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Long-lasting impacts of winds on Arctic sea ice through the ocean's memory

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This modelling study reveals that the changes in the ocean state induced by wind perturbations can significantly influence the Arctic sea ice drift, thickness, concentration and deformation rates even after the wind perturbations have been eliminated for years. Wind perturbations can change the Arctic Ocean liquid freshwater content locally or basin-wide, thus changing the sea surface height and ocean surface geostrophic current accordingly. Such changes in the ocean can last for many years, which enforces long-lasting and strong imprint on sea ice. Both the changes in sea surface height gradient force (due to changes in sea surface height) and ocean-ice stress (due to changes in ocean geostrophic velocity) are found to be important in determining the overall impacts on sea ice. Depending on the preceding atmospheric mode driving the ocean, the ocean's memory of wind forcing can lead to changes in Arctic sea ice characteristics with very different spatial patterns. We identified these spatial patterns associated with Arctic Oscillation, Arctic Dipole Anomaly and Beaufort High modes through dedicated numerical simulations in this study. Our results suggest the importance of initial ocean state in sea ice prediction on subseasonal to decadal time scales.