2022 Workshop: Upper Atmospheric Response to Natural Hazards

Long title
Upper Atmospheric Response to Geological and Atmospheric 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. 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 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, 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 natural disasters.

Agenda

Date: Tuesday, June 21, 2022

Time: 10:00 - 12:00 CDT

Location: Room - Topaz 3

The LINE Hotel

111 East Cesar Chavez Street, Austin, TX 78701

10:00 - 10:10 **Pavel Inchin** (*Embry-Riddle Aeronautical University*)**:** Upper Atmosphere Observations and Modeling as Tools for the Investigation of Natural Hazard-generated Acoustic and Gravity Waves

10:10 - 10:20 **David Themens** (*University of Birmingham, UK*)**:** Global Propagation of Ionospheric Traveling Ionospheric Disturbances Associated with the 2022 Tonga Volcanic Eruption

10:20 - 10:30 **Aa Ercha** (*MIT Haystack Observatory*)**:** Significant Ionospheric Hole and Equatorial Plasma Bubbles after the 2022 Tonga Volcano Eruption

10:30 - 10:40 **Claire Gasque** (*University of California Berkeley*)**:** Rapid Volcanic Modification of the E-Region Dynamo: ICON's First Glimpse of the Tonga Eruption

10:40 - 10:50 **Jia Yue** (*NASA Goddard Space Flight Center*)**:** La Soufriere Volcanic Eruptions Launched Gravity Waves into Space

10:50 - 11:00 **Justin J. Tyska** (*The University of Texas at Arlington*)**:** Volcano-generated Ionospheric Disturbances: Comparison of GITM-R Simulations with GNSS Observations

11:00 - 11:10 **Xing Meng** (*JPL/CalTech*)**:** Modeling the Co-Seismic Ionospheric Disturbances During the 16 September 2015 Illapel M8.3 Earthquake

11:10 - 11:20 **Min-Yang Chou** (*NASA Goddard Space Flight Center*)**:** Ionospheric Conjugate Effect Driven by the 2011 Tohoku Tsunami Induced Gravity Waves

11:20 - 11:30 **Christopher Heale** (*Embry-Riddle Aeronautical University*): The Upper Atmospheric Response to Severe Thunderstorm Systems over the Summertime Continental United States

11:30 - 11:40 **Olusegun Jonah** (*SRI International*)**:** Investigating the Ionospheric Perturbation Following the Beirut Explosion Event

11:40 - 11:50 **Roberto Sabatini** (*Embry-Riddle Aeronautical University*)**:** Impact of Explosion-generated Acoustic Waves on the Upper Atmospheric Layers

11:50 - 12:00 **Kenneth Obenberger** (*Air Force Research Laboratory*)**:** Using the Ionosphere as a Radar Target to Detect Conventional Surface Explosions

Justification

Recently, 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 and atmospheric 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 and atmospheric hazard-related acoustic and gravity waves 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 Hazards, Acoustic and Gravity Waves, Upper Atmospheric Perturbations
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