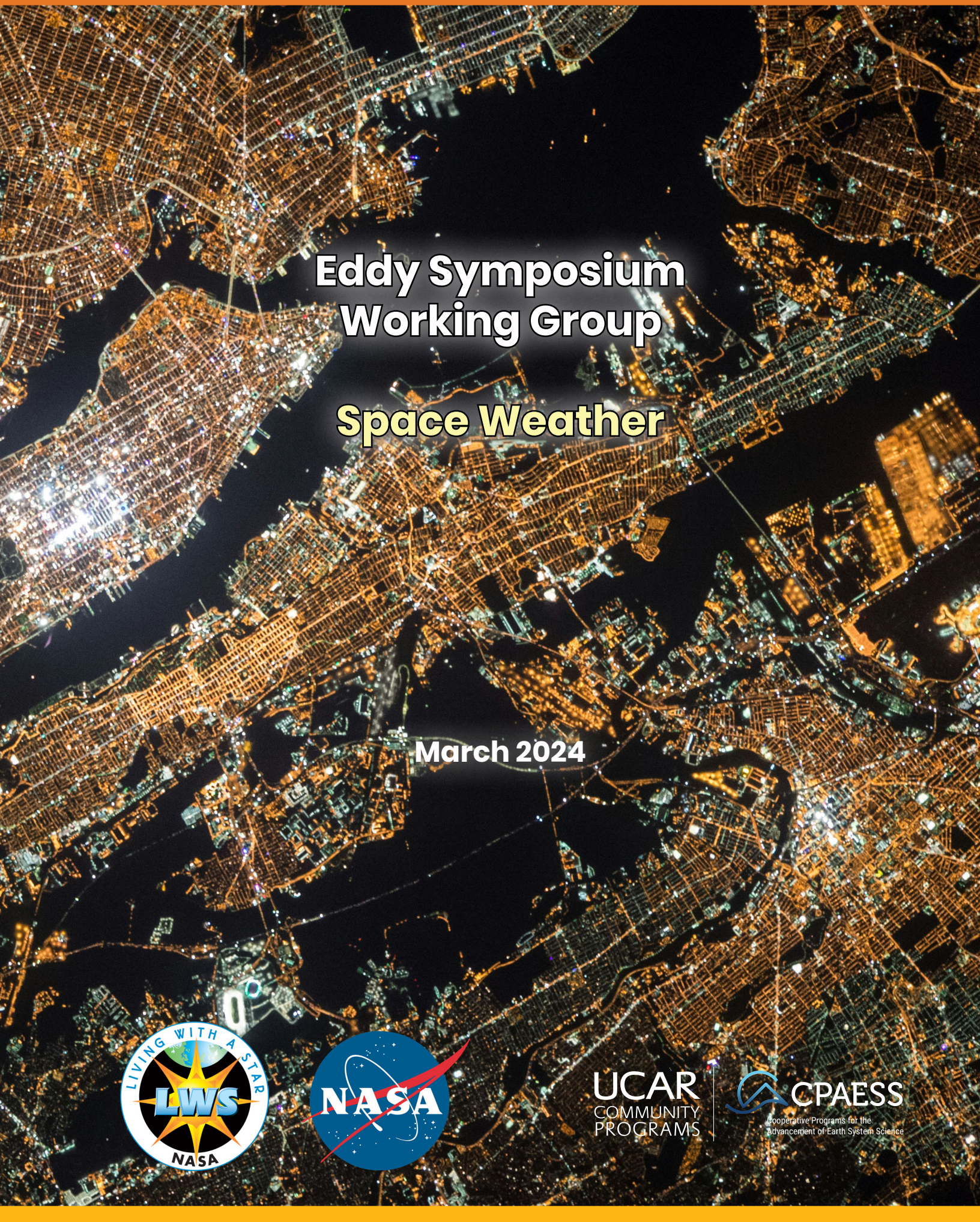

Eddy Symposium Working Group

Space Weather

March 2024

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Space Weather

by Vincent Ledvina and Eddy Space Weather Working Group

Motivation

Open science is the future of Heliophysics. Heliophysics is an inherently trans-disciplinary science that requires cross-field collaborations. In order to solve grand challenges in Heliophysics, we must embrace the concept of open science and make our research methods, results, and discussions open and available to other researchers and the public. The field of Heliophysics currently faces a number of problems that may be addressed by making our science more open. For example, new research is increasingly utilizing “big data” and complex analysis tools, which centralize research to privileged and wealthy institutions. Making these data and tools freely available and easy to use democratizes science, increases connectedness, and accelerates discovery. Furthermore, Heliophysics faces a worsening “pipeline problem” - a decreasing replenishment of the Heliophysics workforce due to a number of factors, one of which is an overall lack of inspiration to join the field. An extension of this phenomenon is the “leaky pipeline” whereby underrepresented and minority populations leave the field at higher rates. Free and open access to science results allows the general public to explore and gain inspiration from space science research.

The Sun shines for everyone. While worthy efforts have been made to describe these problems and propose solutions utilizing open science, mainly U.S.-agency efforts from NASA, NOAA, NSF, etc., have been highlighted. The Sun touches everyone - space weather has global impacts, however, not everyone relates to space weather in the same way - space weather’s effects have regional granularity. Open science also has the potential to reach across borders and connect scientists around the world. Targeted efforts will make science equitable. As such, addressing open science should be done on a global scale but with careful attention to specific areas (e.g., India, Africa, U.S., Brazil, etc.). Solutions should be proposed that carefully address and target specific needs.

Existing efforts need to be elevated. Much commentary on open science focuses mostly on highlighting problems without proposing solutions. The current and future landscape of research analysis tools needs to be surveyed in the context of open science. Emerging technologies like artificial intelligence, machine learning, and augmented reality are underutilized in space physics research. Sharing open science success stories from other science fields will inspire efforts in Heliophysics.

Progress

The first step in the open science revolution is writing about it. To inform agencies around the world of the needs of the Heliophysics community, it is important to raise awareness about specific problems in Heliophysics and share solutions to those challenges using open science. During the 2023 Eddy Symposium, a team of students and researchers gathered to produce a presentation outlining these initial thoughts, which is uploaded on Zenodo, and in 2024, the team is writing the paper, "Bridging Gaps in Space Weather with Open Science for a Resilient Future: A Global Perspective" intended to be published in a peer-reviewed journal.

Next Steps

The power of open science needs to be shared far and wide. The white paper, ideally, will be published by the next Eddy Symposium in 2024. Furthermore, the team will pursue venues to present their sentiments around open science, such as the International Heliophysics Data Environment Alliance (IHDEA) meeting or Software for the NASA Science Mission Directorate Workshop. It is possible the team's ideas surrounding open science, especially those focused on underserved or underrepresented communities, could be presented. This work is unique in that it focuses on global challenges with regional specificity, offering tailored open-science solutions to unique problems. Follow-up papers may expand on facets of open science, such as citizen science, complexity science, or science communication.