2023 Workshop: Natural and Artificial Hazards

Long title
Upper Atmospheric Response to Geological, Atmospheric, and Artificial Hazards
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 are able to 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 modelling 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, tornados, thunderstorms, non-nuclear explosions, nuclear detonations, rocket exhausts, etc., which are studied from different observational and modeling approaches. 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 hazard-induced upper atmospheric dynamics, including research-based tools that may lead to early warning systems against such disasters.

Agenda

Date: Wednesday, June 28, 2023

Time: 13:30 - 15:30 PDT

Location: Room - Harborside

Wyndham San Diego Bayside Hotel

1355 North Harbor Drive, San Diego, CA 92101

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13:30-13:33 **Sovit Khadka** (*Orion Space Solutions*): Prelude of the Workshop Session

13:33-13:46 **Lei Liu** (*University of Colorado Boulder*): Concentric Traveling Ionospheric Disturbances Associated with the 2022 Tonga Volcanic Eruption

13:46-13:59 **Joe Huba** (*Syntek Technologies*): Modeling the 15 January 2022 Tonga Event with SAMI3/HIAMCMC/MESORAC

13:59-14:12 **Rezy Pradipta** (*Boston College*): Near-field Anisotropy of Traveling Ionospheric Disturbances from the 15 January 2022 Tonga Volcano Eruption

14:12-14:25 **Pavel Inchin** (*Embry-Riddle Aeronautical University*)**:** Earthquake Source Parameter Impacts on Seismic Infrasound Propagation to the Upper Atmosphere

14:25-14:38 **Justin J Tyska** (*University of Texas at Arlington*): Ionospheric Disturbances Generated by the 2015 Calbuco Eruption: Comparison of GITM-R Simulations with GNSS Observations

14:38-14:51 **Hanli Liu** (*High Altitude Observatory*): Observations of Secondary Gravity Wave in the Thermosphere Using Double Layer Airglow Network

14:51-15:04 **Christopher J Heale** (*Embry-Riddle Aeronautical University*): Severe Thunderstorm Generated Gravity Waves and their Deep Propagation into the

Thermosphere

15:04-15:17 **Min-Yang Chou** (*NASA Goddard Space Flight Center*)**:** Anthropogenic Concentric Gravity Waves Driven by the Launch of a SpaceX Falcon 9 Rocket in the Ionosphere

15:17-15:30 **Alexander Fletcher** (*Naval Research Laboratory*): Modeling the Formation, Evolution, and Measurement of a Rocket-Released Barium Cloud

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. 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
Fuse the knowledge base across disciplines in the geosciences
Keywords
Natural and Artificial Hazards, Acoustic and Gravity Waves, Upper Atmospheric Perturbations
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