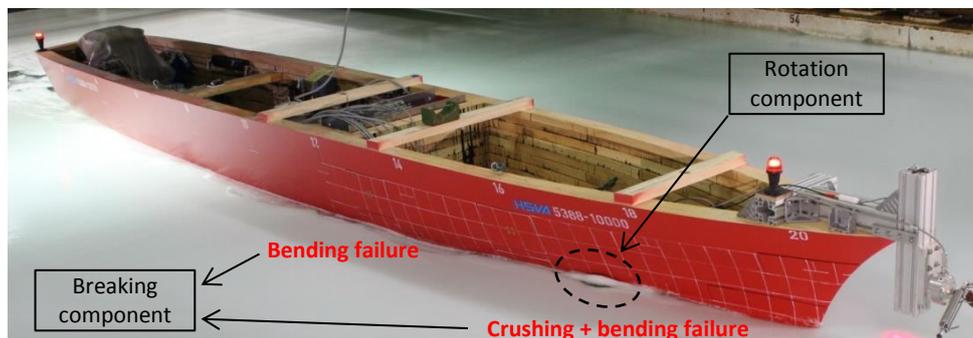


# Investigations on the ice transport around a ship hull and its relation to other resistance components

Context:

For typical icebreaking vessels with low stem and low flare angles the major components of the hull-ice interaction process are quite well understood. Analytical methods exist to predict the average resistance level based on few input parameters related to the hull shape characteristics and the ice properties. For non-typical icebreaking vessels the interaction process includes many additional phenomena like cracking, splitting and crushing, which are difficult to be described by straightforward approaches. The demand for a more profound understanding of ice-interaction with non-icebreaking shaped vessels results from an increasing number of those ships accessing polar waters, such as cruise expedition vessels and government vessels with multiple missions (coast guard, rescue and salvage). Even if the sailing time of those vessels in ice is limited to a few weeks in a year, a detailed assessment of their capabilities in ice is required to meet the performance requirement.

A study to investigate and understand the basic process of sea-ice interaction with ships of open-water or moderate icebreaking shape is currently ongoing at HSVA. The objective is to identify the major process phenomena and to find correlations between parameters, especially those between the hull geometry, ice properties and motion characteristics of a vessel. The study is supported by the Office of Naval Research (ONR) and includes theoretic investigation and physical model tests conducted in the large ice model basin of HSVA.



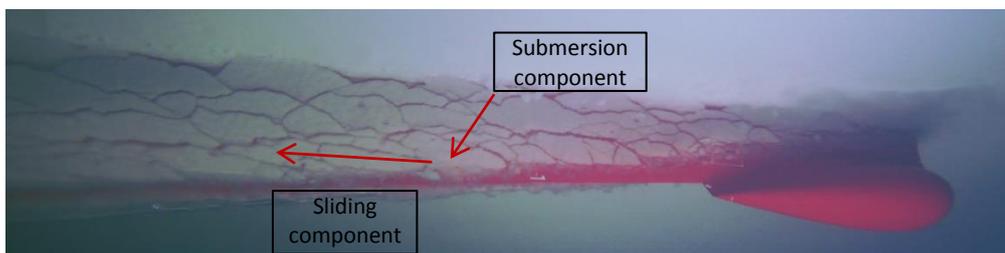
**Figure 1 – Instrumented ship model in level ice; above water view of the ice transport**

Topic:

Within the frame of this study, it is proposed to perform a detailed analysis of the transport of the broken ice under the ship hull and its influence on the ice resistance. The task includes:

- Literature study on ice resistance components and ice transport
- Detailed analysis of model test video footage
- Estimation of the resistance components due to ice transport
- Development of a mathematical model and comparison with model test results

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**Figure 2 – Underwater view of the ice transport under the hull**