Glitter helps to monitor ocean waves

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Sun glitter reveals elegant features in this image which was captured by Sentinel-2A off Western Australia. Signatures of internal waves, surface-wind wave can be seen clearly, as well as the ghostly pattern of wave–current interactions that appear as darker swirls and eddy structures. The rigid straight line running roughly north–south in the left of the image marks a Sentinel-2A detector boundary and shows a different intensity of Sun glitter. This is because the detector is physically offset from the adjacent detector, introducing a change in geometry. This feature is exploited in Sun-glitter imagery to determine wave spectrum information. Credit: contains modified Copernicus Sentinel data (2016), processed by ESA

The notion of glitter might appear as somewhat frivolous, but scientists are using Sun glitter in images from the Copernicus Sentinel-2 mission to map the motion of the sea surface.

Created by wind blowing across the surface, wave patterns are complex and highly varied. Being able to predict their movement can greatly benefit mariners, port and rig builders, coastal farmers and more.

Since measurements of waves from buoys and ships are limited in numbers and in coverage, satellites provide the answer over the oceans. As well as the well-established use of measurements of roughness from satellite sensors, Sentinel-2's multispectral camera can also have an important role to play in mapping ocean waves.

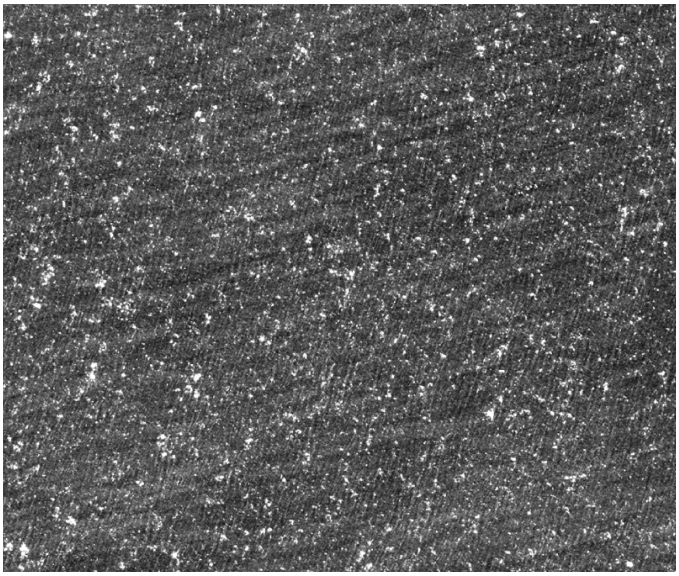
Many images from Sentinel-2 capture the glitter of sunlight that can be turned into wealth of information about the direction, height and movement of waves.

Two papers in AGU Publications describe how a team of scientists developed a method to do just this. Highly scattered light means rough seas, for example.

They used this information to build a series of detailed images of wave patterns off the coast of Dorre Island in Western Australia.

Building on this technique and through ESA's Scientific Assessment of Ocean Glitter project, they were able to map how waves develop in regions where there are strong ocean currents.

Sun glitter seen from the coast at St Mathieu Beacon, Brittany, France in conventional photography. The glitter patterns reveal long swell waves and the shorter wind waves riding above. Credit: M. Yurovskaya



Sun glitter patterns measured by Sentinel-2A in the western Mediterranean Sea in Band. Surface swell waves are seen in a roughly north–south orientation with bright areas showing large breaking waves. The wind was very strong (about 20 m/s) blowing from the west. Dark patches in the image are areas of flows leading to calmer waters and reduced Sun glitter. Credit: contains modified Copernicus Sentinel data (2016), processed by ESA

"We went on to test our method on the Agulhas Current, a historically treacherous current around the southernmost coast of Africa," said Vladimir Kudryavstev from the Russian State Hydrometeorological University's Satellite Oceanography Laboratory.

"Using data collected in January 2016, we traced the behaviour of ocean waves and their interactions with currents.

"We found that ocean surface currents transform dominant surface waves, which are the tallest surface waves in a given area, driven by local wind and large-scale swells.

"They also showed how wave packets can be deflected and trapped by ocean surface currents, creating surface waves that are much higher than normal."

With two Sentinel-2 satellites now in orbit, the amount of data available for using glitter to map ocean waves will soon be doubled.

ESA's Craig Donlon adds, "The development of new approaches to exploit advances in technologies that are now carried on the Sentinel-2 satellites means that we are not only able to gain further scientific knowledge of surface ocean dynamics, but we are also able to develop the next generation of the operational products for Copernicus."

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