

Meridional gap in the rate of ocean acidification between the subtropics and the tropics in the western North Pacific

*Masao Ishii^{1,2}, Daisuke Sasano^{1,2}, Naohiro Kosugi¹, Katsuya Toyama¹, Hideyuki Nakano¹, Kazutaka Enyo², Yusuke Takatani², Shinji Masuda^{2,1}, Yosuke Iida^{2,1}, Atsushi Kojima^{2,1}, Toshiya Nakano^{2,1}, Keith Bradley Rodgers³

1. Meteorological Research Institute, Japan Meteorological Agency, 2. Global Environment and Marine Department, 3. Princeton University

Increasing acidity of seawater as a consequence of increasing anthropogenic CO₂ emissions is one of the chronic stressors that is expected to have large-scale consequences for marine ecosystems and their services to human society over the coming decades. This problem, referred to as ocean acidification (OA), is one of the major concerns indicated in SDG14, stimulating research on not only the encroachment of OA and the variability of seawater acidity in space and time, but also the impacts on marine organisms. The subtropical and tropical zones in the western North Pacific constitute regions where numerous coral reef habitats with rich marine biodiversity and productivity are distributed and are severely threatened by the OA. Here we present the results of time-series measurements of oceanic CO₂ variables in these regions over the past three decades, and demonstrate that accumulation of excess CO₂ and ensuing OA are in fact occurring. In the Kuroshio-recirculation region of the subtropics, the rates of CO₂ increase and OA are consistent with those expected from the growth of the atmospheric CO₂ concentration under air-sea CO₂ equilibrium. However, the rates are ~40% slower in the tropics. The slower rates in the tropics are attributable to the transport of excess CO₂ from the surface layer of northern/eastern subtropical gyre to the thermocline of tropics through shallow meridional overturning circulation with its elapsed time of 10 - 15 years and the accelerating growth rate of atmospheric CO₂ concentration over the recent decade. Accordingly, it is likely that the impacts of OA on marine ecosystem and socio-economic impacts will emerge earlier in the northern subtropics than in the tropics. OA is “the other CO₂ problem” and can be “the other reason to act” to achieve the +1.5°C target of the Paris Agreement. This is particularly true for countries like Japan where reliance on marine resources and ecosystems for food supply is high.

Keywords: ocean acidification, western North Pacific, Sustainable Development Goal 14