2024 Workshop: Atmosphere-Space Coupling towards IPY

Long title
Atmosphere-Space Coupling Studies with Advanced Observations and Numerical Modeling towards IPY 2032 and 2033
Conveners
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Description

In the last two decades, 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.

An NSF supported "GEOSCOPR" (Geospace Exploration and Observation with Scientific COllaboration in Polar Regions, towards IPY 2032) workshop was held in October 2023, to assess the vitality of our scientific community, identify important scientific priorities, and begin to organize and plan for the upcoming International Polar Year (IPY) 2032 with a particular emphasis on Antarctic polar research program. Recognizing the increasing challenge to undertake Antarctic research supported by the U. S. Antarctic Program, a major focus of the workshop was to engage other scientific communities and international colleagues to find common

areas of interest that could lead to efficiencies and mutual benefit through collaboration.

This CEDAR 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

Zoom link for this IPY workshop (Tuesday 10am-12pm Pacific Time June 11):

https://cuboulder.zoom.us/j/92126556964

Meeting ID: 921 2655 6964

Agenda —

1) Introduction of GEOSCOPR, IPY, and Antarctica Research by Zhonghua Xu, Mike Hartinger, and Xinzhao Chu (~20 min)

2) Jens Oberheide on “A statistical study of the day-to-day variability of diurnal and semidiurnal tides based on MIGHTI/ICON observations” (~12+1 min)

3) Chihoko Cullen on gravity waves (~10+1 min)

4) Yun-Ju Chen on plasma density enhancement in the polar cap (~10+1 min)

5) Sharon Vadas on Antarctica GW research and IPY (~10 min)

6) Shasha Zou on polar research and SCAR AGTAT (~10+1 min)

7) Shun-Rong Zhang on atmosphere-space coupling (~10 min)

8) Toshi Nishimura on "Auroral research in Antarctica and contributions to lidar science" (~10 min)

9) Mark Conde on "Thermospheric wind and temperature measurements with FPI instruments at McMurdo & South Pole" (~6 min)

10) Geonhwa Jee and Qian Wu on "Ground-based observations for the polar upper atmosphere at Korean Antarctic stations" (~8 min)

11) **Discussions on pipeline, infrastructure, and science collaboration** to be moderated by Xinzhao Chu, Xian Lu, Zhonghua Xu, and Jackson Jandreau.

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) What are the wave contributions to the constituent, energy, and momentum transport? How do vertical coupling impact the upper atmosphere and geospace?
2) What are the roles of plasma-neutral coupling and neutral winds in shaping the compositions and structures in the space-atmosphere-interaction region?
3) What factors determine the ion and neutral transport from the D-E regions to the F region? How do they contribution to the formation of thermosphere-ionosphere metal layers (both neutral and ionic) at all latitudes?
4) What ground-based observations and infrastructures are needed in the polar regions to advance CEDAR sciences and prepare for the International Polar Year 2032-2033?
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
Fuse the knowledge base across disciplines in the geosciences
Workshop format
Short Presentations
Keywords

Atmosphere-space coupling, ion and neutral transport, wave dynamics, neutral winds, IPY

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