季節海氷域化する北極海における海氷－海洋アルベドフィードバック効果の実証

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Evidence for ice-ocean albedo feedback in the Arctic Ocean shifting to a seasonal ice zone

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Sea ice in the Arctic Ocean is a sensitive component of the global climate. Satellite observations reveal the drastic reduction of summer sea ice extent and thus the reduction of a thick multiyear sea ice cover [1]. Associated with such change, “ice-ocean albedo feedback” has received increasing attention as a major factor in sea ice retreat of the Arctic Ocean. This feedback is owing to a gap of surface albedos between “black” open water and “white” sea ice: once sea ice concentration decreases at the beginning of the melt season, heat input into the upper ocean through the increased open water fraction is enhanced, leading to a further decrease in ice concentration through sea ice melt. However, quantitative understanding of heat and sea ice budget in the ice-covered area of Arctic Ocean is still insufficient. Here we have calculated heat budget and sea-ice budget over the Pacific Arctic Ocean using sea ice parameters (e.g., concentration, drift velocity, and mean thickness) derived from satellite observations for 36 years from 1979 to 2014. Results show that the amount of heat input through the open water fraction in the ice-covered area quantitatively corresponds well with the volume of sea ice melt during the melt season (Figure 1). Also, we have found that the ice melt volume significantly correlates with the ice divergence in the earliest stage of melt season (mid-May to early-June), particularly after 2000s. This indicates the enhancement of sea ice melt through the ice-ocean albedo feedback, and it is confirmed by a simplified ice-ocean coupled model [2]. A comparison between sea ice conditions before and after 2000 suggests that a doubled ice divergence in the early melt season associated with the reduction of multiyear ice can explain about 70 % of increased sea ice melt through the ice-ocean albedo feedback [3].

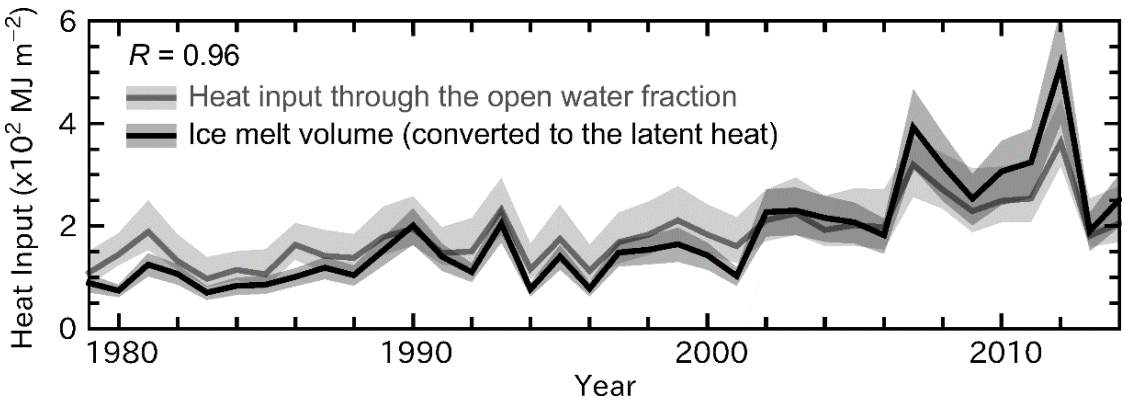

Figure 1. Interannual variations of total heat input into the upper ocean through the open water fraction (gray line) and the sea ice melt volume (black line) over the ice-covered area.

References

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