

Ice Sheet System model

What ISSM cannot do (yet)

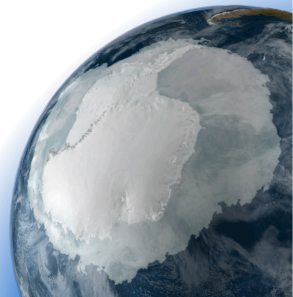
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Missing capabilities

Larour et al.

Ice models

Basal conditions

Inversion and data
assimilation

Ice/atmosphere
interactions

Ice/ocean interactions

Other capabilities

Numerics

Outline

- 1 Ice models
- 2 Basal conditions
- 3 Inversion and data assimilation
- 4 Ice/atmosphere interactions
- 5 Ice/ocean interactions
- 6 Other capabilities
- 7 Numerics

Missing capabilities

Larour et al.

Ice models

Ice models

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Other capabilities

Numerics

- Ice anisotropy not included (ice fabrics)
- Ice considered isotropic
- Cold ice model used in thermal model
- No polythermal ice
- Moving grounding line based on hydrostatic equilibrium
- Not implemented for full-Stokes (based on contact mechanics)
- Ice front and margins fixed in time, no calving law
- Calving rate equal to ice velocity

Missing capabilities

Larour et al.

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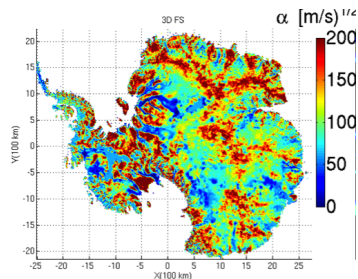
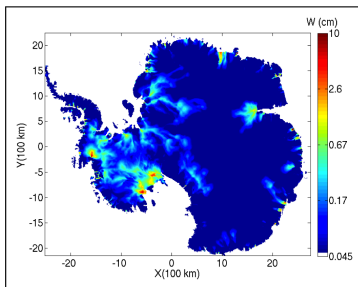
Other capabilities

Numerics

Basal conditions

- Basal friction fixed in time
- Hydrology not coupled to basal friction
- Sub-glacial hydrology only

→ No englacial hydrology



Missing capabilities

Larour et al.

Ice models

Basal conditions

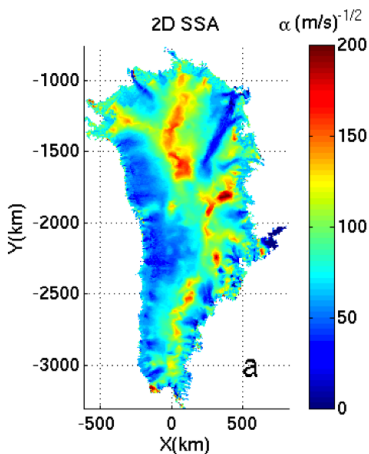
Inversion and data
assimilationIce/atmosphere
interactions

Ice/ocean interactions

Other capabilities

Numerics

Inversions and data assimilation



Inversions limited to:

- Ice rheology
- Basal friction
- Ice thickness consistency with velocities

→ Assimilation for a given time

Missing capabilities

Larour et al.

Ice models

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Other capabilities

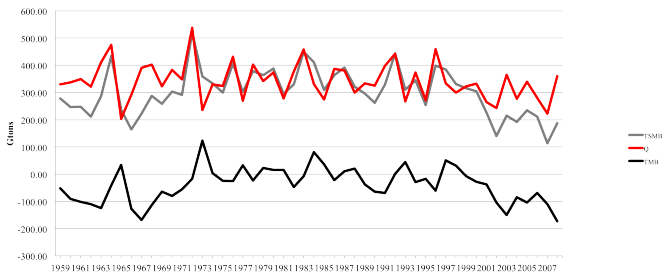
Numerics

Ice/atmosphere interactions

Interaction between ice and atmosphere not modeled

- Surface mass balance transformed into ice
- No PDD model (Positive Degree Day)
- Snow instantaneously transformed into ice
- No firn compaction

Timeseries: Total Surface Mass Balance (TSMB), Discharge (Q), and total Mass Balance (TMB)



Schlegel et al., in preparation

Missing capabilities

Larour et al.

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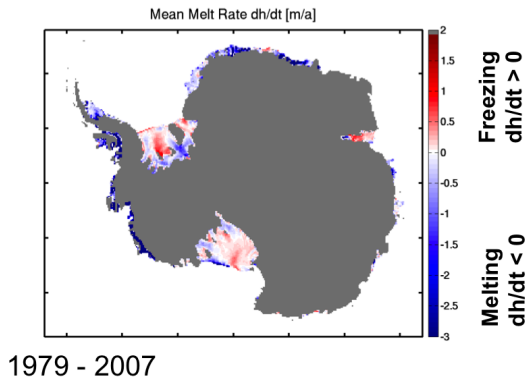
Numerics

Ice/ocean interactions

Interaction between ice and ocean not included

- Melting rates under ice shelved prescribed
- Sea level fixed at $z = 0$

→ ECCO3 project to couple ocean and ice models



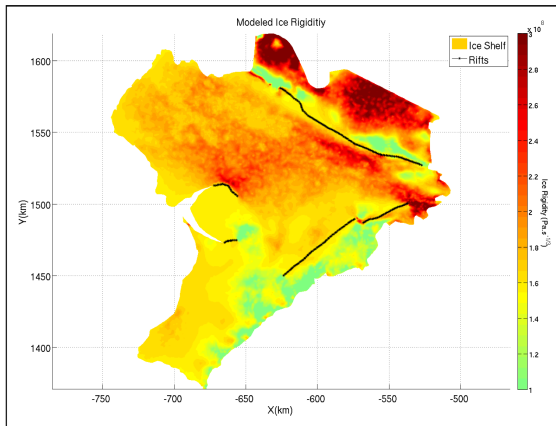
Schodlok et al., submitted

Missing capabilities

Larour et al.

Other capabilities

- Post-glacial rebound
- Rift propagations



Missing capabilities

Larour et al.

Ice models

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Other capabilities

Numerics

Numerics

- Only triangle (2D) and prismatic (3D) elements
- No quadrangle elements
- Only P1 (piecewise linear nodal functions)
- No quadratic or higher-order interpolations
- Non-linear iterations based on Picard method (fixed-point)
- No Newton iterations
- Direct solver used for full-Stokes model
- No scalable solver (iteratif solver)

Thanks!

