2016 Workshop: Coupling

Long title
Coupling between the atmosphere, ionosphere, and magnetosphere through tropospheric and magnetospheric sources
CEDAR-GEM
Conveners
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Description

The atmosphere, ionosphere, and magnetosphere are constantly connected by electromagnetic wave and particle coupling. Tropospheric sources such as lightning and ground-based VLF transmitters launch electromagnetic waves that propagate through the ionosphere and into the magnetosphere as whistler-mode waves. These waves roughly follow magnetic field lines and interact with radiation belt particles, inducing energetic particle precipitation into the upper atmosphere. Similarly, naturally-occurring wave sources in the magnetosphere, including chorus, hiss, and electromagnetic ion-cyclotron (EMIC) waves, induce particle precipitation through wave-particle interactions that scatter particles into the loss cone.

This energetic particle precipitation (EPP) affects both the upper atmosphere as well as the radiation belt particle populations. In the upper atmosphere, effects include energy deposition, production of NOx and HOx, and x-ray production through bremsstrahlung. Radiation belt populations are affected by precipitation, as EPP forms a primary loss mechanism and thus affects the lifetimes of radiation belt enhancements.

The proposed workshop is designed to take advantage of the assembled CEDAR/GEM communities to discuss the current state of knowledge in atmosphere-ionosphere-magnetosphere coupling through energetic electron precipitation. This workshop will bring together researchers interested in the effects of tropospheric sources on particle precipitation into the upper atmosphere as well as those interested in radiation belt dynamics and particle lifetimes. The workshop will be geared towards quantitatively addressing the overarching questions: i) how does particle precipitation control upper atmosphere chemistry and dynamics? ii) how

does the upper atmosphere affect radiation belt populations and lifetimes?

Justification

This workshop addresses coupling processes in the Space-Atmosphere Interaction Region (SAIR) and the quantification of coupling processes between the upper atmosphere and magnetosphere.. Wave sources from lightning, transmitters, chorus, hiss, and EMIC waves affect radiation belt populations through wave-particle interactions and result in particle precipitation in the upper atmosphere. These processes thus couple regions ranging from the troposphere, upper atmosphere, ionosphere, radiation belts, and magnetosphere.

This workshop addresses the Decadal Survey AIMI Science Goal 3: Ionosphere-Thermosphere-Magnetosphere Coupling, and the specific question: How do high-latitude electromagnetic energy and particle flows impact the geospace system? While this workshop is not restricted to high-latitude effects, most precipitation does occur at high latitudes. It further pertains to AIMI Science Goal 2: Meteorological Driving of the IT System, through the coupling of lightning energy into the magnetosphere and radiation belts, and its resulting effects on radiation belt populations.

This workshop pertains to the GEM Focus Group “Quantitative Assessment of Radiation Belt Modeling”. Radiation belt modeling is used to quantify the effects of waves on radiation belt particle populations. This workshop addresses the wave sources themselves, as well as the atmospheric effects on the resulting radiation belt populations. Radiation belt modeling is a critical step in the complete coupling processes. The workshop addresses key objectives of the CEDAR Strategic Plan. It directly pertains to the CEDAR Strategic Thrust #1: "Encourage and undertake a systems perspective of geospace,” Thrust #2 "Explore exchange processes at boundaries and transitions in geospace," and Thrust #6 "Fuse the knowledge base across disciplines in the geosciences."

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