Recent efforts in sustaining long-term observations, data-sharing and analysis of atmospheric GHGs and ocean variables

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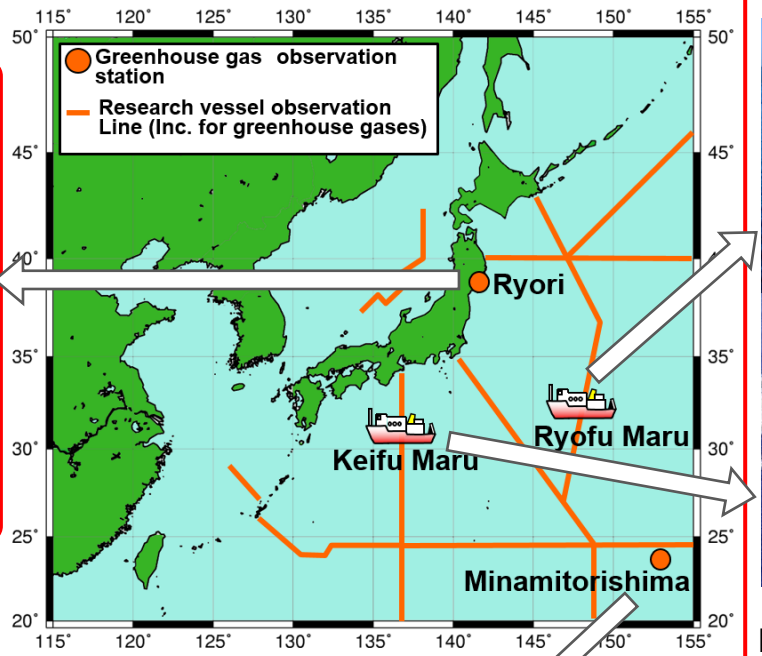
GHG observation network of JMA

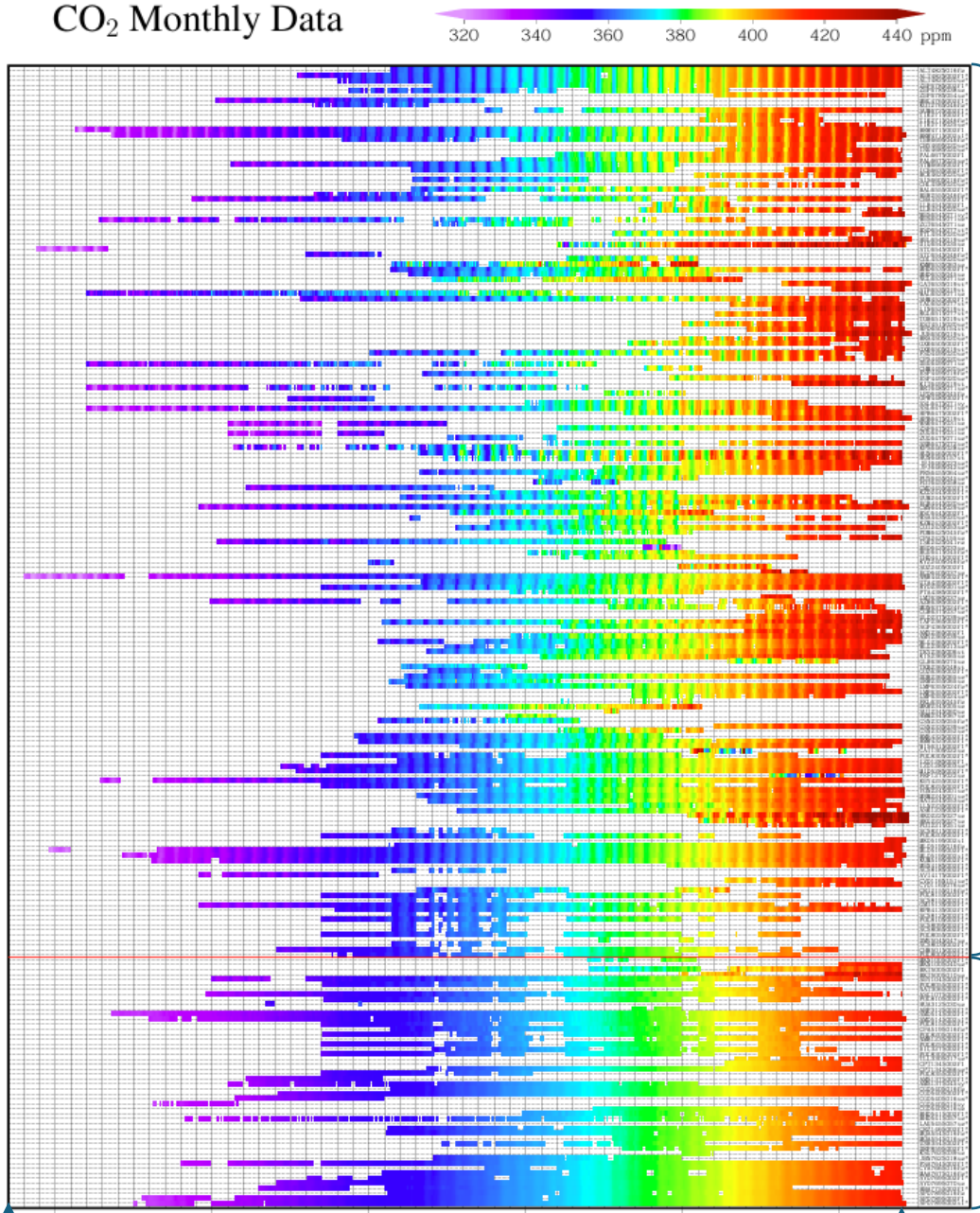
WMO-GAW regional station Ryori (RYO)



Research Vessels Observation

WMO-GAW global station Minamitorishima (MNM)

WMO/GAW-WDCGG (World Data Centre for Greenhouse Gases)



Since 1968

Northern Hemisphere

Equator

Southern Hemisphere

End of 2023

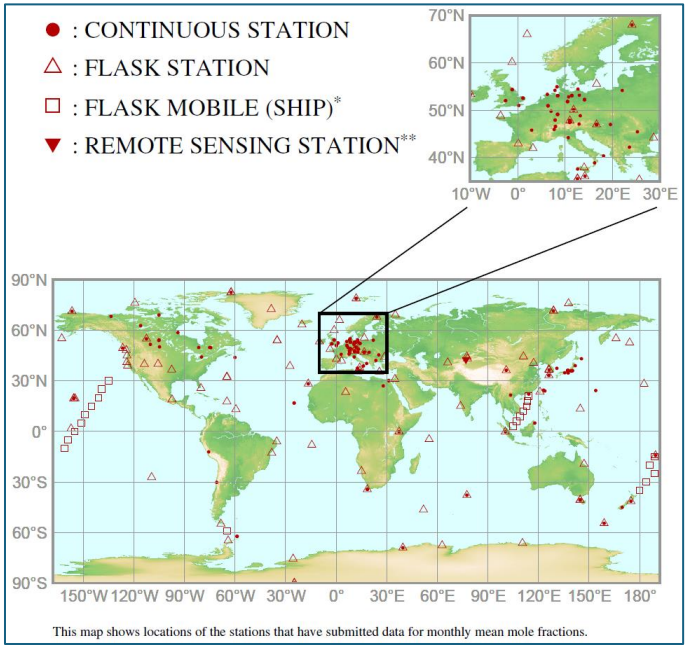
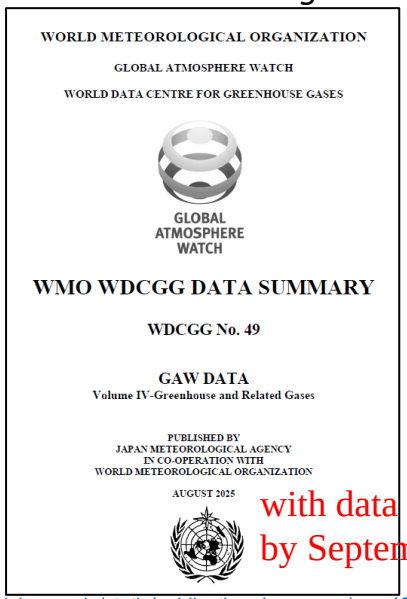


Figure in page 4

Figure in page 3

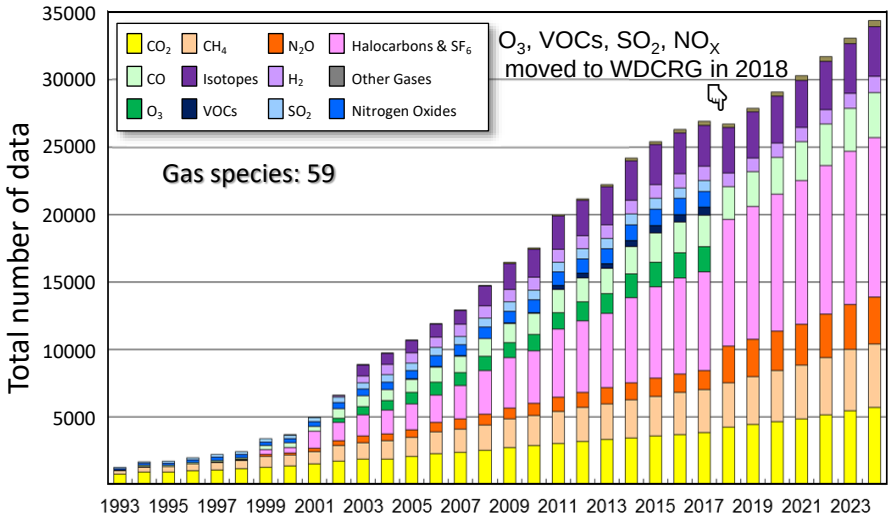


with data submitted by September 2024

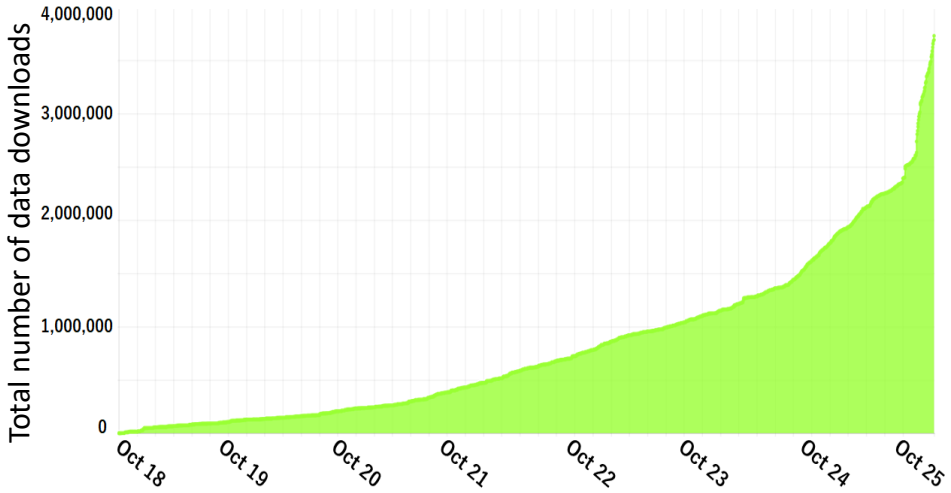
https://gaw.kishou.go.jp/static/publications/summary/sum49/sum49.pdf

Increase in total archive data volume and downloads

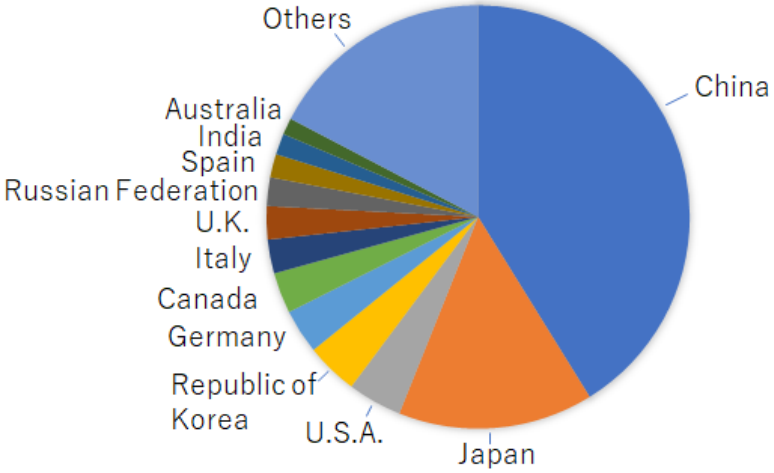
Increase of archived data



Total number of downloads since the launch of the new WDCGG website



User's Country / Territory

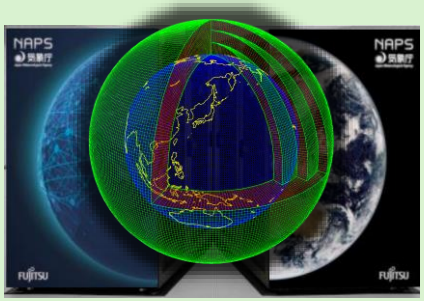


Purpose of Use and Number of Users

Scientific research	2214
Education	1179
Model validation and assimilation	170
Other	107
Satellite calibration	31

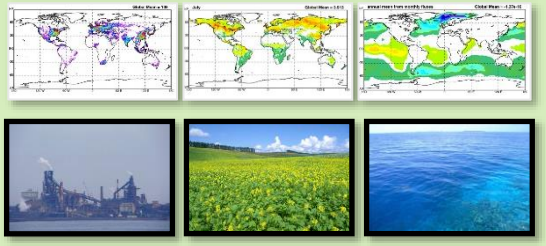
As of Nov. 2024

Global CO_2 distribution analysis by using numerical modelling



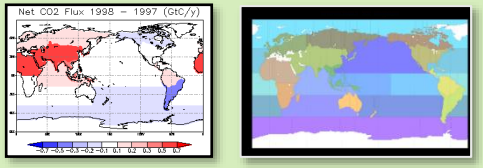
GSAM-TM

Transport model developed based on JMA's numerical weather prediction model

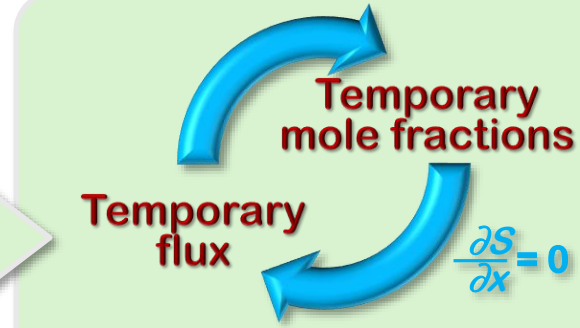


Prior fluxes

Fossil fuel, biosphere, Ocean

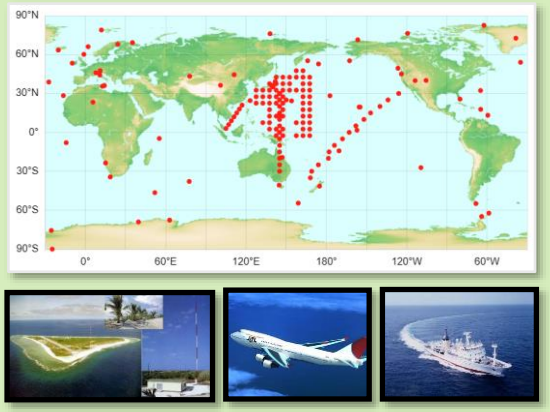


Regional pulse fluxes



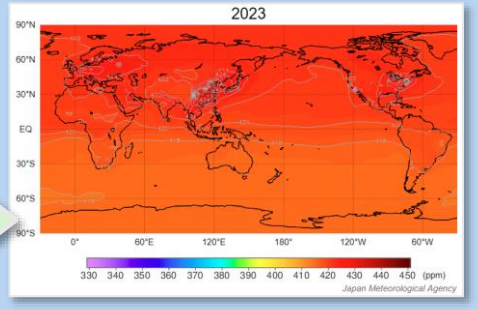
Inversion Analysis

Data assimilation to estimate CO_2 sources

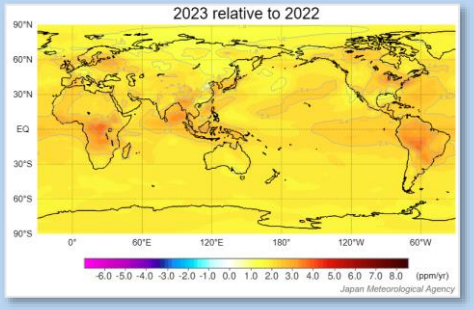


Observation data

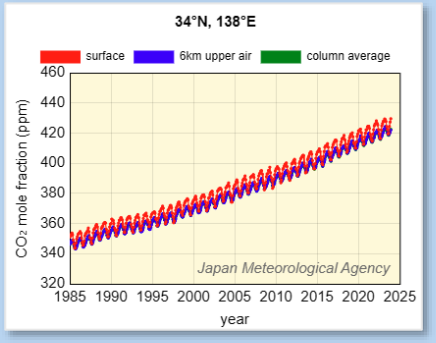
Monthly mean of observed CO_2 mole fractions reported from stations to WDCGG are used



Mole fraction map



Growth rate map

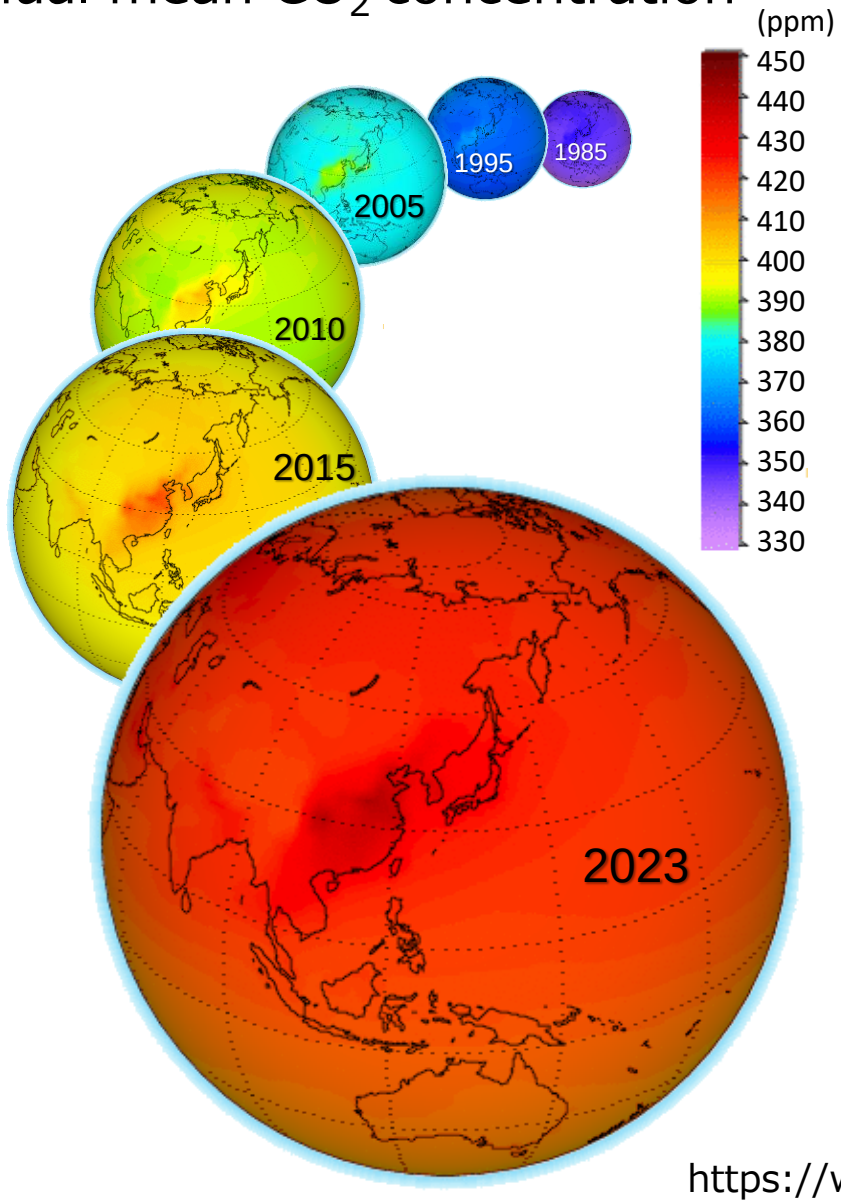


Mole fraction time series

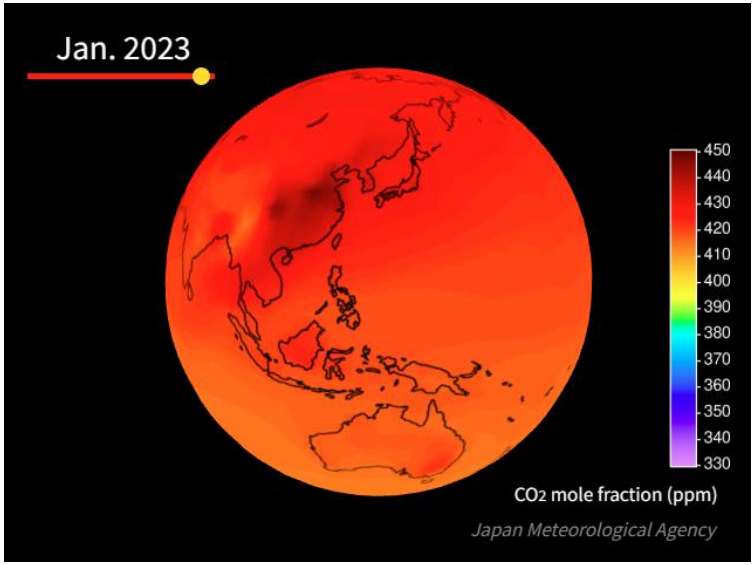
https://www.data.jma.go.jp/ghg/kanshi/info/calc_info_e.html

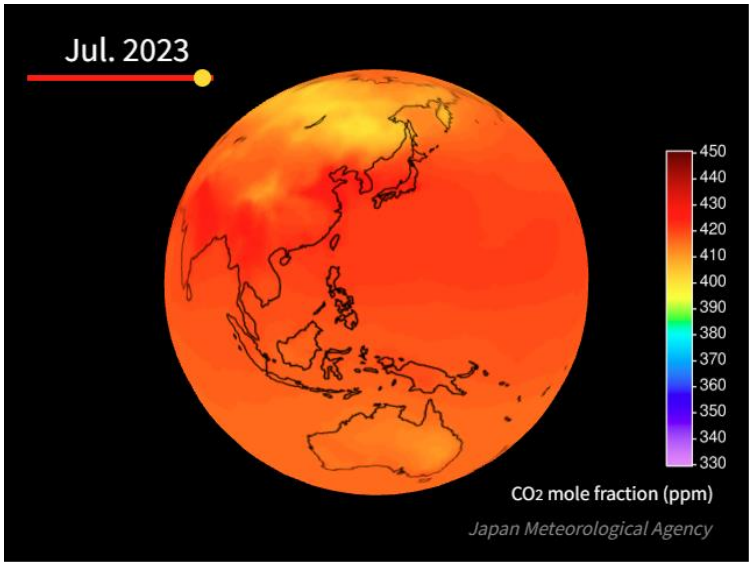
CO_2 distribution maps

Annual mean CO_2 concentration



Seasonal variation of CO_2

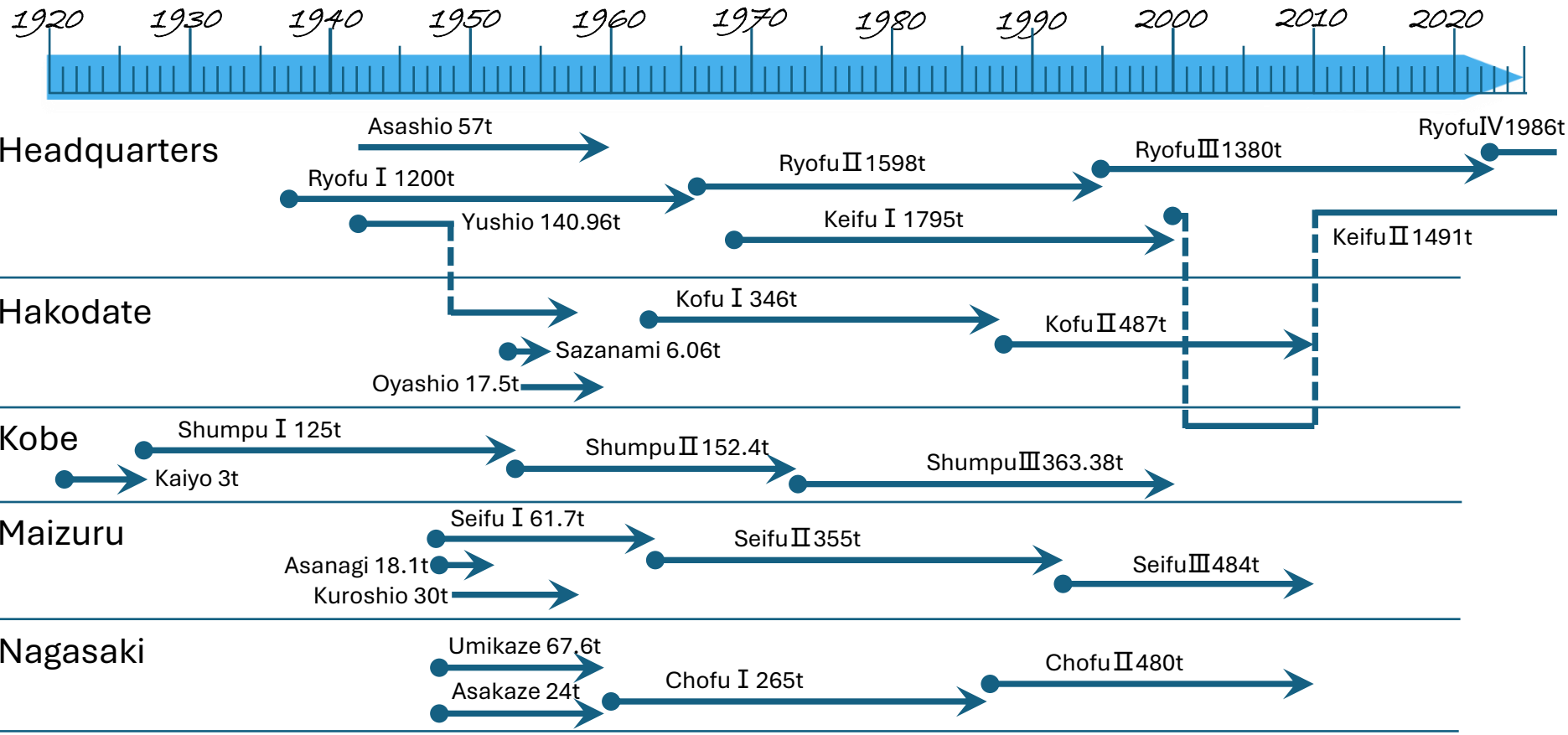


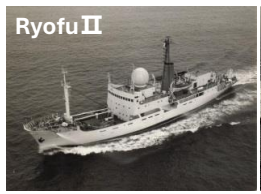


https://www.data.jma.go.jp/ghg/kanshi/info_kanshi_e.html

100 years History of Marine Observation in JMA

Shipboard observation in JMA began before 100 years ago. These observed data, especially in the old age, is very important to clarify the climate change because of lack of data. In addition, JMA began the observation along 137°E in winter from 1967 by Ryofu Ⅱ. In 2016 we won the PICES ocean monitoring service award for these remarkable long term record and contribution for a lot of researches in the world on the circulation structure and the biogeochemical cycle.





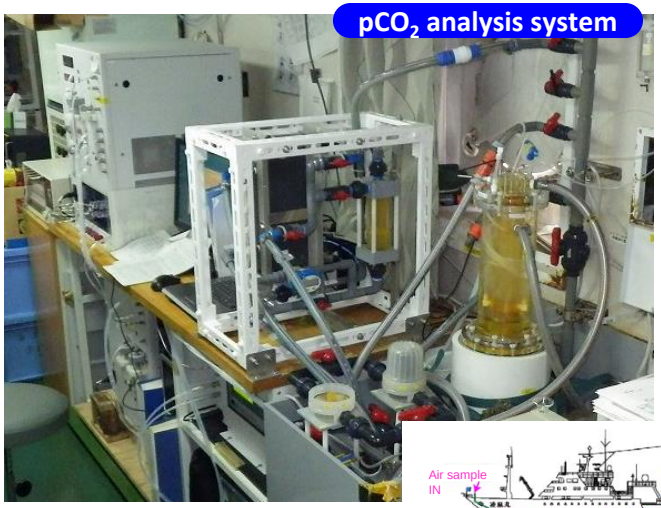
Increase of pCO_2 on the surface sea

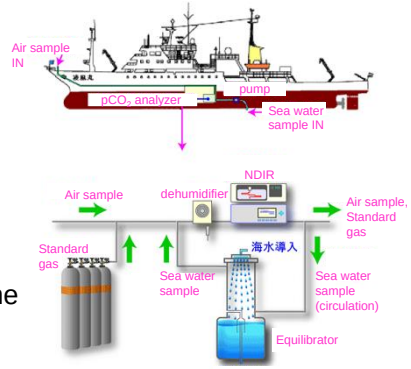
Observation of the partial pressure of carbon dioxide (pCO_2) is made by using the non-dispersive infrared (NDIR) analyzer. The sampling system can introduce the ambient air taken from the head of this ship, the standard gases to calibrate the analyzer, and the air mixed with the surface sea water.

The surface sea water is pumped up under the bottom of this ship and mixed with the air by this equilibrator.

Our pCO_2 data is shared in the international database (SOCAT ver.4). 18% of this database in the north-west Pacific area is our data.

pCO_2 analysis system

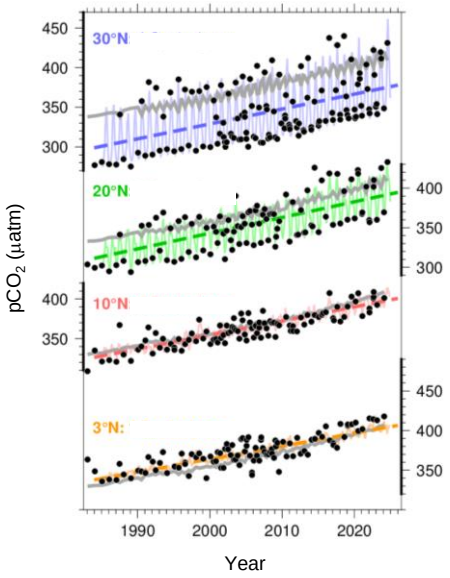


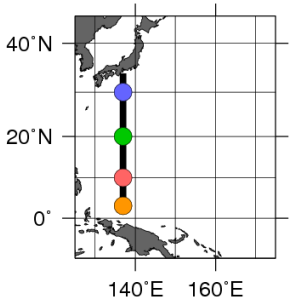


Schematic diagram of the pCO_2 analysis system

Long term trend of pCO_2 in surface sea water along 137°E

pCO_2 on the surface sea water is also increasing, accompanying by increase of pCO_2 in the atmosphere.

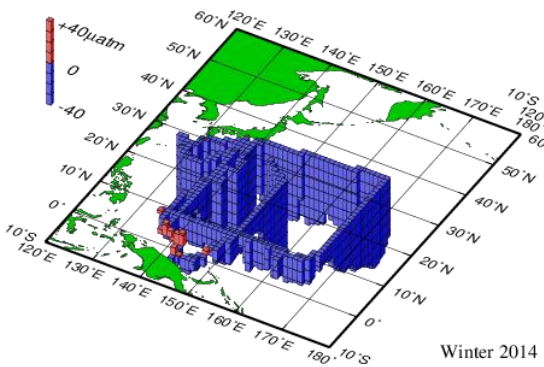


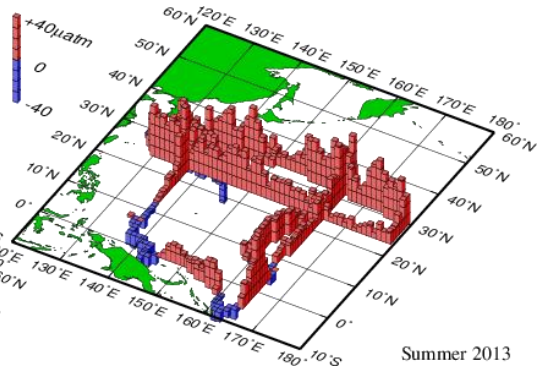


Long term trend of pCO_2 along 137°E.
observed on the surface sea water (dots),
estimation (line), long term trend (dashed line)
pCO_2 in the atmosphere (gray line)

CO_2 flux on the surface sea water

CO_2 flux is different in season.
red: Emission of CO_2 to the atmosphere
blue: Absorption of CO_2 into the ocean





Ocean Acidification – another aspect of CO_2 emissions

Carbon dioxide absorbed in the ocean is accumulated on the surface layer of the ocean and gradually mixed with deeper layer by the vertical convection in the winter season and current under the surface layer. In addition, dissolved carbon dioxide acidify sea water.

Dissolved inorganic carbon

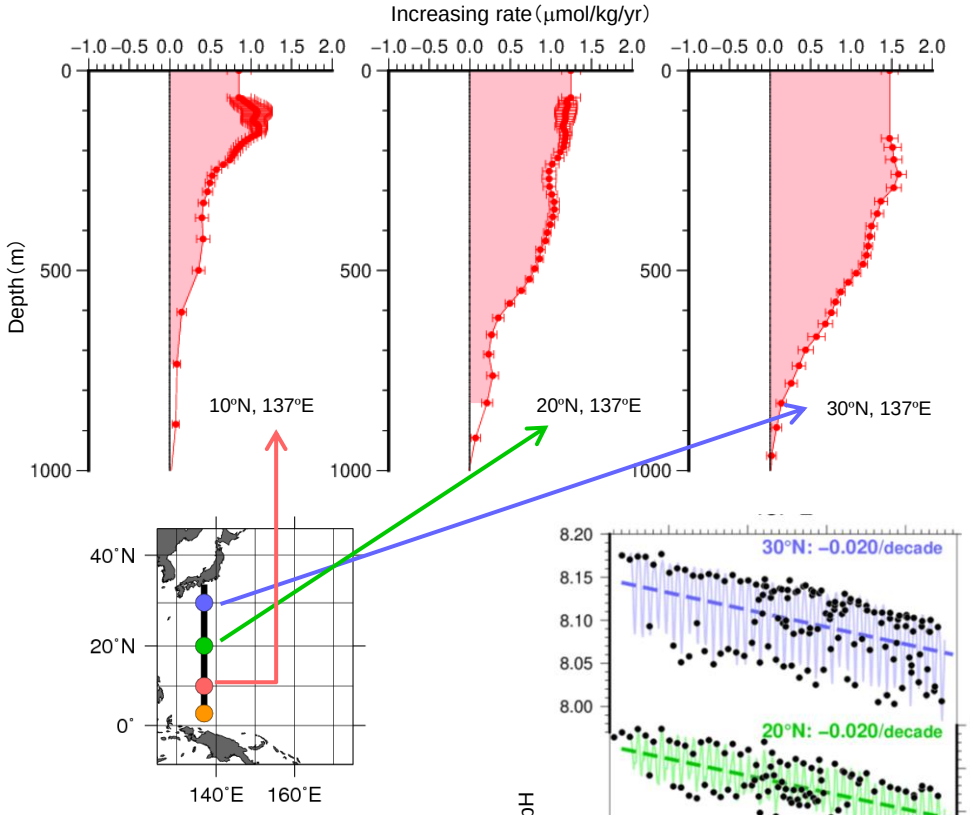
CO_2 absorbed from the atmosphere is observed as dissolved inorganic carbon (DIC) in the sea. CO_2 is also generated by decomposition of organic matter in the ocean.

pH spectrophotometer

pH varies with temperature, pressure, biological activity, and dissolved carbon.

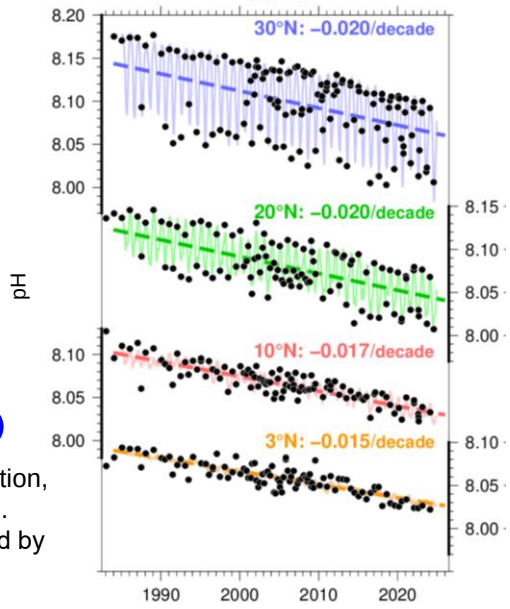
Accumulation of anthropogenic CO_2

Accumulation of the anthropogenic CO_2 is estimated from the long-term record of the observed DIC data. It's indicated that large amount of carbon is accumulated around the mid latitude area and mixed at the depth of 1000m.



Acidification of the ocean

From our long-term record of the observation, pH is gradually decreasing on the surface. It's indicated that the sea water is acidified by dissolving anthropogenic CO_2.

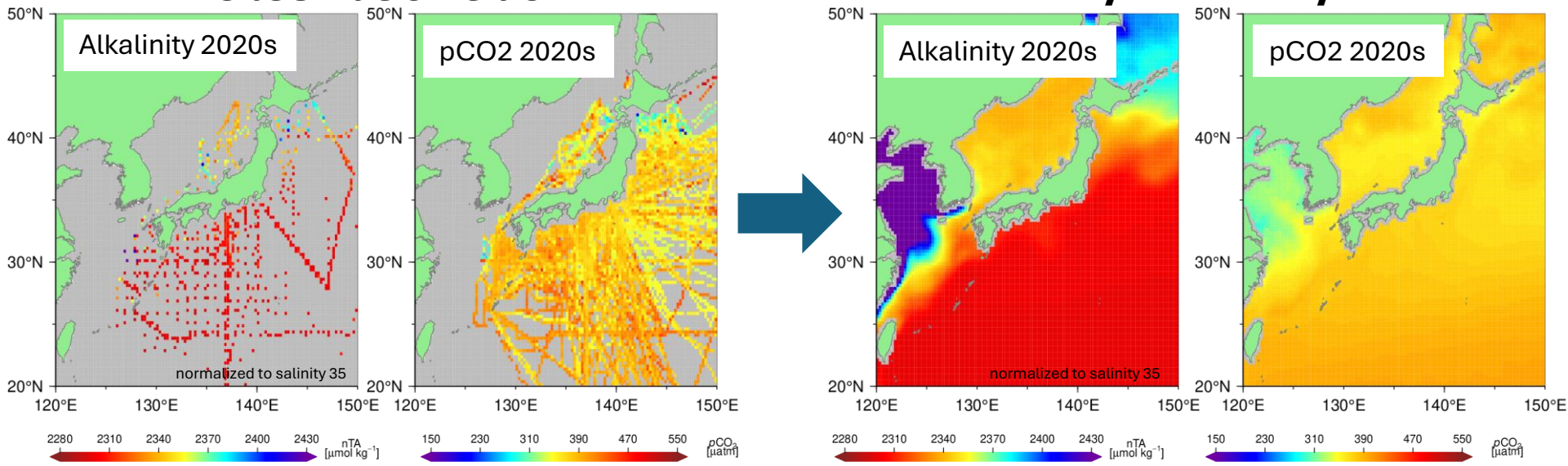


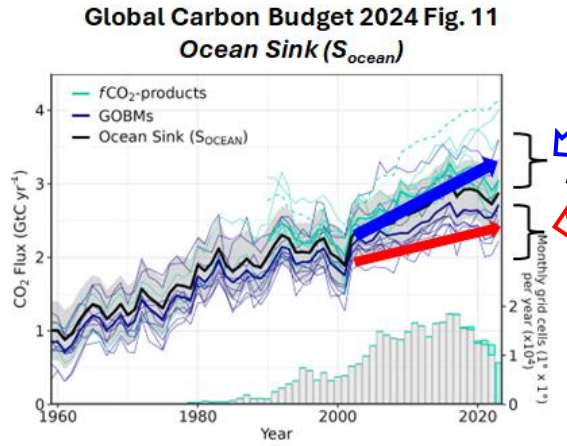
Mapping surface ocean carbonate variables in East Asian marginal seas

* Interpolating measurements of surface ocean carbonate variables by using a machine-learning method and then reconstructing monthly maps of carbonate variables.

[Env. Res. Technol. Dev. Fund SII-8/S-22] https://www.data.jma.go.jp/kaiyou/english/co2_flux/co2_flux_data_en.html

Observation track ***Gap-filled maps***





Surface ocean observation-based estimates

GCB ocean CO2 sink estimate (mean of model-based and obs.-based estiamtes)

Ocean model-based estimates

1. Investigating bias and discrepancy in recent ocean sink trends between model-based and obs.-based outputs.

2. To obtain an appropriate S_{ocean} estimate and uncertainty