

【5-1802】

Assessment Study for Air Quality Improvement Obtained from the 2020 Global Sulphur Limit in Marine Fuels

SAKURAI Tatsuya

Meisei University

2-1-1 Hodokubo, Hino, Tokyo 191-8506, JAPAN

E-mail: tatsuya.sakurai@meisei-u.ac.jp

Key Words: Seto Inland Sea, MARPOL Annex VI, 2020 IMO Global Sulphur Limit, SO₂, PM_{2.5}, air quality model, emission inventories

This project is an observation and simulation study to evaluate the effect of the 2020 IMO global sulphur limit on air quality. Long- and short-term observations were performed in the Setouchi region, which was expected to be strongly affected by ship exhaust gas. Through observation data and numerical simulation analyses, the mechanism for high PM_{2.5} pollutions around coastal areas was investigated. Moreover, quantitative evaluations were conducted to improve PM_{2.5} pollution expected by the 2020 IMO sulphur limit. Then, the future direction of PM_{2.5} countermeasures was assessed based on the evaluation of the source apportionment and sensitive analysis.

For the numerical simulation, air pollutant emission inventories for ships were developed considering ships in navigation, ships at anchor, and fishing boats. The first database was estimated by using activity data of the 2015 Japanese fiscal year. The second set was estimated by considering marine fuel oil use with <0.50% sulphur content; the database had been released to the public and is being used in government studies on PM_{2.5} countermeasures.

The short-term observation, conducted at Kanmon Straits, showed that the concentration of SO₂ in ship exhaust gas significantly decreased before and after the sulphur limit. The long-term observations, conducted at two special sites in the Setouchi region suggested that the decrease in the sulphur content of marine fuel oil decreased the concentration of vanadium in the atmosphere, although evaluating the observation results was not easy due to unexpected occurrences, such as COVID-19 and the impact of the volcanic gases (Nishinoshima).

The numerical simulation analysis suggested that the high PM_{2.5} concentrations in the Setouchi region were mainly due to emission characteristics, which were enhanced by meteorological properties. Under such the region-specific condition, the simulated PM_{2.5} decreased from approximately 15% to 9% due to the effect of the sulphur limit. This improvement in PM_{2.5} is equivalent to a reduction in the number of stations that did not meet the environmental standard. Out of 58 stations, 18 had not met the standards, which improved to 13 stations in the 2018 fiscal year. After the sulphur limit, the contribution rate of the large-scale stationary sources accounted for approximately 24% of PM_{2.5} under the region-specific condition, indicating that they were high-priority sources for future PM_{2.5} countermeasures in Japan. Among the large-scale stationary sources, the electric power industry was the most significant because it emitted the largest number of PM_{2.5} precursors.

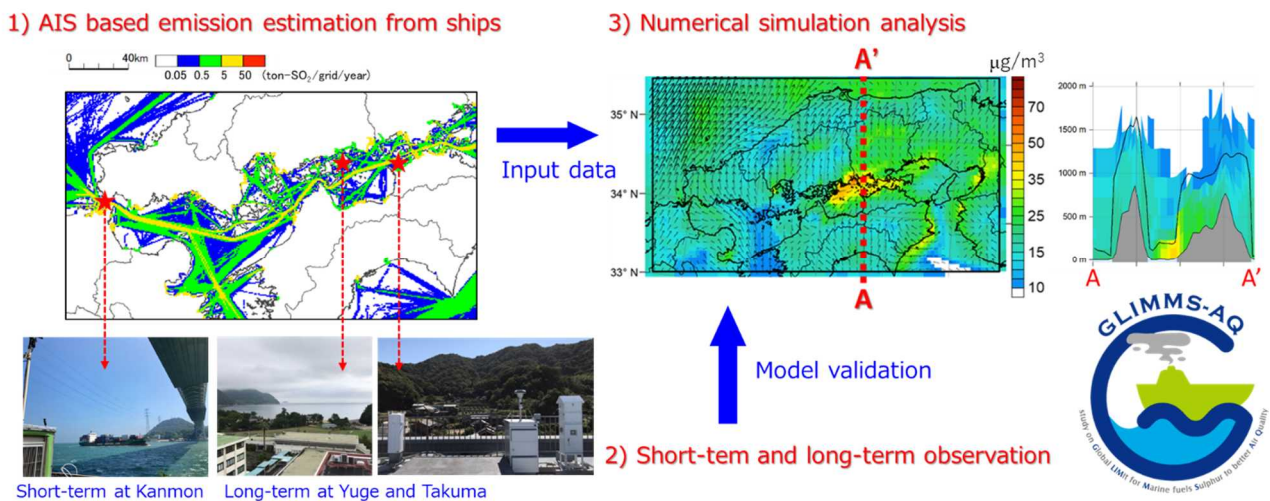


Fig. 1 Outline of “study on **Global Limit for Marine Fuels Sulphur to better Air Quality** (GLIMMS-AQ)”

<Journal articles>

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