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Title: *Dynamic and thermodynamic barrier effects of the Arctic upper halocline*

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On the ice covered ocean, the friction stress of sea ice, not wind stress, acts at the sea surface. The motion of sea ice “drags” the sea water and produces an Ekman layer just under sea ice with the action of Coriolis force. The Ekman layer is quite similar with that of open water driven by wind. However, in summer Arctic, there is a thin layer with ice melt water under sea ice with the salinity 20-28 and the thickness about 5-20 m. Under the fresher layer there is a halocline (also a pygnocline), in which the density increases abruptly. Based on the turbulence algorithm of Pacanowski and Philander (1981), the vertical turbulent friction coefficient weakens obviously at the pygnocline. With this effect, the friction stress of sea ice can transfer little down across the pygnocline, which is called the barrier layer. In this study, field observation data in central Arctic for profiles of temperature, salinity and current in 2010 summer is analyzed to identify the momentum transferring and solar heating. It is verified that the barrier layer has two main functions to the vertical water structure. One is that the Ekman layer becomes thinner and terminates at the pygnocline, with which the more kinetic energy is absorbed by the fresh layer and produces a more uniform mixed layer. The other is that the heat induced by solar radiation under the barrier layer cannot be transferred upward through the barrier layer either, and the accumulated heat there produces the Near Surface Temperature Maximum just under the pygnocline. The dynamic and thermodynamic effects greatly influence the ice melting in summer and the ice formation in autumn.