Seasonal variation of water masses in the Chukchi Sea : results of DBO pilot study in 2010

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Svein Vagle (IOS), Jianfeng He (PRIC),
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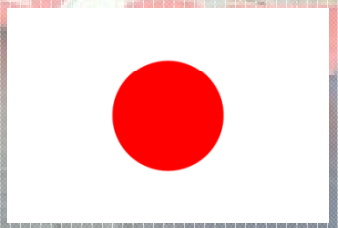
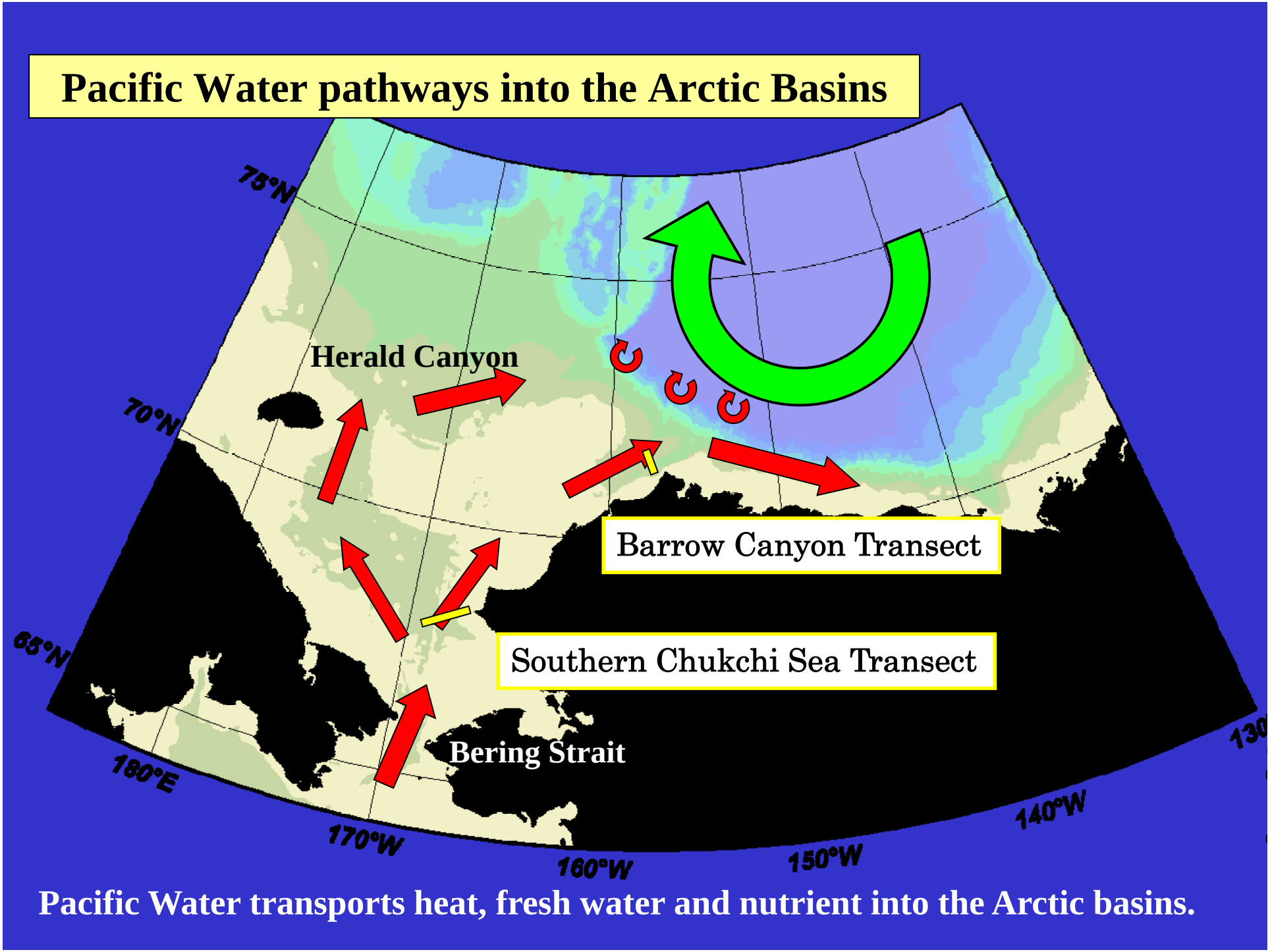


Pacific Water pathways into the Arctic Basins

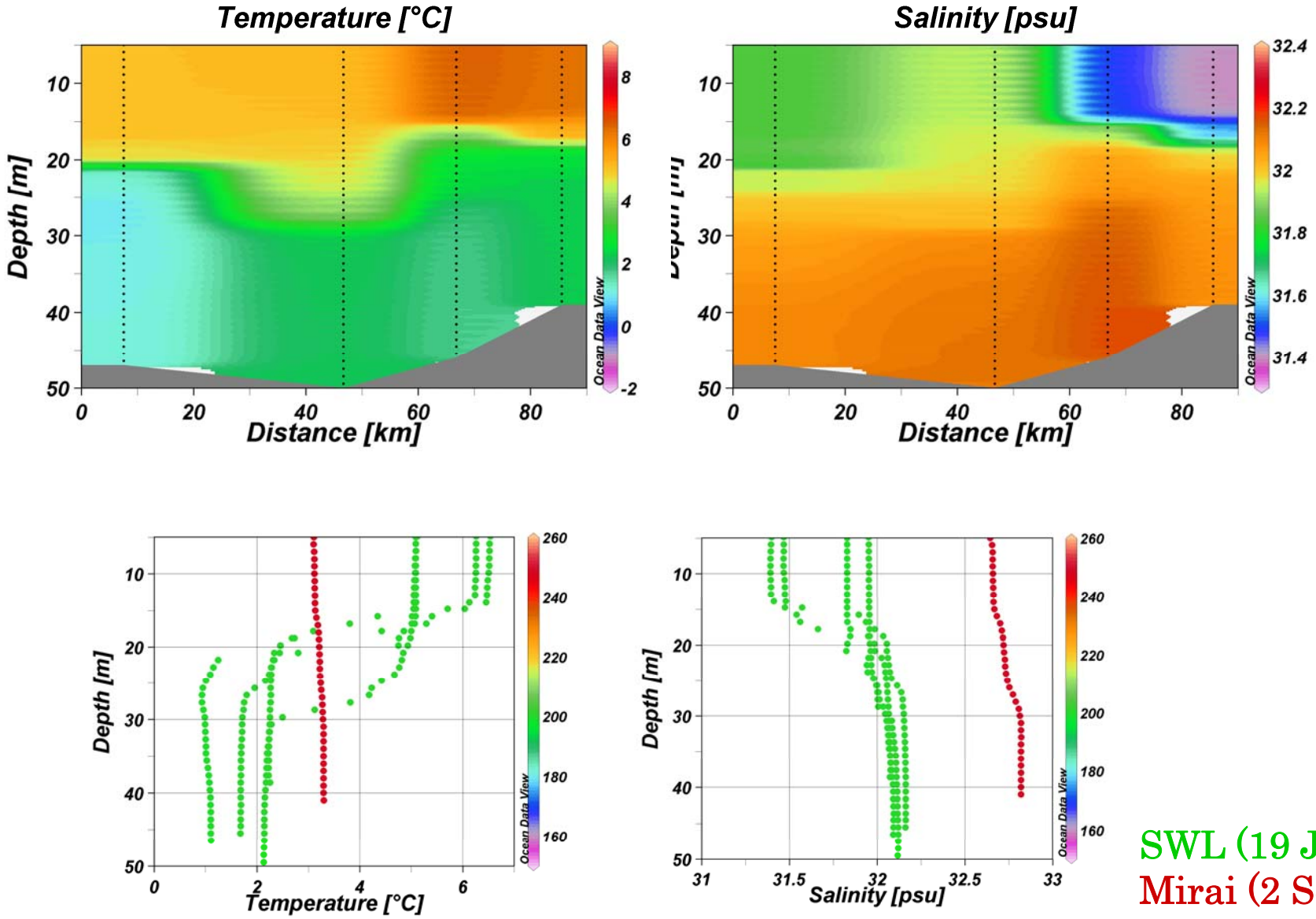


Pacific Water transports heat, fresh water and nutrient into the Arctic basins.

Southern Chukchi Sea Transect

- Healy, US (July)
- SWL, Canada (July)
- Mirai (hotspot station only), Japan (Sep)

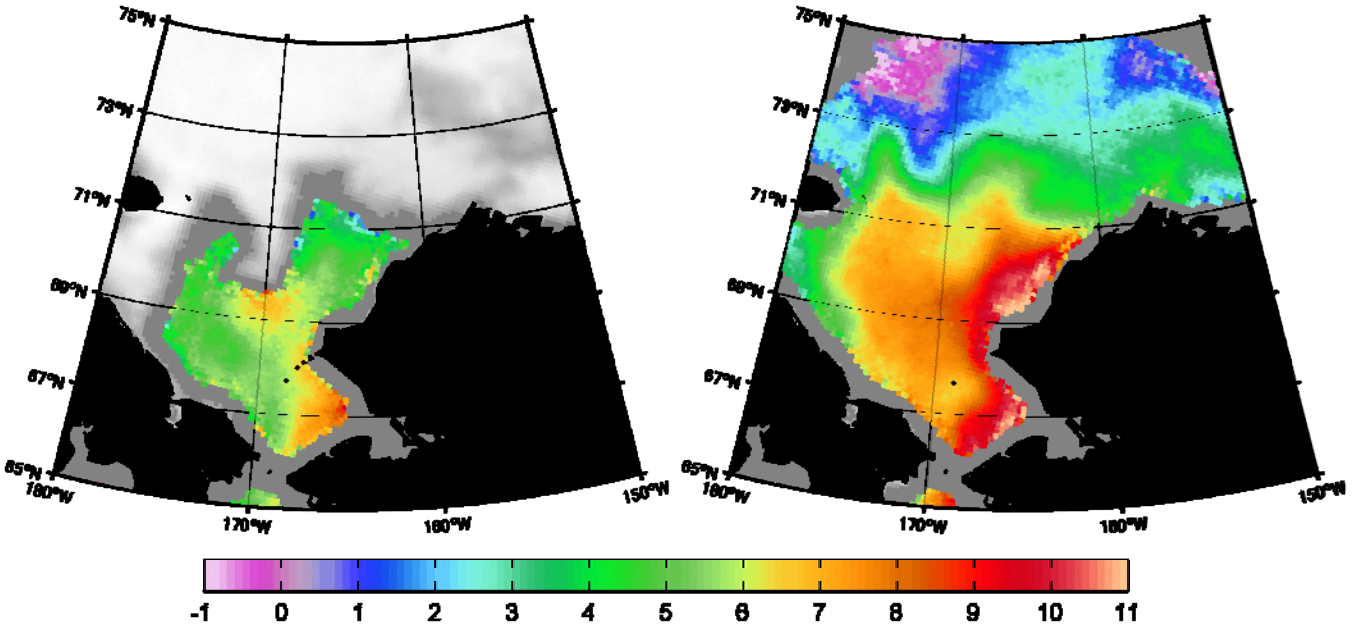
Temperature and Salinity section in July by SWL

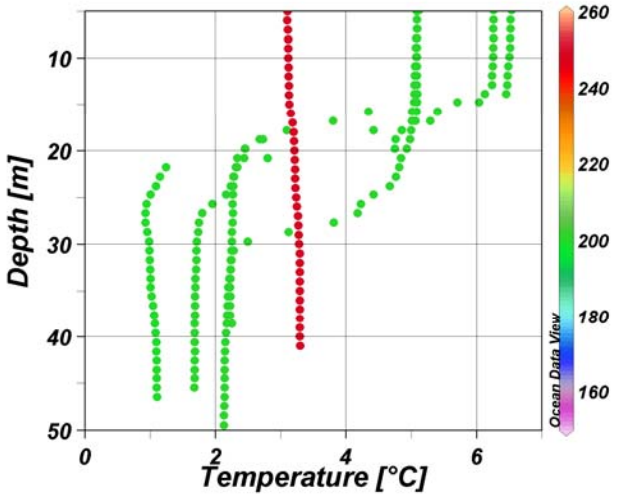


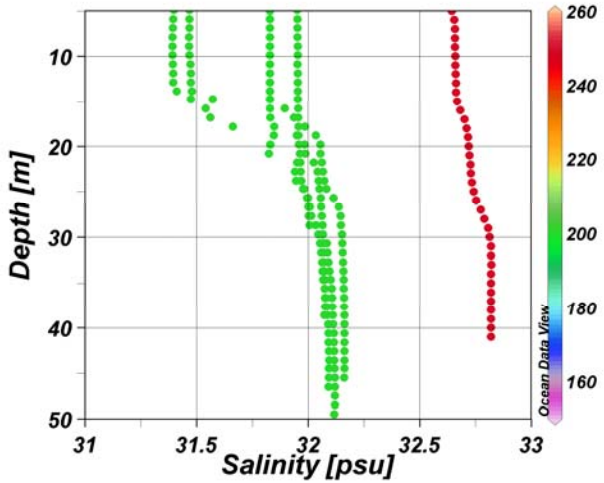
Surface Temperature (AMSR-E weekly)

SWL (July 16-21)

Mirai (Sep 2-9)







SWL (19 July)

Mirai (2 Sep)

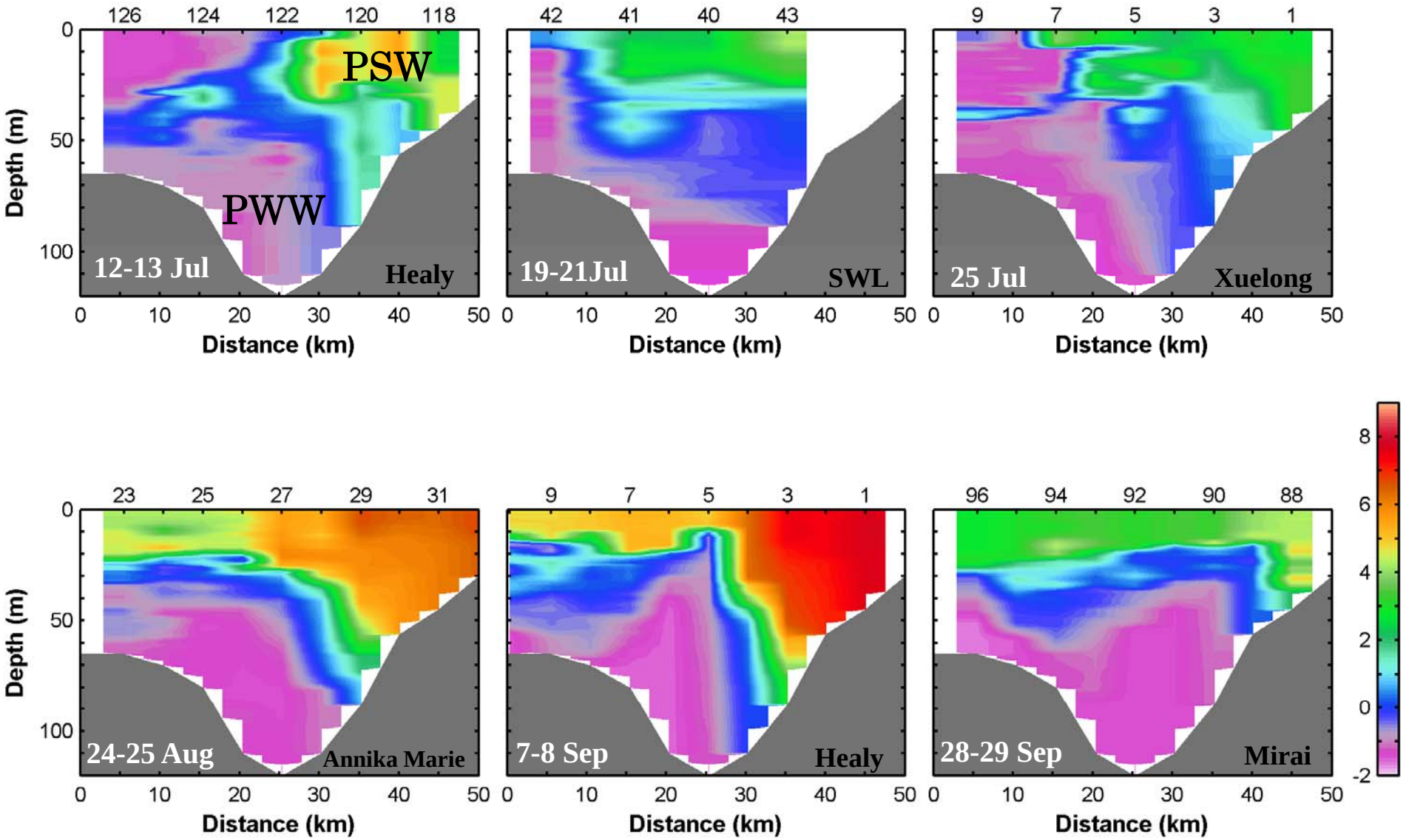
Barrow Canyon Transect

- Healy, US (July 12-13)
- SWL, Canada (July 19-21)
- Xuelong, China (July 25)
- Annika Marie, US (Aug 24-25)
- Healy, US (Sep 7-8)
- Mirai, Japan (Sep 28-29)

6 cruises by 4 nations

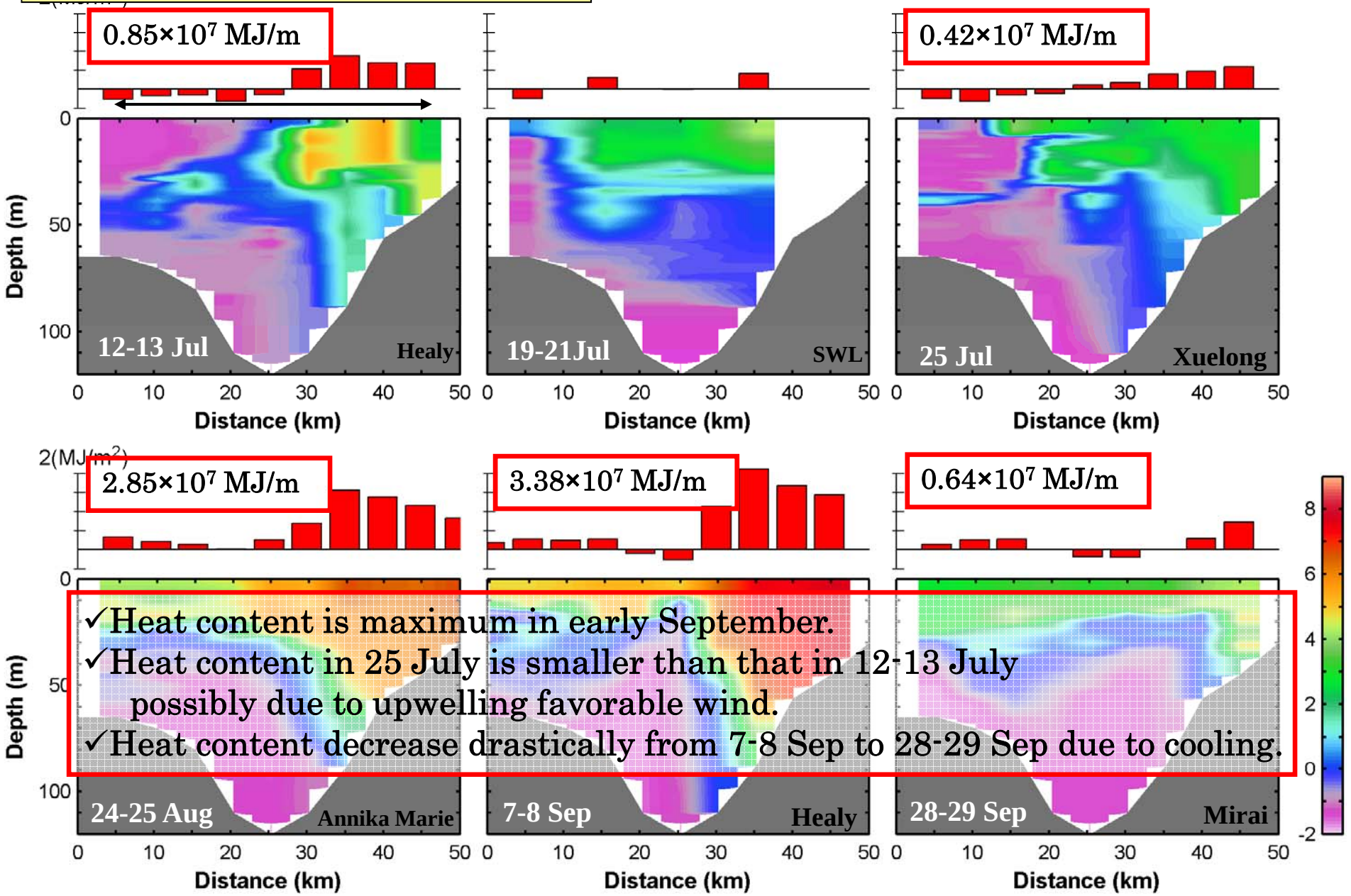
Temperature Sections

PSW: Pacific Summer Water
PWW: Pacific Winter Water



Heat Content

$\int T\,dz$

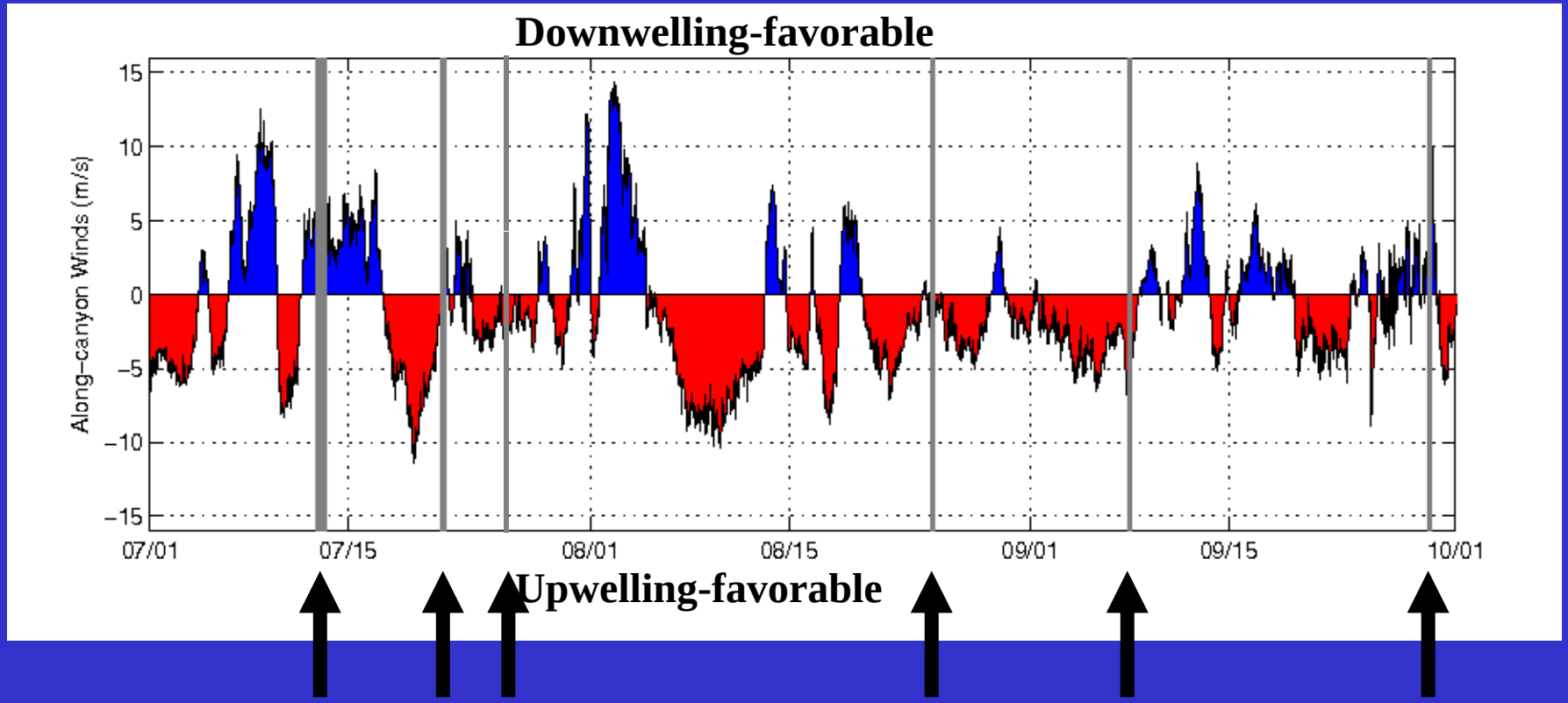


✓Heat content is maximum in early September.

✓Heat content in 25 July is smaller than that in 12-13 July possibly due to upwelling favorable wind.

✓Heat content decrease drastically from 7-8 Sep to 28-29 Sep due to cooling.

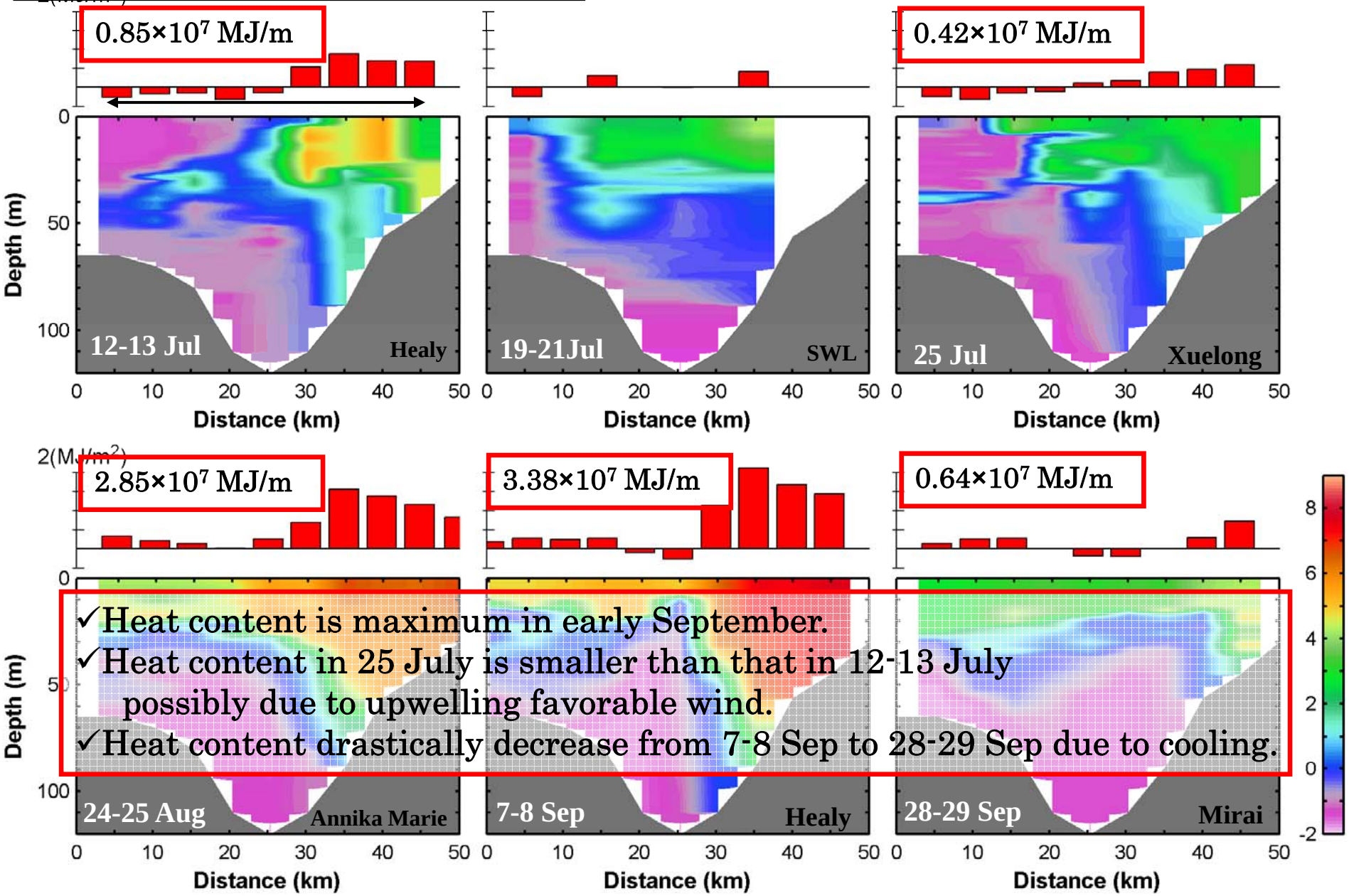
Along-canyon winds Summer 2010



Courtesy R. Pickart

Heat Content

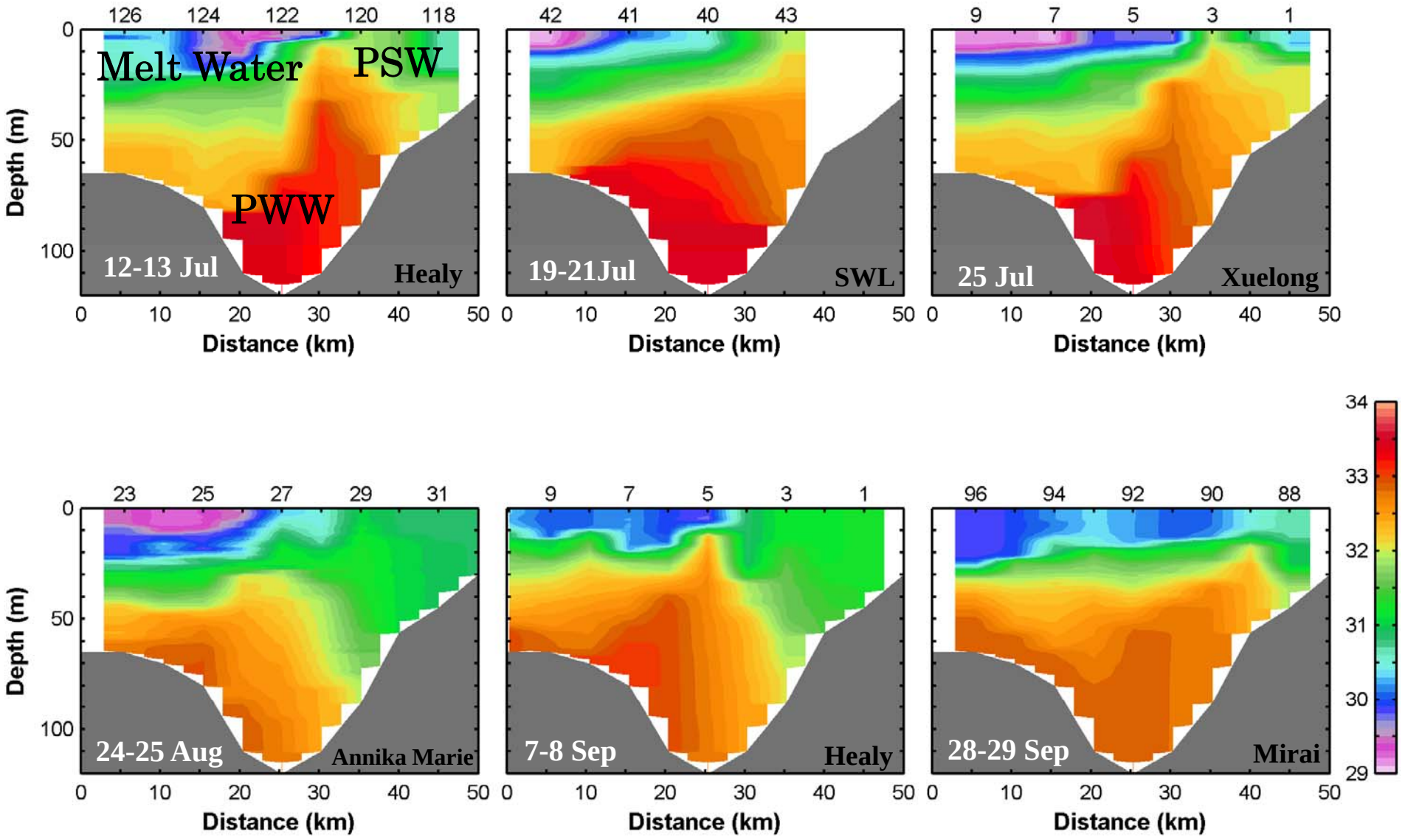
$\int T\,dz$



- ✓Heat content is maximum in early September.
- ✓Heat content in 25 July is smaller than that in 12-13 July possibly due to upwelling favorable wind.
- ✓Heat content drastically decrease from 7-8 Sep to 28-29 Sep due to cooling.

Salinity Sections

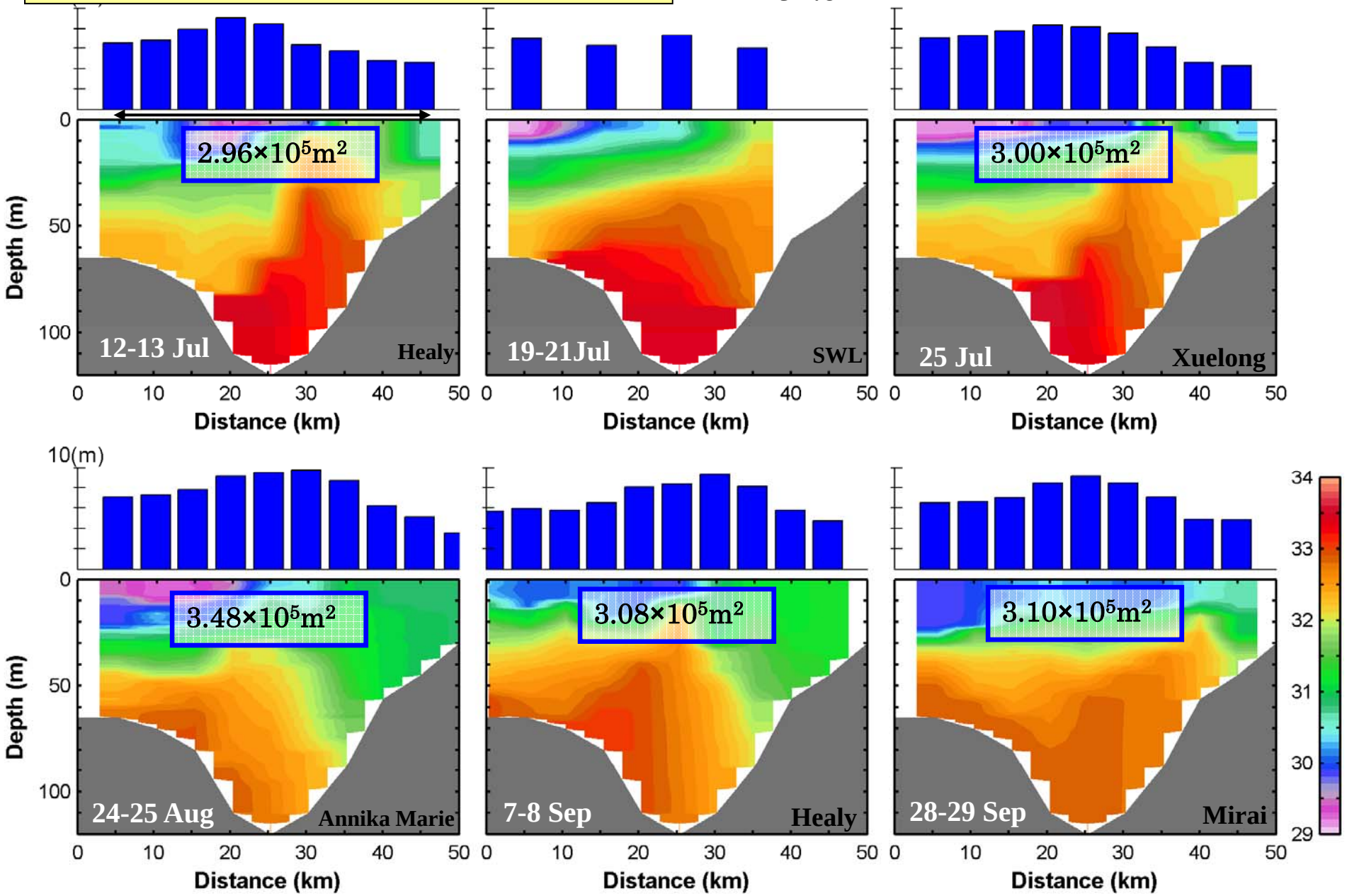
PSW: Pacific Summer Water
PWW: Pacific Winter Water



Fresh Water Content

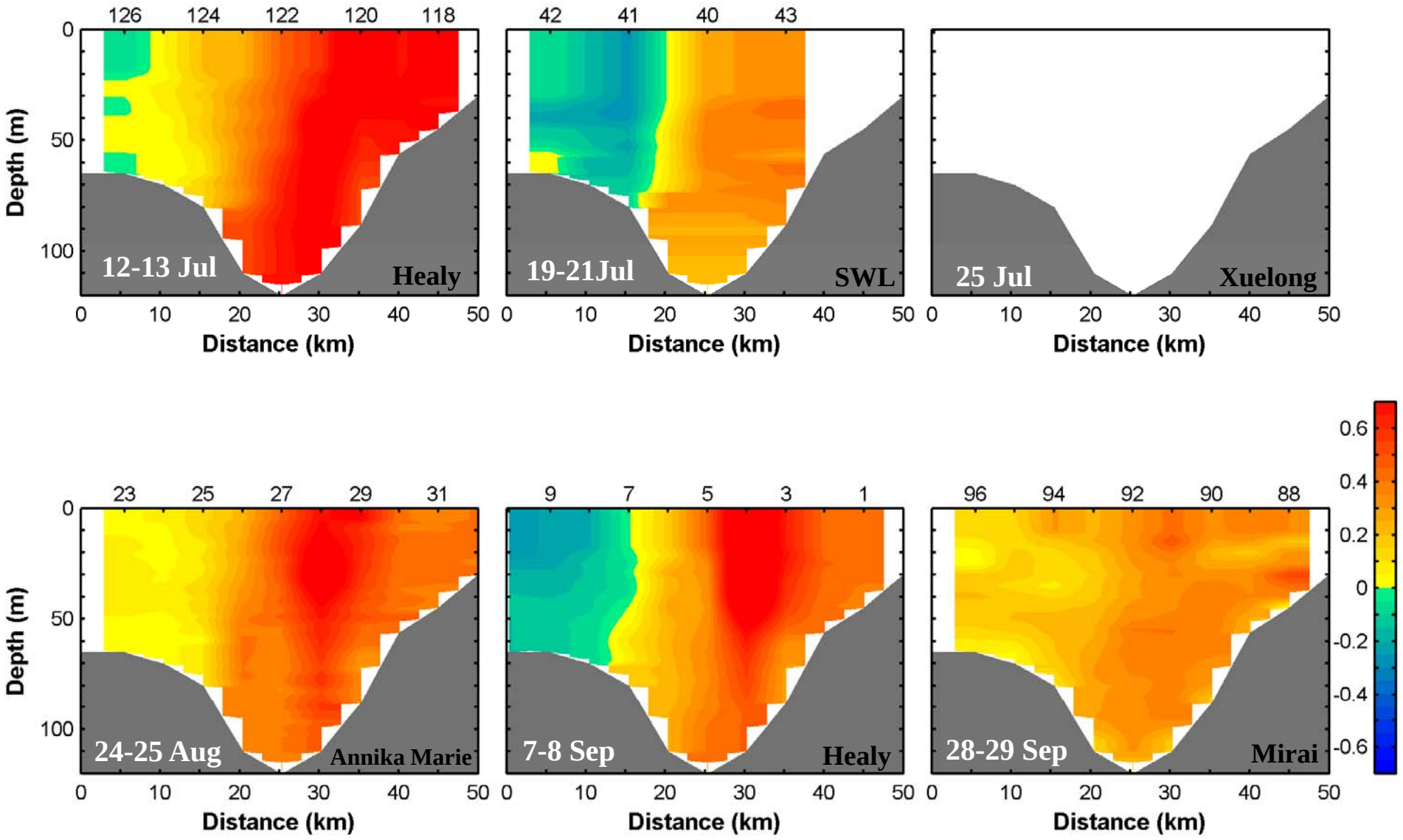
$$\int \frac{34.8\text{-}S(z)}{34.8} dz$$

e.g. Proshutinsky et al., 2008

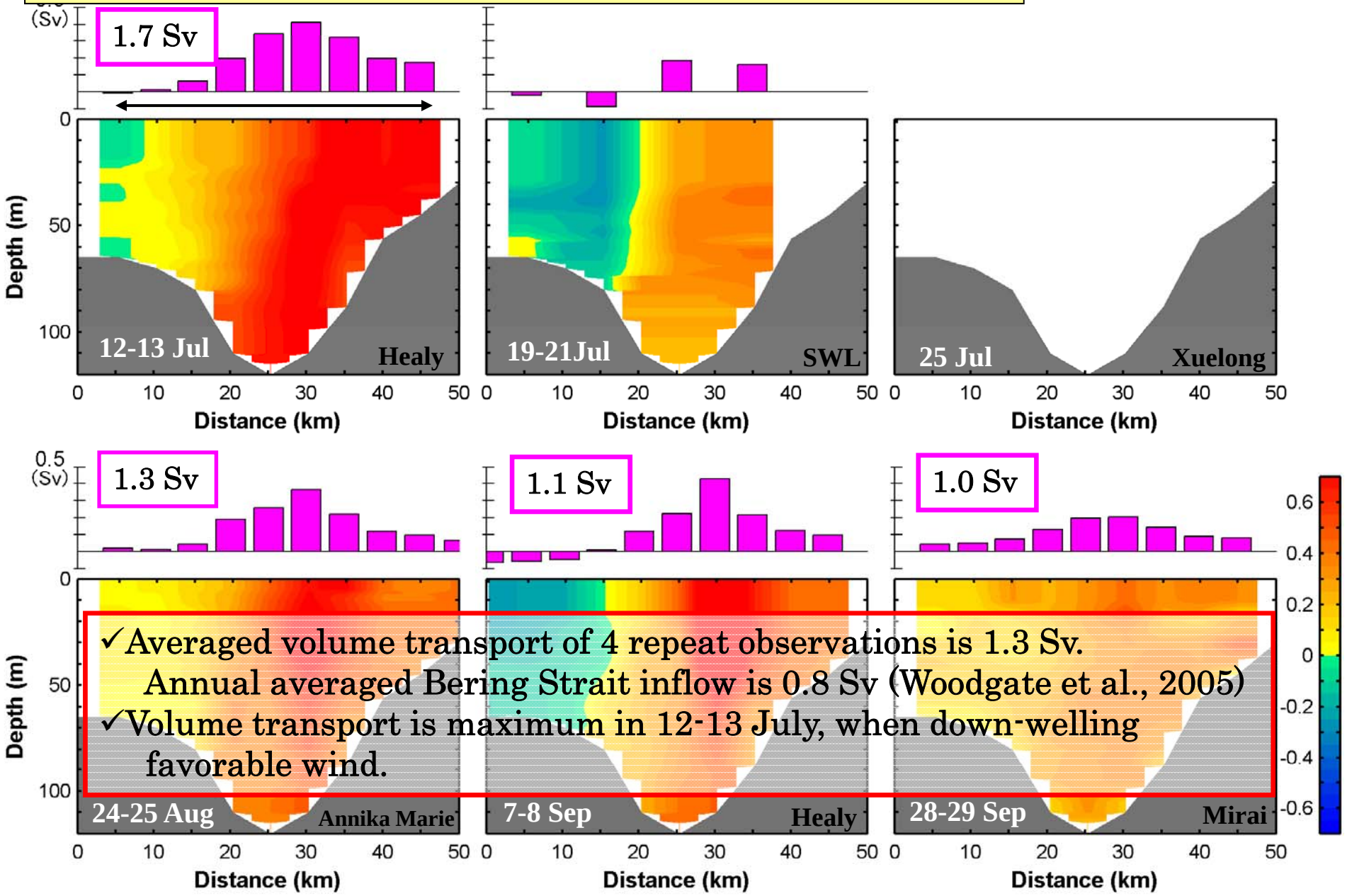


Velocity Section

Positive: downwelling
Negative: upwelling



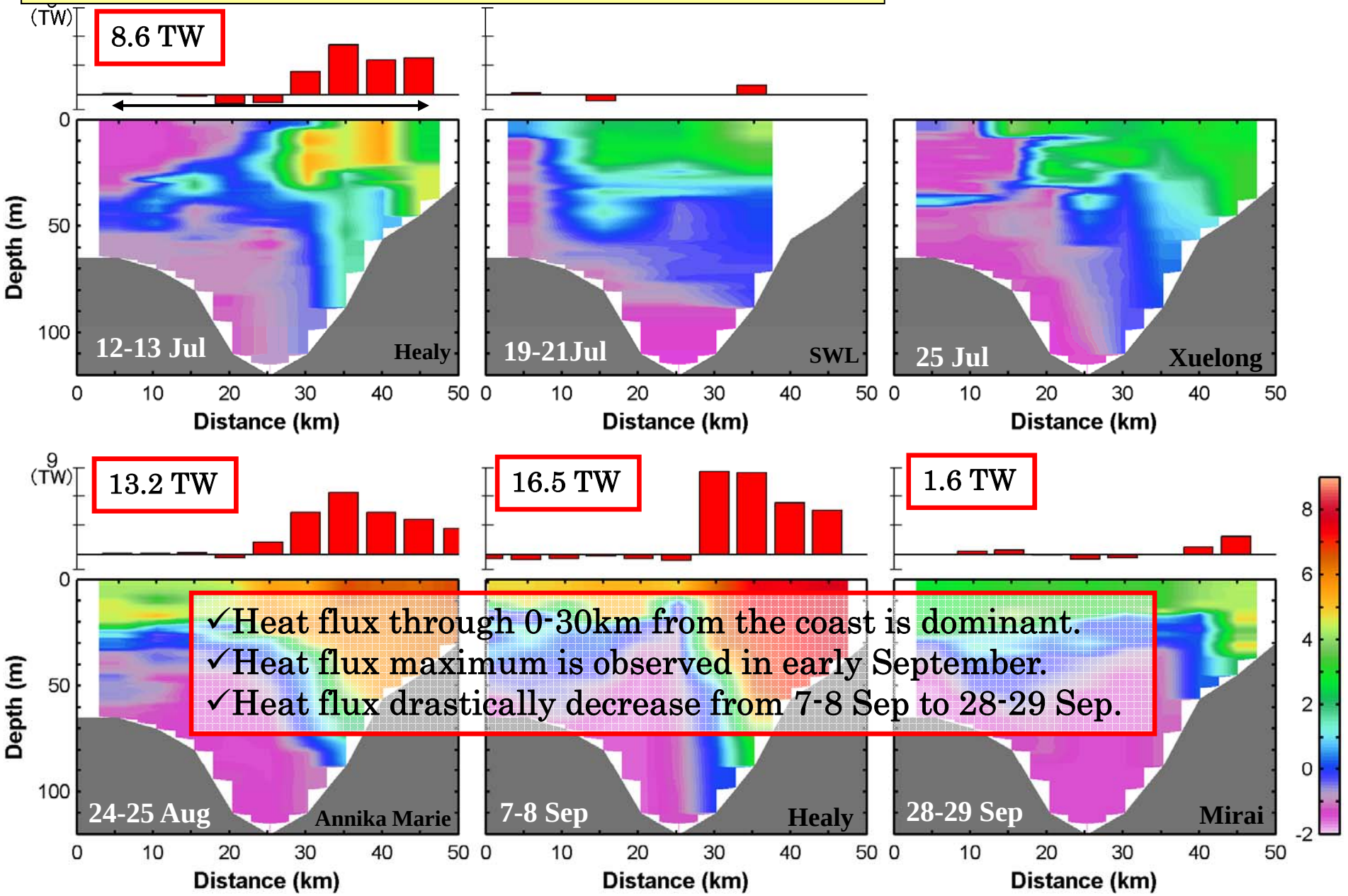
Volume transport through the canyon



✓Averaged volume transport of 4 repeat observations is 1.3 Sv.
Annual averaged Bering Strait inflow is 0.8 Sv (Woodgate et al., 2005)

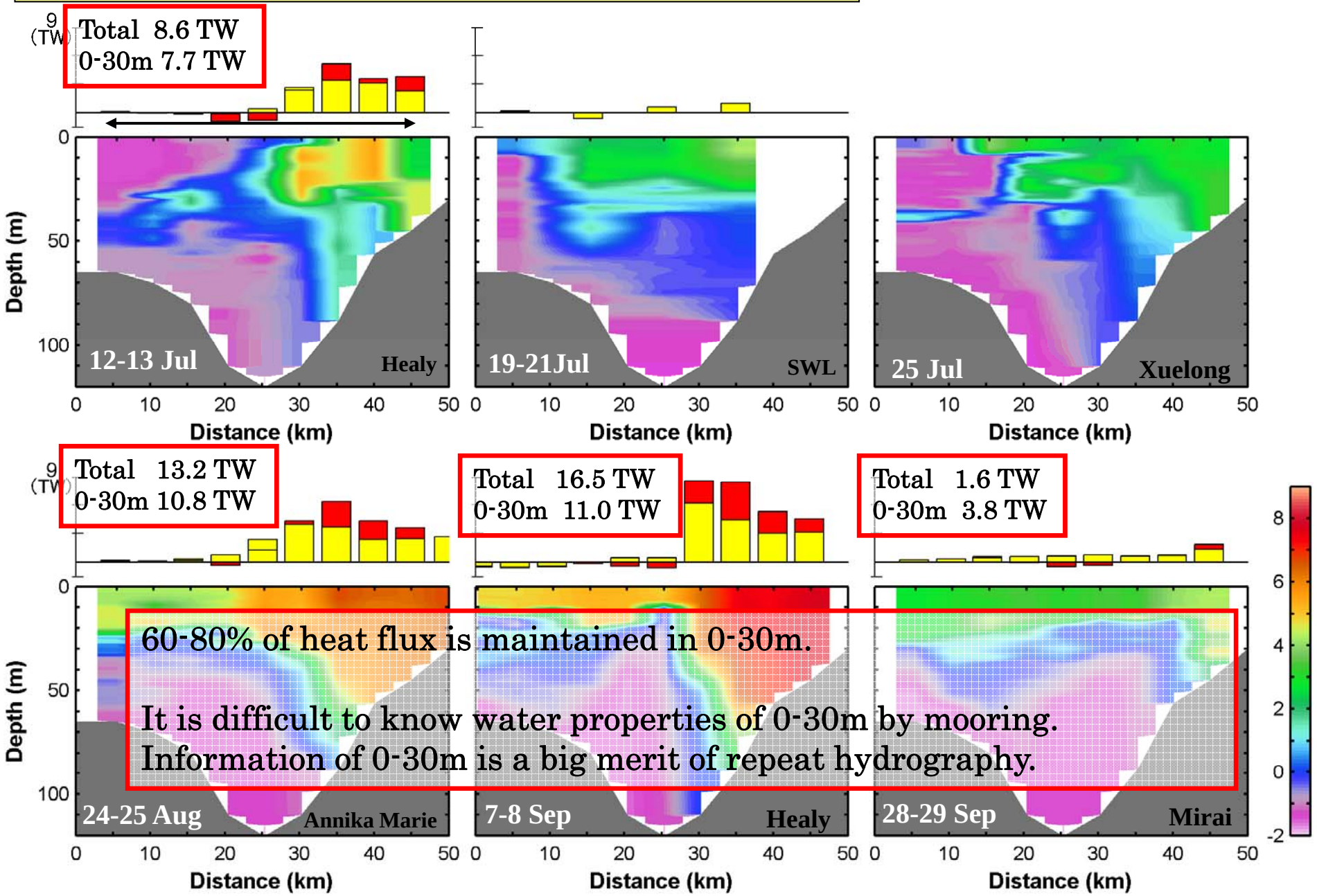
✓Volume transport is maximum in 12-13 July, when down-welling favorable wind.

Heat Flux through the canyon



- ✓Heat flux through 0-30km from the coast is dominant.
- ✓Heat flux maximum is observed in early September.
- ✓Heat flux drastically decrease from 7-8 Sep to 28-29 Sep.

Heat Flux through the canyon

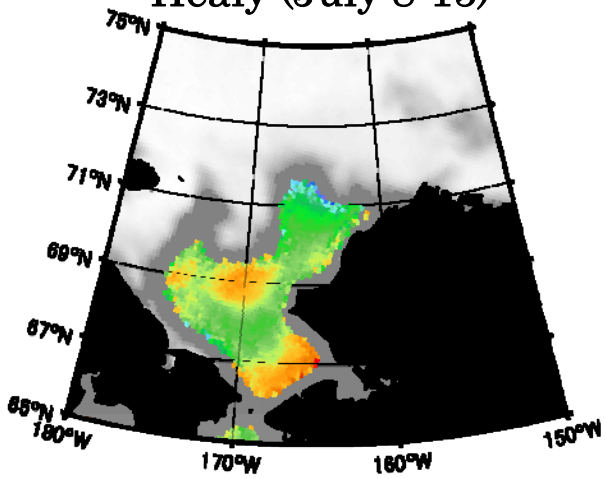


60-80% of heat flux is maintained in 0-30m.

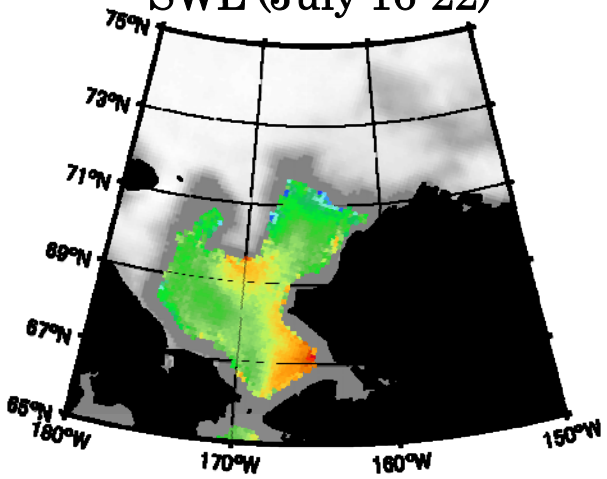
It is difficult to know water properties of 0-30m by mooring.
Information of 0-30m is a big merit of repeat hydrography.

Surface Temperature (AMSR-E weekly)

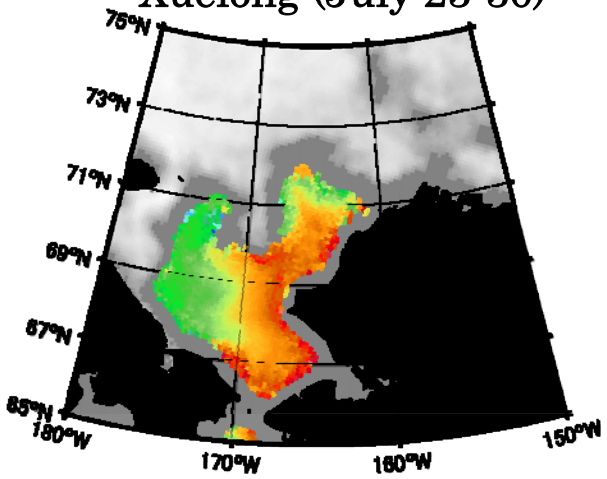
Healy (July 8-15)



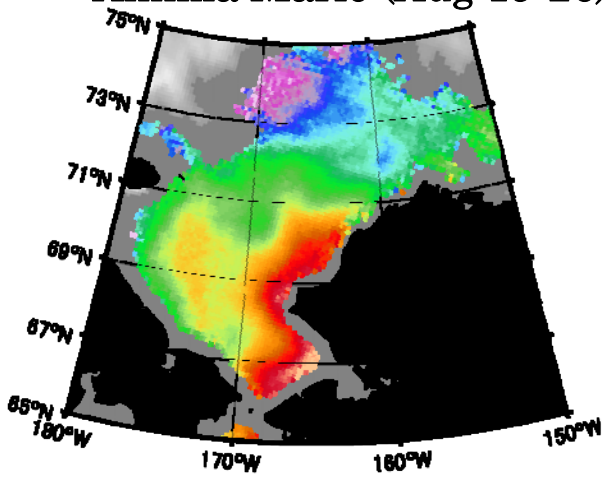
SWL (July 16-22)



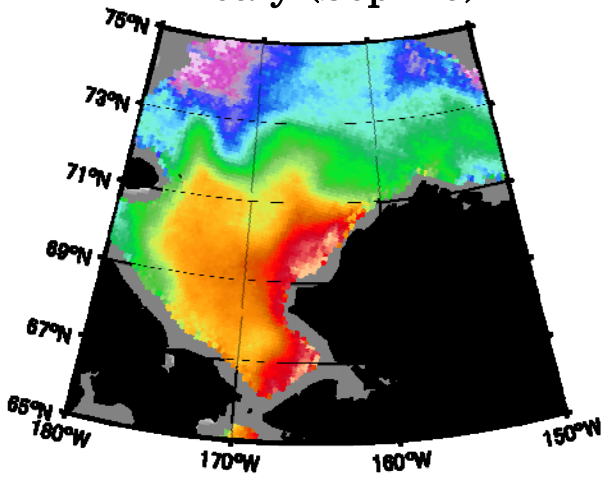
Xuelong (July 23-30)



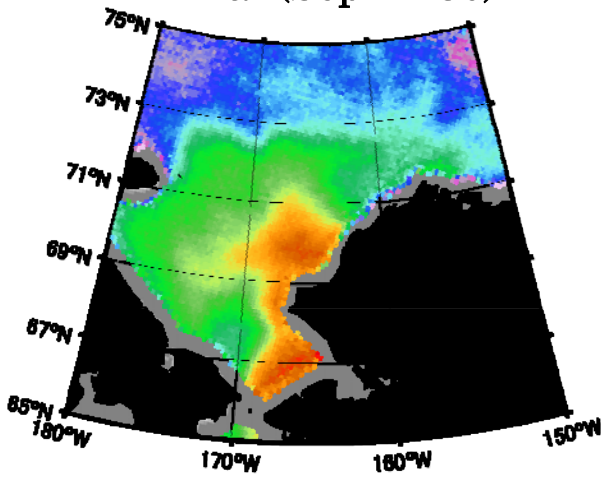
Annika Marie (Aug 19-26)



Healy (Sep 2-9)



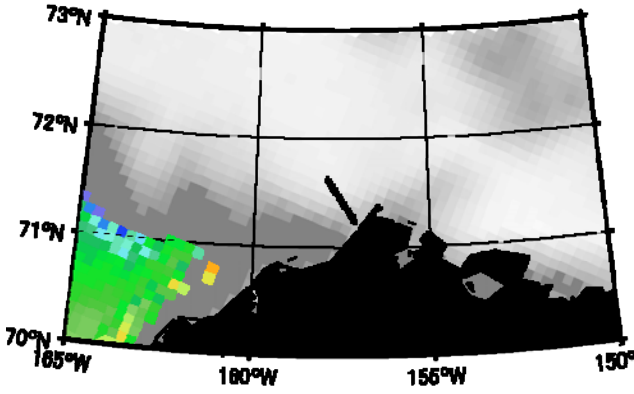
Mirai (Sep 24-30)



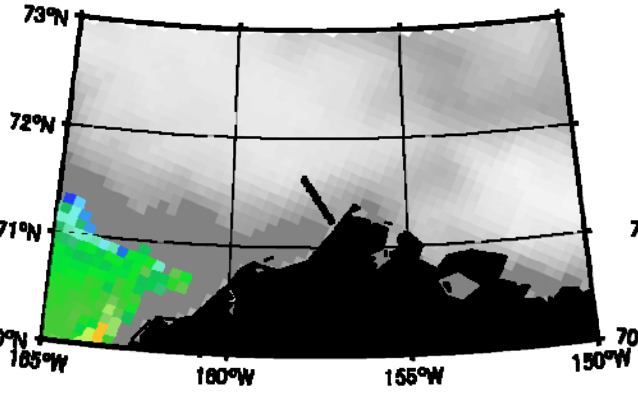
Surface Temperature (AMSR-E weekly)

Resolution 12km

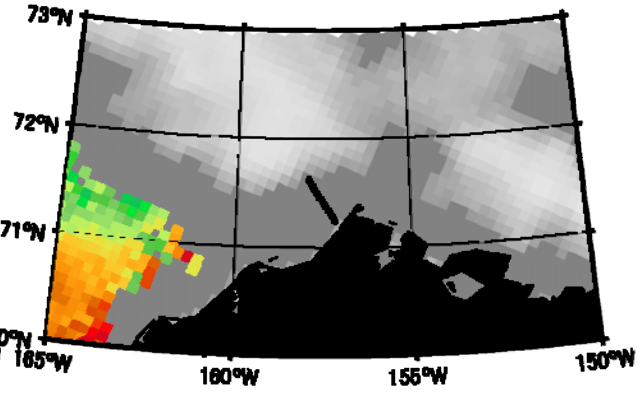
Healy (July 8-15)



SWL (July 16-22)

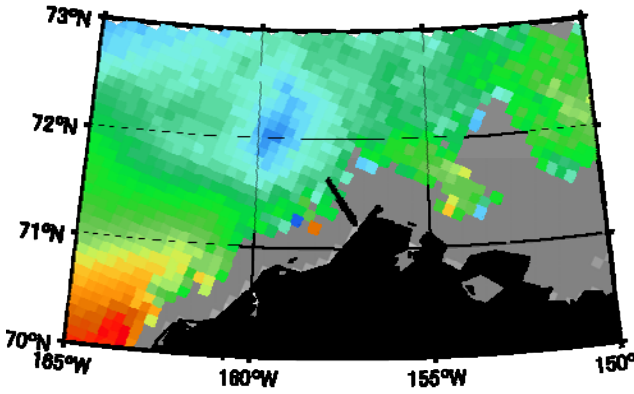


Xuelong (July 23-30)

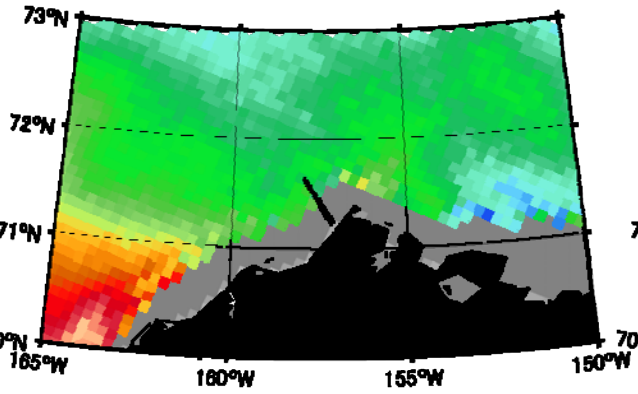


Surface temperature derived from Microwave Satellite is too coarse to capture warm Pacific Summer Water plume through the canyon.

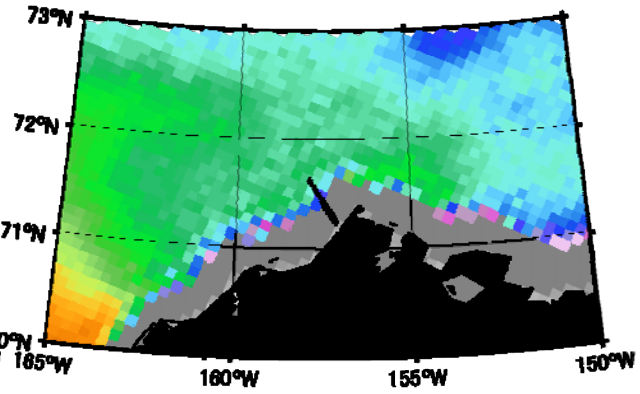
Annika Marie (Aug 19-26)



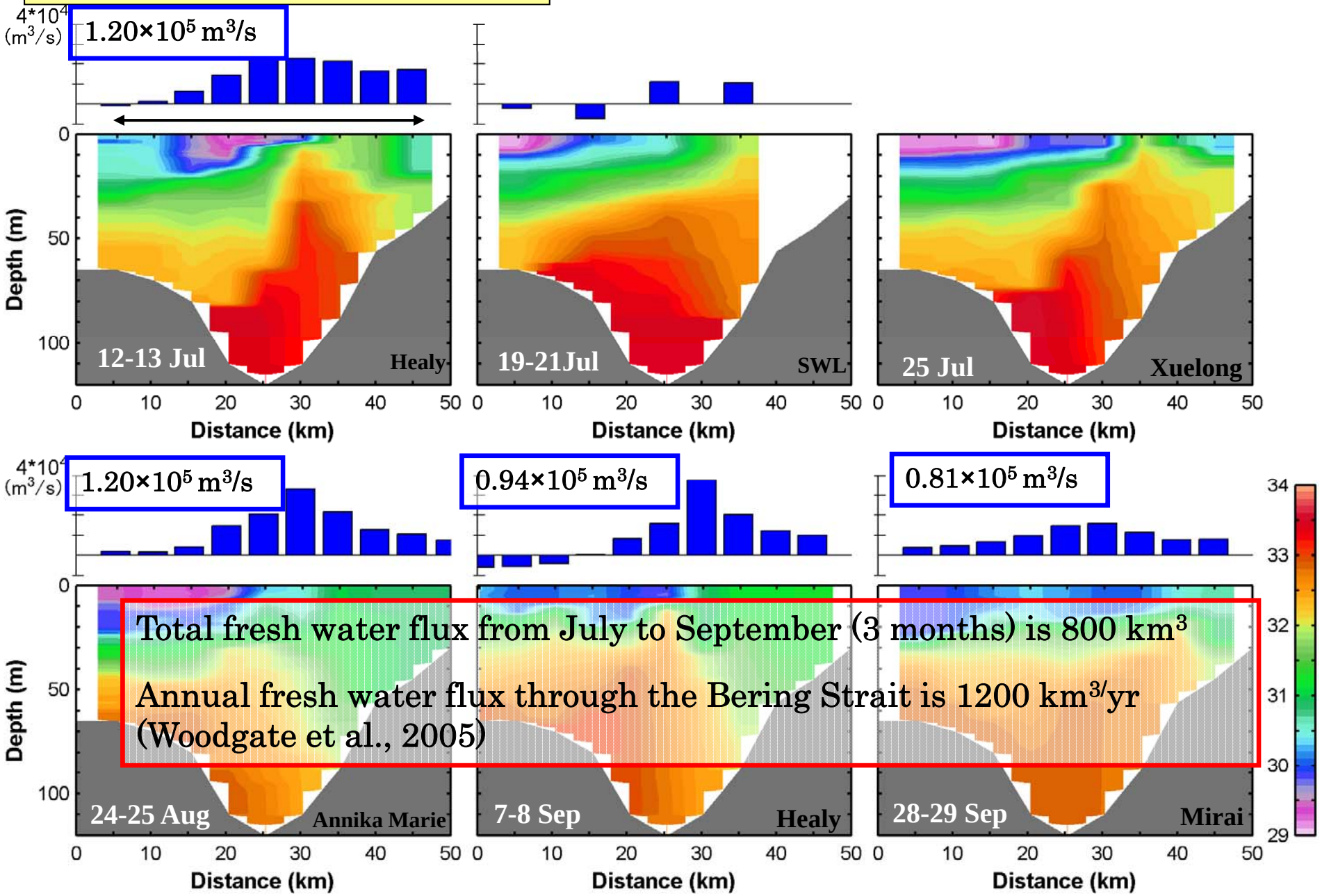
Healy (Sep 2-9)



Mirai (Sep 24-30)



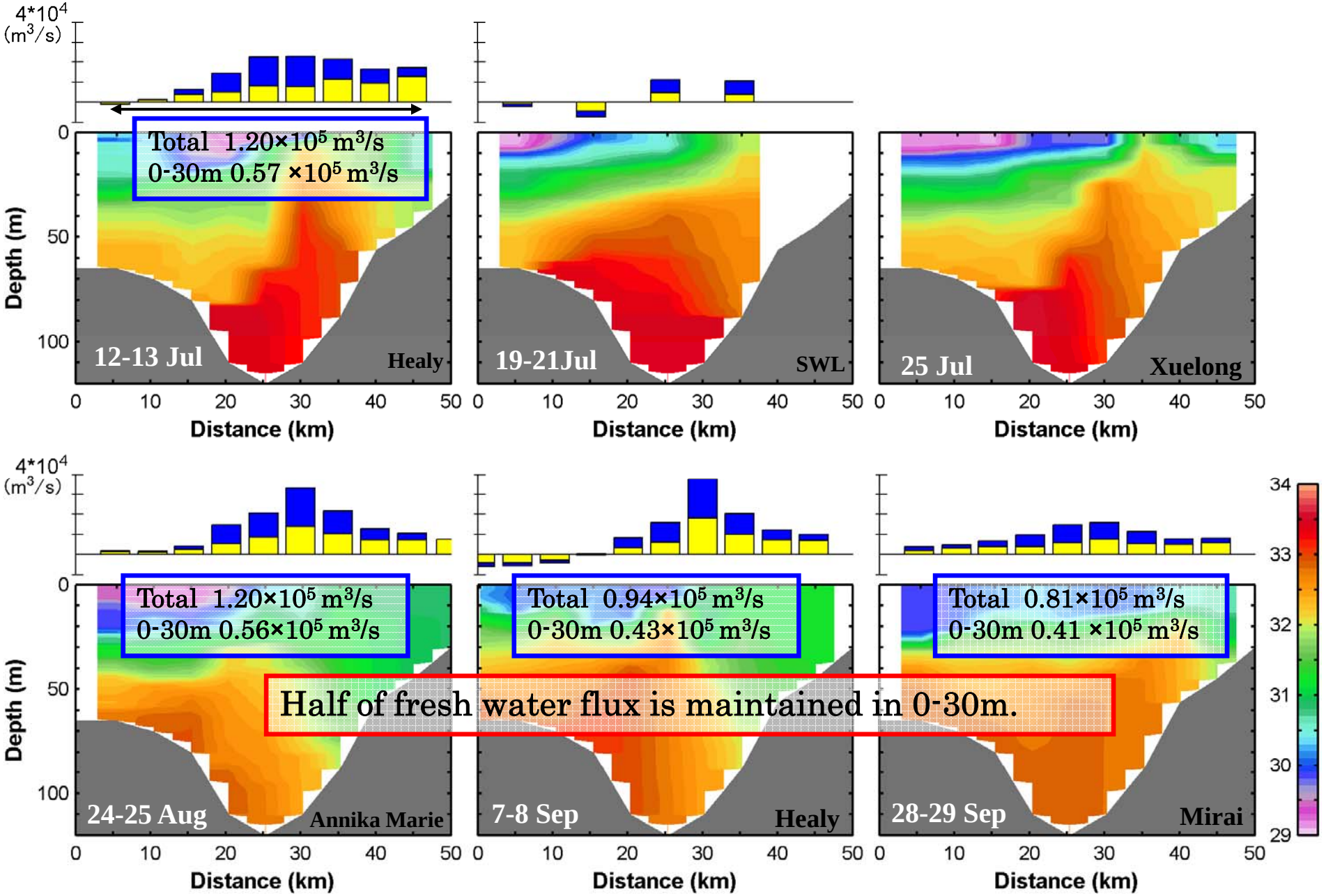
Fresh Water Flux



Total fresh water flux from July to September (3 months) is 800 km^3

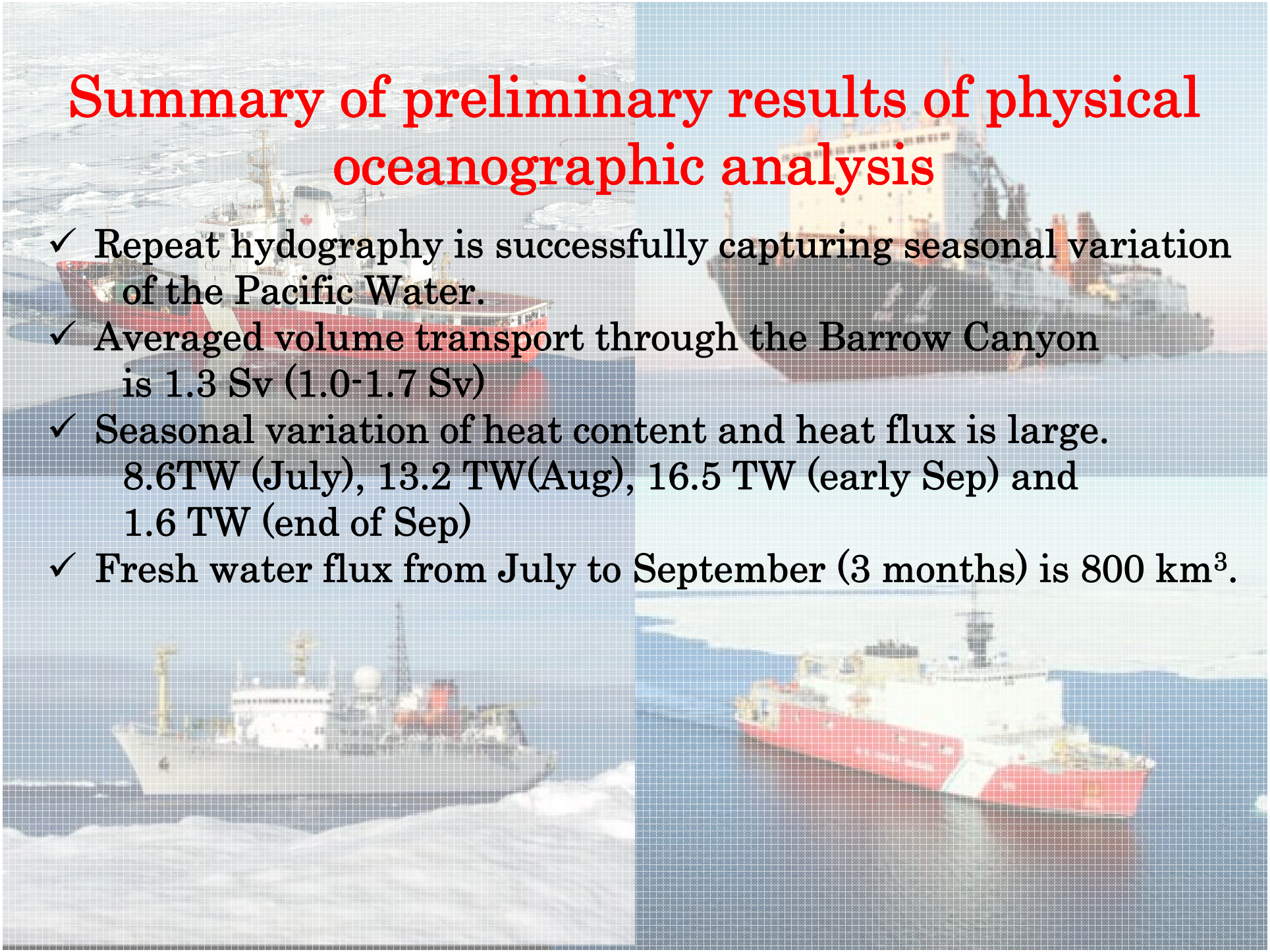
Annual fresh water flux through the Bering Strait is 1200 km^3/yr (Woodgate et al., 2005)

Fresh Water Flux



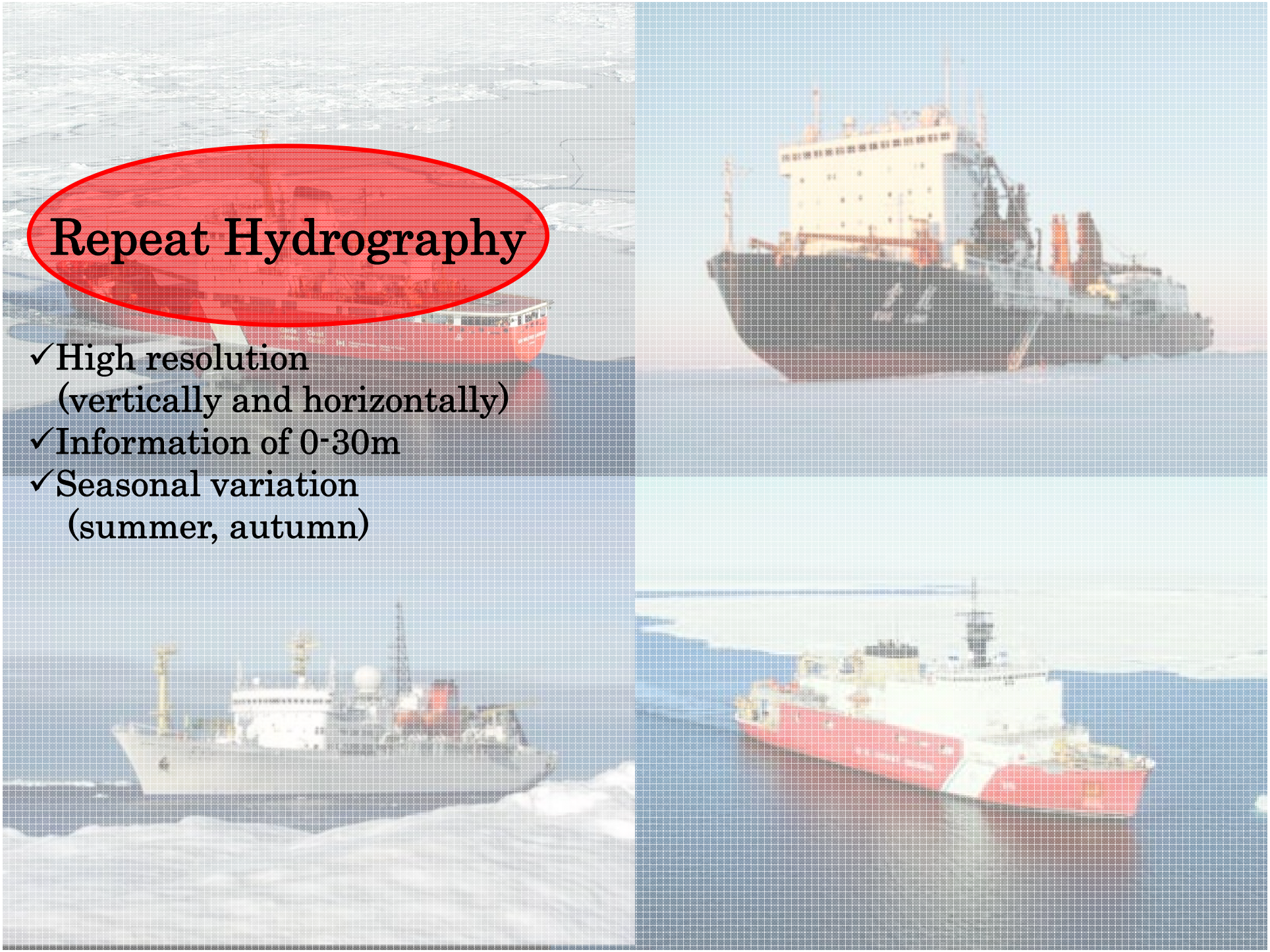
Summary of preliminary results of physical oceanographic analysis

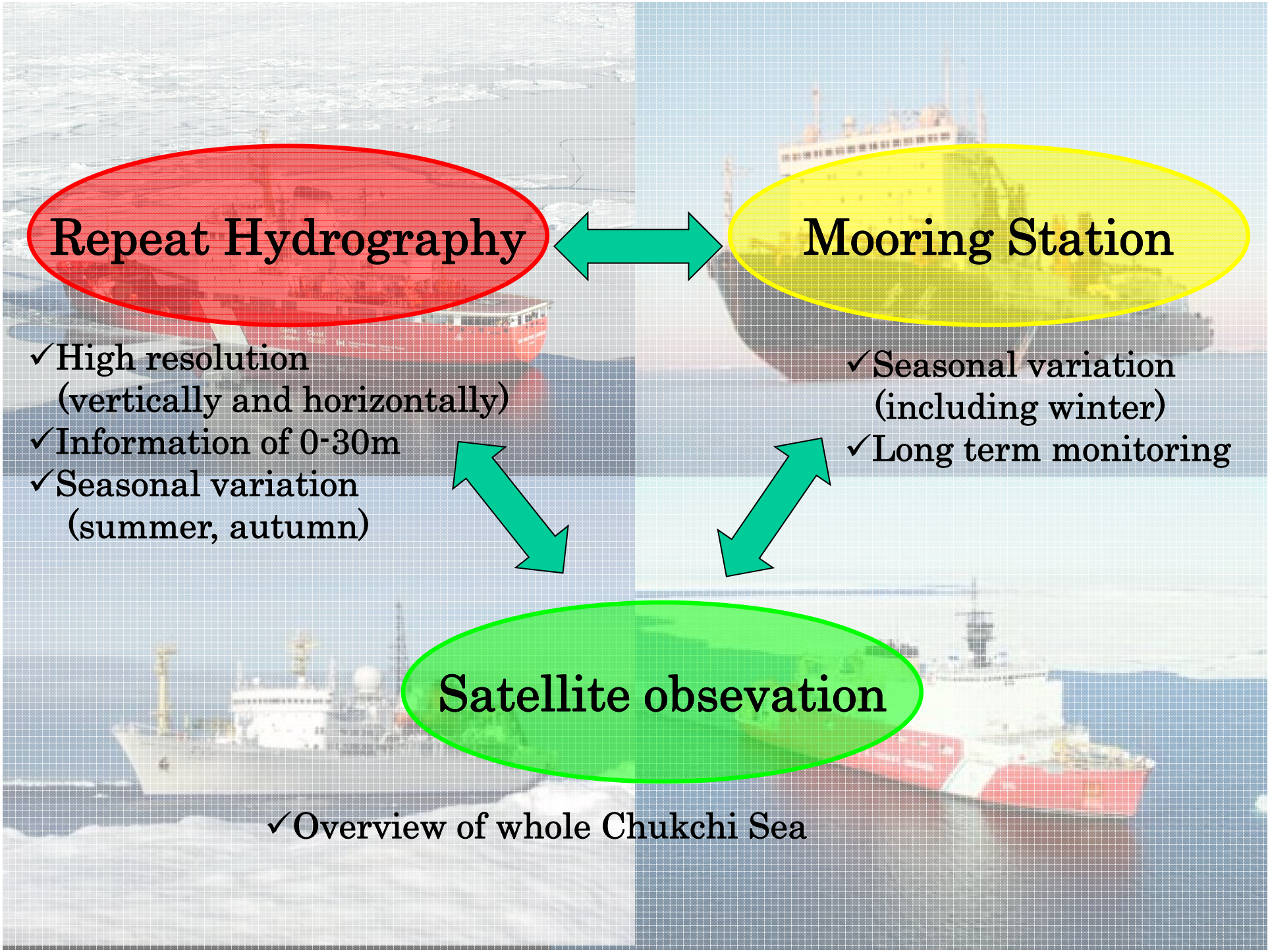
- ✓ Repeat hydography is successfully capturing seasonal variation of the Pacific Water.
- ✓ Averaged volume transport through the Barrow Canyon is 1.3 Sv (1.0-1.7 Sv)
- ✓ Seasonal variation of heat content and heat flux is large. 8.6TW (July), 13.2 TW(Aug), 16.5 TW (early Sep) and 1.6 TW (end of Sep)
- ✓ Fresh water flux from July to September (3 months) is 800 km^3.



Repeat Hydrography

- ✓High resolution (vertically and horizontally)
- ✓Information of 0-30m
- ✓Seasonal variation (summer, autumn)




Repeat Hydrography
Mooring Station
✓High resolution
(vertically and horizontally)
✓Information of 0-30m
✓Seasonal variation
(summer, autumn)
✓Seasonal variation
(including winter)
✓Long term monitoring
Satellite obsevation
✓Overview of whole Chukchi Sea