2023 Workshop: Atmosphere-Space Coupling

Long title
Atmosphere-Space Coupling Studies with Advanced Observations and Numerical Modeling
Conveners
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Description

In the last 15 years, lidar observations have evolved from being limited to relatively narrow altitude ranges (up to ~110 km) to the significantly extended altitude ranges of neutral profiling from near the ground up to ~200 km and ion detection up to ~300 km in altitudes. Lidar observations have led to numerous discoveries such as the thermosphere-ionosphere metal layers, secondary gravity wave generation, and upward sensible heat fluxes in the lower thermosphere, etc. Furthermore, a Helium lidar has demonstrated He measurements to about 700 km. These recent results demonstrate the huge potentials that lidars and their future generations will bring to the atmosphere-space physics, composition, chemistry, and dynamics. Coordinating development of lidar, radar, and other instruments as well as strategical deployment of these instruments will enable cutting-edge science and provide fuel to discovery science in the next decades.

This workshop solicits presentations focusing on the recent progress in space-atmosphere coupling studies as well as discussions on the future vision on how to develop observational and instrumentation strategies to advance space-atmosphere physics. Topics include, but are not limited to, electrodynamics and neutral dynamics that help interpret the neutral and ionic metal species and their transport in the D, E, and F regions, observations and modeling of constituents, thermal structures, neutral tidal winds and gravity waves, and ionospheric-magnetospheric observations (such as TIDs, airglow emission, and sporadic E layers, etc.). We also welcome numerical modeling and theoretical studies that can help interpret

observations and understand the underlying space-atmosphere coupling.

Agenda

The time given below is in San Diego, CA time zone (Pacific).

This workshop can be joined online using the Zoom link below:

https://cuboulder.zoom.us/j/91008874788 ;

10:00 - 10:18 **Xinzhao Chu** – “Observations of multiple metal species (up to ~350 km) and progress of lidar development in China” + "Introduction to Open Discussions" (18 min)

10:18 – 10:31 **Selvaraj Dharmalingam**– “Multiple Ionospheric Descending Layers Over Arecibo” (13 min)

10:31 – 10:44 **Yingfei Chen** – “Annual variations of predawn TINa layers observed with lidar over Boulder and possible connections to tidal winds and conjugate photoelectrons” (13 min)

10:44 – 10:57 **Bharat Kunduri / Mike Ruohoniemi (SuperDARN)** - "A multi-instrument experimental campaign to analyze the dynamics of mid-latitude sporadic-E layers" (13 min)

10:57 – 11:10 **Roger Varney** – A brief tutorial on conjugate photoelectrons (13 min)

11:10 – 11:23 **Arunima Prakash** – “Resolving the mystery of missing solar cycle signature in PMCs from McMurdo, Antarctica” (13 min)

10:23 – 11:36 **Jintai Li** – “Investigation of two fishbone structures over Alaska with lidar and HIAMCM: evidence of secondary and tertiary gravity waves” (13 min)

11:36 – 11:49 **Vishnu Kumar** – “Advancements in Iron Fluorescence Lidar System Development for Wind and Temperature Measurements at the HAARP Research Facility” (13 min)

11:49-11:54 **Yucheng Zhao** -- "Multi-instrument measurement capability of mesospheric gravity waves in Antarctica" (5 min)

11:54 – 12:00 **Open Discussions:** From recent discoveries to thoughts on future directions (moderated by Xinzhao Chu and Xian Lu)

Each speaker please leaves 1-2 min for Q & A. For example, a 13-min talk should finish the talk at 11-12 min, and then leave 1-2 min for questions.

Justification

This workshop aims to bridge the neutral atmosphere communities with the ionosphere and magnetosphere communities to tackle some fundamental science questions and make new paths for the future. The science and technical challenges include
1) How are thermosphere-ionosphere metal layers (both neutral and ionic) formed in the mid and low latitudes? What factors determine the ion and neutral transport from the D-E regions to the ionospheric F region?
2) What are the roles of plasma-neutral coupling and tidal winds in shaping the compositions and structures in the space-atmosphere-interaction region?
3) What are the wave contributions to the constituent, heat, and momentum transport?
4) How do multistep vertical coupling impact the upper atmosphere and geospace?
5) How to advance remote sensing technologies, especially lidars, and deploy them strategically to transform the CEDAR research on the space-atmosphere coupling studies?

Related to CEDAR Science Thrusts:
Explore exchange processes at boundaries and transitions in geospace
Develop observational and instrumentation strategies for geospace system studies
Keywords
Atmosphere-space coupling, ion and neutral transport, wave dynamics, future lidars
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