

# Modeling Collaboratory for Subduction Research Coordination Network

Gabriel Lotto

The University of Texas at Austin

The MCS RCN Steering Committee

GeoPRISMS Workshop

San Antonio, TX

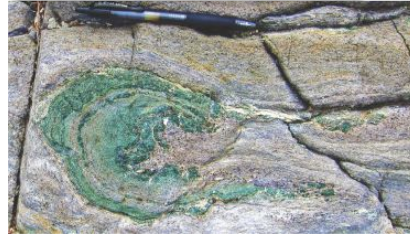
February 28, 2019



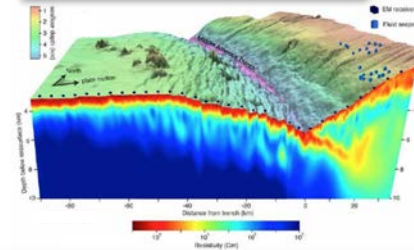
# Modeling Collaboratory for Subduction (MCS)

- modeling framework for multidisciplinary data integration
- physics-based hazard assessment
- collaborative, open, reproducible, modular approach

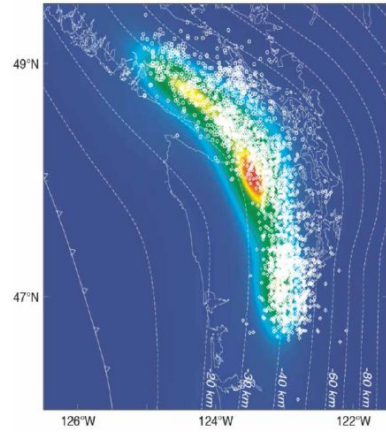
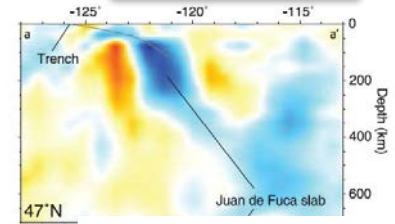
*geological constraints*



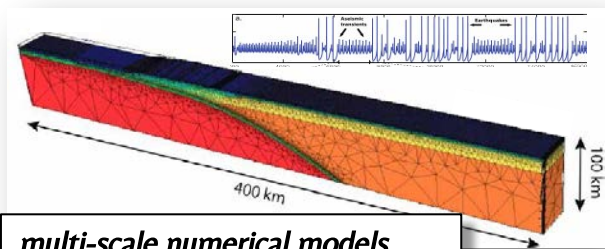
*active source and MT*



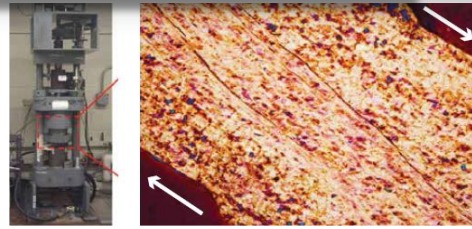
*passive source*



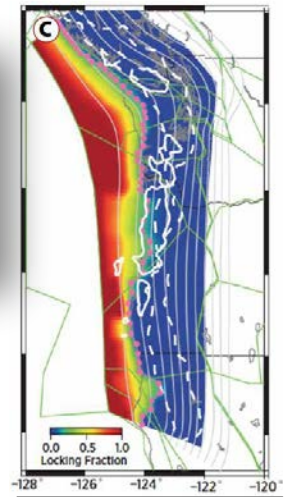
*earthquake source seismology*



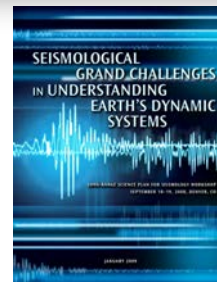
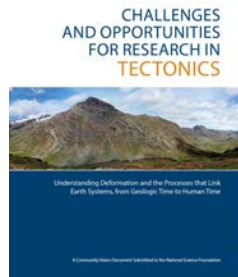
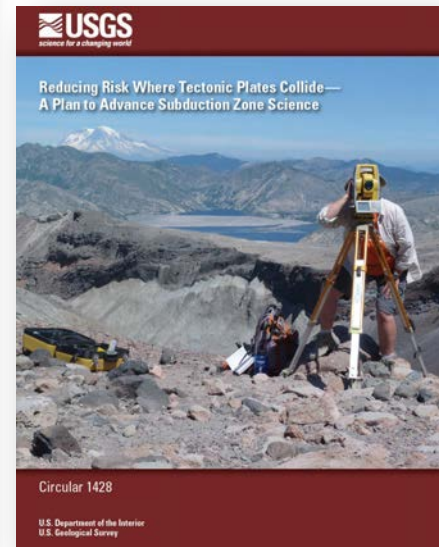
*multi-scale numerical models*



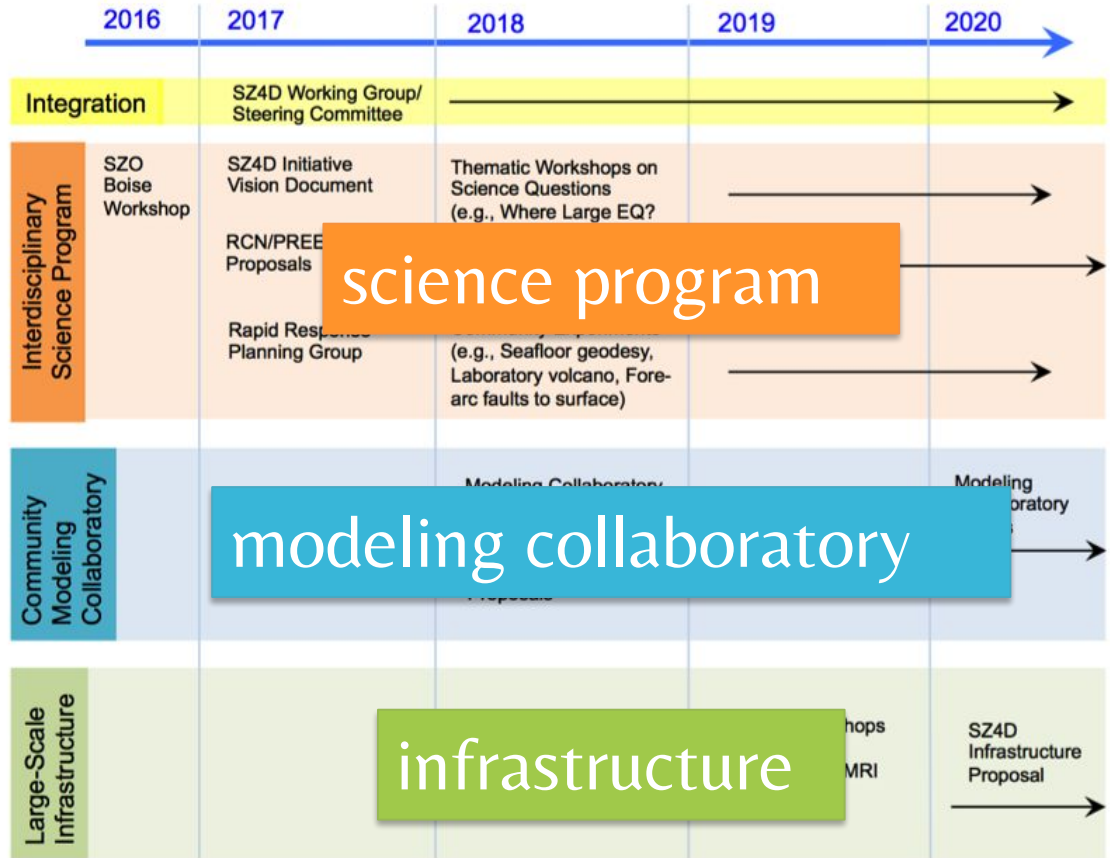
*rock mechanics experiments*



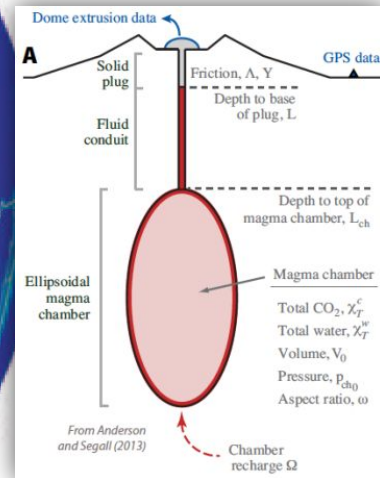
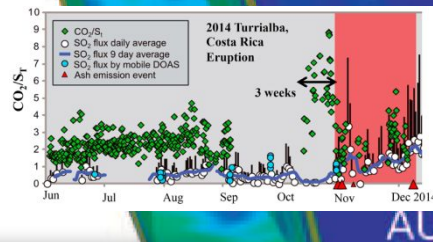
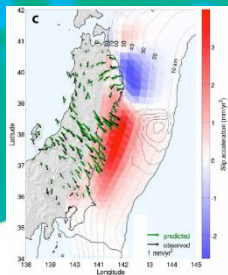
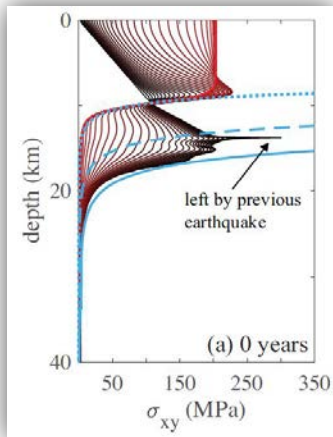
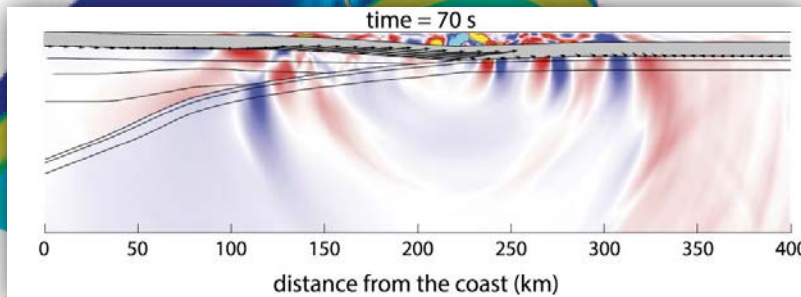
*on and offshore geodesy*



# SZ4D implementation recommendations



# Multi-scale, multi-physics problem



with incomplete data,  
incomplete physics

# MCS: Modular Community Systems Science

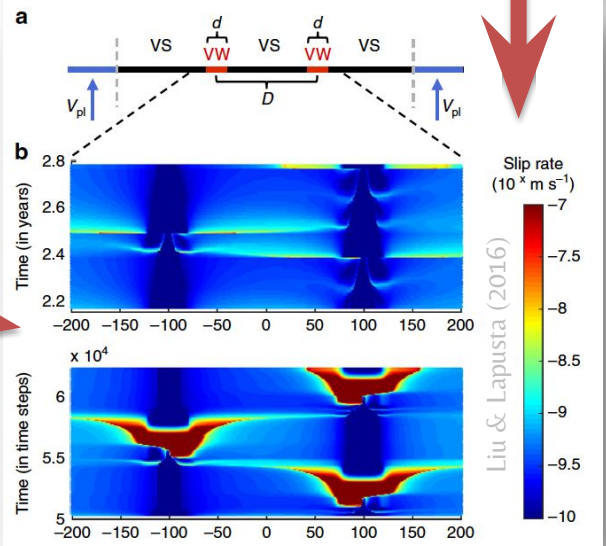
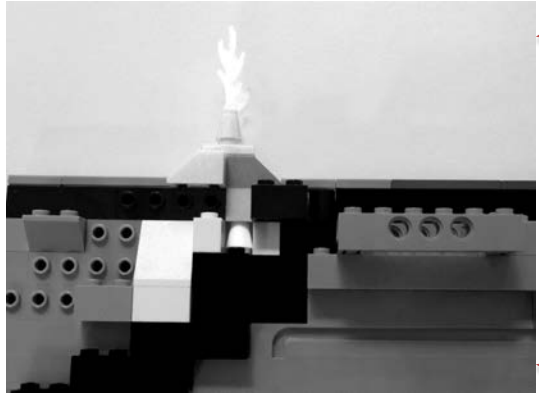
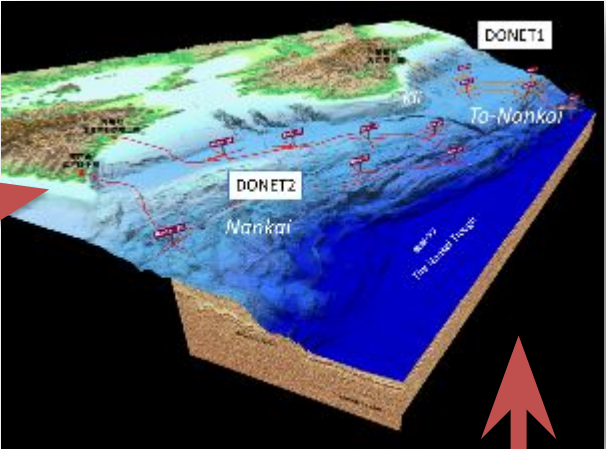


reassembly  
encouraged

# MCS implementation and partnerships



regional sensor networks

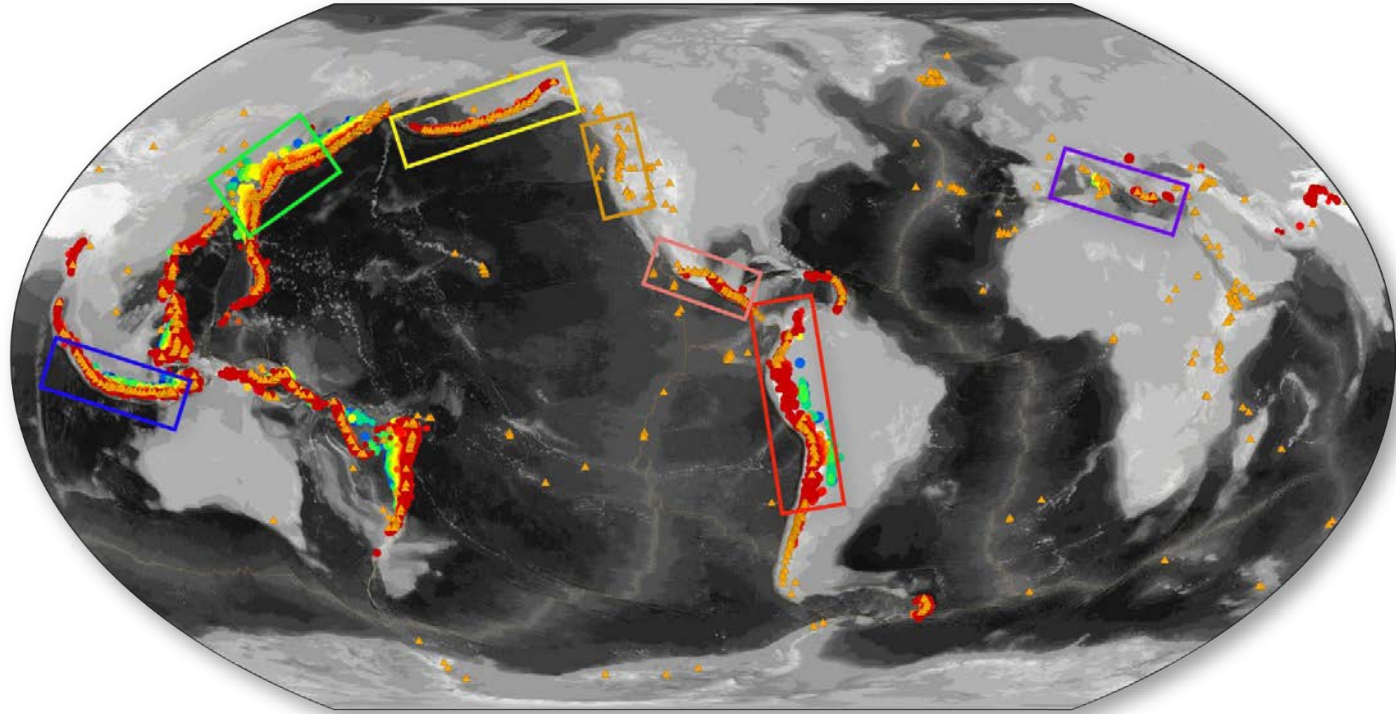


ab initio physics models



# MCS: Global observatory integration

- apply and test modeling framework across different:
  - tectonic settings
  - stages of seismic & volcanic cycle
- support a network of global observatories
- **strengthen an integrative community for open science – research and training**

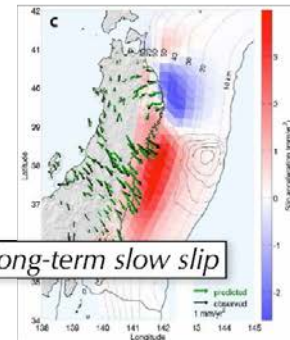
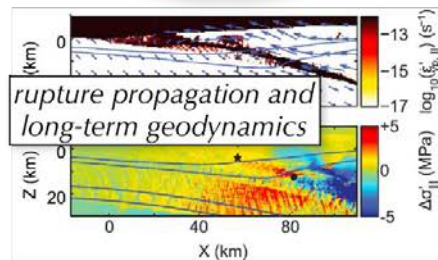
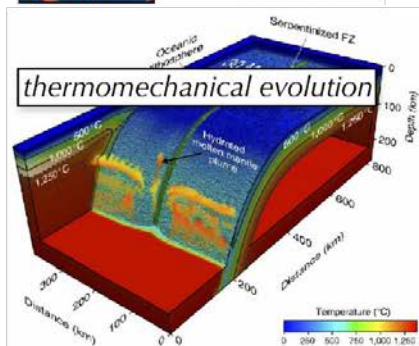
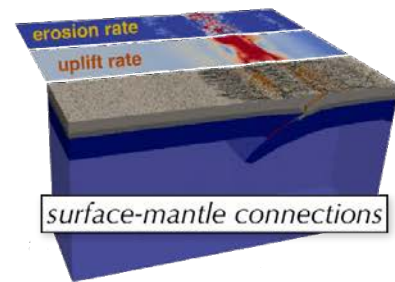
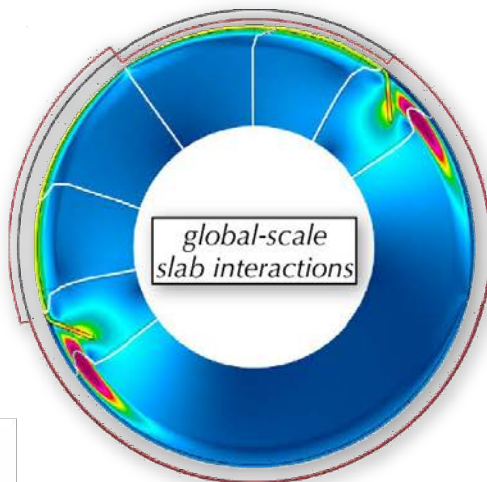
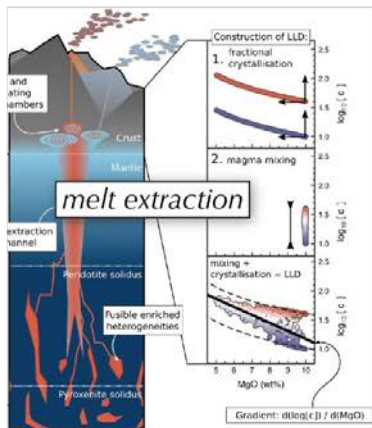
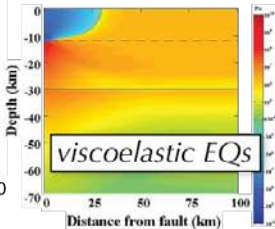
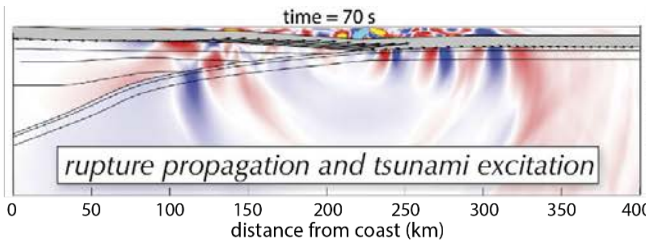
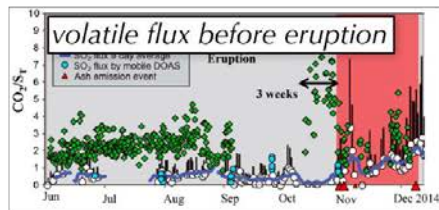


(*example* observatories, completed to various degrees)



# Aims of the MCS Planning RCN

- identify knowledge and implementation gaps
- study micro-physics upscaling and cross-scale interactions
- empower high performance computing
- evaluate the state of the art of megathrust and volcano modeling efforts



MCS  
RCN

@sz4d\_mcs contact@sz4dmcs.org

## Modeling Collaboratory for Subduction

*Research Collaboration Network*

About Us

Fluids Workshop

---

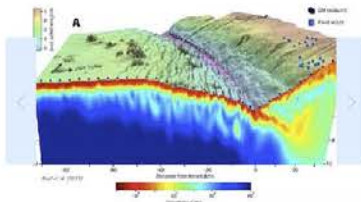
### Modeling Collaboratory for Subduction RCN

---

The Planning for the Modeling Collaboratory for Subduction (MCS) Research Collaboration Network (RCN) is a community effort that was funded by the National Science Foundation in September of 2018 as part of the SZ4D process.

We organize workshops and webinars, and support virtual collaboration among scientists studying subduction across all spatio-temporal scales. Our goal is to pave the way for a Modeling Collaboratory for Subduction, a new center for data-integrative modeling that will include physics-based, decadal-scale hazard assessment for earthquakes, volcanoes and tsunamis.

The MCS RCN is run by a steering committee and locally organized by [Thorsten Becker](#) at UTIG, UT Austin. For questions or comments, message [contact@sz4dmcs.org](mailto:contact@sz4dmcs.org).



sz4dmcs.org

## Steering Committee and Administrative Lead

 @sz4d\_mcs [contact@sz4dmcs.org](mailto:contact@sz4dmcs.org)



## News and Updates

twitter: @sz4d\_mcs

### • Future Workshops

Our 2nd workshop will be focused on modeling megathrust earthquakes in subduction zones. It will be held at the University of Oregon, from October 7-9.

Our third workshop will center on modeling volcanic systems, and its date and time are TBD.

### • Fluid Modeling Workshop

We would like to announce the first of our three workshops, which will focus on fluid and magma transport modeling in a subduction zone context. We aim to bring together a diverse selection of modelers and earthquake and volcano scientists to synthesize existing modeling efforts and identify the disconnects and knowledge gaps between fluid migration models of various spatial and temporal scales. This workshop



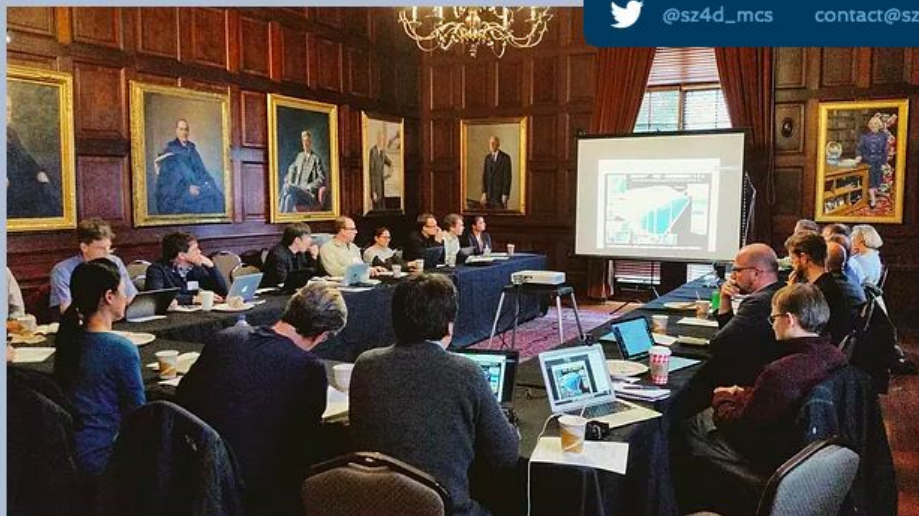
---

## RCN Kickoff Meeting December 9, 2018

---

Our Kickoff Meeting on December 9, 2018, in Washington, DC was our community's first opportunity to discuss the goals and of our research collaboration network (RCN) in person. The meeting was also broadcast live via webinar.

We heard brief presentations from members of our steering committee, several US agencies, and international partners represented by attendees from Japan and Europe. Along with representatives of community centers (CIG, CSDMS, SCEC) and our sister RCNs under the SZ4D framework, we discussed the broad vision of a potential Modeling Collaboratory for Subduction as suggested within the [SZ4D report](#). The MCS RCN will lead a series of workshops and webinars focusing on understanding the underlying physical processes and modeling challenges associated with subduction zone hazards. This report summarizes the discussions and provides links to resources.



@sz4d\_mcs

contact@sz4dmcs.org

### Download meeting documents

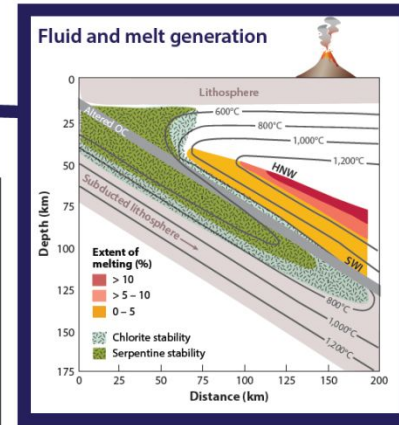
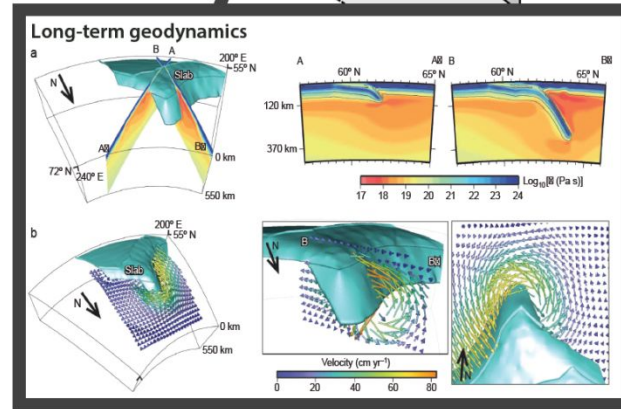
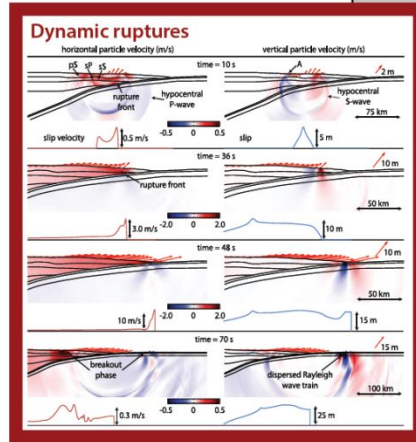
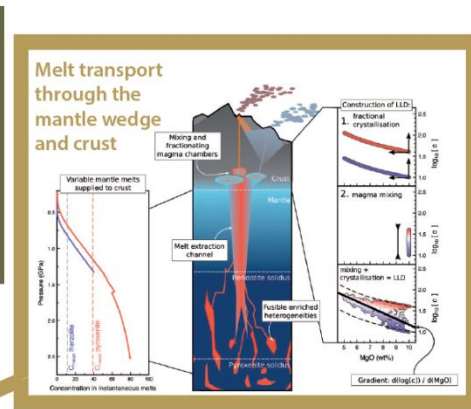
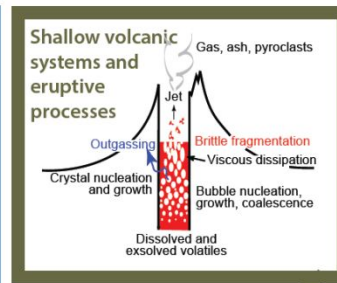
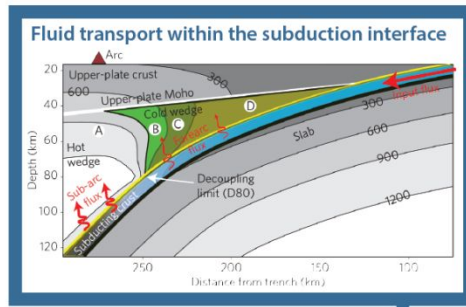


[Full meeting report](#)



[Presentations](#)

# Workshop focus problems



# Join us for our upcoming workshops and several cyber-infrastructure webinars

## Workshop 1: Fluid and Melt Transport

- Fluid migration & fracture formation in magma systems
- Lithosphere-scale magma transport
- Microscopic and short-time-scale processes

**May 30 - June 1, 2019**

## Workshop 2: Megathrust Modeling

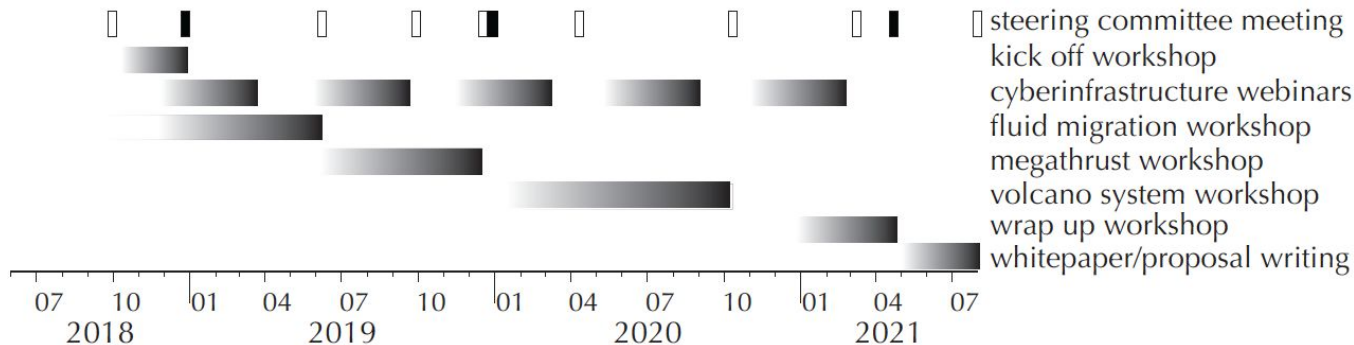
- Loading of subduction faults and seismic cycles
- Forecasting the spatial distribution of earthquakes
- Do we know the material and structural parameters?

**October 7 - 9, 2019**

## Workshop 3: Volcano Modeling

- Location, timing, and magnitudes of volcanic eruptions on an arc scale
- How does the lithosphere influence magma transport?

**TBD 2020**



# Fluids Workshop: May 30 - June 1 @UMN

## *Applications open thru March 15*



- ❖ **Large/regional-scale fluid migration models for subduction zones**
  - Fluids and megathrust earthquake interactions?
  - Fluid pathways in the slab and mantle
- ❖ **Crust/lithosphere-scale models for magma transport**
  - Patterns of crustal magma transport?
  - Eruption cycle & distribution of volcanoes
- ❖ **Microscopic & short-time-scale mechanisms**
  - Dominant microscopic mechanisms at various time and spatial scales?
  - Micro-scale fluid pathways
- ❖ **Bridging across domains and scales**
  - Interactions of melts and fluids
  - Critical processes on a subduction system scale?
  - Numerical modeling challenges?

# Fluids Workshop: May 30 - June 1 @UMN

## *Applications open thru March 15*



- ❖ **Conveners:** Ikuko Wada, Leif Karlstrom
- ❖ **Session chairs:** Yajing Liu, Adam Simon, Matt Haney, Luca Caricchi, Patrick Fulton, Jessica Warren, Laurent Montesi, Carolina Lithgow-Bertelloni
- ❖ **Speakers include:** Diane Arcay (Montpellier), Taras Gerya (ETH), Richard Katz (Oxford), Jeanie Kavanagh (U. Liverpool), Tobias Keller (Stanford), Robert Skarbek (Columbia)
- ❖ Modelers who think about subduction zones at vastly different temporal & spatial scales
- ❖ **May 29** - ECS program designed to showcase new multiscale modeling approaches to fluid transport from slab to surface by young scientists





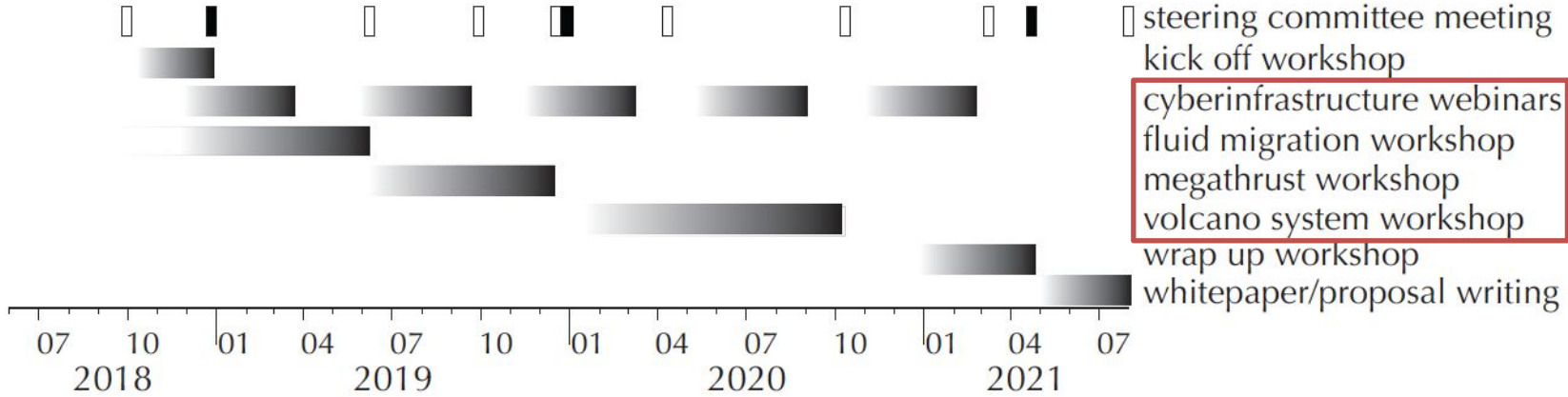
# Fluid Transport Modeling Workshop

May 30 - June 1, 2019  
University of Minnesota, Twin Cities

[Apply below](#)

Additional slides

# MCS RCN - sz4dmcs.org



# MCS RCN Model Building workshops

- **Fluid and melt migration microphysics upscaling: a common mode of interaction for all systems**
  - How are fracture formation and fluid migration coupled in the magma plumbing system?
  - What is the role of fluid transport in explaining interseismic deformation phenomena, such as slow slip?
  - How to best incorporate the micro-physics and up-scale?
- **Megathrust modeling (system I): Physics and interactions (with tectonics, convection and volcanoes)**
  - How are subduction zone faults loaded, and what is the best way to incorporate the insights from long-term and short-term models for seismic cycle models?
  - Can integrated models be used to forecast the spatial distribution of earthquakes? Do we know the material and structural parameters at the appropriate conditions?
- **Volcano modeling (system II): Physics and interactions (with earthquakes, tectonics, convection)**
  - How do numerical simulations on an arc-scale constrain the location, timing, and magnitudes of volcanic eruptions?
  - On the scale of volcanic systems, how does the lithosphere (e.g. material & stress state) influence the magma transport?
- **Cyber infrastructure needs**
  - Do we have the software tools available or under development to address the right multiscale, multi-physics problems?
  - What are the best practices to empower a diverse community of scientists to use cutting edge hardware?
  - What are the database needs, and how to merge the modeling with database frameworks?

# The MCS planning RCN

- In person workshop series (20-30 people, possibly with EPOS)
- Webinar series on cyberinfrastructure
- Online collaboration support (e.g. Slack)
- Three year, \$400k program – funded in Fall of 2018
- Steering committee
  - defines milestones and refines RCN
  - in charge of coordination and inclusiveness of efforts
  - workshop organization – SC plus external chairs
  - community engagement (online collaboration)
  - works with part-time admin on outreach and open documentation of workshop results and reports

# Workshop series

- Setting the stage for the MCS and the RCN
- Hands-on, problem oriented
  1. Building an megathrust model
  2. Handling fluid and melt migration
  3. Building a subduction zone volcano model
  4. Cyber infrastructure and modeling needs
- MCS implementation and white paper

# SC RCN Coordination Strategy

- Links with other SZ4D RCNs (e.g. volcano by Fischer & Co.)
- Links with CIG, NASA, EarthCUBE, SCEC, NCEO
- International collaboration: Form strong links with EU (e.g. EPOS), Japan (e.g. JAMSTEC, U Tokyo & Tohoku), and SE Asia
  - Japan's post K effort (Hori and Ichimura)
  - EU EPOS (volcano supersites (WP11), multi-scale observatories (WP16)): Elisa Calignano (Utrecht), Massimo Cocco (INGV)
  - planned EU Cost action: Francesca Funicello (Rome)