Japan's Update to FARO 2024 on Arctic Science Activities

Takuji Nakamura
National Institute of Polar Research
Research Organization of Information and Systems
Japan

Arctic Challenge for Sustainability Ⅱ 2020-2025

<< *Project Goal* >>

Promoting advanced and interdisciplinary research on the Arctic, aiming social implement of its results.

4 Strategic Goals

Strategic Goal 1
Advanced Observation of Arctic Environmental Change

Strategic Goal 2
Improvement of Weather and Climate Prediction

Strategic Goal 3
Impact of Arctic Environmental Change on Society

Strategic Goal 4
Legal/Policy Response and Research Implementation for a Sustainable Arctic

2 Priority Subjects

Priority Subject 1
Capacity Building and Research Promotion

Priority Subject 2
Strategic Dissemination of Arctic Information

11 Research Programs

- Atmosphere
- Ocean
- Cryosphere
- Land
- Teleconnection
- Climate Prediction
- Human Society
- Arctic Sea Routes
- Coastal Environments
- International Law
- International Relations

- **>220 Researchers participating**
- **Total budget >5 Billion Yen (34 MEUR)**

Research Infrastructures

- International Collaboration Site
- Research Vessel
- Earth Observation Satellite Data
- Arctic Data archive System

RIs: International Collaboration Sites

In ArCS II, observation and research sites in the Pan-Arctic are allocated as 'International Collaboration Sites' under MOUs with key Arctic institutes to promote advanced joint studies by precisely monitoring changes in the area and to utilize them as on-site platforms for capacity building of ECRs.

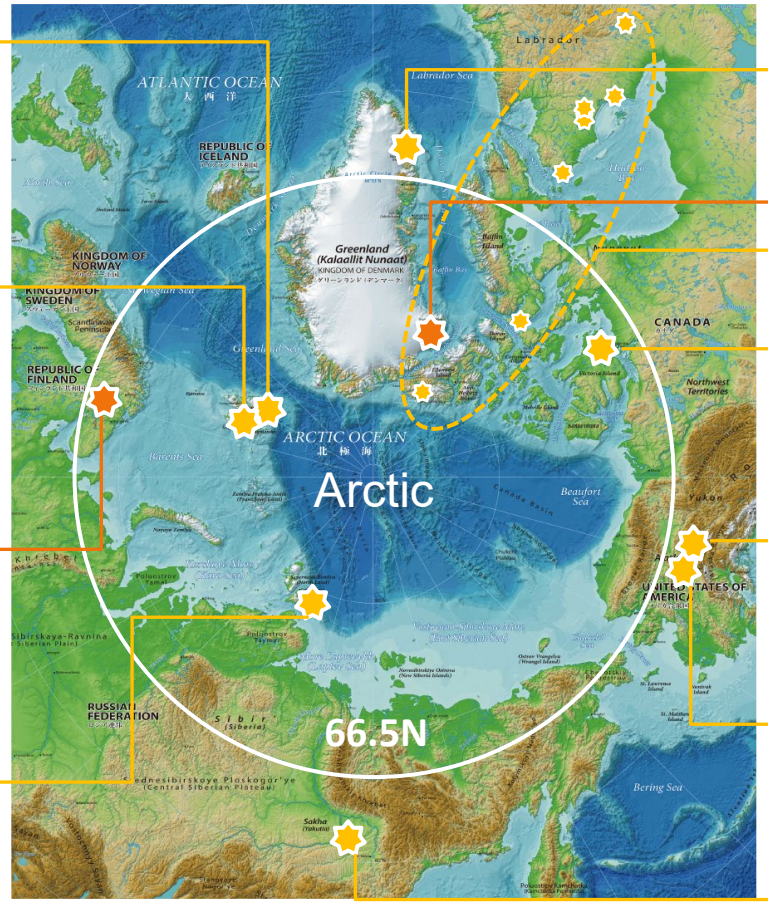
- 11 Arctic sites in 6 countries (Qaanaaq-Siorapaluk & Pallas-Sodankylä have been newly added in ArCS II)
- NIPR started integrated Arctic observations based at Ny-Ålesund in 1991 under close collaboration with Norwegian Polar Institute and NySMAC. In 2019, the new 'NIPR Observatory' was inaugurated.
- Since 1999, IARC/ UAF has been taking a pivotal role in promoting US-Japan collaborative studies and training ECRs especially from JAXA, JAMSTEC and HU.
- Based on MOUs with IBPC and AARI of Russia, Russia-Japan joint studies and programs have been continued in Yakutia and at Ice Base Cape Baranova.

Ny-Alesund NIPR Observatory

University Centre in Svalbard (UNIS)

Pallas-Sodankyla GAW station

Ice Base Cape Baranova



Greenland Institute of Natural Resources (GINR)

Qaanaaq-Siorapaluk Research Base

Centre d'etudes Nordiques (CEN)

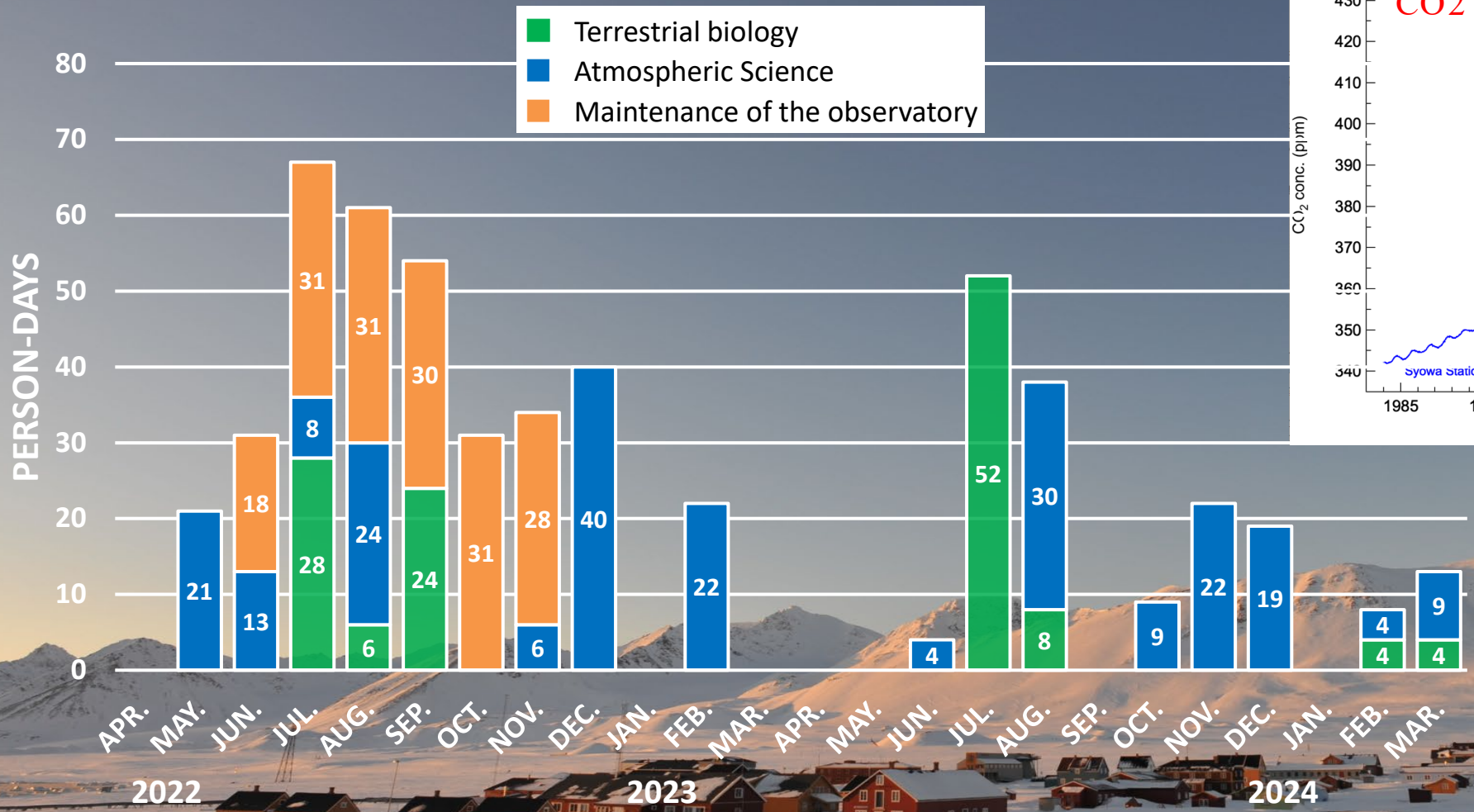
Poker Flat Research Range (PFRR)

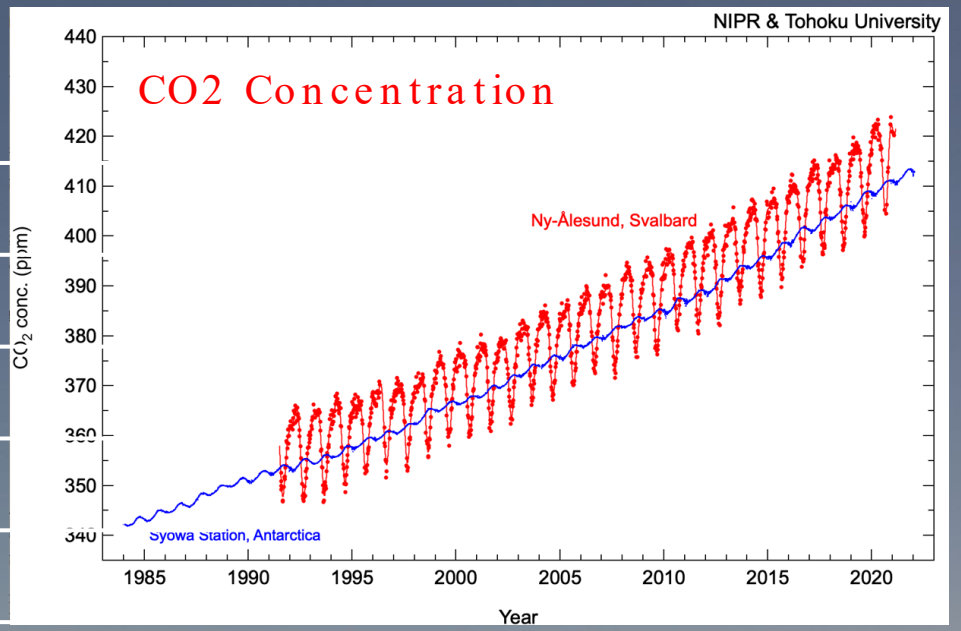
Canadian High Arctic Research Station (CHARS)

International Arctic Research Center (IARC/UAF)

Spasskaya Pad Forest Station

Japanese activities at Ny-Ålesund since 2022

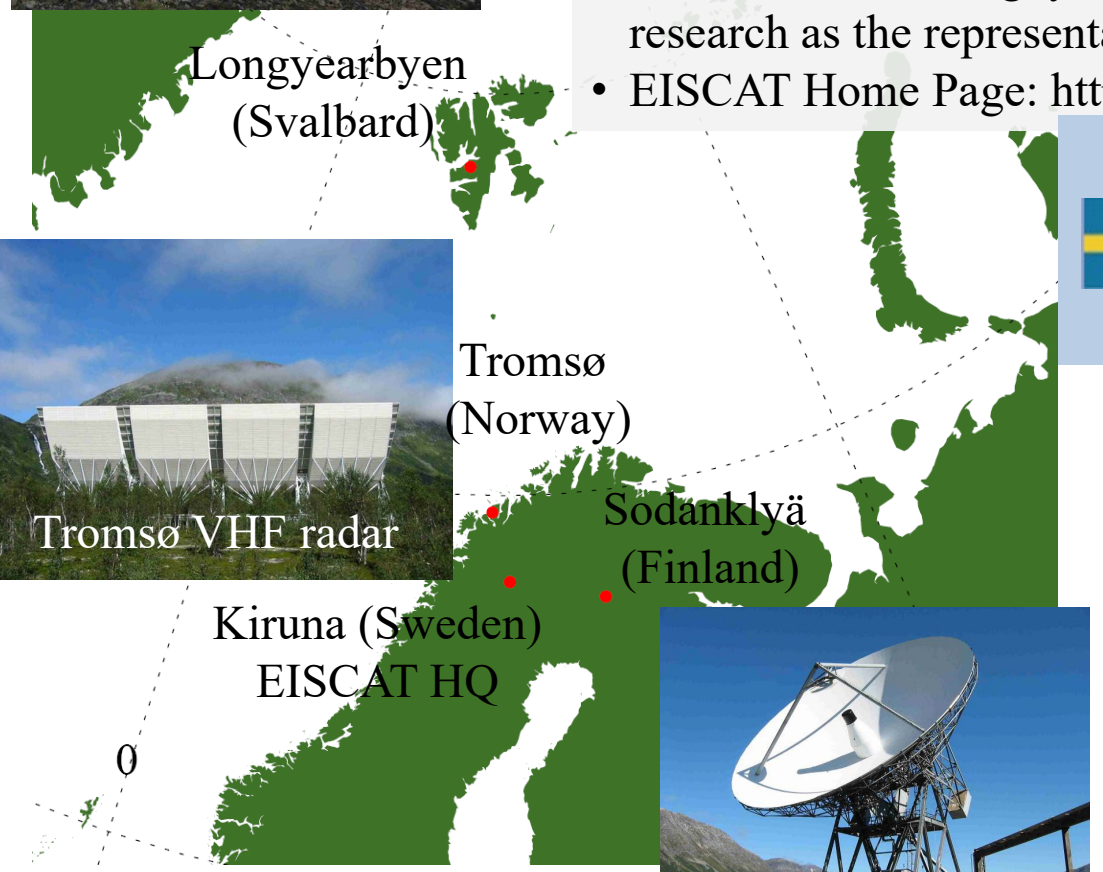




Veksthuset NIPR Observatory
2019～

Contribution to EISCAT Scientific Association

- The EISCAT Scientific Association is an international research organization operating three incoherent scatter radar systems, and is funded and operated by Sweden, Norway, Finland, Japan (since 1996), China (since 2007), the United Kingdom.
- EISCAT studies the interaction between the Sun and the Earth as revealed by disturbances in the magnetosphere and the ionized parts of the atmosphere.
- NIPR and ISEE Nagoya University promote joint usage of the EISCAT data and collaborative research as the representative organization in Japan.
- EISCAT Home Page: https://eiscat.se/

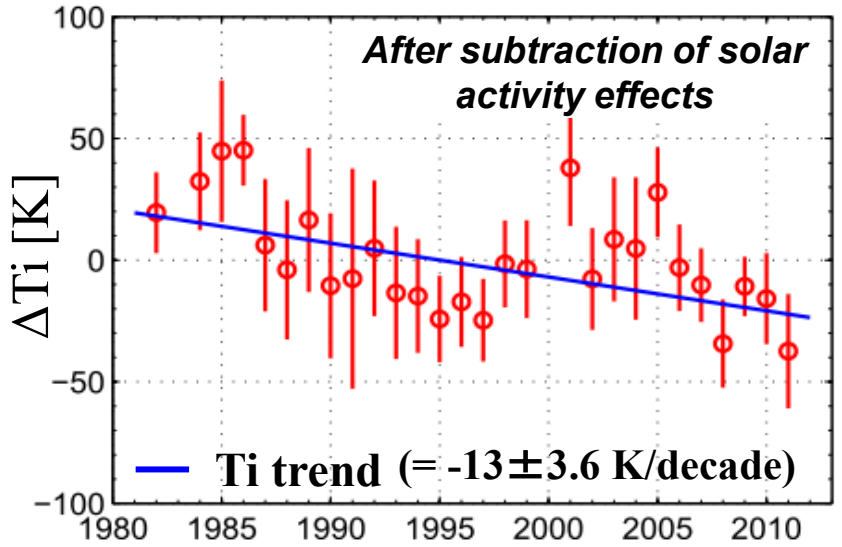


6 associate countries

1996~ 2007~

4 affiliate institutions

2016~ (KOPRI,KASI) 2020~ (DLR) 2020~ (METI)



(Left figure) Ion temperature measured with the EISCAT Tromsø UHF radar at an altitude of ~320 km is decreasing every year by 1-2 degrees.
The upper atmosphere is cooling closely related to the global warming near the ground due to the energy balance in the whole atmosphere.

Contribution to EISCAT_3D implementation

- EISCAT_3D is an international research infrastructure, using radar observations and the incoherent scatter technique for studies of the atmosphere and near-Earth space environment above the Fenno-Scandinavian Arctic.
- The radar system is designed to investigate how the Earth's atmosphere is coupled to space but it will also be suitable for a wide range of other scientific targets for e.g., space weather forecasts and research on climate change.
- First-light of the EISCAT_3D is planned in 2024.

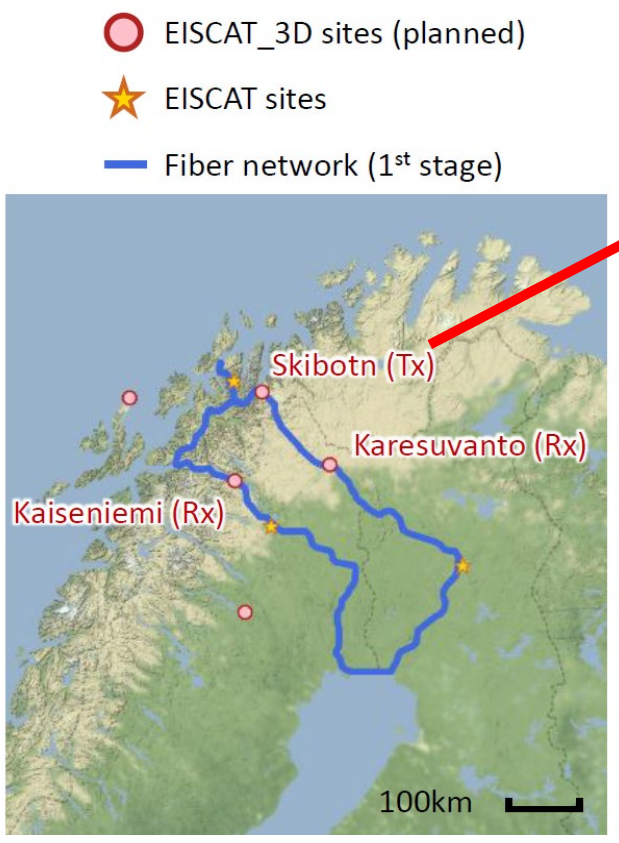
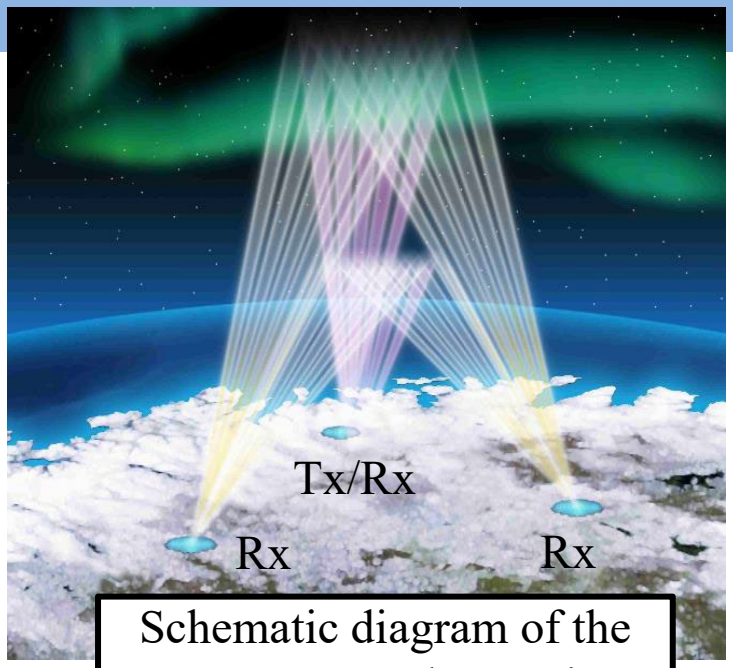


Photo of EISCAT_3D Radar Core Site, Skibotn, Norway.
(Taken on 18 August 2023, courtesy of EISCAT headquarters)



Schematic diagram of the EISCAT_3D observation

High energy-efficient SSPAs for engineering verification tests

- NIPR had been developing high energy-efficient SSPAs for engineering verification tests since 2014.
- It is expected that 37 Sub Array Transmitters (SATs, corresponding to 3.4 MW Tx power) will be in place when the 1st stage of EISCAT_3D operation starts. Japan contributes to the procurement of 15 SATs out of the total so far.

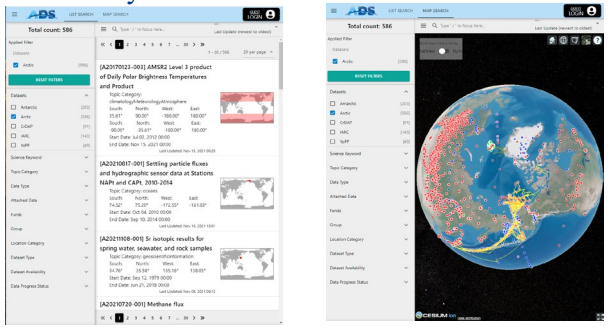
RIs: Arctic Data archive System (ADS)

Overview of Arctic Data archive System(ADS)

The Arctic Data archive System (ADS) aims to develop an Open Science infrastructure for Arctic research, and will promote the mutual distribution of the Big Data of Arctic research. Furthermore, ADS will develop analysis and visualization Web services for integrated Big Data, and intends to generate new value with Big Data.

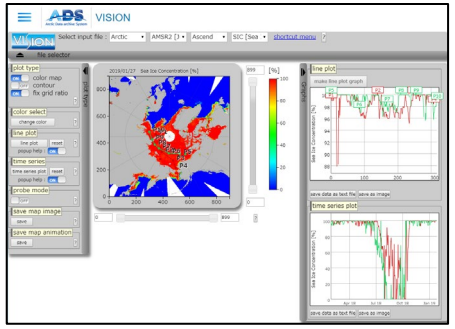
Data publication, analysis and provision by **ADS**

Registration and publication of the survey and observation data



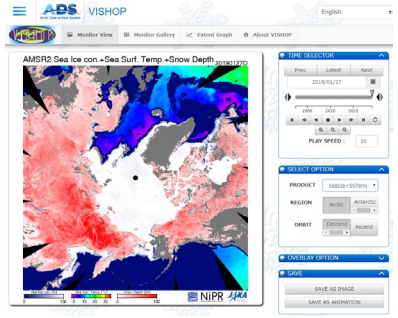
ADS database KIWA

Online Analysis of satellite and model simulation data



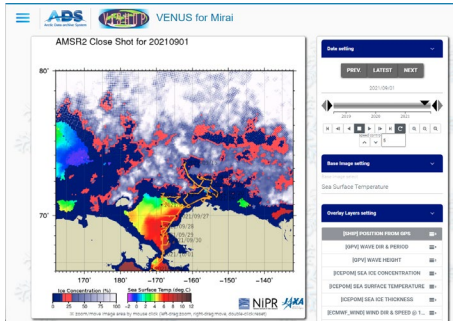
VISION

Near real-time polar environmental monitoring system



VISHOP

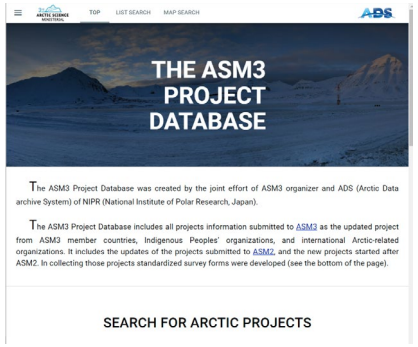
Ship navigation support service "VENUS"

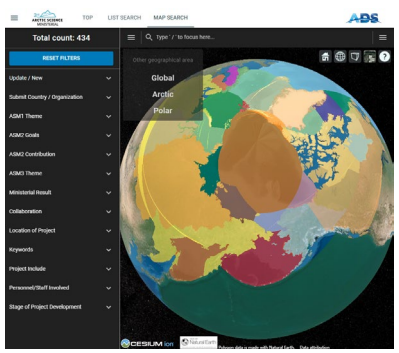


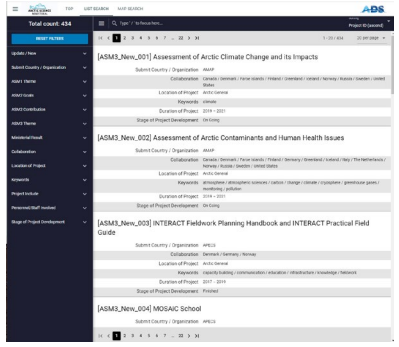
VENUS for MIRAI Cruse

Contribution to 3rd Arctic Science Ministerial **(ASM3)**

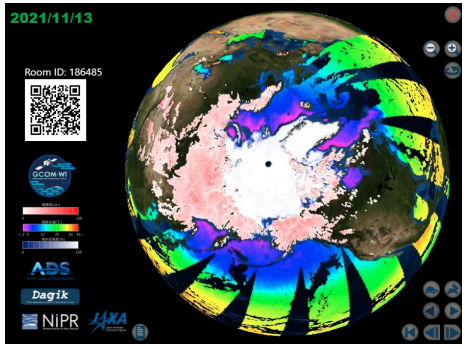
Development of the Project Database mapping all of the ASM3 submitted projects







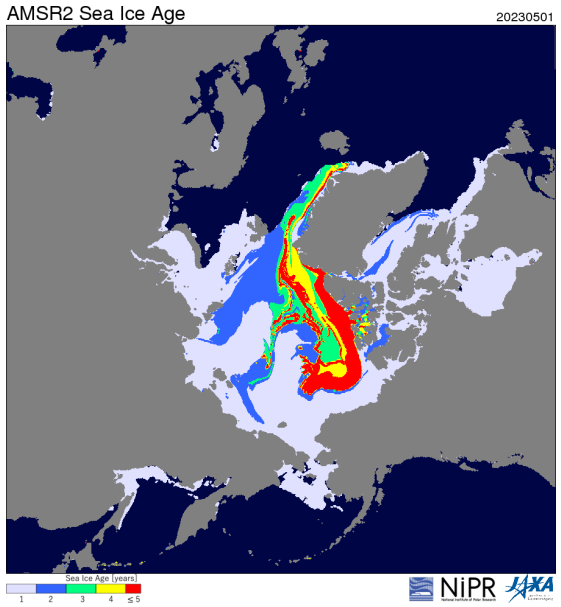
Enhanced educational content



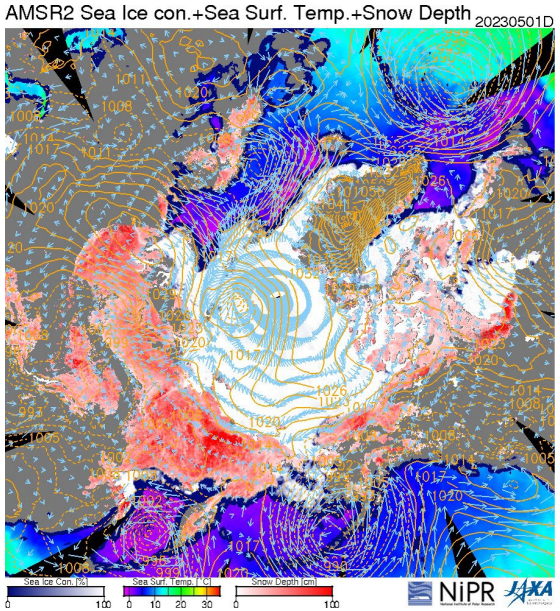
Development of a 3D globe that can be controlled with a smartphone

Arctic Data archive System (ADS)

New products implemented in VISHOP



Sea ice Age



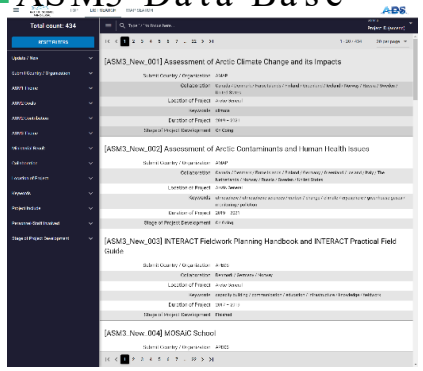
Pressure and wind fields

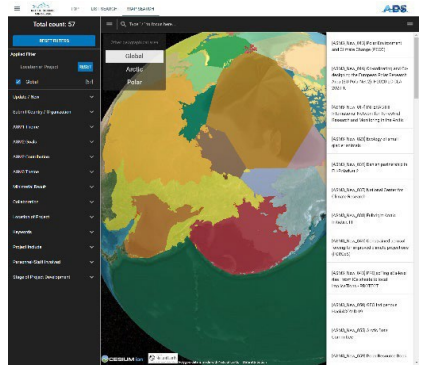
In collaboration with the Arctic Sea Ice Information Center, we have constructed a historical dataset using the Arctic sea ice age algorithm and started daily updates through automatic calculations. This dataset was registered in ADS-KIWA and implemented in ADS-VISHOP.

In order to understand the Arctic sea conditions, we have implemented the necessary pressure and wind field data in ADS-VISHOP.

New data product

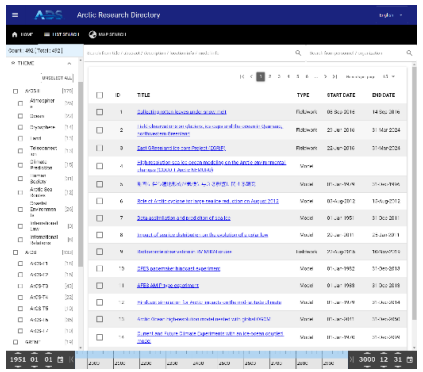
ASM3 Data Base

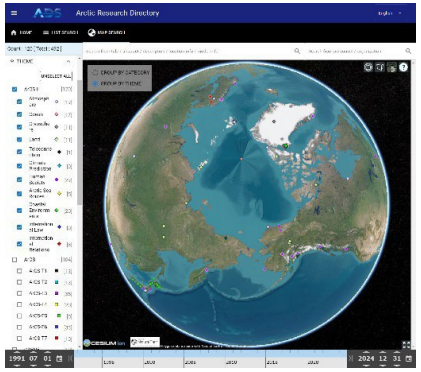




At ASM3 (3rd Arctic Science Ministers Meeting) held in Japan in May 2021, a database on Arctic research, including activities of each country after ASM2, was created and a public tool was made available.

arDirectory update ArCS II information and web system





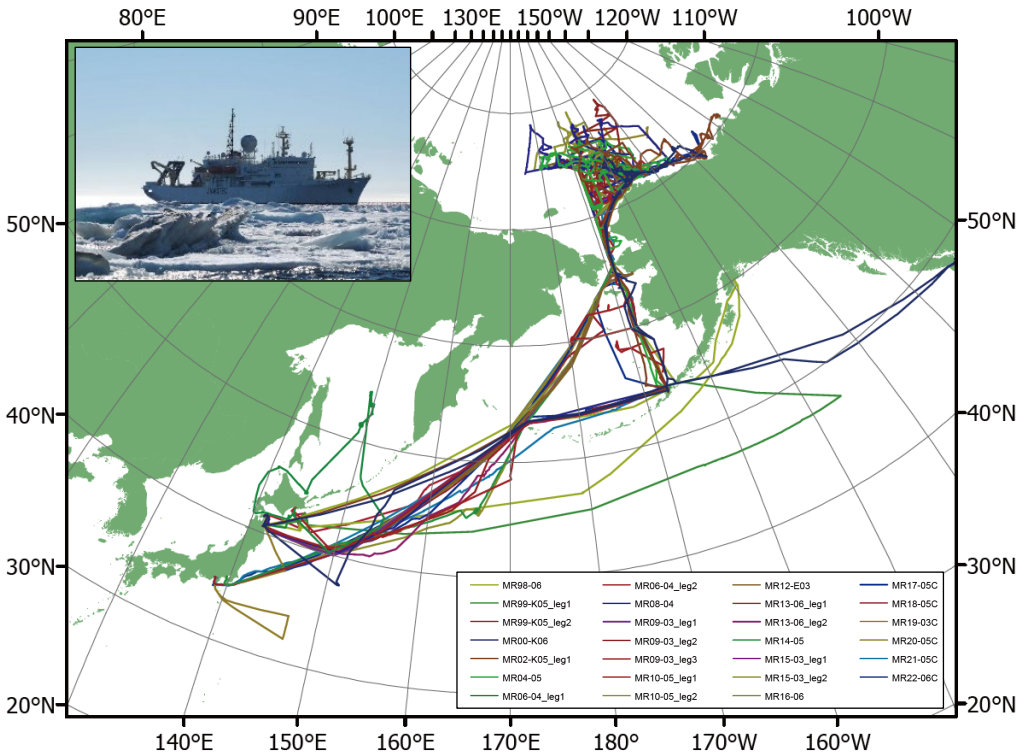
The new system of arDirectroy's web was built and the information of ArCS II project was updated.

ArCS II
Arctic Challenge for Sustainability II

JAMSTEC 国立研究開発法人 海洋研究開発機構
Japan Agency for Marine-Earth Science and Technology

R/V Mirai Arctic observation cruise

- JAPAN/JAMSTEC has been conducting multidisciplinary observations in the Pacific sector of the Arctic Ocean using the R/V Mirai for 21 cruises over 26 years (1998-2023).
- While the R/V Mirai is not an icebreaker, our focus has been on studying the effects of sea ice reduction in the area. We have published numerous findings resulting from the observed consequences of sea ice melt.



All cruise tracks of R/V Mirai in 1998-2022

- In 2023, we conducted an observation cruise in the Pacific sector of the Arctic Ocean, as shown in the map above.
- As part of this cruise and as a new initiative towards establishing an "International research platform," we issued a "Call for Early Career Scientists' proposals" not only in Japan but also in other countries.

  As a result, 6 ECS scientists from the US, UK, Denmark, and Portugal were selected as successful applicants for this call and conducted their observation in collaboration with Japanese scientists.
- We plan to conduct a similar observation cruise in 2024.

JAMSTEC 国立研究開発法人 海洋研究開発機構
Japan Agency for Marine-Earth Science and Technology

Japan's first research icebreaker for Arctic science (ARV Mirai II)

● Japan's new research icebreaker, "Arctic Research Vessel (ARV) Mirai II"

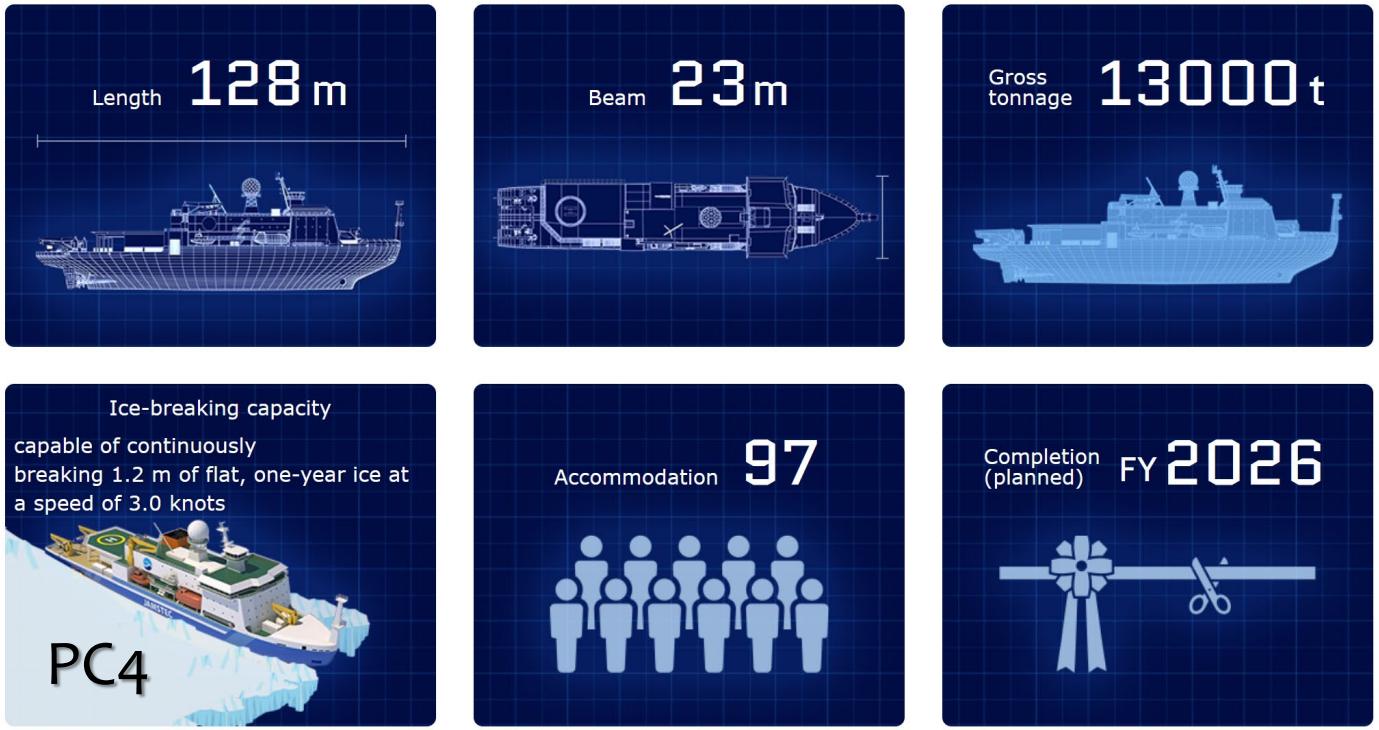
Since 1998, R/V Mirai cruises have conducted in the Pacific sector of the Arctic Ocean.
However, our observation research are limited in the sea ice reduction area.

December 2020: A construction of Japan's new research icebreaker had been decided.
November 2023 "The first international workshop on Arctic Ocean observation: Future Collaboration by Research Vessels and Icebreakers" (Group photo below)

February 2024 **The new icebreaker was named as "ARV Mirai II."**

March 2025 Launching
November 2026 Delivery
Summer 2027 First Arctic cruise

Group photo of the first international workshop on Arctic Ocean observation in Tokyo on November 17-18, 2023



Schematics of the specification of new research icebreaker, ARV Mirai II