

Elmer/Ice course

28th and 29th October 2019, Reykjavik

Introduction

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Program

Monday 28th October

9:00-9:15 Arrival of the participants

9:15-9:30 Welcome words by Guðfinna Aðalgeirsdóttir, general announcements

9:30-9:45 Introduction on Elmer/ice (OG)

9:45-10:30 Short description of Solver Input File (sif file) (PR)

10:30-11:00 Coffee break

11:00-12:00 Toy flow-line model: basic diagnostic (TZ)

12:00 Lunch (on your own expense)

13:00-15:30 Toy flow-line model: thermo-mechanical coupling (TZ)

15:30-16:00 Coffee break

16h00-17h30 Toy flow-line model: sliding, prognostic runs (TZ)

19h Course dinner (place to be specified, on your own expense)

Program

Tuesday 29th October

9:00-9:30 Tête Rouse Context (OG)

9:30-10:30 Tête Rouse setup and diagnostic (OG)

10:30-11:00 Coffee break

11:00-12:00 Tête Rouse prognostic (OG)

12:00 Lunch (on your own expense)

13:00-15:30 Midtre Lovenbreen application (PR)

15:30-16:00 Coffee break

16:00-18:00 Questions on your own modeling

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

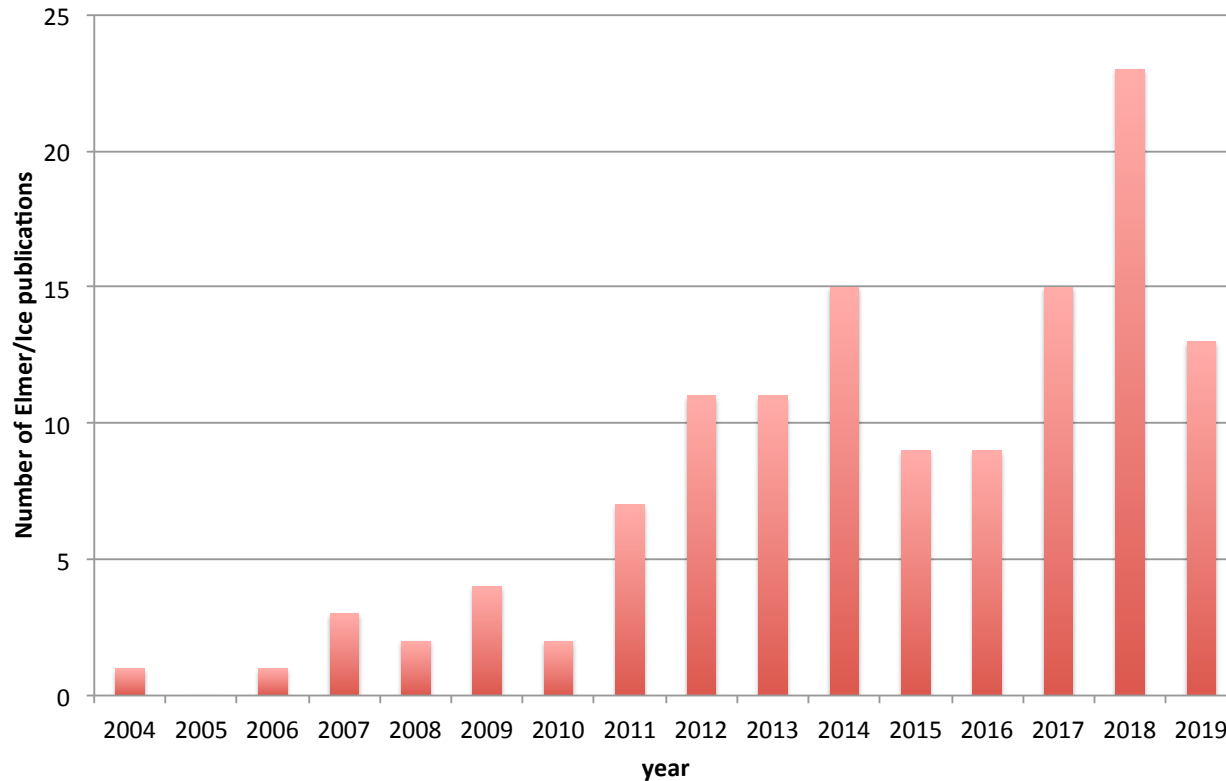
- ✓ May 2013 – Second SVALI summer school – Finland
- ✓ 2-day beginner Elmer/Ice course, 3-4 Oct. 2013, LGGE, Grenoble, France
- ✓ 3-day Elmer/Ice advanced workshop, 4-6 Nov. 2013, CSC, Espoo, Finland
- ✓ April 2014 – Second Elmer/Ice users meeting – EGU 2014
- ✓ **3-day beginner Elmer/Ice course, 27-29 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

and now back in Reykjavik

A growing community

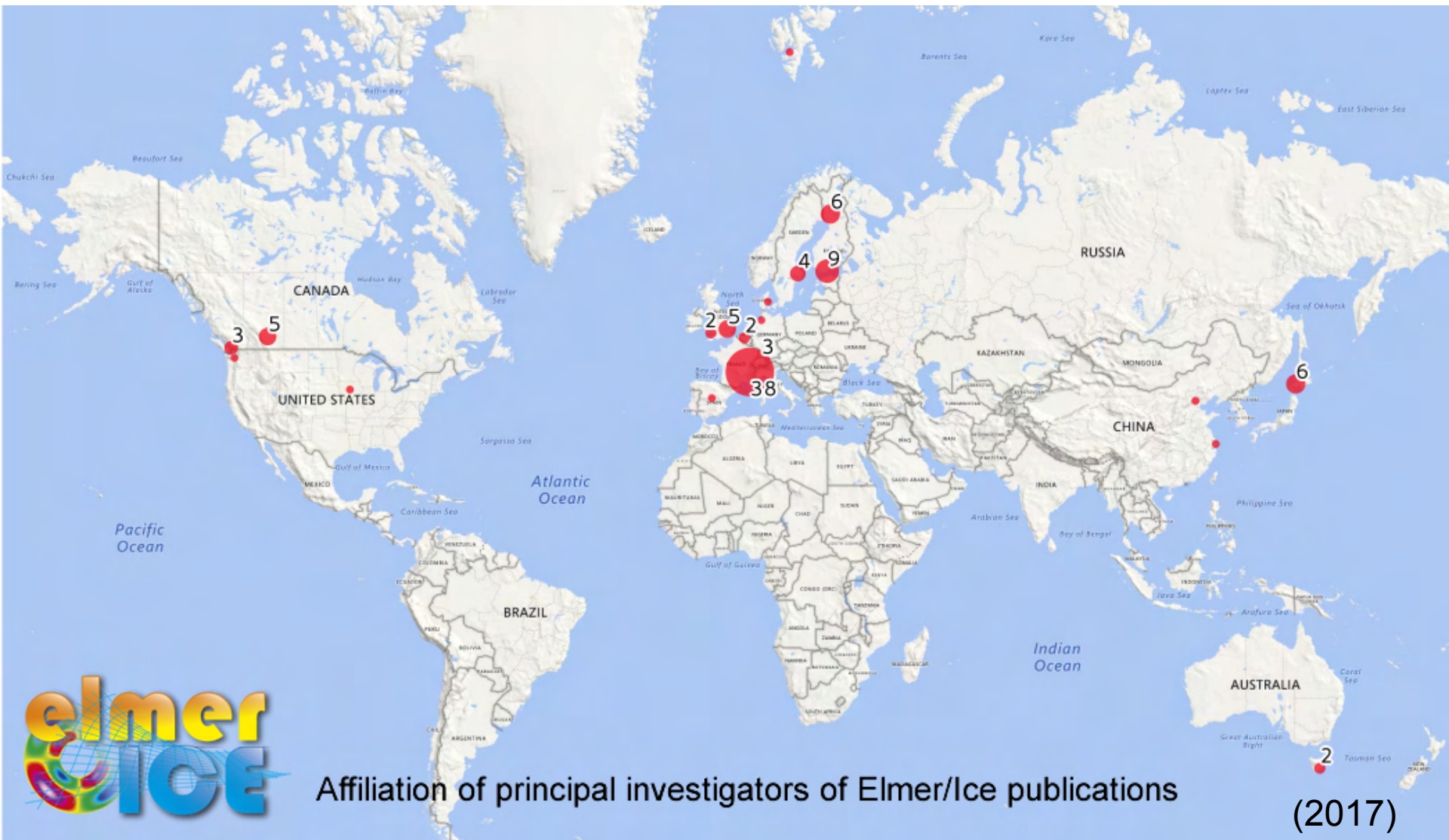


17 Courses ~ 320 participants

5 Elmer/Ice users meetings

126 publications

An international community



Gagliardini et al., GMD 2013 – 121 citations



Elmer/Ice applications

126 (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, Antarctica)
- Flow of anisotropic ice
- Glaciers, Greenland, Antarctica
- 9 cited references including results from Elmer/Ice in the 5th IPCC report

elmer ICE

News Publications Capabilities Elmer Ice-Sheet Users Community FORUM Courses Tutorials Materials Documentations

search...

Elmer/Ice


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

Elmer/Ice is a full-Stokes, finite element, ice sheet / ice flow model. The aim of this website is to present the capabilities of Elmer/Ice and to distribute course materials and tutorials.


Elmer/Ice is an add-on package to [Elmer](#), which is a multi-physics FEM suite mainly developed by [CSC-IT Center for Science Ltd.](#), Espoo, Finland. Initially started by CSC, IGE and ILTS, currently multiple institutions and individuals contribute to the development of Elmer/Ice.

Modeling the Re-appearance of a Crashed Airplane


Written by Olivier Gagliardini.



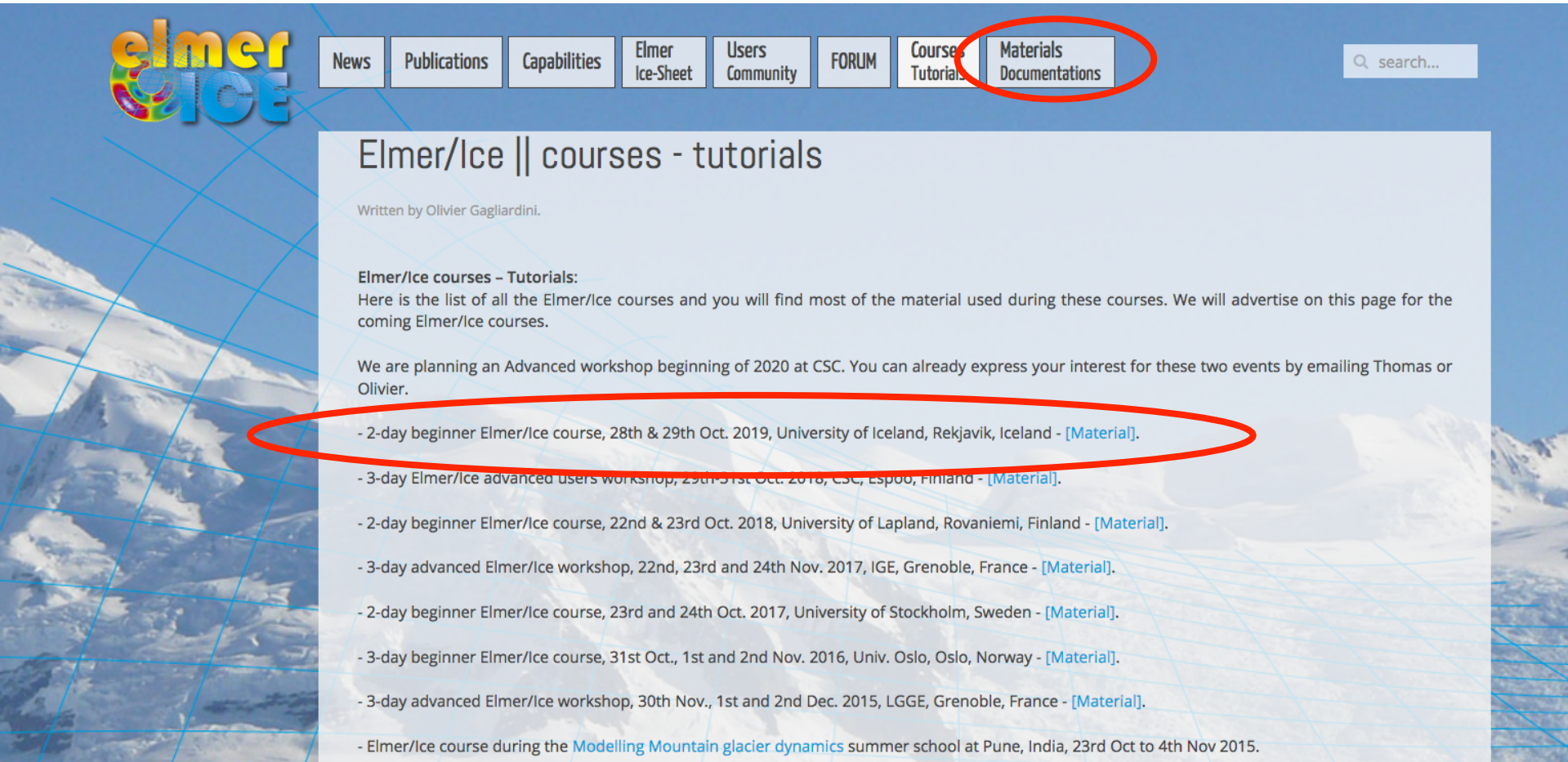
In this study we used Elmer/Ice to reconstruct the space-time trajectory of the Dakota airplane which crashed on the Gauligletscher in 1946 and was subsequently buried by snow accumulation. Our aim was to localize its present position and predict when and where it would re-appear at the surface. As a first step we modeled the ice flow field and the evolution of Gauligletscher from 1946 using a combined Stokes ice flow and surface mass balance model, which was calibrated with surface elevation and velocity observations. In a second step the modeled ice velocity fields were integrated forward-in-time, starting from the crash location. Our results suggest that the main body of the damaged aircraft will be released approximately between 2027 and 2035, 1 km upstream of the parts that emerged between 2012 and 2018. Our modeling results indicate that the recently found pieces of the Dakota might have been removed from the original aircraft location and moved down-glacier before being abandoned in the late 40s.



Read more: Compagno L., G. Jouviet, A. Bauder, M. Funk, G. J. Church, S. Leinss and M. P. Lüthi, 2019. *Modeling the re-appearance of a crashed airplane on Gauligletscher, Switzerland*, *Frontiers in Earth Science*, 7, 170, DOI: 10.3389/feart.2019.00170



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News Publications Capabilities Elmer Ice-Sheet Users Community FORUM Course Tutorials **Materials Documentations**

Elmer/Ice || courses - tutorials

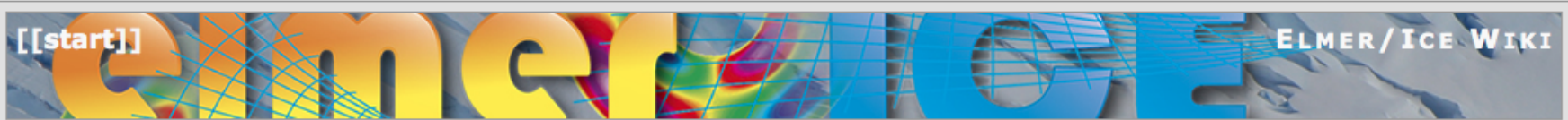
Written by Olivier Gagliardini.

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.

We are planning an Advanced workshop beginning of 2020 at CSC. You can already express your interest for these two events by emailing Thomas or Olivier.

- 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.

Much more material available than what we will present today



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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](#).

start.txt · Last modified: 2012/12/03 17:45 by tzwinger

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, etc..)

Currently 46 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

Elmer Discussion Forum • Index page - Mozilla Firefox

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www.elmerfem.org/forum/index.php

Most Visited Linux Mint Elmer/Ice elmerfem.org

phpBB Elmer Discussion Forum Bulletin Board for Elmer FEM Users

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It's currently 02 Sep 2013, 10:54

View unanswered posts • View active topics

FORUMS	TOPICS	POSTS	LAST POST
General General discussion about Elmer	345	1289	by GastónGarcía 29 Aug 2013, 22:01
Installation & compilation Discussion about building and installing Elmer	166	680	by Jyh-Shyong 30 Aug 2013, 18:02
ElmerSolver Numerical methods and mathematical models of Elmer	944	4108	by drueffer 30 Aug 2013, 16:54
ElmerGUI The graphical user interface of Elmer	228	908	by raback 26 Aug 2013, 00:05
ElmerPost Post processing utility for Elmer	90	346	by Edmund 30 Jul 2013, 11:01
Elmer/Ice Extension of Elmer in computational glaciology	8	27	by tzwinger 22 Aug 2013, 13:56
External tools Mesh generators, CAD programs, and other tools	113	558	by NickR7 30 Aug 2013, 18:04
Software development Discussion about coding and new developments	37	120	by Takala 22 Aug 2013, 09:02
Bug reports Clearly defined bug reports and their fixes	80	230	by millm 29 Aug 2013, 12:55
Contributed Cases Elmer cases by the users for the users	15	33	by sebastien ROUQUETTE 29 Apr 2013, 14:49
HPC High Performance Computing with Elmer	3	5	by madtom1999 21 Oct 2012, 15:34
Commerical services A forum for commercial service requests and offerings	3	3	by aether 12 Dec 2012, 11:33

ANNOUNCEMENTS	TOPICS	POSTS	LAST POST
Updates Updates in software, documentation, sites etc.	20	83	by mzenker 08 Jul 2013, 16:20
Events Courses, user meetings, seminars etc.	14	17	by raback 12 Apr 2013, 13:54

MISCELLANEOUS	TOPICS	POSTS	LAST POST
Testing Here you can test posting, attachments, ...	4	6	by Takala 03 Apr 2013, 10:16

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

54 abonnements 180 abonnés

Tweets Tweets et réponses Médias J'aime

Elmer/Ice @ElmerIce1 · 19 août
#ElmerIce1 used to reconstruct the space-time trajectory of the Dakota airplane which crashed on the Gauligletscher in 1946
elmerice.elmerfem.org/news/122-model...

Elmer/Ice @ElmerIce1 · 12 juil.
Sliding dominates slow-flowing margin regions, Greenland Ice Sheet
elmerice.elmerfem.org/news/119-slidi...

Important links (summary)

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

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

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

Elmer Forum

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

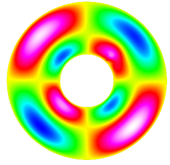
Elmer/Ice webpage

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

Elmer/Ice wiki

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

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

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"
```

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

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		