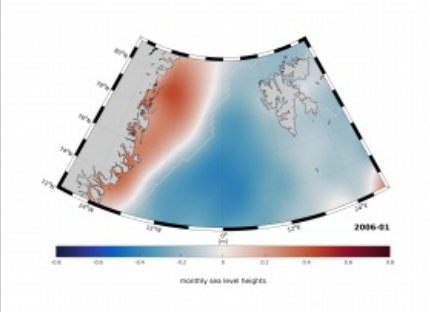
Virtual Contact Lenses for Radar Satellites Improve Sea-level Measurements



Radar satellites supply the data used to map sea levels and ocean currents. However, up until now, the radar's 'eyes' have been blind where the oceans are covered by ice. Researchers at the Technical University of Munich (TUM) have now developed a new analysis method to solve this problem.

The melting of the polar ice cap would have a drastic effect: sea level would rise by several metres around the world, impacting hundreds of millions of people who live close to coasts. This means one of the most important questions of our time is how climate change is affecting the polar regions, explained Dr Marcello Passaro of the TUM German Geodetic Research Institute.

The blind spot of the radar "eye"

But changes in sea level and ocean currents in the ice-covered regions of the Arctic and Antarctic in particular are very difficult to detect. The reason: the radar signals of the altimeter satellites that have been surveying the surfaces of the earth and oceans for more than two decades are reflected by the ice at the poles. This renders the water underneath the ice invisible.

But ocean water also passes through cracks and openings in the permanent ice, reaching the surface. These patches of water are however very small and the signals are highly distorted by the surrounding ice. Here standard evaluation methods like those used for measurements made on the open seas are incapable of returning reliable results. Together with an international team he has now developed a data analysis method which sharpens the focus of the radar's eyes.

An algorithm for all occasions

The core of this virtual "contact lens" is the adaptive algorithm ALES+, (Adaptive Leading Edge Subwaveform). ALES+ automatically identifies the portion of the radar signal which is reflected by water and derives sea level values using this information only.

This makes it possible to precisely measure the altitude of the ocean water which reaches the surface through ice cracks and openings. By comparing several years of measurements, climate researchers and oceanographers can now draw conclusions about changes in sea level and ocean currents.

The special thing about our method is that it is adaptive, Dr Passaro said. It enables to use one and the same algorithm to measure sea level in both open and ice-covered ocean areas. ALES+ can also be used for coastal waters, lakes and rivers. Here the signals are highly varied, but always exhibit certain characteristic properties which the system then learns. The scientists were able to use a test scenario in the Greenland Sea to demonstrate that ALES+ returns water levels for ice-covered and open ocean regions which are significantly more precise than the results of previous evaluation methods.

The ocean east of Greenland is covered by ice all year round (the white line shows the boundary of the oceanic ice). The water underneath is subject to a dynamic seasonal process and is influenced by the currents of the Atlantic ocean.