

# ASPECT 2020 Virtual User Meeting Log

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# Summary

This is a quick retrospective on the first virtual ASPECT user meeting that took place Jan 21st-23rd, 2020. After an initial forum query it became clear that there was great interest in the community for such a meeting. A preliminary time period was discussed and finalized, and 4-8 weeks after the initial discussions the meeting took place. It saw 35 participants in total, with participation during any particular time ranging from 8 to 25, which is very comparable to ASPECT's usual hackathon participation. 16 of the participants had never attended one of ASPECT's in person hackathons before.

As intended for the meeting a mix of presentations, Q&A and discussions allowed to learn more about ASPECT's features, recent developments, and our community members, and the event sparked some discussions that lead to new features in the following days. Our log document, the feedback slides, and the presentations were made available to all participants. Considering the very positive feedback we received, we will certainly plan for repeating this type of event in the future, possibly with some minor modifications like an introductory session for beginners, and some scheduled time for one on one discussions. The optional practical sessions on day 3 saw less participation, which probably means a good timeframe for such a meeting is about 2 days of about 6 hours each (to leave time for tasks beside the meeting, and to accommodate international time zones).

A big part of the success of the meeting were our 10 community members, who gave excellent presentations and were not afraid of bringing their scientific and software development work to a new presentation format!

After the meeting a group of developers was interested in continuing this format in a less organized way by scheduling biweekly meetings of 1 hour to talk about any ASPECT related topics. These meetings will not have a set agenda and are purely to discuss whatever ASPECT related topic is of interest to the participants. The meetings are open to anyone interested in the development and application of ASPECT. We will start these calls Jan 29th and will continue every two weeks afterwards.

# Logistics

Recent changes / announcements:

**Zoom link:** <https://zoom.us/j/715761049>

Schedule and documents:

<http://bit.ly/aspect-user-meeting-materials>

Introduction slides and Feedback:

<https://www.menti.com/r893em2puw>

Or: www.menti.com Code: 77 63 48

Hackathon signup:

<https://geodynamics.org/cig/events/calendar/2020-aspect-hackathon/>

## Participants and areas of interest

Name, affiliation, email	Goals and interests for this meeting
1. Rene Gassmoeller, UC Davis, rene.gassmoeller@mailbox.org	1.
2. Lorraine Hwang UC Davis ljhwang@ucdavis.edu	1. To learn the needs of the user community.
3. Wolfgang Bangerth Colorado State University bangerth@colostate.edu	1.
4. Juliane Dannberg University of Florida judannberg@gmail.com	1. Get feedback from the community on melt models 2. Catch up on what others have worked on
5. Timo Heister Clemson University heister@clemson.edu	1.
6. Menno Fraters Utrecht University menno.fraters@outlook.com	1. Want to discuss where world builder cookbooks would fit in into the current cookbook framework in the manual
7. John Naliboff UC Davis jbnaliboff@ucdavis.edu	1. Discuss development of material models in ASPECT (plasticity, elasticity, ...)
8. Anne Glerum	1. Plasticity formulations 2. Free surface
9. Agnes Kiraly CEED, University of Oslo agnes.kiraly@geo.uio.no	1.
10. Conrad Clevenger Clemson University tcleven@g.clemson.edu	1. Discuss features of GMG Stokes solver 2. Create list of important features to add
11. Sophie Coulson Harvard University slcoulson@g.harvard.edu	1. Learn about new features 2. Talk about dynamic topography models and see who else is running similar models

12. Fiona Clerc MIT/WHOI fclerc@mit.edu	1.
13. Adam Holt University of Miami aholt@miami.edu	<ol style="list-style-type: none"> <li>1. Material model developments (e.g. visco-elasto-plastic module)</li> <li>2. Particles vs. fields for composition</li> <li>3. Catch up on recent developments/ASPECT applications.</li> </ol>
14. Esther Heckenbach GFZ Potsdam hecken@gfz-potsdam.de	
15. Thilo Wrona GFZ Potsdam wrona@gfz-potsdam.de	
16. Iris van Zelst University of Leeds i.vanzelst@leeds.ac.uk	<ol style="list-style-type: none"> <li>1. Want to get up to speed with ASPECT's current functionalities and community</li> <li>2. Will potentially be using ASPECT for subduction modelling, so trying to figure out what is/isn't possible at present / how to proceed (still very early stages!)</li> </ol>
17. Michael Pons GFZ Potsdam ponsm@gfz-potsdam.de	<ol style="list-style-type: none"> <li>1. Subduction modelling</li> <li>2. Visco-plastic &amp; Phase transitions</li> <li>3. isotherm mesh refinement module</li> <li>4. Newton solver</li> </ol>
18. Dan Sandiford University of Tasmania dan.sandiford@utas.edu.au	<ol style="list-style-type: none"> <li>1. Connect with more of the ASPECT community</li> <li>2. Share some experiences with helping to benchmark visco-elastic-plastic rheology in ASPECT</li> <li>3. Catch up on progress in other areas of development</li> </ol>
19. Cedric Thieulot Utrecht University, NL c.thieulot@uu.nl	Getting up to date on EVP rheology in the code Discuss Free surface
20. Jeroen van Hunen Durham University, UK jeroen.van-hunen@durham.ac.uk	<ol style="list-style-type: none"> <li>1. Hear about latest developments</li> <li>2. Who is working on what</li> <li>3. Interested in combination: free surface+particles</li> </ol>
21. Erik van der Wiel Utrecht university e.vanderwiel@uu.nl	

22. Joyjeet Sen Jadavpur University senjoyjeet@gmail.com	
23. Tim Craig University of Leeds t.j.craig@leeds.ac.uk	
24. Xin Zhou University of Minnesota zhou1482@umn.edu	
25. Ludovic Jeannot Utrecht University l.jeannot@uu.nl	<ol style="list-style-type: none"> <li>1. Interpolation when setting up initial conditions?</li> <li>2. GMG test seem successful: talk to Conrad</li> </ol>
26. Max Rudolph	
27. Emmanuel Njinju Virginia Tech njinju85@vt.edu	<ol style="list-style-type: none"> <li>1. High viscosity contrast and convergence issue</li> <li>2. Lithospheric control of melt generation</li> <li>3. BALTO-ASPECT plug-in</li> </ol>
28. Maaïke Weerdesteijn UO, CEED m.f.m.weerdesteijn@geo.uio.no	<ol style="list-style-type: none"> <li>1. Surface deformation due to surface loading</li> <li>2. Viscoelasticity: 3D rheology implementation</li> </ol>
29. Antoniette Grima UCL a.grima.11@ucl.ac.uk	
30. Daniel Douglas University of Hawaii daniel92@hawaii.edu	<ol style="list-style-type: none"> <li>1. Elasticity Implementation</li> <li>2. Surface deformation due to surface loading</li> </ol>
31. D. Sarah Stamps Virginia Tech dstamps@vt.edu	<ol style="list-style-type: none"> <li>1. Continental rifting</li> <li>2. Regional 3D modeling</li> <li>3. BALTO-ASPECT plug-in</li> </ol>
32. Andrew Hollyday Columbia University andrewh@ldeo.columbia.edu	
33. Grant Euen Virginia Tech egrant93@vt.edu	<ol style="list-style-type: none"> <li>1. Thermal convection 3D spherical shell models</li> </ol>

34. Kodi N. (OPeNDAP)	
35. Jim/James Gallagher (OPeNDAP) /	

# Notes on projects and group discussions

2 or 3 groups for each Discussion breakout

## Discussion 1

### Summary of New Features (in the last year)

- Main place to inform yourself without watching github is the website: [aspect.geodynamics.org](http://aspect.geodynamics.org) > development logs all changes and “changes after vx.x.x”
- Changes are categorized - New, Changed, Fixed, Incompatibility
- Impt changes:  
[https://aspect.geodynamics.org/doc/doxygen/changes\\_current.html](https://aspect.geodynamics.org/doc/doxygen/changes_current.html)
  - for Users: 59, 58, 54, 52, 45, 42, 43, 44 etc.
- NEW: Parameters option on the website gives list of all parameters
  - [https://aspect.geodynamics.org/doc/parameter\\_view/parameters.xml](https://aspect.geodynamics.org/doc/parameter_view/parameters.xml)

### Repository Structure for ancillary materials - cookbooks, teaching materials, models, presentations, etc.

- Teaching: tutorial, lectures, workshops
- Models: Into >cookbooks
- But other materials are very LARGE. How do we share so we do not have to recreate material?
- Several different types of files: input file should be under version control. Or do you want the original files that were with VM (VM's are large)? Most people would want the current/up to date version.
- Start a google drive folder for presentations?, parameter files in cookbooks and link to it? Could get out of sync. Where would the documentation go?
- Original idea was cookbooks was part of the “step” system on how we teach how to use and that built on each other. Do we need a new definition?
- Timo: put prms with light documentation into a tutorial/xyz/ folder, build from there
- Use Dropbox/gdrive for presentations? And link to parameters.

## **Pdf manual vs. html as primary format (example: Rayleigh or SPECFEM documentation)**

- Benefit: manual lags behind the addition of new features.
- Could be generated from markdown instead of latex.
- Rayleigh example:
  - <https://github.com/geodynamics/Rayleigh>
  - <https://rayleigh-documentation.readthedocs.io/en/latest/>
- Major effort. Would require a group of people to do this.
- Google search works much better in html
- Latex/pdf: Have more control on layout than the markdown.
- Equations: are still tex in the markdown (some end of line issues for clean up)
- Automatically rebuilt with new development version. What happens with manual when using a regular release?
- Parameters update once a month. Do they go in this document?
- What is the best way to get this done? We will discuss a path forward before the next hackathon and either do it as a concerted effort before the hackathon or start a transition during the hackathon.

## **Model building 1 - Breakouts**

### **Subduction Cookbook / Models (Main zoom room)**

#### Participants

John (leader), Lorraine, Cedric, Iris, Xin, Anne, Esther, Michael, Fiona, Menno, Erik, Joyjeet, Juliane, Rene

#### Discussion Summary

We should have a series of cookbooks that systematically build-up in complexity and describe different strategies for handling the non-linear rheology and material interfaces with additional complexity. These will be in addition to the cookbooks proposed by Anne, Menno, and Magali.

#### Subduction Cookbook Ideas

- We need to have multiple subductions cookbooks in ASPECT that illustrate various features and levels of complexity (rheology, free surface vs free-slip)
- Features that would be useful to illustrate in subduction cookbooks:
  - Different geometry models (box verse chunk)
  - Initial slab geometry
  - Using free surface verse sticky air
  - Viscosity jump between upper and lower mantle

- Defining composition and rheology for different layers (crust versus mantle)
- Initial weak interface
- Multiple people are working cookbooks:
  - Magali + PhD student
    - models Magali has already shown results for
    - We need to ask Magali about the status (Menno will do this)
  - Menno
    - simple slab model in 2- and 3-D with world builder
    - Nearly ready to go, will submit a pull request soon
  - Anne
    - Will adapt models from the 2018 Solid Earth paper to current format and add them as benchmarks, cookbooks, or some combination thereof.
    - Also could add models done in collaboration with Susanne Buitert and Cedric, but these have very resolution sensitive results: <http://geo.mff.cuni.cz/theses/2014-Quinquis-PhD.pdf> (chapter 4)

## Subduction Common Technical Issues

- Free surface versus sticky air
- Tracking various material properties
- How to treat the slab interface (especially the resolution inside the weak zone) also creates divergent solutions
- Phase changes

## GMG discussion: viscosity averaging, benchmarks, other geometries, Newton

Conrad  
Timo  
Ludo  
Emmanuel

Ludo used GMG on realistic setup: need to send results to Timo and Conrad.

## GMG Discussion breakout group, day 1

Goals for this group:

- Plan / timeline for GMG
- Strategies for large runs
- Benchmarks

### Strategies for large runs:

- Think about parallel IO and filesystems
- compiler, optimization flags, MPI library
- Pick reasonable model size vs core count (10-50k DoFs/core)

**Strategies for large viscosity ratio and convergence issues:**

- Average material model parameters
- Limit the range of viscosities
- Use GMG if you can, otherwise:
- "Use full A block" as preconditioner
- Use expensive solver

**Benchmarks / Realistic problems:**

- Sticky air instead of free surface extension benchmark (John)
- Density from tomography, spherical (Ludo)
- Solcx, cells not aligned for viscosity averaging
- Test problem with/without grain size (Rene)

## Options for viscosity averaging:

- a) as it is: require averaging
- b) Only average viscosity
- c) Project + limiter, Q2 vs DGQ2?
- d) Transfer solutions and re-evaluate material
- e) global no averaging, GMG averaged
- => c) seems to be the most promising

**TODO list for GMG implementation:**

- Periodic Boundary
  - IDR solver scheme to further reduce memory footprint
  - Formulations:
    - Newton
    - Free surface
    - Melt transport
    - Traction boundary conditions
  - Current bugs: 64-bit adaptive issues
  - w-BFBT Schur complement as separate project
  - Discontinuous pressure
-

# DAY 2

## Coding Groups 1

Please note possible topics:

- We like the idea of beginners implementation group: Thilo Wrona, Esther, Iris, Michael, Lorraine, John, Jeroen
- $vr/v\theta/v\phi$  decomposition of velocity for spherical models (we got it running but code needs cleaning): CT / Erik / Ludo, menno, the PR was merged after the meeting
- Implementing time-dependent gravity models
- DELAY: Manual to markdown conversion? John, Timo, Lorraine, menno

## Beginners Implementation Group

Participants: Thilo Wrona, Esther, Iris van Zelst, Michael Ponsl, Lorraine Hwang, John Naliboff(Lead, Jeroen van Hunen

## Discussion 2

Please note possible topics:

- Free surface models and limitations, Implementation and strategies of sticky air in models: Michael, Anne, CT, erik, Jeroen, Rene
- Anyone with EVP questions and details of implementation (current PR): Anne, menno, Esther, Thilo, Lorraine, Iris, John, Kodi Neumiller
- Anyone with GMG / Solver related questions?

## EVP Questions

Participants: Menno Fraters, Timo Heister, Esther, Thilo Wrona, Lorraine Hwang, Iris van Zelst, John Naliboff (lead), Kodi Neumiller

## Key Points

- We need to find a new way for specifying material model values associated with compositional fields that are not rock types (e.g., stress, finite strain, etc). In 3D, the parameter file structures are somewhat unreadable when listing values for more than 10 compositional fields.
- We should look into other methods for defining the EVP rheology and give the user the option to choose from a list of formulations.
- We should look into assembly of compositional fields for DG - can be optimized
- We need Conrad to work on GMG with compositional fields!

## Free Surface and Sticky Air Models

Participants: Michael Pons, Anne Glerum, Cedric Thielot, Erik van der Wiel, Jeroen van Hunen, Rene Gassmoeller

- The free surface using the normal surface direction for projecting the Stokes velocity still shows non-symmetrical behavior in practical models and simple benchmark models (like advecting a triangular hill)
- A likely reason could be the difference between ways to compute the face normal directions close to kinks in the surface, a good benchmark could therefore be to use an analytically prescribed normal direction for the benchmark and see if that solves the observed oscillations.

## Discussion 3

Please note possible topics:

- There is some interest in using melt flow for subduction models, but the implementation remains complicated
- General feedback for the meeting was very positive. See feedback in the menti presentation in this directory.

## Day 3

Participants:

- Mostly main developers, + Cedric Thielot, Michael Pons, Xin Zhou
- We discussed feedback on the technical aspects of the meeting / retrospective
- We scheduled a time for a regular informal developer meeting, bi-weekly on Wednesday 10 am pacific time, starting Jan 29th

# Retrospective

- Generally very positive, repeat next year
- Will have to schedule more formal content for day 3 to make people attend? Or not announce day 3 and make it available for individual meetings
- Wrap up the previous day on beginning of next day for users unable to attend the previous day
- Make introductory slides that are online for people to see participants
- Gently nudge new participants to mention their projects and problems