

Online Elmer/Ice course

November 2020

Introduction

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Program (1/3)

When you start watching this first introduction video:

- ✓ You should have a working version of Elmer (and Elmer/Ice, gmsh and paraview) on your computer
- ✓ You should have registered to the Slack channel

If not the case, contact us!

Program (2/3)

Week 47 – 16-20 November 2020

You will start working by yourself, watching a number of tutorial videos.

Links to the videos (to be watched in the right order) are given on the wiki

- <http://elmerfem.org/elmerice/wiki/doku.php?id=courses:courses>

You will have zoom sessions in parallel to answer questions

And the Slack channel will also be used to answer questions

1. Short introduction on Elmer/Ice (this video) - Olivier
2. Short description of sif file - Peter
3. Flow line model - basic diagnostic - Thomas
4. Flow-line model: thermo-mechanical coupling - Thomas
5. Flow-line model: sliding - Thomas
6. Flow-line model: prognostic runs - Thomas

Program (3/3)

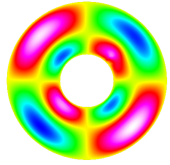
Week 48 – 23-27 November 2020

- Monday: Moving to 3d - Tete Rouse diagnostic - Olivier
- Tuesday: Tete Rouse diagnostic - Olivier
- Wednesday: Moving to 3d - Tete Rouse prognostic - Olivier
- Thursday: Elmer/Ice-sheet (Lower order model and inverse problem) - Fabien
- Friday: Elmer/Ice-sheet (Lower order model and inverse problem) - Fabien

Two possible slots / day to follow the course : 9am OR 5pm CET

Each slot will be approximately 2hours

Elmer/Ice in relation to Elmer



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

Elmer is constantly developed towards improved performance, utilizing international projects such as FP7 PRACE and HPC Europa2.



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 and its development is supported by various groups and funding...



norden

Top-level Research Initiative



Tipping Points in Antarctic
Climate Components



Tipping Points in Antarctic
Climate Components

Online Elmer/Ice Course - November 2020



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 `elmerice/`)

To get Elmer/Ice installed, add the following option to the cmake build command:

```
-DWITH_ElmerIce:BOOL=TRUE
```

To use it (in the SIF file):

```
Procedure = File "ElmerIceSolvers" "NameSolver"
```

or

```
Procedure = File "ElmerIceUSF" "NameUSF"
```

Short history of Elmer/Ice (not anymore so short...) 1/3

- ✓ 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 – SVALI summer school – 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 – EGU 2013

Short history of Elmer/Ice (not anymore so short...) 2/3

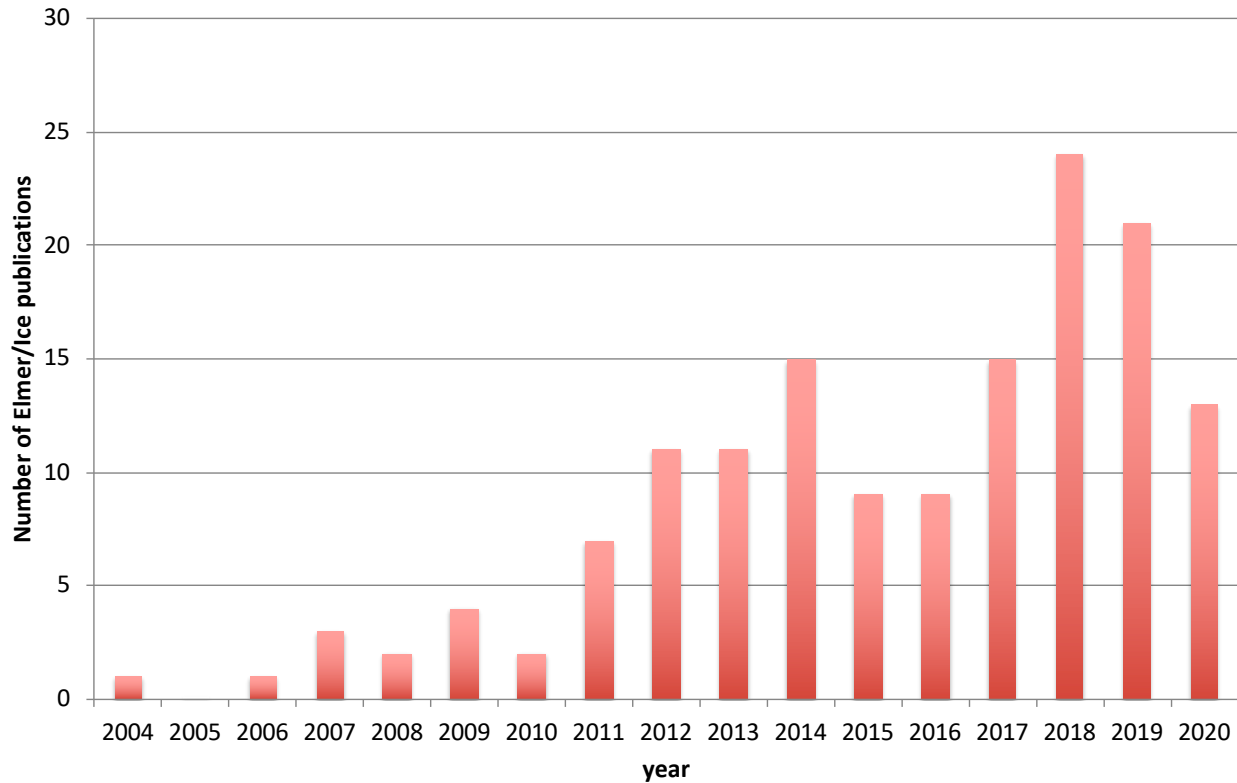
- ✓ May 2013 – Second SVALI summer school – Finland
- ✓ 2-day beginner Elmer/Ice course, 3-4 Oct. 2013, LGGE, Grenoble, France
- ✓ 3-day Elmer/Ice advanced workshop, 4-6 Nov. 2013, CSC, Espoo, Finland
- ✓ April 2014 – Second Elmer/Ice users meeting – EGU 2014
- ✓ 3-day beginner Elmer/Ice course, 27-29 Oct. 2014, IMO, Reykjavík, Iceland
- ✓ April 2015 – Third Elmer/Ice users meeting – EGU 2015
- ✓ 2-day beginner course, 1&2 Nov 2015, CIC, Copenhagen, Denmark
- ✓ 3-day Elmer/Ice advanced workshop, 30 Nov, 1&2 Dec 2015, LGGE, Grenoble, France
- ✓ 3-days beginner course, Oct 2016, Oslo
- ✓ April 2017 – Fourth Elmer/Ice users meeting – EGU 2017

Short history of Elmer/Ice (not anymore so short...) 3/3

- ✓ 2-day beginner Elmer/Ice course, 23rd and 24th Oct. 2017, University of Stockholm, Sweden
- ✓ 3-day advanced Elmer/Ice workshop, 22nd, 23rd and 24th Nov. 2017, IGE, Grenoble, France
- ✓ 2-day beginner Elmer/Ice course, 22nd & 23rd Oct. 2018, University of Lapland, Rovaniemi, Finland
- ✓ 3-day Elmer/Ice advanced users workshop, 29th-31st Oct. 2018, CSC, Espoo, Finland
- ✓ April 2019 - Fifth Elmer/Ice Users Meeting - EGU 2019
- ✓ 2-day beginner Elmer/Ice course, 28&29 October 2019, University of Iceland, Iceland
- ✓ Since COVID crisis, 2 more online Elmer/Ice users meetings

and now an online Elmer/Ice beginner course...

A growing community

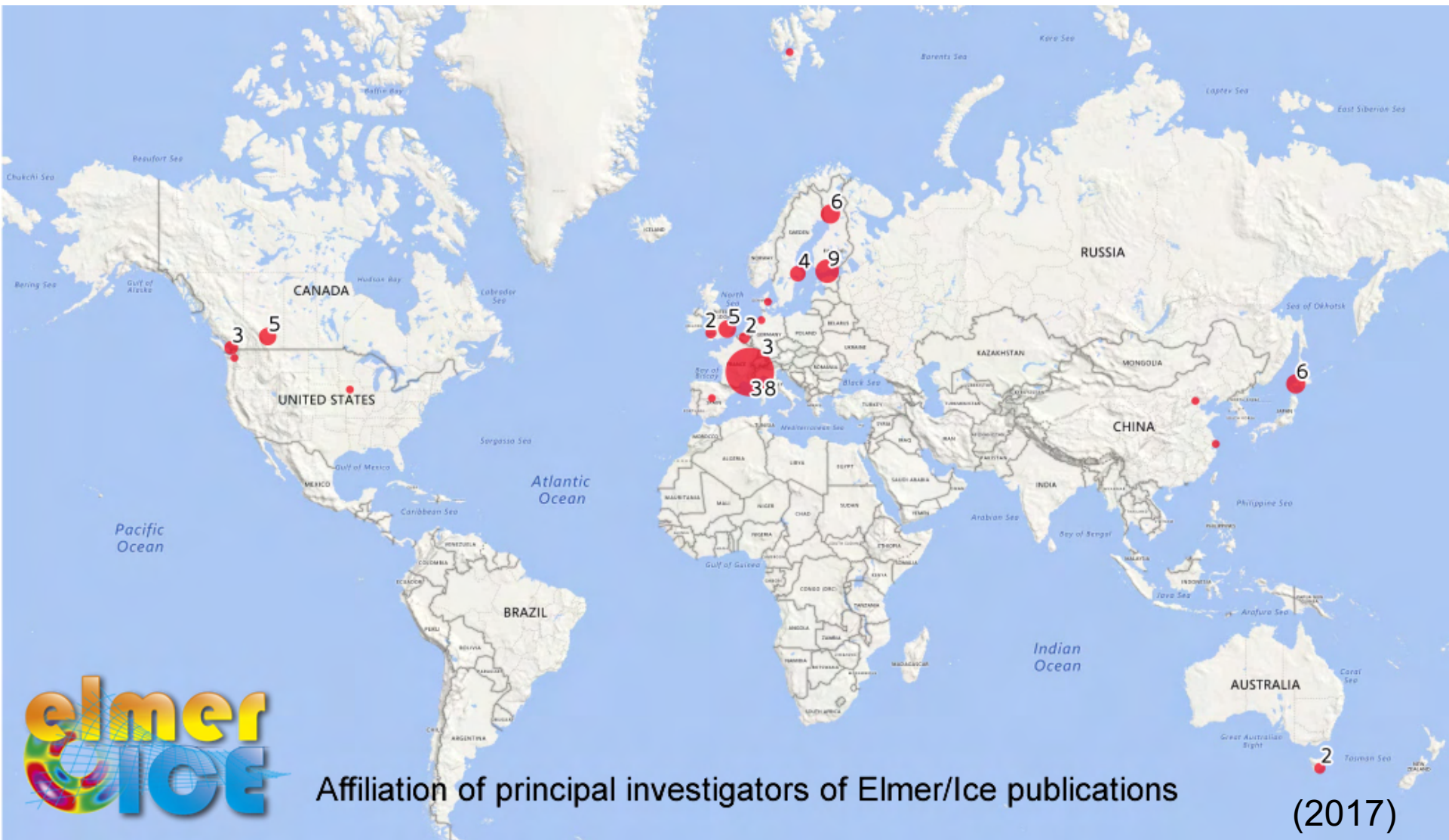


18 Courses ~ 380 participants

7 Elmer/Ice users meetings

148 publications

An international community



Elmer/Ice capabilities

- **Full-Stokes** equations but also SIA, SSA, diagnostic or transient
- Various **rheologies** (Glen's law, firn/snow and anisotropic flow laws)
- **Temperature** solver accounting for the upper limit at melting point (+ enthalpy solver)
- **Transport equations** for density, fabric, age ...
- **Post-processing solver** for strain-rate and stress fields
- Various **friction laws** (Weertman, effective-pressure dependent friction law)
- **Free surface evolution** as a contact problem (Grounding line dynamics)
- **Inverse methods** (linear adjoint and Arthern and Gudmundsson 2010 methods)
- Tools or plug-ins for **meshing** (YAMS, external and internal extrusion of footprint)
- **Highly parallel** Stokes solver
- **Basal hydrology** (2 approaches on the distribution)
- **Calving** (3 approaches, one in the distribution)
- **Damage mechanics**

Elmer/Ice capabilities

	Flow equations	Stokes	SSA	SSA*	SIA	ISCAL
Rheology	Glen	X, Inv Adj + Rob	X, Inv Adj	X	X	X
	GOLF	X				
	CAFFE	X				
	POROUS	X				
	Damage	X	X	X	X	X
Basal friction	Linear	X, Inv Adj + Rob	X, Inv Adj	X		
	Weertman	X	X	X		
	Coulomb	X	X	X		
	Budd	X	X	X		
	Tsai		X	X		
Free surface	dS/dt	X	X	X	X	X
	dH/dt	X, Inv	X, Inv	X, Inv	X, Inv	X, Inv
Grounding line	Contact	X				
	Hydrostatic	X	X	X	X	
Calving	Fracture+Damage	2D				
	crevasse depth	X				
Temperature	Temperate	X	X	X	X	X
	Enthalpy	X	X	X	X	X
Hydrology	Two layers	X	X	X		
	<i>GlaDS</i>	X	X	X		

Elmer/Ice applications

148 (known) publications using Elmer/Ice since 2004

- ISMIP, MISMIP, MISMIP-3d, ISMIP6
- 2D and 3D Grounding line dynamics
- Ice2sea and SeaRISE contributions (Greenland)
- Inverse methods (Variegated, Vestfonna ice-cap, GIS, AIS)
- Flow of anisotropic ice
- Glaciers, Greenland, Antarctica
- 9 cited references including results from Elmer/Ice in the 5th IPCC report

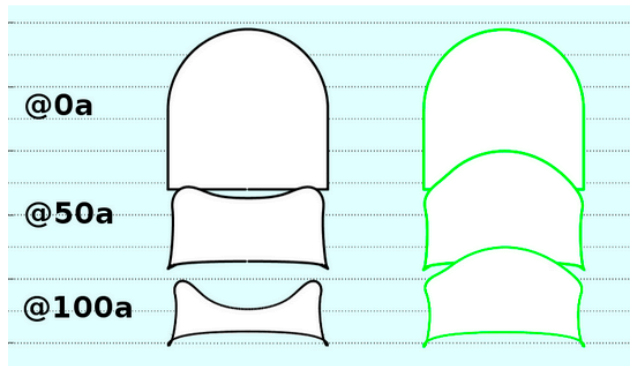


Search

Elmer/Ice News

WRITTEN BY OLIVIER GAGLIARDINI.

Fate of a snow cave and a rigid container buried at Dome C using Elmer/Ice



This study takes place in the framework of the international project Ice Memory, which aims to create a global ice archive sanctuary in Antarctica gathering ice cores collected all over the world on glaciers that will likely have melted away in the coming decades due to climate change. To preserve the quality of the cores over decades to century, they must be stored at a constant temperature well below melting point. The most energy-efficient way to fulfill this requirement is to have the storage facility buried into the polar firn at Dôme C, at an initial depth of around 10 meters beyond which the firn temperature does not show any seasonal variability. The possible storage solutions range from unreinforced snow caves excavated in the firn to the burying of rigid containers, including various combinations of both. However, because the surface mass balance at Dôme C is positive and is expected to remain so in the coming decades, the natural fate of any cavity excavated in the firn is to close-off and any rigid body buried in the firn will have to bear ever-increasing pressure. Here, we take advantage of the Elmer/Ice Porous Solver intended to simulate the flow of compressible firn in

order to assess the sinking rates and typical lifetimes of two-end member cases in terms of rigidity of the storage solution: an unreinforced snow cave and a perfectly rigid container. Our results show that the lifetime of a snow cave depends strongly of the initial density in its surrounding. On the other hand, the presence of a rigid container within the firn induces a perturbation of the flow, leading to the formation of patches of high density over its walls. These high density patches are associated to significant



NEWS

PUBLICATIONS

CAPABILITIES

ELMER
ICE-SHEET

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FORUM

COURSES

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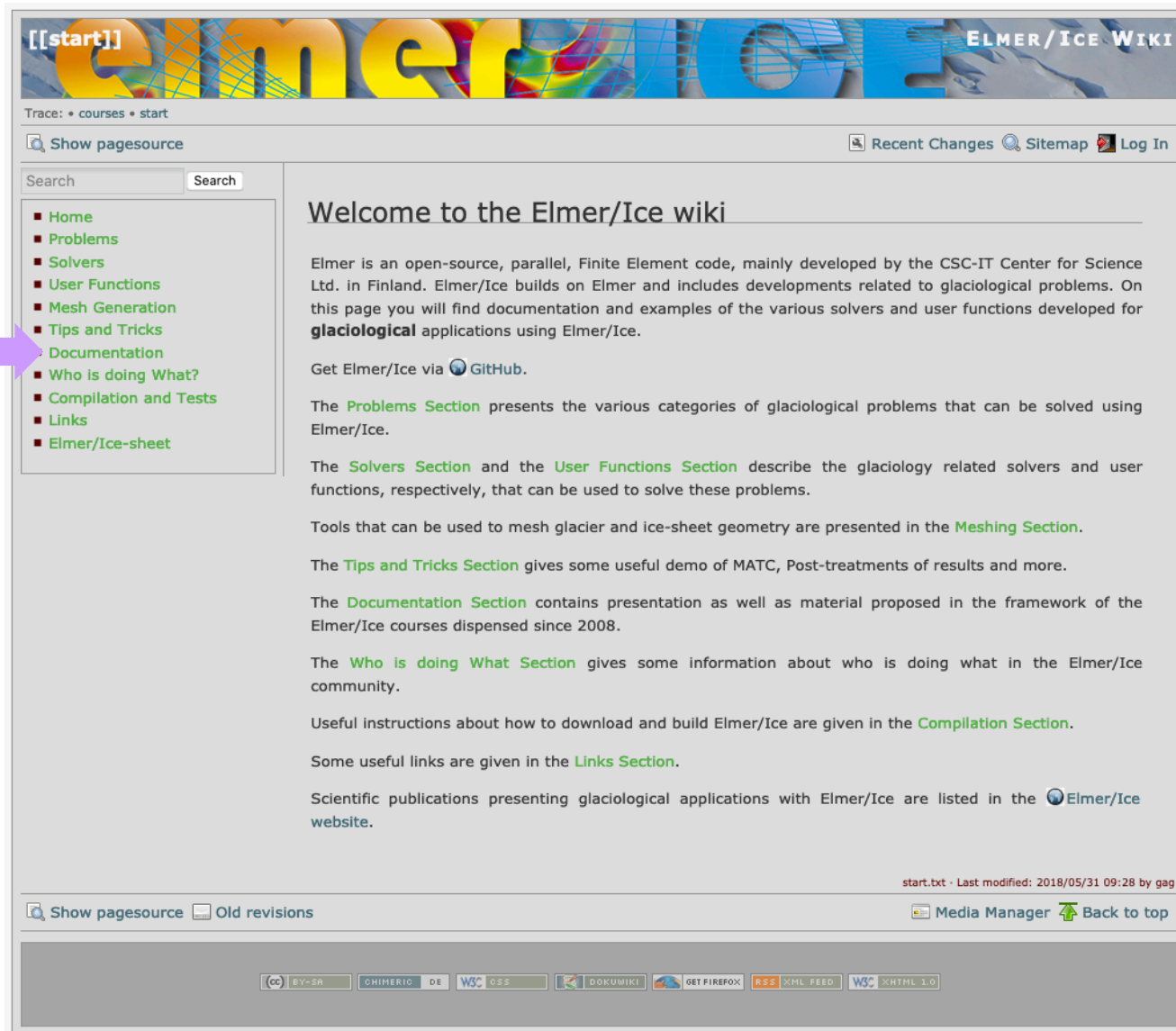
WRITTEN BY OLIVIER GAGLIARDINI.

Elmer/Ice || courses - tutorials

Elmer/Ice courses – Tutorials:

Here is the list of all the Elmer/Ice courses and you will find most of the material used during these courses. We will advertise on this page for the coming Elmer/Ice courses.

- Online Elmer/Ice beginner course, 23-27 November 2020 - [Material].
- 2-day beginner Elmer/Ice course, 28th & 29th Oct. 2019, University of Iceland, Reykjavik, Iceland - [Material].
- 3-day Elmer/Ice advanced users workshop, 29th-31st Oct. 2018, CSC, Espoo, Finland - [Material].
- 2-day beginner Elmer/Ice course, 22nd & 23rd Oct. 2018, University of Lapland, Rovaniemi, Finland - [Material].
- 3-day advanced Elmer/Ice workshop, 22nd, 23rd and 24th Nov. 2017, IGE, Grenoble, France - [Material].
- 2-day beginner Elmer/Ice course, 23rd and 24th Oct. 2017, University of Stockholm, Sweden - [Material].
- 3-day beginner Elmer/Ice course, 31st Oct., 1st and 2nd Nov. 2016, Univ. Oslo, Oslo, Norway - [Material].
- 3-day advanced Elmer/Ice workshop, 30th Nov., 1st and 2nd Dec. 2015, LGGE, Grenoble, France - [Material].
- Elmer/Ice course during the Modelling Mountain glacier dynamics summer school at Pune, India, 23rd Oct to 4th Nov 2015.



[[start]] **ELMER/ICE WIKI**

Trace: • courses • start

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- Solvers
- User Functions
- Mesh Generation
- Tips and Tricks
- Documentation
- Who is doing What?
- Compilation and Tests
- Links
- Elmer/Ice-sheet

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.

Get Elmer/Ice via [GitHub](#).

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 **Documentation Section** contains presentation as well as material proposed in the framework of the Elmer/Ice courses dispensed since 2008.

The **Who is doing What Section** gives some information about who is doing what in the Elmer/Ice community.








Useful instructions about how to download and build Elmer/Ice are given in the **Compilation Section**.

Some useful links are given in the **Links Section**.

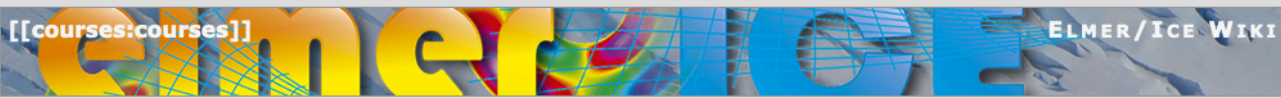
Scientific publications presenting glaciological applications with Elmer/Ice are listed in the [Elmer/Ice website](#).

start.txt - Last modified: 2018/05/31 09:28 by gag

Show pagesource Old revisions Media Manager Back to top

The screenshot shows the Elmer/Ice wiki page titled "Courses / Publications / Meetings". The page header includes the Elmer/Ice logo and the text "[[courses]]" and "ELMER/ICE WIKI". Below the header, there is a breadcrumb trail: "Trace: • courses • start • courses". A search bar is located at the top left, and navigation links for "Recent Changes", "Sitemap", and "Log In" are at the top right. The main content area is divided into two columns. The left column contains a sidebar with a search box and a list of navigation links: Home, Problems, Solvers, User Functions, Mesh Generation, Tips and Tricks, Documentation, Who is doing What?, Compilation and Tests, Links, Elmer/Ice-sheet, Documentation, Courses Material, Best coding Practices, User meetings, Publications (thesis), and Elmer/Ice Logo. A purple arrow points to the "Documentation" link in the sidebar. The right column contains the main text of the page, which starts with "In these pages, you will find the material used during the various Elmer/Ice courses dispensed since 2008 and a list of not peer-reviewed publications (the peer-reviewed publications can be found in the Elmer/Ice website). You will find also the material presented during the Elmer/Ice Users Meetings held during EGU since 2013. Finally, the page Best Coding Practices will give you some useful information on how to correctly write your own contributions to Elmer/Ice." Below this text, it says "You can find the Elmer documentation (Model, Solver, ElmerGrid) on this page." At the bottom of the page, there are links for "Show pagesource", "Old revisions", "Media Manager", and "Back to top". The footer of the page includes a Creative Commons license (CC BY-SA), logos for CHIMERIC, DE, W3C, DOKUWIKI, GET FIREFOX, RSS, XML FEED, and W3C XHTML 1.0.



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- Documentation
 - Courses Material
 - Best coding Practices
 - User meetings
 - Publications (thesis)
 - Elmer/Ice Logo

Elmer/Ice courses - Material

Since 2008, a number of Elmer/Ice courses have been instructed. In this page, you will find the presentation and the material used during these courses. Because Elmer/Ice is evolving and some errors in the presentations have been found, it is recommended to start with the latest material.

Online course 23-27 November 2020

The course consists of two phases:

Video instructions for self learning (16-20/11/2020): we provide a number of videos for self study that constitute the first part of the course. We will provide support via interactive sessions during this period to complete the exercises. Of course, questions could also be sent trough the Slack channel.

Online course (23-27/11/2020): consisting of daily online sessions. To accommodate all time zones, there will be a session starting at 8am CET and one starting at 5pm CET. All session will be kept below 2 hours.

Before the course, one should have a working Elmer/Ice installed on her/his computer. For that you can either:

- install Elmer and Elmer/Ice directly on your computer, following instructions [here](#).
- install the virtual appliance. Instructions** can be found [here](#) (easiest solution).

University of Iceland - Reykjavik - 28-29 October 2019

The [University of Iceland](#), in collaboration with [CSC](#) (Finland) and [IGE](#) (France) is organizing a 2-day beginner Elmer/Ice course from 28th to 29th October 2019. This course is hosted by the University of Iceland and sponsored by the [H2020 project TIPACCs](#) as well as [Finnish Academy Project COLD](#).

Download the list of participants, program and useful informations [here](#).

Title	Presentation	Material
Introduction	pdf	-
Elmer basics	pdf	-
Toy flow-line model	pdf	tar file

Elmer/Ice mailing list

Subscribe to the Elmer/Ice mailing list:

http://mail.elmerfem.org/mailman/listinfo/elmerice_elmerfem.org

Not a big flux, but important information (bug, new version, new publication, etc..)

Currently 64 members

Elmer/Ice Forum

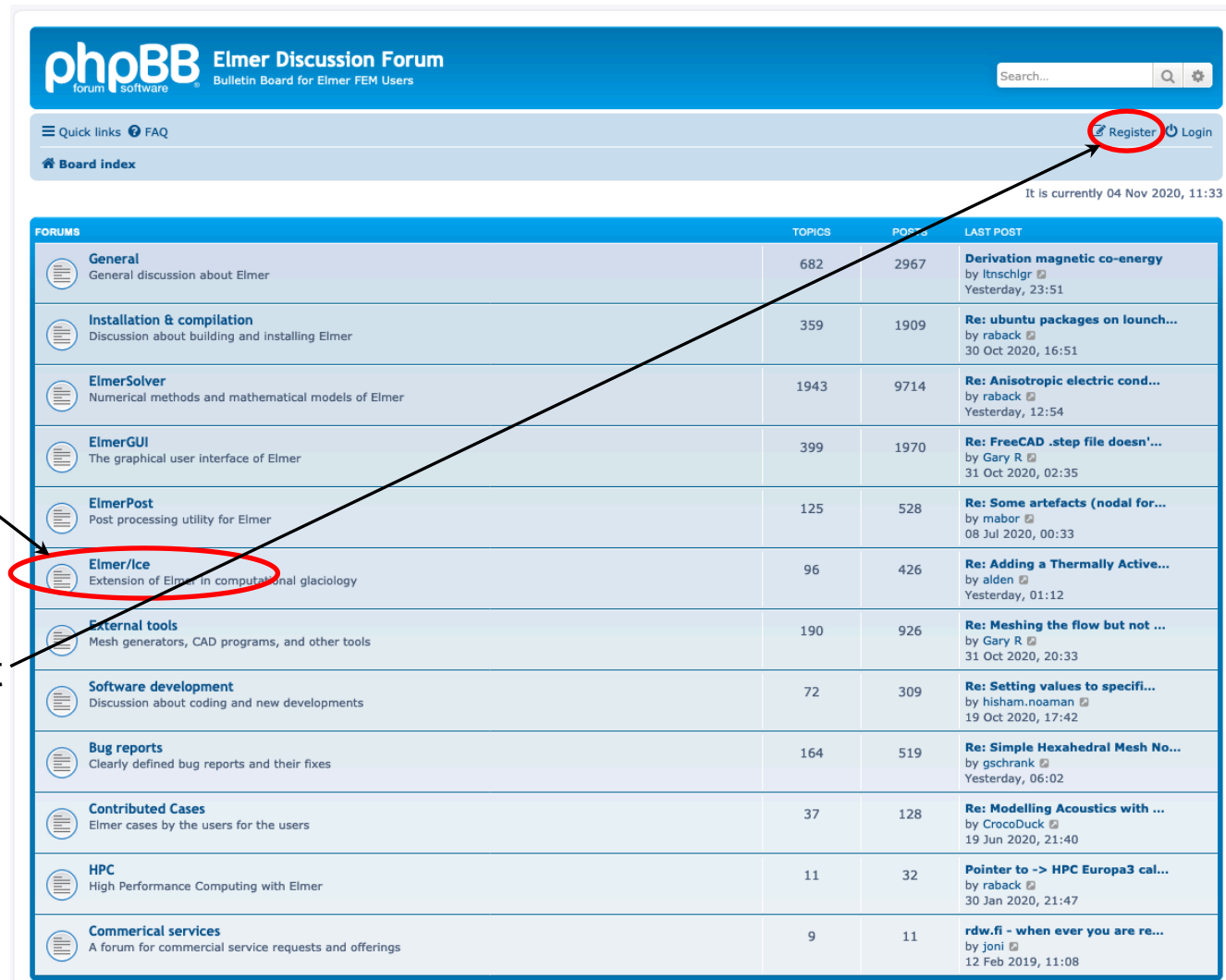
Under

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

•Go to **Elmer Forum**:
find answers on all
aspects of Elmer

•Click on **Elmer/Ice**
link: find answers
specific to Elmer/Ice

•To get access:
Register in upper right
corner



The screenshot shows the Elmer Discussion Forum interface. At the top, there is a navigation bar with the phpBB logo, the forum name 'Elmer Discussion Forum', and a search bar. Below the navigation bar, there are quick links for 'Quick links', 'FAQ', and 'Board index'. The main content area is a table of forum categories. The 'Elmer/Ice' category is circled in red. In the top right corner, the 'Register' button is also circled in red, with a black arrow pointing from the 'Elmer/Ice' link to it.

FORUMS	TOPICS	POSTS	LAST POST
General General discussion about Elmer	682	2967	Derivation magnetic co-energy by ltnschlgr Yesterday, 23:51
Installation & compilation Discussion about building and installing Elmer	359	1909	Re: ubuntu packages on launch... by raback 30 Oct 2020, 16:51
ElmerSolver Numerical methods and mathematical models of Elmer	1943	9714	Re: Anisotropic electric cond... by raback Yesterday, 12:54
ElmerGUI The graphical user interface of Elmer	399	1970	Re: FreeCAD .step file doesn'... by Gary R 31 Oct 2020, 02:35
ElmerPost Post processing utility for Elmer	125	528	Re: Some artefacts (nodal for... by mabor 08 Jul 2020, 00:33
Elmer/Ice Extension of Elmer in computational glaciology	96	426	Re: Adding a Thermally Active... by alden Yesterday, 01:12
External tools Mesh generators, CAD programs, and other tools	190	926	Re: Meshing the flow but not ... by Gary R 31 Oct 2020, 20:33
Software development Discussion about coding and new developments	72	309	Re: Setting values to specifi... by hisham.noaman 19 Oct 2020, 17:42
Bug reports Clearly defined bug reports and their fixes	164	519	Re: Simple Hexahedral Mesh No... by gschrack Yesterday, 06:02
Contributed Cases Elmer cases by the users for the users	37	128	Re: Modelling Acoustics with ... by CrocoDuck 19 Jun 2020, 21:40
HPC High Performance Computing with Elmer	11	32	Pointer to -> HPC Europa3 cal... by raback 30 Jan 2020, 21:47
Commerical services A forum for commercial service requests and offerings	9	11	rdw.fi - when ever you are re... by joni 12 Feb 2019, 11:08

Elmer/Ice
80 Tweets

Elmer/Ice
@ElmerIce1

Open Source Finite Element Software for Ice Sheet, Glaciers and Ice Flow Modelling

elmerice.elmerfem.org A rejoint Twitter en janvier 2014

60 abonnements 230 abonnés

Tweets Tweets et réponses Médias J'aime

Vous avez retweeté

Protect-slr @ProtectSlr · 13 oct.
Happy to launch the #H2020 PROTECT website protect-slr.eu today!
#Protect_Slr aims at producing robust global, regional and local projections of #sealevelrise from the land-based #cryosphere on a range of timescales and #climatechange trajectories.
[@EU_H2020](https://twitter.com/EU_H2020)

Recherche Twitter

Vous pourriez aimer

Stedy @StedyFrance [Suivre](#)
Sponsorisé

IGS EGG @egg_igs Vous suit [Suivre](#)

VAW Glaciology @VAW_glaci... Vous suit [Suivre](#)

[Voir plus](#)

Tendances pour vous

Tendance dans la catégorie France
#Nantes
3 011 Tweets

#MâchezMasqués
Testez votre haleine grâce à l'haleinotest Hollywood
Sponsorisé par HollywoodChewingGum

Tendance dans la catégorie France
Jean-Pierre Vincent

Football · Tendances
Ferland Mendy
Tendance avec [Deschamps](#) et [Aouar](#)

Tendance dans la catégorie France
CSI 93
3 330 Tweets

[Voir plus](#)

Elmer/Ice on Slack

Rechercher dans Elmer/Ice

#beginner-course-nov2020

Ajouter un thème

40

Mardi 20 octobre

Other related issue, if you are running OS X Catalina: version of VirtualBox (6.1.14) has issues with that system - revert back to 6.1.12 if you encounter a crash upon startup of your appliance

Seth Campbell 20 h 28
got it up and running! Thanks a ton for the help!

zwingorthomas 20 h 28

Mercredi 21 octobre

Cruz Daniel Garcia Molina 7 h 57
a rejoint #beginner-course-nov2020, avec j_b_barre_elmer.

Jeudi 29 octobre

Jialin Hong 5 h 31
joined #beginner-course-nov2020.

zwingorthomas 10 h 39
Hi @canal.

I got notified that the original Ubuntu VM (downloads before 2020-10-24 20:39 UTC) had a broken ParaView installed. ParaView launches but doesn't render anything. Also, I came across the fact that some runs don't work with the installed Elmer version (issue with the derivation of viscosity in Newton method). I now updated Elmer version and installed the latest ParaView version in an updated version of the appliance, which is uploaded under <https://www.nic.funet.fi/pub/sci/physics/elmer/bin/VirtualMachines/>

The new version is set up for 4 GB RAM (so perhaps too large for some smaller laptops) and has 5 GB download size.

If you do not want to invest into another heavy download, you can, alternatively, apply changes in the old appliance. Therein, you can download latest version of Paraview (v5.8) from <https://www.paraview.org/download/> - for the Ubuntu VM, pick Python3.7 version, for instance this one <https://www.paraview.org/paraview-downloads/download.php?submit=Download&version=v5.8&type=binary&os=Linux&downloadFile=ParaView-5.8.1-MPI-Linux-Python3.7-64bit.tar.gz>

For re-compiling Elmer inside the appliance, follow instructions given in the [Readme-file](#)

Sorry for the inconvenience.

Thomas

Envoyer un message à #beginner-course-nov2020

Fil de discussion #general

Jesse Velay-Vitow 26 oct. à 15 h 15
Hi all, I have a question regarding scalability of the Elmer/Ice code for runs on standard X86 clusters. Are there any examples of sample runs that show when increasing node count produces diminishing returns in terms of computational efficiency? I have to write an expected computational needs document for my supervisor.

3 réponses

zwingorthomas il y a 8 jours
Both, strong and weak scalability, have been discussed for a direct solver (MUMPS) and the initial version of the block-precconditioner in <https://gmd.copernicus.org/articles/6/1299/2013/gmd-6-1299-2013.pdf>

zwingorthomas il y a 8 jours
This is, though, quite outdated. Newer versions of the pre-conditioned code include vector operations, which should increase the computing performance and hence speed up the wall clock time, but at the same time (as "communication sucks") increases the impact of message passing and hence might lead to a worse scalability, as usually networks do not develop as fast as computation does (modifié)

Jesse Velay-Vitow il y a 7 jours
Okay, thank you I will read this and Try to estimate an allocation request based on it.

Répondre...

invitation link:

https://join.slack.com/t/elmerice/shared_invite/zt-i7i90bad-wDAI41bjXvaiX~cfwuS7Kg

Important links (summary)

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

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

<https://www.csc.fi/web/elmer>

Elmer source code

<https://github.com/ElmerCSC/elmerfem>

Elmer Forum

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

Elmer/Ice webpage

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

Elmer/Ice wiki

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

Important notices

In this course

- We will not teach finite element method (can give references)
- We will focus on some technical aspects of using Elmer for glaciological applications

What we expect from this course ?

- giving you a kick-start in Elmer/Ice
- some fruitful collaborations to begin