

United Nations Office for Outer Space Affairs

UN/Austria Symposium

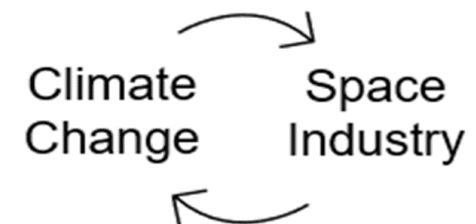
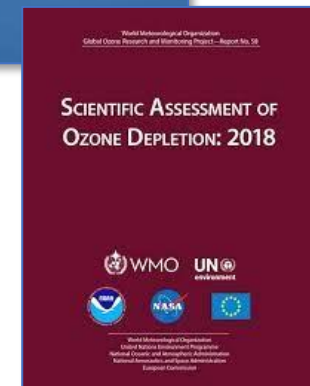


Greening Space Systems Engineering

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Introduction

- The Aerospace Corporation has pioneered research concerning the global impact of space systems since 1990s
- Aerospace guided research on ozone depletion caused by solid rocket motors with innovative data collection programs
- Coauthor/Contributor to UNEP Ozone Assessments
- Encourages communication between the space system engineering, atmospheric science, and relevant policy communities
- Promotes space industry growth and innovation within the context of the growing Climate Crisis



Spaceflight and the Global Atmosphere

- Launch and reentry emissions affect climate and stratospheric ozone
- Spaceflight emissions and their global impacts are complex and not well constrained
- Recent research (NOAA, MIT, ESA) significantly advanced scientific understanding
- An effort to constantly improve spaceflight emissions science benefits the industry and policymakers:
 - anticipate emissions growth and new space technologies
 - better align with faster space system lifetime cycles
 - promote industry/science collaboration
 - reduce uncertainty and the potential for bad regulation
- At some increased level of spaceflight activity (**yet to be defined**) mitigation for climate or ozone protection may be required (**yet to be defined**)



JGR Atmospheres

Research Article | [Token Access](#)

The Climate and Ozone Impacts of Black Carbon Emissions From Global Rocket Launches

Christopher M Maloney [✉](#) Robert W Portmann, Martin N Ross, Karen H Rosenlof

First published: 01 June 2022 | <https://doi.org/10.1029/2021JD036373>

Earth's Future

Research Article | [Open Access](#) | [CC](#) [i](#)

Impact of Rocket Launch and Space Debris Air Pollutant Emissions on Stratospheric Ozone and Global Climate

Robert G. Ryan [✉](#) Eloise A. Marais, Chloe J. Balhatchet, Sebastian D. Eastham

First published: 09 June 2022 | <https://doi.org/10.1029/2021EF002612>

Long-term Challenges to Space Industry Sustainability

- The space industry is an indispensable part of the global economy and provides critical information for humanity to manage climate change
- Interest in the dual impacts of spaceflight on climate and ozone is growing in proportion to the pace of space activity and to the intensity of climate change
- Future stratospheric pollution protection (geoengineering?) must allow for space industry emissions
- Life-Cycle Assessment (LCA) norms must be defined
- Sustainable growth and innovation
- Anticipate the end of low-cost fossil hydrocarbons

