

Coupling, Energetics, and Dynamics of Atmospheric Regions

July 15, 2025

CEDAR Community Statement on DYNAMIC and GDC

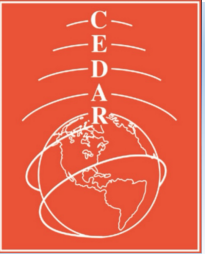
NASA space missions are essential to the United States' global leadership in understanding, mitigating, and forecasting the impacts of upper atmospheric disturbances on orbital spacecraft and on our increasingly technology-dependent society. The US-led CEDAR¹ community strongly endorses these efforts. More specifically, the CEDAR community concurs with the US National Academies' assessments in 2013 and 2024 that NASA's proposed DYNAMIC and GDC² missions will be critical components of this work. DYNAMIC will measure prevailing winds, temperatures, and densities at altitudes from 100–250 km across the globe. GDC, as proposed before its cancellation, would measure key geophysical parameters in the ionosphere-thermosphere system from 300–500 km across different local times. The National Academies' 2013 Decadal Survey³ confirmed that these data are amongst the highest-ranking observations needed to advance space weather forecasting capabilities. The need for DYNAMIC and GDC was strenuously reaffirmed by the 2020 Midterm Assessment⁴, the 2021 Space Weather Gap Analysis Report⁵, and the 2024 Decadal Survey⁶, which noted that they will “improve the nation's satellite collision avoidance and space traffic coordination capabilities” (p.118). These missions directly address national priorities identified in the FY26 President's Budget Request⁷, particularly the strategic focus on space weather and satellite collision avoidance. However, funding to develop these missions is not included in the PBR.

DYNAMIC and GDC observations will address the long-standing and well-recognized observational gap in the low Earth orbit (LEO) and very low Earth orbit (VLEO) region below 300 km altitude, where increasingly crowded space operations require reliable orbital traffic management and space weather forecasting. Both CEDAR and DYNAMIC/GDC seek to understand the response of the LEO and VLEO environment to energy inputs from below (atmospheric waves, tides) and from above (auroral activity, coupling with the magnetosphere, solar irradiance) that change the density that satellites experience on-orbit. This is of vital importance because the space industry can no longer rely on models of the average behavior of the space environment to make accurate predictions of orbital drag. Small errors in drag estimation lead to large uncertainties in predicted satellite paths when an object is moving 17,000 miles per hour. By 2035, there are likely to be well over 100,000 satellites in LEO with a significant number operating below 300 km. By 2035, the US space economy will be worth over \$1T. These new challenges must be faced with new observations that map the density of the thermosphere in real time.

DYNAMIC and GDC complement and extend the science of the CEDAR program and align with the 2024 Decadal Survey's emphasis on system science and societal relevance by filling an observational gap in the LEO and VLEO region and enabling the study of multiscale coupling between neutral and ionized components of the upper atmosphere. Variability in the ionosphere and thermosphere directly affects GPS signal accuracy, which is critical for precision agriculture, cell phone navigation, transpolar

¹ CEDAR is a community of one-to-two thousand US and international scientists. The CEDAR acronym stands for “Coupling, Energetics, and Dynamics of Atmospheric Regions”.

² The GDC acronym stands for “Geospace Dynamics Constellation”. The DYNAMIC acronym stands for “Dynamical Neutral Atmosphere-Ionosphere Coupling”.



Coupling, Energetics, and Dynamics of Atmospheric Regions

airline flight paths, and national defense systems. DYNAMIC and GDC observations will improve the reliability of the radio communication systems, which are widely used during natural disasters, as well as military applications. Improved observations and modeling of upper atmosphere variability will enhance national resilience in navigation, aviation, and communications infrastructure. These observations will serve as input to state-of-the-art space weather forecasting models. As a result, their contributions to orbit prediction, space domain awareness, and space weather predictability will directly support economic growth, national defense, and the long-term usability of the near-Earth space environment. The CEDAR community fully and unequivocally supports DYNAMIC and GDC science and the realization of these missions.

We recognize that NASA must work within the constraints of the federal budget. We also recognize that advancing the DYNAMIC and GDC missions is essential to meeting pressing scientific and strategic priorities. The CEDAR community views DYNAMIC and GDC to be missions of exceptional scientific and strategic value and expresses strong support for their continued advancement. We urge Congress to provide NASA the resources to make these missions a reality. Advancing these missions to launch will affirm hope for a future of scientific advances in the LEO and VLEO regions, help safeguard the American people, and ensure the United States remains globally competitive in space weather prediction.

³National Research Council 2013. Solar and Space Physics: A Science for a Technological Society. Washington, DC: The National Academies Press. <https://doi.org/10.17226/13060>

⁴National Academies of Sciences, Engineering, and Medicine 2020. Progress Toward Implementation of the 2013 Decadal Survey for Solar and Space Physics: A Midterm Assessment. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25668>.

⁵NASA 2021 Space Weather Gap Analysis Report:

https://science.nasa.gov/science-pink/s3fs-public/atoms/files/GapAnalysisReport_full_final.pdf

⁶The Next Decades of Discovery in Solar and Space Physics: Exploring and Safeguarding Humanity's Home in Space (2024):

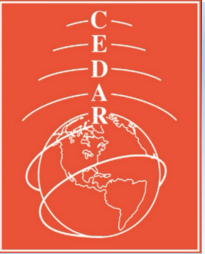
<https://www.nationalacademies.org/our-work/decadal-survey-for-solar-and-space-physics-heliophysics-2024-2033>

⁷FY26 President Budget Request: <https://www.nasa.gov/fy-2026-budget-request/>

Geonhwa Jee, Korea Polar Research Institute, Incheon, Republic of Korea

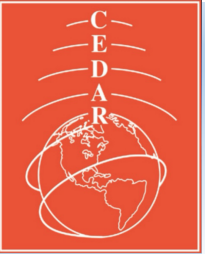
Signatories (Name, Affiliation and/or City & State)

1. V. Lynn Harvey, University of Colorado Boulder, CO
2. Larisa P. Goncharenko, MIT Haystack Observatory, MA
3. Douglas E. Rowland, Rockville, MD
4. Tomoko Matsuo, University of Colorado Boulder, CO
5. Jack Wang, Catholic University of America
6. Xian Lu, Clemson University



Coupling, Energetics, and Dynamics of Atmospheric Regions

7. Anna DeJong, Howard Community College, MD
8. Scott Bailey, Virginia Tech
9. Eframir Franco-Diaz, Computational Physics Inc.
10. Jeffrey P. Thayer, University of Colorado Boulder, CO
11. Aimee Merkel, LASP, University of Colorado Boulder
12. Daniel A. Brandt, MTRI, Michigan Technological University
13. Yue Deng, University of Texas at Arlington
14. Mark Moldwin, University of Michigan
15. Amy Keesee, University of New Hampshire
16. L. Claire Gasque, University of California, Berkeley
17. Katelynn R. Greer, University of Colorado Boulder
18. Quan Gan, University of Colorado Boulder
19. Pavel A. Inchin, Computational Physics, Inc.
20. Jerry D. Lumpe, Computational Physics, Inc.
21. Qingyu Zhu, University of Texas at Dallas
22. Laura Holt, NorthWest Research Associates
23. Larry Paxton, APL
24. Romina Nikoukar, Applied Physics Laboratory, MD
25. Jared Bell, Ellicott City, MD
26. Matthew Young, University of New Hampshire
27. Ramon Lopez, University of Texas at Arlington
28. Hassan Akbari, Catholic University of America
29. Sudha Kapali, Computational Physics, Inc.
30. Rod Heelis, University of Texas at Dallas
31. Chris Pankratz, LASP, University of Colorado, Boulder
32. Lindsay V. Goodwin, New Jersey Institute of Technology
33. Scott L. England, Virginia Tech
34. Larry Lyons, UCLA
35. Nathaniel A. Frissell, The University of Scranton
36. Cheng Sheng, University of Texas at Arlington
37. Cora E. Randall, University of Colorado Boulder (Emerita)
38. Weichao Tu, West Virginia University
39. John W. Meriwether, Center for Solar-Terrestrial Research, New Jersey Institute of Technology
40. Evans H. Callis, University of Alaska Fairbanks
41. Philip J. Erickson, MIT Haystack Observatory, MA
42. Cesar E. Valladares, Boston College, MA
43. Jeffrey M. Forbes, University of Colorado Boulder
44. William E. McClintock, LASP University of Colorado, Boulder



Coupling, Energetics, and Dynamics of Atmospheric Regions

45. Haonan Wu, NSF NCAR HAO, Boulder, CO
46. Chih-Ting Hsu, NSF NCAR High Altitude Observatory, CO
47. Federico Gasperini, Orion Space Solutions
48. Michael Hartinger, Space Science Institute
49. Brian J. Harding, University of California, Berkeley
50. Mark G. Conde, University of Alaska Fairbanks
51. Colin C. Triplett, University of California, Berkeley
52. Zhonghua Xu, Virginia Tech
53. Jens Oberheide, Clemson University, SC
54. Subarna Mondal, Indian Institute of Geomagnetism
55. Xueling Shi, Virginia Tech
56. Michael Liemohn, University of Michigan
57. Brentha Thurairajah, Virginia Tech
58. Steven M. Smith, Boston University
59. Garima Malhotra, University of Colorado Boulder, CO
60. Richard Collins, University of Alaska Fairbanks
61. Stephen R. Kaeppler, Clemson University, SC
62. Ja Soon Shim, USRA
63. Mariangel Fedrizzi, University of Colorado Boulder
64. Zishun Qiao, NSF NCAR High Altitude Observatory, CO
65. Anthony J. Mannucci, Jet Propulsion Laboratory, California Institute of Technology
66. Geoffrey Jenkins, University of Michigan, Ann Arbor, MI
67. Bhagyashree Waghule, University of Colorado Boulder
68. Thomas Berger, University of Colorado Boulder
69. Anton Buynovskiy, University of Colorado Boulder
70. Julia Putt, University of Colorado Boulder
71. Yen-Jung Wu, University of California, Berkeley
72. Weijia Zhan, University of Colorado Boulder
73. Yun-Ju Chen, University of Texas at Dallas
74. Luis Navarro, University of Colorado Boulder, CO
75. Eric Sutton, University of Colorado Boulder, CO
76. Sebastijan Mrak, APL, MD
77. Richard Eastes, University of Colorado Boulder, CO
78. Aidan Thayer, New Jersey Institute of Technology, NJ
79. Astrid Maute, University of Colorado Boulder, CO
80. Thomas Immel, University of California, Berkeley, CA
81. Seebany Datta-Barua, Illinois Institute of Technology, Chicago, IL