



First Elmer/Ice users meeting
9 April 2013 – Vienna (EGU 2013)

Program

- ✓ General presentation of Elmer/Ice – Olivier Gagliardini (LGGE)
- ✓ Recent important developments – Thomas Zwinger (CSC)
- ✓ Calving in Elmer/Ice
 - Joe Todd (Scott Polar Research Institute)
 - Jean Krug (LGGE)
- ✓ Work in Rovaniemi and sediment model - Rupert Gladstone (Arctic Centre)
- ✓ Dorothee Vallot (Upssala) – PhD program...
- ✓ Cavity and erosion - Flavien Beaud (SFU)
- ✓ Other know developments from people not at EGU
 - Hydrology: Basile de Fleurian (LGGE) and Mauro Werder (SFU) models
 - Temperature: Enthalpy solver, Adrien Gilbert (LGGE)
 - Inverse methods: Fabien Gillet-Chaulet (LGGE)
- ✓ Discussion / Prospective / Strategy for the future developments

Elmer/Ice versus Elmer

Elmer is an open-source, parallel, Finite Element code, mainly developed by the CSC-IT Center for Science Ltd. in Finland.

Elmer/Ice builds on Elmer and includes developments related to **glaciological** problems.

Elmer/Ice includes a variety of dedicated solvers and user functions for glaciological applications.

The main core of the code is Elmer which needs to be installed before compiling the Elmer/Ice package.

Short history of Elmer/Ice

- ✓ EGU2002: OG was looking for a 3D FE code to model the flow of strain-induced anisotropic polar ice – meet TZ
- ✓
- ✓ March 2003: OG visited CSC for few days: AIFlowSolver and FabricSolver partly implemented
- ✓ August 2005 – One year visit of OG at CSC (Anisotropy, cavity, glaciers, ISMIP tests, ...)
- ✓ February 2008 – First Elmer/Ice Course - Grenoble
- ✓ June 2011 – Second Elmer/Ice Course – Finland
- ✓ 2012 – Elmer/Ice has now a website, a logo and a mailing list
- ✓ 2012 – Elmer/Ice comes as a Elmer Package – New wiki
- ✓ 2012 – Elmer/Ice course at UBC/SFU
- ✓ 2013 – Elmer/Ice courses at Univ. Washington and Univ. Alberta
- ✓ 9 April 2013 – First Elmer/Ice users meeting – Here we are...

Elmer/Ice website

<http://elmerice.elmerfem.org/>

elmer ice NEWS PUBLICATIONS CAPABILITIES USERS COMMUNITY COURSES TUTORIALS MATERIALS DOCUMENTATIONS LOG IN

Q search...

Welcome

Elmer is an open-source, parallel, Finite Element code, mainly developed by the [CSC-IT Center for Science Ltd.](#) in Finland. Elmerice builds on Elmer and includes developments related to glaciological problems.

Elmerice includes a variety of dedicated solvers and user functions which are described in these pages.

The aim of this website is to present in detail the Elmerice capabilities and to distribute course materials and tutorials.

Elmerice is mainly developed by CSC (Espoo, Finland), the Laboratory of Glaciology and Environmental Geophysics LGGE (Grenoble, France) and the Institute of Low Temperature Science ILTS (Sapporo, Japan), but others contributors are welcome!

Elmer/Ice at EGU 2013

Written by [Oliver Jaglandini](#).

Don't miss the first **Elmerice users meeting** to be held during the EGU 2013, Tuesday 9th April 12:15-15:00, Room Y3. More information regarding this meeting can be found [here](#).

Here is a list of the known Elmerice talks and posters that will be presented at the forthcoming EGU in Vienna, 8-12 April 2013. Please, if your talk/poster is not listed, contact me (OG) and I will add your presentation.

Tuesday, April 09, 2013

12:15-15:00 Elmerice users meeting, Room Y3.

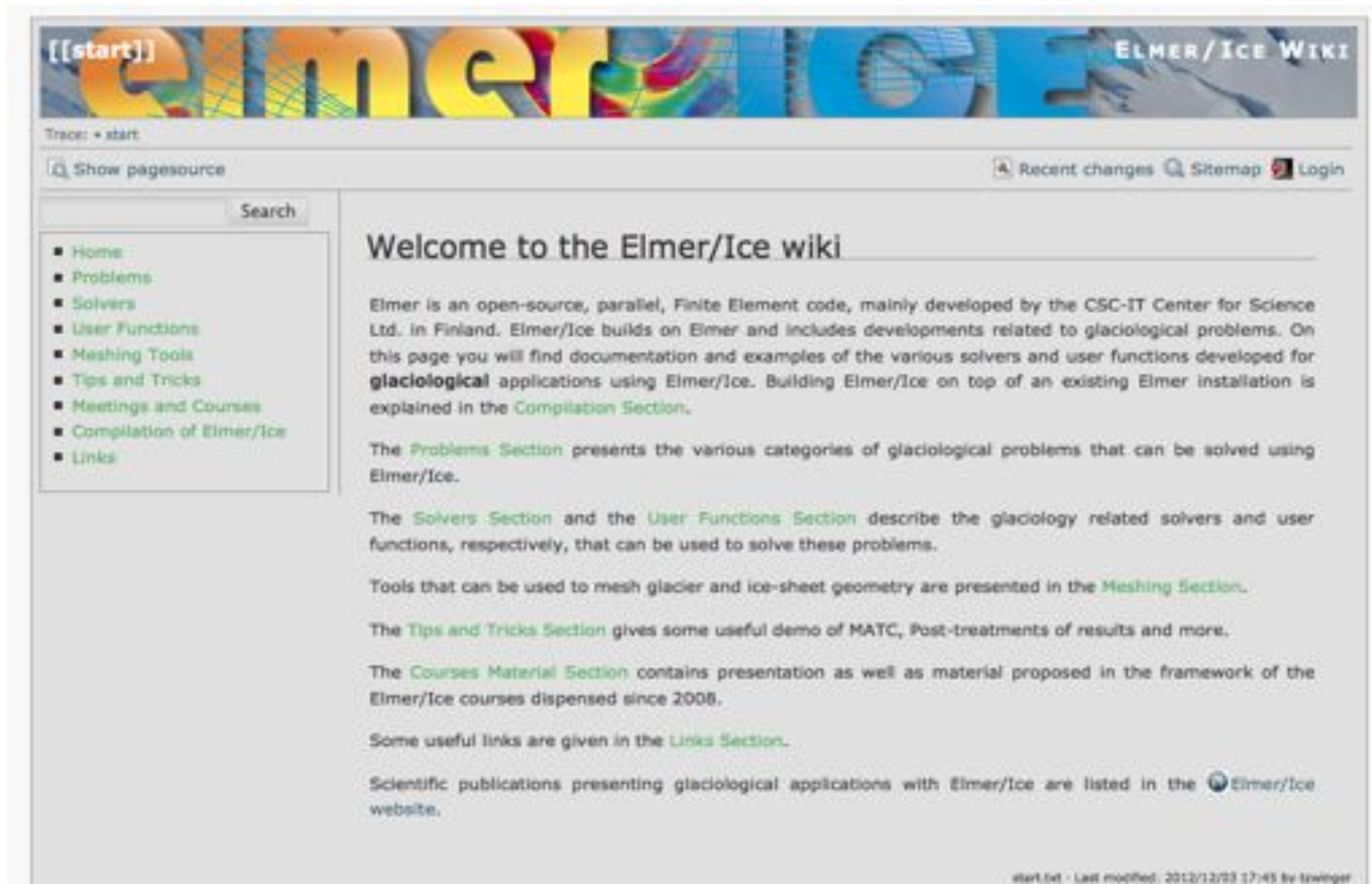
15:30-17:00 / Room G3 - CR1.3 - Subglacial Environments of Ice Sheets and Glaciers

- 16:45-17:00: [EGU2013-12218](#) Importance of basal processes in simulations of a surging Svalbard outlet glacier. Rupert Gladstone, Martina Schäfer, Thomas Zwinger, Tazio Strazzi, Yongmei Gong, John Moore, and Thorben Durse.

First Elmer/Ice users meeting - 9 April 2013 - EGU 2013



Elmer/Ice wiki <http://elmerice.elmerfem.org/wiki/doku.php>



[[start]]

Trace: • start

Show pagesource

Recent changes Sitemap Login

Search

- Home
- Problems
- Solvers
- User Functions
- Meshing Tools
- Tips and Tricks
- Meetings and Courses
- Compilation of Elmer/Ice
- Links

Welcome to the Elmer/Ice wiki

Elmer is an open-source, parallel, Finite Element code, mainly developed by the CSC-IT Center for Science Ltd. in Finland. Elmer/Ice builds on Elmer and includes developments related to glaciological problems. On this page you will find documentation and examples of the various solvers and user functions developed for **glaciological** applications using Elmer/Ice. Building Elmer/Ice on top of an existing Elmer installation is explained in the [Compilation Section](#).

The [Problems Section](#) presents the various categories of glaciological problems that can be solved using Elmer/Ice.

The [Solvers Section](#) and the [User Functions Section](#) describe the glaciology related solvers and user functions, respectively, that can be used to solve these problems.

Tools that can be used to mesh glacier and ice-sheet geometry are presented in the [Meshing Section](#).

The [Tips and Tricks Section](#) gives some useful demo of MATC, Post-treatments of results and more.

The [Courses Material Section](#) contains presentation as well as material proposed in the framework of the Elmer/Ice courses dispensed since 2008.

Some useful links are given in the [Links Section](#).

Scientific publications presenting glaciological applications with Elmer/Ice are listed in the [Elmer/Ice website](#).

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Important links

Elmer at CSC (documentation, how to install, ...)

<http://www.elmerfem.org/>

<http://www.csc.fi/english/pages/elmer>

Elmer Forum

<http://elmerfem.org/forum/>

Elmer/Ice webpage

<http://elmerice.elmerfem.org/>

Elmer/Ice wiki

<http://elmerice.elmerfem.org/wiki/doku.php?>

Elmer/Ice mailing list

To subscribe to the Elmer/Ice list *elmerice@elmerfem.org*, just sent an email to *majordomo@elmerfem.org*, with in the body the text:

subscribe elmerice

If you do not know how to use mailing lists run by majordomo you may sent a mail with "help" in the message body.

Elmer/Ice Package

All the Solvers, User Functions and Meshers presented on the Elmer/Ice wiki comes as an Elmer/Ice package on the Elmer distribution (in `elmerfem/elmerice`)

List of the material available (05/04/2013)

- 20 Solvers
- 7 User Functions
- 4 Mesh Tools

Elmer/Ice Package - Solvers

Solvers

AIFlowSolve_nID2.f90
AIFlowSolve_nIS2.f90
CaffeSolver.f90
ComputeDevStressNS.f90
ComputeEigenValues.f90
ComputeNormal.f90
ComputeStrainRate.f90
DeformationalHeat.f90
ExportVertically.f90
FabricSolve.f90
Flowdepth.f90

ForceToStress.f90
GetHydrostaticLoads.f90
GolfLaw.f90
GroundedSolver.f90
IntegrateVertically.f90
IntegratedVelocity.f90
PorousSolve.f90
SIASolver.f90
SSASolver.f90
Temperatelce.f90
fAandfB_in.f90

Elmer/Ice Package

User Functions

Buoyancy.f90

CaffeFlow.f90

USF_Contact.f90

USF_LateralFriction.f90

USF_ShapeFactor.f90

USF_Sliding.f90

USF_Zs.f90

Mesh tools

ExtrudeMesh.c

MshGlacier.f90

MshGlacierDEM.f90

MshGlacierSynthetic.f90

Elmer/Ice capabilities

- Full-Stokes equation but also SIA, SSA, diagnostic or transient
- Various rheology (Glen's law, firn/snow and two anisotropic flow laws)
- Temperature solver accounting for the upper limit at melting point
- Evolution equations for density, fabric, ...
- Dating, evaluation of strain-rate and stress fields
- Various friction laws (Weertman, effective-pressure dependent friction law)
- Grounding line dynamics as a contact problem
- Inverse methods (linear adjoint and Arthern and Gudmundsson 2010 methods)
- Tools to mesh glaciers (YAMS, extrusion of footprint)
- Highly parallel Stokes solver

Elmer/Ice applications

More than 30 publications using Elmer/Ice since 2004

- ISMIP, MISMIP, MISMIP-3d
- 2D and 3D Grounding line dynamics
- Ice2sea and SeaRISE contributions (Greenland)
- Inverse methods (Variegated, Vestfonna ice-cap, GIS)
- Flow of anisotropic ice

see <http://elmerice.elmerfem.org/publications>

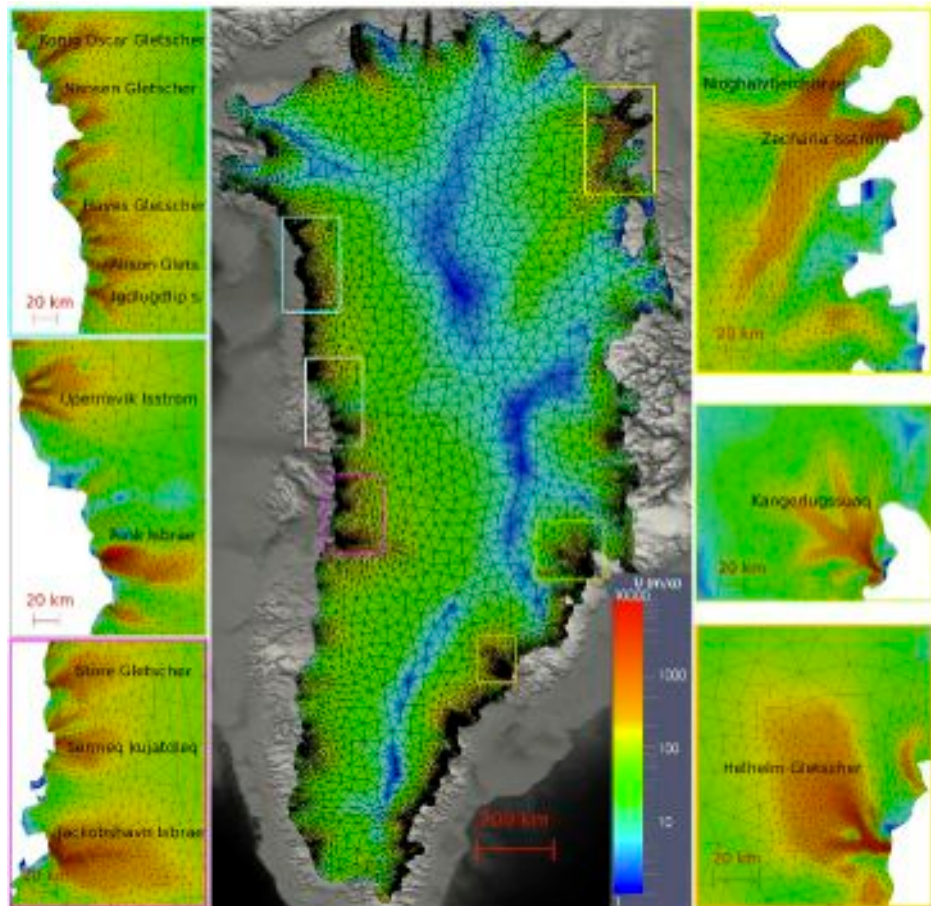
GMD paper

Capabilities and performance of Elmer/Ice, a new generation ice-sheet model

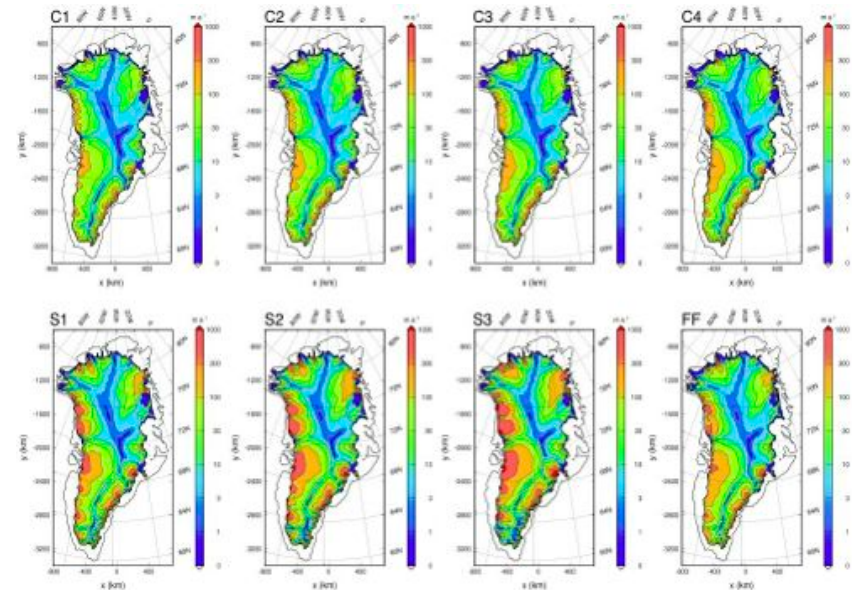
O. Gagliardini^{1,2}, T. Zwinger³, F. Gillet-Chaulet¹, G. Durand¹, L. Favier¹, B. de Fleurian¹, R. Greve⁴, M. Malinen³, C. Martín⁵, P. Råback³, J. Ruokolainen³, M. Sacchetti¹, M. Schäfer⁶, H. Seddik⁴, and J. Thies⁷

Few recent examples

Grenland within ice2sea
@Fabien Gillet-Chaulet, LGGE



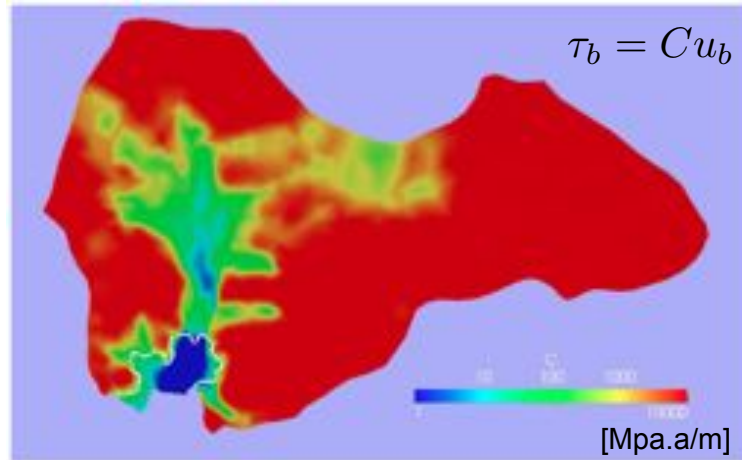
Grenland within SeaRise
@Hakime Seddik, ILTS



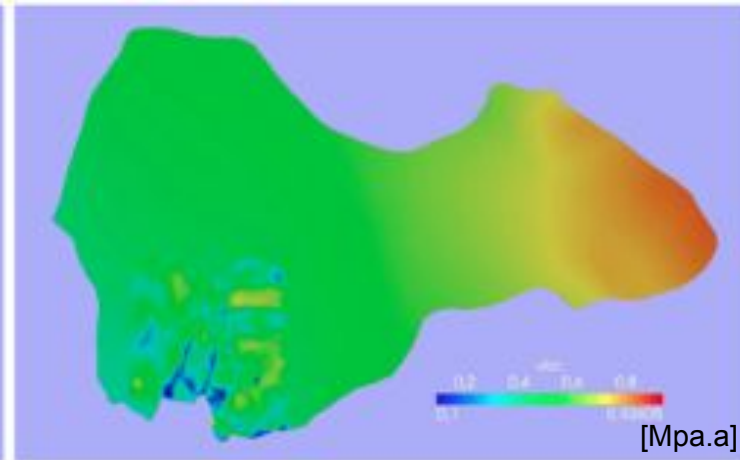
Few recent examples

Grounding line 3D @Lionel Favier, LGGE

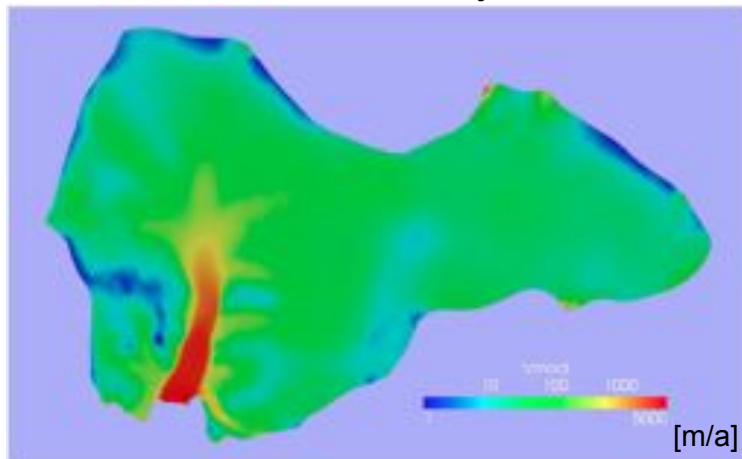
Inverted **basal friction** parameter



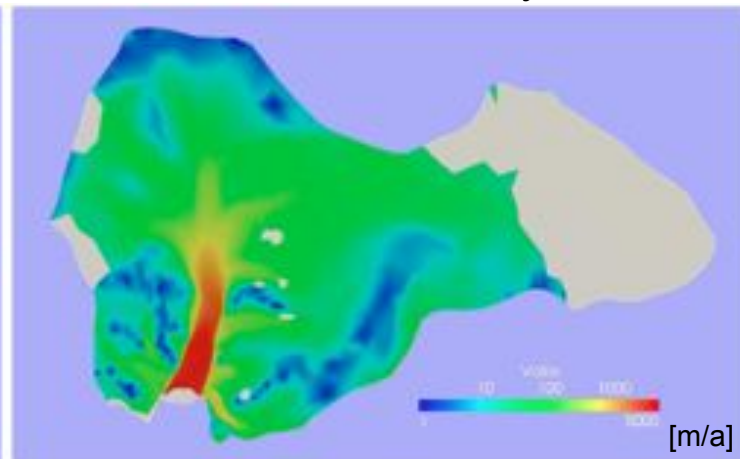
Inverted surface **effective viscosity**



Inverted surface velocity

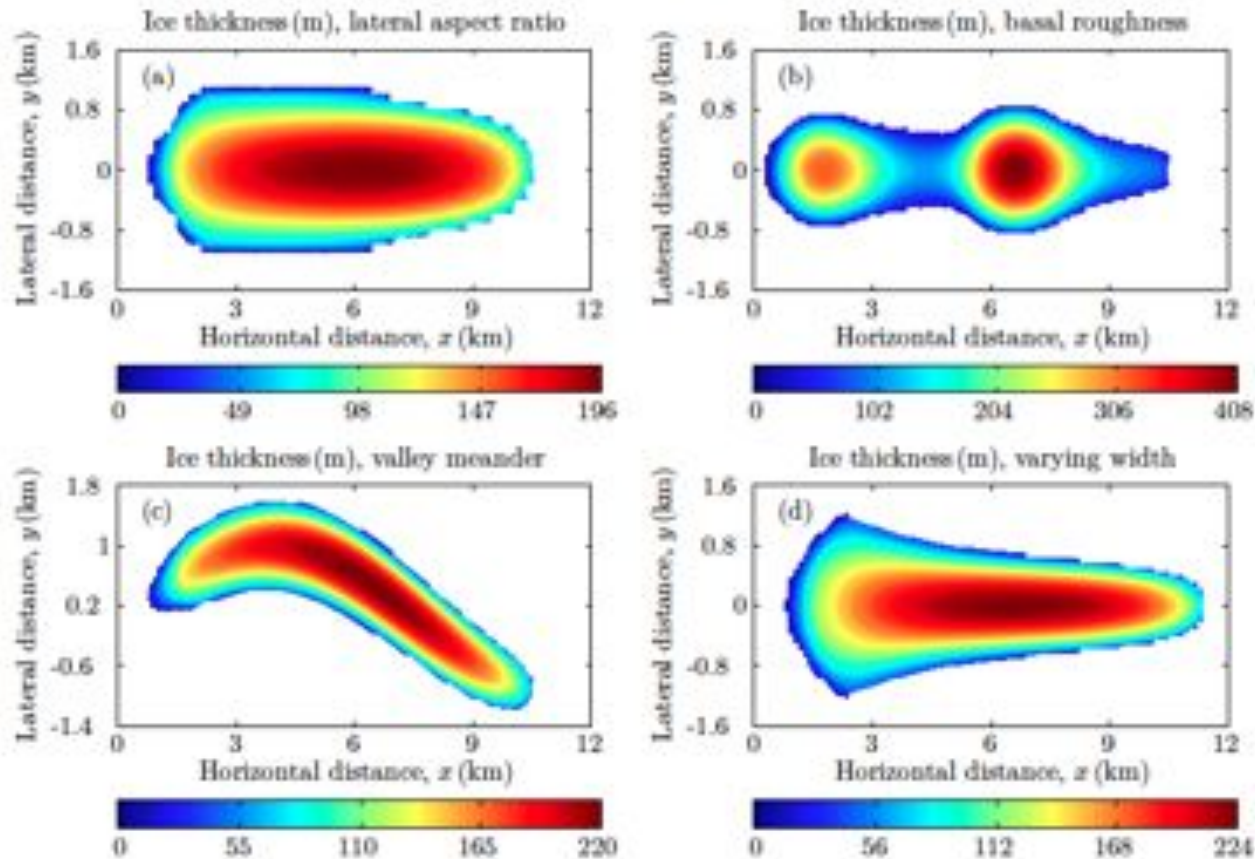


Observed surface velocity (Rignot et al., 2011)



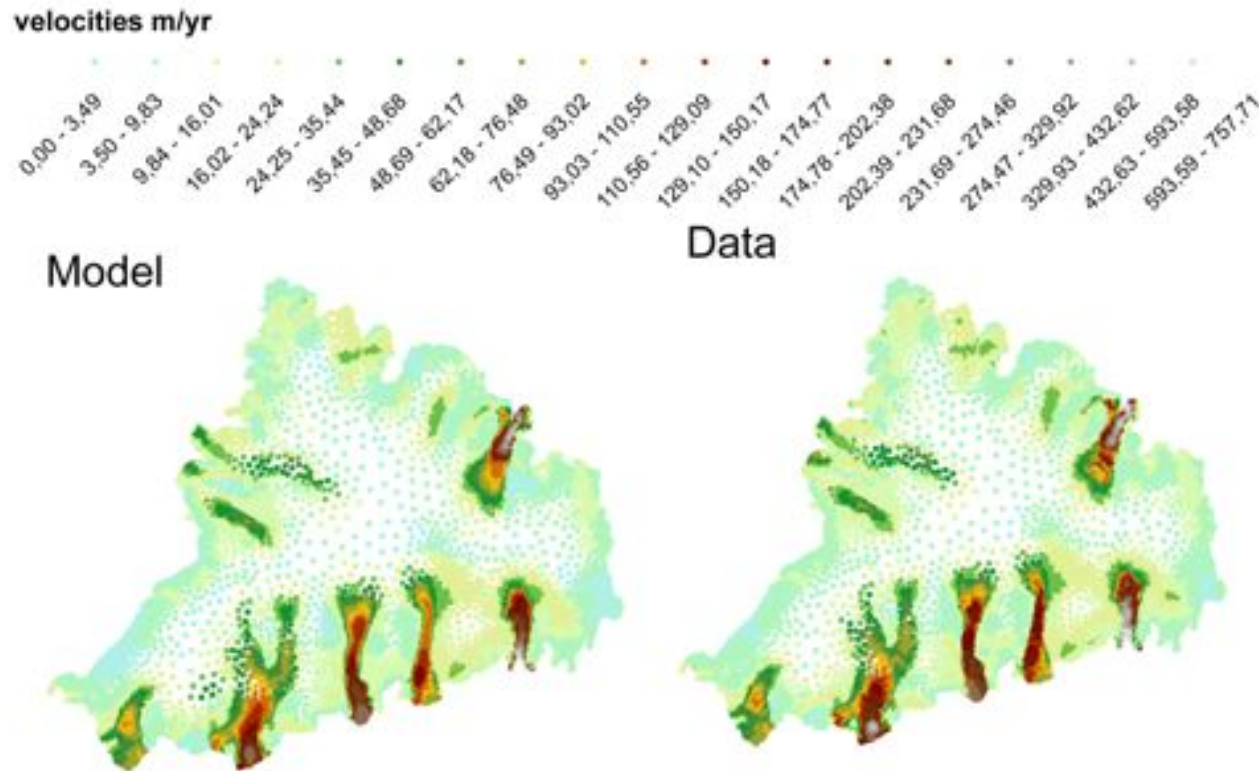
Few recent examples

Volume/Area relation @Surendra Adhikari, Univ. Calgary



Few recent examples

Vestfonna ice cap basal friction @Martina Schäfer, Univ. Lapland



Current or planned developments

- **Calving law (damage mechanics)**
- **Hydrology model to infer basal water pressure**
- Moving margins / remeshing / adaptive mesh
- Coupling with an ocean model / Implementation of a plume model
- Accounting for refreezing in the temperature equations
- Inversion of bedrock topography
- Lower order Stokes models