

Indicator 14.3.1

Indicator Name, Target and Goal

Indicator 14.3.1 Average marine acidity (pH) measured at agreed suite of representative sampling stations

Target 14.3 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels

Goal 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Definition and Rationale

○ Definition

Average marine acidity (pH) is defined as the average value of observation-based acidity in the winter surface seawater on the 7°-33°N latitude along the 137°E meridian.

○ Concepts

Marine acidity is represented as pH, the concentration of hydrogen ions on a logarithmic scale.

○ Rationale and Interpretation:

Japan Meteorological Agency (JMA) has conducted Hydrographic observation along the 137°E meridian over 50 years. This line is one of the longest observation lines in the world and the observation contributes to the international observational project.

As suitable for detecting the long-term trend in ocean acidification because of small inter-annual variability, the indicator is defined as the winter pH along the 137°E meridian.

The time series observation indicates a clear trend of ocean acidification (decreasing pH) since 1984.

Data Sources and Collection Method

Observational data of carbon dioxide partial pressure, etc. obtained by the two research vessels of the JMA, Ryofu Maru and Keifu Maru is available from the JMA website. (https://www.data.jma.go.jp/gmd/kaiyou/db/vessel_obs/data-report/html/ship/ship_e.php).

Observational data of oceanic greenhouse gases is published in the JMA website “Annual Report on Atmospheric and Marine Environment Monitoring Data.” (https://www.data.jma.go.jp/gmd/env/data/report/data/index_e.html)

Method of Computation and Other Methodological Considerations

○ Computation Method

Observation-based pH data in total scale at in-situ temperature is calculated from the data of continuous observation value of carbon dioxide partial pressure and total alkalinity (TA) based on carbonate system chemical equilibrium in seawater. It is known that salinity-normalized TA (NTA) does not show any significant temporal and spatial variation in the subtropical and tropical zones of the western North Pacific (Midorikawa et al., 2010, *1). TA is calculated from NTA and salinity by formula of $TA = NTA / 35 * \text{salinity}$. pH values are obtained by every 1° latitude and averaged in 7°-33°N latitude along the 137°E meridian.

○ Comments and limitations

Uncertainties of carbon dioxide partial pressure and TA of the JMA measurements are estimated to be 2µatm and 4µmol/kg, respectively (Ishii et al., 2009,*2, Midorikawa et al., 2010, *1). Consequently, the obtained pH value from these estimation results includes 0.002 uncertainty as standard deviation.

The pH values in winter we report are different from the annual mean values, particularly in the northern subtropics where the seasonal variation is large (approximately 0.10). However, the average declining speed of pH values in winter does not differ significantly from that of the annual average values for the past decades (*3). Therefore, the pH values in winter are suitable for monitoring the long-term trend.

The indicator is available each year since 1984 and is able to show the progress of ocean acidification for a multi-decadal time scale.

Data Disaggregation

N/A

References

- (*1) Midorikawa, T., M. Ishii, S. Saito, D. Sasano, N. Kosugi, T. Motoi, H. Kamiya, A. Nakadate, K. Nemoto, and H. Y. Inoue (2010), Decreasing

pH trend estimated from 25-yr time series of carbonate parameters in the western North Pacific, Tellus 62B, 649–659. doi: 10.1111/j.1600-0889.2010.00474.x

(* 2) Ishii, M., H.Y. Inoue, T. Midorikawa, S. Saito, T. Tokieda, D. Sasano, A. Nakadate, K. Nemoto, N. Metzl, C.S. Wong, and R.A. Feely (2009), Spatial variability and decadal trend of the oceanic CO₂ in the western equatorial Pacific warm/fresh water. Deep-Sea Res. II, 56, 591-606.

(* 3) Ocean acidification in the western North Pacific
(https://www.data.jma.go.jp/gmd/kaiyou/english/oa/oceanacidification_en.html)

Custodian Ministries of Data

Japan Meteorological Agency, Ministry of Land, Infrastructure, Transport and Tourism

Custodian Ministries of Related Policies

Ministry of Education, Culture, Sports, Science and Technology

International Organizations

Intergovernmental Oceanographic Commission (IOC) of UNESCO