# HIGH RESOLUTION SATELLITE IMAGING OF NITROGEN DIOXIDE FROM LOW EARTH ORBIT

# CLEAN AIR: HOW POLICY AND DATA CAN ENFORCE HUMAN RIGHTS

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## SOCIOTECHNICAL SYNTHESIS

Modern industrialization and the expansion of urban areas has led to a hazardous increase in air pollution worldwide, seemingly unconstrained by global regulatory bodies. Smaller, cheaper, and customizable satellites allow for unique remote sensing opportunities to monitor the Earth's atmosphere from Low Earth Orbit. The proposed design of a CubeSat equipped with a spectrograph will allow for the detection of anthropogenic nitrogen dioxide at a high spatial resolution, exceeding the capabilities of current spacecraft. Following the experimental data through to its social impact requires an understanding of relational power dynamics in political spaces. Examining air pollution in a wider context questions the effectiveness of policy aimed to restrict emissions and protect the environment and public health. Tracing the outcomes of multiple legislative actions demonstrates the need to view clean air as part of the human right to a safe environment, and the need to prioritize this right above all else.

The development of a novel nitrogen dioxide monitoring satellite will improve upon the existing knowledge of pollutants in dense urban landscapes. By designing for the industry-wide accepted form of a CubeSat, the availability of commercial components facilitates production while retaining flexibility in the specifications for the payload. A collaborative design team has worked over the past two years to advance the mission concept through multiple design phases, resulting in a solar-powered maneuverable spacecraft capable of spectroscopic data collection over nine major urban areas.

The payload has been allocated to half the satellite volume, while electronics comprise one-third, and the attitude adjustment mechanisms complete the remainder of the 3U, or 10 cm x 10 cm x 30 cm, CubeSat. The satellite will have a lifespan of at least one year in orbit, during which it will collect nitrogen dioxide emission data over Beijing, Dakar, Delhi, Denver, Houston,

Los Angeles, New York City, Paris, and Seoul, while frequently communicating with a ground station at the University of Virginia in Charlottesville.

The motivation to study nitrogen dioxide emissions is derived from an awareness of how increasing air pollution poses a threat to both the environment and to public health, which is incomplete without an examination of the mutual impact between data and legislation. Including an ethical component to the analysis of governmental responses to air pollution illuminates the failures to improve living conditions when human rights are ignored or undervalued. A review of scientific journal articles, legislative documents, and personal interviews is employed alongside Actor-Network Theory to investigate how experimental data can support the right to clean air.

Political actions such as the Clean Air Act within the United States of America and the quick mobilization to reduce emissions in the People's Republic of China illustrate the requirement for a comprehensive, rights-based approach when enacting solutions to the issue of air pollution. A true solution cannot be implemented blindly, but requires an iterative approach and open communication between all affected actors, such as environmental scientists, health professionals, political leaders, and the general public. The right to clean air must be recognized by national and international organizations, allowing for complete protection and enforcement of this and other associated rights; with these obligations in place, successful and nondiscriminatory action can be taken to improve the living environment for all.

Facilitating the collection of air pollution data by satellites is only the first step in pursuing environmental justice. However, extensive scientific evidence is crucial to supporting the passage of new regulations, as well as proving their efficacy. With increased collaborations between engineers, scientists, and policy makers, we may hope for a better future of clean air and clear skies.

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