Trace Gas Flux and Turbulence

Eddy-Covariance Solutions

INNOVATIVE | RELIABLE | ECONOMICAL

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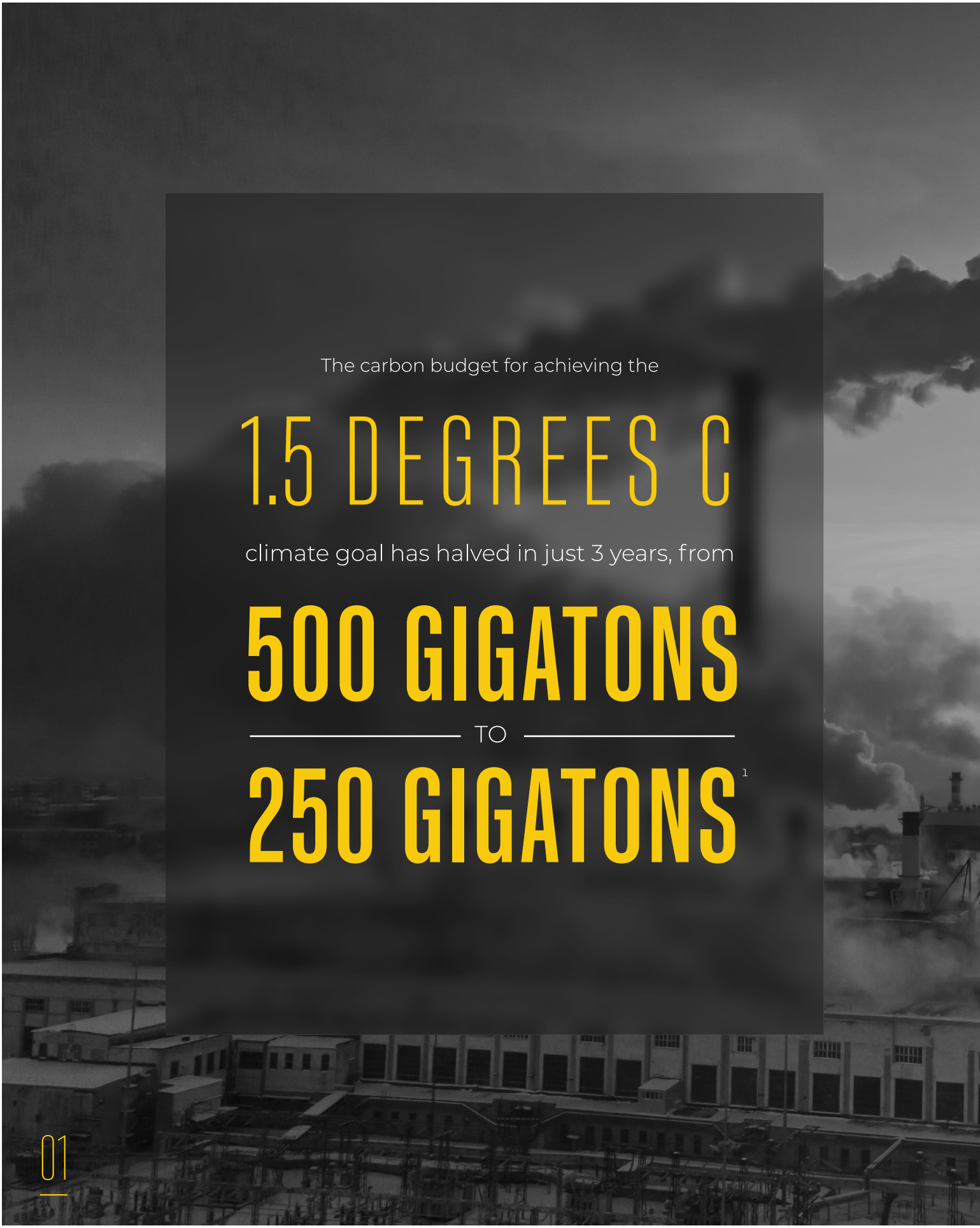


The carbon budget for achieving the

1.5 DEGREES C

climate goal has halved in just 3 years, from

500 GIGATONS

TO

250 GIGATONS[1]

Global Initiatives

The accelerated rate of carbon emissions has led to rapid changes in the atmosphere, cryosphere, biosphere, and oceans. Humankind and the natural world are impacted daily by extreme weather events—to a devastating degree. There are an estimated 3.3–3.6 billion people living in areas highly vulnerable to climate change. However, many of these areas contribute the least to the current climate change.

At Campbell Scientific, we strive to make a difference in your lives, the communities in which you live, and the quality of life you enjoy on this planet. Our innovative solutions for measuring carbon fluxes provide researchers with the critical data needed to inform policy that will ultimately ensure a sustainable future for humankind.

References

1 **Forster, Piers M., Christopher J. Smith, Tristram Walsh, William F. Lamb, Robin Lamboll, Mathias Hauser, Aurélien Ribes et al. "Indicators of Global Climate Change 2022: annual update of large-scale indicators of the state of the climate system and human influence." Earth System Science Data 15, no. 6 (2023): 2295-2327**

Challenges

Human-caused increases in greenhouse gas emissions are accelerating global warming. This is leading to loss of life and property, due in large part to an increase in the frequency and severity of extreme weather. The result is an estimated two million deaths worldwide and economic losses of 4.3 trillion USD between 1970 and 2021, according to data analyzed by the WMO in 2023.[2] The need for accurate climate measurements and robust data is critical to shaping policy that aims to reduce anthropogenic greenhouse gas emissions and slow the rate of global temperature rise.

References

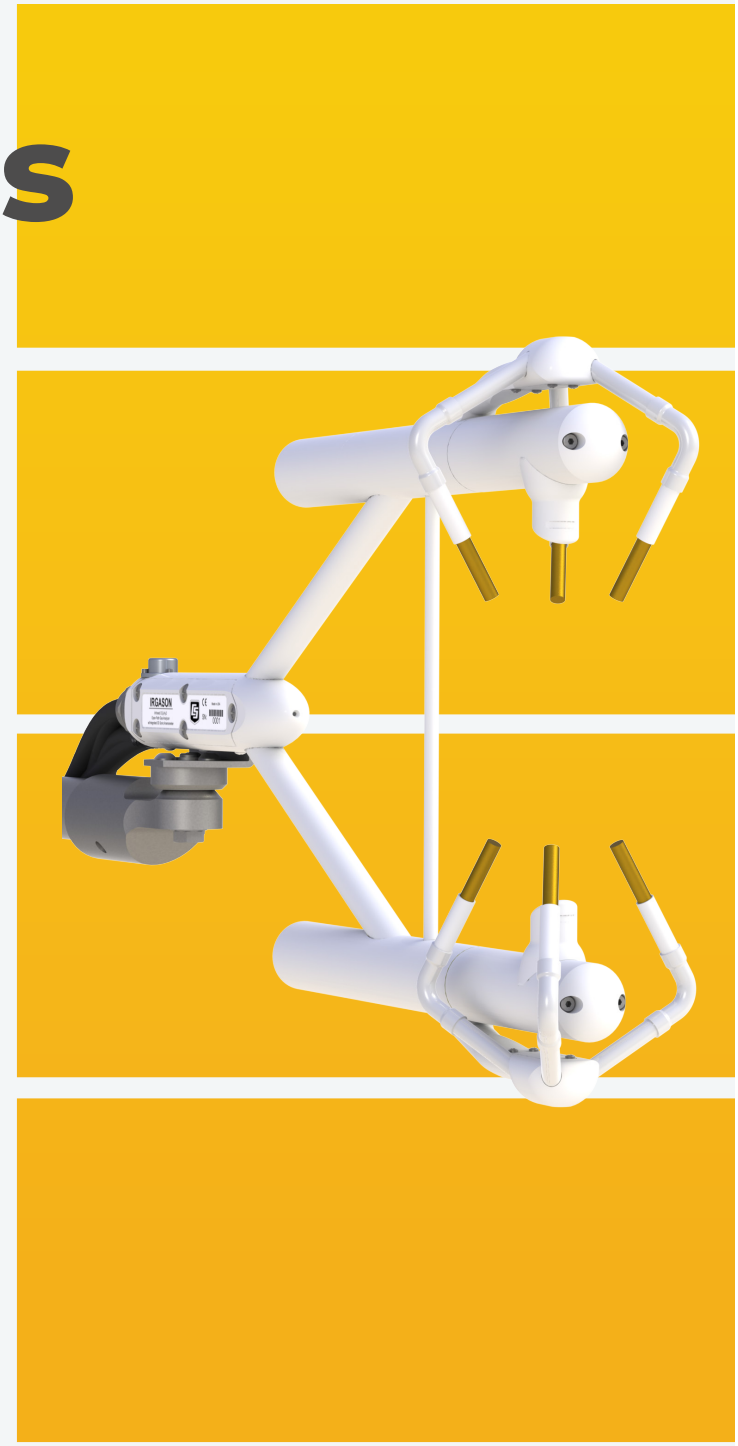
2 Stuart, Lauren, Jürg Luterbacher, Roseline Devillier, Laura Paterson, Kate Solazzo, and Isha Bhasin, eds. "United in Science 2023 Sustainable Development Edition." United in science 2023, 2023. https://library.wmo.int/idurl/4/68235.

Solutions

Campbell Scientific offers gas analyzers and sonic anemometers that accurately measure the amount of carbon dioxide and water vapor exchange between the Earth's surface and the atmosphere using the eddy-covariance technique. These instruments are designed to be low power and robust so that they can be used reliably in remote areas around the world.

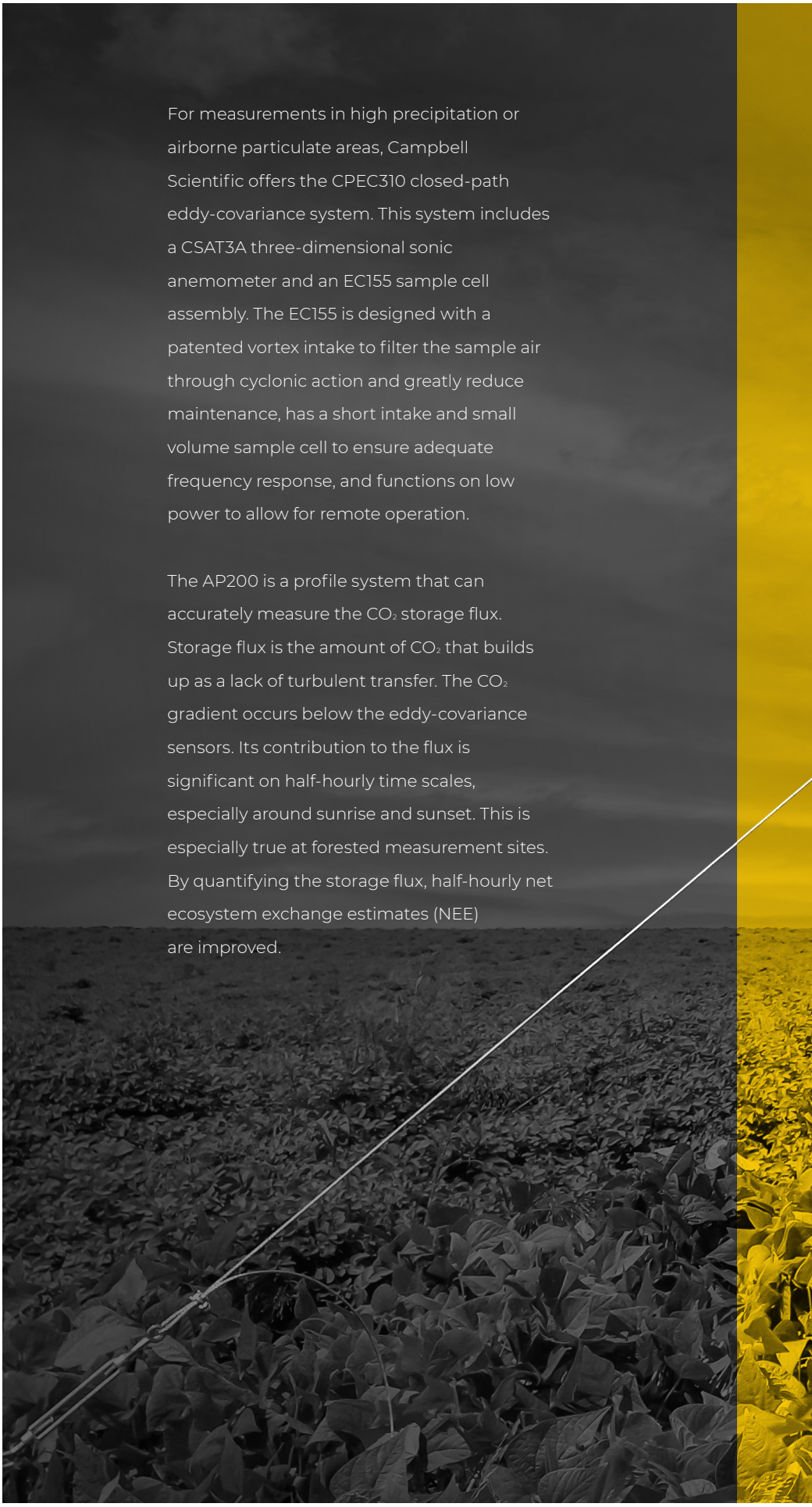
Our flagship IRGASON® fully integrates the open-path gas analyzer and sonic anemometer with an aerodynamic design. This allows for an easier installation while also providing carbon dioxide, water vapor, three-dimensional wind, and sonic temperature co-located measurements.

https://www.campbellsci.com/gas-flux-turbulence

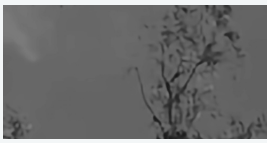


For measurements in high precipitation or airborne particulate areas, Campbell Scientific offers the CPEC310 closed-path eddy-covariance system. This system includes a CSAT3A three-dimensional sonic anemometer and an EC155 sample cell assembly. The EC155 is designed with a patented vortex intake to filter the sample air through cyclonic action and greatly reduce maintenance, has a short intake and small volume sample cell to ensure adequate frequency response, and functions on low power to allow for remote operation.

The AP200 is a profile system that can accurately measure the CO_2 storage flux. Storage flux is the amount of CO_2 that builds up as a lack of turbulent transfer. The CO_2 gradient occurs below the eddy-covariance sensors. Its contribution to the flux is significant on half-hourly time scales, especially around sunrise and sunset. This is especially true at forested measurement sites. By quantifying the storage flux, half-hourly net ecosystem exchange estimates (NEE) are improved.



Case Studies



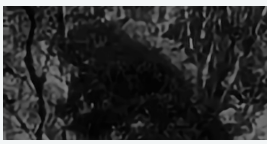
Australia:
Ecological Research

The Warra long-term ecological research (LTER) site located in Southwestern Tasmania was founded in 1995 to monitor long-term ecological health and dynamics within a wet eucalyptus forest. Studies at the site primarily monitor the eco-physiological processes and rates of carbon accumulation and decomposition in the forest; measure the exchanges of carbon dioxide, water vapor, and energy between the forest and the atmosphere using eddy-covariance micrometeorological techniques; and attempt to link eco-physiological processes and rates of carbon accumulation and decomposition with the site biota.

Utah:
Flux Stations

The Utah Geological Survey, supported by the Utah Division of Water Rights, has constructed a network of eddy-covariance stations across Utah to measure evapotranspiration. These stations measure the combined water evaporation from land and water transpiration by plants. Consumptive use—the water absorbed and transpired by plants—contributes significantly to evapotranspiration in vegetated areas, including croplands.

Utah: Flux Station



Australia:
Ecological Research

China:
Flux Cooperation

Qingyuan Forest CERN is a field laboratory directly supported by the Chinese Academy of Sciences (CAS) and is administrated principally by the Institute of Applied Ecology (IAE), CAS. The field of mountain forests in Qingyuan Forest CERN stretch over a heterogeneous landscape that theoretically challenges the techniques of measuring fluxes commonly applicable to homogeneous landscapes. For the three sensor towers, this project integrates the CPEC310 and the AP200 as the main state-of-the-art components. Also chosen were research-grade micrometeorological sensors, nitrate-related trace-gas analyzers durable in various weather conditions, and soil CO_2 flux systems compatible with the CPEC310 and AP200 in system control and data sharing.

https://www.campbellsci.com/case-studies

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Paul Inkenbrandt,
Utah Geological Survey | Utah Flux Network

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As a trusted provider of measurement solutions since 1974, Campbell Scientific has delivered the information that helps mitigate severe weather casualties; aids scientists in gathering data to assist in the understanding of climate change and other human-made environmental impacts; and supports countless organizations, institutions, and national agencies in providing more efficient services to their people. Our instrumentation hardware is known to be the best in the business. Our software services provide an unrivaled level of insight. Our project delivery expertise combines both to deliver a unique end-to-end solution capable of changing the world.

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