Impacts of increased Siberian wildfire on air quality, climate, and economy, assessed with MIROC/SPRINTARS sensitivity experiments

*Teppei J Yasunari[1,2,3], Shigeto Wakabayashi[4], Toshihiko Takemura[5], Daiju Narita[6]

1. Arctic Research Center, Hokkaido University, 2. Global Station for Arctic Research, GI-CoRE, Hokkaido University, 3. Center for Natural Hazards Research, Hokkaido University, 4. School of Engineering, Hokkaido University, 5. Research Institute for Applied Mechanics, Kyushu University, 6. Graduate School of Arts and Sciences, The University of Tokyo

Wildfire is of large concern recently because it sometimes causes disasters in surrounding areas where people live, emits a large amount of air pollutions, and may also induce health issues. Siberian wildfire is a well-known wildfire in the world. To assess the impact of increased Siberian wildfires on air quality, climate, and economy, we implemented six AGCM (Atmospheric General Circulation Model; 15-year integration and analyses for the last 10 years) and AOGCM (Coupled Atmosphere-Ocean General Circulation Model; 100-year integration and analyses for the last 50 years) sensitivity experiments with MIROC/SPRINTARS model (version 5.9.0; [1-3]) for which we change the biomass burning (BB) emissions and climate conditions (i.e., different Representative Concentration Pathway, RCP, scenarios; RCP2.6 and RCP8.5 [4]): (1) the baseline experiment with the Global Fire Emissions Database (GFED) BB emissions [5] in 2004 (lower BB case) under the present climate condition in 2005 (PC05); (2) the increased BB case only replacing the BB emission over the defined Siberian domain (70˚-140˚E; 42.5˚-70˚N) to that in 2003 under PC05; (3) the doubling #2 BB emissions over the Siberian domain under PC05, expecting a more severe wildfire case in the future; (4) same as #2 but under the RCP2.6 condition in 2030; (5) same as #2 but under the RCP8.5 condition in 2030; (3) same as #3 but under the RCP8.5 condition. For the air quality assessment, here we use the outputs from the AGCM experiments to assess the air quality for which we further assess the premature mortality and its economic impacts due to the worse air quality in Japan (the method will be mentioned in detail at the presentation). For the climate impact, we used the outputs from AOGCM to here mainly assess the global aerosol and cloud radiative forcing, and surface air temperature. The relevant assessment of the climate impact on economy will be presented by Narita, D., et al. in the same session.

For example, the increased Siberian wildfire would likely induce the maximal premature mortality due to lung cancer and cardiovascular diseases and their economic impacts of approximately 7,000 persons/year and 1.56 trillion JPY in economic loss in Japan, respectively (Based on the difference between Experiments #3 and #1). Under the similar increase of air pollution case but under the RCP8.5 climate condition, the global aerosol shortwave and cloud longwave radiative forcing at the top of atmosphere and the surface showed the negative maxima. This would also increase the global 2-m temperature of 0.43 K. More details will be shown on the day of the presentation.

References:
[1] Watanabe, M., et al. (2010), Improved Climate Simulation by MIROC5: Mean States, Variability, and Climate Sensitivity, *J. Clim.*, 23, 6312–6335, doi:10.1175/2010JCLI3679.1.
[2] Takemura, T., Okamoto, H., Maruyama, Y., Numaguti, A., Higurashi, A., and Nakajima, T. (2000), Global three-dimensional simulation of aerosol optical thickness distribution of various origins, *J. Geophys. Res.*, 105(D14), 17853–17873, doi:10.1029/2000JD900265.
[3] Takemura, T., T. Nakajima, O. Dubovik, B. N. Holben, and S. Kinne, 2002: Single-scattering albedo and radiative forcing of various aerosol species with a global three-dimensional model, *J. Clim.*, 15, 333-352, doi:10.1175/1520-0442(2002)015<0333:SSAARF>2.0.CO;2.

[4] Moss, R. H., et al. (2010), The next generation of scenarios for climate change research and assessment, *Nature*, 463, 747–756, doi:10.1038/nature08823.
[5] Randerson, J. T., G. R. van der Werf, L. Giglio, G. J. Collatz, and P. S. Kasibhatla (2013), Global Fire Emissions Database, Version 3.1. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1191.

Keywords: wildfire, air pollution, climate impact, health impact, economic impact, aerosol

