

Modeling Collaboratory for Subduction

An Integrative Group of SZ4D

Eric Dunham, on behalf of MCS/SZ4D
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The implementation plan is out!

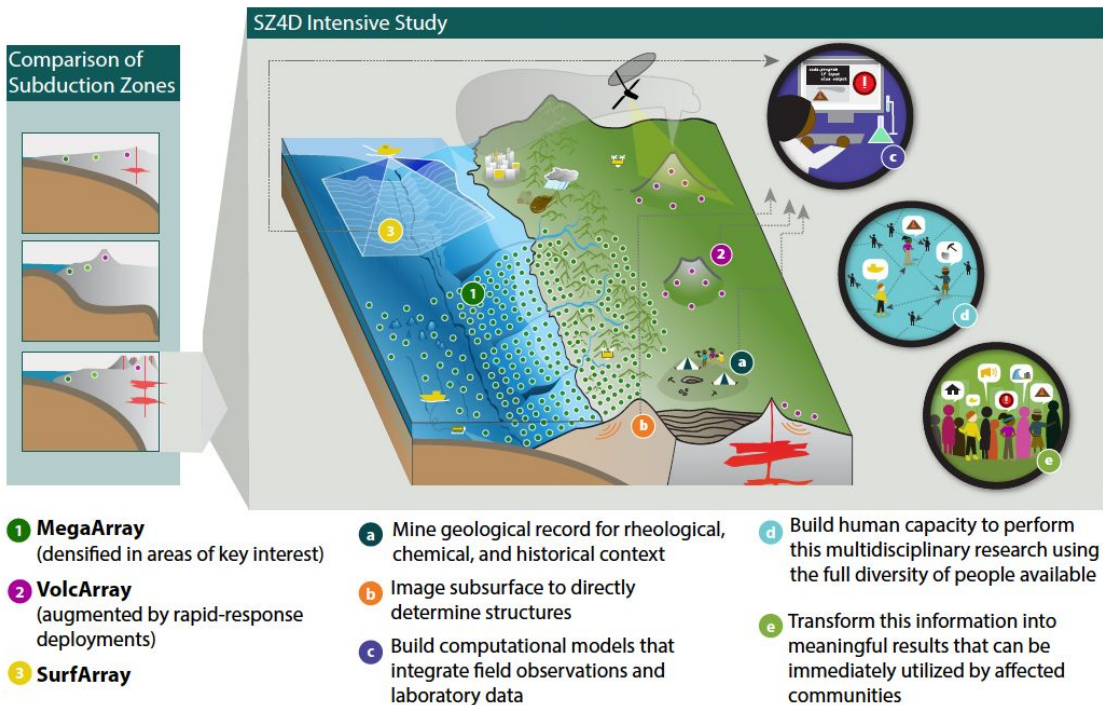
Hilley, G. E. (ed.), Brodsky, E. E., Roman, D., Shillington, D. J., Brudzinski, M., Behn, M. Tobin, H. and the SZ4D RCN (2022). SZ4D Implementation Plan. Stanford Digital Repository.
Available at <https://purl.stanford.edu/hy589fc7561>.

Implementation Plan

Objectives: Answer science questions in 3 areas:

- Earthquakes
- Volcanoes
- Surface processes

through observational arrays, modeling, field work, and experiments + capacity building



SZ4D currently has funding and pending proposals for additional planning and international coordination, but no funding yet for implementation plan (instrument array, modeling, and other activities)

Faulting and Earthquake Cycles (FEC) working group

When and where do large, damaging earthquakes happen?

- 1 How do subduction zone fault systems interact in space and time? How do these fault systems and associated deformation regulate subduction zone evolution and structure?
- 2 What controls the speed and mode of slip in space and time?
- 3 Do distinctive precursory slip or distinctive foreshocks occur before earthquakes? What causes either foreshocks or precursory behavior?
- 4 Under what physical conditions and by what processes will slip during an earthquake displace the seafloor and increase the likelihood of generating a significant tsunami?

The Modeling Collaboratory for Subduction has identified several critical needs to facilitate FEC-related modeling (Dunham et al., 2020). These include **community earthquake cycle modeling codes that couple subduction zone fault slip with additional relevant processes (viscoelasticity, inelastic yielding, fluid transport, pore pressure, temperature evolution, and tsunami generation)**, which are required for physics-based seismic hazard assessment and early warning capabilities. They will also be necessary to understand linkages between subduction zone behaviors and structures, and to understand processes and quantitatively test hypotheses. Results will depend on the stress state and material structure, motivating development of **codes for longer timescale geodynamics that account for feedbacks with the evolving land- and seascape, localization of deformation and formation of faults, thermal structure, and loading from mantle convection and plate tectonic forces**. Regional-scale modeling must be paired with **global geodynamics modeling** to account for processes such as trench rollback.

–p. 44 of Implementation Plan

MCS Org Chart

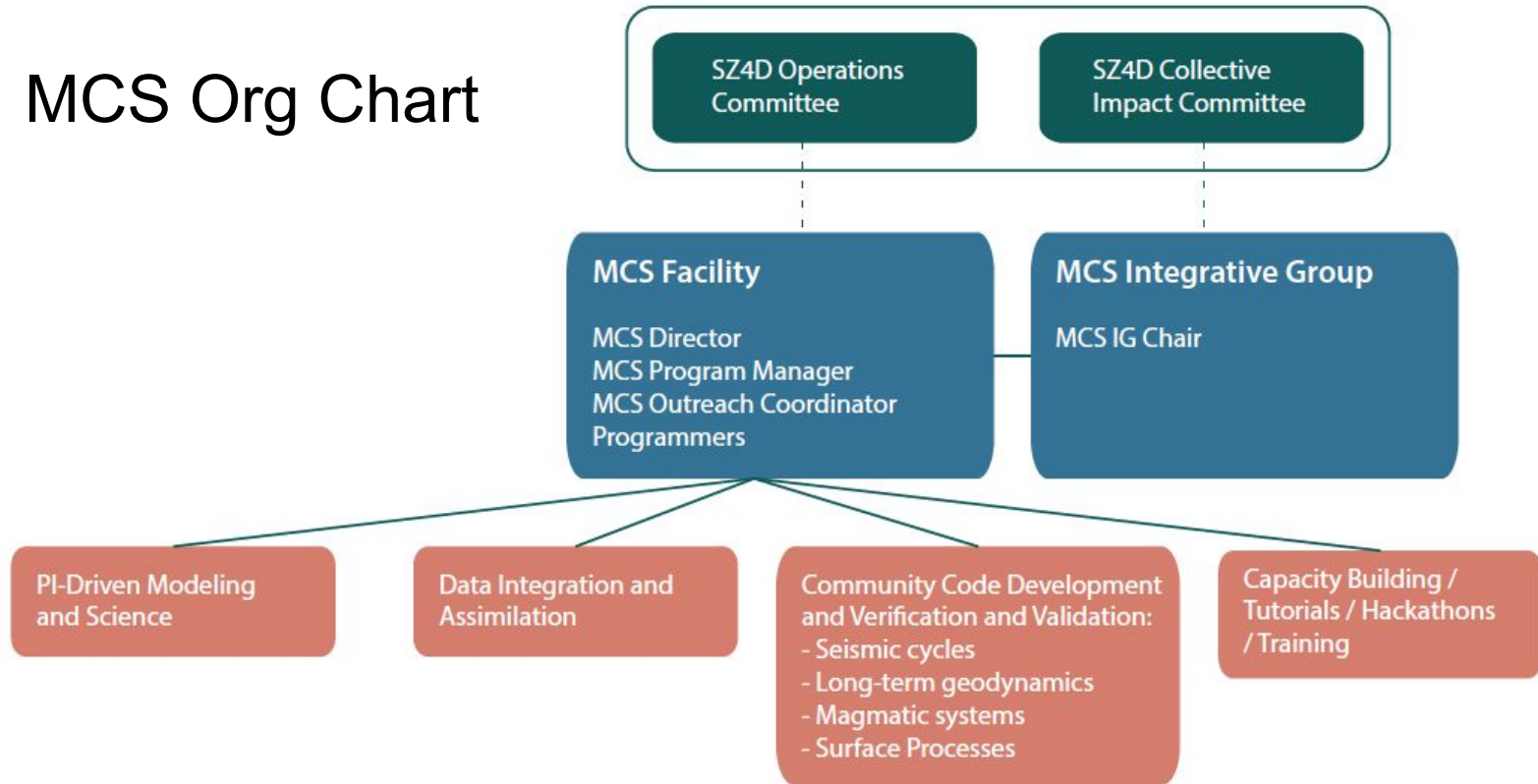


Figure MCS-2. MCS organizational structure. Yellow boxes illustrate the two main components of the MCS: operations (MCS Facility) and science (MCS integrative group). The MCS integrative group, in coordination with the SZ4D Collective Impact Committee, will set priorities for code and model development efforts, workshops, training, and other activities performed by the MCS Facility. The orange boxes denote the activities that will be performed by the MCS Facility.

What's the future for earthquake modeling?

Our community is rapidly expanding with an increasingly diverse set of applications:

- Continental transform faults
- Dipping faults in continental crust
- Subduction megathrusts and tsunami generation
- Slow slip and tremor
- Oceanic transform faults
- Seismic swarms
- Induced seismicity (wastewater disposal, hydraulic fracturing, geothermal, carbon capture and underground storage, etc.)
- Volcanic caldera collapse, ring faulting, trapdoor faulting; volcanic seismicity
- Ice stream and glacier sliding
- Landslides
- Structural geology (folding, bedding plane slip, etc.)
- Geodynamics and long-term tectonics

→ Build on the phenomenal success and community efforts by SCEC dynamic rupture and SEAS, but **expand to encompass all of these areas**

→ **Coordinated activities** (code development, verification & validation, training) to avoid redundancy and fragmentation of community, **jointly funded**