2015 Workshop: Geospace variations

Long title
Long-term variations in the geospace environment
Conveners
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Description

Long term variations in the geospace environment are caused by a variety of sources, including the 11-year solar cycle and the secular variation in the geomagnetic field. Accurate knowledge of long-term trends in all portions of the geospace environment are essential to understand and predict behaviour in the ionosphere and thermosphere. The changing predictions for the current solar cycle (24) are a good example of how this gap in our knowledge limits forecasting capability. It also highlights the importance of incorporating multiple sources of data.

There are now many instruments and datasets that have been operating continuously or sporadically over several solar cycles, allowing long-term studies of the influence of solar irradiance, secular changes in the magnetic field, and changes in the composition of the lower atmosphere and thermosphere. This workshop will address the progress and problems in our understanding of these long-term variations. Invited talks will give an overview of the available datasets and discuss the current state of investigation of long-term variations in the sun, geomagnetic field, ionosphere/thermosphere, and lower atmosphere. Submitted presentations and directed discussion will cover topics including long-term variation in the solar spectrum, the influence of changes in lower atmospheric composition on the upper atmosphere, and the long-term variability of the ionosphere. This workshop will help observational space physicists and modelers share their progress and requirements to better attack the problem of long-term variations in interconnected regions of the geospace environment.

Agenda

- Klenzing -- Session Overview (pdf)
- Solomon -- Solar variability and anthropogenic change in the upper atmosphere (pdf)

- Cnossen and Richmond -- Causes of long-term change in the upper atmosphere (pdf)
- Dombeck -- Solar cycle (long-term) variations of auroral particle acceleration from FAST satellite data (pdf)
- Burrell -- Studying ionospheric solar-cycle variations with SuperDARN (pdf)
- Stoneback -- Pysat and DINEOFs, a system for system science (pdf)
- Cullens -- The 11-year solar cycle variations on gravity waves using WACCM and SABER (pdf)
- Zhang -- Multiple ISR observations of upper atmospheric long-term cooling (pdf)
- Yue -- Long-term trend of SABER carbon dioxide (pdf)
- She -- Long-term trend of midlatitude mesopause temperature trend deduced from quarter century (1990-2014) Na lidar observations (pdf)

Justification

Quantifying the long-term variations in the geospace environment to improve the understanding of the ionospheric and atmospheric response to solar and terrestrial inputs with the aim of improving the community's prediction capability. This prediction capability is vital for mission planning (e.g., satellite drag) as well as applying our present models to solving geospace phenomena under an unexpected solar cycle.

This workshop is aligned with CEDAR Strategic Thrusts #1 — Encourage and Undertake a Systems Perspective to Geospace — and #4 — Develop Observational and Instrumentation Strategies for Geospace System Studies. As part of the discussion, we will examine existing observatories throughout Heliophysics and Earth Sciences (including, but not limited to, TIMED, Aqua, Terra, and Aura) to maximize the impact of long-term observations of solar spectra and lower atmospheric measurements in our current studies of the geospace environment.

This workshop is aligned with the Decadal Survey goal #2 — Determine the dynamics and coupling of Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs.

Summary

This session's goal was to consider the various types of long-term variations that affect the geospace environment from the magnetosphere-ionosphere boundary down to the mesosphere. Three invited speakers gave overviews on long term

changes in the atmosphere due to CO2 and other atmospheric gases (Stan Solomon), the influence of secular changes in the magnetic field on the ionosphere and thermosphere (Art Richmond), and the influence of the solar cycle on auroral precipitation and how this precipitation affects the ionosphere-thermosphere system (John Dombeck). Contributing speakers discussed ongoing work on long-term variations in the polar ionosphere and the MLT region, as well as a new python library designed to allow simultaneous analysis of multiple ground and space-based datasets. The MLT studies included a gravity wave analysis performed with WACCM, ISR observations of long-term atmospheric cooling, long term changes in CO2, and mesopause temperature variations deduced from Na LIDAR observations.

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