

Continuous observation of atmospheric oxygen concentration onboard a cargo ship sailing between Japan and North America

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In-situ observation of atmospheric oxygen (O₂) and carbon dioxide (CO₂) mixing ratios have been conducted in the North Pacific by using a cargo ship, New Century 2 (NC2), sailing between Japan and United State since December 2015. A fuel-cell type analyzer (Oxzilla-II) and a non-dispersive infrared analyzer (LI-840) are used for the measurements of the O₂ and CO₂, respectively. To detect their variations in the atmosphere, the flow rates of the air samples introduced into the analyzers and the outlet pressure are precisely controlled. We adopted the relatively low flow rates of the air samples of 10 cm³ min⁻¹, which sacrifice the precision and time resolution, mainly to reduce the consumption rate of the reference gases stored in high-pressure cylinders. The final precisions of the O₂ and CO₂ measurements when the system is set in the laboratory is 1 ppm for O₂ (4 per meg for O₂/N₂ ratio) and 0.1 ppm for CO₂. After the in-situ observation started onboard NC2, we found that the ship movement caused false wavy variations of O₂ signal with the amplitude of more than several tens ppm and the period of about 20 seconds. Although we have not solved the problem at this stage, hourly averaging considerably suppressed the errors associated with the ship movement; comparison between the in-situ observation and flask sampling of air samples onboard NC2 shows that the averaged differences are -2.1 ± 9.2 per meg and -0.02 ± 0.33 ppm, respectively. The one-year data clearly show seasonal variations in the extensive North Pacific region.