

北極海における海水激減メカニズムについての考察

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Mechanisms on Catastrophic Reduction of Arctic Sea Ice Cover

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Abstract

The rate of recent sea ice reduction in the Arctic Ocean exceeds that of global warming. The pattern of sea ice reduction accompanies discontinuous changes. This implies that the Arctic climate system is not only influenced by global warming, but also involves significant positive feedback mechanisms that accelerate the reduction of sea ice. Changes of sea ice area in the Arctic Ocean do not show uniform reductions in both space and time. In the present study, we investigate sea ice reduction in distinct regions and time frames, taking into consideration preconditions for the occurrence of tipping points. The initiation of a positive feedback system is found in strengthening ocean and ice circulations since the late 1990s. The activation of both sea ice and ocean circulation caused ocean warming. This contributed to less formation and growth of sea ice in the Pacific Sector. Consequently, ice reduction actually occurred due to an imbalance between ice melt and formation. The sustaining of strong circulations was a precondition leading to a huge anomalous sea ice reduction in 2007 with a zonal asymmetric distribution. The resultant zonal asymmetry establishes a new atmospheric pattern (dipole pattern) associated with southerly winds in the Pacific sector of the Arctic Ocean. Now, the Arctic climate is governed by a strong coupling system linking ocean, ice, and atmosphere. Multi-disciplinary studies are now required to understand the catastrophic Arctic changes and the fate of the Arctic and global climate.

Key words : Arctic climate system, discontinuous sea ice reduction, activations of ocean and sea ice circulations, positive feedback, precondition

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