Ice, Mud and Water

Plans and thoughts of Rupert Gladstone and colleagues relating to Elmer/Ice usage and code and community development

Collaborators include (in no particular order) John Moore, Martina Schäfer, Dorothée Vallot, Yongmei Gong, Ian Rutt, Garry Clarke, Basile de Fleurian, Martin Luethi, Ben Galton-Fenzi, Roland Warner, Nathan Bindoff, and of course Thomas Zwinger (what Elmer/Ice related presentation doesn't?)

Contents of presentation

1. Current Elmer/Ice work at Rovaniemi/Uppsala (main focus: Svalbard).

2. Development plans: deformable sediment modelling.

3. Development plans: ice-ocean interactions.

4. Thoughts on the growing Elmer/Ice community.

1. Current work with Martina Schäfer (slides provided by Martina)

Research context

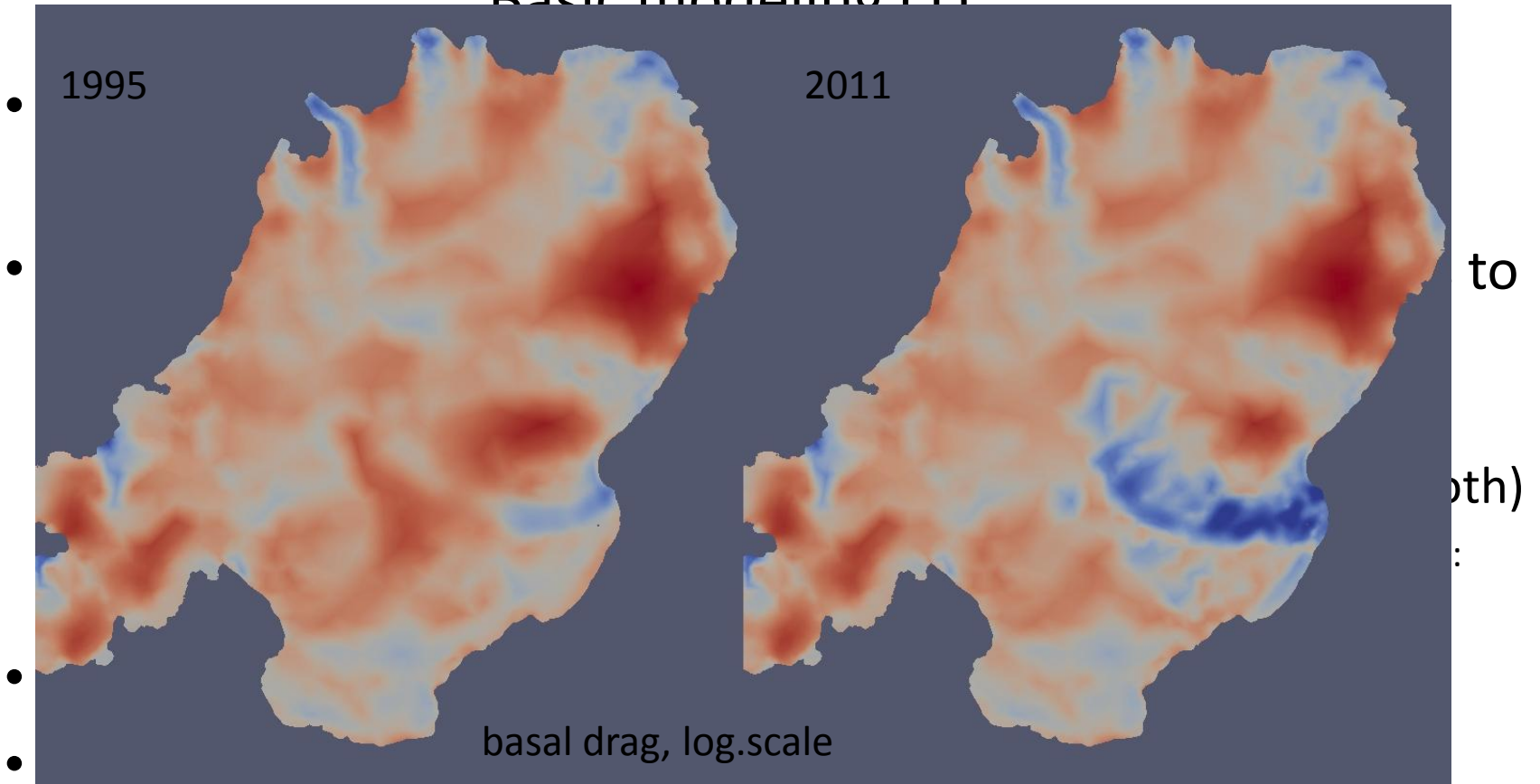- surface DEM from NPI maps (1990)

- bedrock from different radar data (Petterson et al 2011/Thor...

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Basic modeling (1)

1995

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- basal drag, log.scale
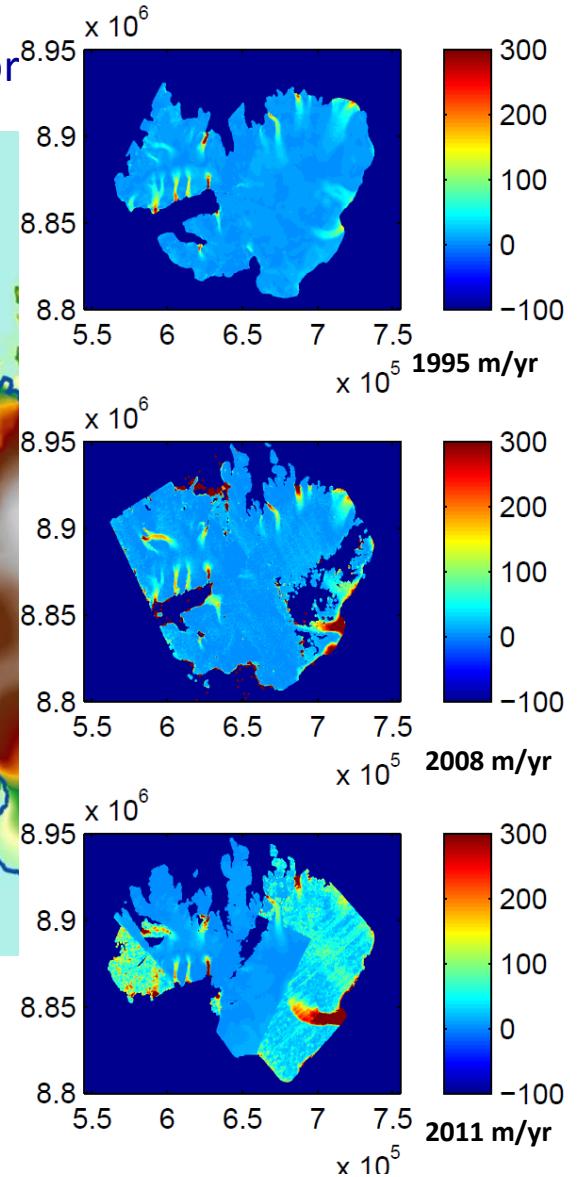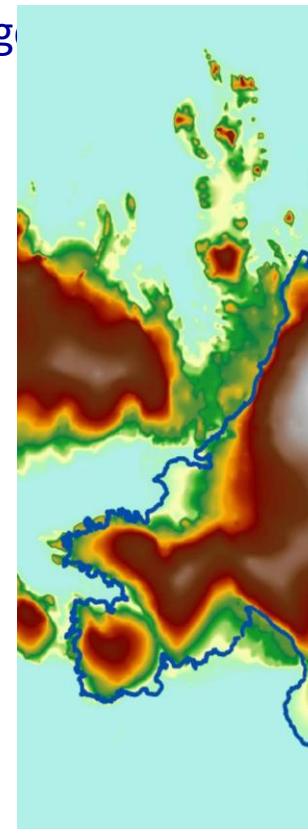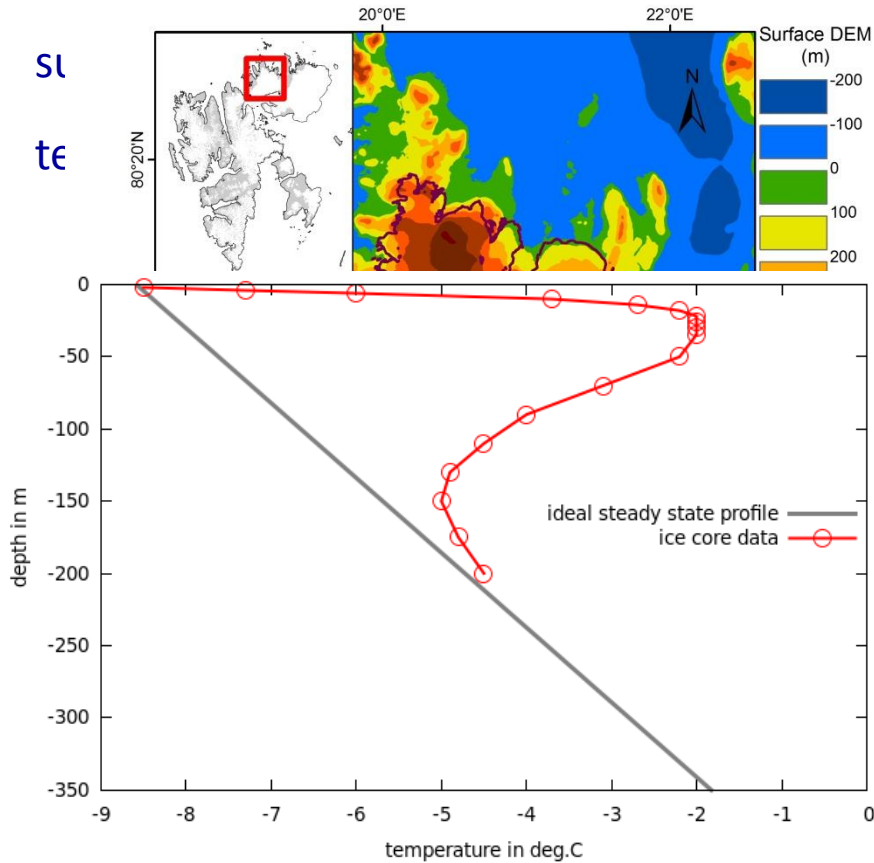
sliding law in forward simulations

Basic modeling (2)

- study of different heat sources
  - strain heat is mostly neglectable
  - friction heat is in most outlets crucial to obtain pressure melting point at the basis
  - firn heating (latent heat through refreezing) essential to explain measured temperature profiles in central part
- changes in flow regime can't be captured only by temperature
  - Franklinbreen/B3 are at pmp and still accelerate
  - whole area of outlets is at pmp, but basal drag coefficient is not constant

basal temperature
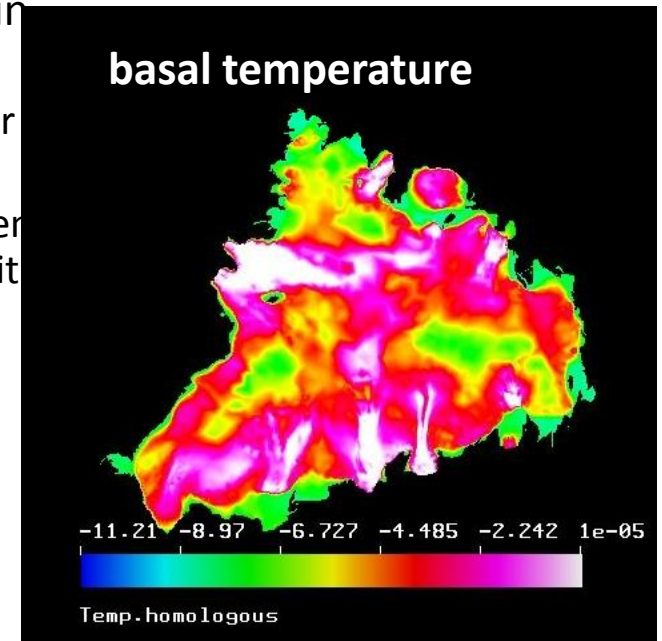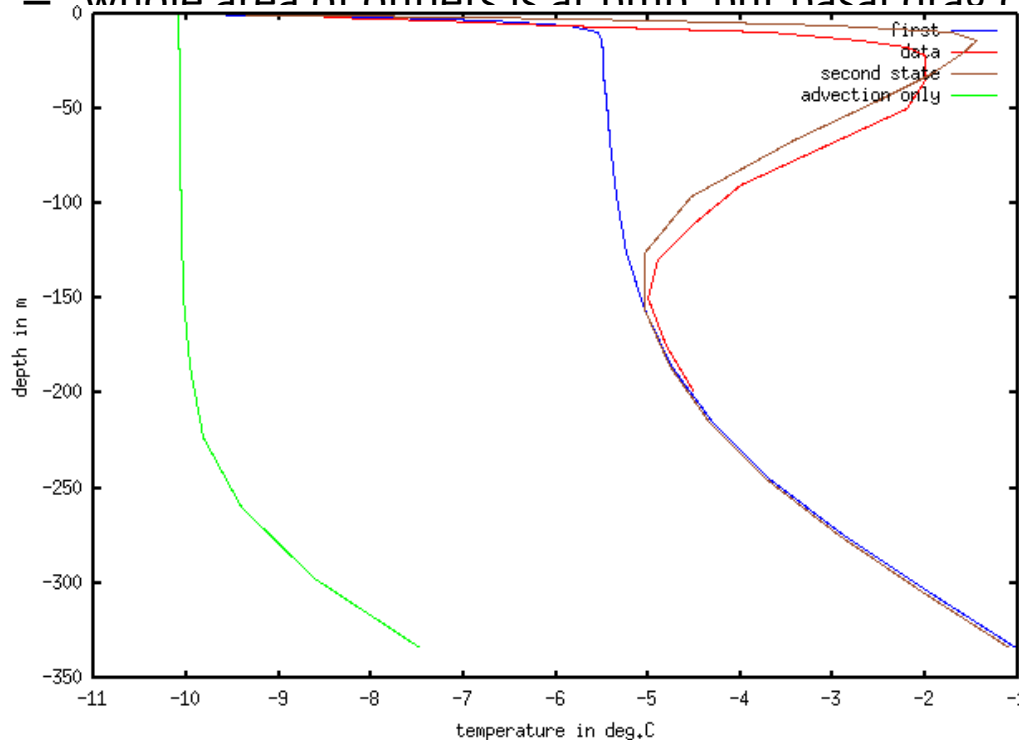
2. Sediment modelling

Vague thoughts…

- Deformable sediment probably underlies Austfonna glaciers (and many others, but I'm currently working on Austfonna).
- We don't currently have a model for deformable sediment in Elmer/Ice.
- Sediment yield strength has a strong dependence on pore water pressure, therefore we need a hydrology model also.
- Basile de Fleurian has done some development in this area (Olivier to talk about this later on?).
- Garry Clarke provides a physical description including dependence of sediment yield strength on porosity as well as pore water pressure (important for a compressible sediment).
- Our plans for moving forward are not definite yet, but both myself and Dorothée Vallot are interested in sediment model development for Elmer/Ice, and application to Nordaustlandet icecaps.
- Watch this space, and let me know if you are interested in being involved.
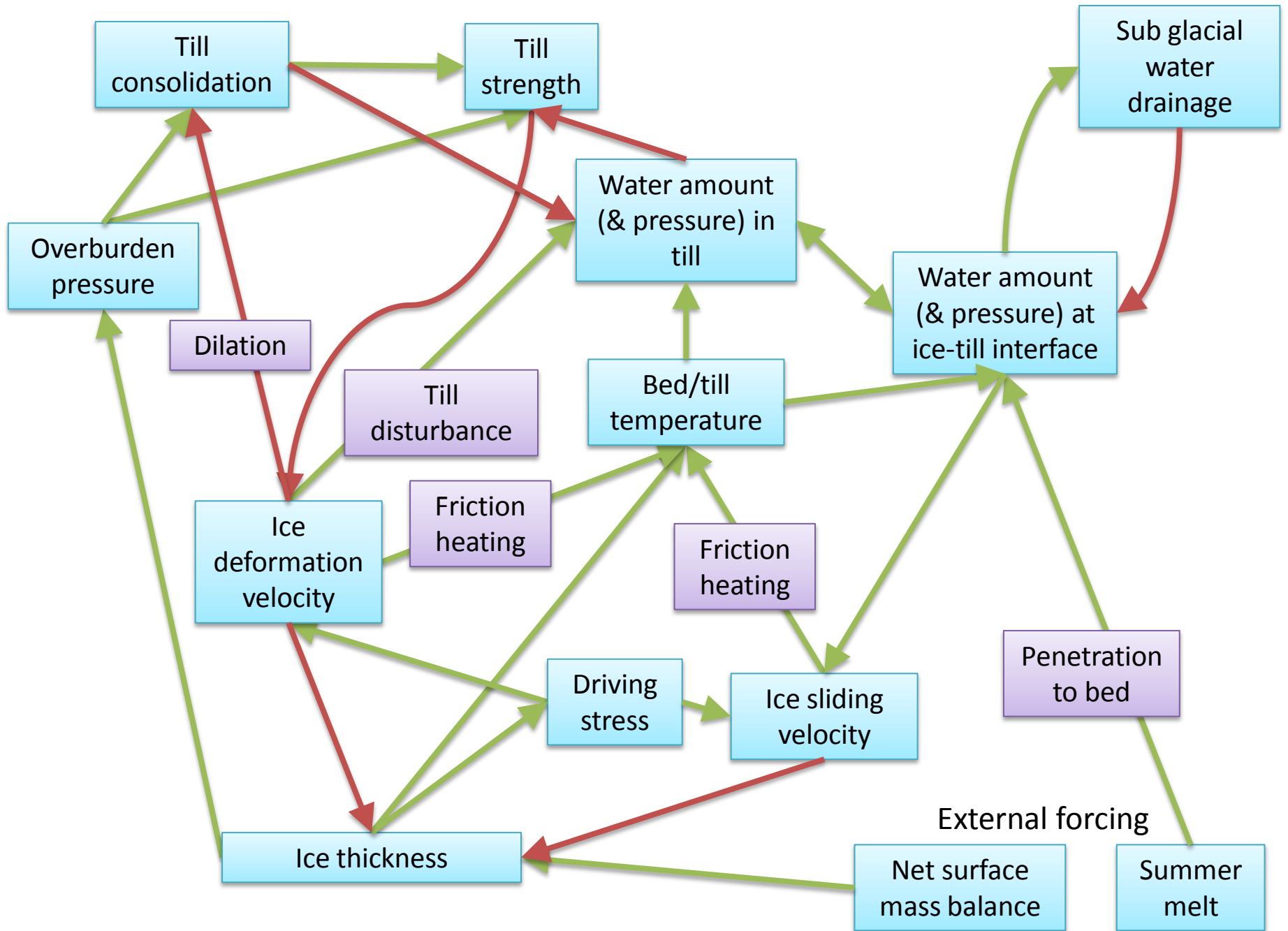
Plug

- I have a talk on this work today!
- "Importance of basal processes in simulations of a surging Svalbard outlet glacier"
- Session: "Subglacial Environments of Ice Sheets and Glaciers"
- 16:45 in room G3

3. Ice – ocean interactions
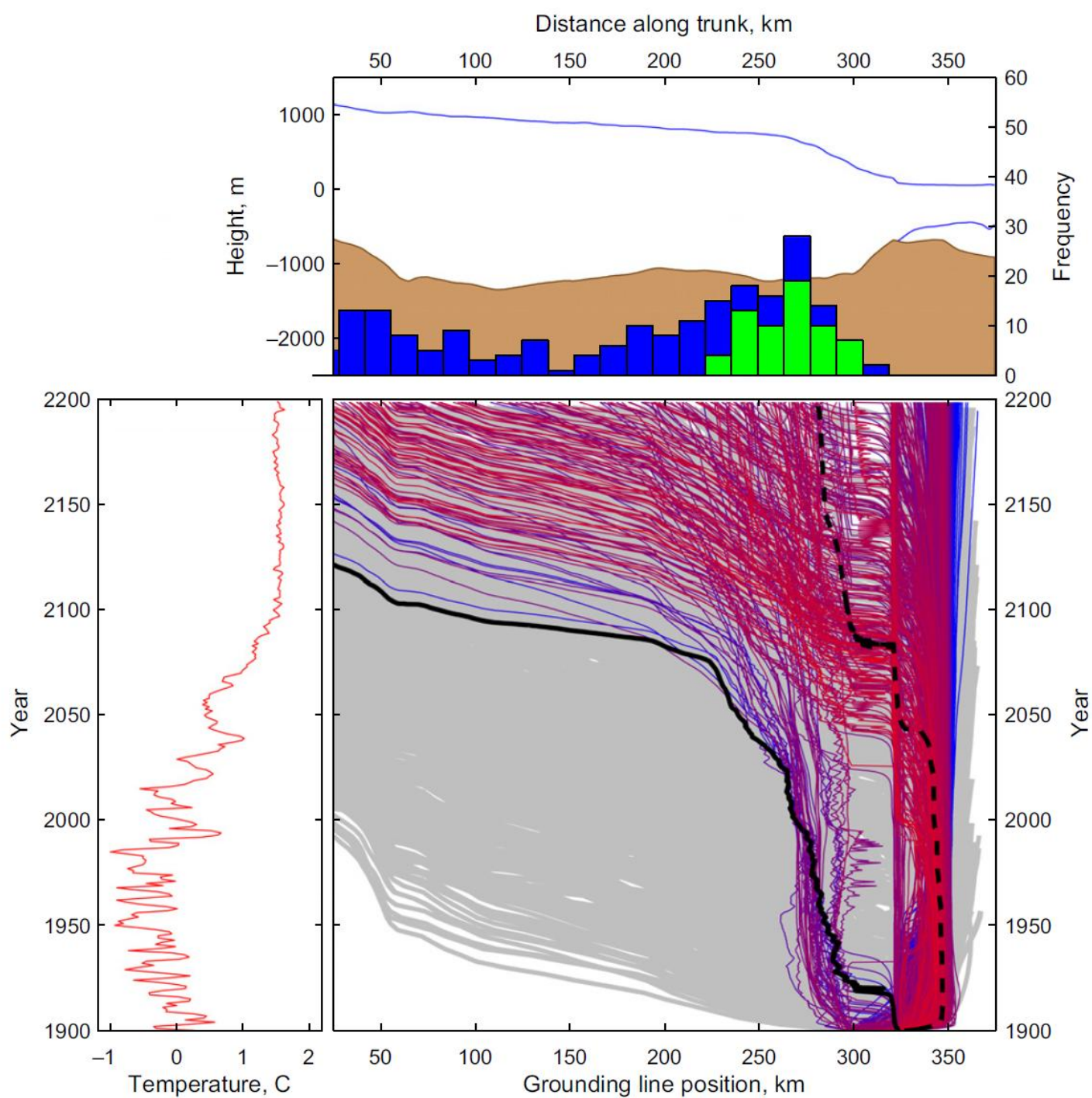
Flexibility in ice-ocean coupling

- I will couple the Regional Ocean Modelling System (ROMS, developed to include sub shelf processes by Ben Galton-Fenzi) to either Elmer/Ice or BISICLES (block structured adaptive mesh model, good for longer timescales).

- BUT we (i.e. The ice dynamic modelling community) would like multiple options for ice-ocean coupling to allow to switch between different ice dynamic models and different ocean models.

- Therefore… we need to think about a well defined coupling framework, potentially involving third party coupling toolkits (e.g. MCT, cpl7, ESMF) and or application programming interfaces (APIs, Thomas has written one for Elmer/Ice).

- Need to work with different groups to come up with a suitable framework. In the first instance at least Steph Cornford (Mr BISICLES, at least on this side of the Atlantic) and Thomas or Olivier (the high lords of Elmer/Ice).

- We may also want to consider PISM, CISM, Sicopolis etc…

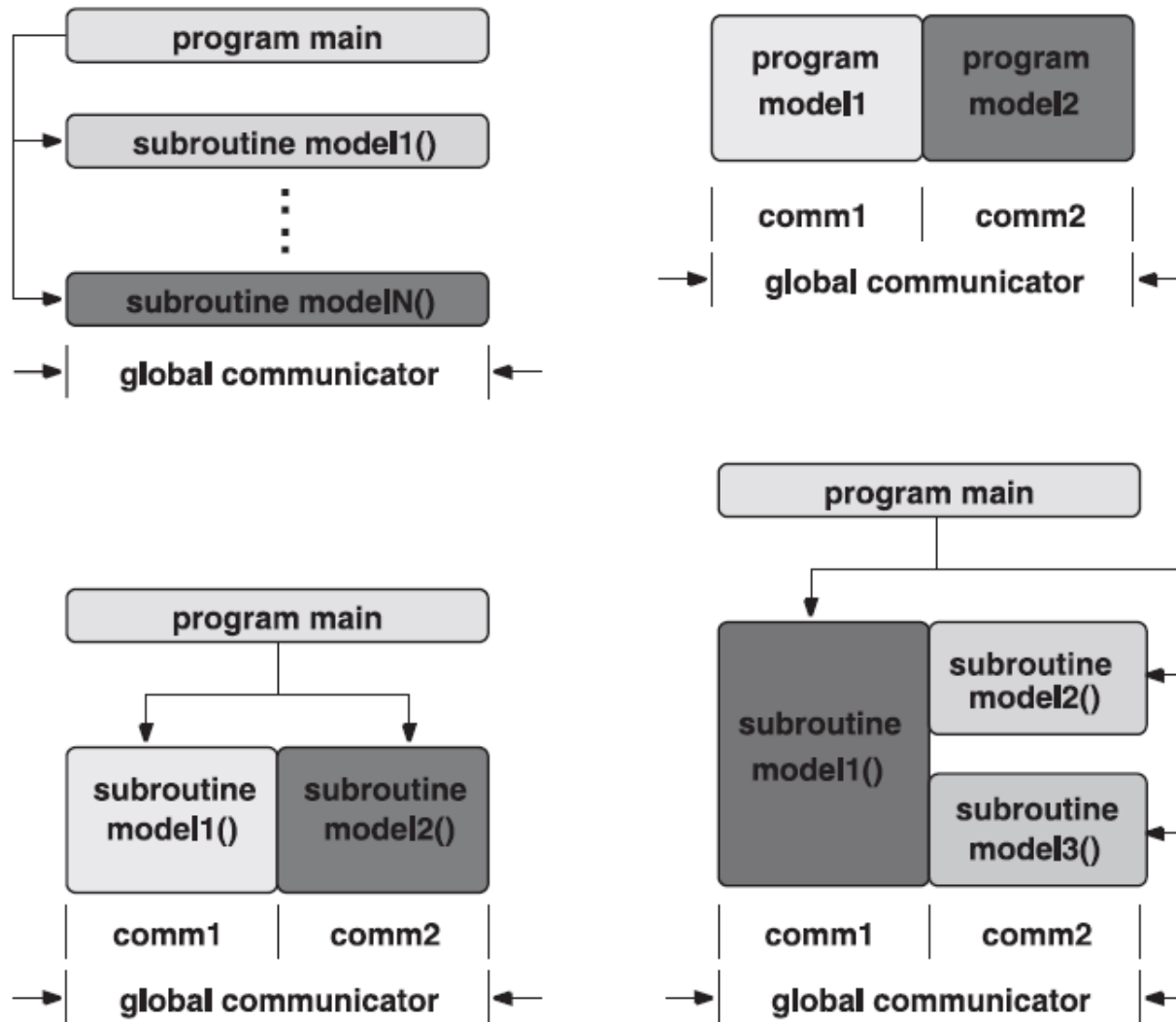# Some basic layouts for parallel coupled models

Figure from Larson et al. 2005, International Journal of High Performance Computing Applications

Single executable concurrent coupling involving the Regional Ocean Modelling System (ROMS)

'Master' program
• initialize MPI

MODEL1
• initialize MCT
• initialize MODEL1
• time=0: exchange initial data with MODEL2 via MCT

model integration with MODEL1 time step

• time = MCTtime : exchange modeled fields with MODEL2 via MCT
• time = end : finalize MCT, return to 'Master'

MCT

Coupling Toolkit

Model

MODEL2
• initialize MCT
• initialize MODEL2
• time=0: exchange initial data with MODEL1 via MCT

model integration with MODEL2 time step

• time = MCTtime : exchange modeled fields with MODEL1 via MCT
• time =end : finalize MCT, return to 'Master'

'Master' program
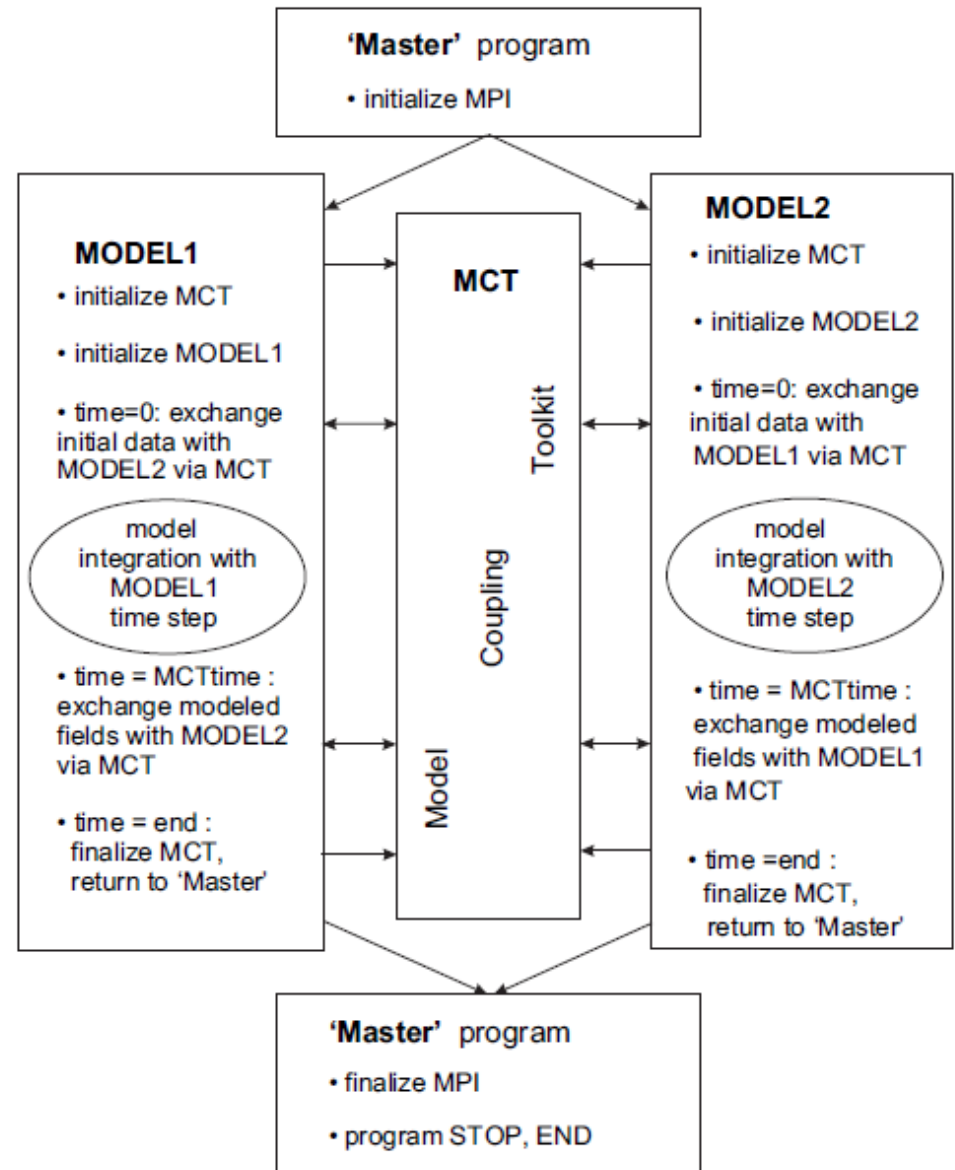• finalize MPI
• program STOP, END

Figure from Warner et al., 2008, Environmental Modelling and Software

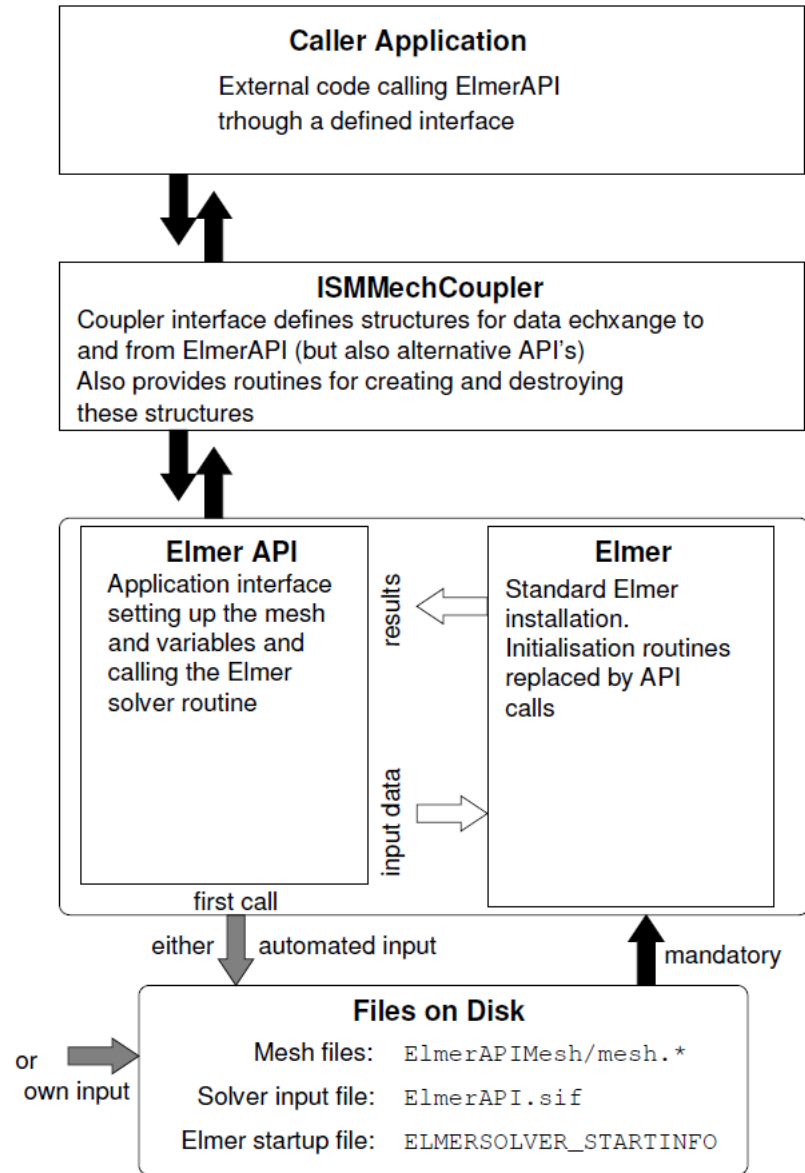An Elmer/Ice API already exists, though current functionality is limited to steady state simulatons

Figure from Zwinger 2009 EGU poster

4. Elmer/Ice direction and community

A series of comments, questions, and suggestions (apologies for ensuing walls of text).

Who owns Elmer/Ice? Olivier? Thomas? The whole Grenoble group? CSC?

- Should CSC/Grenoble be viewed as the developmental core, with others as "users"?

- Or is the aim for a fully involved (democratic?) community? Do we all have a stake in Elmer/Ice? Perhaps the size our stake reflects the work put in?

- Comment from Ian Rutt: "…to make an Elmer/Ice community really work, it will require people to understand and go along with a sense of shared ownership… if you're part of the community you're expected to contribute where you can… The rules would need to be very clear!"

- Perhaps complicated by the relationship between Elmer and Elmer/Ice, and ownership of Elmer.

Elmer/Ice email list

- Great that exists. Olivier using it for announcements, Martina using it for technical questions. Would be good to see more people using it.

- Clarify expected usage of email list? Possible uses include sharing Elmer/Ice news items, asking for help when stuck, debugging, discussions about potential new physics...

- Change settings so that REPLY goes to sender and REPLY ALL to list?

Zwinger/Raback/Gagliardini cloning

- Or if we can't clone them...
- The Elmer/Ice key people are very busy.
- Can we help reduce their load by making more use of the Elmer/Ice email list, instigating an Elmer/Ice steering group, or any other means? (suggestions welcome)
- Thomas, what can the international Elmer/Ice community do to make your life easier? Would it help if more funding proposals involving Elmer/Ice asked for a small amount of funding for CSC, making your contributions more official?

Elmer/Ice steering group?

- Elmer/Ice committee/steering group: at least one member from Grenoble, CSC, elsewhere (i.e. at least 3 people, probably 4-6 would be ideal).

- Clearly defined role of Elmer/Ice steering group distinct from Elmer itself (Elmer/Ice community coordination, direction, code control, knowledge of developments, planning meetings, courses etc).

- Possible roles within the steering group: tech lead, science coordinator, community access officer, defensive development officer, media whore…

Community access/control

- Elmer/Ice wiki:
- Give everyone write access? Or just key people have access? Or something in between.
- Same question for Elmer/Ice section of Elmer svn repository.
- Same question for Elmer/Ice web site.
- Maybe review initial contributions and grant full access once robustness/flexibility of contributions is proven?
- Appoint member(s) of steering group to oversee member contribution review and write access provision?
- See also http://www.artofcommunityonline.org/

Elmer/Ice: a research code somewhere between "development" and "production"

- Who are the intended user base for Elmer/Ice?
- What level of technical and scientific skills should they have?
- Should they be able to debug seg faults?
- Should new users be able to treat Elmer/Ice as a "black box"?
- Do the Elmer/Ice developers need to make the code more robust/user friendly?
- We could add a section on the Elmer/Ice wiki or web site summarising the state of the code and developers intentions in terms of level of required user expertise.

Defensive development in the Elmer and Elmer/Ice communities

- By "defensive development" I mean things like debugging, meaningful error messages, reducing potential for user error.
- Elmer often seg faults. Perhaps a collabration between users and developers can help identify causes of seg faults and provide more meaningful error messages?
- Bugs can creep in through lack of communication (e.g. recent issue or changes in Elmer not reflected in Elmer/Ice code, see recent email discussion with Peter and Martina).
- Appoint member(s) of the steering group to assume a "defensive development" role to ensure that important Elmer developments are propogated to Elmer/Ice, and perhaps also to liase with Elmer team regarding debugging, and to be proactive in terms of testing/debugging Elmer/Ice code.
- Martina suggests an email sent to the Elmer/Ice list whenever there is a significant change to Elmer or Elmer/Ice that impacts on the way the code is used.

Suggested additions to the Elmer/Ice wiki from Martina

- A conversion table for the units (Martina offers to do that).
- A section with tips for Paraview which are specific for Elmer/Ice applications, e.g. how to get info about boundary conditions from Elmer to paraview.
- Template sif files for "typical" simulations (Martina has some and could make them available).
- Tips for resolving typical problems involving failure of solvers to converge (e.g. parameters to change, which variables to look at). I guess this would be essentially a list of examples put there by people who have had a problem, fixed it, and are willing to share their experience with others.

Further comments from Martina

- Martina is regularly in touch with Ethan and offers to contact him about data if it would help the Elmer/Ice calving group.
- Elmer advanced course. For people with some experience of running Elmer, who have started to learn how to fix errors, perhaps even have written their own solvers. They could bring examples of how they solved old problems, and or work on fixing current unsolved/unsatisfactorily solved problems. Not sure if this should be Elmer wide or specifically Elmer/Ice.
- Could some of the positive collaborative aspects from Ice2sea feed into the Elmer/Ice community?