

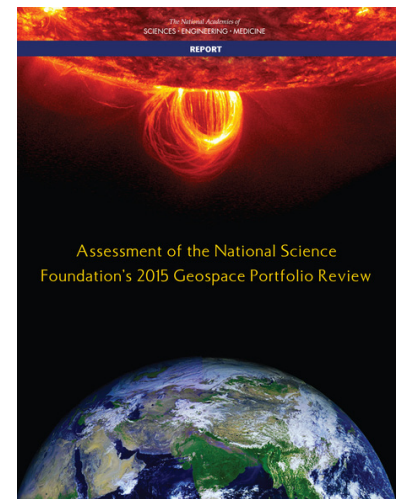
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Assessment of the National Science Foundation's 2015 Geospace Portfolio Review

Geospace researchers study how Earth's upper atmosphere and magnetosphere interact with our local space environment, which encompasses space weather, solar wind, and background radiation. Geospace science is a cross-disciplinary enterprise that includes facilities, programs, and activities within the National Science Foundation (NSF) as well as other U.S. agencies and international programs. Within the NSF, this research takes place under the auspices of the Geospace Section (GS) of the Division of Atmospheric and Geospace Sciences, which supports critical components of the nation's solar and space physics program. In 2015, an NSF review committee examined the portfolio of facilities, research programs, and activities funded by the GS and made recommendations in the report *Investments in Critical Capabilities for Geospace Science 2016 to 2025* (ICCGS). At the request of the NSF, the National Academies organized a study to independently assess how well the ICCGS recommendations and proposed balance of investments align with the science priorities outlined in the 2013 National Academies' decadal survey *Solar and Space Physics: A Science for a Technological Society*.

NEED FOR A STRATEGIC PLAN The National Academies finds that the ICCGS committee fulfilled its charge by completing a thorough and conscientious portfolio review. However, the lack of a strategic plan for geospace science within NSF may prevent the GS from fully acting upon the recommendations put forward in ICCGS. As the GS strives to meet the challenge of leveraging limited resources to maximize their impact on geospace sciences, it needs to define how it fits into the broader geospace science community and what role it will play in tackling key scientific and societal priorities within the field. GS involvement in the National Space Weather Strategy and the Space Weather Action Plan is one critical area that should be considered in a strategic plan. This plan should be aligned with decadal survey priorities, demonstrate awareness of evolving capabilities outside NSF, and be regularly updated with close community involvement to respond to new discoveries and evolving budgets.

DIVESTMENT, REBALANCING, AND PARTNERSHIPS ICCGS recommends rebalancing the GS program to provide a source of funding for new programs by terminating funding for the Sondrestrom Incoherent Scatter Radar (\$2.5 million annually) and reducing funding for the Arecibo Observatory from \$4.1 million to \$1.1 million annually. While the National Academies recognizes that reducing funding for existing facilities is necessary to address decadal survey priorities in a flat-budget scenario, many details remain to be considered before this divestment can be effectively implemented. Operations at both sites are complex, which introduces a degree of uncertainty regarding how much money



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will be saved, how long it will take until funds are available for reallocation, and what capabilities will remain to support geospace sciences at Arecibo. To replace most of the capabilities at Sondrestrom, the ICCGS recommends joining the European Incoherent Scatter Scientific Association (EISCAT). The National Academies considers joining EISCAT to be a sensible approach that would ensure U.S. Access to state-of-the-art instrumentation at a lower cost. However, the time it will take to enter the EISCAT partnership may be longer than assumed by the ICCGS, which could delay new GS initiatives.

The ICCGS report concluded that science productivity is low for CubeSat missions as compared to other GS programs and recommended a stricter set of guidelines and a greater focus on science, along with a decrease in funding. The National Academies, which recently released the report *Achieving Science with CubeSats: Thinking Inside the Box*, found that CubeSats have demonstrated that they can be a platform for high-value science. While the National Academies agrees with ICCGS that NSF should seek partnerships for CubeSat programs, the GS should carefully consider the impact associated with decreasing funding for the CubeSat program before additional resources through intra-divisional partnerships can be obtained.

MIDSCALE FUNDING OPPORTUNITIES A decadal survey priority for geospace sciences is the creation of a Midscale Projects Program to support experiments that are too small for large scale funding initiatives and too large

for smaller grants. However, the \$5-6 million per year that would be needed for a viable midscale funding program does not fit within the GS budget envelope. The development and implementation of a Midscale Projects Program will require coordination between the Division of Atmospheric and Geospace Sciences, the Directorate for Geosciences, and NSF.

MOVING FORWARD ICCGS puts forth the goal that the GS should be in the “vanguard of NSF initiatives to promote engagement of women and under-served populations.” In order to develop a vibrant and diverse workforce, the GS must take aggressive action to address the lack of diversity and representation in solar and space physics. The GS could accomplish this by working with existing NSF diversity programs and adopting their best practices and featuring diversity efforts prominently on the GS website.

In order to guide the future evolution of the GS portfolio, ICCGS recommends two separate semi-decadal reviews, one for grants and one for facilities. The National Academies agrees that periodic senior reviews would help prioritize existing investments and allow for new opportunities, but they are concerned that two sets of reviews, rather than a single unified review, would overly burden the GS administration. Overall, the ICCGS suggestions to the GS regarding management processes are excellent. The responsibility now passes to NSF to implement the recommended changes.

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