2024 Workshop: Discovery science in the lower thermosphere

Long title
Very Low Earth Orbit (VLEO): Discovery science at the New Frontier
Conveners
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Description

Very Low Earth Orbit (VLEO) region of interest extends from about 90km to 300km. In this regime, orbits decay very rapidly with lifetimes ranging from less than a year to hours. Vehicles operating here require propulsion to extend their life but how much propulsion is required? To answer that question, we need to understand the density, composition, and their variability in response to forcing from above and below.

This is the new frontier for spaceflight operations – and it is poorly characterized. How do we use our models and instruments to provide relevant characterization of this region? You may remember that SpaceX/Starlink lost about 40 commercial spacecraft because they didn't realize that a relatively small geomagnetic disturbance had enhanced the density at the altitudes at which they were inserting their spacecraft into orbit.

Please join us if you are interested in how we explore this new frontier using: groundbased instrumentation, first principles and empirical modeling, spacebased in situ sensing , remote sensing from space, sounding rockets, commercial suborbital flights, etc.
Help us understand the limits of our knowledge.
Join us to work together to establish a new initiative to enhance our scientific understanding, develop new funding sources and establish the relevance of CEDAR science to this problem.

Our objectives are:
1) Develop a community of interest (COI) to encourage science investment (NSF, NASA, etc) in the region
2) Encourage the CEDAR community to explore existing methods of characterizing this environment and its variability (e.g. waves, tides, geomagnetic and solar activity, etc.)
3) Share what we can measure and how (e.g. groundbased active and passive experiments; commercial suborbital; novel techniques for in situ sampling) - new ideas are particularly welcome.
4) Determine what the models need to improve the accuracy of the representation of the physical processes in the transition from fluid to free molecular flow and how that affects the drag environment experienced by spacecraft.

Agenda

OWL and lower thermosphere observations
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ASTRE mission
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Lower atmosphere UV remote sensing
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AGW and the VLEO environment

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Justification

CEDAR science addresses the open issues in understanding and predicting the density, composition, winds, and temperature in the ionosphere and thermosphere. This region, which encompasses the SAIR, sees the transition from fluid behavior to free molecular flow. At the top of the VLEO region, the response is controlled by solar/geomagnetic variability. At the bottom of the VLEO region, the response is controlled by the lower atmosphere. What happens in between? In the last few years, there has been increasing interest in the practical commercial and government use of VLEO because there are many advantages in operating in that region. CEDAR can help make the case that the science questions we ask are relevant to use of VLEO. To fully utilize the VLEO, we need to characterize the processes that shape the VLEO environment, its variability and the cause of that variability and whether we can accurately model and predict the behavior of the VLEO environment.

Related to CEDAR Science Thrusts:
Explore exchange processes at boundaries and transitions in geospace
Develop observational and instrumentation strategies for geospace system studies
Include a virtual component?
Yes
Keywords
satellite drag, SAIR, models, instruments
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