Global Challenges in Focus

Innovative Technology in the Water, Sanitation and Hygiene (WASH) Sector

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Introduction

Access to adequate water, sanitation and hygiene (WASH) embodies a fundamental human right recognized by the United Nations General Assembly. The United Nations 2030 Agenda for Sustainable Development reinforces this importance through Sustainable Development Goal 6: “Ensure availability and sustainable management of water and sanitation for all.” Access to safe water and sanitation, and sound management of freshwater resources, are priority challenges that must be met before several other Sustainable Development Goals (SDGs) can be achieved.

As indicated by the name, WASH covers three strongly linked, overlapping subsectors. For example, good sanitation and hygiene are difficult to achieve without adequate and clean water, and poor sanitation affects water quality. Often, challenges, actors, products and solutions act together across these subsectors, creating the rationale for grouping them under the umbrella term of WASH. Major development and humanitarian organizations implement large WASH programs specifically addressing the interconnectedness. Such programs often contain activities related to water supply, toilets and latrines, safe sanitation practices, waste management and disease vector control.

Technology often plays an important role by providing resource-efficient solutions to some of the challenges associated with WASH. This is emphasized in the targets for SDG 6, including support for technologies in areas such as water harvesting, desalination, efficient use, treatment and recycling. WASH innovation focuses mainly on water supply and sanitation, whereas hygiene is considered more a matter of behavioral change (Rush and Marshall, 2015).

This brief focuses on the water supply aspect of WASH and highlights the role of technological innovation in relation to managing limited freshwater resources in situations of scarcity and/or threats to the quality of the water supply. Specifically, it brings in remote sensing as a family of technologies that are increasingly utilized for understanding and managing water resources and warning of potential situations of water scarcity. The brief also looks at water distribution systems and technologies applied to optimize systems and limit water waste and overextraction.

The freshwater challenge

One of the main challenges of access to clean, fresh water is its highly uneven spatial and temporal distribution. The impacts of pollution, waste and poorly managed collection and distribution systems further exacerbate the situation, leading to a major global challenge in which 2.1 billion people lack access to safe drinking water and 4.5 billion people are without safely managed sanitation services (WHO/UNICEF, 2017). Coupled with unsafe hygiene practices, these factors cause an estimated more than 340,000 child deaths annually from diarrhea-related diseases worldwide (WHO, 2015).

It is estimated that 3.6 billion people are living in areas that are potentially water scarce for at least one month of the year, and this number could reach 5.7 billion by 2050 (UN-Water, 2018). Population increase, economic growth and higher living standards (WHO, 2015) continue to increase the demand for fresh water by 64 billion cubic meters each year, a trend that is likely to continue (Worldometer, 2019).

Anticipated and already manifested consequences of climate change are likely to further aggravate fresh water availability by affecting rainfall and mountain glacial melting, which in turn have an impact on river systems. In addition, reserves of fresh water may be polluted through flooding, and the world is likely to see an increased demand for crop irrigation. The water crisis in Cape Town between 2015 and 2018 illustrated how a major city can run out of water, resulting in potential health impacts and economic consequences through an estimated 370,000 job losses in the province (Neille *et al.*, 2017). It also showed how temporary measures can be taken to halve urban water use in a very short time. Several other major cities are likely to face serious water-related problems in the coming years, including Indonesia's capital Jakarta, where the northern coastal part of the city is in imminent danger of inundation by seawater, primarily due to land subsidence, or sinking, caused by excessive groundwater extraction.

Challenges in rural areas are also formidable and frequently exacerbated by competing uses of water. Agricultural irrigation is globally the largest user of fresh water. In rural areas, pollution of surface- and groundwater and the sharing of unsafe water collection points with domestic animals have severe impacts on health and the economy (Barnes *et al.*, 2018; Reddy and Behera, 2006; Schriewer *et al.*, 2015).

Ensuring an adequate, stable supply of clean, fresh water is an increasingly critical challenge. The water management process has several stages, involving replenishing water reserves, managing extraction sustainably, ensuring efficient transport and distribution, and properly treating and disposing of wastewater separate from immediate sources and reservoirs. Technology has an important role to play in all of these stages.

Replenishment of water reserves

Replenishment of water reserves subsequently available for human consumption is a natural process and part of the global water cycle. However, both human activities and natural phenomena may dramatically change the conditions for the replenishment. Understanding how, when and by how much the reserves are being replenished, and preferably predicting this, is increasingly critical to ensuring an adequate water supply.

Early warning systems

Early warning systems involving satellite-borne sensors can monitor and analyze regional seasonal precipitation patterns, and from these streamflow forecasts can be derived. These systems can measure water levels in rivers and lakes, monitor seasonal crop development and warn of potential dramatic shortfalls and crop failures. As this can be done in near real time, the delay between incident and action can be reduced dramatically, which can help water authorities distribute water among users more efficiently (García *et al.*, 2016).

On the horizon: Nanotechnology in water desalination

Water desalination is a family of technologies that are increasingly used to replenish freshwater reserves in areas with severe water scarcity. The technologies are well tested and mature, and innovations and process refinements continue to reduce energy requirements and costs. Some nanotechnologies have the potential to further unleash desalination at scale. Nanomaterial graphene-based membranes could boost the desalination market over the next three to five years by significantly reducing production costs (WEF, 2018).

Satellite observation of rainfall and crop development is considered so reliable that it is used as a basis for compensation payments in index-based insurance schemes in remote areas. If neither rainfall nor the crop is observed to develop according to a predicted pattern baseline, an estimate of corresponding compensation will be paid to the insurance holder, potentially when the need arises. This is a vast improvement from the process of *in situ* rainfall monitoring, sampling of crops, and reporting, which is both expensive and slow. Rainfall-based index insurances are used in several countries by the World Food Programme in its R4 Rural Resilience Initiative (WFP, 2018).

On the horizon: Desert water harvesting

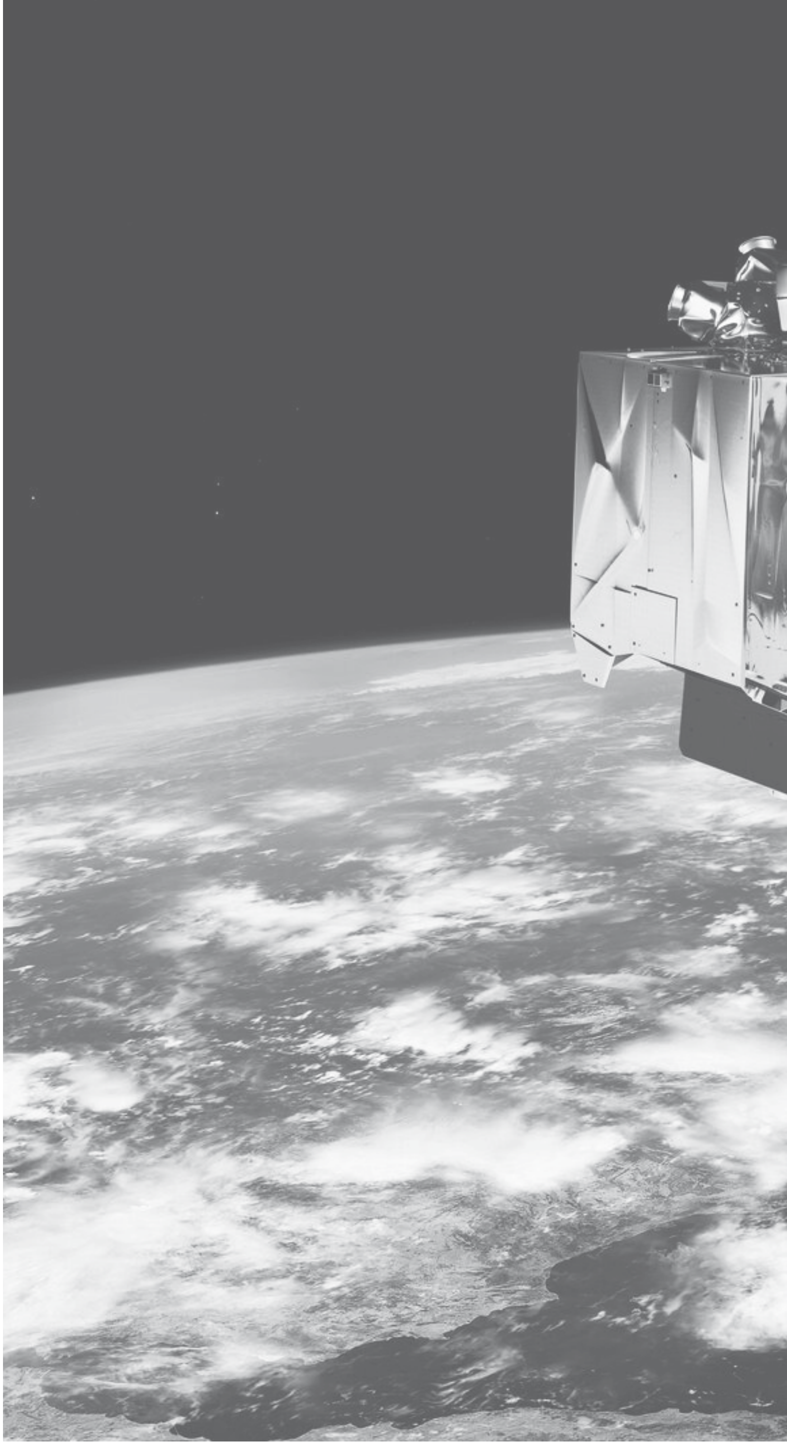
A new device powered by sunlight could help solve water scarcity problems in deserts by harvesting water from the air. The device uses a novel material that can pull large amounts of water into its many pores. A kilogram of the material can capture several liters of water each day in humidity levels as low as 20 percent, typical of arid regions. Massachusetts Institute of Technology (MIT) scientists hope that a version of the technology could eventually supply clean drinking water in some of the driest and poorest parts of the world (WEF, 2018).

Technology can help provide data and part of the solution, but social, behavioral and economic factors must also be taken into account. An example of a technology-based, holistic approach to early warning of water-related security threats is the Water, Peace and Security Partnership that is being piloted in West Africa and the Middle East (IHE Delft, 2019). The system is based on four pillars:

- Improve decision-makers' understanding of the links between water and human security by providing consistent and reliable data, including models based on global data sets, local knowledge and satellite images.
- Mobilize government, community and private sector decision-makers through awareness raising and knowledge building for improved actions.
- Build capacity through learning to help reduce water-related security threats.
- Strengthen the dialogue for conflict resolution through "water diplomacy", mediation, discussion and rule of law.

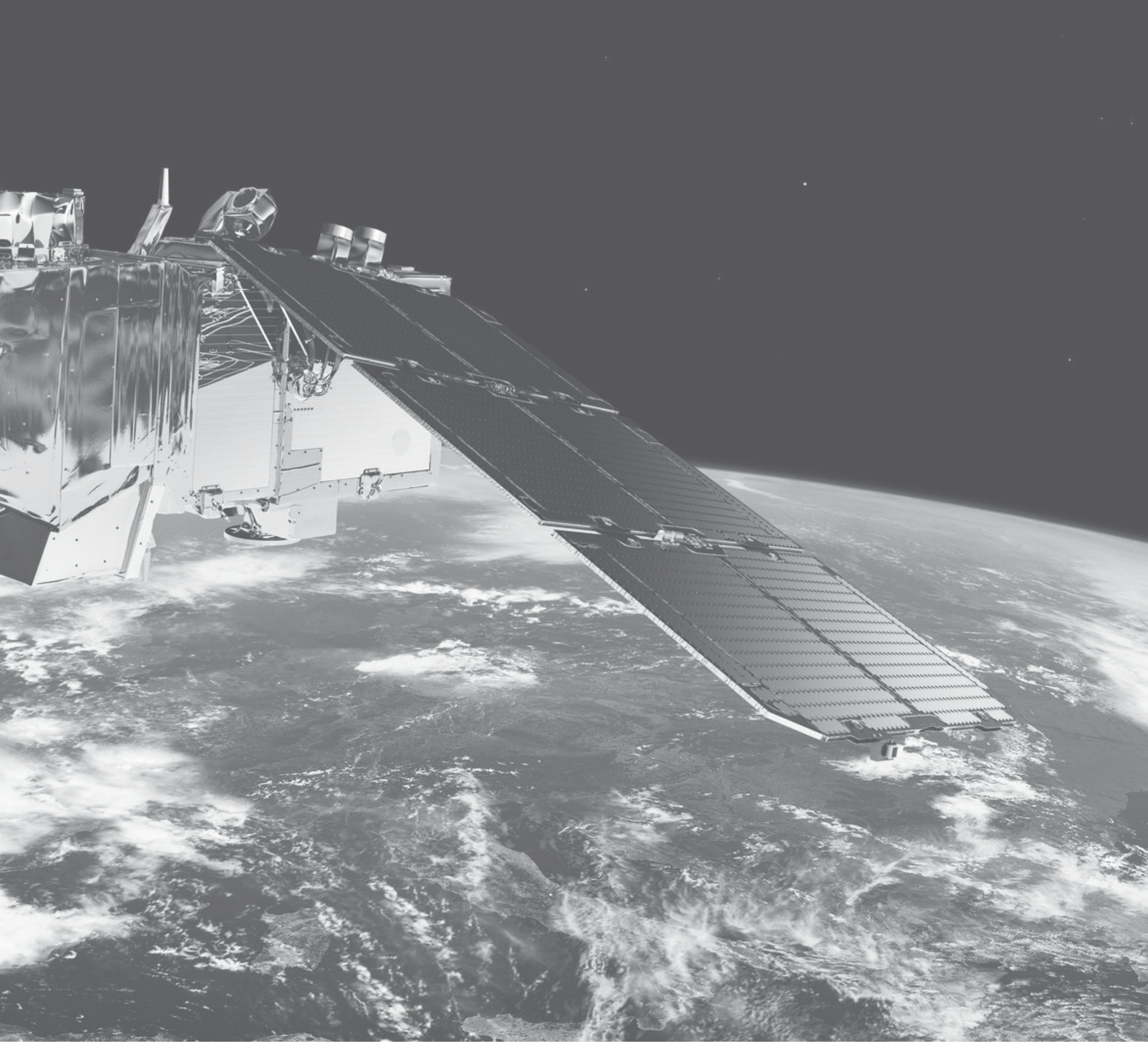
Remote sensing and geographical information system (GIS) technologies

Satellite-based Earth observation is a highly advanced, rapidly developing technological field, with high levels of engagement from the private sector. Of approximately 2,000 satellites orbiting Earth, 768 are Earth observation satellites (Beam, 2019). New satellite constellations are launched regularly, providing new image products with higher spatial resolution, shorter revisit periods, and more advanced sensors. An example is the EU's Sentinel-2 satellite (pictured), fully deployed since 2017. Sentinel-2 is a two-satellite constellation providing images of down to 10-meter resolution with 13 spectral bands and a five-day global revisit period (ESA, 2019). Sentinel-2 is an open-data, public-domain project providing free images, but several private satellite operators offer much higher resolution images in a competitive market.



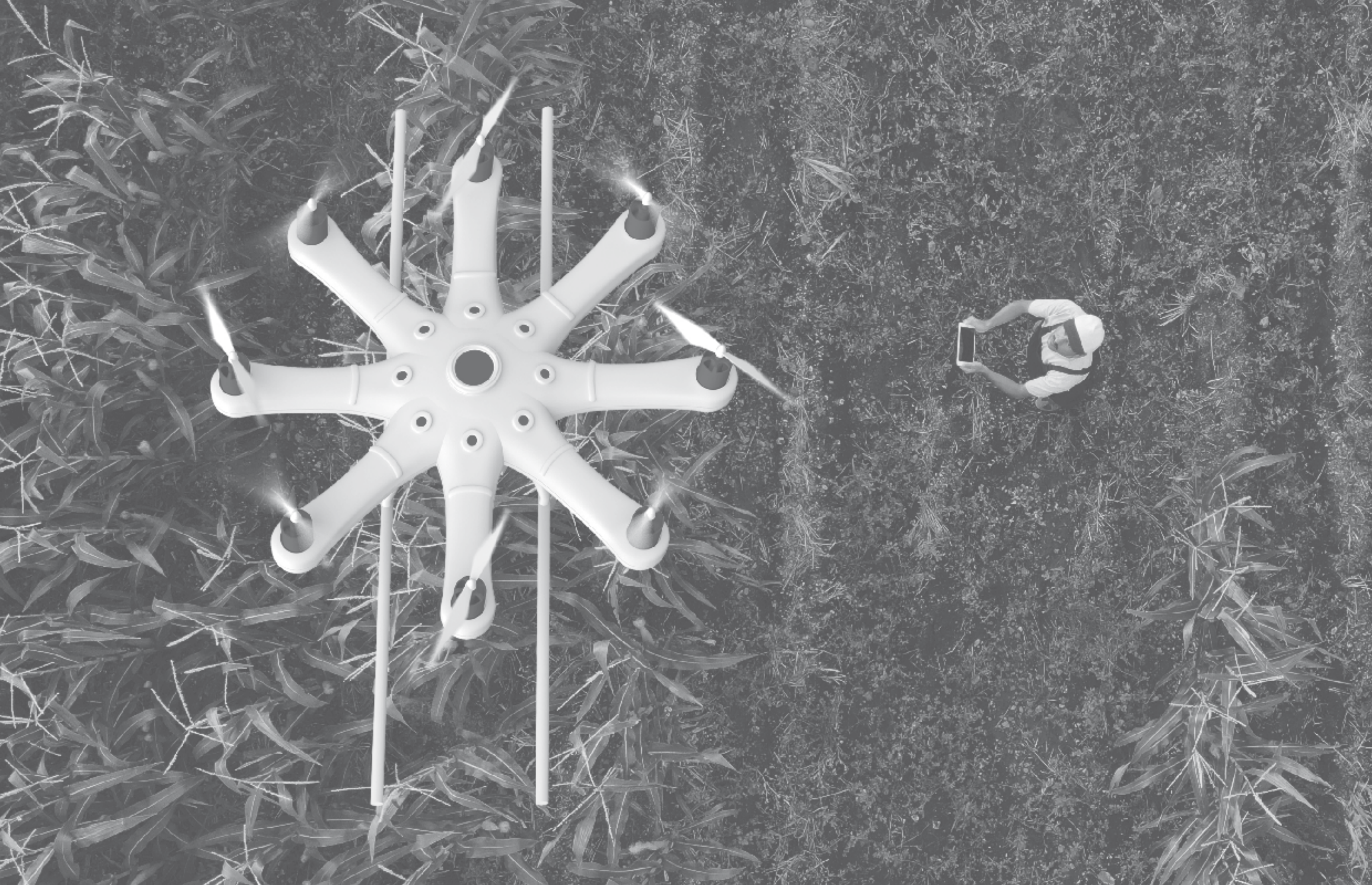
Satellites: Basic principles

Earth observation satellites record landscape elements through advanced imaging instruments, typically recording separate parts of the reflectance light spectrum in five to ten numeric spectral bands. When a large number (hundreds or thousands) of narrow spectral bands are recorded, it is referred to as a hyperspectral image. By combining and manipulating spectral bands, information on specific properties can be optimized and analyzed, for example, red and near-infrared bands for analyzing vegetation growth. This information can be combined with other geospatial data in GIS to further enhance analyses and produce visualizations. The images produced by each spectral band have a fixed resolution, expressed as the length of one pixel in meters on earth. The resolution required depends on the object of study. Most Earth observation satellites operate with resolutions in the range of 30 to 0.5 meters.



A satellite encircles Earth, and changes position above it, in a predefined orbit optimized for its specific purpose. The exception is geostationary satellites, which remain in the same position relative to a location on Earth, but is only possible above the equator at an altitude of 35,786 kilometers. Most satellites therefore only cover a specific location on earth for a short period of time, and with a fixed time interval called the revisit period. An orbit can be defined so that the satellite passes above a target location during daytime with a fixed interval. The sensors are often designed so that they can be programmed to "look sideways" to both sides of the orbital path and thereby cover a larger swathe of terrain in one pass. Earth observation satellites are often operated as a constellation of several satellites, which decreases the time revisit period. This can be crucial for obtaining cloud-free images and for observing fast-changing landscape elements and events. Most Earth observation satellites record reflectance light, but radar-based systems are also common and often used for estimating water resources. InSARs (interferometric synthetic aperture radars) are radar sensors capable of detecting very small deformations on the land surface. A large number of military Earth observation satellites are in operation, but very little public information on these is available.

The Copernicus Sentinel-2 from the Copernicus Programme developed by the European Space Agency (Photo: © ESA/ATG medialab)



Satellite images are able to provide information for an entire water basin and do not depend on local hydro-meteorological monitoring systems or data-sharing agreements.

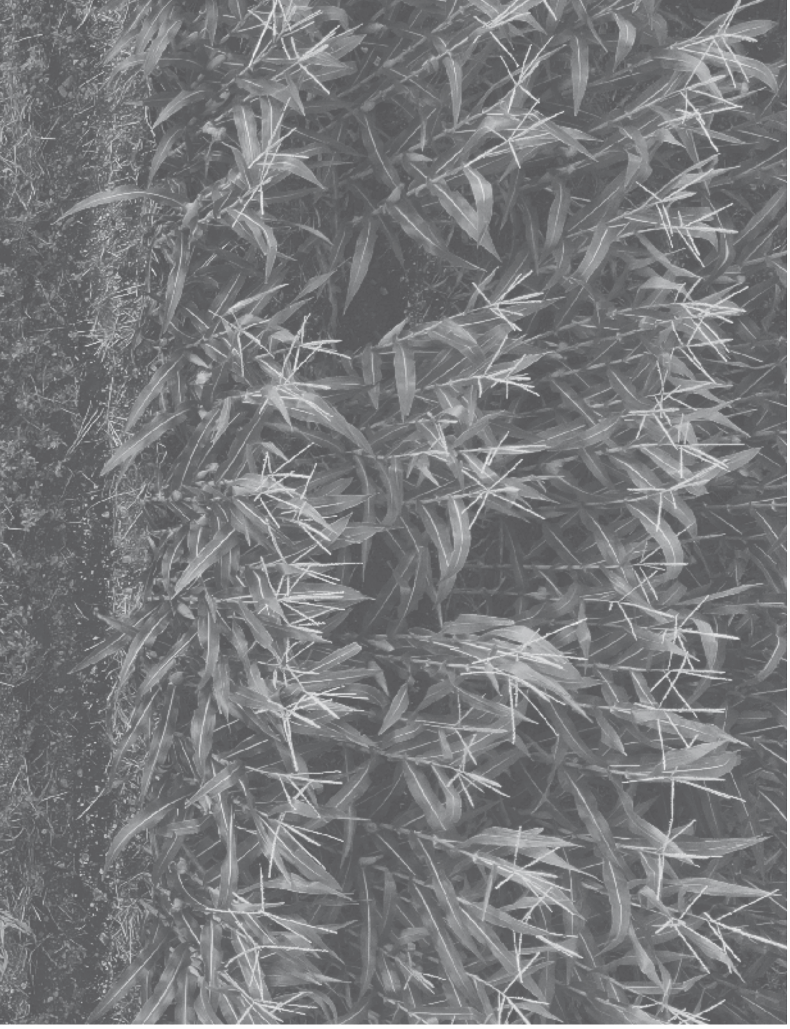
A major limitation with multispectral satellite images is their dependence on cloud-free observation conditions. Sensors on unmanned aerial vehicles (or drones) can provide a cost-effective alternative, especially for point-in-time observation of smaller areas, and are increasingly used for field monitoring, management and evaluation of water resources. Drones may be the optimal solution in inaccessible areas or fragile and conflict-prone contexts. Drones can provide aerial photogrammetry (producing maps from aerial photographs) that ties images to preset data points on the ground (georeferencing), enabling the production of highly detailed 3D images and interactive models. Depending on the spatial extent of the study site, drones can be more versatile than satellite images for collecting local information, for example by focusing high-resolution or specialized sensors on specific landscape features such as potentially polluted reservoirs, lakes and rivers.

In construction projects, drones can help monitor progress by taking high-resolution pictures and videos, replacing costly staff-based inspections. In Kinshasa, Democratic Republic of the Congo, drones are playing a crucial role in a World Bank urban water supply project developing potable water supply systems for a quickly growing urban population. Drones are deployed to plan interventions, supervise complex construction sites and record progress (Boulenger, 2018).

Drones are also increasingly used to provide a variety of soil-monitoring data at a lower cost than satellite imagery. For example, drones equipped with hyperspectral, multispectral or thermal sensors can produce detailed 3D maps allowing farmers to obtain accurate data on soil and crop conditions and thereby optimize the use of water, fertilizer, pesticides and other inputs (PwC, 2016). This information can be linked to fully- or semi-automatic farming machinery capable of applying inputs customized to detailed location-specific needs. An advanced example of the latter is systems in which drones are used to conduct seed spreading and pesticide spraying, directed by detailed maps of field conditions (XAG, 2019).

InSAR images (see 'Satellites: Basic principles' box) are helping to fill data gaps in groundwater management by detailed monitoring of the Earth's surface. InSAR instruments, which can collect data regardless of weather conditions or time of day, are able to determine changes in the Earth's surface elevation within a centimeter's precision. When groundwater is being overextracted, or replenished, InSAR instruments can detect this through changes in surface levels. Such hydrological insight can provide an unprecedented understanding of groundwater usage, helping to address issues of overextraction and capacity assessment (WEF, 2018).

GIS technology is particularly useful for visualizing and analyzing spatial data in relation to water resources. As water resources are affected by physical, environmental and socioeconomic factors, the ability of GIS to combine, overlay, analyze and process highly diverse data sets makes it a versatile tool



Agricultural drone technology
(Photo: Getty Images / © baranozdemir)

for mapping and predicting water resources. GIS can also incorporate satellite images, as well as results from complex hydrological modeling software and monitoring systems, and therefore provides more holistic analyses of water resource management.

For example, in the Lake Victoria region of East Africa, the World Bank has implemented a project to improve the collaborative management of the water basin that straddles Kenya, the United Republic of Tanzania and Uganda. A GIS database and a water resources information system makes basin-monitoring data publicly available, helping to coordinate and improve decision-making regarding shared natural resources (World Bank, 2018). Along the same line of thinking, the International Groundwater Resources Assessment Centre aims to centralize information on global groundwater resources and make this publicly available on an interactive web-based GIS portal (UN-IGRAC, 2019).

Digital Earth Africa is developing a unique continental-scale platform to democratize capacity to process and analyze satellite data. Using the Data Cube technology developed by Geoscience Australia, which calibrates and standardizes large data sets, the platform will track changes across Africa in unprecedented detail, and provide data on a vast number of issues concerning the continent's environmental conditions, including water resources. Digital Earth Africa will translate over 30 years of satellite imagery into information and insights on the changing African landscape and coastline. The Data Cube will turn raw data into actionable data for sustainable development through decision-making products tailored for local needs and challenges. Easily available and understandable environmental data have the potential to enable African governments, non-governmental organizations, businesses, communities and individuals to make more informed decisions about water resources and other environmental issues (GEO, 2018).

On the horizon: cloud seeding

Cloud seeding is a technology with a long history dating back to 1947, when seeding clouds with dry ice caused severe snowfall. In colder climates, silver iodide is commonly used as seed crystals that provoke aggregation of droplets into rainfall. In warmer climates, salt is used. Tests are now also done using drones to alter electrical properties of clouds and thereby provoke rainfall.

While the effectiveness of cloud seeding has been questioned (Bruintjes, 1999), the United Arab Emirates (UAE) is strongly promoting the technology with government research grants. Claiming to be able to increase rainfall by 15 to 35 percent, an arid country like the UAE welcomes a cost-effective supplement to resource-intensive desalination-based freshwater generation (Brown, 2018; Duncan, 2019).

Data-sharing platforms are also crucial in forecasting emergencies and can give real-time or near-real-time alerts for rapid actions. Cloud-to-Street is a remote-sensing platform that maps floods in near real time. The company brings together open-source satellite images, social vulnerability data and hydrological modeling to create an integrated assessment of social and physical risk to floods in urban contexts. Community observations are collected on a web-based platform, and these help to produce rapidly updated flood maps useful for disaster relief as well as longer-term flood aversion planning. The initiative has the potential to reduce access barriers to scientific data and empower vulnerable communities to prepare and respond to disasters. It can also be used to evaluate flood damage and trigger insurance payouts, as well as provide backup to rainfall-based index insurances (Cloud to Street, 2019).

Water distribution

Water from reserves and reservoirs must be transported and distributed to end-users. This process can imply major technical and social challenges, as well as energy consumption and other costs. Non-revenue water – water lost through system leaks or used by customers but not paid for – is a major challenge, especially in large cities with old or complex water networks. Water system leaks in developing countries have been estimated at 45 billion liters of water per day that could have served up to 200 million people (Kingdom *et al.*, 2006). Several technologies are available or are being developed to mitigate some of these challenges, including advanced technologies to optimize water distribution, prevent water pollution and reduce risks to health.

Flooding in the streets of Jakarta, Indonesia
(Photo: WIPO / Oksen)

Blockchain

Blockchain technology can provide cost-efficient security in a variety of electronically based transactions. It uses decentralized digital ledger technology that creates a common digital history, tracking the ownership of assets without requiring a central authority. This allows transactions to be rapidly processed and settled, while reducing the risk of fraud or data mismanagement. By eliminating the need for intermediary service providers such as banks, transaction costs can also be reduced. In relation to water management, blockchain can enable fast and secure peer-to-peer transactions of water rights without the need for a central (water) authority. This is useful when, for instance, a consumer has an unspent surplus of water that another consumer is willing to purchase. Smart contracts consist of code attached to a transaction specifying threshold conditions for a transaction to be implemented. This could be a useful tool in water management, for example by initiating water right transfers based on water levels in a reservoir.

Blockchain technology can therefore improve water management efficiency, and farmers in the same water basin can decide to trade their allocations based on the latest weather data, crop prices, market trends and longer term climate trends – much of which is already accessible from their mobile devices. Such a trading system can make water usage more efficient by enabling peer-to-peer trading, dynamic pricing and optimal demand–supply balancing (PwC, 2018).

A real-world example of such a model is demonstrated by AQUA Rights, a company based in the United States (U.S.) that uses a type of cryptocurrency to trade water rights. A blockchain platform collects data from smart water meters and converts water rights into digital assets, or cryptocurrencies called AQUA tokens, using smart contracts that can be traded securely (Aqua Rights, 2019). An Australian company, Civic Ledger, is developing a blockchain-based water ledger system that operates as a platform using smart contracts and a token system to ensure efficient use and distribution of water and secure water rights for farms. This potentially also creates more liquidity in the water market and increases farmer capital accessibility (Civic Ledger, 2019).

Water loss and sensor-based management systems

Many countries lack data on water quality and services efficiency, especially in rural areas, which makes it difficult to estimate resources and assess delivery. This can be due to a lack of financing for hydro-meteorological agencies, a lack of training and capacity building in data collection and management, safety issues or hard-to-reach measurement locations (García *et al.*, 2016). Therefore, transparent, accessible, reliable, consistent and disaggregated data are needed to ensure that all stakeholders are included in water governance.

The increased use of sensors in water supply infrastructures helps to address some of these challenges. When sensors are connected, for example over the Internet, information can be gathered on accessible, user-friendly platforms, which in turn aids decision-makers to detect disruption and abnormalities in water supply systems.

An example of a connected water sensor system is the Swedish company Aqua-Q's early warning system, Aquatrack. This is an automated detection, warning and sampling system operating continuously in drinking water supply systems, prefiltered lake or source water, or treated wastewater. When sensors detect abnormal microcontaminants (biological and microdebris), a water sample is automatically collected when the anomaly is observed and an alarm is raised. This allows for rapid response to situations of, for example, filter leakage and surface water penetration, and establishes a detailed periodic pollutant profile that can be used to optimize the treatment process. Such a continuous monitoring and warning system can help prevent major public health impacts, especially in fragile water supply systems in developing countries. The system has been implemented only in Sweden so far, but projects in developing countries are foreseen (Aqua-Q, 2019).

The unprecedented connectivity offered by the Internet can be used to track and control networked assets at local, regional and global levels through a single, unified, intuitive platform. For instance, Grundfos, a Danish water pump manufacturer, and Ericsson, a Swedish information technology company, have created an Internet-based ecosystem for improving water infrastructure management by collecting data from millions of connected assets. Ericsson's Internet-based accelerator platform enables Grundfos to collect health and performance data from the network of connected water pumps. This "smart" water network

Water reservoir in Burkina Faso (Photo: WIPO / Oksen)

enables maintenance needs to be predicted and system downtime to be reduced. It also shows how to optimize pressure, flow and delivery of water, thereby reducing water losses (Ericsson, 2019).

Going a step further, Birdz, a subsidiary of French company Veolia, a major water- and resources-management company, is collaborating with Ledger, a French information security and blockchain company, which will equip Birdz water sensors with a Ledger specialized microchip. This will ensure the integrity of water data by signing and encrypting all data before being sent to the cloud and registered in a blockchain, effectively preventing data manipulation and increasing the confidence of water supply monitoring data, a major issue in relation to non-revenue water (Ledger, 2019).

Grundfos has also developed a demand-driven distribution technology, which has been implemented in the village of Prek Pha-Aov in Cambodia. The Takéo Safe Water Supply company had been experiencing a non-revenue water rate of up to 26 percent, high costs for pump maintenance and replacement, and dissatisfied customers in households furthest from the plant, for whom adequate water pressure could not be maintained. After completing a full audit of the water system, including factors such as pressure, flow and energy consumption, the project installed high-efficiency water pumps, control panels and pressure sensors. The sensors measure pressure and flow based on local water consumption, and send this information back to the control panel at the water plant. Over time, the system learns to predict the village's hour-to-hour consumption patterns and adjusts overall system pressure by switching pumps on or off to compensate. After one year, the plant had achieved a 20 percent saving in energy use, 13 percent reduction in non-revenue water from leakage, and 29 percent reduction in pipe bursts (State of Green, 2019).

Another example of applying advanced technologies to water networks is the Indian enterprise Piramal Sarvajal, which provides communities with access to safe water using automated water dispensing units, or "water ATMs". Payment can be by coins or radio-frequency identification subscription cards yielding 10 liters of clean water daily per card. In 2019, over 180 water ATMs served 300,000 people across 12 Indian states. The solar-powered and Internet-connected water ATMs include connected sensors that allow water quality, flow, pressure and leakage, as well as each pay-per-use transaction, to be monitored remotely and ultimately provide data to support the optimization of water distribution (Piramal Sarvajal, 2019). The improved water access allows women and girls, the traditional water collectors, to have more time for other income-generating activities (Andres *et al.*, 2018).

Water leaks can also be detected by satellite images. Utilis, an Israeli water service company, analyses satellite images for evidence of fresh water on the ground and these can, in combination with GIS, identify leaks in water distribution networks. The accurate, rapid and cost-effective detection of leaks saves water, time and labor. This technology has been applied in several European cities, and, most recently, in South Africa (Utilis, 2019). When physical sensors cannot withstand harsh environments or are too expensive, or if abnormalities persist in physical-sensor readings, virtual sensors can be deployed as a low-cost alternative. Virtual sensors employ artificial intelligence that uses deductive reasoning to process information from various machines to determine what a physical sensor output would be, a type of measurement by proxy. The results are transcribed in a real-time configuration that is understandable and accessible for water managers and stakeholders alike.

For example, ClimaCell, a weather technology company based in Israel and the U.S., announced in early 2019 the deployment of a new weather forecast and flood hazard warning system based on virtual sensors. ClimaCell's proprietary meteorological modeling relies on sensor data from millions of connected installations not originally designed for weather observation. These can be cellular network towers, where signal interference is a telltale sign of rain, sensors in cars, mobile phones, or a range of other installations where use and sensor data provide weather-related information. By harnessing this vast number of data, the company claims to be able to provide accurate, fast, updated and highly localized weather information that can be distributed directly to various computer applications. This example illustrates how sensor data from alternative sources can be mobilized and, through the sheer number of independent observations, can compensate for the lower quality of observation data than dedicated, certified weather stations (ClimaCell, 2019).

Water ATMs saves women and girls from having to fetch and carry water long distances every day.
(Photo: Piramal Sarvajal)

Ericsson and the Swedish Meteorological and Hydrological Institute have developed a method for using telephone network microwave data to provide weather information with improved temporal and spatial accuracy. Analyses of microwave signal loss patterns provide real-time maps of rainfall as weather fronts move across the telephone network. Countries that may not have an extensive weather-monitoring network are likely to have a microwave-based telephone network. The first countrywide rollout of Ericsson Weather Data took place in Rwanda in 2018, providing a high level of foresight and early warning during flood events and for crop insurance data (SMHI, 2019).

From the WIPO GREEN database of solutions and technologies
www3.wipo.int/wipogreen-database/

BuntPlanet from Spain offers dynamic monitoring and a decision support system for water utilities to detect and locate water losses and mitigate the effects of climate change. BuntBrain Leakfinder is web-based software that uses flow data to detect leaks and water losses. It combines advanced forecasting mathematical algorithms with big data, cloud computing and hydraulic simulation to reduce the time taken to detect and locate leaks.

The National University of Singapore provides a multiple-channel piezoelectric (material capable of producing electric charge when applying mechanical stress) sensor system for online monitoring of water quality. The system consists of an array of piezoelectric sensors with different types of receptor coatings for multiple water quality parameters covering inorganic, organic and biological contaminants. Water samples are drawn from the water source or piping system and introduced to the flow cell array in which the piezoelectric sensors are mounted. Warnings, alarms and process control commands are displayed on local or remote monitors and sent to prescribed recipients when water quality thresholds are reached.

WaterQuest technology from India is a virtual prospecting program that can locate high-volume, naturally desalinated, self-recharging and self-replenishing perennial water sources globally at depths between 300 and 800 meters. The virtual prospecting program claims high accuracy in finding water using proprietary algorithms that are based on artificial intelligence and pattern recognition, further backed by one of the world's largest curated databases of hydrogeological information including hydrogeological maps, geophysical data from oil or mineral exploration studies, thermal data, gravitational field data, magnetic field data and others.

The technology has already been proven and tested in over 1,200 locations across diverse geographies and water wells drilled in severely drought-prone regions, including Argentina, Chile, France, Israel, Mexico, Niger, Peru, Portugal, Spain, the UAE and Uruguay.

Source: *www3.wipo.int/wipogreen-database/*

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The WIPO Global Challenges Division is responsible for addressing innovation and IP at the nexus of interconnected global issues, with a particular focus on global health, climate change and food security. The Division's activities, including the two multi-stakeholder platforms it administers and trilateral cooperation with the World Health Organization and World Trade Organization, aim to harness the power of innovative partnerships to generate practical solutions for the benefit of all – especially developing countries.

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