2017 Workshop: Thunderstorm Coupling and Effects

Long title
Electrical and Dynamical Coupling Between Thunderstorms and the Atmosphere-Ionosphere System(s)
Conveners
Jonathan Snively
Ningyu Liu
Jérémy Riousset
Robert Marshall
Description

This workshop focuses on the electrical and dynamical coupling processes that occur between thunderstorms and the atmosphere-ionosphere systems over short time scales (milliseconds-to-hours). These include lightning processes and effects spanning from the atmosphere into the SAIR, such as Transient Luminous Events (TLEs) – e.g., sprites, halos, elves, and jets – that indicate strong electrical coupling via fields, and Terrestrial Gamma-ray Flashes (TGFs) that reveal the presence of energetic electrons. Also included are the wave-dynamical coupling processes associated with long-period (~1-4 minute) acoustic waves (AWs) and short-period (~5-30 minute) gravity waves (GWs), which are readily generated within and above strong convective storm systems at large amplitudes. Both AWs and GWs impose dynamical variability spanning a wide range of scales, perturb densities in the MLT (in airglow layers and the environments in which TLEs form), and strongly (and observably) modulate the D-, E-, and F-region ionosphere.

Our workshop will be composed of short presentations (≤10 minute) on state-of-the-art investigations of thunderstorm-related processes that enable or indicate coupling within the atmosphere-ionosphere (from troposphere to SAIR) over short time scales. We welcome presentations on all methodologies, including theory, modeling, observation, and experiment.

Agenda

(10:00-10:04) *Introduction*

(10:04-10:18) M. Geoff McHarg: "High Speed Sprite Imaging and Spectroscopy"

(10:18-10:32) Wei Xu: "A Novel Type of Transient Luminous Event Produced by Terrestrial Gamma-ray Flashes"

(10:32-10:46) Chad Renick: "LWPC modeling of lightning induced ionospheric perturbations using overlapping VLF propagation paths”

(10:46-11:00) Jacob Engle: "Numerical and analytical studies of critical radius in spherical and cylindrical geometries for corona discharge in air and CO2-rich environments”

(11:00-11:14) Ningyu Liu: "Elves associated with terrestrial gamma ray flashes"

(11:14-11:28) Irfan Azeem: TIDs from convective storms and squall lines

(11:28-11:42) Ming-Yan Chou: Concentric waves and TIDs from typhoons

(11:42-11:56) Jonathan Snively: “The acoustic-gravity wave spectrum above convective sources”

(11:56-12:00) *Conclusions*

Justification

This workshop emphasizes the fundamental physical processes driven by thunderstorms that enable coupling between the troposphere through the mesosphere, thermosphere, and ionosphere, i.e., the Space-Atmosphere Interaction Region (SAIR). It is motivated by the need to quantify coupling and variability imposed by particles, fields, and waves, their momentum and energy, from the troposphere to the SAIR that occur over short time scales (milliseconds-to-hours). Lightning discharges and convective dynamics enable this strong coupling via electrodynamic, chemical, and neutral-dynamical processes and effects that may be dramatic and nonlinear. Strong progress continues to be made via new theory, modeling, and observations across a wide range of altitudes, scales, and systems; this is readily measured by the extent to which processes and effects can be explained, understood, modeled, and predicted.

Investigations into thunderstorm-driven processes contribute towards addressing the Decadal Survey AIMI Science Priority 2, to “Understand how tropospheric weather influences space weather” and Priority 3, to “Understand the plasma-

neutral coupling processes that give rise to local, regional, and global-scale structures and dynamics in the AIM system". Further, they are in full accord with CEDAR Strategic Thrust #1 (viz., to "Explore system characteristics of the space-atmosphere interaction region in terms of nonlinearities, preconditioning and memory, feedback, instabilities, emergent behavior, and cross-scale coupling"), and all aspects of Thrust #2 (overall, to "Explore Exchange Processes at Interfaces and Boundaries").

View PDF