IFM-GEOMAR
Leibniz-Institut für Meereswissenschaften
an der Universität Kiel

RV Sonne-Transbrom ship cruise during October 2009

From 9 to 24 October 2009 the IFM-GEOMAR (Kiel, Germany) conducted a cruise with RV Sonne in the tropical western Pacific to investigate trace gas emissions on a transit between Tomakomai (Japan) and Townsville (Australia) in different biogeochemical regimes and their stratospheric contribution.

The project aims to reduce uncertainties in stratospheric halogen loading and ozone depletion resulting from oceanic emissions and atmospheric transport of ozone depleting substances. The tropical oceans are a known source of reactive bromine and iodine to the atmosphere in the form of short-lived brominated and iodinated methanes as e.g. bromoform ($CHBr_3$), dibromomethane (CH_2Br_2) and methyl idodie (CH_3I). Elevated atmospheric concentrations above the oceans are related to oceanic supersaturations of the compounds and to natural photochemical and biological production. Increasing scientific evidence suggests that there could be significant contributions from the ocean derived, halogen-containing short lived substances to stratospheric ozone depletion, which is addressed in the scientifc program of the Sonne ship cruise. This cruise is part of the national research project ”TransBrom”(www.ifm-geomar.de/~transbrom). The tropical western Pacific is a largely uncharacterized region for the oceanic compounds and a projected hot spot for their emissions and transport pathways into the stratosphere.

Of particular relevance during the cruise was the characterization of the climate-sensitive oceanic emission strengths of a suite of halogenated gases in various biogeochemical regimes and the investigation of the real contribution of these emissions to stratospheric bromine with a new transport model. This was validated by the atmospheric structure determination through intense radio, ozone and water vapor sounding during the cruise. We further investigated more marine trace gases as nitrous oxide (N_2O), dimethylsulfide (DMS), oxygen (O_2) and carbon dioxide (CO_2), and possible relationships between these compounds. Satellite measurements of phytoplankton groups, obtained by special retrieval methods from the SCIAMACHY and GOME-2 instruments give further information about biogeochemical conditions during the cruise. The total atmospheric column concentrations and atmospheric concentration profiles of several other long-lived trace gases were also determined. These measurements allow to study the transport of tropospheric trace gases through the tropopause, in this way yielding information on the entry of natural and anthropogenic tropospheric trace gases into the stratosphere.

This might have been the first oceanic study, we are aware of, where the transport of oceanic emission of halogenated trace gases from the surface into the stratosphere was investigated. The impact of the natural ozone depleting substances will be highly sensitive to climate change in terms of their emissions to the atmosphere, their transport, and their chemical processing. Future changes in the mechanisms, that regulate these processes, are largely unknown. Therefore the oceanic emissions have the potential to cause surprises in the future evolution of the ozone layer in the changing climate, unless they are better understood. The measurements are thus needed to improve the understanding of future stratospheric halogen loading and therewith ozone depletion.

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