2026 Workshop: Hazards

Long title

Impacts of Natural and Artificial Hazards on the Upper Atmosphere

Conveners

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Description

Synoptic atmospheric hazards, such as hurricanes and strong frontal activity, and defined geological hazards, such as seismic and volcanic activities, can trigger acoustic and gravity waves that propagate upwards and can be detected in the upper atmosphere. Additionally, man-made artificial, accidental, and intentional explosive events are also equally responsible for generating shock or acoustic wave signatures in the geospace environment. Observation and modeling of these events can give new insights into our understanding of the dynamics, chemistry, and fundamental coupling processes between the troposphere and the middle and upper atmosphere. In system theory, such lower atmospheric events can be thought of as a defined input, x(t), into a complex system, h(t), where the CEDAR community can observe y(t) and gain insight on the fundamental transfer function(s) representing the underlying physical processes controlling the upper atmospheric response. This workshop welcomes short interactive presentations on the upper atmospheric response to various natural and artificial phenomena occurring in the oceans, on land, and in the lower atmosphere. Such phenomena include but are not limited to earthquakes, surface and submarine volcanic eruptions, tsunamis, typhoons, cyclones, hurricanes, tornadoes, thunderstorms, non-nuclear explosions, nuclear detonations, rocket exhausts, etc., which are studied from different observational and modeling approaches. Improved capabilities in forecasting these disasters can save hundreds of lives and protect billions of dollars in property from damage. Rapidly growing and practical automated processes, such as Artificial Intelligence (AI) and Machine Learning (ML), can analyze massive data sets, enabling scientists to gain new insights and optimize performance. These advancements are crucial for hazard-related preparedness and response. The workshop seeks to bring together research communities from different disciplines and backgrounds so as to fundamentally develop a deeper understanding of the geophysical processes involved. It is anticipated that the impact of this activity can lead to new projects related to natural and artificial hazard-induced upper atmospheric dynamics, including research-based AI/ML tools that may lead to early warning systems against such disasters.

Agenda

Date: *Friday, June 26, 2026*

Time: *10:00 - 12:00 CDT*

Location: *Room 102*

Iowa Events Center, Convention Center

730 3rd Street, Des Moines, IA 50309

Presentation Timing: *10 Minutes (7 Minutes Talk* **+** *3 Minutes Q&A and Speaker Transition)*

Remote Participation Link:
https://us06web.zoom.us/j/86472157038?pwd=hUdMpE3OUTOoaoJcMOlGIZZ7XDACeF.1

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10:00-10:10 **Paul A. Bernhardt** (*University of Alaska, Fairbanks*): Rocket Engine Burns in the Ionosphere that Amplify Whistler Waves and Reduce Radiation Belt Hazards to Satellites

10:10-10:20 **Feng Ding** (*Institute of Geology and Geophysics, CAS, Beijing, China*): An Abrupt Decrease in Electron Temperature Inside the Ionospheric Density Holes During the Launches of Carrier Rockets

10:20-10:30 **Jonathan B. Snively** (*Embry-Riddle Aeronautical University*): Modeling the Propagation, Evolution, and Interaction of Acoustic and Acoustic-Gravity Waves from Surface to Exobase (*Virtual*)

10:30-10:40 **Edgardo E. Pacheco** (*Jicamarca Radio Observatory, Peru*): The Impact of the Hunga Tonga–Hunga Ha’apai Volcanic Eruption on the Peruvian Ionosphere

10:40-10:50 **Justin Tyska** (*University of Texas at Arlington*): Impact of Acoustic and Gravity Wave Specifications on the Ionosphere-Thermosphere Generated by the 2022 Hunga Tonga-Hunga Ha’apai Eruption: Comparison of GITM simulations

10:50-11:00 **Ayden Gann** (*George Mason University*): Satellite Observations of Gravity Wave Activity in the Stratosphere and Mesosphere During Hurricane Sam in 2021

11:00-11:10 **Maosheng He** (*National Space Science Center, CAS, Beijing, China*): Reassessment of Ionospheric Responses to GRB 221009A: Disentangling Instrumental, Illumination and Geophysical Effects

11:10-11:20 **Andriy Zalizovski** (*Institute of Radio Astronomy of NAS of Ukraine, Kharkiv, Ukraine*): Impact of Terrestrial Weather on the Ionosphere over Antarctic Peninsula: Statistics of Long-term Observations at the Akademik Vernadsky Station

11:20-11:30 **Jaime Aguilar Guerrero** (*Embry-Riddle Aeronautical University*): Multi-layer Characterization of Convective Gravity Waves from the CGWaveS Campaign, AWE, and GNSS

11:30-11:40 **Yucheng Zhao** (*Utah State University*): Impacts of Natural Hazards on the Upper Atmosphere as Seen by AWE

11:40-11:50 **Pavel Inchin** (*Computational Physics, Inc.*): GNSS-TEC Observations for Constraining Undersea Earthquake Rupture Evolution

11:50-12:00 **Ryan Volz** (*MIT Haystack Observatory*): Preliminary Results for Radar Observations of the 2026 May 30 Cape Cod Bay Bolide (*Virtual*)

Justification

A powerful submarine volcano (Hunga Tonga-Hunga Ha'apai) erupted in mid-January 2022 near the South Pacific Kingdom of Tonga. The event generated a tsunami and related ocean waves across the world. This violent explosion itself reached the near stratosphere, triggering an acoustic shockwave in the troposphere that was strong enough to generate waves that reached the Earth’s ionosphere. The geospace community is currently using this event to study the response function of the middle and upper atmosphere. The Tonga event, and more generally other synoptic geological, atmospheric, and artificial hazards, can generate atmospheric waves that can “ping” the upper atmospheric system. The impacts and consequences of such “perturbation or system theory” approach are not well understood, as the fundamental dynamics, chemistry, and coupling mechanisms are still poorly constrained. Besides observations, newly practiced AI/ML-based modeling is a critical tool for forecasting natural/artificial disasters. It approximates the real system’s behavior, raising awareness among the public as well as emergency responders. As such, it is an ideal time to hold a CEDAR workshop so as to enable the community to present, discuss, update, and improve our understanding of geological, atmospheric, and artificial hazard-related acoustic and gravity wave propagation and upper atmospheric responses. These efforts can be highlighted in various CEDAR strategic thrusts, specifically in Thrusts 1, 3, 5, and 6.

Related to CEDAR Science Thrusts:

Encourage and undertake a systems perspective of geospace

Explore processes related to geospace evolution

Develop observational and instrumentation strategies for geospace system studies

Fuse the knowledge base across disciplines in the geosciences

Manage, mine, and manipulate geoscience/geospace data and models

Workshop format

Short Presentations

Keywords

Natural/Artificial Hazards, Acoustic/Gravity Waves, Modifications/Perturbations in the Upper Atmosphere, AI/ML-Based Models

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