Melt Ponds on sea ice

Every summer snow on Arctic sea ice melts completely and only ponds of melt water are remaining. These melt ponds consist mostly of fresh water. In wide parts of the Arctic these melt ponds start to form in early June and disappear in September, when the surface freezes again. Depending on the surface roughness of the sea ice, different sizes and shapes of ponds form, most of them with a diameter of a few meters. On young and level sea ice, ponds are often connected to large networks and it is difficult to define where one ends and the next begins. The color of the melt ponds depends on the thickness of the sea ice beneath the pond. If the dark ocean is covered by thick sea ice it is less transparent and thus the water on the ice seems light blue to turquoise. In contrast, melt ponds on thin ice are much darker. Therefore, on thick multi-year sea ice the melt ponds appear turquoise, on thin one-year sea ice dark blue to black.

Arctic sea ice in summer with melt ponds.
Photo: Marcel Nicolaus, AWI

Most important for our work is the amount and distribution of melt ponds on the ice, because this determines the surface energy budget during summer. Our main tool for large scale observations are aerial photographs, while the effects of energy transfer may be quantified through our radiation measurements. In contrast to the white surrounding sea ice, the melt ponds reflect a much lower fraction of the solar radiation. At the same time, much more radiation enters the sea ice and reaches the ocean beneath. This is because the reflecting “surface scattering layer “of snow and deteriorated sea ice is missing, and is replaced by accumulations of melt water.

Light is the main source of energy (as needed for photosynthesis) within and beneath the sea ice. Together with the availability of nutrients, it is the basis of marine life. Therefore, our research questions on melt ponds and their impacts are closely related to the work of our colleagues from polar biology. Together we work on questions like ‘Where and when is sufficient light/radiance available for biological production?’ or ‘What are the physical properties of transmitted light? Is it possible to derive the community compositions from spectral radiation measurements? Furthermore, the radiation transfer in and through the sea ice influences the warming and melting of the ice. A key question is ‘When and where does the sea ice melt and how much?’.

Polarstern during 'TransArc' campaign.
Photo: Marcel Nicolaus, AWI

ROV station on sea ice during TransArc 2011.
Photo: Marcel Nicolaus, AWI