The Study on Near Surface Temperature Maximum in the Canada Basin for 2003-2008 in Response to Sea Ice Variations

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ABSTRACT

The vertical properties and the space-time variations of the upper water mass in the Canada Basin are investigated using CTD data collected from 2003 to 2008. In most areas there were four temperature maximum waters in the Canada Basin in summer which named North Atlantic Intermediate Water (NAIW), Alaskan Coastal Water (ACW), summer Bering Sea Water (sBSW) and Near Surface Temperature Maximum (NSTM). The temperature of the NSTM was higher than the freezing point and lower than ACW except in ice-free area where the maximum temperature might reach 2°C. In this paper, the vertical structures of temperature show that the maxima of NSTM in 2007 were higher, while the salinity, density and depth of NSTM were lower than that in other years. The observations suggest the following ice-ocean processes are occurring. The melting ice water reduced the salinity and density of the mixed layer water when the sea ice melts earlier in summer. The solar radiation heated the water more with lower sea ice concentration and ice extent. At the same time the intensification of air-sea heat exchange might accelerate the upward heat flux and reduce the net downwards heat transport, which led to the depth of temperature peak of NSTM deeper than before. In Canada Abyssal Plain, the NSTM occurred nearly every year but in 2003. In 2008, the NSTM for the first time occurred in the north of 80°N. The reduction of the Arctic sea ice could increase and enhance the NSTM occurrence.

KEY WORDS: Arctic; Canada Basin; Sea ice; Near Surface Temperature Maximum

1. INTRODUCTION

The properties of the shallow temperature maximum waters (STMs) in the Canada Basin were discussed by Shimada et al. (2001), and three distinct varieties of STMs were recognized on the basis of the salinity range: Surface Mixed Layer Water (SMLW) with S < 30 psu; Eastern Chukchi Summer Water (ECSW) with 31 < S < 32 psu; and Western Chukchi Summer Water (WCSW) dominated the eastern Chukchi Borderland (that is WCSW), sBSW dominated the temperature maximum (Steele et al., 2004). This decrease of sea ice cover has led to an increase in the annual amount of solar energy absorbed in the upper ocean. The Chukchi and southwestern Beaufort seas have experienced the greatest increase in absorbed solar radiation (Perovich et al., 2007).

Perovich et al., 2010) named the temperature maximum as the Near Surface Temperature Maximum (NSTM) and systematically studied its spatial structure and temporal variation. Under the influence of global warming, the Arctic is experiencing rapid change. The sea ice cover has declined at a rate of -11% per decade from 1979-2007 and the sea ice extent observed in September 2007 was 37% less than the climatological average for the same period (Comiso et al., 2008). This decrease of sea ice cover has led to an increase in the annual amount of solar energy absorbed in the upper ocean. The Chukchi and southwestern Beaufort seas have experienced the greatest increase in absorbed solar radiation (Perovich et al., 2007).

In this study, the CTD data in Canada Basin observed during 2003-2008 are collected to study the NSTM phenomenon and the relationship with the sea ice. The CTD data were issued by the Joint West Arctic Climate Study (JWACS) and the Beaufort Gyre Exploration Project (BGEP). The dates the data obtained at are all in summer (July-September). The sea ice concentration is collected from the group of Physical Analysis of Remote Sensing images (PHAROS) of Bremen University using AMSR-E daily sea ice concentration product with the resolution of 6.25 kilometers from 2003 to 2008.