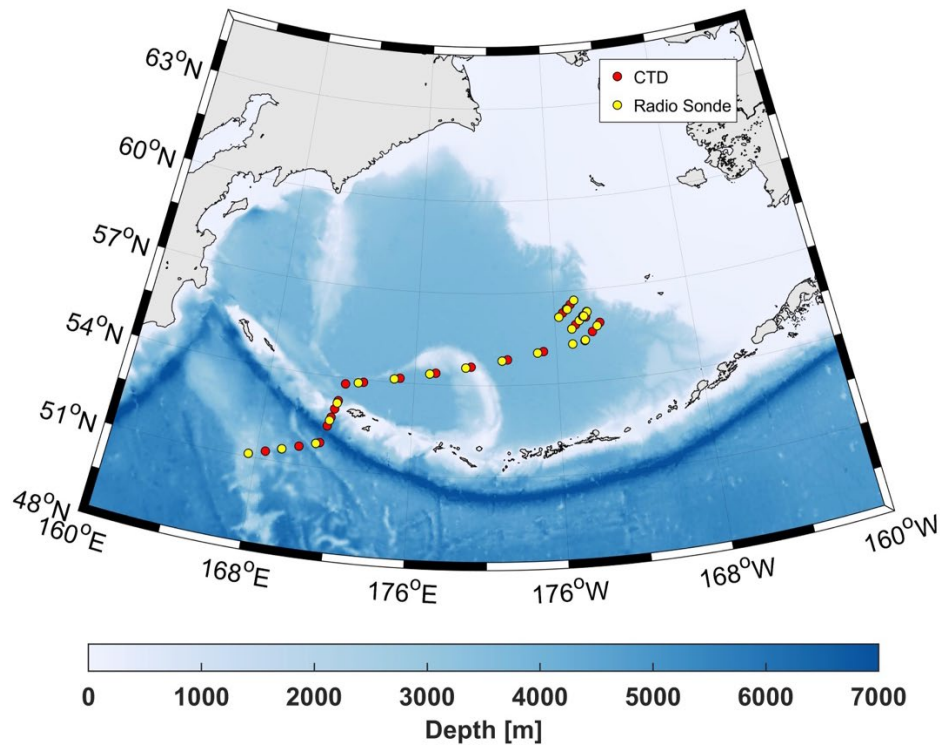


# 2021 RV ARAON research activities in Bering Sea

## 1. Research activities

On-site observation was conducted in the Bering Sea on the Korea Polar Research Institute icebreaker RV Araon, 8 – 14 July 2021, in order to obtain physical property data on oceanic-atmospheric environments in the Bering Sea (Figure 1).



**[Figure 1]** A station map of in-situ ocean observation during the cruise (red dots) and along-track locations of radiosonde balloon launch (yellow dots)

## 2. Materials and methods

### 1) Ocean and atmospheric observations

Ocean Temperature-Salinity-Depth Measurement Equipment (CTD) & Ocean currents (LADCP) observations were performed: 1) near the Near Strait where the exchange between the North Pacific and the Bering Sea occurs, and 2) on the continental slope where the Bering Slope Current passes. Expendable CTD (XCTD) observation was additionally performed between CTD cites to fill the gap between the sites. Temperature and salinity profiles were obtained from the surface layer to about 50 m above the floor using the ship's CTD equipment. The quality of the obtained data was improved through post-processing such as removing outliers, correction of time differences between sensors, and correction of heat, and profiles at vertical 1m intervals at each station were obtained. In the case of XCTD, a vertical 1 m interval profile from the surface

layer to the depth of about 1100 m was obtained. Using LADCP installed in the CTD frame, ocean current data were obtained during the CTD operation. The obtained data were improved by using software provided by Columbia University's LDEO laboratory, such as Shipboard-ADCP and GPS calibration, and an average profile of 8 m vertical from each station to the bottom was obtained. A total of 28 radiosonde launches were carried out onboard IBRV Araon in the Bering Sea to obtain vertical profile data on temperature, humidity, wind direction, wind speed, and air pressure. Most of the radiosondes reached the altitude above 25 km and up to 30 km, to gain the meteorological profile data from the troposphere to the mid-stratosphere.

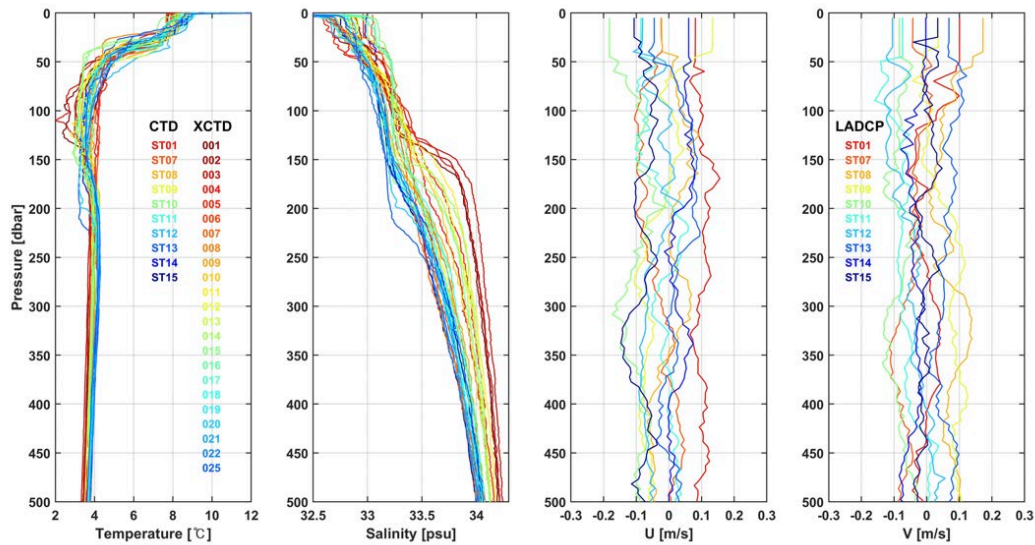
## **2) Timeseries measurement using superstation buoy**

The ocean-atmosphere comprehensive observation buoy was installed in the western part of the Bering Slope to collect data, and was recovered on Araon way back after its northern expedition. Ocean and atmospheric time series data were obtained for 60 days from 15 July to 13 September 2021. Atmospheric data such as wind direction, wind speed, humidity, radiation heat, and atmospheric pressure were collected and transmitted to Korea Polar Research Institute. Ocean sensors were installed on mooring line to collect time-series data of surface and upper ocean water temperature, salinity, and velocity.

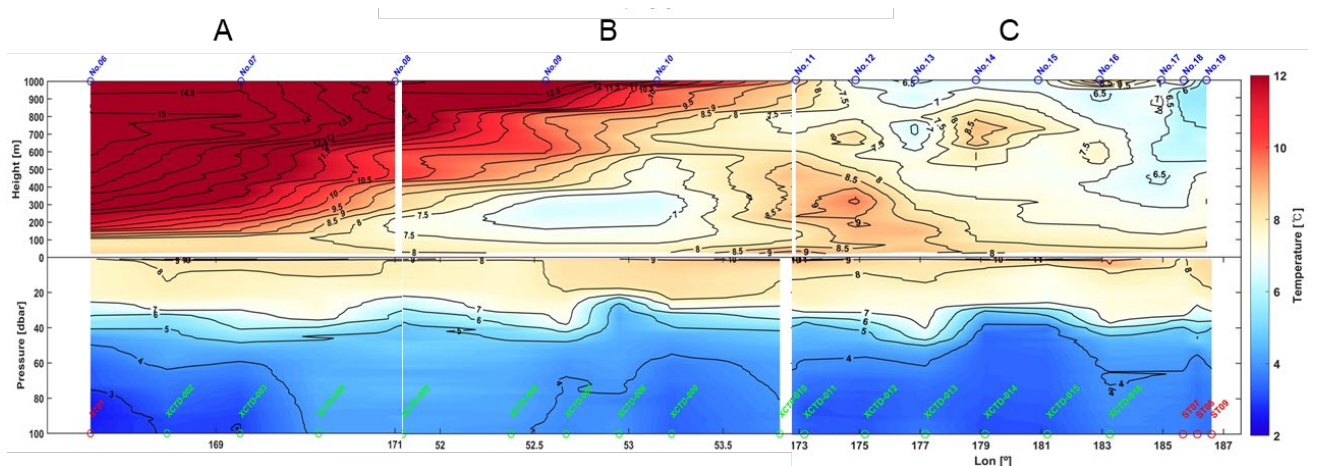
## **3. Scientific achievements**

### **1) Ocean observations**

The vertical distribution of water temperature and salinity was obtained using CTD and XCTD. The water temperature minimum layer was found from the center of the Bering Sea to the continental slope at a water depth of 50 to 200 m (Figure 2). The radiosonde was operated at 6-hour intervals to regularly observe temperature, humidity, atmospheric pressure, wind direction, and wind speed in the upper atmosphere. Radiosondes are very important data for understanding atmospheric characteristics because they directly observe the upper atmosphere vertically. The radiosonde reaches an altitude of 30 km and transmits the atmospheric vertical profile to the ground in real time. At the mouth of the Bering Sea, mixing was active due to the interaction of ocean currents and topography, and the stratification was weak, and the atmosphere showed a low surface temperature and strong stability profile. From the entrance of the Bering Sea to the continental slope, the stratification of the upper water temperature became stronger, and at this time, the neutral stability profile prevailed in the atmosphere (Figure 3).



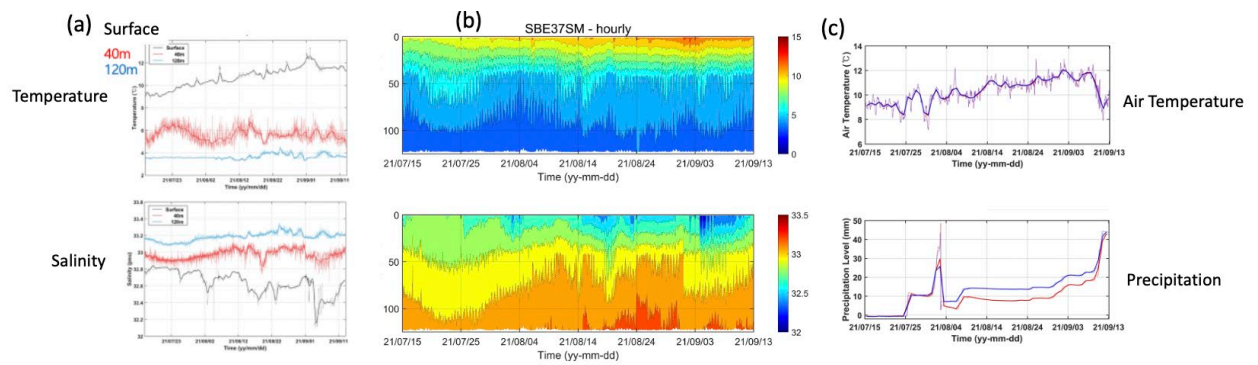
**[Figure 2]** Vertical profiles of temperature, salinity, current (zonal and meridional velocity) from CTD, XCTD, LADCP



**[Figure 3]** Vertical section map of atmosphere and ocean temperature

## 2) Timeseries measurement using superstation buoy

While the overall surface water temperature and salinity fluctuation during the observation period showed a clear tendency of high temperature and low salinity, this trend was not clear at 40 m and 120 m. The increase in surface water temperature can be attributed to seasonal fluctuations. Surface salinity shows a decreasing trend, which is consistent with the trend of increasing and fluctuating rainfall in the precipitation data of the comprehensive observation buoy. We observed short-term temperature–salinity changes, especially at 40 m, characterized by 20 times of fluctuations for 10 days that concur with the ocean current fluctuations. This may infer that the ocean temperature and salinity fluctuations are related to the semi-diurnal tide.



**[Figure 4]** Temperature and salinity timeseries (unit: °C, psu) and (c) air temperature and precipitation from the atmospheric sensors

#### 4. Publications

We have not yet published papers in scientific journals out of the results from the expedition. However, several papers have been presented in various meetings.