2024 Workshop: Hazards

Long title
Upper Atmospheric Response to Natural and Artificial Hazards
Conveners
Sovit Khadka
Xing Meng
Pavel Inchin
Irfan Azeem
Cesar Valladares
Andrew Gerrard
sovit.khadka@arcfield.com
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, 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 and artificial hazard-induced upper atmospheric dynamics, including research-based tools that may lead to early warning systems against such disasters.

Agenda

Date: Thursday, June 13, 2024

Time: 13:30 - 15:30 PDT

Location: Room – Pacific A&B

Wyndham San Diego Bayside Hotel

1355 North Harbor Drive, San Diego, CA 92101

This session is combined with the Traveling Ionospheric Disturbances (TIDs) session.

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

13:33-13:46 **Sharon Vadas** (*NorthWest Research Associates*): TIDs Induced by the Secondary Gravity Waves (GWs) from the Tonga Eruption on 15 January 2022 and the Spectrum of GWs Generated by a Tsunami

13:46-13:59 **Sebastijan Mrak** (*Johns Hopkins University*): Uncertainties in GNSS-TID Processing and Impacts on Scientific Interpretations of TIDs

13:59-14:12 **Björn Bergsson** (*Embry Riddle Aeronautical University*): Characterizing Ionospheric Responses to Convectively Generated AGWs using TEC and Weather Radar Observations

14:12-14:25 **Kuldeep Pandey** (*New Jersey Institute of Technology*): Differential Mode Delays of HF Radio Waves in Presence of TIDs

14:25-14:38 **Paul Bernhardt** (*University of Alaska*): Surprising Impact of Man's Activities on the Radiation Belts

14:38-14:51 **Rezy Pradipta** (*Boston College*): Observations of Ionospheric Disturbances Associated with the 4 August 2020 Port Beirut Explosion by DMSP and Ionosondes

14:51-15:04 **Jonathan Snively** (*Embry-Riddle Aeronautical University*): AIRWaveS: Atmosphere-Ionosphere Responses to Wave Signals

15:04-15:17 **Kenneth Obenberger** (*Air Force Research Laboratory*): Remote Sensing Small Explosives with an Ionospheric Radar

15:17-15:30 **Dustin Hickey** (*U.S. Naval Research Laboratory*): Observations of MSTIDs Driven by the Lower Atmosphere

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
Explore processes related to geospace evolution
Develop observational and instrumentation strategies for geospace system studies
Fuse the knowledge base across disciplines in the geosciences
Include a virtual component?
Yes
Keywords
Natural/Artificial Hazards, Acoustic/Gravity Waves, Modifications/Perturbations in the Upper Atmosphere
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