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Challenges and progress in applying space technology in support of the sustainable development goals

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ABSTRACT

The global community, with coordination from the United Nations, is energized to pursue the Sustainable Development Goals (SDGs), a list of 17 important aspirations that summarize the key challenges of our era. The SDGs apply to every nation and represent an international effort to eliminate extreme poverty, ensure access to safe drinking water, strengthen food security, and produce clean and reliable energy, among other pursuits. Space technology is already being used around the world to advance progress toward the SDGs and monitor their related Indicators. This paper explores how six technologies related to space—satellite Earth observation, satellite communication, satellite navigation and positioning, human spaceflight and microgravity research, space technology transfer, and basic scientific research—are being used to realize the vision that the SDGs represent.
6 space technologies we can use to improve life on Earth

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Technologies from Multiple Sectors of Space Can Support the Sustainable Development Goals

- Satellite Earth Observation
- Satellite Positioning & Navigation
- Human Space Flight & Microgravity Research
- Satellite Communication
- Space Technology Transfer
- Fundamental Scientific & Technology Research; Education

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Technologies from Multiple NASA organizations contribute to the Sustainable Development Goals, such as….
We identified 272 examples of NASA projects that are proposed for submission to the Space Solutions Compendium.
NASA Technology Spinoff inputs to the Space Solutions Compendium SDGs feature 9, 13, 11 and 7
NASA research on water filtration for astronauts has been applied in commercially available products.

In the 1960s, Johnson Space Center commissioned an electrolytic silver ion generator to purify water on the Apollo missions. The silver ion-based purifiers never flew on NASA missions, but here on Earth, they’ve given rise to filter systems for home faucets, pools, spas, boilers, hospitals, and more.

Carbon impregnated with silver ions forms the filter bed for most of Puronics’ product lines. Credit: Puronics Water System Inc.
NASA Satellite Earth Observation inputs to the Space Solutions Compendium feature SDGs 11, 13 and 15
Impact Assessment for Applying Satellite Earth Observation Data to SDG15 Monitoring in Ghana

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Space Enabled Research Group at MIT Media Lab¹; NASA Goddard Space Flight Center²; East Carolina University³; Ghana Statistical Service⁴; Ghana Space Science and Technology Institute⁵

The project is supported by the NASA Ecological Conservation Project between 2018 and 2023. The project aimed to assess the impact of a project funded by the NASA Ecological Conservation Program between 2018 and 2023. The project was conducted in response to an invitation by the Ghana Statistical Service and the Ghana Space Science and Technology Institute. The government of Ghana prioritized creating space-based approaches for mapping mining and estimating metrics for Sustainable Development Goal 15's vision: satellite Earth Observation data. PI Wood teamed up with participants from the Massachusetts Institute of Technology, Goddard Space Flight Center, and East Carolina University. The team compiled the baseline data to understand the extent of deforestation due to mining in southwest Ghana between 2007 and 2021, creating national land use maps for 2015 and 2020, and creating an application to estimate those SDG15 indicators based on the Land Use/Land Cover maps.

The project creates an ESRI Desktop application for the Ghana Statistical Service to calculate estimates of the following SDG indicators using an input of any Land Use/Land Cover Map:

- **SDG 15.1.1**: Forest area as a proportion of total land area
- **SDG 15.1.2**: Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type
- **SDG 15.4.1**: Coverage by protected areas of important sites for mountain biodiversity

Designing applications to foster the health of terrestrial and wetland ecosystems in the coastal zone of West Africa (SDG15, Ecosystem Viability 2040)

The project applies the Systems Architecture and EVOT Frameworks to guide the approach for assessment. Systems Architecture is a structured method from Systems Engineering for data collection and analysis to describe and evaluate a system. In this case, the system is the coastal zone of West Africa, and the intentional system is the coastal zone of Ghana. The team uses interviews and administrative documents to collect data about the stakeholders, Needs, Objectives, Functions, and Forces for the system, shaping changes before and after the project. The EVOT Integrated Modeling Framework tracks the technical outputs and results from the EVOT framework to shape changes before and after the project. Using EVOT, the team accounts for evidence related to environmental changes, socioeconomic outcomes, policy decisions, and technology investments.
Earth Science to Action
A new strategy for science & solutions

Vision
A thriving world driven by trusted, actionable Earth science

Objective 1: Knowledge
Holistically observe, monitor and understand the Earth system

Objective 2: Solutions
Deliver trusted information to drive Earth resilience activities
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