Researchers use drones to photograph seaweeds: The tidal zone from a bird's-eye view

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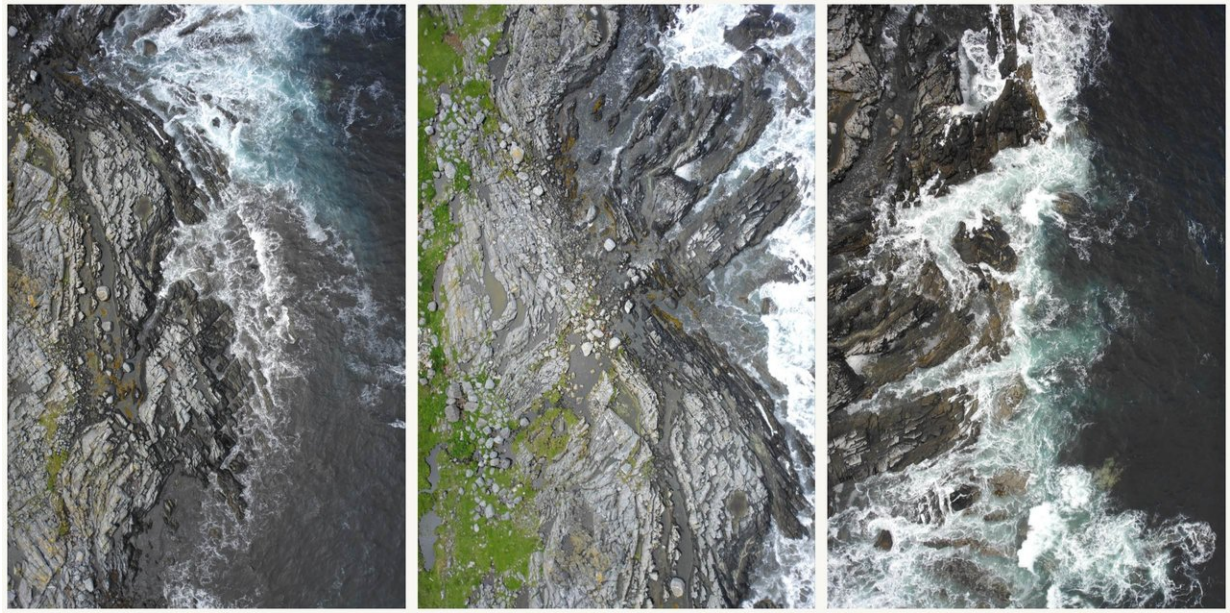

When the drone flies 100 meters above the ground, it takes pictures with a 3 x 3 cm resolution. This is 1,000 times better than a satellite, which takes pictures with a 30 x 30 m resolution. Credit: NIVA

Drones are the future for nature mapping and monitoring. Compared to satellite pictures, drone images provide 1,000 times better image resolution and one million times more data points, says Kasper Hancke, marine biologist at Norwegian Institute for Water Research (NIVA).

It is a surprisingly nice and calm summer day at Søre Sunnmøre, by the outermost islands of Western Norway. While off-piste hippies are still skiing on the very last summer snow further in the fjords, the kayak season has already started out here in a silent bay close to Fosnavåg. But it is not all peaceful. A buzzing noise is heard from above; a massive drone is flying systematically along the shoreline. By the shore, a man is standing with seaweeds to his knees, holding in his arms a rack taller than himself. This is marine biologist Kasper Hancke from the Norwegian Institute for Water Research (NIVA). He is here to photograph a section of nature that most of us usually don't see – the zone between the low and high tide.

– "Usually, when we are mapping the tidal zone, we do the registration manually: Spiral wrack, bladder wrack, knotted wrack, toothed wrack, and so on. But now we try, for the first time, to take pictures from above instead," says Hancke. "When the drone flies 100 meters above the ground, it takes pictures with a 3 x 3 cm resolution. This offers 1,000 times better image resolution, or one million times more data points, than satellite images, which often have a 30 x 30 m resolution."

Hancke is convinced that drones are the future for mapping and monitoring of nature and natural resources.

Machine learning and fingerprints

Later, as the winter storms are approaching Fosnavåg, Hancke is safely back in his office in Oslo. The drone pictures are saved on his computer, and Hancke has started the process of analysing them. The software uses machine learning; it recognizes patterns in the pictures and categorize the different elements. The program can then determine how much seaweed of each type there is in the area depicted. Hancke explains: "Each family of seaweed has its own colour signature, which the software recognizes. This is due to the combination of wavelengths

reflected by the different types of seaweed. Each family gets its own fingerprint, expressed in colours. The software recognizes the seaweed's fingerprint, and thereby categorizes the elements in the picture."

Researchers mapping biodiversity and ecological status in intertidal zones usually apply manual techniques and visual observations. But this time, a NIVA researcher team tested the use of novel drones with high-tech sensors for mapping marine flora and fauna. Credit: NIVA

Identification by colour is called multi-spectral image analysis, which is how the software distinguishes between different groups of seaweeds. Hancke is optimistic about future analysis involving hyperspectral image analysis, which has an even higher resolution of colours. The drone photos can then be used to identify the precise amount of each single

species of seaweeds and mixed kelp forests, and calculate the amount of epiphytes on the seaweed surfaces.

One year ago, Hancke's colleague Trine Bekkby was in Søre Sunnmøre to map the littoral zone for Artsdatabanken (Norwegian Biodiversity Information Centre) and the EU project EfficienSea. She found both toothed wreck, oarweed, sugar kelp, tangle, and red algae. In June this year, she came back and continued the work one level up, in the intertidal zone. She did traditional mapping – with a camera and notebook. As Bekkby had already mapped the distribution of seaweeds in Søre Sunnmøre when Hancke searched for a drone testing site, it made the decision easy. By using her seaweed registrations from Søre Sunnmøre, he can now validate the drone pictures, and improve the machine learning algorithms.

New models for mapping

The mapping project in Søre Sunnmøre has been running since 2016, and is a collaboration between researchers from NIVA, Geological Survey of Norway (NGU), and Institute of Marine Research (HI). The geological and biological data are used to develop a standard method for marine "nature types" mapping according to the classification system of Nature in Norway (NiN).

The ongoing mapping of coastal areas in Søre Sunnmøre is also part of a pilot project, Møre Pilot, under the EU project called EfficienSea. EfficienSea aims to improve the knowledge about where there are vulnerable ecosystems, so that future shipping and building of new constructions can be avoided in the most vulnerable areas.

Using the new, high-resolution seafloor maps from NGU, Bekkby and her colleagues are also working on developing new models to map nature types. Their hope is that they can use NGU's shallow-marine geological

maps together with data on the physical environment, such as temperature, salinity, wave exposure and light to model the different nature types along the coast.

Big potential for drones

Two rooms to the left from Bekkby's office at NIVA, sits Hancke. He pictures a bright future for drone mapping, which will be a lot more efficient and cost-saving than today's mapping methods. Drone mapping also provides continuous observations along the shores, instead of single data points that need to be extrapolated, like now. In the future, Hancke also wants to use drones for taking underwater photos from the air, not only photos of the exposed intertidal. Cameras that are adapted for underwater photos are not yet on the market, but NIVA has developed their own special equipment for this purpose.

"Further, drone pictures can be used to monitor the expansion of introduced species, like the pacific oyster. We are also working towards use of drones for quantification of plastics and marine litter in the coastal oceans and along the shores, and are developing automated image analysis routines," Hancke says.

Provided by Norwegian Institute for Water Research (NIVA)

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