Unraveling the climate vulnerability web

Integration of Physical, Biological, Human Social, and Economic Models in Time and Space

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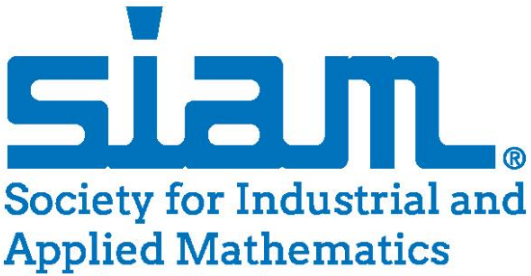
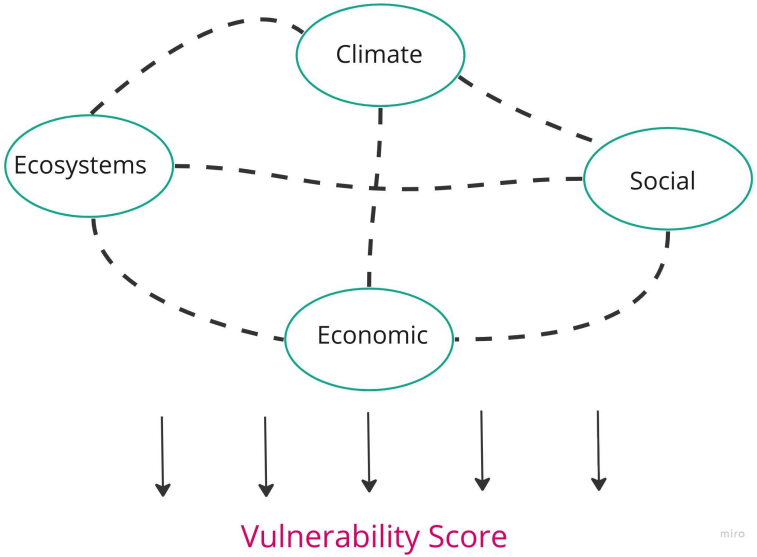


Big idea

Integrate **climate**, **social**, **economic**, and **ecological** models to identify vulnerability, and reduce risk in human and ecological systems.

Ex: Absorption of CO_2 by ocean and land ecosystems is sensitive to climate, anthropogenic activity, and atmospheric CO_2 concentrations, creating a **feedback loop**



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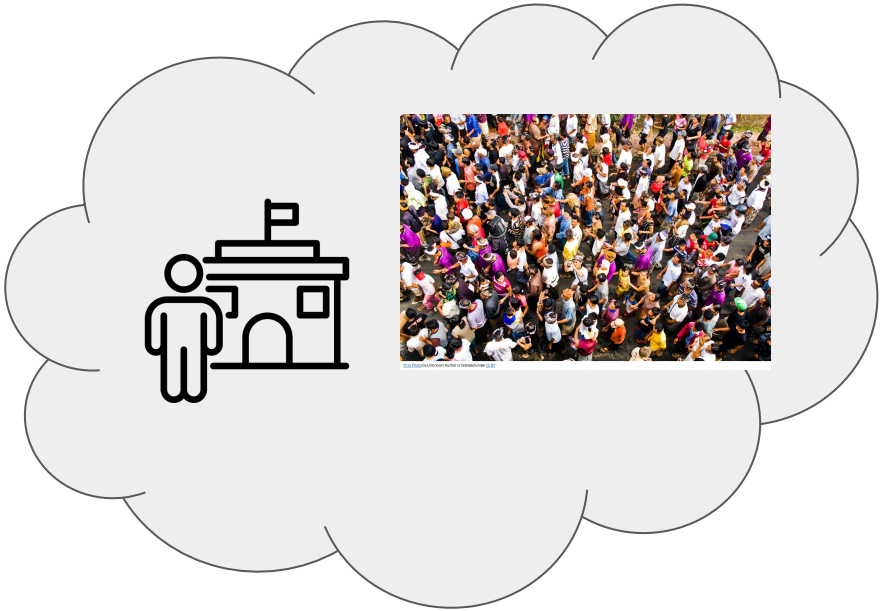
Expected values and impacts

- **Emergent phenomena from model interaction**
  - tipping points, bifurcation, cascades, positive feedback loops
  - new understanding of nonautonomous dynamical systems and extreme rare events
- **Traceable and attributable uncertainties**
  - focus future model improvements, scientific development, and data acquisition
- **Coupling across multiple fidelities**
  - development of machine-learning and data-driven approaches to overcome shortfalls in processes
- **Improved understanding of extreme events**
- **Assessment for IMF/World Bank funded communities allocations**.

Requirements

New **funding** and **project governance** to actively facilitate communication between all disciplines and stakeholders

- New mathematical and computational approaches
- Virtual center
- Crowdsourcing of subject matter experts and citizen science initiative
- Experts from STEM and social science disciplines as well as local community stakeholders



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Expected challenges

- Massive scale of the project (4-8 years of funding for completion)
- Creating and coupling models that use **different time and space** scales and different data
- **Mathematical challenges:** dealing with nonlinear feedbacks, uncertainty, emergent behaviors, transient dynamics
- Model **uncertainties propagate** across different scales
- Forming a synergistic multi-disciplinary team at an unprecedented scale (requires **new funding mechanisms**)
- **Data interoperability** across data generated from different types of models and gathered from disparate sources

Broader impacts

- Vulnerabilities are directly linked to **national security**
  e.g., drought → migration → civil unrest → etc.
- **Justice:** women and underserved communities/states bear the disproportionate impact of adverse climate change effects
- **Outreach:** Understanding vulnerabilities requires meeting with local government, NGOs, and private sector stakeholders to understand vulnerabilities
- **Students** involved in these projects will get firsthand experience working on a **multidisciplinary team** with significant **social, economic, and ecological implications**

Thank you