Overview of the GDC STDT

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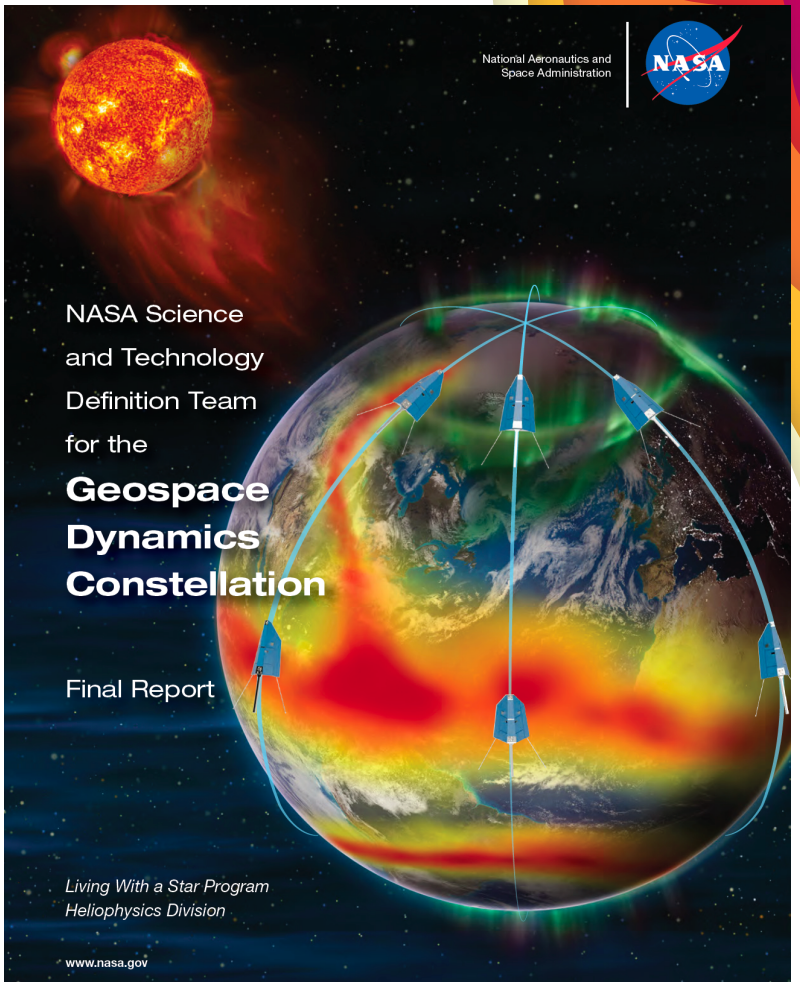
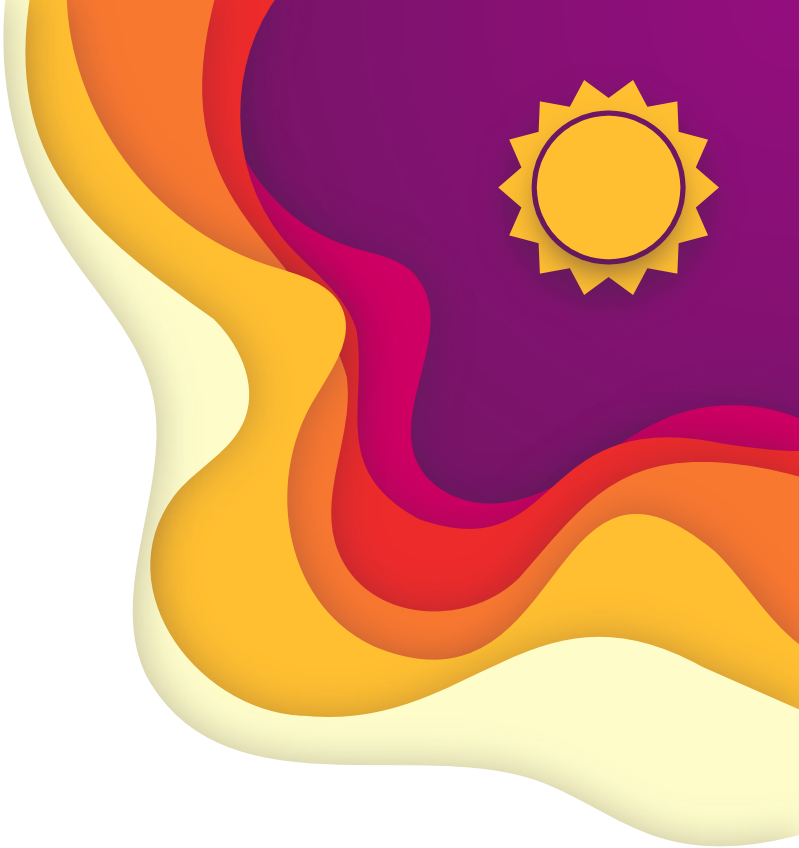
Thanks to Aaron Ridley, Jared Leisner and the entire STDT team



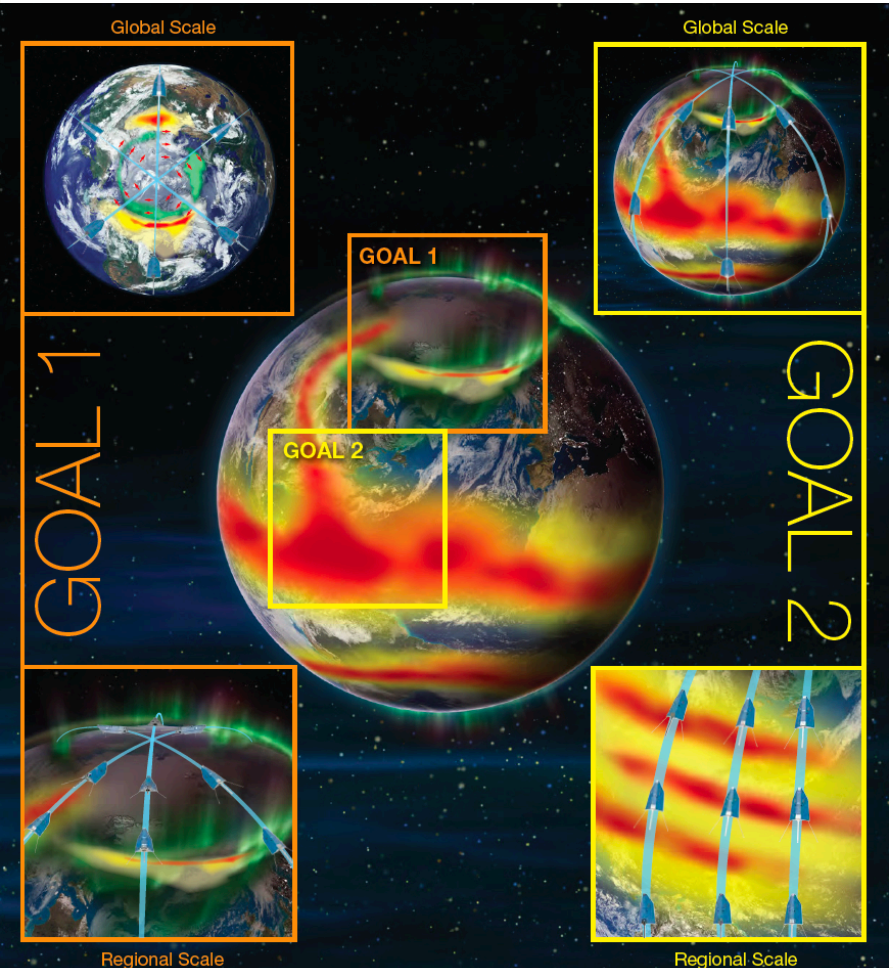
Motivation

- The Geospace Dynamics Constellation (GDC) mission is the next Living With a Star mission recommended by the 2013 Decadal Survey
- GDC's high-level goal is to explore the upper atmospheric reaction to energy input, which drives significant space weather
- The Science and Technology Definition Team was formed to refine the **science goals and objectives** for GDC from the Decadal Survey recommendation



- The STDT **addressed options** and considerations to inform NASA's selection of a **mission architecture**

GDC Science Goals



Goal 1

Understand how the high latitude ionosphere-thermosphere system responds to variable solar wind/magnetosphere forcing.

Goal 2

Understand how internal processes in the global ionosphere-thermosphere system redistribute mass, momentum, and energy.

GDC Science Objectives: Prioritization

Core

Objective 1.1: Determine how high-latitude plasma convection and auroral precipitation drive thermospheric neutral winds.

Main objective

Core Comprehensive

Objectives 1.2 (plasma structures), ***1.3*** (neutral structures), ***2.1*** (penetration e-fields), ***2.2*** (propagating structures), ***2.3*** (composition)

Extremely important: will help to address core objective

Core Enhancing

Objectives 1.4 (lower atmospheric influence), ***2.4*** (variability driven by lower atmosphere), ***2.5*** (radiative cooling), ***2.6*** (hemispheric asymmetries)

Very important: will augment the science return

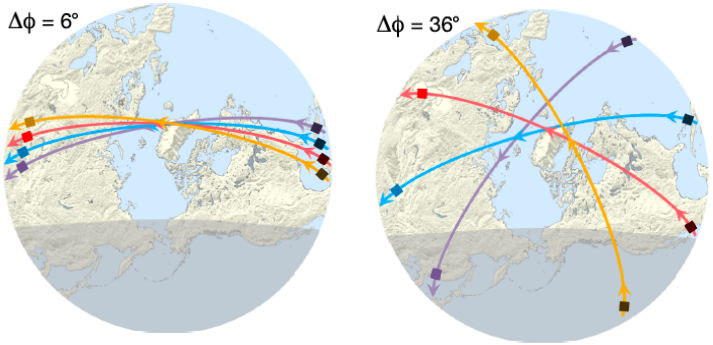
Implementation Architectures

The STDT conducted a modeling study in order to help NASA bound option space. This study address three key architecture questions:

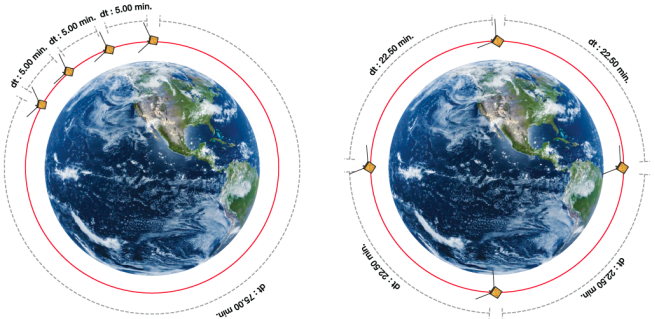
- What is the optimum number of satellites within an orbit plane?
- What is the optimum number of orbit planes?
- What is the magnitude of temporal and spatial gradients that need to be resolved?

MxN spacecraft

With or without sacrificial CubeSats

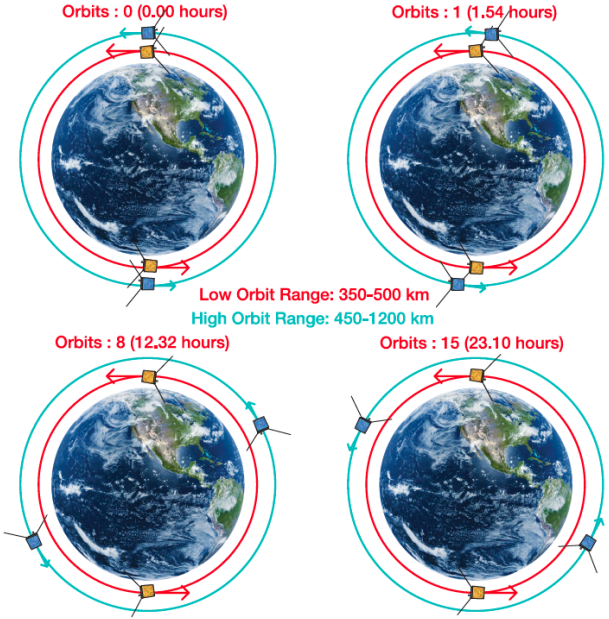


Different re-visit times:



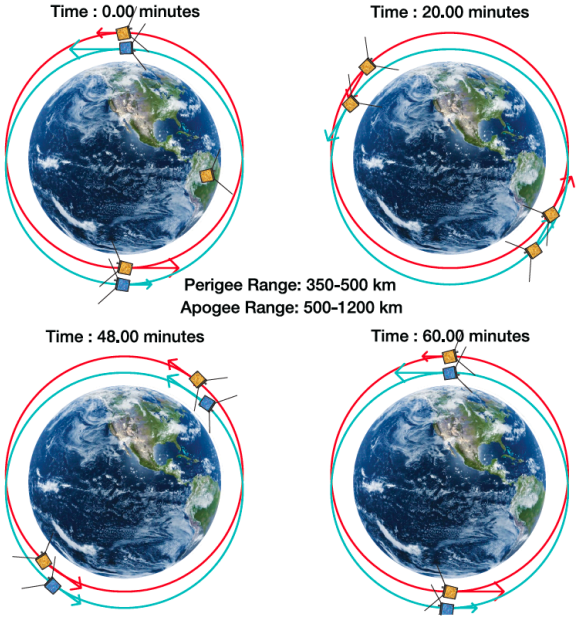
Implementation Architectures

High/Low architecture



High fliers may take different measurements than low fliers

Over/Under architecture



More conjunctions of high and low altitudes

Recommendations

- Support GDC as the next Heliophysics mission
- Accept the prioritization of objectives, with neutral winds being a fundamental physical parameter that must be measured
- Emphasize the need for ground-based observations, lab calibration activities, modeling resources and new technology development alongside the main GDC effort
- Implementation: Recommend that there are 3+ satellites per orbit plane and 4+ orbit planes
- NASA should include GDC in cross-agency collaborations due to strong synergies in science, measurements, and space weather goals

Backup Slides

GDC Science Objectives

Goal 1: Understand how the high latitude ionosphere-thermosphere system responds to variable solar wind/magnetosphere forcing.

Obj. 1.1: Determine how high-latitude plasma convection and auroral precipitation drive thermospheric neutral winds.

Obj. 1.2: Determine how localized, coherent plasma density features arise and evolve.

Obj. 1.3: Determine how neutral winds, auroral precipitation, and collisional heating drive high-latitude neutral density structures.

Obj. 1.4: Determine how atmospheric tides and gravity waves influence the IT response to magnetospheric inputs.

Goal 2: Understand how internal processes in the global ionosphere-thermosphere system redistribute mass, momentum, and energy.

Obj. 2.1: Determine the relative importance of penetration electric fields and disturbance winds in driving plasma density variations at mid- and low-latitudes during geomagnetic storms.

Obj. 2.2: Identify the processes that create and dissipate propagating structures within the ionosphere and thermosphere during active and storm conditions.

Obj. 2.3: Determine the connections between winds and neutral density/composition variations at mid- and low-latitudes during geomagnetic storms.

Obj. 2.4: Characterize the spatial and temporal variability in IT parameters that results from the transfer of momentum and energy from atmospheric tides and gravity waves.

Obj. 2.5: Quantify the roles of radiative cooling and neutral winds in dissipating thermospheric energy.

Obj. 2.6: Determine how hemispheric asymmetries in the Earth's magnetic field, seasonal variations, and magnetospheric input affect the IT system.