

Mapping Submerged Aquatic Vegetation from Space

Artificial intelligence and high-resolution satellite imagery are game changers for maritime surveying, providing synoptic insight on submerged aquatic vegetation.

Mads Christensen ^A, Lotte Nyborg ^A

A: DHI GRAS

The challenge

Traditionally, monitoring of submerged aquatic vegetation is based on highly detailed diver transects in a limited number of locations repeated every year. While providing a detailed breakdown of species distribution along those transects, the approach is expensive, and it misses large-scale spatial patterns. Furthermore, it is subject to large uncertainty due to the mobility of vegetation between years.

While interpretation of aerial and drone photos provides one means to map and monitor submerged vegetation over larger areas, the photos still do not provide large-scale synoptic overviews covering larger areas.

Access to maps of underwater vegetation covering larger regions and even entire countries provides unique and valuable insights into the marine environment and the dynamics affecting it.

The space-based solution

The Sentinel missions under ESA's Copernicus programme provide a continuous monitoring framework offering high temporal data coverage in high resolution, covering countries and continents on a weekly basis. The Sentinel satellites deliver impactful data that can be used to map and mon-

itor submerged aquatic vegetation covering large areas, and long-term time-series of Sentinel-2 data is an ideal vantage point for assessing spatio-temporal dynamics of underwater vegetation over large areas.

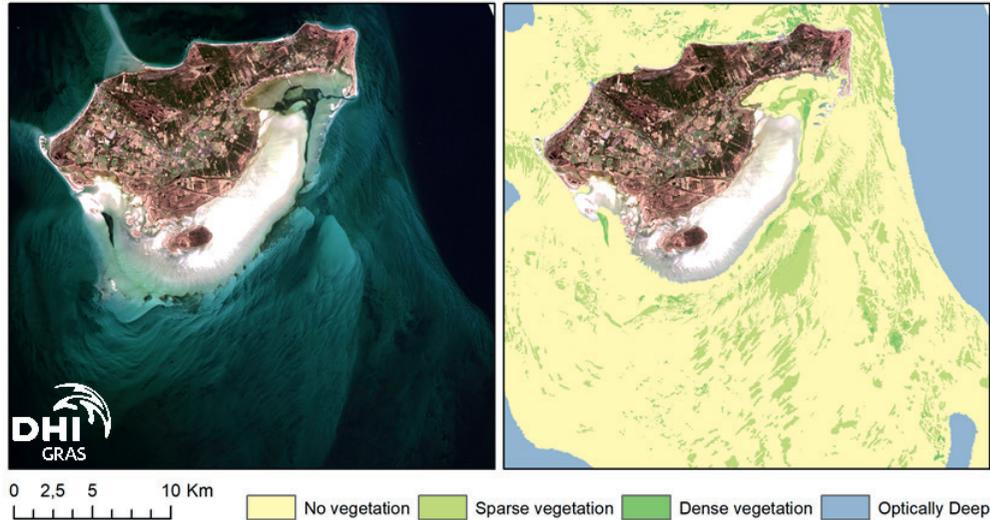
By combining Sentinel-2 satellite data, novel machine-learning techniques and advanced data processing, DHI GRAS has created the first-ever national overview of the spatial distribution of shallow-water submerged aquatic vegetation in Denmark.

” Seabed vegetation is one of the most important marine habitats in coastal water ecosystems. However, the spatial distribution has until now been relatively limited. I expect Sentinel data to be a game changer in the assessment of spatial coverage for future marine management and as input to environmental impact assessments.

Anders Eriksen, DHI

Using hand selected training data points derived from orthophotos and atmospherically corrected Sentinel-2 mosaics covering all Danish territorial

Satellite-derived mapping of submerged aquatic vegetation around the Danish island of Laesoe.



waters, a gradient boosting algorithm was applied to classify underwater vegetation density at national level.

The national mapping provides key insight on the distribution of aquatic vegetation (eelgrass and macroalgae) observed in 2018 and forms an important baseline for evaluation of changes at large to regional scale in the coming years.

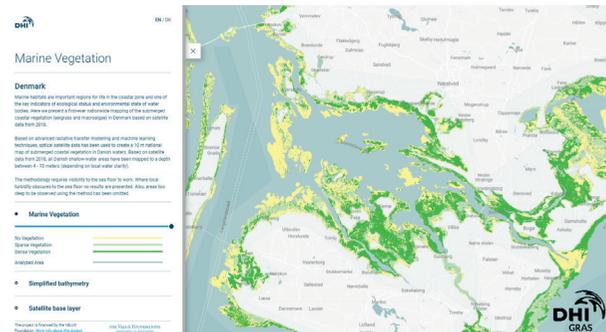
Benefits to citizens

Aquatic vegetation is an overall indicator of ocean and estuary health and a critical component of marine ecosystems, providing important ecosystem services, including habitat for invertebrates and fish.

However, effective environmental impact assessments and marine management policies have been hampered by lacking data and information on the extent and dynamics of aquatic vegetation. Satellite-based solutions to map and monitor the distribution of underwater vegetation dynamics in shallow water areas provide a cost-effective and efficient tool for consistent synoptic monitoring of large areas. By delivering key insight on vegetation status and trends. The mapping provides a critical tool, enabling management authorities and decision-makers to make more effective decisions towards protecting and managing marine environments and resources.

Outlook to the future

The national map of submerged aquatic vegetation in Denmark provides an important baseline on the current status of vegetation density in Danish territorial waters. With an established methodology in place, future efforts will aim to further advance the baseline by making continuous assessments on year-to-year and intra annual variations in vegetation cover at national level. This will provide further insight on vegetation growth rates, seasonality patterns and impact of extreme events and climate change on vegetation health and coverage.



The satellite-derived national level dataset on submerged aquatic vegetation in Denmark <http://satlas.dk/marine-vegetation/dk/>.

Acknowledgements

This activity was made possible by a generous grant from the VELUX Foundation as part of their Environment and Sustainability activities.