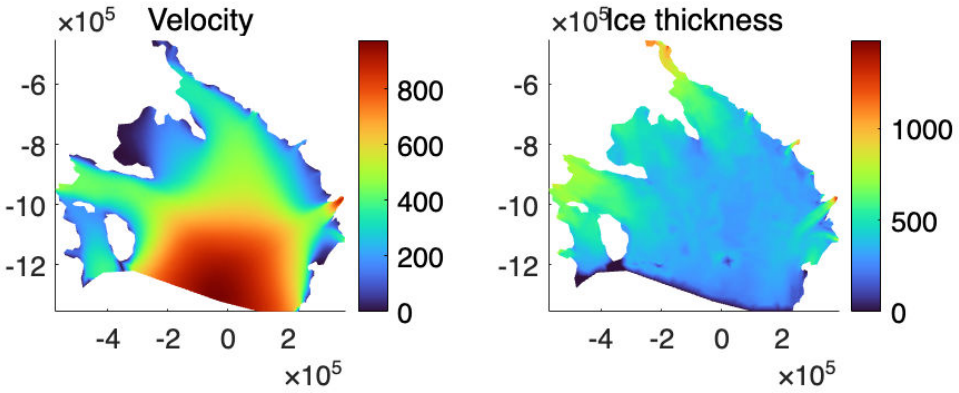
```
% Load the model we have derived from the inversion (only for the ice shelf
% -- which means the mds model)
cd '/Users/rishi/Desktop/ISSM-macOS-Silicon-MATLAB/examples/Pig/Models'
md = loadmodel('Ross_Inversion_Bedmachine.mat')
```

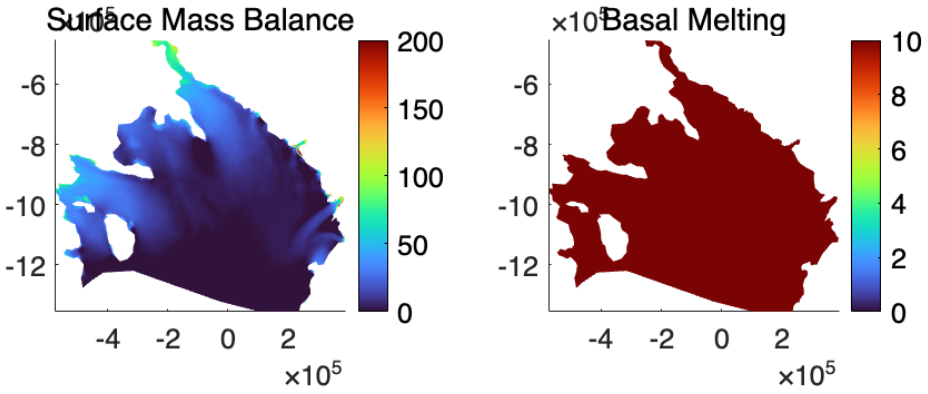
```
md =
               mesh: [1x1 mesh2d]            -- mesh properties
               mask: [1x1 mask]              -- defines grounded and floating elements
           geometry: [1x1 geometry]          -- surface elevation, bedrock topography, ice thickness,...
          constants: [1x1 constants]         -- physical constants
                smb: [1x1 SMBforcing]        -- surface mass balance
      basalforcings: [1x1 basalforcings]     -- bed forcings
          materials: [1x1 matice]            -- material properties
             damage: [1x1 damage]            -- parameters for damage evolution solution
           friction: [1x1 friction]          -- basal friction/drag properties
       flowequation: [1x1 flowequation]      -- flow equations
       timestepping: [1x1 timestepping]      -- time stepping for transient models
     initialization: [1x1 initialization]    -- initial guess/state
              rifts: [1x1 rifts]             -- rifts properties
         solidearth: [1x1 solidearth]        -- solidearth inputs and settings
                dsl: [1x1 dsl]               -- dynamic sea-level
              debug: [1x1 debug]             -- debugging tools (valgrind, gprof)
            verbose: [1x1 verbose]           -- verbosity level in solve
           settings: [1x1 issmsettings]      -- settings properties
           toolkits: [1x1 toolkits]          -- PETSc options for each solution
            cluster: [1x1 generic]           -- cluster parameters (number of CPUs...)
   balancethickness: [1x1 balancethickness]  -- parameters for balancethickness solution
      stressbalance: [1x1 stressbalance]     -- parameters for stressbalance solution
      groundingline: [1x1 groundingline]     -- parameters for groundingline solution
          hydrology: [1x1 hydrologyshreve]   -- parameters for hydrology solution
             debris: [1x1 debris]            -- parameters for debris solution
      masstransport: [1x1 masstransport]     -- parameters for masstransport solution
            thermal: [1x1 thermal]           -- parameters for thermal solution
        steadystate: [1x1 steadystate]       -- parameters for steadystate solution
          transient: [1x1 transient]         -- parameters for transient solution
           levelset: [1x1 levelset]          -- parameters for moving boundaries (level-set method)
            calving: [1x1 calving]           -- parameters for calving
    frontalforcings: [1x1 frontalforcings]   -- parameters for frontalforcings
                esa: [1x1 esa]               -- parameters for elastic adjustment solution
               love: [1x1 love]              -- parameters for love solution
           sampling: [1x1 sampling]          -- parameters for stochastic sampler
           autodiff: [1x1 autodiff]          -- automatic differentiation parameters
          inversion: [1x1 m1qn3inversion]    -- parameters for inverse methods
                qmu: [1x1 qmu]               -- Dakota properties
                amr: [1x1 amr]               -- adaptive mesh refinement properties
   outputdefinition: [1x1 outputdefinition]  -- output definition
            results: [1x1 struct]            -- model results
       radaroverlay: [1x1 radaroverlay]      -- radar image for plot overlay
      miscellaneous: [1x1 miscellaneous]     -- miscellaneous fields
  stochasticforcing: [1x1 stochasticforcing] -- stochasticity applied to model forcings
```

```
% plot a data and check whether the data is properly imported
plotmodel(md,'data',md.results.StressbalanceSolution.Vel,'title','Velocity',
'colormap','turbo', ...
            'data',md.geometry.thickness,'title','Ice
thickness','colormap','turbo')
```




```
% reinitialize the ice level set for the shelf
md.mask.ice_levelset = reinitializelevelset (md,md.mask.ice_levelset);

%Apply basal melt conditions
md.basalforcings.groundedice_melting_rate =
zeros(md.mesh.numberofvertices,1);
md.basalforcings.floatingice_melting_rate =
25*ones(md.mesh.numberofvertices,1);

%Apply surface mass balance conditions
searise='/Users/rishi/Desktop/ISSM-macOS-Silicon-MATLAB/examples/Data/
Antarctica_5km_withshelves_v0.75.nc';

smb   = ncread(searise,'presprcp')'; % surface mass balance - precipitation
data
x1=double(ncread(searise,'x1'));
y1=double(ncread(searise,'y1'));
surface = double(ncread(searise,'usrf'));
basal_melt = double(ncread(searise,'melt'));

% apply surface and basal melt focing on the model for the transient run
md.smb.mass_balance =
double(InterpFromGridToMesh(x1,y1,surface',md.mesh.x,md.mesh.y,0));
%md.basalforcings.floatingice_melting_rate =
double(InterpFromGridToMesh(x1,y1,basal_melt',md.mesh.x,md.mesh.y,0));
```

```
%check whether the surface mass baalance is properly implemented
plotmodel(md,'data',md.smb.mass_balance,'title','Surface Mass
Balance','caxis#1',[0 200],...
    'data',md.basalforcings.floatingice_melting_rate,'title','Basal
Melting','caxis#2',[0 10])
```

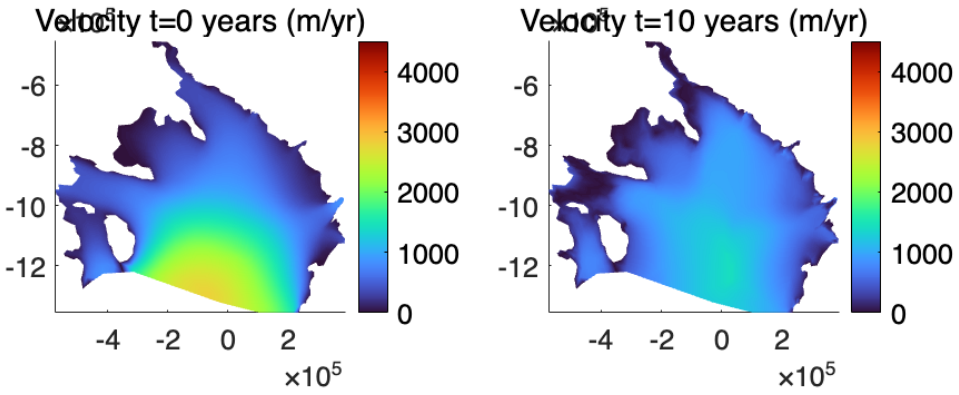



```
%Indicate the components of transient to activate
md.transient.ismasstransport = 1;
md.transient.isstressbalance = 1;
md.transient.isgroundingline = 1;
md.transient.ismovingfront = 0;
md.transient.isthermal = 0;

%Specify time steps and length of simulation (years)
md.timestepping.start_time = 0;
md.timestepping.time_step = 0.1;
md.timestepping.final_time = 10;

%Disable inverse method
md.inversion.iscontrol=0;

%Initialize fields for transient and add boundary conditions
md.initialization.vx = md.results.StressbalanceSolution.Vx;
md.initialization.vy = md.results.StressbalanceSolution.Vy;
md.initialization.vel = md.results.StressbalanceSolution.Vel;
```

```
md.masstransport.spcthickness = NaN*ones(md.mesh.numberofvertices,1);

%Request additional outputs
md.transient.requested_outputs={'default','IceVolume','IceVolumeAboveFloatat
ion','TotalSmb','TotalFloatingBmb'};

%Solve transient solution and change messages provided
md.verbose = verbose('solution',false);
md=solve(md,'Transient');
```

```
launching solution sequence
hostname contains invalid characters
ssh -l  debangshusmacbookpro.local "source  Ross_Inversion.queue ": Signal 127
Warning:
=============================================================
   Binary file Ross_Inversion.outbin not found!

   This typically happens when the run crashed.
   Please check for error messages above or in the outlog
=============================================================
```

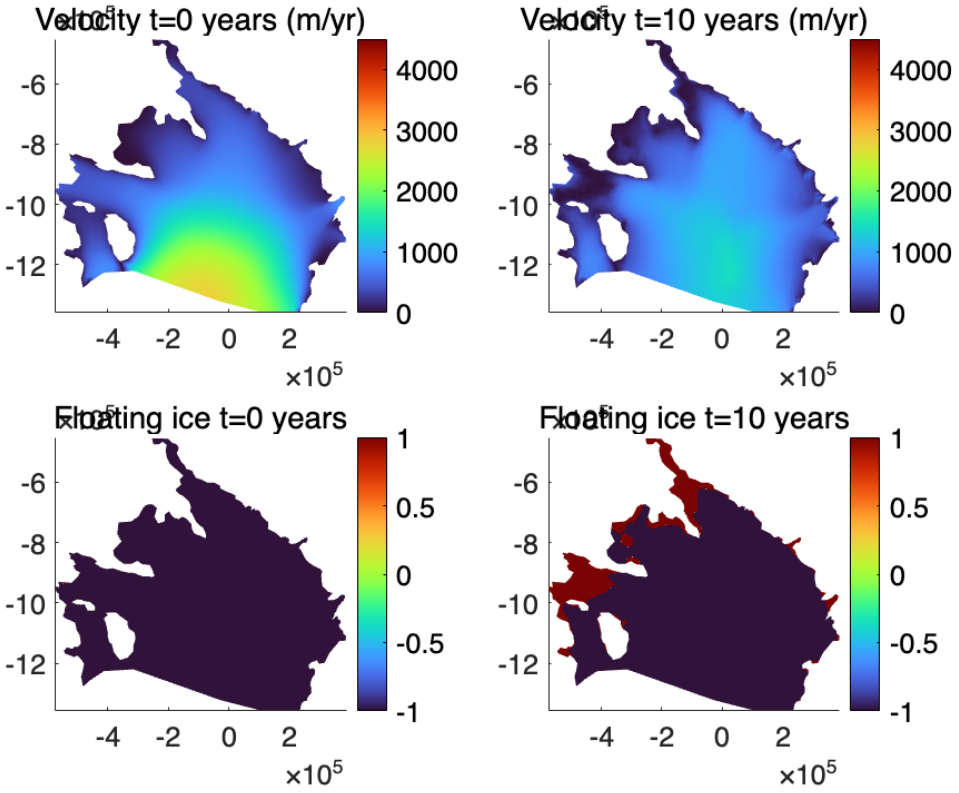
```
%Plot results
plotmodel(md, 'data', md.results.TransientSolution(1).Vel,'title#1',
'Velocity t=0 years (m/yr)',...
  'data', md.results.TransientSolution(end).Vel,'title#2', 'Velocity t=10
years (m/yr)',...
  'caxis#1',([0 4500]),'caxis#2',([0 4500]));
```



```
%Change basal melt rate
md.basalforcings.groundedice_melting_rate =
zeros(md.mesh.numberofvertices,1);
md.basalforcings.floatingice_melting_rate =
10*ones(md.mesh.numberofvertices,1);

%Solve transient solution
md.verbose = verbose('solution',false);
md = solve(md,'Transient');
```

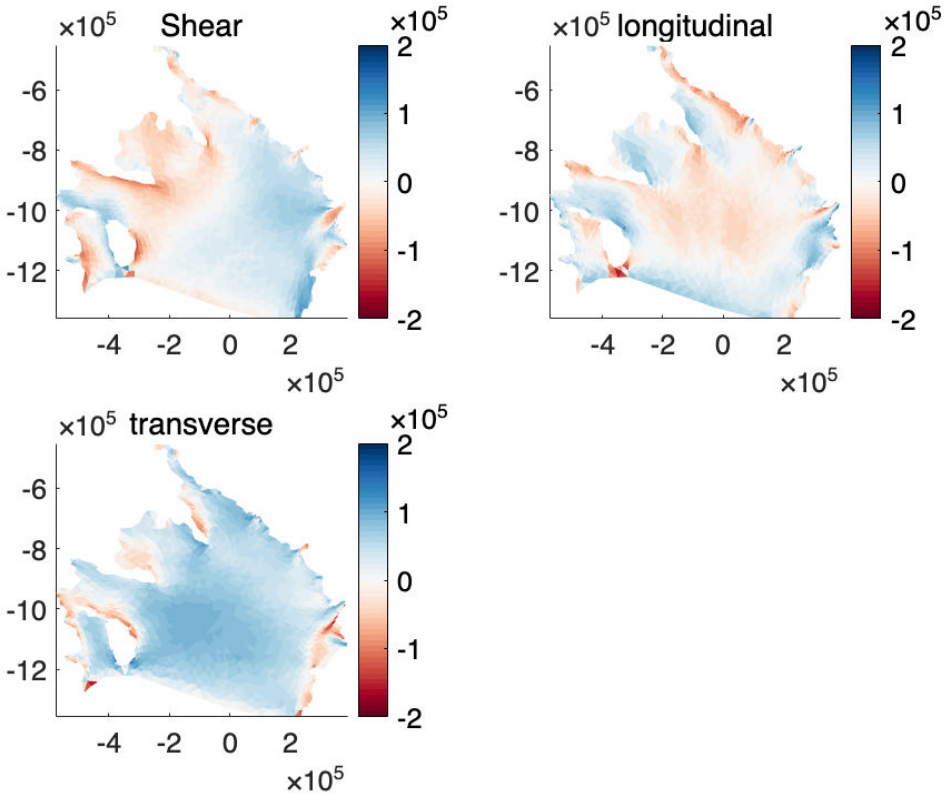
```
launching solution sequence

Ice-sheet and Sea-level System Model (ISSM) version  4.24
(website: http://issm.jpl.nasa.gov forum: https://issm.ess.uci.edu/forum/)

call computational core:
write lock file:

   FemModel initialization elapsed time:   0.012221
   Total Core solution elapsed time:       17.6102
   Linear solver elapsed time:             13.9218 (79%)

   Total elapsed time: 0 hrs 0 min 17 sec
```

```
%Plot results
plotmodel(md, 'data', md.results.TransientSolution(1).Vel,'title#1',
'Velocity t=0 years (m/yr)',...
  'data', md.results.TransientSolution(end).Vel,'title#2', 'Velocity t=10
years (m/yr)',...
  'data', md.results.TransientSolution(1).MaskOceanLevelset,'title#3',
'Floating ice t=0 years',...
  'data', md.results.TransientSolution(end).MaskOceanLevelset,'title#4',
'Floating ice t=10 years',...
  'caxis#1',([0 4500]),'caxis#2',([0 4500]),'caxis#3',([-1,1]),'caxis#4',
([-1,1]));
```

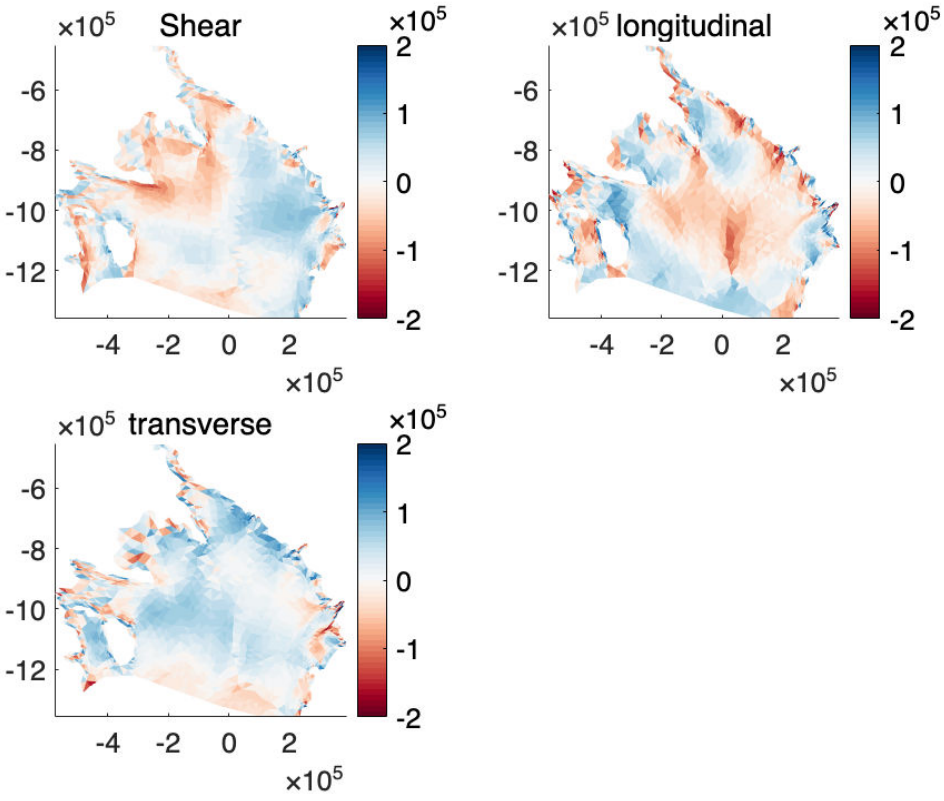



```
% try to produce the mechanical properties of an ice shelf from the
% transient run

% This is the stress and strain output of the first year before run
vx1 = md.results.TransientSolution(1).Vx;
vy1 = md.results.TransientSolution(1).Vy;
md = mechanicalproperties(md, vx1, vy1);
md.results.deviatoricstress_start = md.results.deviatoricstress;

% This is the stress and strain output of the end year after run
vxt = md.results.TransientSolution(end).Vx;
vyt = md.results.TransientSolution(end).Vy;
md = mechanicalproperties(md, vxt, vyt);
md.results.deviatoricstress_end = md.results.deviatoricstress;
```

```
% plotting the Deviatoric Stresses
plotmodel(md,'data',md.results.deviatoricstress_start.xy,'title','Shear',...
'data',md.results.deviatoricstress_start.xx,'title','longitudinal',...
'data',md.results.deviatoricstress_start.yy,'title','transverse','caxis#all'
,[-2e5 2e5]);
colormap(brewermap(50, 'RdBu'));
```




```
% plotting the Deviatoric Stresses for the last year
plotmodel(md,'data',md.results.deviatoricstress_end.xy,'title','Shear',...
'data',md.results.deviatoricstress_end.xx,'title','longitudinal',...
'data',md.results.deviatoricstress_end.yy,'title','transverse','caxis#all',
[-2e5 2e5]);
colormap(brewermap(50, 'RdBu'));
```


×10^5 Shear
×10^5
2
1
0
-1
-2
-6
-8
-10
-12
-4
-2
0
2
×10^5
×10^5 longitudinal
×10^5
2
1
0
-1
-2
-6
-8
-10
-12
-4
-2
0
2
×10^5
×10^5 transverse
×10^5
2
1
0
-1
-2
-6
-8
-10
-12
-4
-2
0
2
×10^5