The amount of bubble injection on the concentrations of N_2 and Ar in the western North Pacific

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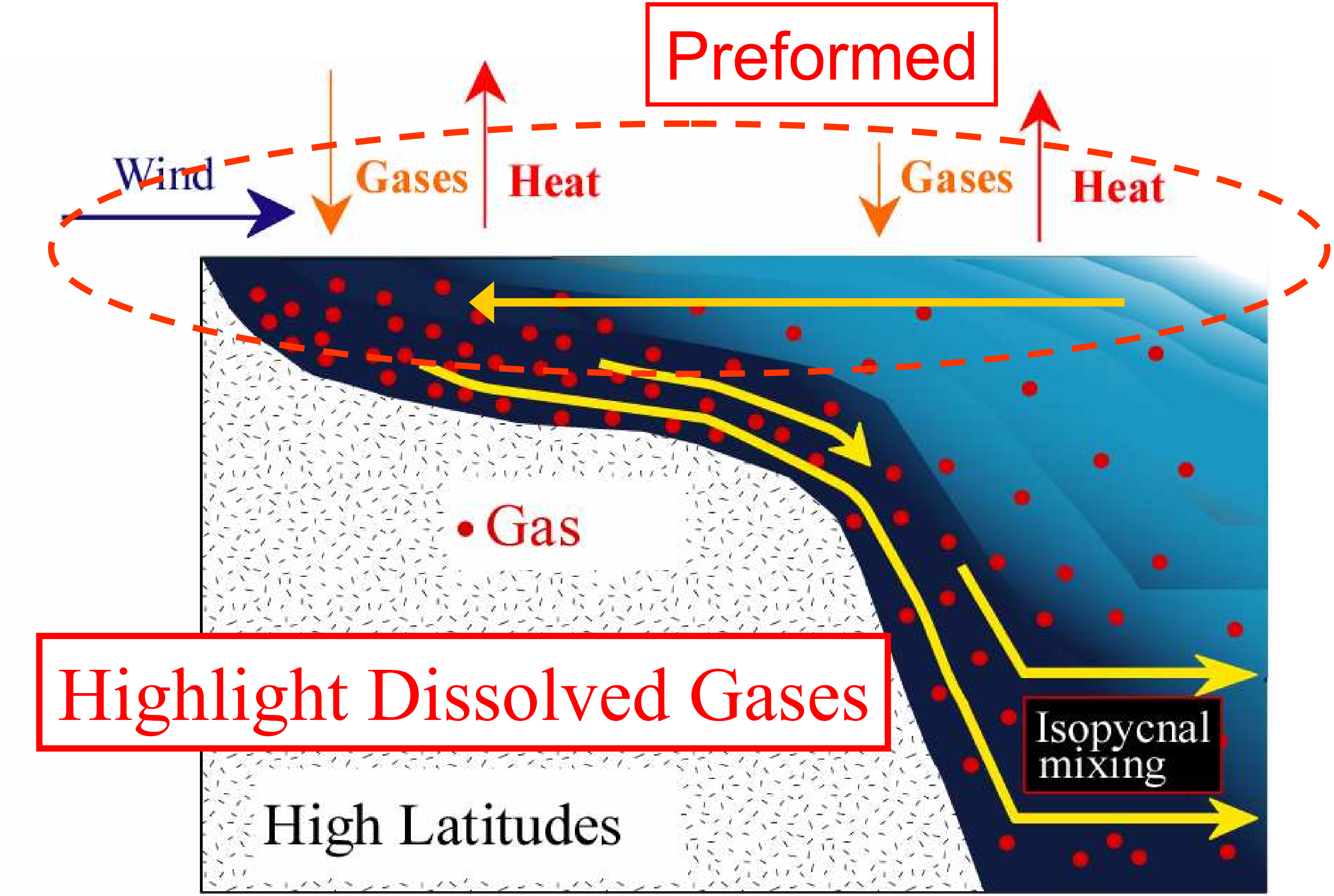
Outline

- Using N_2 and Ar
- Key word : Preformed sea surface state
- Target : Subsurface water mass
- Amount of bubble injection (*B*)
  - Index of preformed wind speed
- Saturation state (*A*)
  - Index of preformed barometric pressure
- Climate change will affect value of *B* and *A*
- Preformed O_2 and CFCs by using *B* and *A*

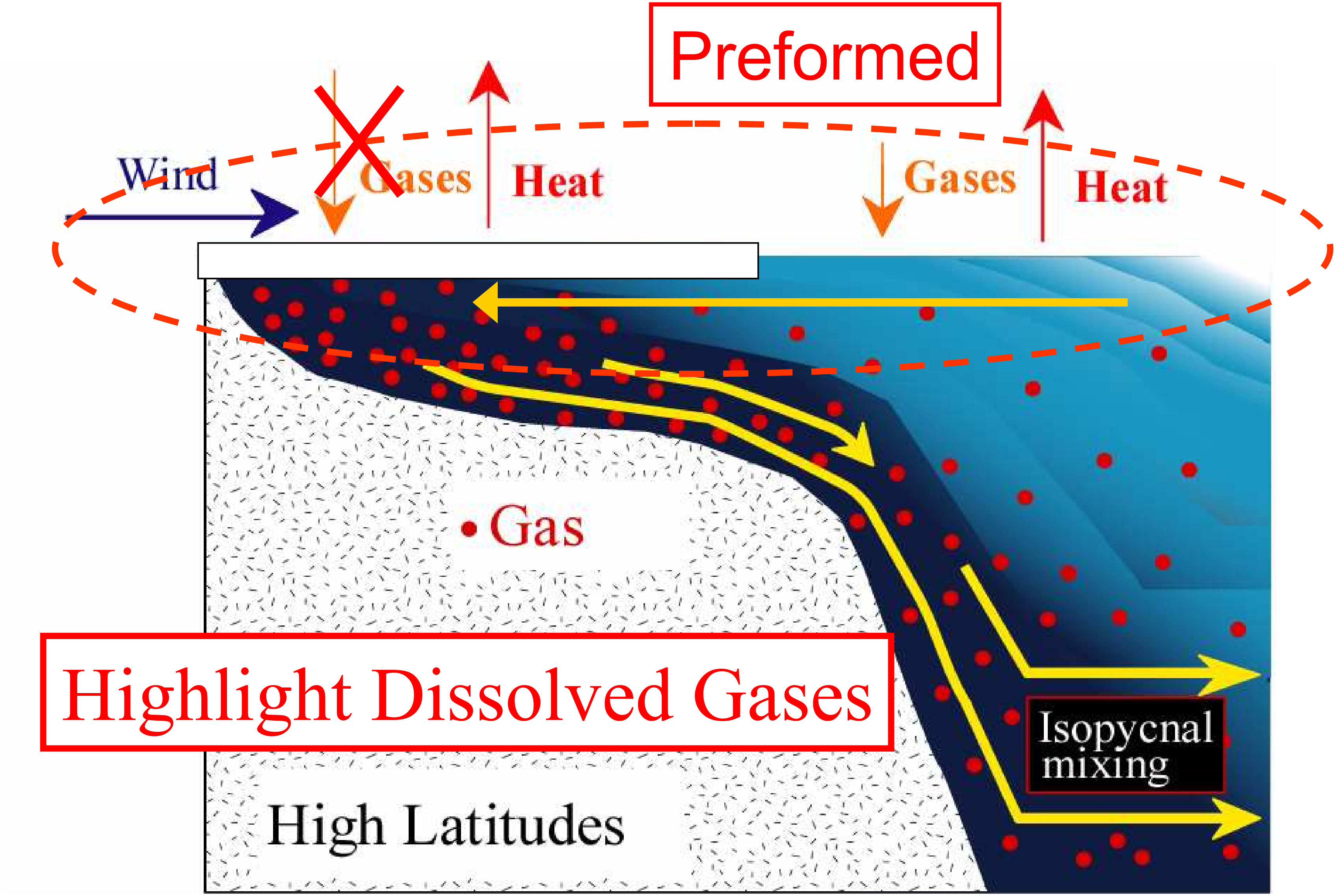
Background : Preformed

High Latitudes, Winter



Background : Preformed

High Latitudes, Winter

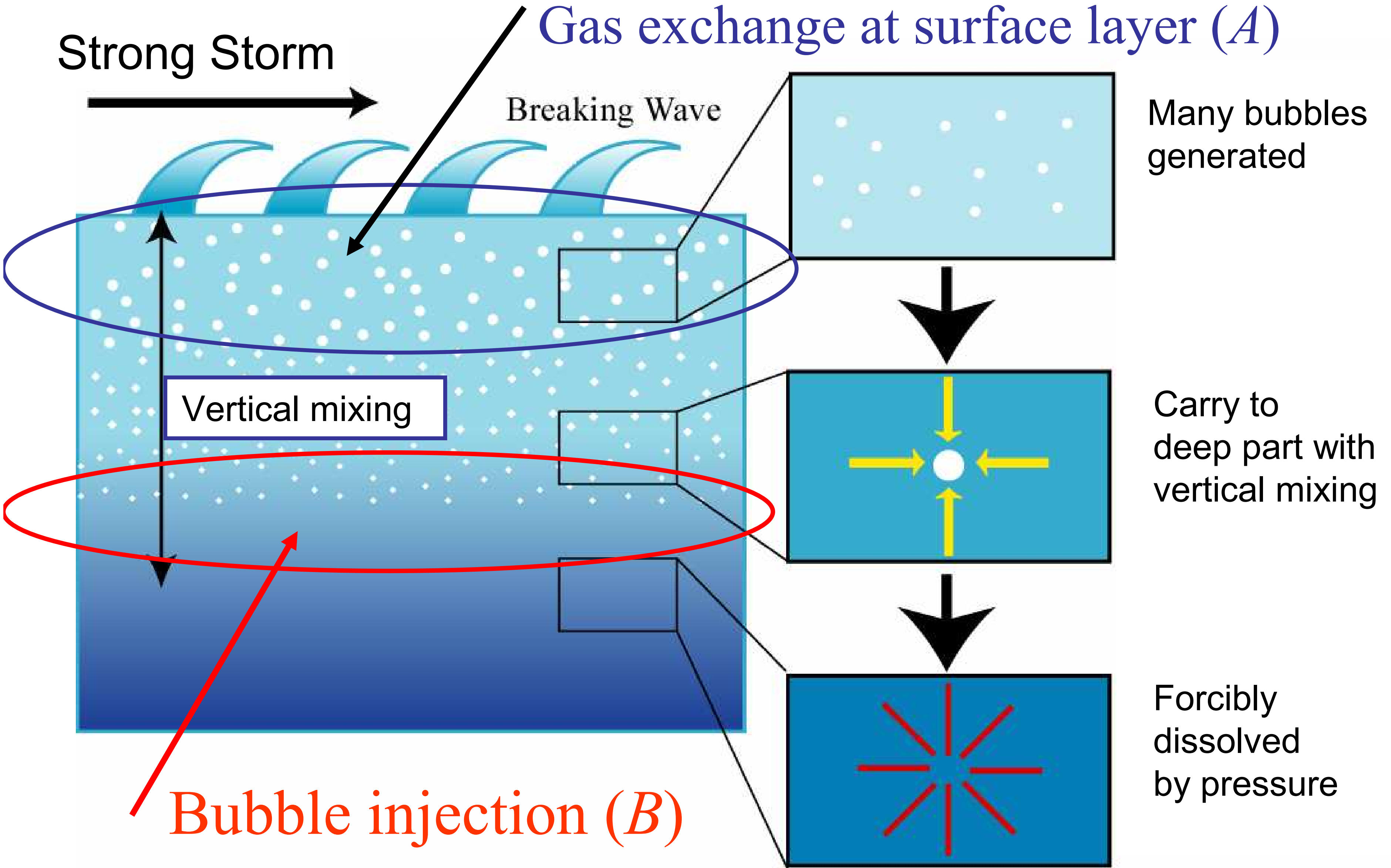


Gas flux process : Two ways

Satu(T,S and P) = equiibrium

Flux = k (Satu(T,S and P) - C)

A is constrained barometric pressure

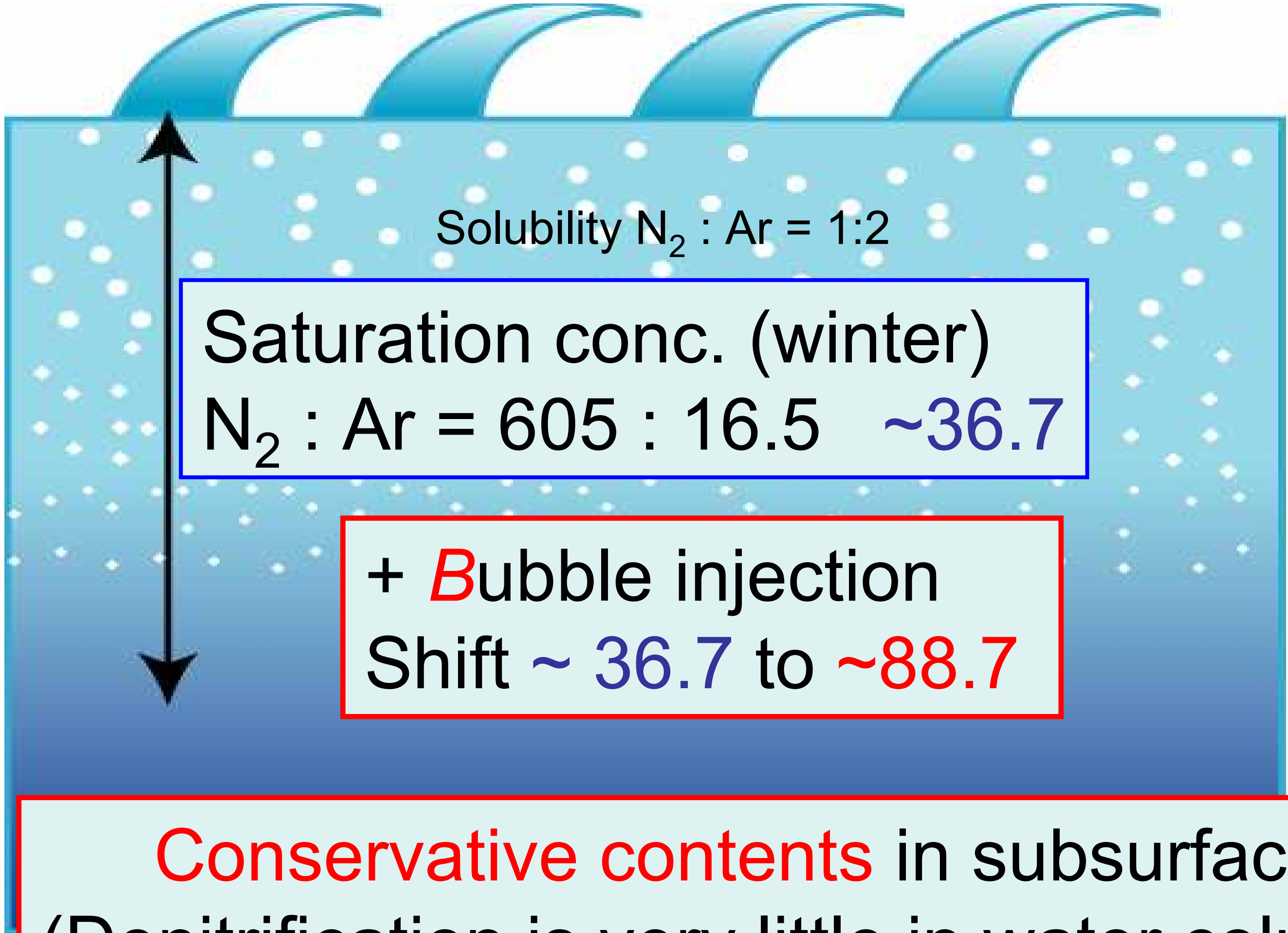


B reflect wind velocity

N_2 and Ar

Atmosphere

N_2 : Ar = 0.7980 : 0.0090 ~88.7 : Constant



Conservative contents in subsurface
(Denitrification is very little in water column)

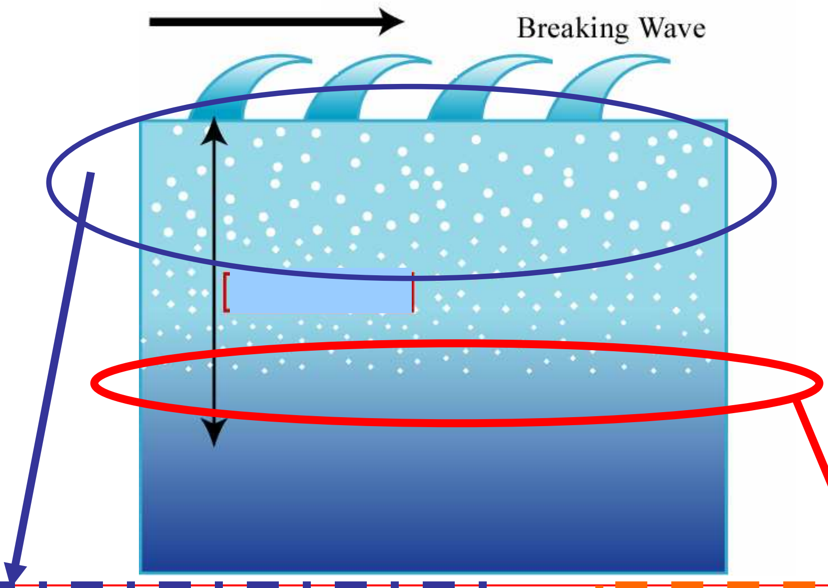
High precision analytical method

(Tanaka and Watanabe, 2007)

Precision < 0.1 %

Thus, concentration of N_2 and Ar in subsurface depend on preformed surface state !!

Estimates of A and B by N_2 and Ar



$$N_{2\ obs} = A \times N_{2\ sat} + 0.7809 \times B \text{ ------- (1)}$$

$$Ar_{obs} = E_{Ar} \cdot A \times Ar_{sat} + 0.0093 \times B \text{ ------- (2)}$$

Conc. Surface Gas Exchange Bubble injection

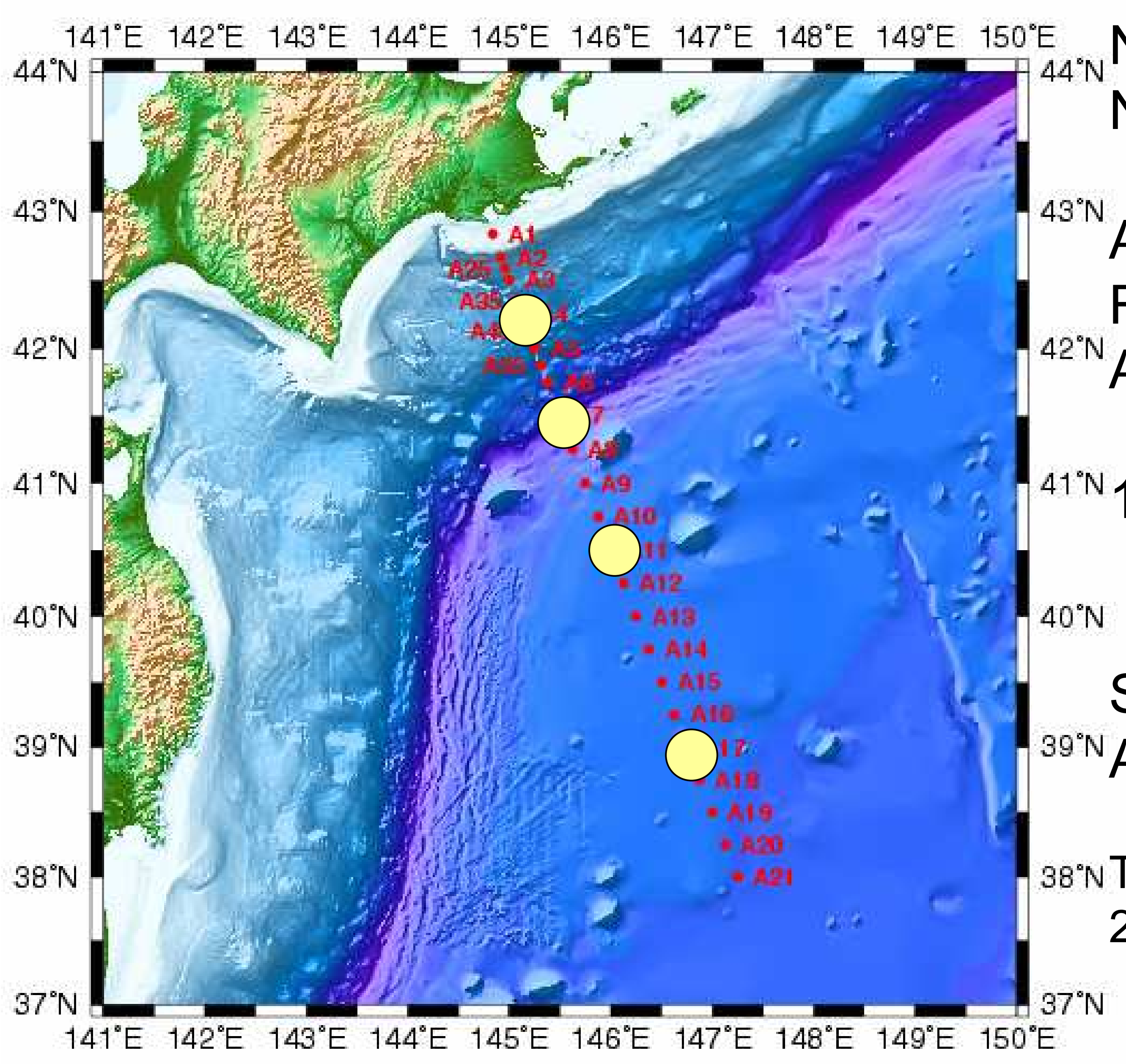
N_{2sat}, Ar_{sat} : Saturation state using by T, S (1 atm., μmol/kg)

E_{Ar} corrected difference between gas exchange rate of N_2 and Ar

Error of B : ±~4 μmol/kg, A ± ~0.06

Sampling area   05 / 2007

Hokkaido, Japan



Northern Western North Pacific

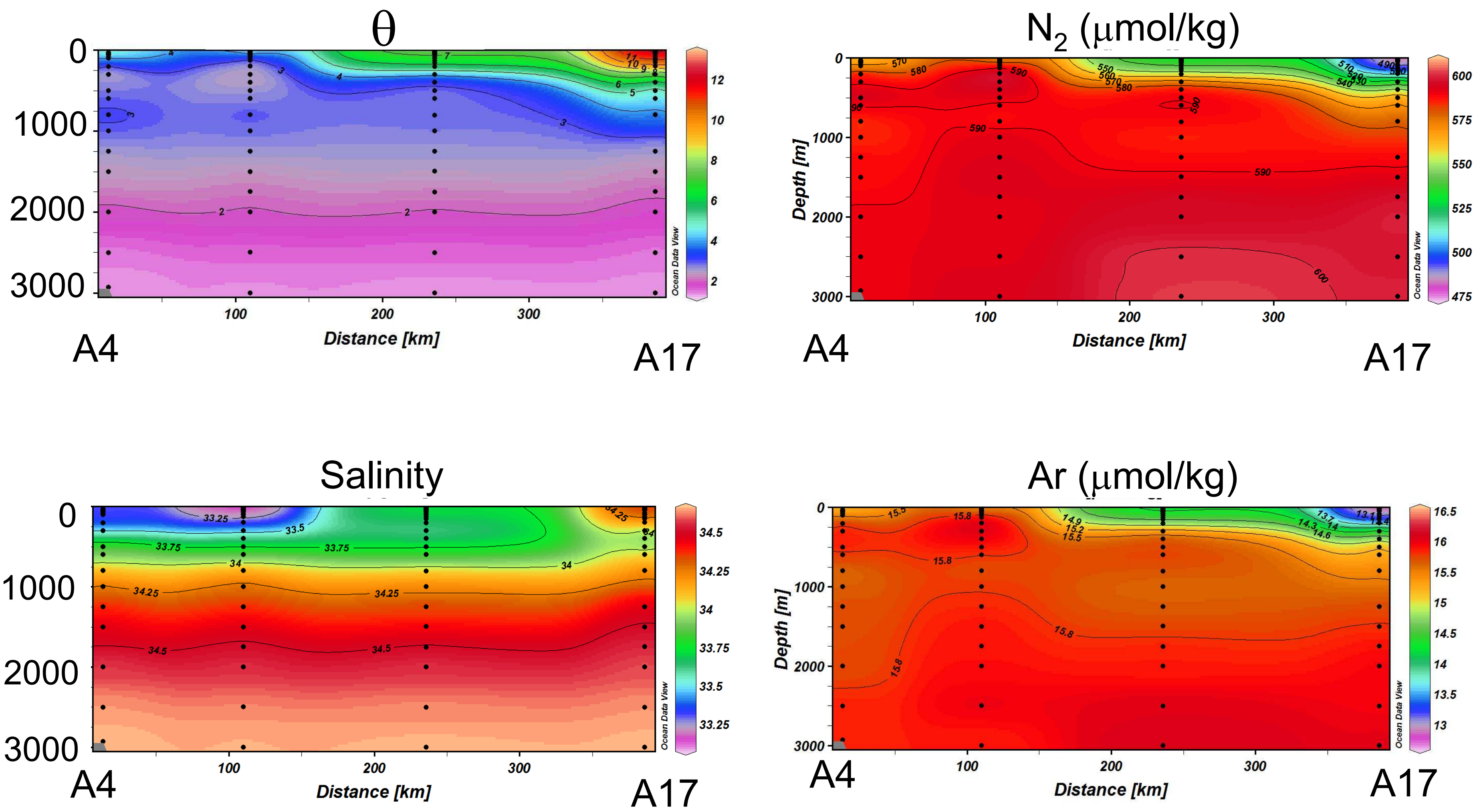
A-line
R/V Hokko-Maru
A4,7,11 and 17

1 station 23 layers
10 ~ 3000m

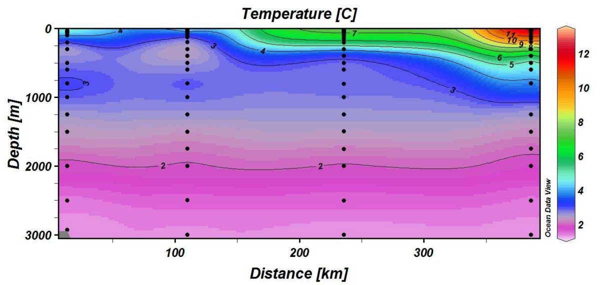
Sampling
Analytical method

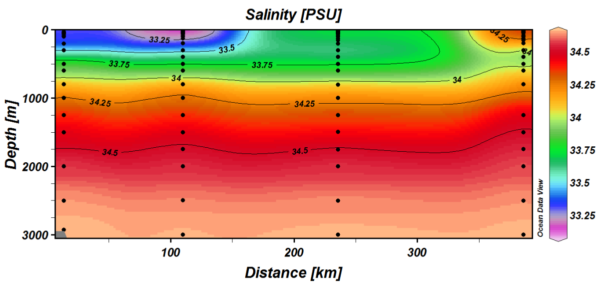
Tanaka and Watanabe, 2007

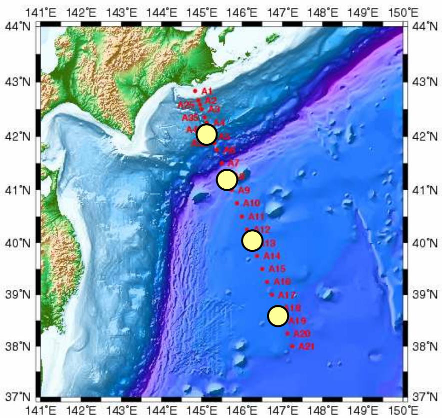
Results, θ, S, N_2 and Ar conc.



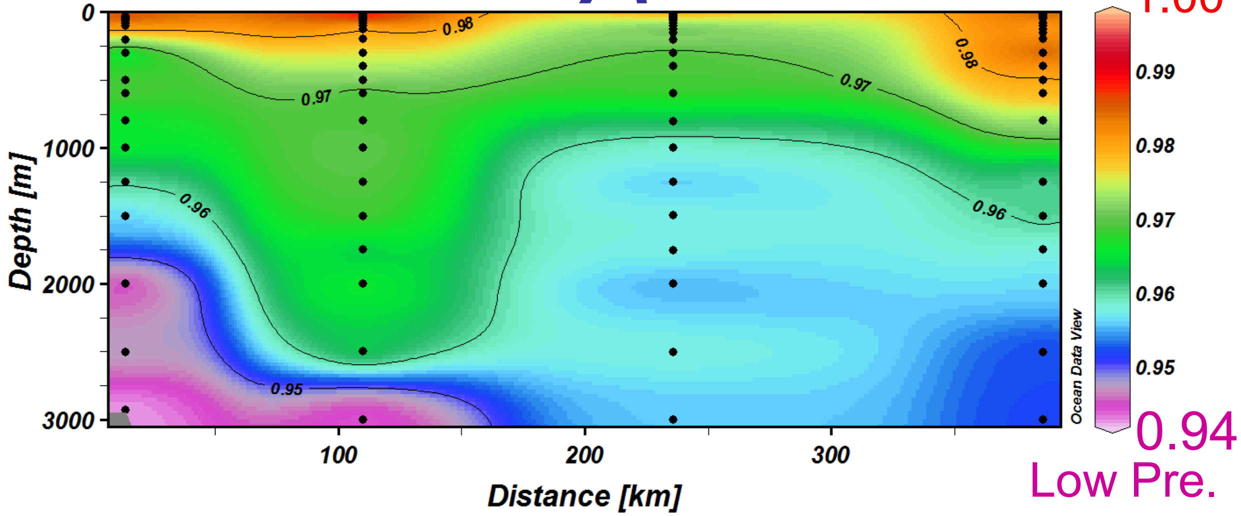
Results : *A* and *B*



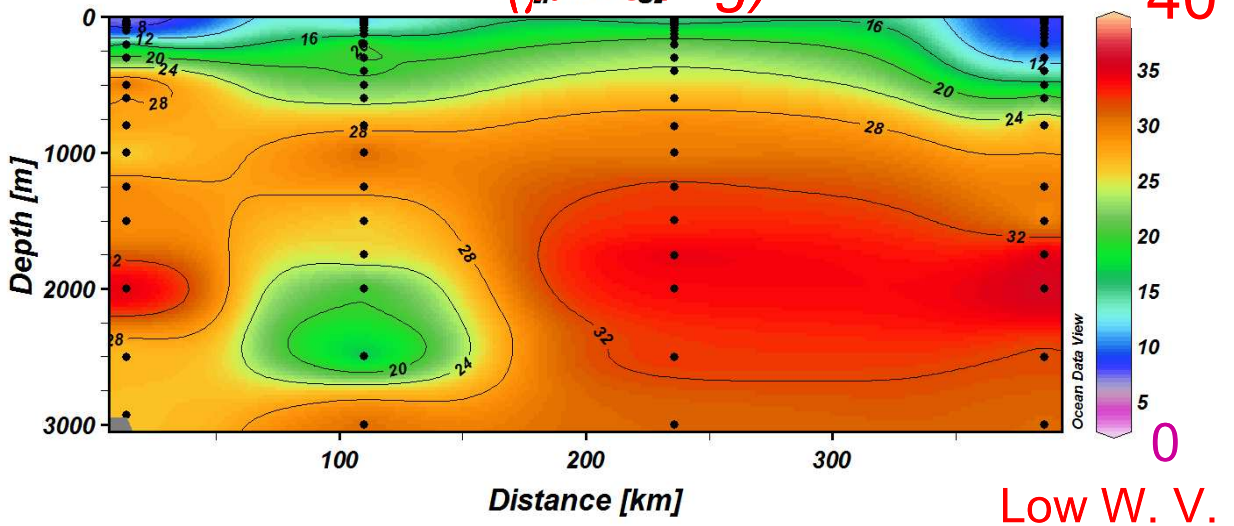




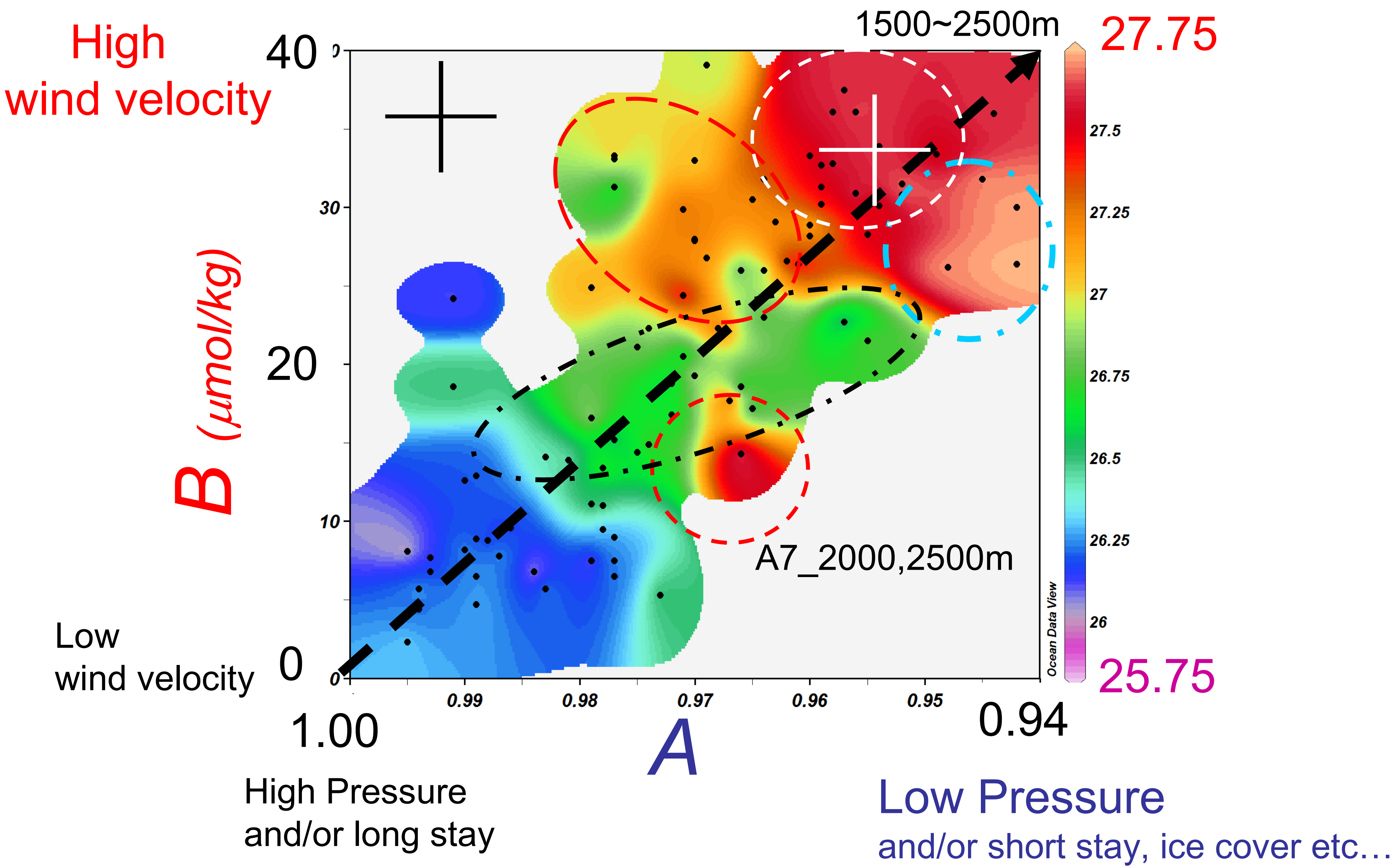
A



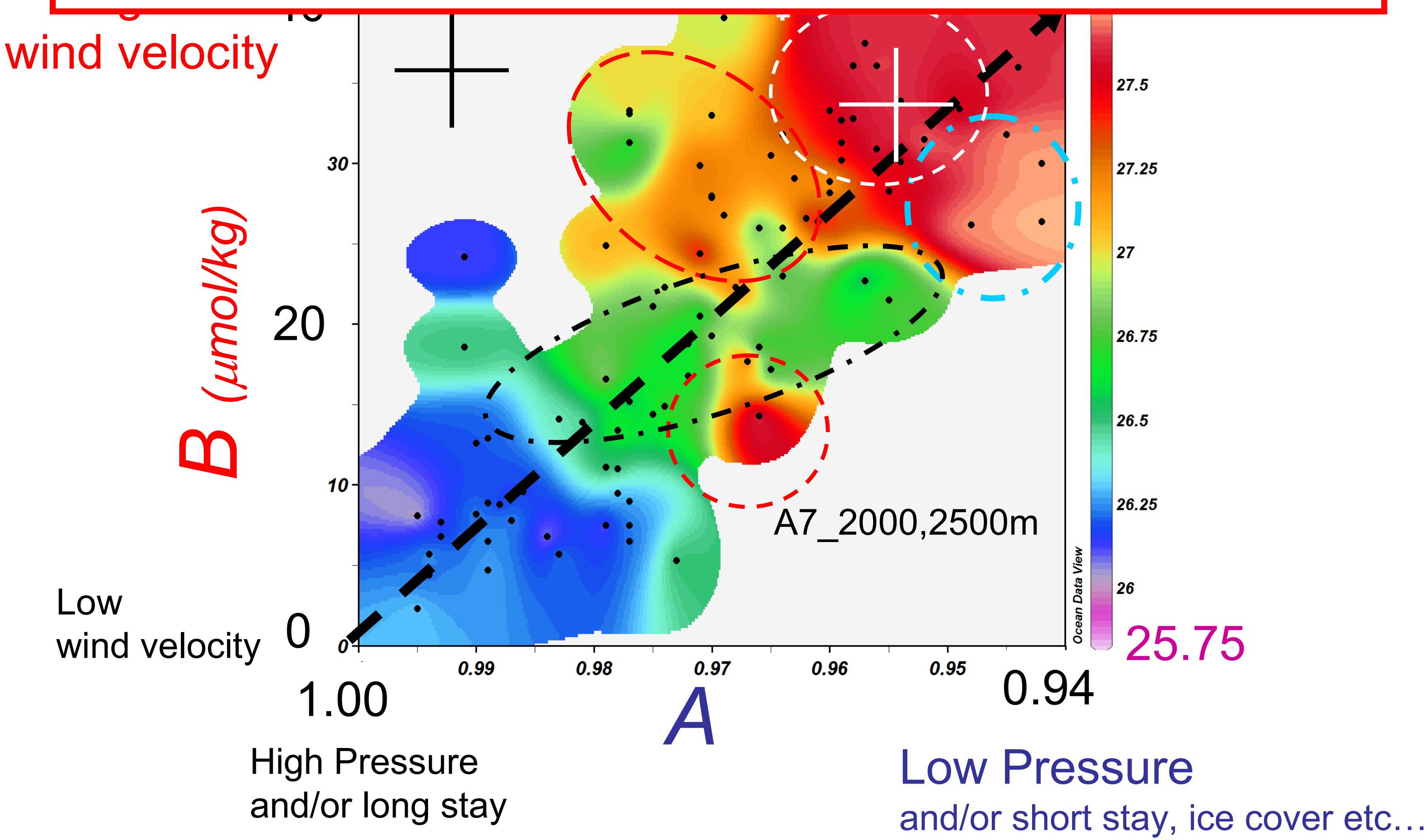
B (μmol/kg)



B vs *A* on Sigmaθ

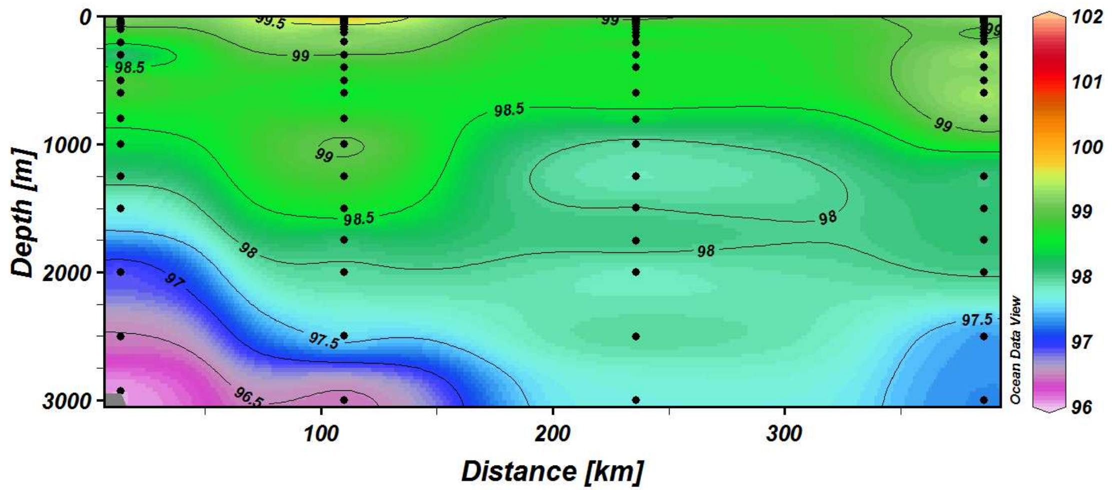


As each water mass had a significantly different value of *B* and *A*, it is possible that we can use *B* and *A* as an index of the preformed sea surface state and as a water mass indicator.



Saturation state of Preformed Other Gases

$SpreZ = (E_Z \times A \times Z_{satu} + Z\ \text{Air Conc.} \times B) / Z_{satu}$



SpreO$_2$

96~100%

AOU

~14 μmol/kg

Over estimated

It is necessary to re-estimate the oceanic uptake of anthropogenic CO_2 by using *PreO*$_2$

Saturation state of Preformed Other Gases

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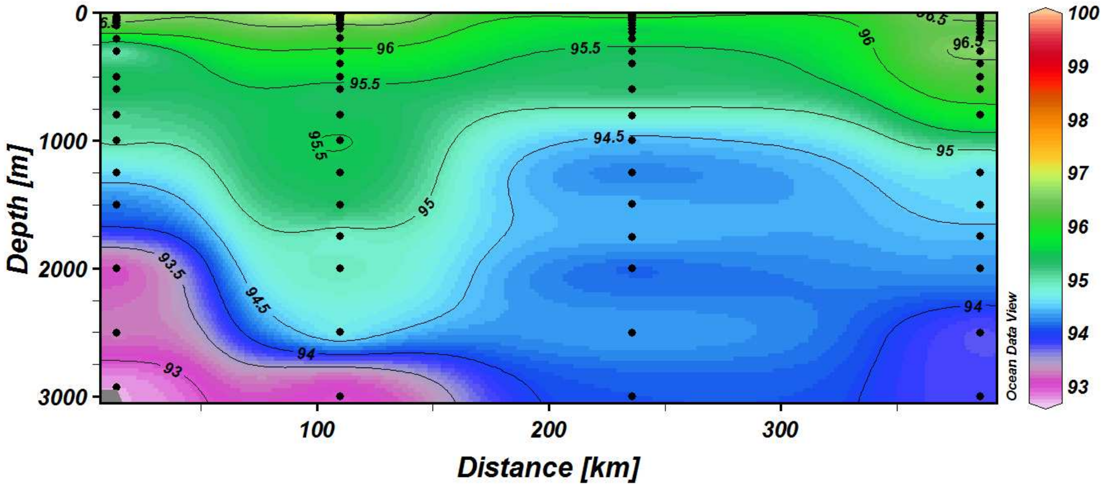

SpreCFC-12

93~98%

CFC age

~7 year gap

It is necessary to re-estimate the pCFCs age by using *PreCFCs*

Conclusion

- Each water mass has characteristic *A* and *B* .
- It is possible that we can use *B* and *A* as an index of the preformed sea surface state and as a water mass indicator.
- Preformed other gases can be estimated by *A* and *B*. It is necessary to re-estimate the various estimates.

Future Plan

- Time series observation
  (Climate change, e.g., NPIW)
- Spatial distribution of N_2 and Ar
- Correlation between surface condition (P, T, Wind speed) and *A*, *B* by time series observation during winter on the sea surface.

Thank you!!