Modeling of acidification in marginal seas

Yasumasa Miyazawa*1, Miho Ishizu1, Tomohiko Tsunoda2
1 JAMSTEC 2 Sasakawa Peace Foundation

Ocean acidification is now observed in open ocean around Japan (Ishii et al. 2011).

Biogeochemical processes associated with the acidification are more complicated and heterogeneous in coastal ocean (Kosugi et al. 2016). For example, the amplitude of seasonal variations of Aragonite Omega exceeds 3 in Tokyo Bay (Yamamoto-Kawai et al. 2015; cf. 0.5 in Ishii et al. 2011).

To elucidate the acidification trend/variation in shelf and coastal ocean seas around Japan, we are developing ocean acidification modeling focusing on nowcasting of the acidification processes around Japan.

‘Marine Crisis Watch’ project

Our research is a part of the ‘Marine Crisis Watch’ project promoted by Sasakawa Peace Foundation (Ocean Policy Research Institute), aiming at constructing a web-based information infrastructure for enhancement of public understanding on-going ocean acidification in the western North Pacific.

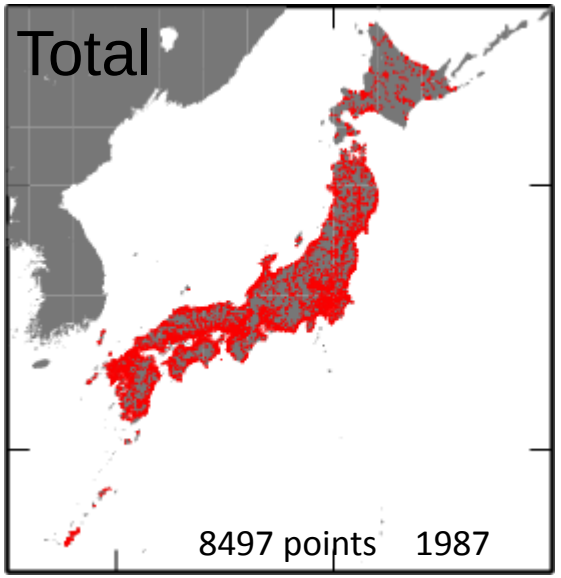
Expecting research period is from FY2016 to FY2019, 4 years.

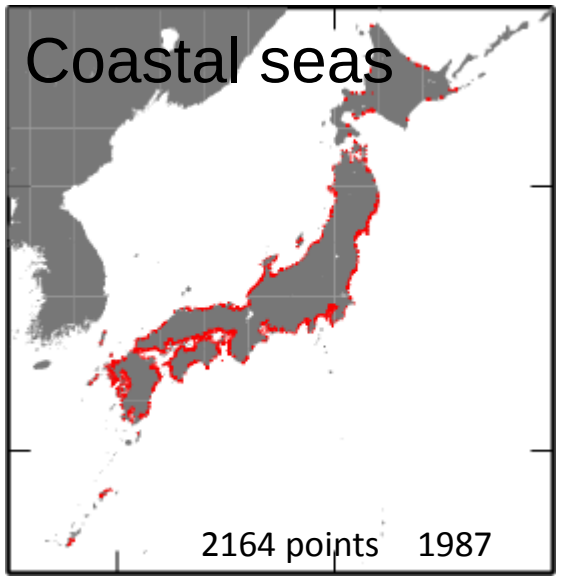
Our group of JAMSTEC is originally developing data-assimilative ocean current forecasting models, and thus we are planning coupling the ocean forecasting with the ocean acidification modeling.

Prior to model development, we have examined actual PH variations recorded in a public water measurement data base.

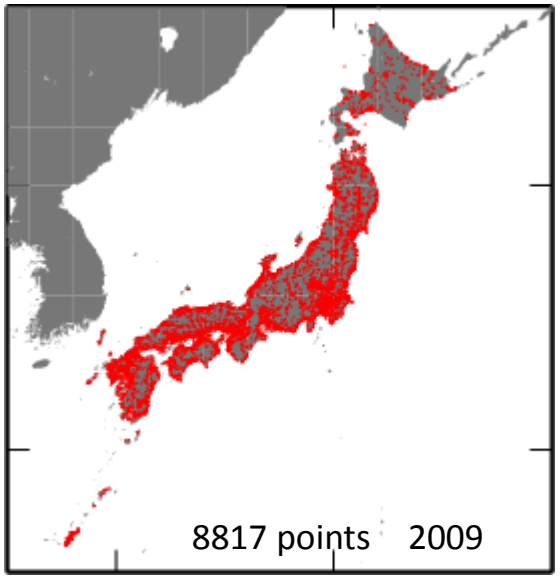
Water quality measurements done by local prefectures

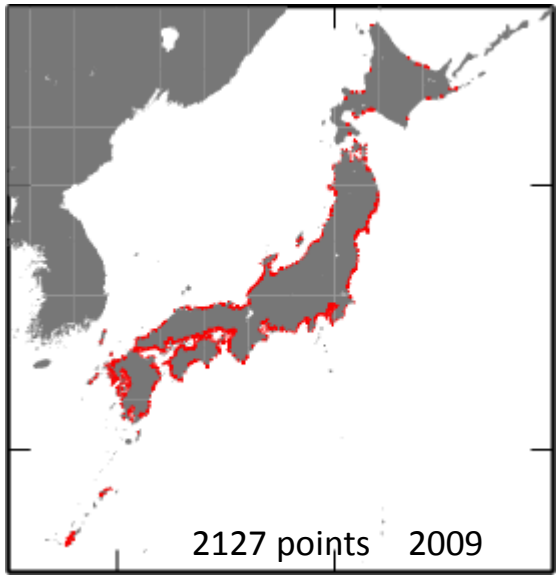
The archive includes the data obtained in lakes, rivers, coastal sea regions.



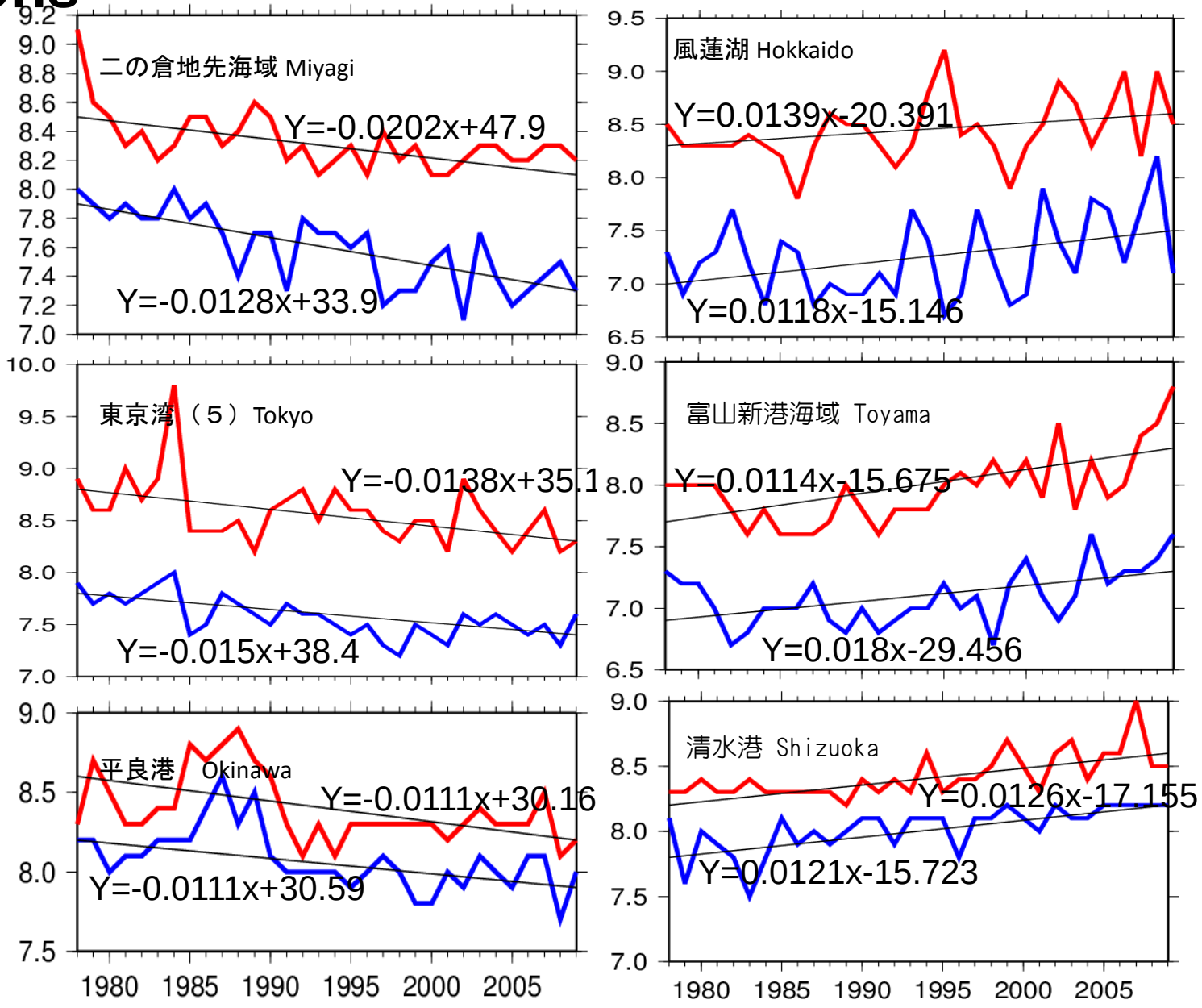


We have analyzed the data obtained in coastal sea regions.



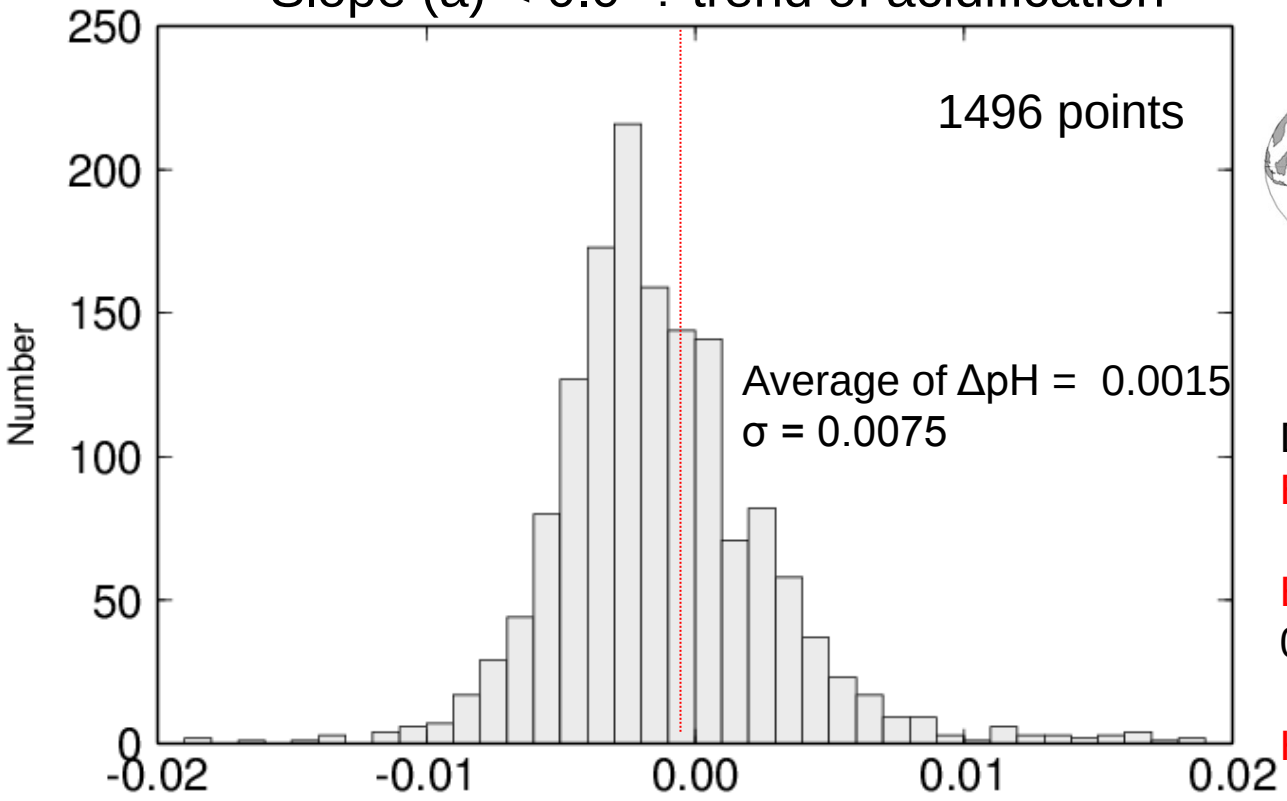


Acidification/ alkalization trends in coastal water regions



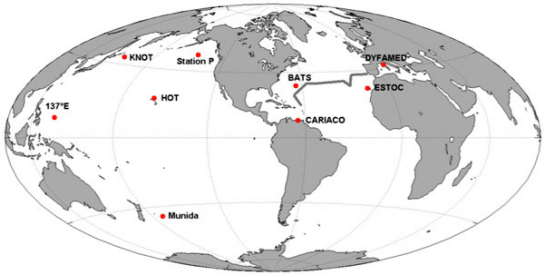
Distribution of slopes of linear regression line (y=ax+b)

Slope (a) < 0.0 ： trend of acidification



Decrease of pH = −0.0015±0.0075 yr−1

Comparable trend of the acidification in open oceans



https://public.wmo.int/en/resources/bulletin/monitoring-ocean-carbon-and-ocean-acidification-0

Decrease in pH

ESTOC ：0.0017±0.0005 yr-1 (mean±1σ)

BATS

0.0017±0.0001 yr-1 in winter

HOT ：0.0019±0.0005 yr-1

JMA along 135E

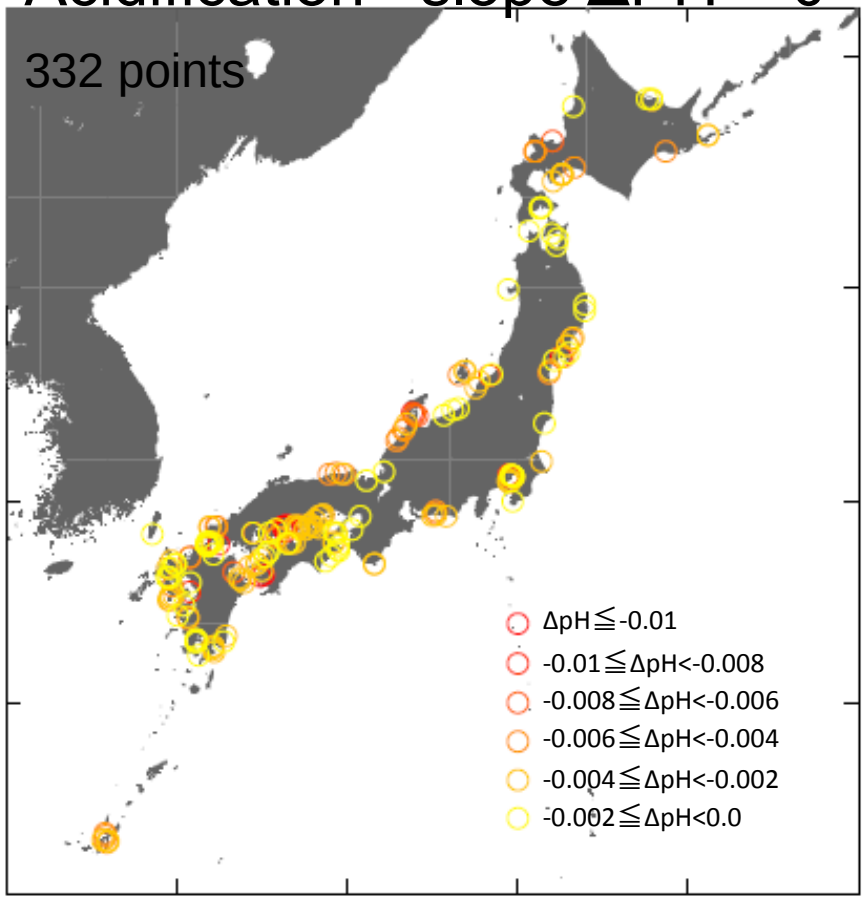
0.0018±0.0021 yr-1 in winter

0.0008±0.0019 yr-1 in summer

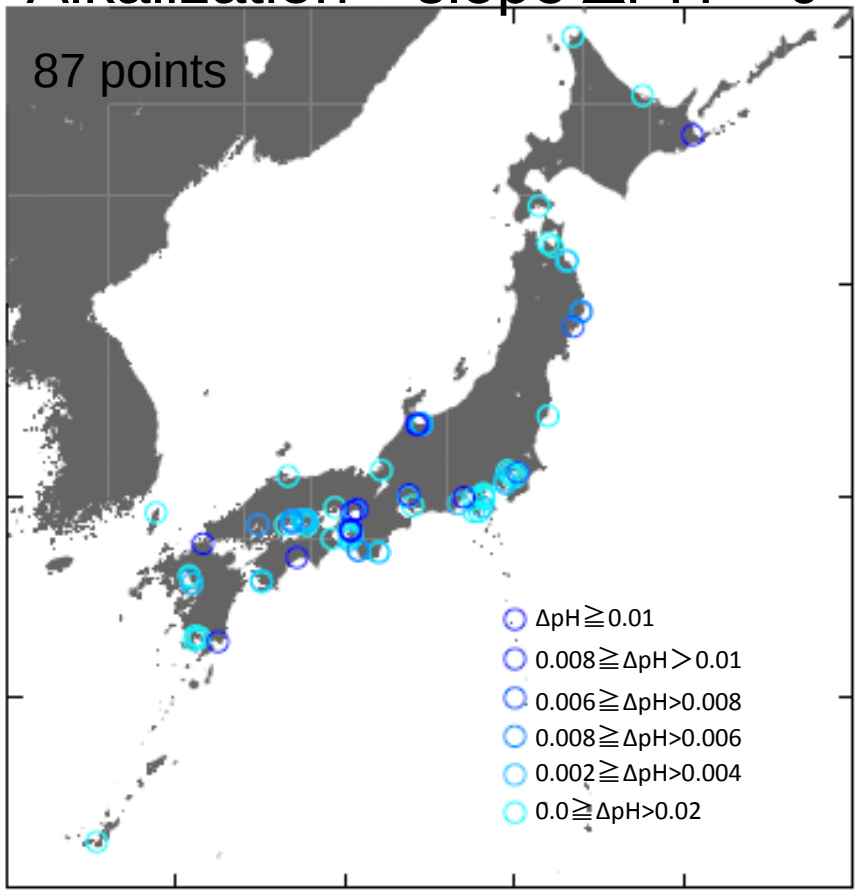
Apparent Acidification/ alkalization points

Dominance of acidification points despite of complicated trend distribution

Acidification slope ΔPH < 0



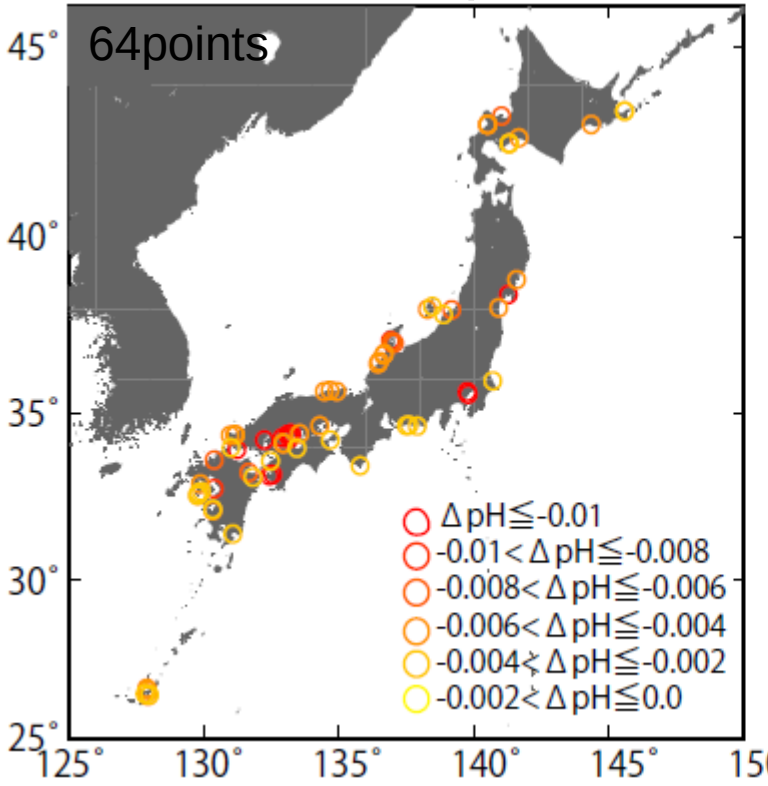
Alkalization slope ΔPH > 0



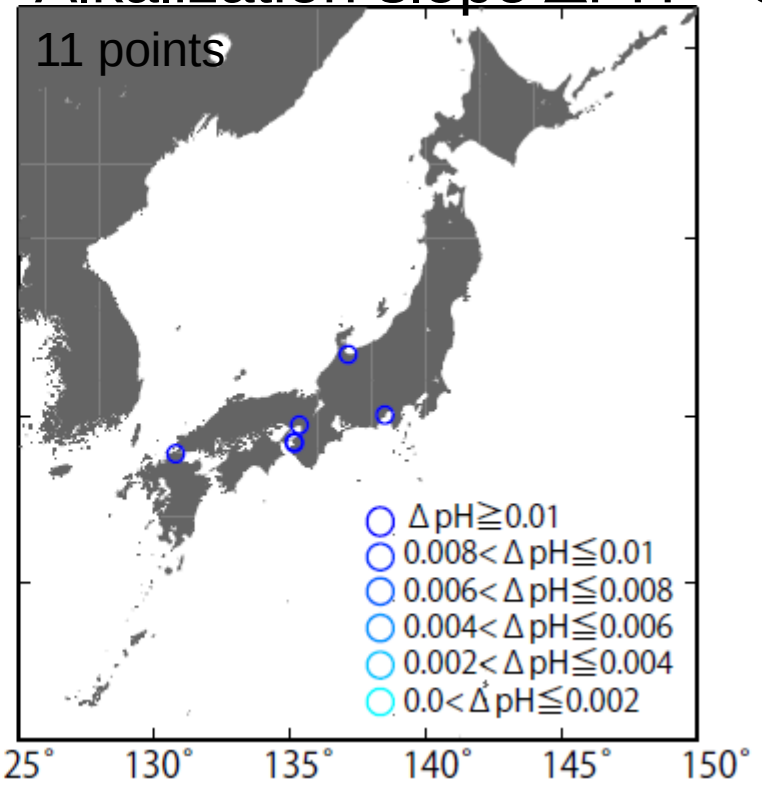
Statistically significant (p>0.05) acidification/alkalization points

Relatively strong signals of the acidification points?

Acidification slope ΔPH < 0



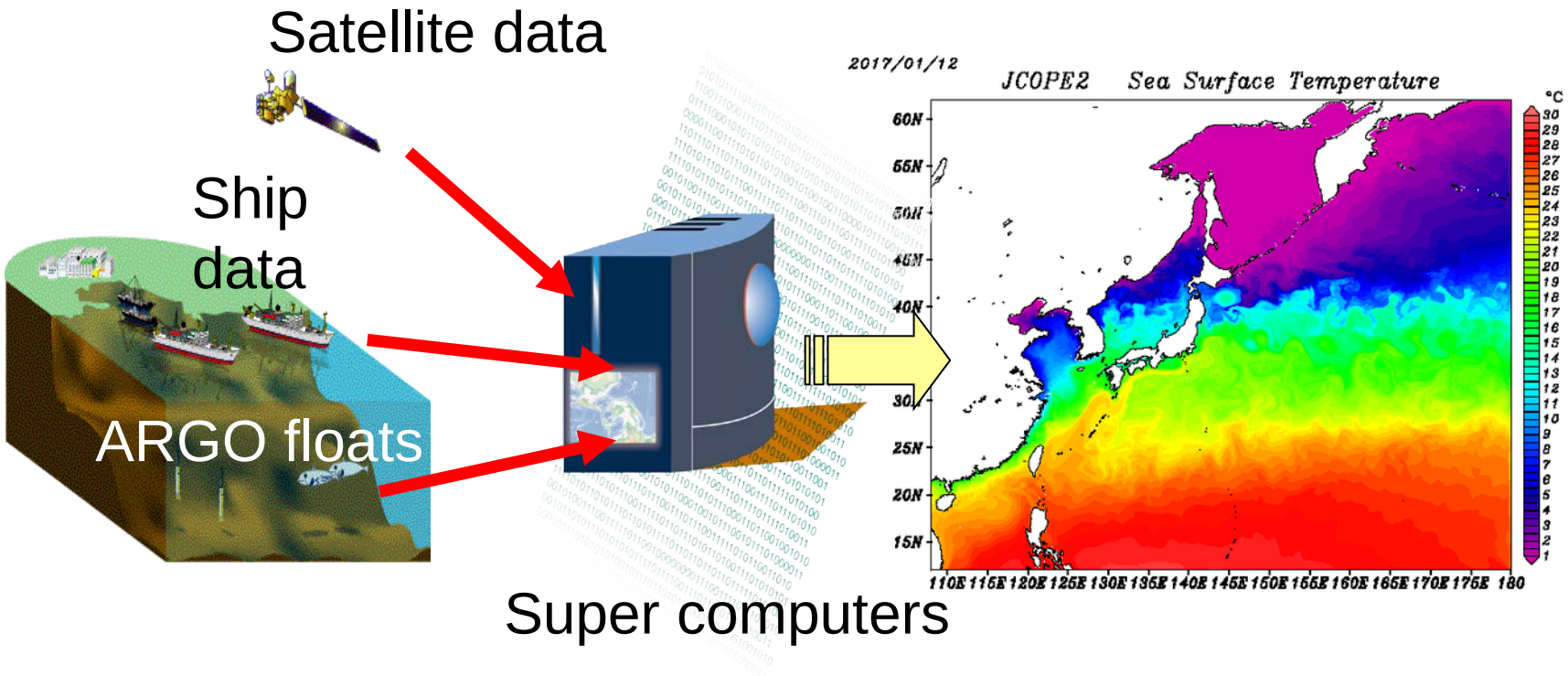
Alkalization slope ΔPH > 0



We need to investigate temporal/spatial dependence of the ocean acidification around Japan coastal ocean

Possible coupling with ocean forecasting

Our group of JAMSTEC is operating ocean forecasting models

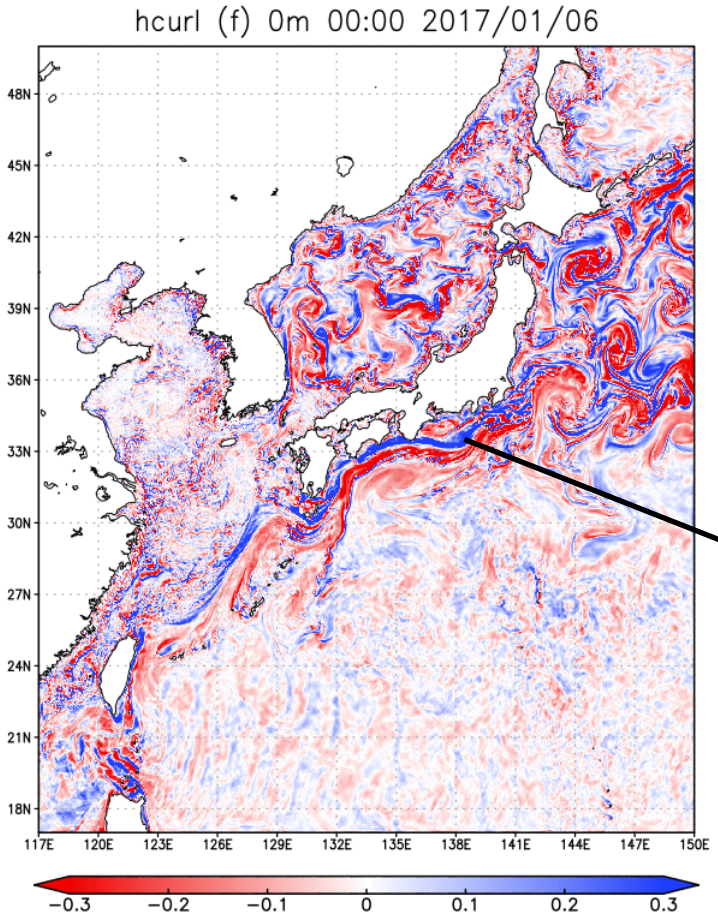


http://www.jamstec.go.jp/jcope/

They would be used for investigation of the on-going acidification in terms of ocean currents/eddies effects

Numerical ocean forecasting

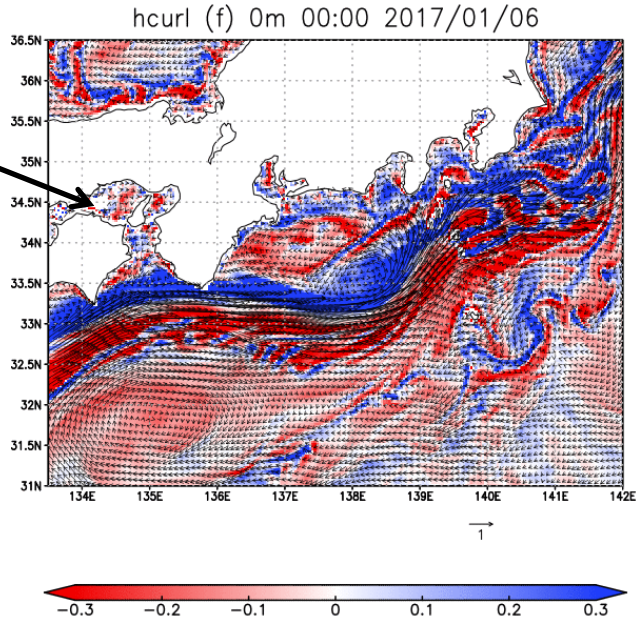
JCOPE-T: Hourly/3km resolution



ocean currents/eddies represented by vorticity

Ocean current and eddy activity is quite evident around Japan

Possible relations between the ocean current and acidification



Zoom-up view

Marine carbon cycle affected by ocean current

Atmosphere

air-sea exchange

Dissolved Inorganic Carbon

coastal processes

pH Ω

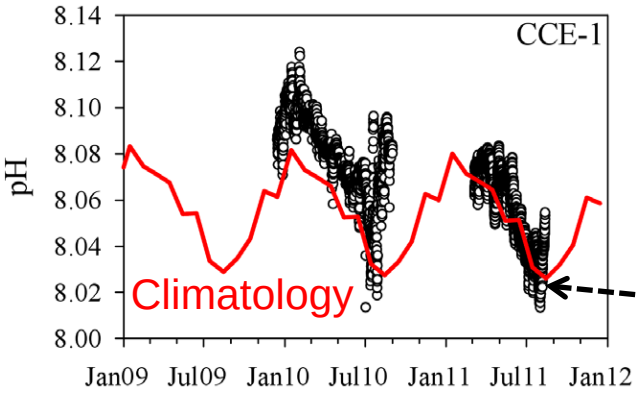
Diagnosis

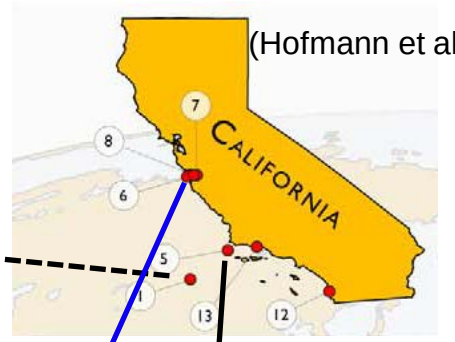
Alkalinity

NPZD

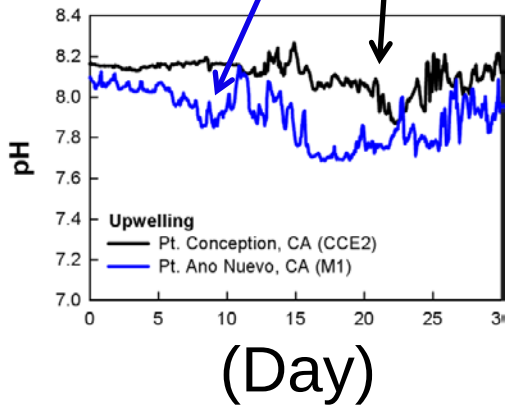
Calcination

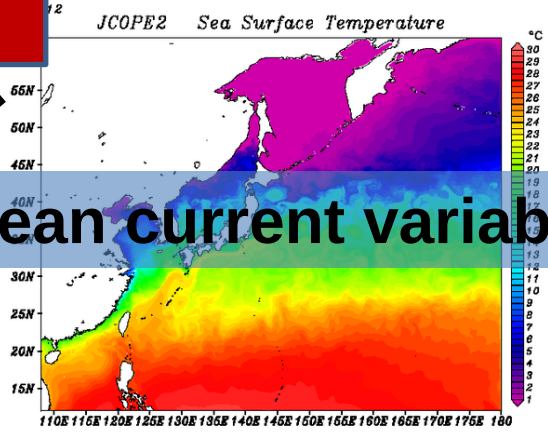
CaCO3





(Hofmann et al. 2011)





ocean current variability

Summary and plan

We have detected strong contrast of the acidification/alkalization among coastal stations in Japan

Some of them might be attributed to very local processes that never be resolved by our ocean forecasting models; however, we will try to find some points that could be affected by the ocean current and eddy activity as well as ones affected by some other resolved processes including large scale fresh water flux from the land, etc.

Nowcasting based on coupling of data-assimilative ocean current models with eco-carbon cycle models together with detailed observation data analysis would be useful for such investigation

Our research may contribute to the global Marine Biodiversity Observation Network (MBON).

Ocean acidification in open ocean south of Japan

www.data.jma.go.jp/gmd/kaiyou/shindan/index_co2.html

国土交通省 気象庁 Japan Meteorological Agency

本文へ | ENGLISH | ご意見・ご感想 | サイトマップ

ホーム | 防災情報 | 各種データ・資料 | 知識・解説

ホーム > 各種データ・資料 > 海洋の健康診断表 > 二酸化炭素と海洋酸性化に関する診断表、データ

二酸化炭素と海洋酸性化に関する診断表、データ

二酸化炭素に関する資料

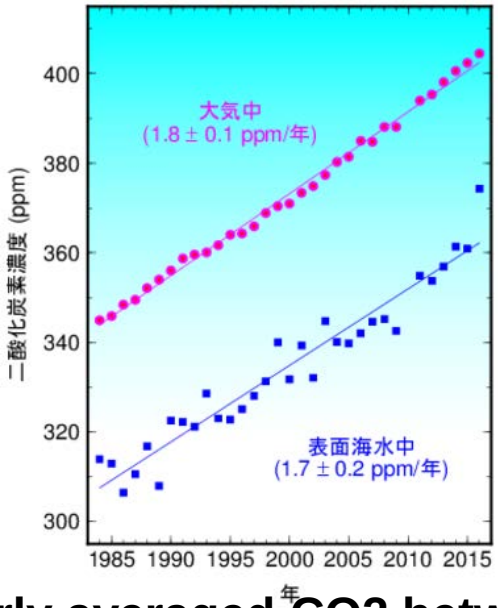
二酸化炭素濃度 長期変化傾向

海洋による二酸化炭素吸収

二酸化炭素蓄積量

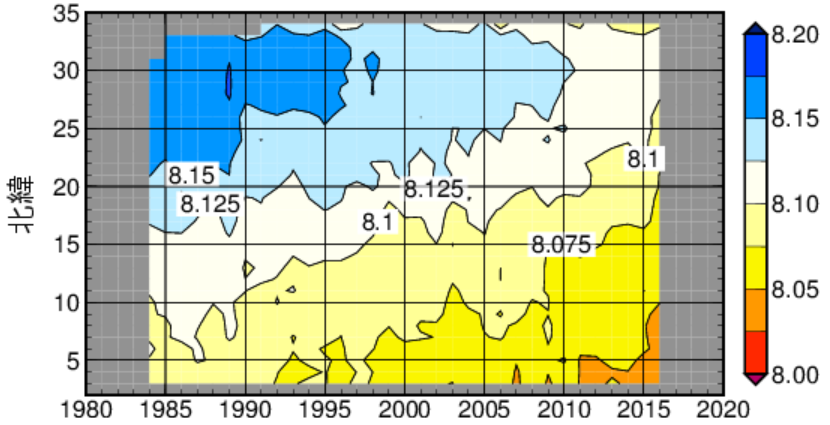
二酸化炭素濃度の長期変化傾向

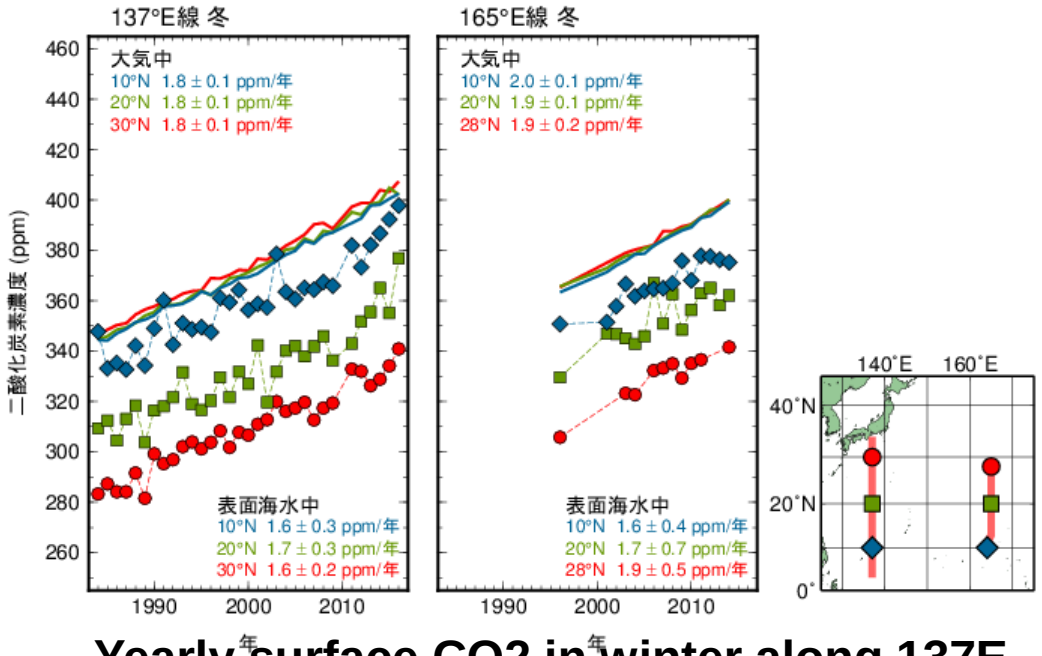
北西太平洋



Yearly averaged CO2 between 7 and 33E along 137 E

Distribution of yearly Surface pH in winter along 137 E





Yearly surface CO2 in winter along 137E and 165 E