2023 Workshop: Solar eclipse’s effects in geospace

Long title
Current understanding of solar eclipse’s effects in geospace and plans for upcoming eclipses
Conveners
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Description

An impulsive reduction in solar irradiation triggers changes in photo-ionization, photo-absorption and heating as the Moon shadow super-sonically traverses through the Earth's atmosphere at fixed locations. This makes eclipses unique natural experiments to study the geospace system’s behavior. New insights into the unique eclipse effects on the geospace system through commonly known fundamental coupling processes have been achieved. These effects include eclipse induced ionospheric density variations associated with irregular EUV sources on the solar disk, electrodynamic disturbances and eclipse-time tidal wave modulation at low and equatorial latitudes, ionospheric disturbances in the conjugate hemisphere, and, potential ionospheric and thermospheric waves, etc. The Great American Eclipse on August 21, 2017 renewed community interest as it provided multi-instrument observation of eclipse-related effects in geospace. Two future solar eclipses will similarly pass through the continental North America on October 14, 2023 (annular) and April 8, 2024 (total). These will provide rare opportunities for the community to study geospace responses to eclipses with coordinated multi-instrument satellite and ground-based data. We thus invite the community members to [1] report new progress in understanding geospace disturbances during recent and past solar eclipse events, and [2] discuss and coordinate observational and modeling analysis of the upcoming October 14, 2023 (annular) and April 8, 2024 (total) eclipses.

Agenda

Wenbin Wang (for Kevin Pham): Simulations of the April 2024 Total Solar Eclipse. 10:05-10:20 AM

Yue Deng/Minjing Li (potentially online): 10:20-10:35 AM

Joe Huba: WILL THE OCTOBER 2023 ECLIPSE SPAWN EQUATORIAL PLASMA BUBBLES? 10:35-10:50 AM

Shane Coyle (10:50-11:05 AM): The 2021 Antarctic Total Solar Eclipse: Waves in the Ionosphere-Magnetosphere System

John Swoboda (11:05-11:20 AM): Exploring the Ionosphere and Thermosphere During the 2024 Eclipse with a Novel Radar Network

Aroh Barjatya (11:20-11:35 AM): Apophis: Rocket campaign to investigate eclipse induced ionospheric electrodynamics

Shun-rong Zhang (11:35-11:50 AM): Ground-based upper atmospheric observations during solar eclipses in Oct 2023 and Apr 2024

Discussion/Plans for collaboration/Pitchers: 11:50 AM-Noon

- **Nathaniel Frissell (Pitcher slide): HamSCI Festivals of Eclipse Ionospheric Science**

File upload
The 2021 Antarctic Total Solar Eclipse: Waves in the Ionosphere-Magnetosphere System (3.29 MB)
Apophis: Rocket campaign to investigate eclipse induced ionospheric electrodynamics (7.25 MB)
Simulations of the April 2024 Total Solar Eclipse (5.08 MB)
Justification

This session will address science questions related to the geospace system's response to solar eclipses and plan for coordinated future eclipse observations in geospace. Solar eclipses induce rapid decreases and recovery of solar heating and photoelectron production that impulsively drive the Earth's upper atmosphere leading to photochemical and dynamic changes. During the 2017 great American eclipse over the continental USA, multi-instrument observations led to renewed interest to study eclipses' effect on the geospace. Since then, numerous solar

eclipses have been observed, including two polar eclipses. However, challenging science and observational questions are still unresolved. Such questions include how eclipses induce/affect the atmospheric and ionospheric waves, photoelectron variations, hemispheric conjugate effects, and polar region magnetosphere-ionosphere-thermosphere (MIT) coupling, etc. Similar to the 2017 eclipse, two more eclipses will traverse through continental USA on October 14, 2023 (annular) and April 8, 2024 (total), providing opportunities for multi-instrument observations of the eclipses' effects on geospace. The session plans to address eclipse-related science questions and discuss coordinated community observational and analysis plans for the upcoming eclipses. This session will address CEDAR Strategic Thrust #2: Explore Exchange Processes at Interfaces and Boundaries (Characterize sources and sinks internally and externally to the SAIR and their possible variations due to the coupling and complexity of the Sun-Earth system).

Related to CEDAR Science Thrusts:
Develop observational and instrumentation strategies for geospace system studies
Workshop format
Short Presentations
Keywords
solar eclipse, impulsive events
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