

# Newsletter

# Center for GeoHazards Studies



Spring 2020

## Letter from the Director: Dr. Greg Valentine

### Special points of interest:

#### STUDENTS:

Interested in becoming more involved?

E-mail Joshua Carlton at [jdcharlt@buffalo.edu](mailto:jdcharlt@buffalo.edu) to learn about the student committee.

#### Inside this issue:

Letter from the Director 1

Research Update 2-3

Graduate Awards Research 4-7

Geohazards Field Stations update 8

Acknowledgements & Center Contact Information 9

The Center for Geohazards is jointly sponsored at UB by the College of Arts and Sciences and by the School of Engineering and Applied Sciences.

The mission of the Center for Geohazards Studies is to nucleate and facilitate multidisciplinary research and training aimed at understanding and mitigating natural hazards and their impacts. As we all live through the COVID-19 pandemic, it is possible to point out many aspects that are analogous to problems surrounding natural hazards. For example, the importance of science in preparing us for, and coping with, disasters has become much clearer. Communication of science-based recommendations, and of the evolution of those recommendations as new data come in, models are honed, and mitigating measures have effects, is paramount. Societal and economic responses and impacts must be studied in concert with research on the processes that generate hazards. And, we can see how important it is to separate fact from non-fact, and how both can spread in unexpected ways through social media. All of these issues are central to producing resilient society in the face of hazards.

The Center for Geohazards Studies facilitates work in all these areas and works to communicate these across the University. In this newsletter we feature:

- Dr. Margarete Jadamec, who studies fluid dynamics of the deep Earth that drives the motion of tectonic plates, which in turn generate massive earthquakes.
- Recipients of the 2020 Center for Geohazards Studies Graduate Research Grants, whose research will range from understanding the timing of earthquakes and volcanic eruptions, to the impacts of climate change on agriculture in the Lake Erie basin.
- Past recipients of the grants who are studying supervolcano eruptions, and the spread of information and misinformation via social media during disasters.
- Advanced experimental research at the Geohazards Field Station, aimed at understanding the causes of some violently explosive volcanic eruptions.

This portfolio of activity represents work in the College of Arts and Sciences, the School of Engineering and Applied Sciences, and the School of Architecture and Planning.

This year's Center-sponsored conference (STRATUS; <http://stratus-conference.com/>) had to be postponed due to COVID-19. This conference will focus on remote sensing via unmanned aerial vehicles (drones), which is emerging as a key tool in disaster preparedness and response. We look forward to holding the meeting in May 2021.

In closing, be safe, and please don't hesitate to contact me if you have questions or suggestions for the Center for Geohazards Studies.

-Greg Valentine

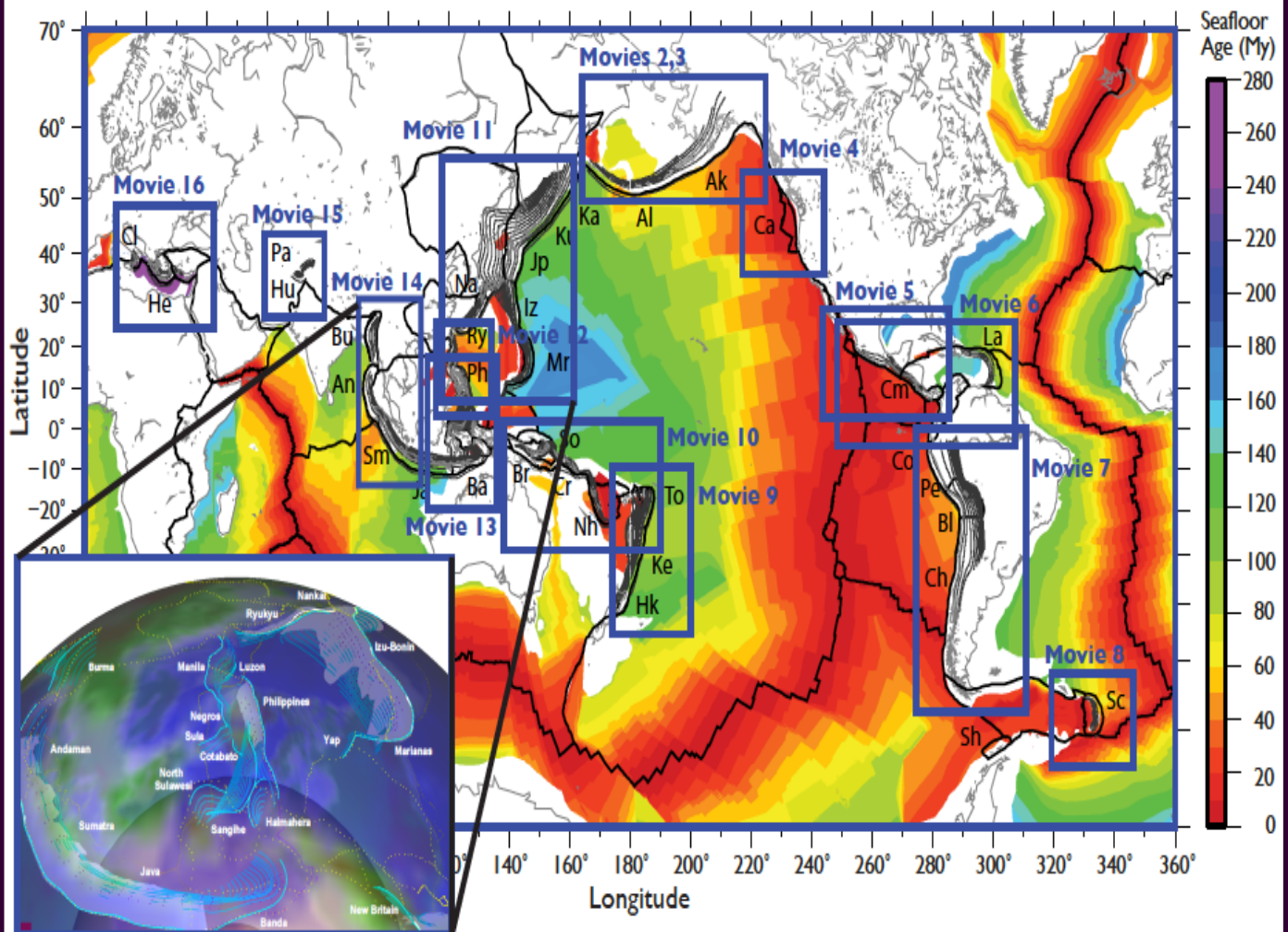
**Research Update:*****Using High Performance Computing and 3D Virtual Reality to Model Subduction Dynamics****Margarete Jadamec**Assistant Professor**Geology Department**Institute for Computational and Data Sciences*

Quantifying plate boundary dynamics, and the dynamics of subduction zones in particular, is critical to understanding plate tectonics and to providing an accurate tectonic framework for the forces governing the world's greatest earthquakes, the distribution of arc volcanism, and large-scale mountain building. However, accurately characterizing the dynamics of subducted oceanic lithosphere, as well as how the subducted plates perturb the surrounding mantle into which they descend, remains a challenge due to the inaccessibility of the Earth's interior. As the plates descend into the interior of the Earth, the spherical nature of the system and material properties of the plates result in complex geometries and intersecting plate segments. Moreover, the material deformation in the upper mantle is predominantly governed by a non-linear dependence on the strain-rate, resulting in non-linear flow dynamics, which together with the complex geometries, require sophisticated tools and model design to accurately quantify the system dynamics. In the Geodynamics Research and Visualization Group here at UB, we are designing and developing state-of-the art, data-driven, models of natural subduction systems on Earth.

We recently released a digital catalogue of virtual tours through the Earth's interior using the ShowEarthModel software, developed by collaborator Oliver Kreylos at the University of California Davis KeckCAVES, showing the spatial connectivity and interactivity of the Earth's modern plate tectonic system. The article was published in Earth and Space Science (Jadamec, et al., 2018, <https://doi.org/10.1002/2017EA000349>), with the digital movie collection available for download at the UB Institutional Repository (<https://ubir.buffalo.edu/xmlui/handle/10477/76912>) and for streaming through UB Panopto ([goo.gl/Y7PDEX](http://goo.gl/Y7PDEX)). This work was recently highlighted in EOS (<https://eos.org/articles/a-new-dimension-to-plate-tectonics>). In addition, at the recently built Geodynamics Research and Visualization Laboratory in Cooke Hall on North Campus, we use a coupled 3D TV-Linux system as well as HTC Vives to explore and interact with data of Earth's interior in a 3D immerse environment. This analysis is an integral part of the development and analysis of high-resolution numerical simulations of plate tectonic boundaries, including the Alaska subduction zone. In terms of system dynamics, recent high-resolution, 3D models of the Alaska subduction zone (PhD alumni Kirstie Haynie, 2019), have shown that the Alaska subduction zone interface and Denali fault intra-continental shear zone are a coupled tectonic system, implying that incorporating the interconnect system dynamics will be critical for future hazards assessment (Haynie and Jadamec, 2017, <https://doi.org/10.1002/2016TC004410>).

In addition, I am pleased to announce the next phase in the Geodynamics Research and Visualization Group initiatives with my recently awarded National Science Foundation CAREER grant "High-resolution Simulations of Subduction Along the Pacific Rim of Fire," which is a 5-year grant that began in Spring 2020. As a part of this award, my group will be developing unprecedented, high-resolution, numerical simulations of subduction along the entire Pacific Rim of Fire system to examine physical mechanisms for anomalous volcanoes at subduction zone edges, as well as exploring the larger questions of coupling between localized subduction zone dynamics and mantle wide convection. In addition, we will be collaborating with the Space Visualization Laboratory at the Adler Planetarium in Chicago to produce visualizations of subduction along the Pacific Rim of Fire in planetarium format.

## Research Update continued: Margarete Jadamec



Location of 16 virtual tours through the Earth's interior superimposed on map of the major tectonic plates colored by sea floor age (Jadamec et al., 2018, Earth and Space Science).



## Student Research Award Recipient - Joseph Tulenko

I am a PhD student working with Dr. Jason Briner in the Glacier History Lab of the Geology Department at UB. For my dissertation, I am using a novel technique that has been developed over the last three decades at institutions across the United States and abroad to date Pleistocene-age deposits. While I primarily focus on reconstructing the glacial history of Alaska using this technique, I am expanding the scope of my research into the realm of geohazards with my latest project. Active tectonism and faulting frequently put the lives of numerous Alaska residents at risk; thus it is crucial to understand and prepare for eventual geohazards in the state. With my latest project which will be supported with a grant from the Center for Geohazards Studies, I am proposing to date a glacial landform deposited outside Anchorage, AK with the hopes of achieving two major goals. First, constraining the age of the landform will help determine the stability of the landform (i.e. the older the landform is, the more stable and less likely to fail and degrade in the event of an earthquake). And second, the landform is cut by a pre-existing fault that runs through southern Alaska. I will calculate the slip rate of the fault using the age of the landform and magnitude of offset by the fault, which can provide geologic context for modern faulting observed in Alaska.



Joseph Tulenko at Sawatch Range in Colorado

## Student Research Award Recipient - Carrie Sachse



Climate change poses real and immediate threats to human society in a multitude of ways. As a graduate student in UB's Department of Urban and Regional Planning, I spend a lot of time thinking about how we can plan now to help mitigate future climate-related hazards. Agricultural production is vulnerable to both rapid-onset climate disruptions, such as extreme weather events and flooding, as well as more incremental changes to the climate over time. Remarkably little research has been done on the specific ways in which food production in the Lake Erie watershed is being impacted by climate change. With support, from the Center for Geohazards Studies, I will be surveying farmers throughout the Lake Erie region about their collective experience of climate-related hazards so far. It is my hope that my thesis will inspire and inform regional-scale planning efforts to mitigate climate-related disruptions to our food supply.

Carrie Sachse from UB Department of Urban and Regional Planning

**Student Research Award Recipient - Caleb Walcott**

My research involves determining the late-Quaternary eruption and exposure history of basalt flows of Mt. Edgecumbe, AK. Located on Kruzof Island, Mt. Edgecumbe is ~15 km west of Sitka, Alaska's 4<sup>th</sup> largest population center and a major tourist destination. Large tephra deposits in Sitka are testament to the magnitude of past eruptions. Despite the geohazard, societal, archaeological, anthropological, and geological significance of the eruption history of Mt. Edgecumbe, and its proximity to a major population hub, the chronology of its eruptive history remains relatively unconstrained. With the support from the Center for Geohazards Studies I am conducting a pilot study using coupled  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  and  $^{36}\text{Cl}$ -exposure dating of Quaternary basalt flows to constrain the island's volcanic history. With these data, I will start a dataset for calculating the eruption recurrence interval to better assess the geohazards risk Mt. Edgecumbe poses to Sitka and its inhabitants.



*Caleb Walcott taken on Kruzof Island, AK*



## Past Student Award Recipients: Meredith Cole

My current research relates to caldera-forming eruptions, especially how large magma volumes (100s-1000s of  $\text{km}^3$ ) are erupted onto the surface, and the influence of caldera collapse on eruptions and resulting deposits. As caldera-forming eruptions precede, accumulating intracaldera deposits will necessitate interactions between the erupting jet and the material accumulated from earlier stages of the eruption. I am working with MFIX (Multiphase Flow with Interface eXchange), an open-source code developed by the US Department of Energy as a multifield framework for modeling of fluid-particle interactions. I have compared two eruption scenarios through MFIX, one with an un-impeded erupting jet, and one with a jet erupting through a "caldera" full of particles. I am investigating the differences between these two scenarios in terms of parameters such as gas volume fraction of the mixture and solid particle velocities throughout the modeling domain.

Field observations of tuff-filled vent structures that cut across their own intracaldera equivalents also have the potential to provide critical insights into caldera eruption processes, and to aid in refining modeling of these scenarios. Grizzly Peak caldera, CO is a deeply eroded caldera, with several exposed levels of intracaldera deposits, including a proposed vent structure (Fig. 1). Currently, I am preparing for field work at Grizzly Peak caldera, which is planned for late this summer.

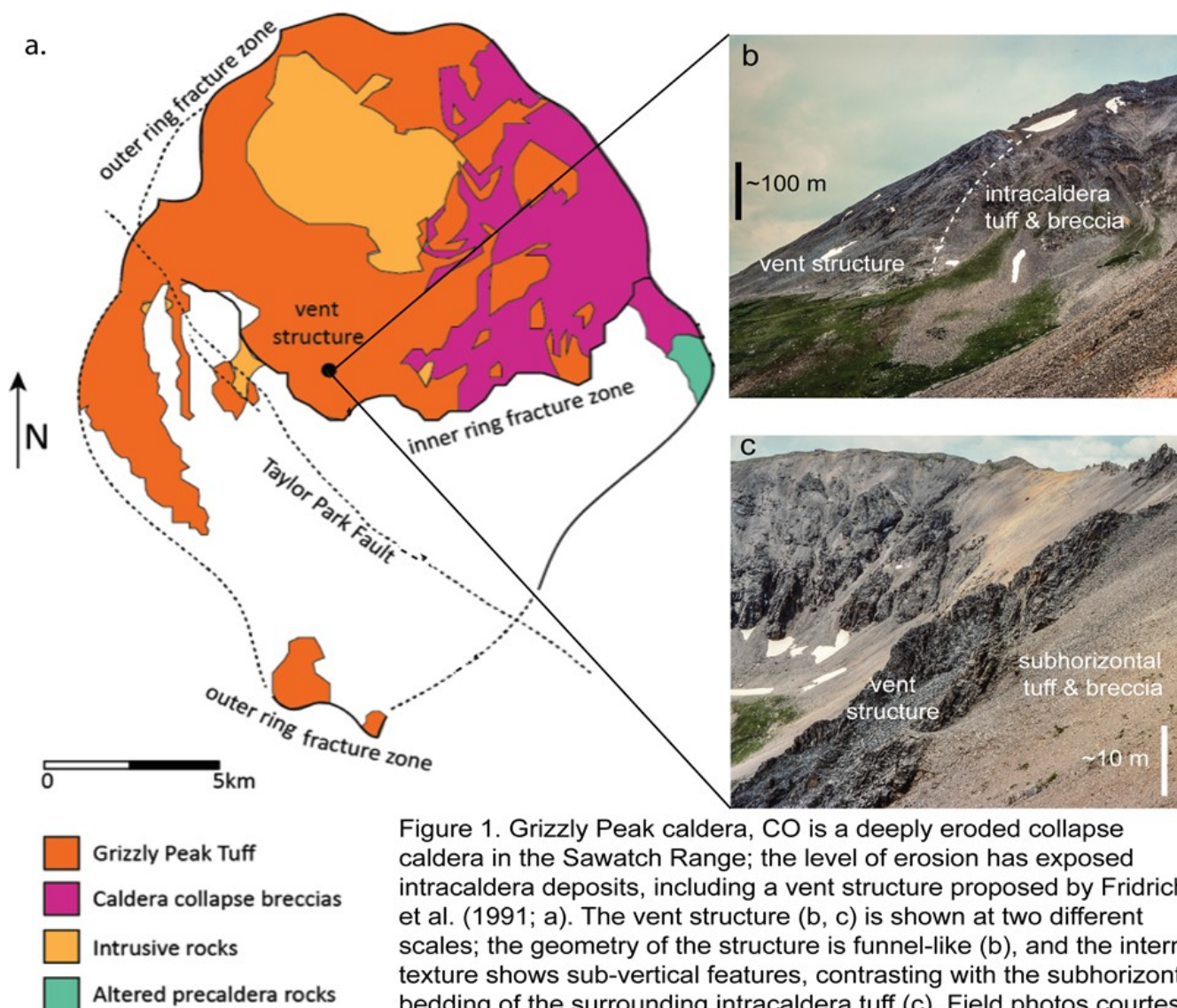


Figure 1. Grizzly Peak caldera, CO is a deeply eroded collapse caldera in the Sawatch Range; the level of erosion has exposed intracaldera deposits, including a vent structure proposed by Fridrich et al. (1991; a). The vent structure (b, c) is shown at two different scales; the geometry of the structure is funnel-like (b), and the internal texture shows sub-vertical features, contrasting with the subhorizontal bedding of the surrounding intracaldera tuff (c). Field photos courtesy of G. Valentine.

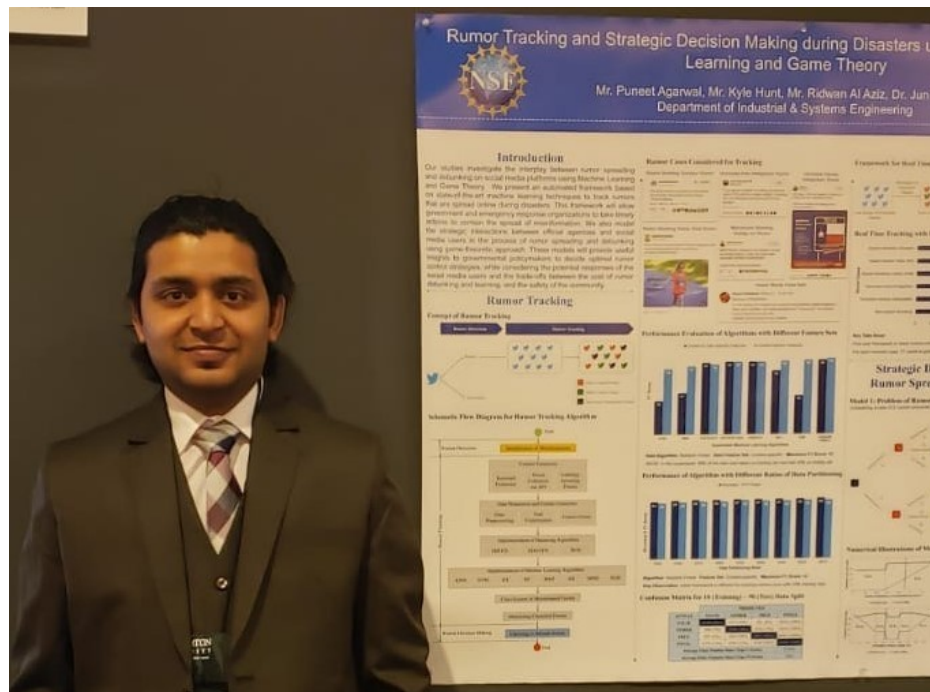
## Past Student Award Recipients: Meredith Cole



Meredith Cole from the Department of Geology in the field outside of Los Alamos, NM, highlighting a soft-sediment deformation feature near the base of the Upper Bandelier Tuff (1.25 Ma), a product of the most recent caldera-forming eruption at Valles Caldera.

## Past Student Award Recipients: Puneet Agarwal

Uprising popularity of social media use has changed the way how information is generated, shared, and disseminated during disaster events. Although there are many significant benefits associated with social media platforms in terms of greater capacity and interactive two-way communication, they have been criticized for propagating misinformation and fake news during disasters, which can cause large scale panic and economic loss. As a PhD candidate advised by Dr. Jun Zhuang in the Department of Industrial and Systems Engineering, applies my research expertise for developing efficient crisis communication and emergency response tools to tackle the spread of misinformation on online social media during disasters. My research project “Interplay of Online and Offline Social Networks for Rumor Spreading and Debunking during Hurricane Florence” is supported by the 2019 Geohazards research award from UB’s Center for



Puneet Agarwal presenting research work in 2019 IISE Conference, Orlando Florida

Geohazards Studies and by an NSF project “Modeling Rumor Spreading and Debunking Strategies on Social Media During Disasters”. My current research is driven by the need for efficient methods to monitor the spread of misinformation during disasters with a minimum level of human intervention. I developed a machine learning framework that offers official organizations and agencies a high speed and an accurate tool to automatically track identified misinformation cases on platforms such as Twitter and make informed decisions on whether to use resources to debunk the false information. I also applied game theory to develop mathematical frameworks that can model the strategic interactions between official agencies and social media users during rumor propagation in disasters. These game-theoretic models serve as decision support tools for the emergency agencies to make critical decisions regarding the rumor cases that need to be debunked, and subsequently releasing correct information to the public by effectively utilizing available resources. These models can also be utilized to determine the optimal debunking strategies for the government agencies so that they can minimize the spread of misinformation during crisis events by addressing the trade-offs between reacting fast with partial/incomplete information and reacting at a later stage with complete information.



**Geohazards Field Station*****Continuing Research on Magma-Water Interaction at the Geohazards Field Station-Ingo Sonder***

Research on magma-water interaction continues. Last year we focused on mixing speeds and trigger delays. Whether or not a trigger is necessary to start intense interaction is a matter of debate. We use a hammer that hits a plunger (that has direct melt contact) in a timely manner as trigger. So far we observed cases in which intense interaction started spontaneously. However, largest interaction intensity is typically reached if a trigger event occurs in a critical time interval after start of magma-water mixing. Preliminary results suggest that this time interval seems to be relatively independent on the size of the experiment. If confirmed, such a result would help to scale experimental results to real-case scenarios.



*Two identical experiments showing intense magma-water interaction. Both video frames are grabbed at the same time after magma-water mixing start. In the upper frame the trigger (twice as long hammer hit) delay was as in the lower frame. The experiment shown in the lower frame shows higher interaction intensity. Intensity is measured by the speed and the amount of material exiting the container. Some more experimentation is necessary to confirm such results.*



## UNIVERSITY AT BUFFALO

Center for Geohazards  
Studies  
University at Buffalo  
126 Cooke Hall  
Buffalo, NY 14260-3050

Phone: 716-645-4858  
Fax: 716-645-3999  
E-mail: [geohaz@buffalo.edu](mailto:geohaz@buffalo.edu)

[geohazards.buffalo.edu](http://geohazards.buffalo.edu)

**Send your research  
updates to  
[Barb Catalano](mailto:bac6@buffalo.edu)  
([bac6@buffalo.edu](mailto:bac6@buffalo.edu))  
to be included in the  
next newsletter or e-  
blast!**

Center for



GeoHazards Studies

### The Center for GeoHazards Studies

*Have changes to your employment, research  
interests, or contact information? Let us know at  
[geohaz@buffalo.edu](mailto:geohaz@buffalo.edu).*

Center for



# GeoHazards Studies

The **Center for GeoHazards Studies** seeks to decrease harmful societal effects of natural phenomena such as volcanic eruptions, landslides, mudflows, and avalanches through research, service, and education. Our team of scientists and engineers works together with social scientists, urban planners and public health researchers to evaluate the broader harmful impact of hazardous natural phenomena. One of our principal goals is to integrate analyses of various hazards with predictions of their effects on human infrastructure and ecosystems in order to evaluate approaches that could lead to a reduction of injury and death. Hazards that are affected or triggered by changes in climate are included within the Center's scope.

### **Special thanks to:**

#### **Advisory Committee Members:**

Amjad Aref, *Civil, Structural and Environmental Engineering*  
Beata Csatho, *Department of Geology*

Amit Goyal, *Research and Economic Development*

Bruce Pitman, *Materials, Design and Innovation*

Chris Renschler, *Geography Department*

Ingo Sonder, *Center for Geohazards Studies*

Janet Yang, *Communications Department*

Jun Zhuang, *Industrial and System Engineering*

#### **Student Representative:**

Joshua Carlton, *Geology Department*

#### **Sponsors:**

College of Arts and Sciences

School of Engineering and Applied Sciences