Mechanisms of future changes in equatorial upwelling: CMIP5 inter-model analysis

*Shoshiro Minobe[1,2], Mio Terada[2], Curtis Deutsch[3]

1. Earth and Planetary Sciences, Faculty of Science, Hokkaido University, 2. Graduate School of Science, Hokkaido University, 3. School of Oceanography, University of Washington

The future change in equatorial upwelling is investigated for the Pacific and Atlantic Oceans using data from 24 Coupled *Model* Intercomparison Project Phase 5 (CMIP5) models for the Representative Concentration Pathway 8.5 scenario until 2100. Three-dimensional velocity components of CMIP5 multi-models are used for the first time in an upwelling study, and allow to divide upwelling velocities into diapycnal and isopycnal velocities. This analysis, combined with inter-model regression, revealed that both the multi-model ensemble (MME) mean and the inter-model variability in the upwelling change in the eastern equatorial Pacific, where strong upwelling change occurs, are explained by two mechanisms. One is that the diapycnal upwelling decreases near the surface, which is associated with a weakened Ekman divergence. The other is that the isopycnal upwelling decreases at depths of 75–200 m around the core of the equatorial undercurrent (EUC) due to EUC flattening. Both the weakened Ekman divergence and the EUC flattening are induced by the locally weakened trade wind over the eastern Pacific basin. In the equatorial Atlantic, both the change in MME mean and the inter-model variability of upwellings are significantly related to the weakened trade wind and enhanced stratification, although these drivers are not independent. The results for the Pacific Ocean imply that future reduction in upwelling may impact the sea surface temperature and marine ecosystem by different mechanisms. The rapid warming of sea surface temperature in the eastern Pacific basin may be related to the near-surface diapycnal upwelling reduction, while the decrease in net community production, which is often measured by marine export production at a depth of 100 m, may be related to the isopycnal upwelling reduction.

Keywords: global warming , variability and mean across multiple models , ocean dynamics

