Forced atmospheric circulation response and its uncertainty to decadal SST variability in the Kuroshio Extension

*Bunmei Taguchi[1,2], Kazuaki Nishii[3,2], Hisashi Nakamura[2,4]

1. Faculty of Sustainable Design, University of Toyama, 2. Research Center for Advanced Science and Technology, The University of Tokyo, 3. Graduate School of Bioresources, Mie University , 4. APL, Japan Agency for Marine-Earth Science and Technology

Despite the recent progress on extra-tropical oceanic influences on the atmospheric circulation variability, their observational and modeling estimates are still diverse among studies. Some studies emphasize the importance of high-resolution for models to simulate realistic atmospheric responses, while other studies report success with lower-resolution simulations. These modeling studies tend to still underestimate the amplitude of the observed response, which also shows large uncertainty. A required task is to make a consistent comparison between the observed and simulated atmospheric responses by separating the forced response from internal variability that is inevitable in the observational estimate due to the limited record length.

Here we separate out a forced component of extra-tropical-ocean-driven atmospheric circulation anomaly with a joint analysis of an atmospheric reanalysis and large ensemble AGCM simulations with two different resolutions and two different SST boundary conditions. SVD analysis is applied to winter-time mean near-surface baroclinicity in the Kuroshio Extension (KE) region between all the AGCM ensemble members and the reanalysis data. This yields temporally co-varying patterns for the two datasets as components that are forced by underlying SST anomalies. The leading SVD mode is characterized by a pulsing of the baroclinicity over the KE on the decadal time scale. Associated with the forced baroclinicity mode in both the AGCM and reanalysis, lower-tropospheric storm track activity is enhanced over the KE region, which is accompanied by upper-tropospheric geopotential anomalies in the Pacific sector. The forced upper-tropospheric wave train extends further downstream over the US continent and into the Atlantic sector, exhibiting the Aleutian and Icelandic low seesaw pattern in the reanalysis.

Keywords: large ensemble AGCM, resolution dependency, atmospheric internal variability , jet stream, Aleutian-Icelandic low seesaw

