

These days, industrial as well as daily living activities in our society are supported by a variety of chemicals. At the same time, these substances have a wide range of impacts when they are released into the environment. This has resulted in the actual observance or fear of harm to environment and human beings.

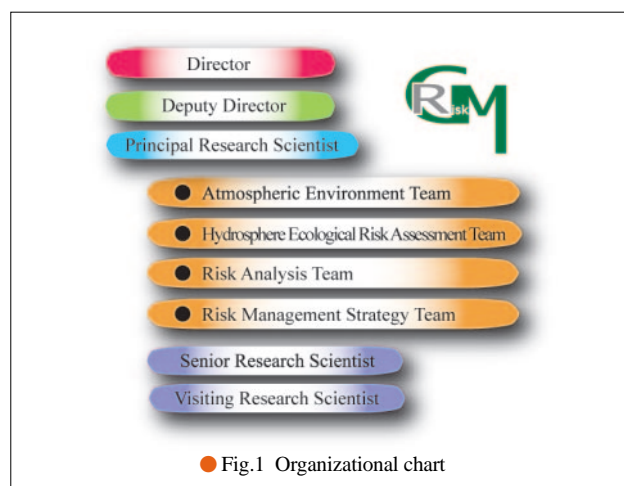
The Research Center for Chemical Risk Management (CRM) promotes research on assessment and management of risk associated with the use of chemical substances.

A major characteristic of CRM research is that it aims to develop risk assessment and management methods by coming to grips with the hazardous chemical substances pose to the environment as events of probability. This is based on the premise that “there is no such thing as absolute safety; risks are always present”. This represents a fundamentally new approach from traditional environmental impact assessments of chemical substances, which have aimed to verify the safety of individual substances based on the premise that “there is a safe level at which chemicals can be used”.

By introducing the new concept of “risk” rather than using polarized criteria (“Is it safe? Or is it dangerous?”),

it becomes possible to perform relative comparisons and evaluations that target multiple numbers of chemicals that may have environmental impact. In terms of risk reduction and management methods as well, the concept makes it possible to evaluate the effects and economic viability of these methods and to issue rational judgments.

CRM’s activities are founded on three pillars: basic research, practical research, and contribution to society. Although “risk” is a concept that has not yet taken firm root in Japan, CRM believes that it will be an essential element of chemical substance management in the future.



## ● National Institute of Advanced Industrial Science and Technology-Atmospheric Dispersion Model for Exposure and Risk Assessment: AIST-ADMER

CRM’s work does not stop at enhancing research activity and producing results. Another of its important missions is providing information on proactive risk evaluation and management as well as efforts to popularize these activities.

In the area of research, CRM actively forecasts the movement of chemicals within the environment and develops simulation models for estimating environmental concentrations so as to advance environmental research. At the same time, it is working to develop all-purpose models that can be shared throughout society.

Even in other countries, risk evaluation methods that can be used in risk management have yet to be developed. That is why CRM is pouring its efforts into this task.

Models and risk evaluation methods are necessities of making decisions concerning risk management, and CRM is making every effort to provide these tools in forms that can be shared by a wide range of people. This is because shared reference tools are an extremely effective means of promoting communication among the various risk management approaches and of forming agreements. The ADMER ver.0.8 β, which works only in the Kanto area of Japan, had been publicly available in FY2002. The ADMER ver.1.0, which works all over Japan, has been available for download on CRM’s web site in the FY2003. Anybody can get and use it at no charge.

## Outline of ADMER

The ADMER was designed to estimate the long-term average spatiotemporal distribution of the concentrations and depositions of chemicals in a comparatively wide region such as the Kanto or Kinki Regions of Japan. The concentrations for a  $5 \times 5$  km square grid spatial resolution of 6 time zones (i.e., 4 hours average) for a month is available.

The ADMER includes some useful functions for calculation and exposure and risk assessment, used for compiling meteorological data and making up gridded emission data for the simulation, and for analyzing the calculation results visually using several kind of maps, charts and graphs, and estimating the size and location of populations exposed to chemicals.

The ADMER has an MS-Windows graphic user interface which may help not only experts of simulation models, but also risk assessors in government or industry performing simulations. The ADMER will be useful for those risk assessments in which spatiotemporal distributions must be considered.

## Application and case examples of ADMER

PRTR system provides the emission data of various chemicals. However,

1. PRTR can only provide the “emission”. Calculation of atmospheric chemical concentration using a model must be performed for the exposure assessment. Suitable risk evaluation cannot be

performed with data on concentration distribution alone. In this case, it is important to estimate population exposed to chemicals.

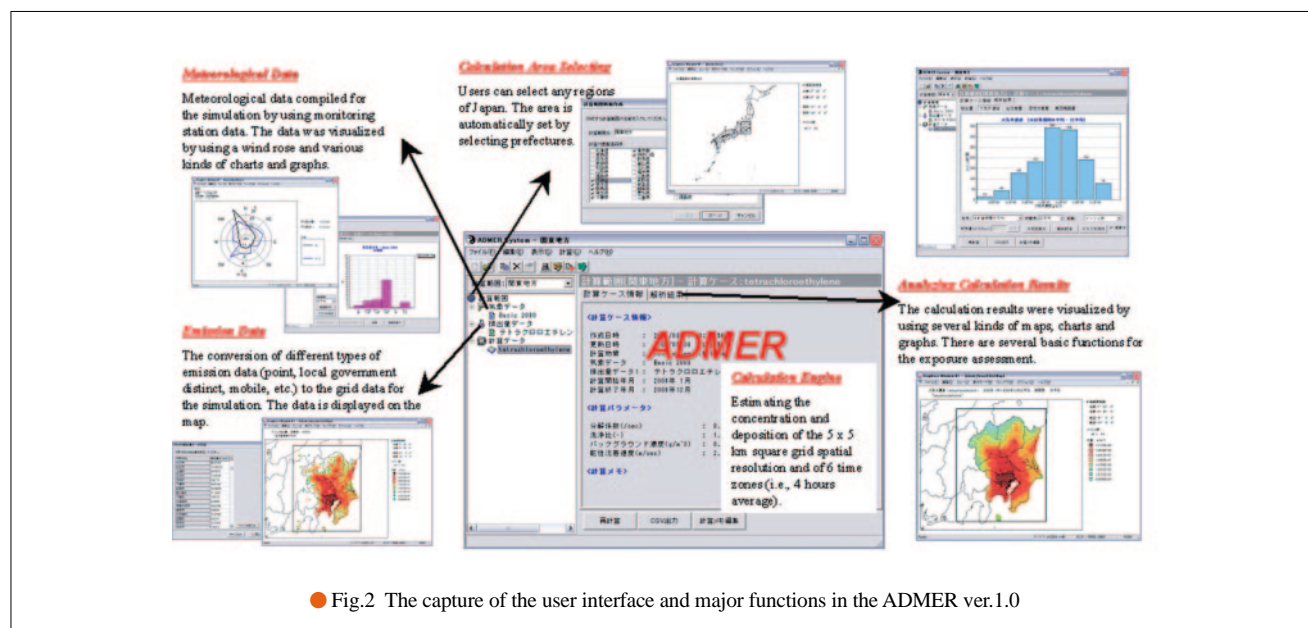
2. It cannot be assumed that all estimated values collected under the PRTR system are reliable. This is because of such factors as the fact that application of the PRTR system has only recently started and that a wide variety of substances are included. Thus, it is important to use a model to check even if a portion of monitoring data can be utilized.

Under these circumstances, application of ADMER can make up for deficiencies that arise when PRTR data will be used alone in exposure evaluation and risk evaluation.

The ADMER has been used in actual risk evaluation under the NEDO (New Energy and Industrial Technology Development Organization) project. It is expected that the international version of the ADMER will be used by even wider range of interested parties, including governments and enterprises.

## Application of ADMER

- Evaluation of chemicals under the Law Concerning the Examination and Regulation of Manufacture, etc., of Chemical Substances
- Reliability checks on PRTR data
- Risk management and communication activities by local governments
- Background data on responsible care by enterprises



● Fig.2 The capture of the user interface and major functions in the ADMER ver.1.0

## ● Risk Assessment Documents

CRM has been releasing risk assessment documents for chemical substances that are deemed to be hazardous for the purpose of use in risk management based on detailed risk analysis.

These documents are expected to establish a scientific basis when government, enterprises, private citizens, and others discuss and take the measures for chemical management. The documents contain the following items:

- 1) Analysis of emission sources
- 2) Simulation of concentration in environment and exposure
- 3) Toxicity assessment
- 4) Presentation of multiple options as risk management measures
- 5) Risk assessment and socio-economic evaluation of these options
- 6) Recommendations on management measures

The risk assessment document is required to have two aspects. The first is deduction based on accurate evidence that leads the approval of a wide range of people, and the second is development and use of new and challenging methods.

In FY2002, CRM issued a risk assessment document of 1,3-butadiene. This document can be downloaded from CRM's web site.

## ● Outline of the Risk Assessment Document of 1,3-Butadiene

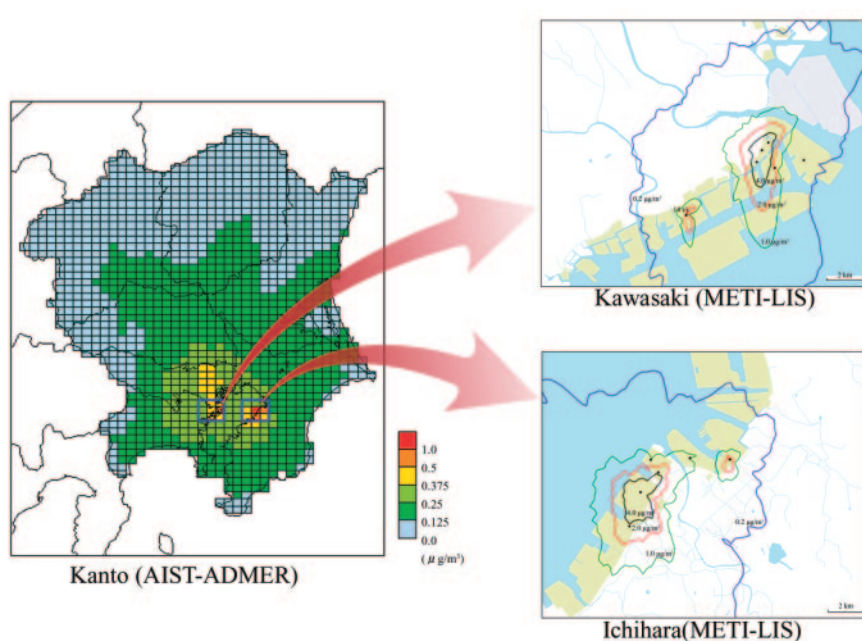
The risk assessment of 1,3-butadiene on human health in Japan was conducted as follows.

The amount of 1,3-butadiene emitted from such emission sources as factories that produce and use 1,3-butadiene and automobiles was analyzed. The results were applied to AIST-ADMER, the atmospheric dispersion model for wide regions, to estimate concentrations in the air at the Kanto region.

With regard to several industrial complexes having large emission sources, the METI-LIS (Ministry of Economy, Trade and Industry-Low rise Industrial Source) dispersion model was applied to estimate detailed distribution of 1,3-butadiene. In addition to these two model analyses, exposure along major roads at the Kanto region was assessed.

After discussing the multiple endpoints of exposure to 1,3-butadiene, as the unit risk for incidence of cancer through inhalation,  $5.9 \times 10^{-6} / (\mu\text{g}/\text{m}^3)$  was obtained from an epidemiological study and as a non-carcinogenic endpoint, ovarian atrophy that increased after a two-year inhalation test on mouse was applied.

According to the results of the exposure assessment and toxicity assessment, the lifetime risk of cancer was estimated in cases where people were exposed to 1,3-



● Fig.3 Results of model analyses of 1,3-butadiene concentration

butadiene over the course of their lives. The result was as follows: Approximately one in four members of the entire population had a lifetime risk of  $10^{-6}$ ; the remainder was between  $10^{-5}$  and  $10^{-6}$ , with an extremely small number exceeding  $10^{-5}$ . Furthermore, it was determined that the risk of ovarian atrophy, which was chosen as the endpoint for evaluation of non-carcinogenic effects, requires no further consideration for the foreseeable future.

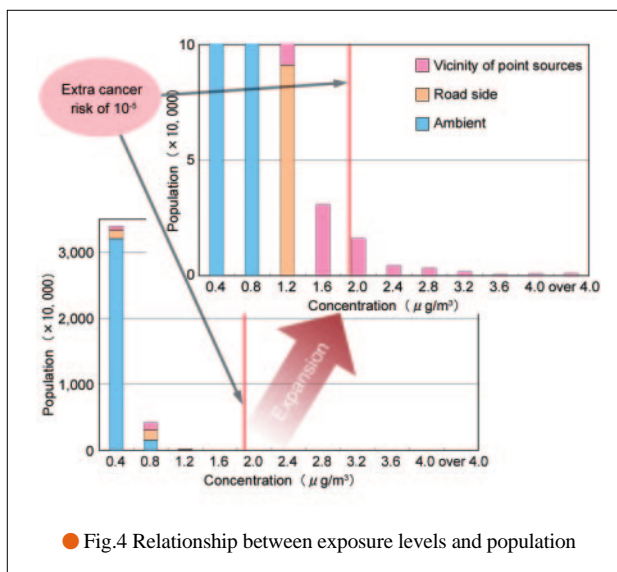
In addition, the results of voluntary management efforts by enterprises that were started in FY1995 were verified. Cost effectiveness analysis of the measures that was conducted in FY1999 showed that the cost per cancer-case prevented was around 200 million yen.

From the results of the above analysis, it was concluded that the risk level associated with 1,3-butadiene is not as high as is concerned in the majority of regions, and that, even in areas around industrial complexes that have high concentrations, voluntary management plans to reduce emissions have been effective in reducing environmental concentrations. Consequently, it is thought that there is little necessity to spend further cost to impose emission restrictions.

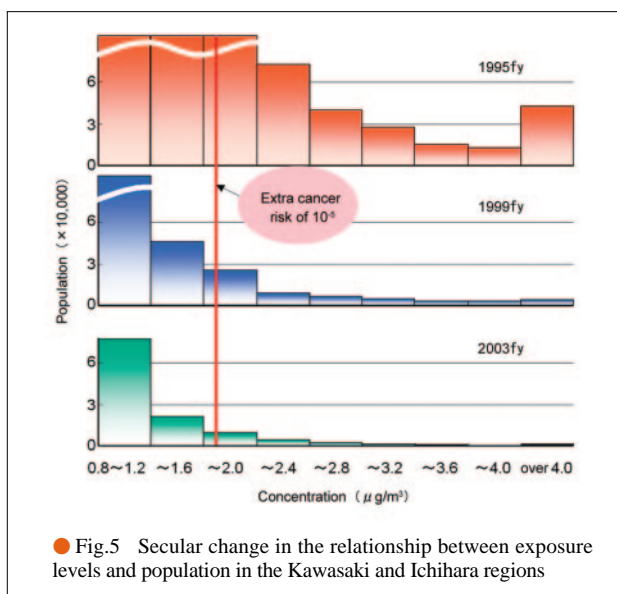
### ● Scheduled Releases for FY2003

In addition to the national-wide version of ADMER, CRM plans to make other software available to the public at no charge. Included are a simple risk evaluation model in Tokyo Bay (**R**isk **A**ssessment **M**odel **T**okyo **B**ay, AIST-RAMTB) and Risk Learning (a computerized tool to evaluate human exposure and health risk of chemical substances).

Risk assessment documents other than the one of 1,3-butadiene will also be released continually.



● Fig.4 Relationship between exposure levels and population



● Fig.5 Secular change in the relationship between exposure levels and population in the Kawasaki and Ichihara regions

In addition to these items, CRM makes open the annual policy statement, information on research projects, contents of lectures, a quarterly newsletter, and other relevant information on its web site.