

A Royal supply of nutrient data over the years

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The application of nutrient analyses in climate studies and global budgets requires high quality data and a rigorous intercalibration between oceanographic analytical laboratories. Since 1989, the Royal NIOZ Nutrient Laboratory has been producing high quality data, as demonstrated in intercomparison studies in the framework of International Council for the Exploration of the Seas (ICES) and Quality Assurance of Information for Marine Environmental Monitoring in Europe (QUASIMEME). In 2008, the laboratory ranked top of the list during a global intercomparison, organized by the Meteorological Research Institute (MRI) in Tsukuba, Japan.



The participants joining the MRI workshop in Japan, November 2007.

In general, a nutrient intercomparison study involves the analysis of sterilized natural seawater for phosphate, silicate, nitrate and nitrite and occasionally ammonium. Before distribution, the sea water samples are tested for homogeneity. Upon analysis, the analytical results are returned to the organizing office and are compared with the assigned values with a defined error (typical target value being $\pm 12.5\%$ in the nineties and $\pm 6\%$ after 2000) depending on the parameter. The laboratory performance per analysis is expressed in a so called Z-value, which is the measured value minus the assigned value, divided by the error limit. Z-scores within plus or minus 1 are considered satisfactory.

Over the years, all QUASIMEME participants have improved the quality of ana-

lysis, yielding more consistent data-sets. Therefore, progressively smaller error limits have been applied since these are calculated from the consensus standard deviation. This narrowing of band-width has reduced the number of participants capable of producing results within Z-scores of plus or minus 1. The figure illustrates the average absolute Z-value for all parameters tested, as achieved by the Royal NIOZ Nutrient Laboratory over the years 1993-2003. It shows a clear improvement in analytical quality over the years, whereas the small rise after the year 2000 is to be attributed to the reduction in the error limit.

International climate studies, however, require improved long-term precision and consistency between laboratories. MRI Japan has taken up this challenge by

commercializing the production of reference material. A fully automated procedure has been developed for homogenizing, double autoclaving and the sterile filling of bottles with Pacific Ocean water. For intercomparison between 55 international marine oceanographic laboratories, six samples of different nutrient concentrations were sent out to each participant in 2006. The error limits used for this MRI intercomparison were below 2.5% for all parameters on all concentration levels, so three times smaller than applied within QUASIMEME over the last years. The final report, released in 2008, showed the NIOZ Nutrient Laboratory to be the best participant with an average Z-score of 0.37 for all concentration levels for all parameters!

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The future goal is to certify the reference material produced in Japan, and to make it available for the entire oceanographic community in order to allow direct comparison of nutrient data between the different research vessels, each operating in their own ocean section.

