ISSM Workshop 2014

Ice Sheet System model

Application to the ISMIP Intercomparison

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BASED ON ISSM TEAM WORK,

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How To

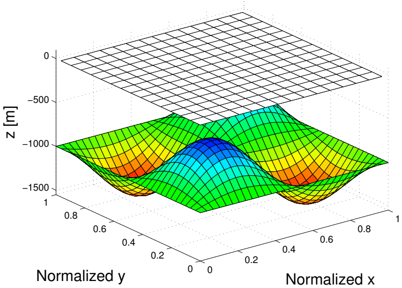
The `runme` file and `*.par` files are giving a layout of the simulation that have to be written down.

- Each code line that have to be typed in is preceded by `%->`
- Keywords introduced by `#` should be typed in Matlab to get informations

The corresponding `Cheaty` files have been completed, you can refer to them if stuck.

Test A

Square ice sheet flowing over a bumpy bed



- Sinusoidal bedrock
- Ice frozen on the bed
- Periodic boundary conditions

Description of test in `ismiphom_description.pdf`

Simulation Layout

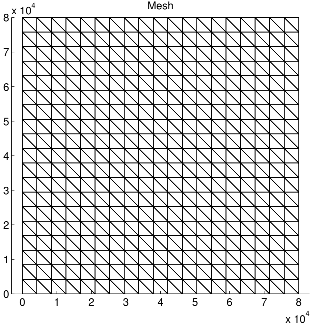
The simulation file `runme.m` is organized into different steps each with the same structure

- model loading
- performing an action
- model saving

The step specifier `step` is defined at the top of the `runme` file.
Each step is enclosed in an `if` loop in which the `perform` keyword act as a counter and updates the simulation name.

Mesh

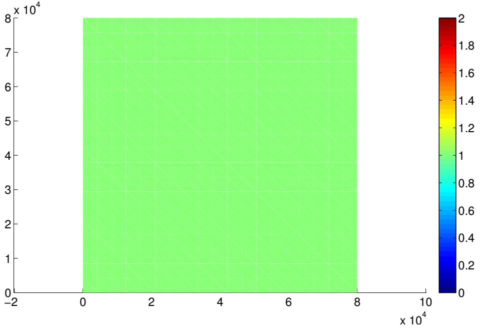
In place of loading a preceding model we initialize one
The action here is the generation of a mesh



Mesh size : 80000 m
Nodes in each direction : 20

Set Mask

Load the `Mesh_generation` model
The action here is the set-up of the grounded mask



Mesh size : 80000 m
Nodes in each direction : 20
All grounded : default

Parameterization

Load the `SetMask` model
The action here is to parameterize the model
Parameterization takes place in the

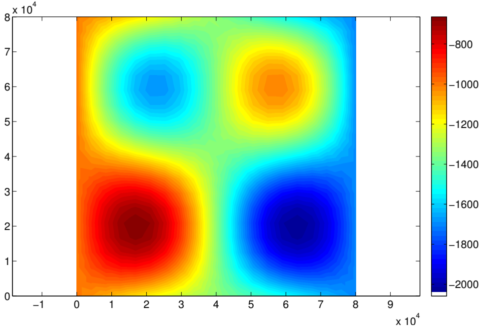
`IsmipA.par` file and regroups

- The geometry
- The basal conditions
- The material parameters
- The default BC

Mesh size : 80000 m
Nodes in each direction : 20
All grounded : default

Geometry

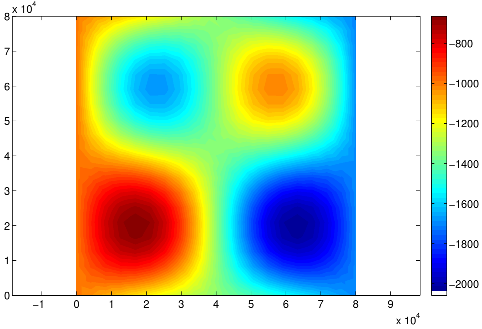
- surface: $s(x,y) = -x \tan(0.5)$
- base: $b(x,y) = s(x,y) - 1000$
  $$+500 \sin\left(\frac{2\pi x}{L}\right) \sin\left(\frac{2\pi y}{L}\right)$$
- thickness: $h(x,y) = s(x,y) - b(x,y)$



Mesh size : 80000 m
Nodes in each direction : 20
All grounded : default

Basal condition

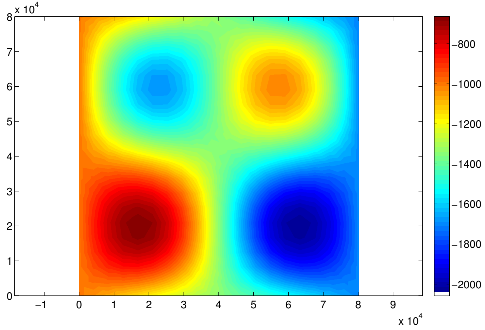
The value are not important as we are dealing with a no-sliding flux.
These will be overridden by the basal boundary conditions.
Take care of the size of the parameters



Mesh size : 80000 m
Nodes in each direction : 20
All grounded : default

Rheology and default BC

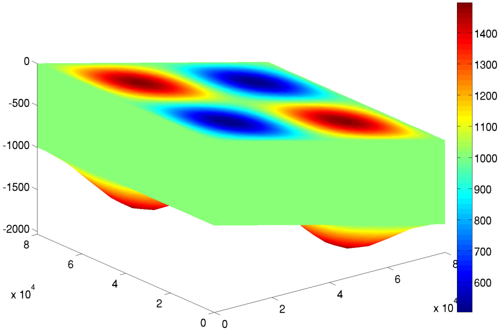
Take care of the size of the parameters
More specific Boundary Condition will be appended in the `runme` file.



Mesh size : 80000 m
Nodes in each direction : 20
All grounded : default
Ice-flow parameter:
$B = 6.8067 \times 10^7$ Pa $s^{1/n}$
Glen's exponent: $n = 3$

Extrusion

Load the `Parameterizization` model
The action here is to extrude the preceding mesh
Save the model



Mesh size : 80000 m
Nodes in each direction : 20
All grounded : default
Ice-flow parameter:
$B = 6.8067 \times 10^7$ Pa $s^{1/n}$
Glen's exponent: $n = 3$
5 layers extrusion

Flow equation

Load the `Extrusion` model
The action here is to define the ice flow model approximation
Save the model

Mesh size : 80000 m
Nodes in each direction : 20
All grounded : default
Ice-flow parameter:
$B = 6.8067 \times 10^7$ Pa s$^{1/n}$
Glen's exponent: $n = 3$
5 layers extrusion
flow model: HO

Boundary conditions

Load the `SetFlow` model
The action here is to refine the boundary conditions
No sliding at the base
Periodic boundaries on the sides
The `find` command give subsets of matrices based on boolean operations
Save the model

Mesh size : 80000 m
Nodes in each direction : 20
All grounded : default
Ice-flow parameter:
$B = 6.8067 \times 10^7$ Pa $s^{1/n}$
Glen's exponent: $n = 3$
5 layers extrusion
flow model: HO

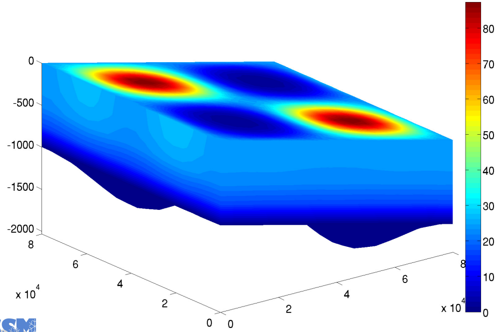
Solve model

Load the `BoundaryCondition` model

The action here is

- to set the cluster
- to set the am mount of output
- to solve the model

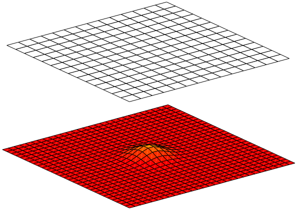
Save the model



Mesh size : 80000 m
Nodes in each direction : 20
All grounded : default
Ice-flow parameter:
$B = 6.8067 \times 10^7$ Pa $s^{1/n}$
Glen's exponent: $n = 3$
5 layers extrusion
flow model: HO

Test F

Square ice sheet flowing over a bump

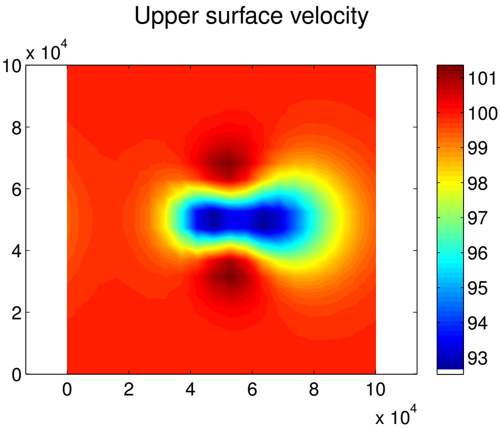


- Gaussian bumped bedrock
- Ice frozen or sliding on the bed
- Periodic boundary conditions
- Transient model until steady-state

Actual Work

- In the `runme` file update the `ParamFile` value
- Fill up the new parameter file `IsmipF.par` with the geometry the new friction parameters the rheology ...
- Complete step8 to take into account the fact that the simulation is transient

Results


Upper surface velocity
x 10^4
10
8
6
4
2
0
0
2
4
6
8
10
x 10^4
101
100
99
98
97
96
95
94
93