Revealing an overlooked source for marine cloud nuclei

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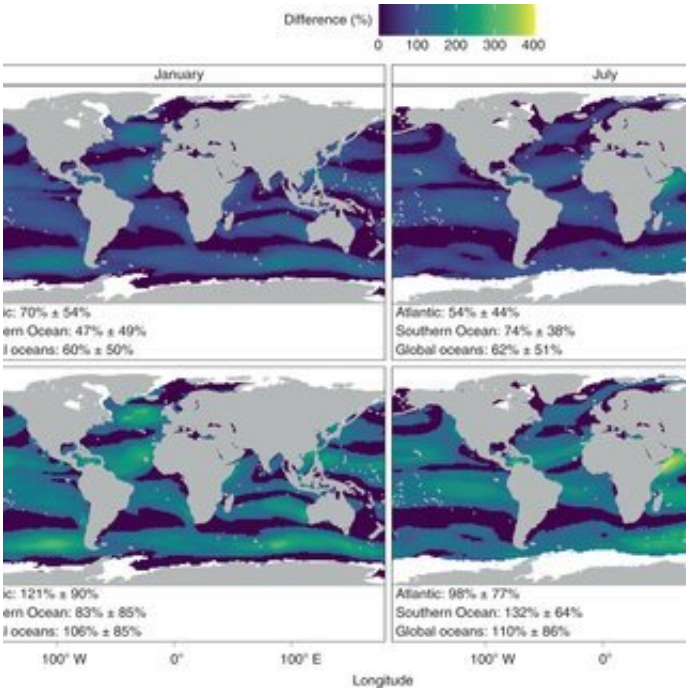

Global estimation of the percentage difference of SSA N_{CCN} using hygroscopicity and free-monomodal parameterization in the global ocean. Credit: *Nature Geoscience* (2022). DOI: 10.1038/s41561-022-00917-2

Sea spray aerosols (SSAs) produced via bubble burst on the interface of atmosphere and ocean, are an important component in the Earth's climate system and constitute a major source of uncertainty in predicting future climate.

The SSA source function is a fundamental input parameter in many global atmospheric transport models. It has been suggested that SSAs contribute a small fraction to cloud condensation nuclei (CCN) in the global ocean, due to the low number concentration of SSAs.

Now, however, a joint research team led by Prof. Huang Rujin from the Institute of Earth Environment of the Chinese Academy of Sciences and Dr. Darius Ceburnis and Prof. Colin O'Dowd from National University of Ireland Galway has found that the contribution of SSA to CCN was largely overlooked on a global scale.

Their findings were published in *Nature Geoscience* on April 7.

In the study, the researchers proposed a new method of deriving SSA number size distribution by using the ultra-high hygroscopicity signature of the sea salt, the major component of SSA over North Atlantic during winter time.

The SSA number size distribution versus meteorological conditions were parameterized based on more than five-year semi-continuous on-line measurement. The newly proposed SSA size-resolved source function used four unconstrained log-normal modes fitting. The relationship between SSA number and wind speed varied for different SSA modes, indicating different bubble-mediated production mechanisms.

Based on the hygroscopicity measurement, the researchers found a large contribution of Aitken mode SSA number, pointing to their potential role in acting as marine CCN. The conventional way to describe SSA number size distribution utilized a very broad lognormal distribution by extrapolating the number size distribution of large particles (larger than 0.5 μm). The mode diameter was constrained to the sea spray laboratory experiments, and the broad distribution aimed to encapsulate multiple unspecified sea spray production mechanisms.

By comparing the two methods, they found that SSA number was underestimated by up to five-fold, depending on the wind speed.

"Our study is the first to elucidate the sub-micron SSA size distribution and its source functions. It reveals the substantial underestimation of SSA number concentration, updates the traditional understanding that SSA was not important to marine CCN, and provides reliable parameterization for air-sea exchange and climate prediction," said Prof. Huang.

More information: Wei Xu et al, Sea spray as an obscured source for marine cloud nuclei, *Nature Geoscience* (2022). DOI: 10.1038/s41561-022-00917-2

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