



## **Long-term monitoring of atmospheric trace gases and aerosols in Asia and Oceania using voluntary observing ships**

Hiroshi Tanimoto, Hideki Nara, Hitoshi Mukai, Yukihiro Nojiri, Yasunori Tohjima, Toshinobu Machida, Yoko Yokouchi, and Shigeru Hashimoto

National Institute for Environmental Studies, Ibaraki, Japan (tanimoto@nies.go.jp, 81 29 8502579)

The National Institute for Environmental Studies (NIES) has been operating a long-term program for monitoring trace gases in the background air over the Pacific Ocean since 1995. The NIES Voluntary Observing Ships (NIES-VOS) program currently makes use of four commercial cargo vessels that are in regular operation in constant routes for long periods and sail over a wide area between various ports (e.g., between Japan and the United States, between Japan and Australia/New Zealand, and between Japan and southeast Asia). These routine platforms offer the advantage of systematic measurements of trace gases and aerosols, providing long-term datasets for pristine background air over the Pacific Ocean and regionally polluted air around east Asia. Ambient measurements are made by combination of continuous instruments onboard ships and flask sampling apparatus followed by laboratory analysis. We observe both long-lived greenhouse gases (e.g., carbon dioxide) and short-lived air pollutants (e.g., tropospheric ozone, carbon monoxide, and black carbon) on a continuous basis. Flask samples are analyzed for carbon dioxide, methane, nitrous oxide, halocarbons, and carbon monoxide by using gas chromatographic techniques. In addition, we recently installed cavity ringdown spectrometers for high-resolution measurement of methane and carbon dioxide to capture their highly variable features in regionally polluted air around southeast Asia (e.g., Hong Kong, Thailand, Singapore, Malaysia, Indonesia and Philippines), which is now thought to be a large source due to expanding socioeconomic activities as well as biomass burnings. Comparison between in situ measurements and flask analyses enabled us to check data quality and thus improve accuracy and precision of overall measurements. Contrasting the Japan-Australia/New Zealand and Japan-southeast Asia cruises revealed regional characteristics of sources and sinks of these atmospherically important species, suggesting the existence of additional sources for methane, nitrous oxides, and carbon monoxide in this tropical Asian region. In the presentation, we will overview long-term trends and interannual variations of multiple species at different latitudinal bands and different geographic regions. In addition, we will highlight the impact of large-scale biomass burning events in El Nino year 2006 on trace species based on the analysis with AIRS satellite data, GFED emissions inventory, and FLEXPART model.