Global modeling study of dust source and soluble Fe input to the Southern Ocean

Akinori Ito[1]*, and Jasper F. Kok [2]

[1]Yokohama Institute for Earth Sciences, JAMSTEC, Yokohama, Kanagawa, 236-0001, Japan. [2] Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, CA 90095, USA. *e-mail: akinorii@jamstec.go.jp

Atmospheric deposition of dust source materials is a significant source of exogenous iron (Fe) in marine ecosystems. Especially, the Southern Ocean is the most biogeochemically important ocean because of its large spatial extent and its considerable influence on the global carbon cycle. The major sources of atmospheric Fe to the Southern Ocean include South America (Patagonia), Australia, and southern Africa. However, there is large uncertainty in our estimate of the dust emissions in the Southern Hemisphere. Recently, the dust sources in these regions have received considerable attention, both for their potential impacts on climate and ecosystems and for their susceptibility to climate and land-use changes.

Here, we use an atmospheric chemistry transport model to investigate the supply of soluble Fe from dust source regions to the oceans in the Southern Hemisphere. We do so using a physically-based dust emission parameterization to better capture emissions from dry soils in non-vegetated areas. We validated the simulated aerosol optical depth (AOD) using ground-based sun photometer (AERONET) measurements near dust source regions. Our model results suggest that dust emissions from open shrublands in arid and semi-arid regions can be a key contributor to Southern Hemispheric dust, and thus to bioavailable Fe deposition to the Southern Ocean. These results highlight the necessity of improving the process-based quantitative understanding of the dust source fluxes in sparsely vegetated areas with changing climate and land-use practice