A study of the sub-surface warm water and its physical mechanism in the Canada Basin

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Ocean University of China

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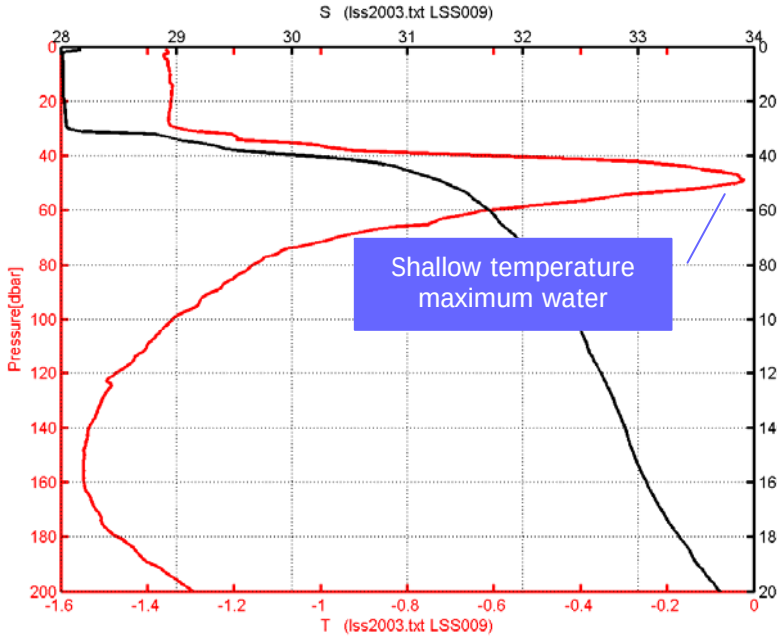
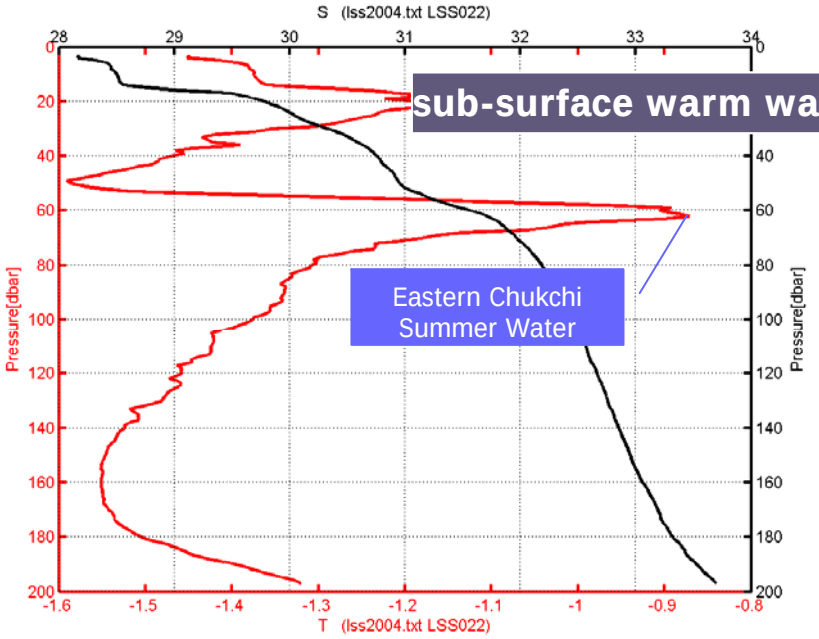
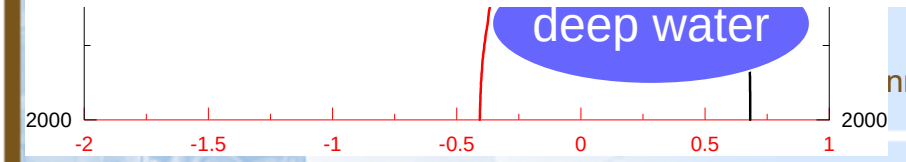
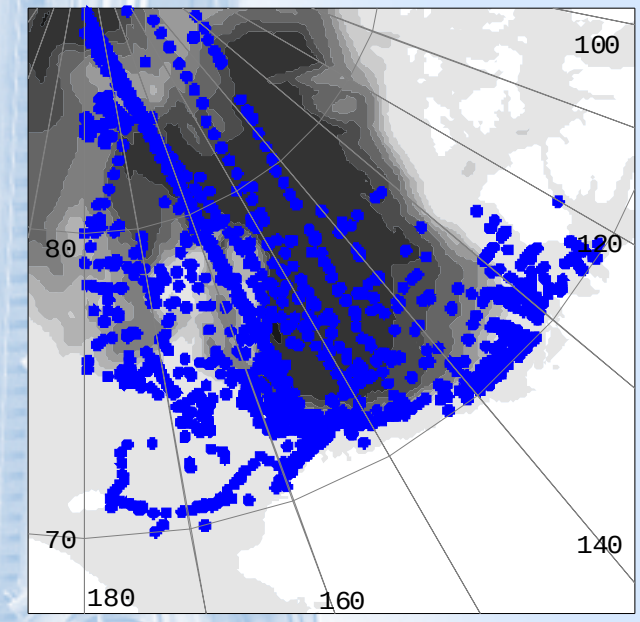
Vertical Structure of the Sub-Surface Warm Water (SSWW)

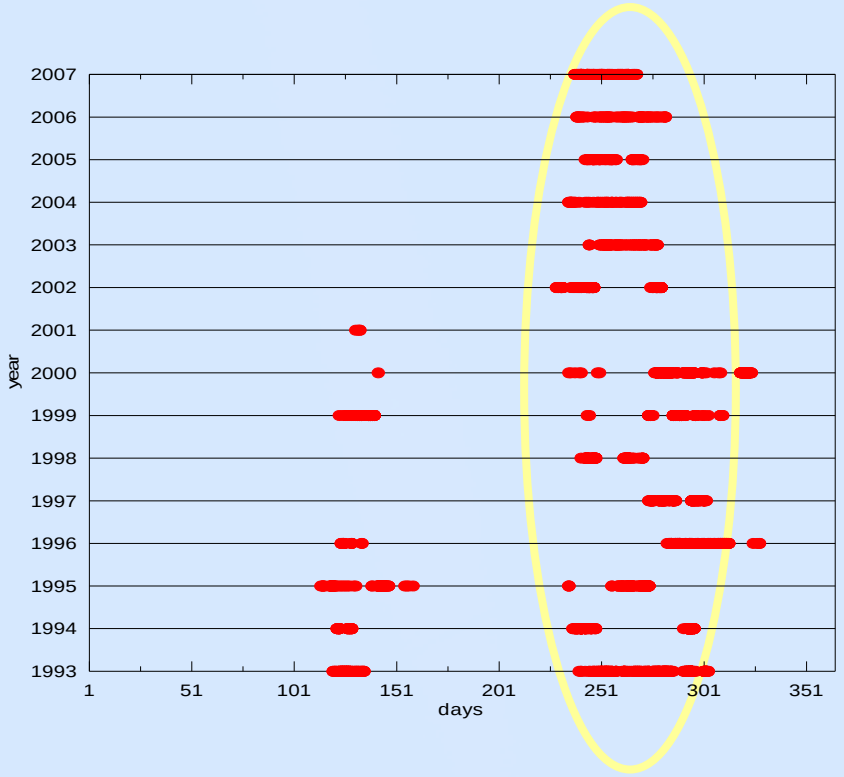




sub-surface warm water

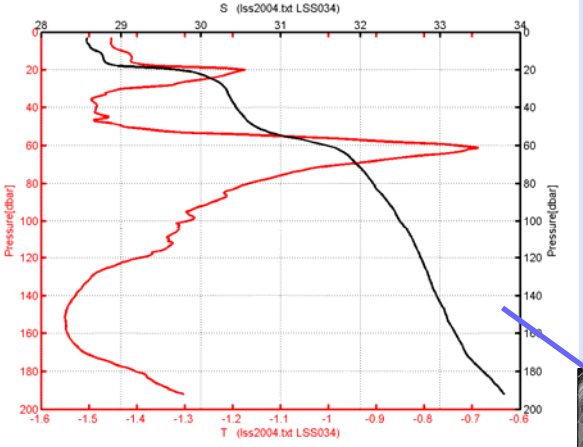




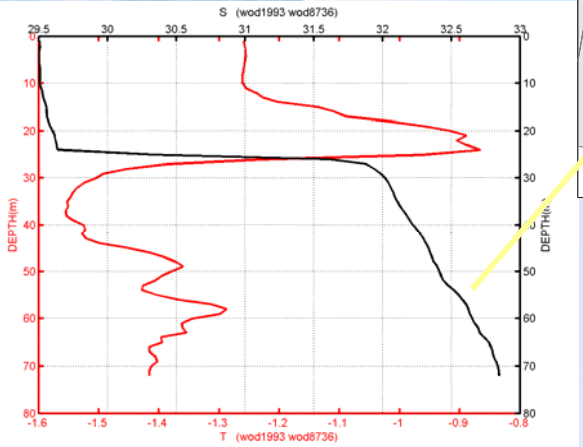


Location and time distribution of CTD data

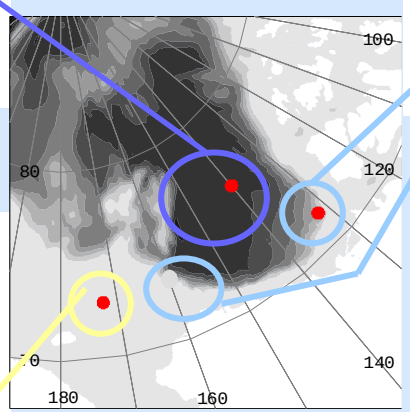
(1882 CTD data used to determine the SSWW from 1993 to 2007)

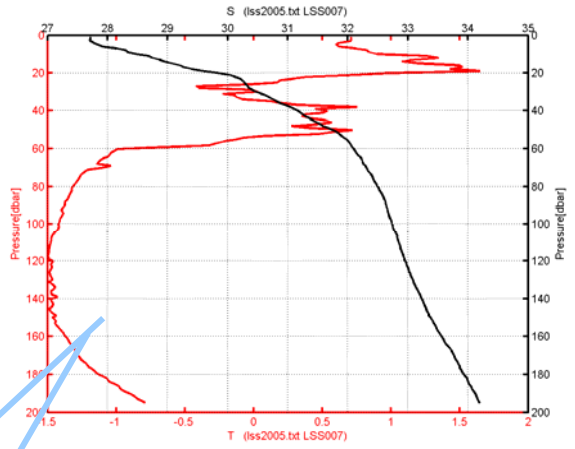


The SSWW in ice covered area



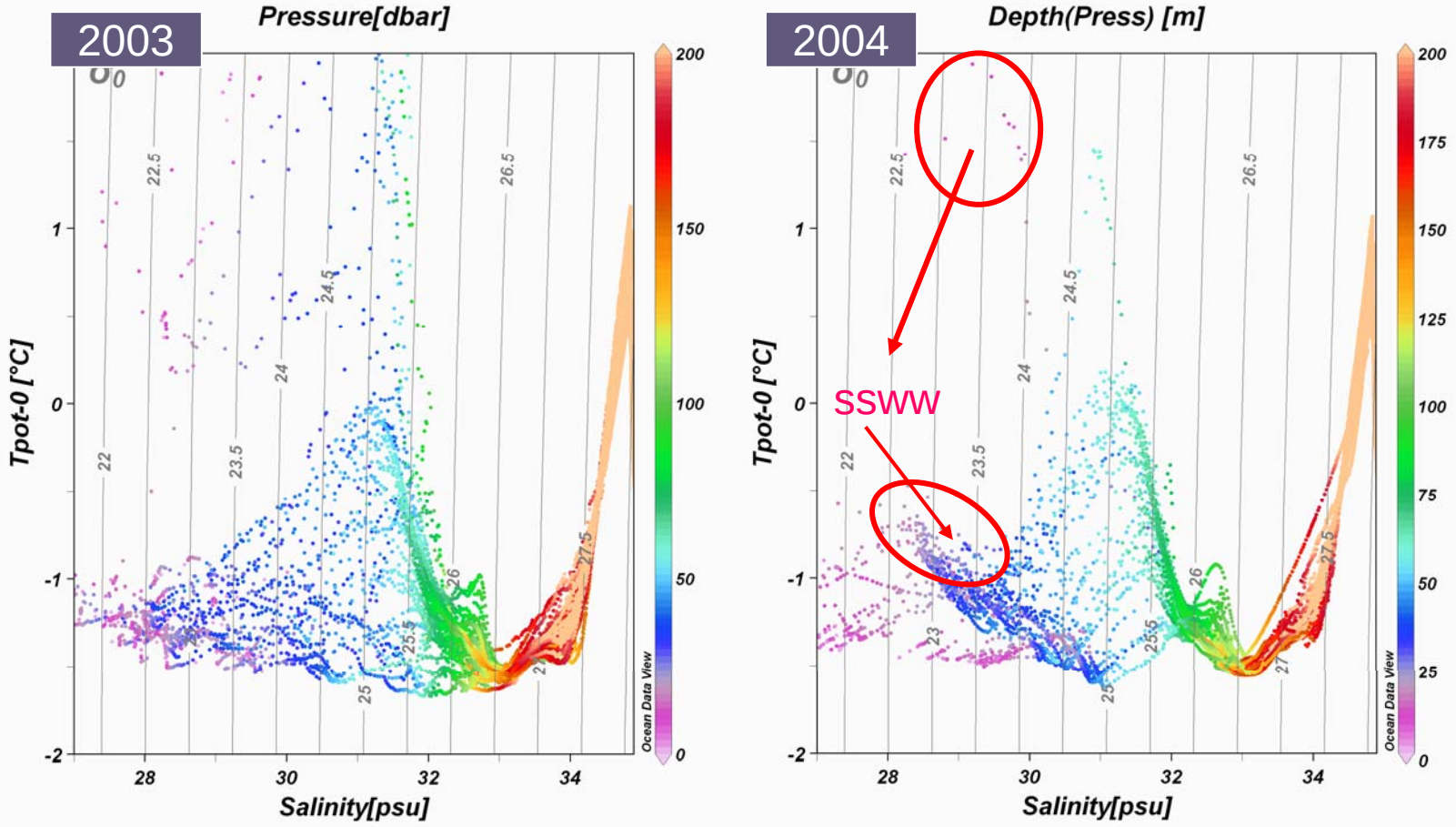
the unstable SSWW



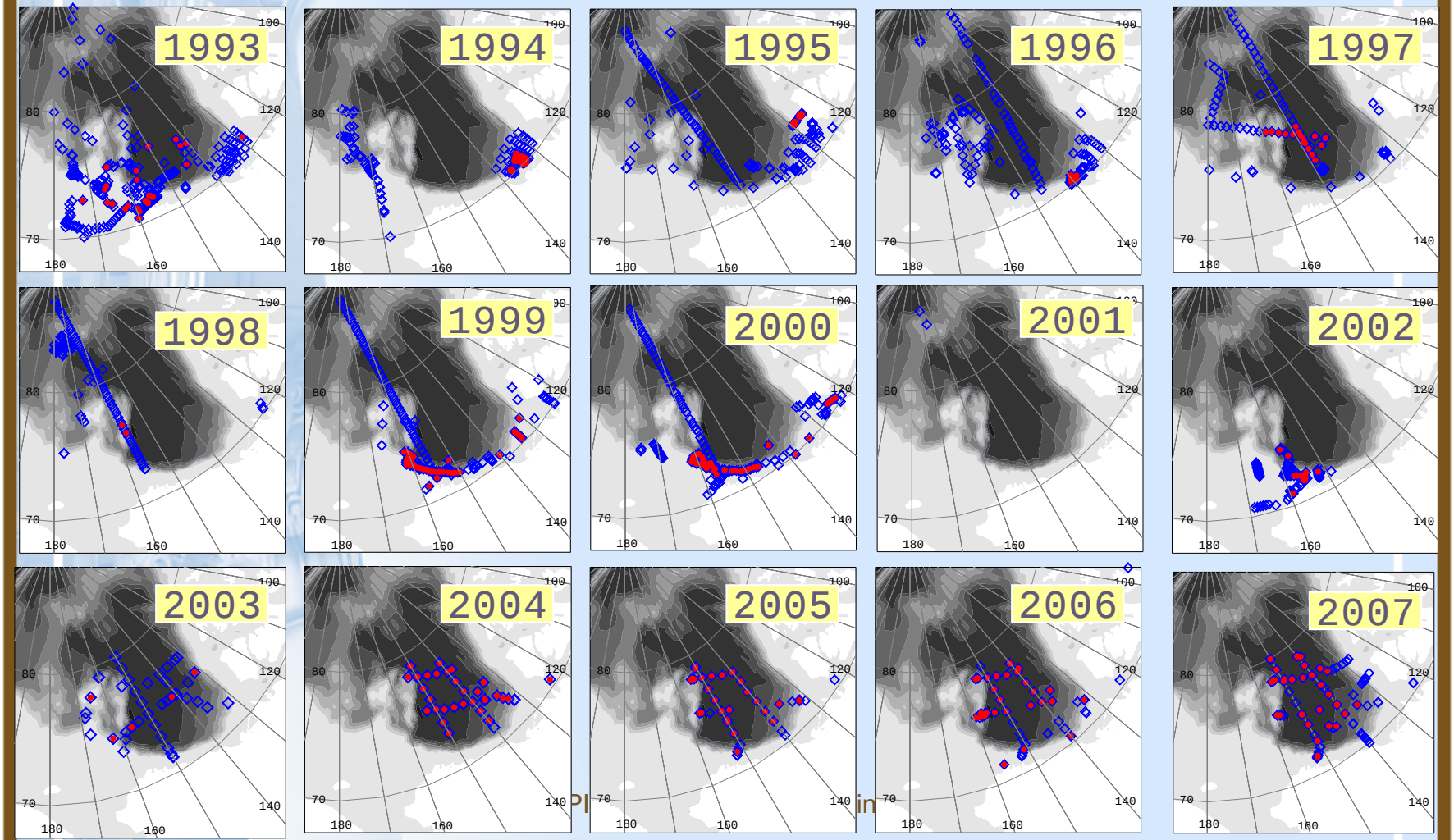


The SSWW in ice free area

(1) the SSWW covered by sea-ice (tmax<-0.5℃);
(2) the SSWW in ice-free sea area (0℃<tmax);
(3) the unstable SSWW


2003
Pressure[dbar]
Tpot-0 [°C]
Salinity[psu]
Ocean Data View
2004
Depth(Press) [m]
SSWW
Tpot-0 [°C]
Salinity[psu]
Ocean Data View

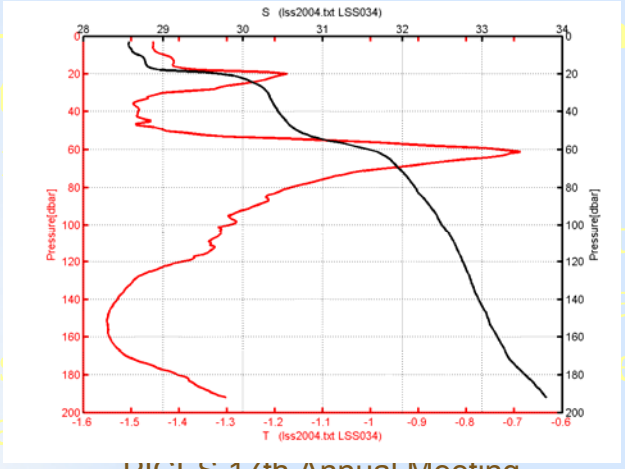
Temporal-Spatial Distribution of the SSWW



A study of the physical mechanism of the SSWW

The formation mechanism of the SSWW is the solar radiation and the surface cooling.

- Most solar energy arriving ice surface is reflected from the surface and absorbed by ice . Little part of solar energy can penetrate ice sheet to heat the water and generate a temperature maximum in the water. Cooling by the ice sheet, the temperature maximum does not occur in the surface but in 20m level .
- Under certain non- d and low air temperature , the those of ice covered , and the SSWW ca
- The gale churning he mixing layer. Once the gale stops, the ating by the gravity. If the solar heat is fa e SSWW will occur. But this is an unsta



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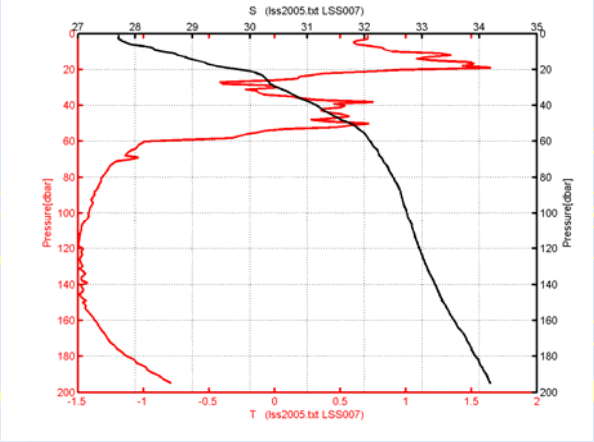

- Most solar energy cted from the surface and absorbed by ic gy can penetrate ice sheet to heat the w ture maximum in the water. Cooling by e sheet, the temperature maximum does no m level .
- Under certain non-ice conditions with calm wind and low air temperature，the thermodynamics is similar to those of ice covered，and the SSWW can be also formed .
- The gale churning up the ice free water causes the mixing layer. Once the gale stops, the mixing layer begins degenerating by the gravity. If the solar heat is faster than the degeneration, the SSWW will occur. But this is an unstable SSWW.

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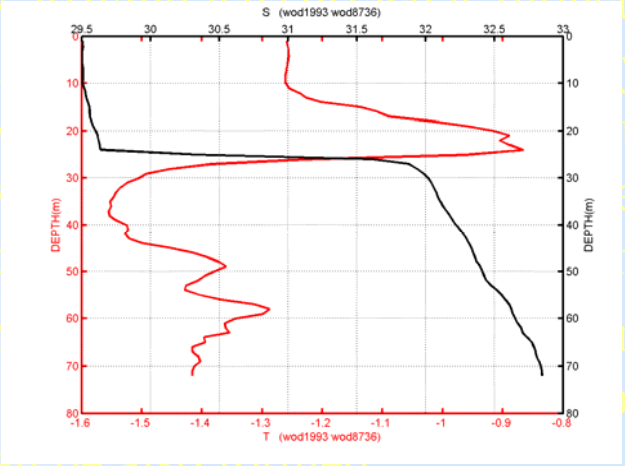
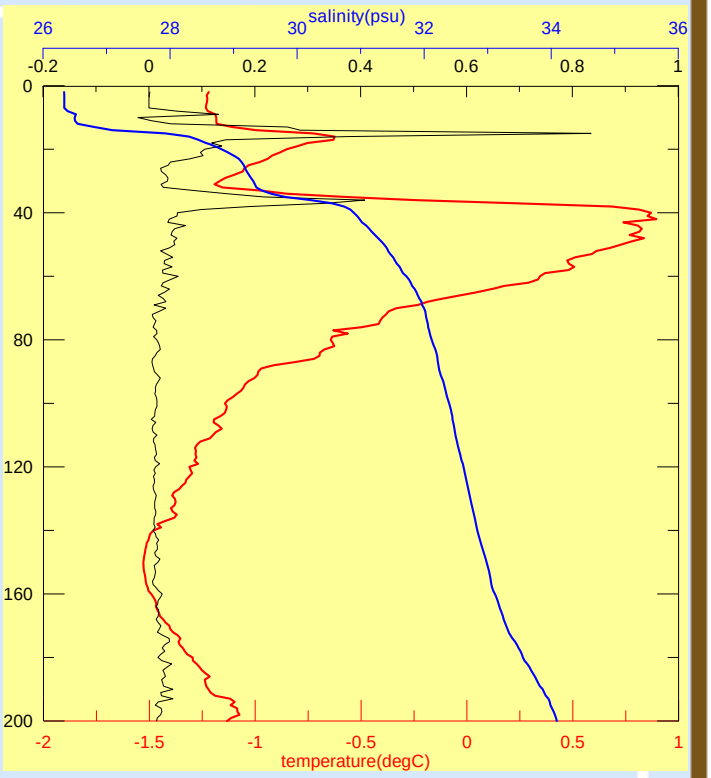


- The gale churning up the ice free water causes the mixed layer. Once the gale stops, the mixed layer begins degenerating by the gravity. If the solar heat is faster than the degeneration, the SSWW will occur. But this is an unstable SSWW.

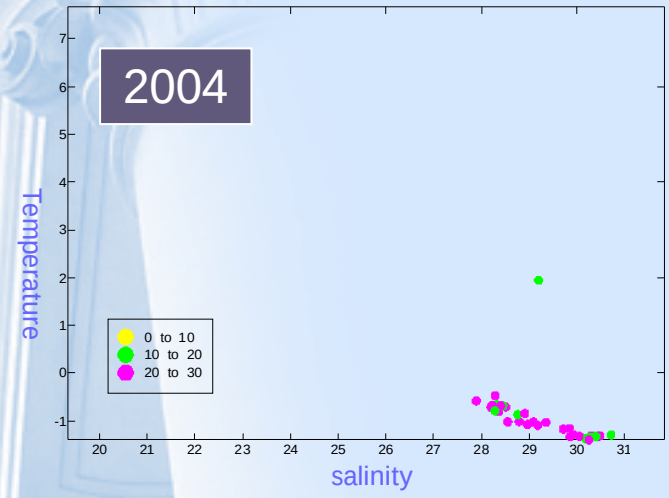
The halocline maintains the SSWW

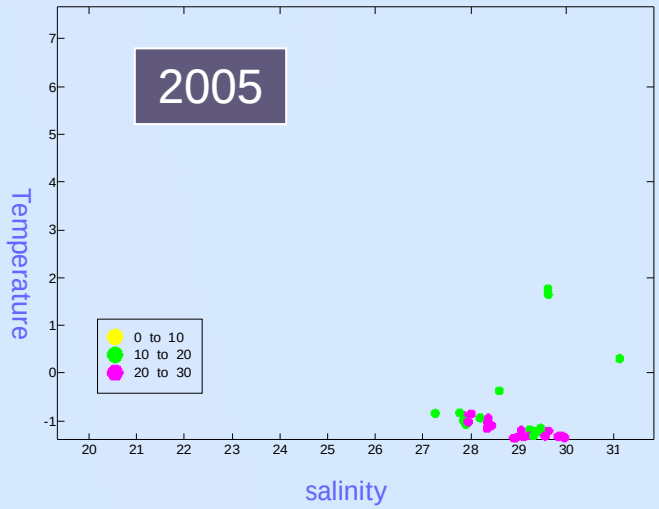


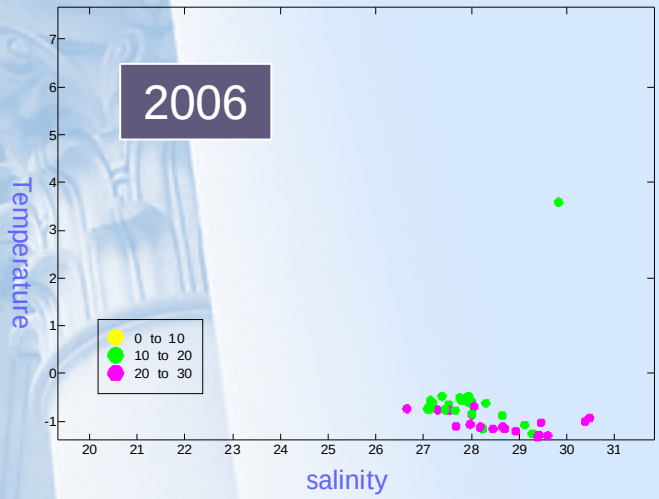
- In the strong halocline layer the vertical stability increases and the mix decreases, so the absorbed heat may retain in the layer, indicating the occurrence of the SSWW and maintaining it.
- Furthermore, the peak of the SSWW occurs in the strongest layer of the halocline, where the turbulent diffusion is the smallest.

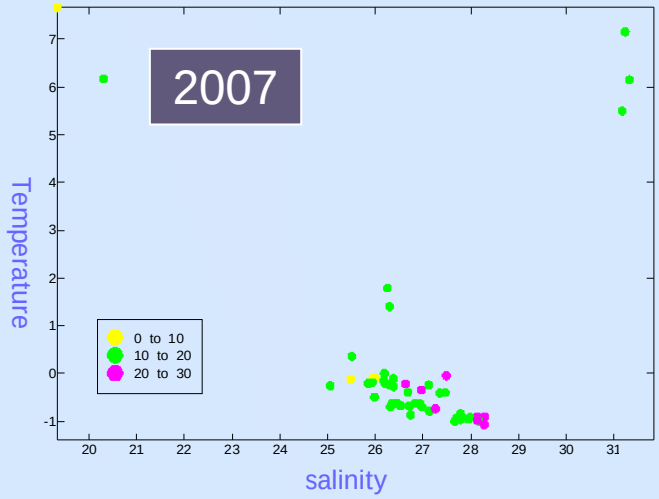
- The influence of the SEA ICE on the SSWW

The SSWW only occurred in small area of Beaufort Sea in 1994、1995、1996, besides the reason of the observation time, which was related with the heavy ice years. In most years the SSWW were found in Chukchi slope, Barrow valley and Beaufort Sea. The reason is the solar radiation may heat the water greatly for the ice melt early in the summer or it is closer to marginal ice zone (MIT) in this sea area. There was no SSWW except 1997, 2004, 2005, 2006,2007 in Canada Abyssal Plain. The reduction of the Arctic sea ice could increase and enhance the SSWW phenomenon.


2004
Temperature
salinity
0 to 10
10 to 20
20 to 30


2005
Temperature
salinity
0 to 10
10 to 20
20 to 30


2006
Temperature
salinity
0 to 10
10 to 20
20 to 30


2007
Temperature
salinity
0 to 10
10 to 20
20 to 30

Conclusion

- the sub-surface warm water (SSWW) appeared in 20m between the mixed layer and the Pacific-origin summer water, with the temperature higher than the freezing point and the salinity below 30 psu.
- Observations from 1993 to 2007 reveal that there were three vertical structures of the SSWW.
- The solar radiation, the surface cooling and the halocline are the physical mechanism of the SSWW.
- The decrease of the sea ice extent and sea ice concentration could increase and enhance the SSWW phenomenon.

Thank you!