

## The Geospace Dynamics Observatory; a mission of discovery for Geospace

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### Abstract

Geospace Dynamics Observatory (GDO) takes advantage a repurposed optical system to provide new, unique, and cost-effective insights into the dynamics of geospace. New missions investigating the ITM system and the magnetospheric-ionospheric coupling processes have generally been very focused on specific phenomena, generally limited by the resource constraints and mission size. Exploring options for observing these regions with instrumentation that is 'non-traditional' is not often considered. The possibility of using very large optics to image Geospace has recently come to the fore. This talk will address the science that would be enabled by flying an ultraviolet telescope imaging the ITM region with an aperture greater than 2 meters. A brief overview of the use of this asset in a science-driven mission concept called the Geospace Dynamics Observatory (GDO) will be presented. This talk will explore the optical and technical aspects of the GDO mission and the implementation strategy. Additionally, the case will be made that GDO will address a significant portion of the priority mission science articulated in the recent Solar and Space Physics Decadal Survey, and provide unprecedented discovery opportunities. One of the problems common to all of geospace research is that of resolving temporal and spatial ambiguities: are the observed changes due the fact that the location of the observation has changed or have the state variables changed? This is a particularly vexing problem for low-cost missions that may have to rely on in situ measurements or other low spatial resolution techniques such as GPS radio occultation. The exceptional capabilities of the GDO mission include (1) unprecedented improvement in signal to noise for global-scale imaging of Earth's space environment that enables changes in the Earth's space environment to be resolved with orders of magnitude higher temporal and spatial resolution compared to existing data and other approaches, and (2) unrivaled capability for resolving the temporal evolution, over many days, in local time or latitude with a continuous view of Earth's global-scale evolution while simultaneously capturing the changes at scales smaller than are possible with other methods. GDO can provide the contextual measurements to support other investigations in space or from the ground or provide its own unique insights into the system. This combination of new capabilities found in GDO is a proven path to major scientific advances. A few examples of potential advances include: 1. Unparalleled advances in the connection of the upper atmosphere to the Sun. In the aurora and lower latitudes, extending the duration of uninterrupted images would advance understanding of the transfer of energy from the Sun to the upper atmosphere and the response of the space environment. 2. Advances in the influence of waves and tides on the upper atmosphere. Increasing both the signal to noise and the duration of the observations would reveal contributions that are not identifiable using other approaches. 3. The ability to probe the mechanisms that control the evolution of planetary atmospheres. The vantage point provided by this mission allows the flux of hydrogen (which is tied to the escape of water from a planet) to be mapped globally. It also allows unique observations of changes in the atmospheric structure and their causes.