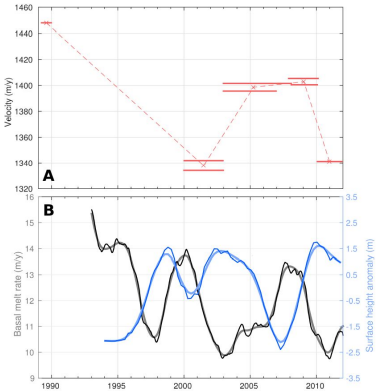

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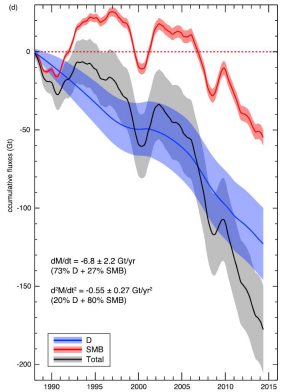

Li et al., 2016

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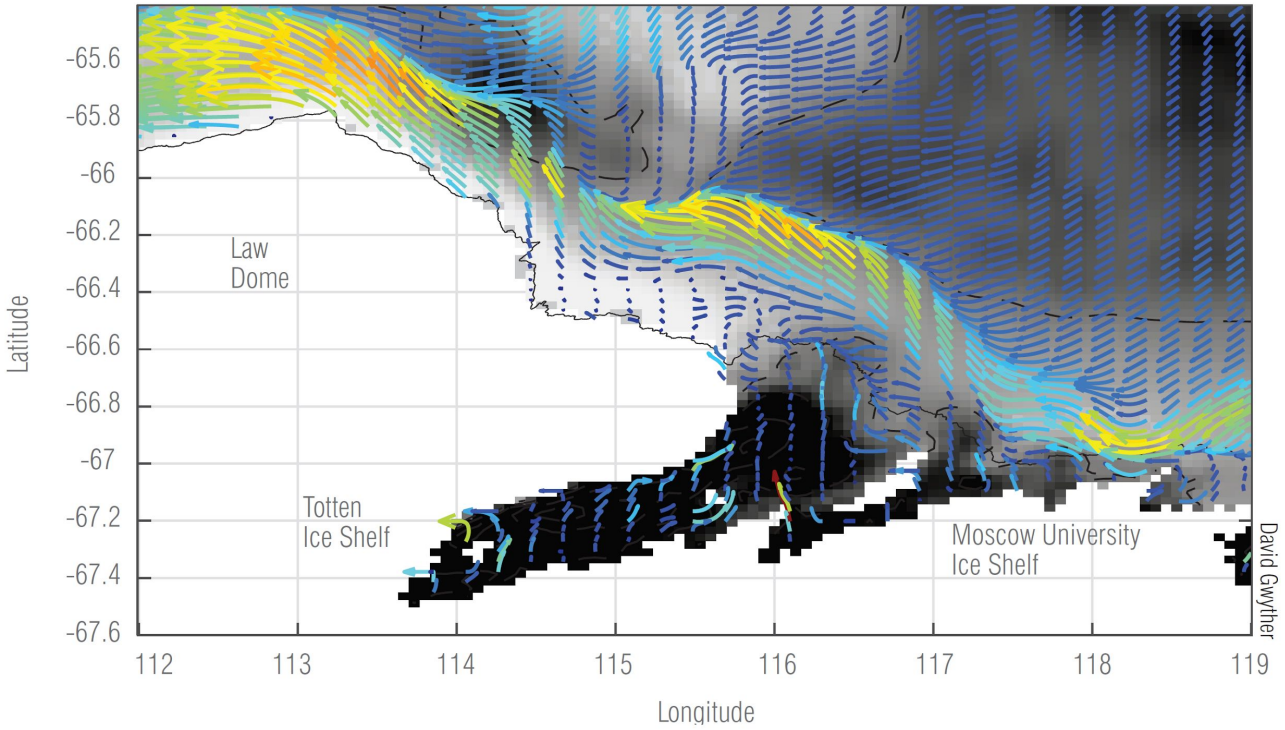
Using ice & ocean models to inform observations

Advantages of models

- Cheap, fast
- Self-contained lab
- Models work
- Guide observations



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Limits to using models to inform observations

- Limitations in model framework requires simplifications
- Approximations and assumptions within parameterisations
- Poorly understood processes
- Model complications, including choice of initial and boundary conditions
- Different models

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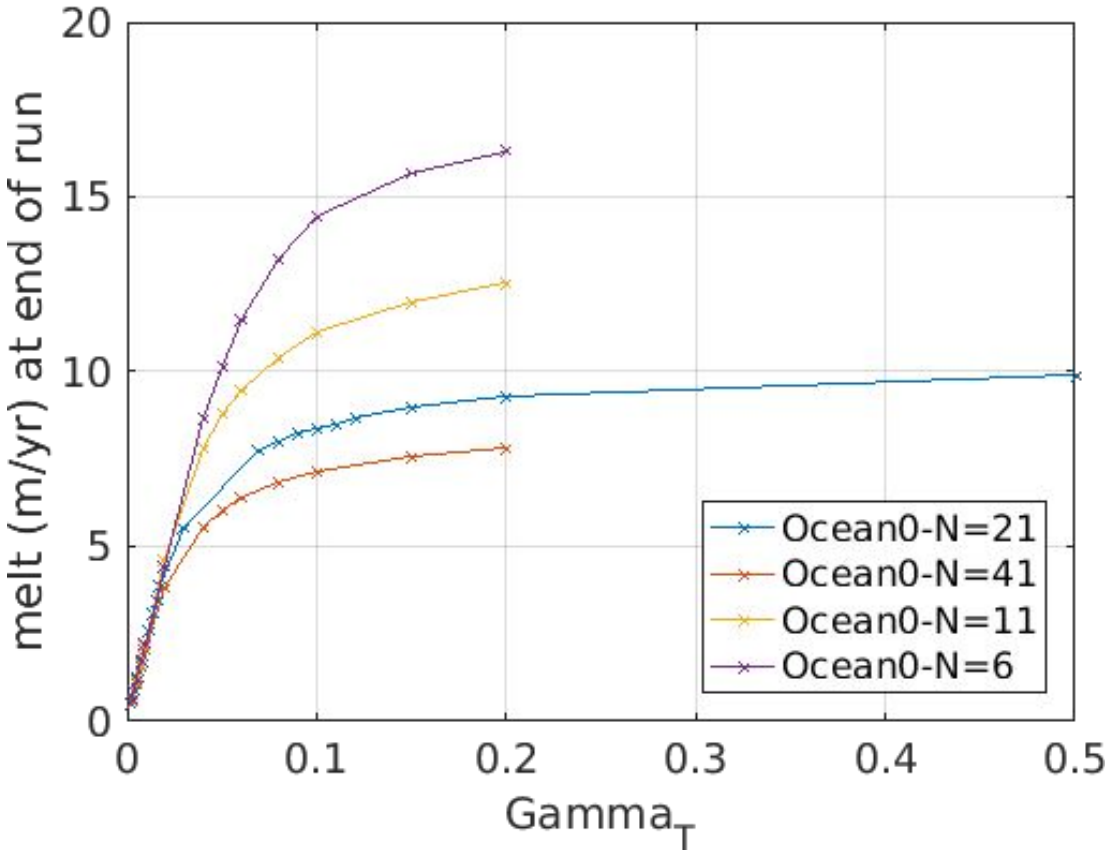
Limits to using models to inform observations

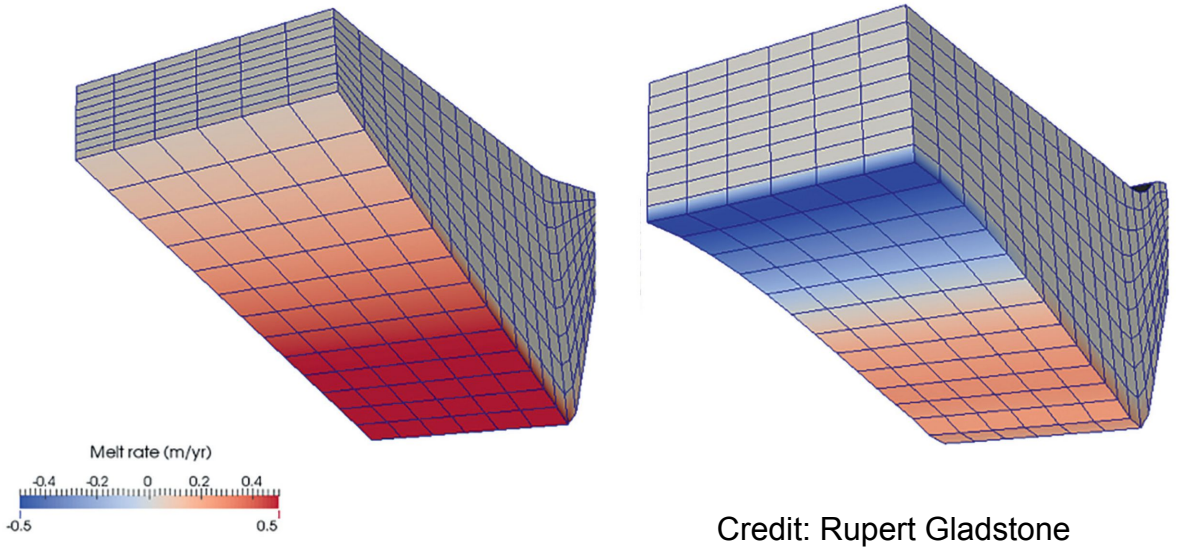
Parameterisations example: Vertical resolution dependency of basal melt rates seen across all models.



Limits to using models to inform observations

Coupling

- Need full ice sheet & ocean coupling to model ocean-driven mass loss.
- Grounding line retreat
- MISI
- Ice sheet feedbacks
- MISOMIP progress



Credit: Rupert Gladstone

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Limits to using models to inform observations

- Key process/tool for linking ice/ocean interaction - needs investment
- Data assimilation and associated challenges
- Parameterisation and model uncertainties limit ability to constrain ocean properties via observations of ice sheet processes.

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Multi-model multi-institutional comparison projects

MISOMIP (Marine Ice Sheet-Ocean Model Intercomparison Project)

CliC targeted activity: David Holland lead. Meetings in 2014, 2016 and 2018. So far three sets of idealised experiments:

- ISOMIP+: Ice/ocean model intercomparison
- MISMIP: Marine ice sheet model intercomparison
- MISOMIP: Marine ice sheet/ocean model intercomparison (coupled)

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Multi-model multi-institutional comparison projects

ISMIP6 (Ice Sheet Model Intercomparison for CMIP6)

- CliC targeted activity: Tony Payne and Helene Seroussi links with MISOMIP
- Bring ice sheet model intercomparisons in line with CMIP community
- Feedbacks and forcings from Atmosphere-Ocean-GCMs
- Requires parameterisations/downscaling for ocean forcing of ice sheets

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Ocean and Ice sheet Ensembles (OIE) project

Motivation:

- Ocean-driven Antarctic mass loss large uncertainty in future SLR
- No broad-scale comparison and evaluation of ocean-ice sheet interaction

Aim:

- A coordinated multi-institute, multi-model comparison of realistic ocean and ice sheet models
- Integration and coordination between modelling and observational studies
- Improve detection and attribution of ice sheet mass change and ocean state.

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OIE phase 1: MISOMIP extension R-ISOMIP

Realistic Ice Shelf Ocean Model Intercomparison Project: R-ISOMIP

Objectives:

- Estimate of model spread and precision
- Assess present-day basal melt rate and ocean states
- Guide the future direction of observations on and beneath ice shelves and sea ice
- Provide ensemble estimates of basal melting under future climate change
- Develop appropriate parameterisations for ice sheet models
- Inform ice sheet model ensembles and guide future ice sheet observations

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R-ISOMIP

- Evaluation of ensembles with observations: e.g. ApRES. *Coordinated ocean observation synthesis for evaluation!*
- Focus regions: Totten, Thwaites, Ross, Amery, Filchner-Ronne, others
- Goal: Initial evaluation of existing models (right) by May 2018.

Ocean Model	Host Institute
MOM	GFDL, USA
MITgcm/ECCO2	JPL, USA
MITgcm	BAS, UK
FESOM	AWI, Germany
BRIOS	AWI, Germany
POP2X / MPAS-O	LANL/Potsdam, USA/Germany
MetROMS - CAISOM	MetNO/ACE CRC, Norway/Australia
COCO	ACE CRC/AORI, Australia/Japan
NEMO	Grenoble, France
ROMS - ACIMA	ODU, USA
Emulator	LANL/Potsdam, USA/Germany

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R-ISOMIP

- Evaluatio
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  synthesis
- Focus reg
  Ross, Am
  others
- Goal: Initi
  models (ri

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MOM	GFDL, USA
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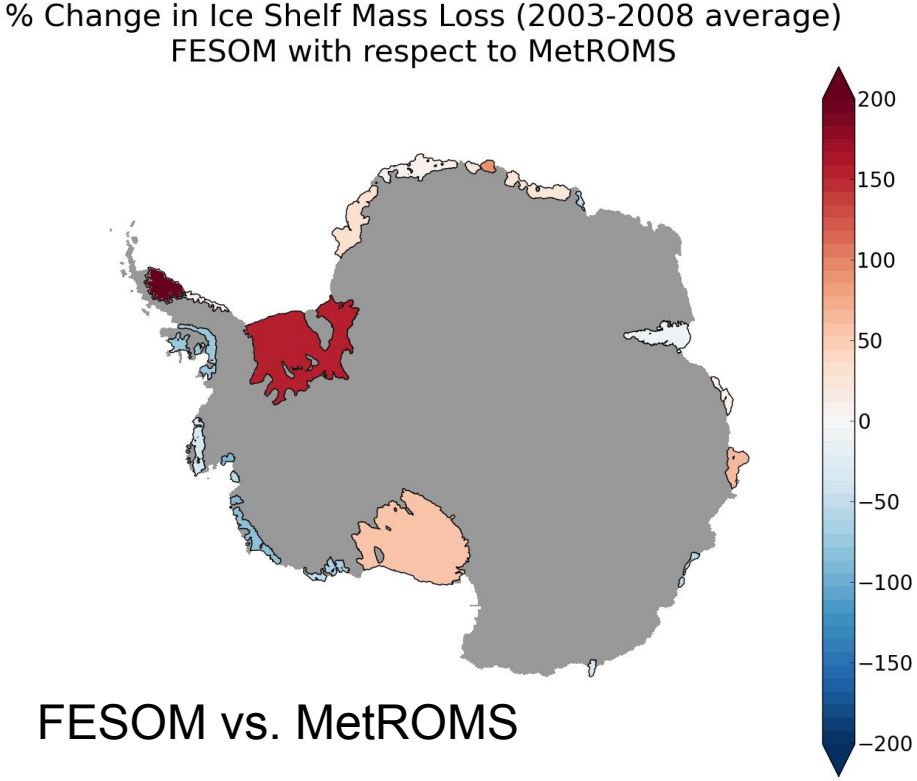
	Potsdam, ermany
	ACE CRC, /Australia
	RC/AORI, a/Japan
	e, France
	SA
	Potsdam, ermany



FESOM vs. MetROMS

Kaitlin Naughton (UNSW, UTAS)

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Possible R-ISOMIP meetings

Dates approx.	Meeting	Location
2018.Q1	ISMIP6 ?	London, UK
2018.Q2	MISOMIP	Abu Dhabi, UAE
2018.Q3	Polar2018	Davos, Switzerland
2018.Q3	FRISP	TBA
2019 June	IUGG	Montreal, Canada
2019.??	TBA	
2020	SCAR OSC	Hobart, Australia
2021	TBA	

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A request

As a modeller, often not sure of best way to help observations.

What data do you want/need for planning, during and after expeditions?

What kind of data do you want?

How can models best guide targeted observations?

What kind of experiments are the most useful for interpreting observations?

Leverage the best aspects of models and observations to produce the best science that we can.

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Closing thoughts

- Observations and models serve complementary roles in understanding the oceans and ice sheets
- Large multi-institute multi-model comparisons allow models and parameterisations to be improved, but need coordinated observations for evaluation
- Models as a tool to guide targeted observations to key regions
- Targeted observations to improve models
- What specific model output do you need to planning, ops and analysis?

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Thank you!

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Using ice & ocean models to inform observations

Challenges of observations

- Sea ice prevents access to deploy or retrieve instruments
- Icebergs can damage moorings, etc
- Snowfall can bury antennae and solar panels - need to revisit
- Produces low spatial resolution or short temporal span measurements

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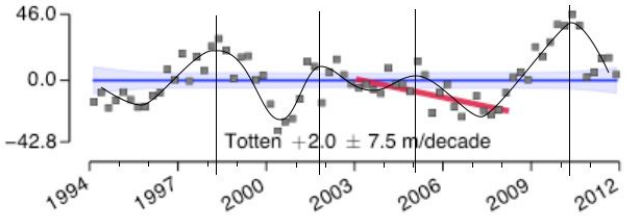
Using ice & ocean models to inform observations

Short sample length

- Shorter period observations may not capture trend
- Longer observations require to detect and attribute change
- Intrinsic variability present may determine a minimum observation length



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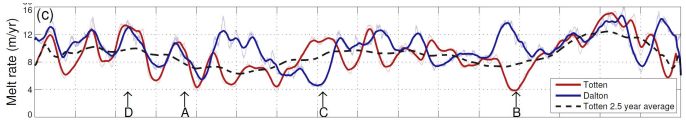

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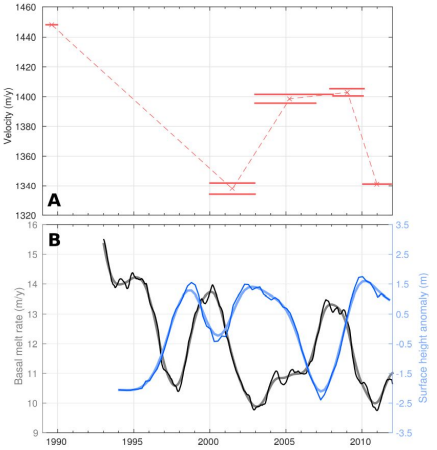

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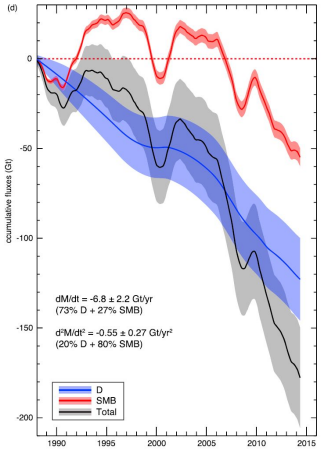

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