Orbital observation

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Remote sensing satellites offer an effective way to monitor and defend mangroves ? vital natural capital that can provide wildlife habitats and protect us from rising sea levels

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Mangroves are small shrubs or trees that typically grow at the boundary between land and water in coastal areas of the tropics, favouring saline and brackish waters. They survive under a range of water oxygen concentrations, temperatures and salinity levels in swampy and muddy environments.

They also offer many natural capital benefits: the trees often grow densely together and have incredibly strong root systems, forming protective barriers against storms that may otherwise destroy the shorelines, intertidal zones or marshes where they grow. Below the waterline, these interwoven roots also serve as safe havens for many species, especially crabs and oysters. Perhaps most importantly, the trees are a critical means of carbon sequestration.

Despite their resilience, however, mangrove forests are like many ecosystems under attack on multiple fronts. Rising sea levels pose serious risks, as do water and air pollution in coastal zones, where the overall environment is put under stress by human development. Even worse, mangroves are being clear-cut in some parts of the world to make way for new ports, energy facilities and beach communities. This unchecked destruction of mangrove habitat threatens many interrelated ecosystems and may diminish natural capital across a broader geographic area, both on- and offshore

However, remote sensing satellites 650km above the Earth can help deal with this critical problem by accurately and efficiently assessing the condition of mangroves and other vital vegetation.

Earth-observing satellites

NASA launched Landsat , the first non-military remote sensing satellite, in 1972, which was able to resolve objects as small as 30m wide. In the decades since then, several commercial companies have put Earth observation satellites into orbit with ever-increasing spatial resolution and more frequent overpasses of the globe; the WorldView satellites operated by US firm DigitalGlobe , for instance, collect imagery with 30cm resolution.

Spatial resolution is important for identifying features on the ground by their physical appearance, size or shape ? roads, buildings and cars are good examples. But the digital sensors aboard today?s sophisticated imaging satellites record far more than the naked eye can see. Most of these devices are multispectral sensors, meaning that they measure reflected energy across the electromagnetic spectrum. The intensity of these returns gives tremendous insight into the ground surfaces and objects from which the energy has been reflected.

Algorithms have been developed to process such multispectral data and classify land use and cover on the Earth?s surface. In other words, the digital data can be used to identify and differentiate a cement car park from a bare field or grass from snow. These algorithms can even tell the difference between the spectral signatures of corn, soy beans, mangroves, evergreens and nearly every other species of tree and vegetation.

Species identification is just the first step: the algorithms are now so powerful that trees and other types of vegetation can also be differentiated by condition or health. Plant stress can often be revealed in satellite imagery long before it becomes visible on the ground. Combine this spectral information with 30cm spatial detail and it?s possible to assess the health of individual trees and small clusters of crops.

Protecting natural capital

A recently completed large-scale mangrove mapping project for Environment Agency ? Abu Dhabi identified mangrove forests and assessed stands, or individual trees where possible, by condition. The project offered a clear understanding of mangroves throughout the emirate that were healthy, compared to those that were under stress.

GIS-based map reports showed precisely where the stressed mangroves were. This allowed teams of scientists on the ground to visit areas of concern, determine the cause of stress and devise a conservation management plan. Where mitigation was not possible, the scientists knew precisely how many hectares were affected so an equal area of new mangroves might be planted elsewhere to offset the loss.

Monitoring change over time is another key benefit of the technology. New imagery of a site in Abu Dhabi was for instance compared with archived multispectral data of the same area to determine the speed at which mangrove health is changing. This gave scientists an idea of how much time they had left to save the stressed trees and prevent healthy ones from a similar fate.

From a natural capital standpoint, satellite imagery gives many stakeholders a way to calculate the value of trees, vegetation and other resources based on precise and unbiased measurements of geographic area and condition. Data derived from satellites can enable a deep understanding of environmental assets, and to some extent their economic value.

In the case of mangroves, this could include the value of fish stocks in the protected intertidal ecosystem, or the value of coastal assets that are protected in storm surges. TCarta has applied this technology successfully around the world for similar mapping and monitoring projects involving numerous species of vegetation on land and in shallow-water coastal environments.

The bottom line is that satellite imagery offers a fast, efficient and cost-effective method for understanding natural capital.

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Further information

- Related competencies include: Management of the natural environment and landscape
- This feature is taken from the RICS Land Journal (March/April 2019)
- Related categories include: Land and resource management