# $NO_X$ emission estimation over Japan based on satellite data with wind field divergence

*Masahiro Yamaguchi[1], Yugo Kanaya[1]

1. Japan Agency for Marine-Earth Science and Technology

Nitrogen dioxide ($NO_2$) is a form of $NO_X$ as important air pollutants, that leads to acid rain, ozone formation, and adverse impacts on human health. Anthropogenic activities involving the fossil fuel combustion such as vehicle engines and power plants are big sources of atmospheric $NO_2$. Despite their importance, it is not easy to create high-resolution emission maps with top-down estimation by direct measurement. In this study, we investigated the wide and detailed $NO_2$ emission map over Japan, based on the divergence of the $NO_2$ horizontal fluxes calculated from the datasets of satellite observation and meteorological model. According to the continuity equation for steady state, the divergence of $NO_2$ flux yields the net balance of sources and sinks. This approach has been demonstrated for the urban scale estimations (Shaiganfar et al., 2011, Shaiganfar et al., 2017, Beirle et al., 2019), and for a global catalog of point sources (Beirle et al., 2020). We also applied this local form of conservation laws to the $NO_2$ emission maps over Japan. Our method used datasets of tropospheric $NO_2$ vertical column density derived from the Sentinal-5P/TROPospheric Ozone Monitoring Instrument (TROPOMI) satellite and wind vector derived from The Meso-Scale Model (MSM). TROPOMI Level 2 data products has daily spatial coverage with high resolution for; 3.5 x 7.0 $km^2$ at beginning of mission in 2018, 3.5 x 5.5 $km^2$ since 6 August 2019. MSM which is one of the numerical weather prediction models operated by JMA provides 51-hour or 39-hour forecasts every 3 hours on 5 km grid all over Japan. Using these datasets, divergence calculations for daily estimation with high spatial resolution can be conducted. Our temporal averaged results showed well linear correlation with $NO_X$ emission from EAGrid2010-Japan (Fukui et al., 2014) and revealed clear distribution of point sources.

Keywords: Nitrogen oxides (NOx), Emission estimation, Nitrogen dioxide (NO2), TROPOMI, Satellite data

 