Developing an Air Quality Index for Space Vehicles and Habitats

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Abstract
The development of an adequate tool to help the layperson understand pollution levels in their environment is of high importance. This tool must be able to inform about the levels of pollution in a simple and understandable way but also can be used for decision-making and mitigation activities to protect the health of the exposed population. One of the most useful and up-to-date approaches for characterizing air pollution is the Air Quality Index (AQI). It is an easily-calculated, powerful, data-driven tool that summarizes a complex phenomenon, such as air pollution, in straightforward indicators. The AQI system has been developed in different countries around the world, mainly for outdoor environments, based on the results of risk assessments, epidemiological studies, and current local air pollution regulations and standards. There is a need for such a system in low gravity indoor environments where air quality is of fundamental importance to astronaut health, with concerns encompassing both gaseous contaminants and particulate matter. Earth-based AQIs cannot be extrapolated to microgravity indoor environments due to different aerosol transport characteristics and altered lung deposition in low and partial gravity. The objectives of this work are to explore what areas of expertise, types of research, and data will be required to formulate a spacecraft-specific AQI. An initial dataset is available for this effort, combined from two aerosol sampling experiments, which have characterized airborne particulate matter on the International Space Station (ISS). We outline future research needs for formulating a narrowly focused version of a widely-used metric, namely, an indoor AQI for future space missions.