

EANET

ACID DEPOSITION
MONITORING NETWORK
IN EAST ASIA



SECRETARIAT FOR EANET

NETWORK CENTER FOR EANET

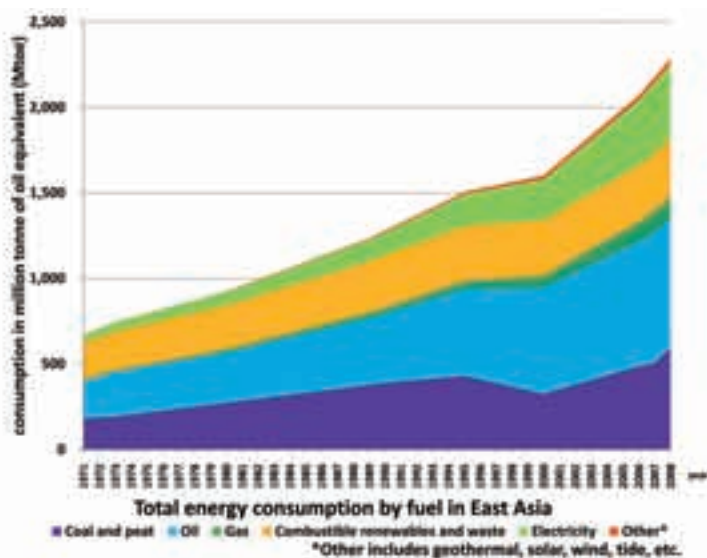
BACKGROUND - Serious air pollution problems in East Asia -

Air, water, land and biodiversity in ecosystems are essential for supporting human life on the planet Earth. But ironically though, the ability and capacity of these systems to support human existence have been imperiled by humans themselves through economic activities. There is evidence of unprecedented environmental changes at the global and regional levels, and these changes have major implications on human well-being, locally.

Almost one-third of the world's population lives in the East Asian region. Due to rapid economic growth and industrialization, many countries in this region are facing a serious threat from air pollution, including acid deposition, particularly if their energy production depends on sulfur-rich coal. Regional cooperation for countermeasures to prevent regional air pollution is urgently needed.

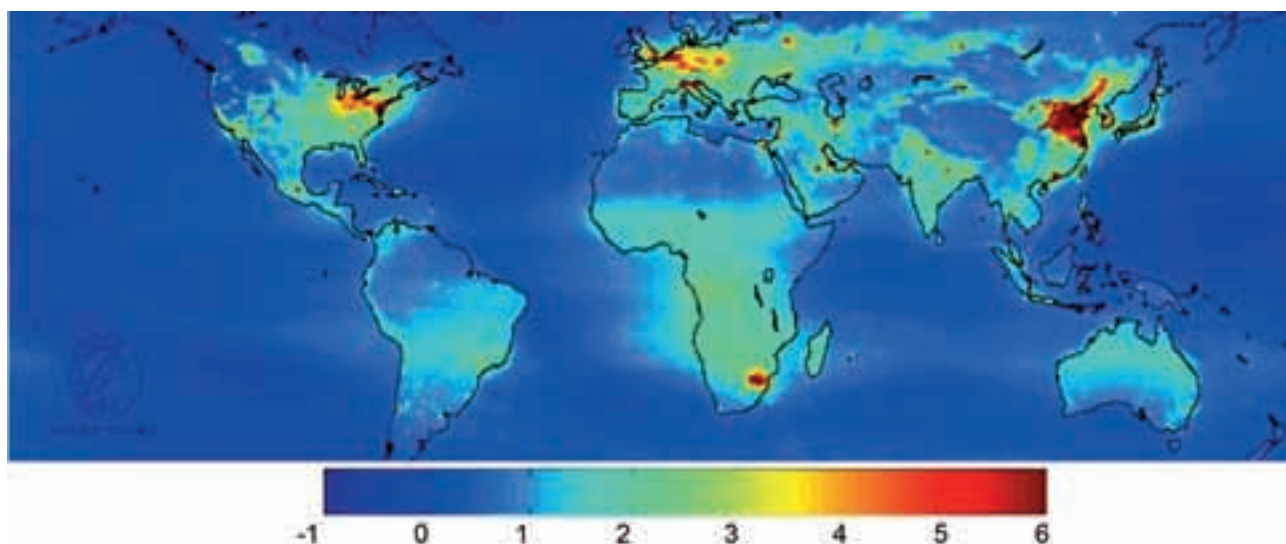


■ Air Pollution in East Asia



Source: International Energy Agency (IEA), Energy Balances of OECD Countries and Energy Balances of non-OECD Countries, 2010 edition

Figure of *Total energy consumption by fuel in East Asia* shows increasing trends of energy consumption in East Asia based on type of fuel. Figure of *Global NO₂ map* clearly shows that East Asia is one of the regions most affected by nitrogen dioxide. The trend of energy consumption in East Asia is likely to cause more serious air pollution in the future. The situation is serious in that unless the fossil-based fuel consumptions and their environmental aftermath are curtailed, the damage they cause to human health and the environment will continue and become more serious in the decades to come.



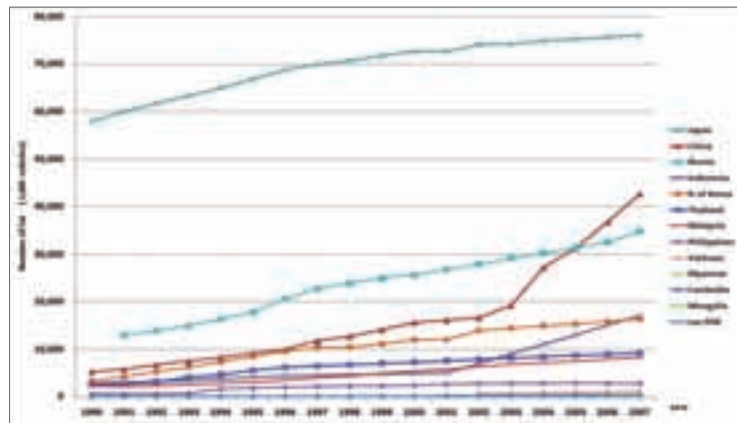
Global NO₂ map based on 4 years worth of satellite data (2003 - 2006) (Unit 10¹⁵ molec/cm²)
Reference: Max-Planck-Institute for Chemistry in Mainz
http://joseba.mpch-mainz.mpg.de/no2_nad.htm

AIR POLLUTION AND ACID DEPOSITION



■ Decline of forests

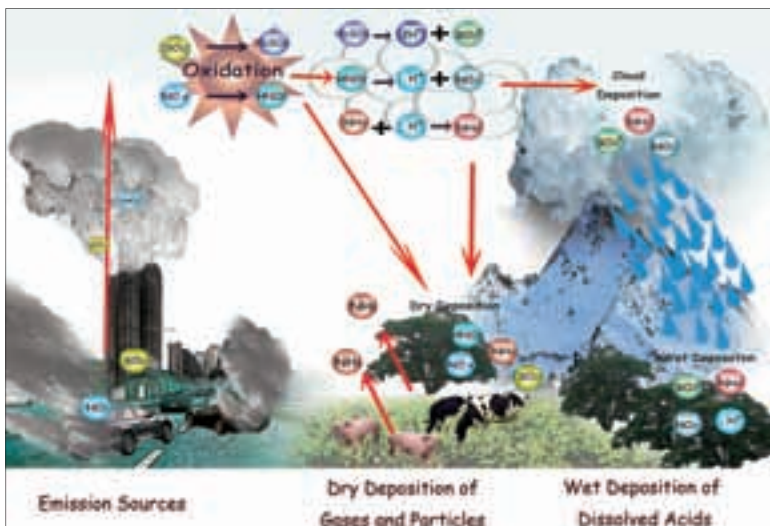
the troposphere gives harmful effects on humans and ecosystem as strong oxidizing substance. These pollutants are emitted from automobiles and industries. Since emission of NO_x in East Asia is rapidly increasing due to rapid rise in the use of automobiles, concentrations of tropospheric ozone are predicted to increase in the future. The figure shows increasing trend of numbers of vehicles in East Asia.



■ Trends of the number of vehicles in East Asia
Reference : World Development Indicators (WB),
World Road Statistics (IRF), UN Statistical Division

Mechanism of Acid Deposition

SO₂ and NO_x are emitted into the atmosphere with other pollutants during combustion of fossil fuels (oil, coal, etc.) by industries and power plants as well as in engines of motor vehicles. These gases are transformed by chemical reactions with air constituents into sulfuric and nitric acids which were transported and come down to the surface of the earth far from the emission sources. The acid deposition phenomena are realized in two types of processes as shown in Figure below. One process is “wet deposition” when acids are taken by cloud waters and brought down to land and water bodies with rain, snow or fog. The large amount of dissolved acids causes the strong acidity of precipitation commonly known as “acid rain”. By another process called “dry deposition”, airborne acids are removed from the air during fine and cloudy days. They pass through air to the ground and deposit on water bodies, grasses, trees, buildings, and even inhaled into the human respiratory system causing health problem.



■ Mechanism of acid deposition

Although ammonia (NH₃), emitted from fertilizers and livestock, does not fall under the criteria as an air pollutant affecting human health, it reacts with nitric and sulfuric acids in the atmosphere to form fine particulate matter through the process of neutralization. After deposition on the ground, ammonium compounds are oxidized into nitrate in soil and produces acid. Moreover, excess nitrogen loads by nitrate and ammonium disturb the nutrient cycles of ecosystems.

ACID DEPOSITION MONITORING NETWORK IN EAST ASIA (EANET)

The Acid Deposition Monitoring Network in East Asia (EANET) is an intergovernmental regional network established for promoting cooperation among countries in East Asia to address acid deposition problems.

Objectives of EANET

- To create a common understanding of the state of acid deposition problems in East Asia;
- To provide useful inputs for decision-making at the local, national, and regional levels aimed at preventing, or reducing adverse impacts on the environment caused by acid deposition; and
- To contribute to cooperation on the issues related to acid rain deposition among the participating countries.

Thirteen Participating Countries of EANET



Major Activities of EANET

EANET addresses the acid deposition including ozone and particulate matter (PM) issues in an integrated approach embarking on the following major activities:

1. Acid deposition monitoring

- Review and revision/establishment where appropriate of the national monitoring plans*
- Implementation of monitoring using common methodologies*
wet deposition, dry deposition, soil/vegetation
inland aquatic environment, catchment

2. Compilation, evaluation, storage, analysis and provision of data

- Submission of monitoring data to the Network Center*
- Issuing of Data Report
- Periodic report on the state of acid deposition
- Dissemination of the data and relevant information through EANET web site

3. Promotion of quality assurance and quality control (QA/QC) activities

- Implementation of QA/QC programs
- Development of Standard Operational Procedures (SOPs)*
- Inter-laboratory comparison projects

4. Implementation of technical support and capacity building activities

- Dispatch of technical missions
- Individual training at the NC
- National training*
- Utilization of existing training programs (JICA Training Course) and others

5. Promotion of research and studies related to acid deposition and air pollution problems

- Joint studies on wet/dry deposition
- Joint study on catchment analysis

6. Promotion of public awareness activities

- Joint project on the development of the national brochure and the environmental study
- Workshop on public awareness

7. Other relevant activities

- Cooperation and exchange of information and experiences with other regional and global networks/initiatives

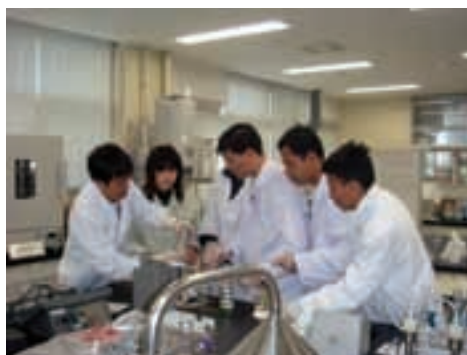
* by participating countries



■ EANET Data Report 2007-2009



■ Public awareness workshop



■ EANET Training



■ Research on dry deposition

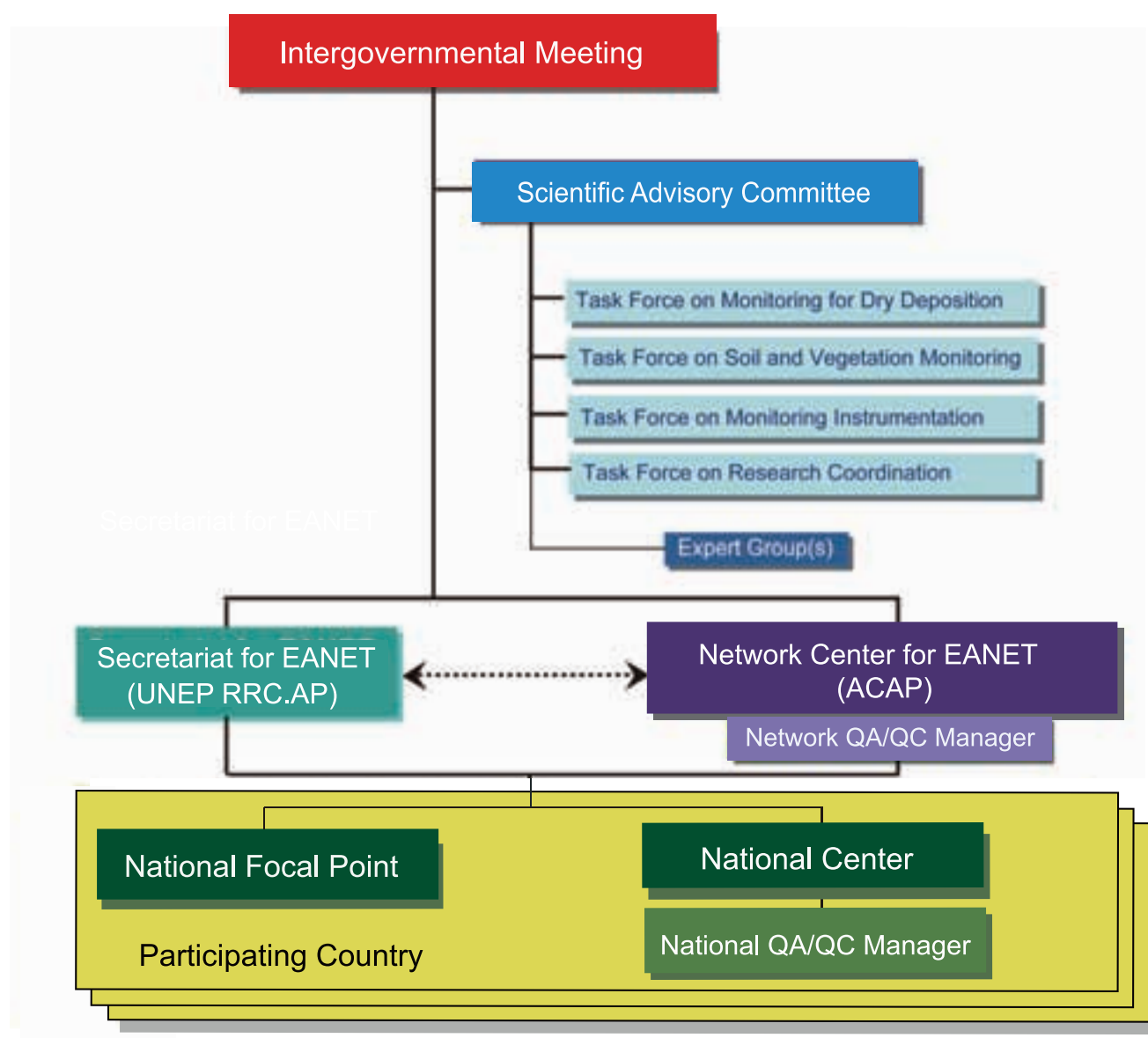
Institutional Framework of EANET

As the institutional framework for EANET, the Intergovernmental Meeting (IG) is the decision-making body of EANET. The Scientific Advisory Committee (SAC) was established under the IG, and the Secretariat and the Network Center were designated to support the network. Several Task Forces and Expert Groups were established under the SAC. These organizations promote the network activities in close communication, coordination and collaboration with the National Focal Points (NFPs), National Centers and National Quality Assurance and Quality Control (QA/QC) Managers in the participating countries.



■ 12th Session of the Intergovernmental Meeting (IG12) in 2010 in Japan

Organizational Structure



Roles of Respective Organizations of EANET

Intergovernmental Meeting

- ◆ Composed of the representatives of all participating countries and make decisions on implementation of the network activities.

Scientific Advisory Committee

- ◆ Composed of scientific and technical experts nominated by the participating countries and advise and assist the IG on scientific and technical issues of network; and
- ◆ Prepare periodic assessment reports on the state of acid deposition in East Asia.

Secretariat

- ◆ Communicate and cooperate with the participating countries;
- ◆ Prepare for the EANET meetings such as the IG and the SAC;
- ◆ Conduct necessary administrative and financial management for the network; and
- ◆ Promote capacity building and public awareness activities in cooperation with the Network Center.

Network Center

- ◆ Compile, evaluate, analyze and store the EANET monitoring data and related information;
- ◆ Disseminate monitoring data and related information;
- ◆ Prepare data reports on acid deposition in East Asia;
- ◆ Provide technical assistance to the participating countries;
- ◆ Implementation and coordinate QA/QC activities in the participating countries;
- ◆ Promote research activities of EANET; and
- ◆ Promote capacity building and public awareness activities in cooperation with the Secretariat.

Participating Countries

National Focal Points

- ◆ Communicate and coordinate with the Secretariat and the Network Center for implementation of the network activities.

National Centers

- ◆ Collect the national monitoring data and submit to the Network Center;
- ◆ Promote national QA/QC activities; and
- ◆ Deal with technical matters on the network activities in the countries.

National QA/QC Managers

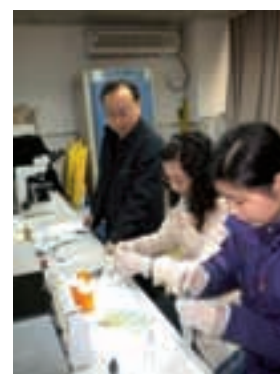
- ◆ Promote national QA/QC activities in cooperation and coordination with the national centers.



■ Scientific Advisory Committee



■ Technical support to participating countries (Senior Technical Managers' Meeting at Network Center)



■ QA/QC activities at a participating country

Monitoring Activities of EANET

EANET monitoring covers five environmental media, wet deposition, dry deposition, soil and vegetation, inland aquatic environment and catchment. The monitoring activities are conducted following a set of monitoring guidelines and technical manuals. Monitoring for wet and dry deposition are implemented in order to measure concentrations and fluxes of acidic and other substances deposited to the ground, while monitoring soil and vegetation, inland aquatic environment and catchment are implemented to assess adverse impacts on terrestrial and aquatic ecosystems.



■ Listvyanka (Russia)



■ Terelj (Mongolia)



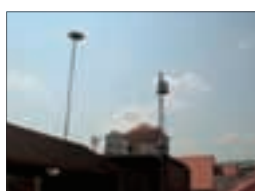
■ Xiamen (China)



■ Imsil (R. of Korea)



■ Sado-seki (Japan)



■ Phnom Penh (Cambodia)



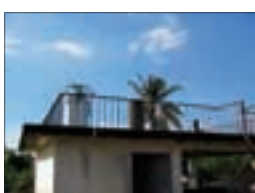
■ Vientiane (Lao PDR)



■ Hanoi (Vietnam)



■ Los Banos (Philippines)



■ Yangon (Myanmar)



■ Bangkok (Thailand)



■ Tanah Rata (Malaysia)



■ Maros (Indonesia)

Pictures of Wet/Dry deposition monitoring sites

- Wet and dry deposition monitoring site
- Wet deposition monitoring site

Monitoring interval and parameters

1. Wet deposition/rainwater

- ◆ Interval: every 24 hours or every precipitation event for the urban, rural and remote sites
- ◆ Major parameters: pH, electric conductivity (EC), concentrations of sulfate (SO_4^{2-}), nitrate (NO_3^-), ammonium (NH_4^+), etc.

2. Dry deposition/air concentration

- ◆ Interval: every day to 2 weeks or every hour when measured by automatic instruments
- ◆ Major parameters: Sulfur dioxides (SO_2), nitrogen dioxides (NO_2), ozone (O_3), etc. Mass and components concentration (such as sulfate) of particulate matter (PM)

3. Soil and vegetation/forest areas

- ◆ Interval: every 3 to 5 years
- ◆ Major parameters: pH, concentrations of exchangeable base cations (Na^+ , K^+ , Ca^{2+} , Mg^{2+}), exchangeable cation exchange capacity (ECEC), etc. for soil, and condition of tree decline and general description for vegetation/forests

4. Inland aquatic environment/lake and river water

- ◆ Interval: 4 times a year for lakes and every 1-2 month(s) for rivers
- ◆ Major parameters: pH, electric conductivity (EC), alkalinity, and concentrations of cations such as ammonium (NH_4^+), and anions such as nitrate (NO_3^-)

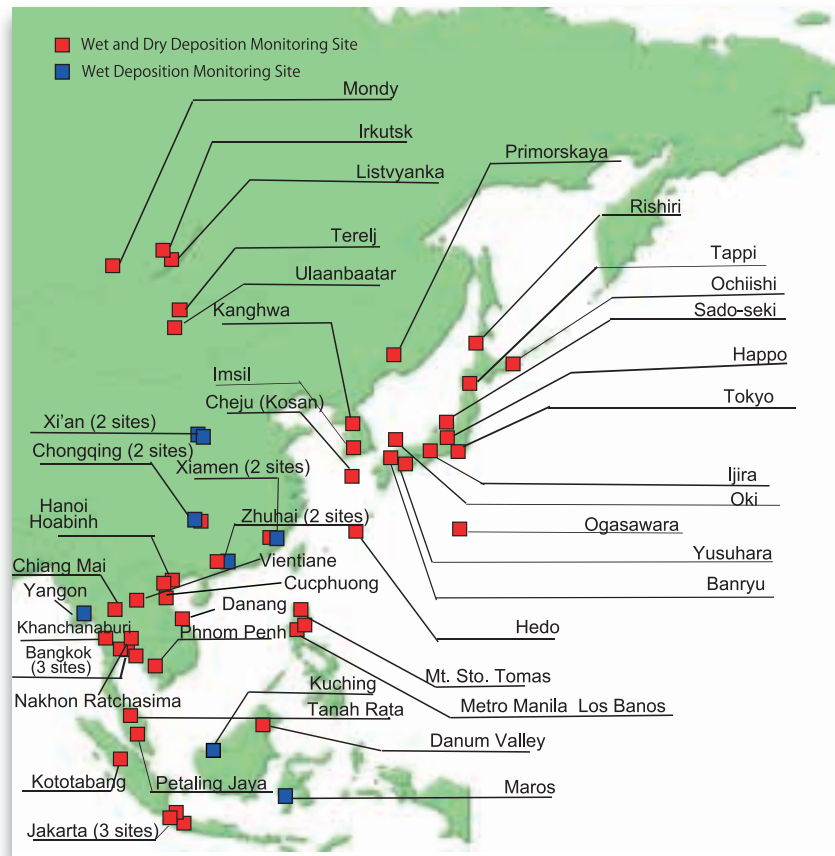
5. Catchment

- ◆ Interval: continuously (precipitation and discharge), every week to 2 weeks (chemical components)
- ◆ Major parameters: Precipitation amount, discharge from the stream, major cations (Ca^{2+} , NH_4^+ , etc.) and anions (SO_4^{2-} , NO_3^- , etc.) in the rainwater and stream water, estimation of total deposition (wet + dry), etc.

Monitoring Sites (as of 2010)

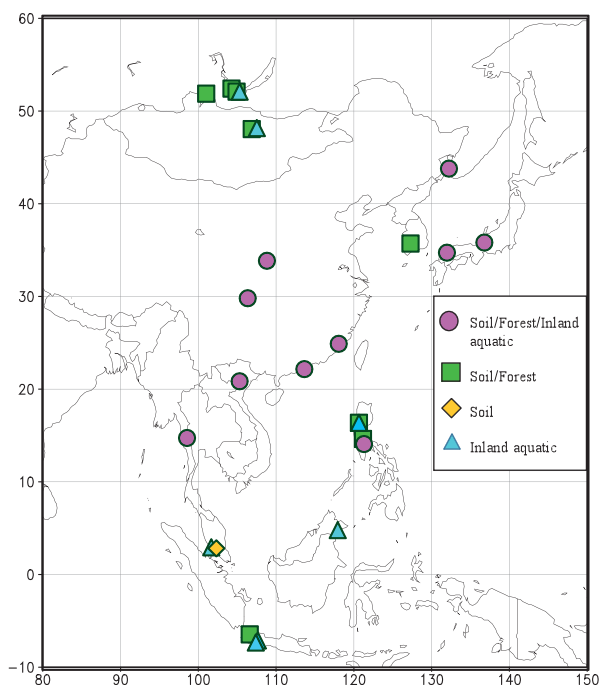
1. Deposition monitoring sites

- (1) Wet deposition: 54 sites
- (2) Dry deposition: 46 sites

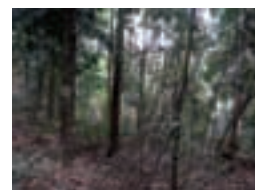


2. Ecological survey sites

- (1) Soil: 19 survey areas (27 forests)
- (2) Forest vegetation: 18 areas (26 forests)
- (3) Inland aquatic environment: 17 lakes/rivers



■ Bogdhan Mt. (Mongolia)



● Chongqing (China)



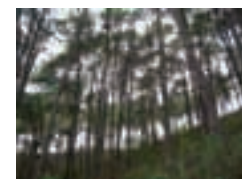
◆ Pasoh (Malaysia)



● Primorskaya (Russia)



● Ijira (Japan)



■ Boneco LTER. (Philippines)



● Vachiralongkorn (Thailand)

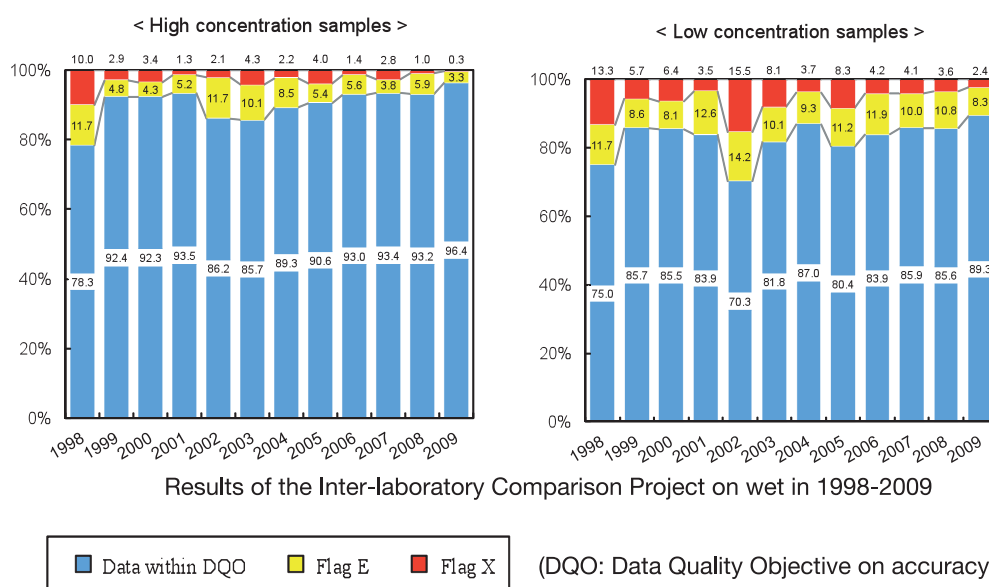
Major Achievements of EANET

■ Network Development

Monitoring sites of EANET are classified as either deposition monitoring sites or ecological survey sites. The number of sites in the network has increased from 42 deposition monitoring sites in 2001 (the start of the regular EANET monitoring activities) to 54 sites (21 urban, 13 rural, and 20 remote sites) in 2010. As a result of the coordinated efforts of EANET participating countries, monitoring of soil and forest vegetation is now being conducted in 27 forests in 19 areas, and monitoring of inland aquatic environment is being done in 12 lakes and 5 rivers as ecological impacts monitoring. Monitoring sites are shown in the Figures in page 8.

■ Development of High-Quality Datasets

High-quality datasets have been developed through the implementation of quality assurance and quality control measures at the national levels and in the Inter-laboratory Comparison Project schemes. Since 2000, summaries of annual monitoring results have been published regularly in the Data Report on Acid Deposition in the East Asian Region. All monitoring data of the participating countries of EANET from 2000 are available to the public through the EANET website and on compact disc.



Flag "E" was applied to data that exceed the DQO by a factor less than 2 ($\pm 15\% \sim \pm 30\%$).
 Flag "X" was applied to data that exceed the DQO by more than a factor of 2 ($< -30\%$ or $> 30\%$).

■ Periodic Report on the State of Acid Deposition in East Asia (PRSAD)

The First Periodic Report on the State of Acid Deposition in East Asia was produced in 2006 as a comprehensive scientific assessment report describing the outcome of five years of EANET's monitoring activities (2000-2004). Part I: Regional Assessment presents the activities of EANET and provides an assessment of the state of acid



■ First Periodic Reports (Regional/National/Executive Summary)

deposition based on the data acquired from the network to date including future directions and possible impacts of pollutants on inland aquatic systems, forests, and soils. Part II: National Assessment is a compilation of National Assessments describing the national monitoring activities, air quality assessments, and control measures implemented at the national level in the participating countries. Part III is the Executive Summary.

■ Capacity Building in Participating Countries

The technical capabilities and skills of the participating countries in acid deposition monitoring and assessment were significantly enhanced through a number of EANET activities including EANET individual training and through the NC technical missions annually to all participating countries to assist them in monitoring performance, laboratory operations, data management, and other procedures. Other activities to enhance the skills and knowledge of personnel included national workshops, individual training courses at the NC, annual expert meetings as well as scientific



■ EANET Training in the Network Center



■ Guideline, Technical Manuals and Training materials

workshops on ecological impacts and other topics related to acid deposition. The Japan International Cooperation Agency (JICA), in cooperation with EANET, conducted the JICA Third Country Training Program in Thailand and the JICA Training Course on EANET in Japan to provide training on acid deposition and air quality management. Numerous EANET publications (Technical Manuals and Guidelines, data publications, reports on QA/QC projects, training materials, etc.) have been produced for use by specialists and researchers involved in monitoring, data quality, and data management. Most are available on the EANET website (<http://www.eanet.cc/product.html>).

■ Raising Public Awareness

Awareness about acid deposition among the general public, particularly among school children and teachers, was raised through a number of activities supported by EANET. Two reports for policy makers were published titled “Goals, Achievements and Way Forward” and “Clean Air for Sustainable Future”. EANET has undertaken joint projects with participating countries to develop brochures and videotapes on acid deposition in the national language, and several times has held “Workshop on Public Awareness on Acid Deposition Problems”



■ Reports for Policy Makers



■ Fact Sheets of 13 participating countries

in the participating countries. An e-learning program on acid deposition problems was developed for environmental education. The capacity building workshops for policy makers were held in EANET to raise awareness of policy makers of participating countries on the adverse impacts on the environment caused by acid deposition. The Factsheets titled “Country efforts and achievements in combating acid deposition” were developed by all participating countries of EANET through collaboration and coordination with the NC and the Secretariat.

■ Enhancing Knowledge and Understanding through Research

A number of joint scientific research projects on acid deposition and its effects were conducted by EANET in countries. Joint projects that were conducted are:

- ◆ Joint study with Japan, Malaysia and Thailand on catchment analysis
- ◆ Joint study with Mongolia on plant sensitivity
- ◆ Joint study with Thailand on dry deposition flux and gas concentration monitoring
- ◆ Joint study with Republic of Korea on dry deposition (aerosol concentration) monitoring methodology
- ◆ Joint study with Russia on evaluation of East Siberian atmospheric environment
- ◆ Model Inter-comparison Study in Asia (a multilateral research activity)



■ Joint catchment study in Thailand



Research fellowship

The annual research fellowship program (introduced from 2005) has been an effective mechanism for encouraging young researchers from across the region to participate in air pollution research activities.

■ Fellowship researcher

EANET Science Bulletin

In order to share research findings among the participating countries, EANET Science Bulletin (Volume 1) was published in November 2008 after endorsement at the Eighth Session of the Scientific Advisory Committee (SAC8) held in October 2008 in Vietnam. The Volume 2 was published in January 2011. The bulletins were also issued on the EANET website. It will be published biennially.



■ EANET Science Bulletin (Vol. 1, 2)

■ EANET Newsletter

The EANET Newsletter has been published biannually since June 2007 so as to share all of information on EANET activities and other relevant information.

History of EANET

1. Expert meetings (1993-1997)

The East Asian region, as a result of rapid industrialization, faces increasing risks of problems related to excess deposition of acidic substances. The World Bank estimated in 1995 that by 2020, if present energy and environmental policies remain unchanged, sulfur dioxide emissions in this region will almost triple the 1990 level. Thus the adverse effects of acid deposition in East Asia will become a critical problem in the near future. With this background, expert meetings were held four times since 1993 to discuss the state of acid deposition in the region, effects on ecosystems and future moves toward regional cooperation on this issue. The experts recommended that acid deposition monitoring should be improved and strengthened.

It was difficult to evaluate the state of acid deposition in East Asia utilizing available monitoring data because monitoring methods and analytical techniques differed greatly among countries in the region. Thus, the expert meetings agreed on the necessity for establishing a regional collaborative monitoring network. For this purpose, the expert meetings developed a preliminary outline for the design of such a network as well as proposed guidelines for monitoring methods.

2. Preparatory Phase activities (1998-2000)

The First Session of the Intergovernmental Meeting on the Acid Deposition Monitoring Network in East Asia (IG1) was held in March 1998 in Yokohama, Japan. Based on the agreement at IG1, the preparatory phase activities of EANET started in April 1998 on an interim basis, to provide useful inputs to the Second Session of the Intergovernmental Meeting (IG2) held in 2000 for the establishment of the Network.

Participating countries during the preparatory phase

China, Indonesia, Japan, Malaysia, Mongolia, Philippines, Republic of Korea, Russia, Thailand and Vietnam (10 countries)

3. Regular Phase activities (from 2001)

The Second Session of the Intergovernmental Meeting of EANET (IG2) was held on 25 and 26 October 2000 in Niigata, Japan with the participation from ten countries in East Asia that had participated in the preparatory phase activities. The major conclusions of the Session are summarized as follows:

IG2 in 2000



Major Conclusions of IG2

1. The Meeting concluded that the preparatory phase activities of EANET had been successful.
2. The Meeting decided to start the EANET activities from January 2001 on a regular basis, based on the "Joint Announcement on the Implementation of EANET" and the "Tentative Design of EANET".
3. The Meeting designated the United Nations Environment Programme (UNEP) as the Secretariat for EANET, and accepted the proposal that the Interim Secretariat would continue its activities until UNEP assumes the role of the Secretariat.
4. The Meeting designated the Acid Deposition and Oxidant Research Center (ADORC) in Japan as the Network Center for EANET.

The Third Session of the Intergovernmental Meeting (IG3) was held in November 2001 in Chiang Mai, Thailand and the "Rules of Procedure for EANET" were adopted. Since then, Sessions of the Intergovernmental Meetings have been taken place annually following the Rules of Procedures.

Progress of EANET

1. Adoption of the “Instrument for Strengthening the EANET”

The Seventh Session of the Intergovernmental Meeting (IG7) held in 2005 adopted the Decision 1/IG7 (Niigata Decision) which decides that the participating countries of EANET should begin a process to discuss an appropriate Instrument and its legal status to provide a sound basis for financial contribution to EANET and will report the results of the discussion to the Tenth Session of the Intergovernmental Meeting (IG10) for its consideration.

The Twelfth Session of the Intergovernmental Meeting on EANET (IG12) held in November 2010 in Niigata, Japan adopted the Decision 1/IG12 on Instrument for the Strengthening the Acid Deposition Monitoring Network in East Asia (EANET). The following were stipulated in the Decision:

1. Adopts the “Instrument for the Strengthening the Acid Deposition Monitoring Network in East Asia (EANET)” for signing in the High Level Segment during IG12 and thereafter.
2. Decides that the Instrument will become operational on the date on which all participating countries have signed it, or on 1st January 2012, whichever is earlier;
3. Encourages participating countries that will not be able to sign the Instrument by the specified date to communicate in writing with the EANET Secretariat before IG13 expressing their willingness to continue their EANET activities; and
4. Decides that IG13 will consider the nature of involvement of the countries that are unable to sign by the specified date.



■ Representatives of 13 participating countries at IG12 in November 2010

The objectives and scope of this Instrument stated in the [Item 2] are:

- a) to create a common understanding of the state of acid deposition problems in East Asia;
- b) to provide useful inputs for decision-making at local, national and regional levels aimed at preventing or reducing adverse impacts on the environment caused by acid deposition; and
- c) to contribute to cooperation on the issues related to acid deposition among the Participating Countries.

The scope of this Instrument may be extended, as decided by the IG.

2. “Strategy on EANET Development” and “Medium Term Plan for EANET”



The Strategy on EANET Development (2006-2010) which was approved by the Eighth Session of the Intergovernmental Meeting (IG8) in November 2006 focused on the whole activities of EANET with clearly stated targets, activities to be undertaken and expected results at the end of the mentioned period. The implementation of the Strategy activities since 2006, and the regular activities of the Secretariat and the NC since the start of EANET, has brought EANET closer towards achieving its objectives. It included the activities relevant to the modeling and emission inventories.

■ Strategy on EANET Development and Medium Term Plan for EANET

Based on the performance review of the Strategy on EANET Development (2006-2010), the “Medium Term Plan for EANET (MTP) (2011-2015)” was adopted at the IG12 in 2010. Twenty-two (22) activities covering all the EANET activities are identified for implementation in the 5-year period, 2011-2015 by the Secretariat, the Network Center, the Scientific Advisory Committee and other relevant bodies of EANET under seven (7) categories.

The MTP focuses on enhancement of the monitoring network, supported by the participating countries, through the implementation of strategic activities to improve geographical coverage, ensure site representativeness, and strengthen monitoring procedures, particularly sampling and analysis, to achieve more comprehensive and precise data. It also includes capacity building activities, activities for promotion of research on acid deposition and other priority chemical species including activities relevant to the modeling and emission inventories, public awareness activities and activities for future development of EANET.

National Focal Points and National Centers of EANET

Participating countries	National Focal Points (Organizations)	National Centers
Cambodia	Department of Environmental Pollution Control, Ministry of Environment (MOE)	Department of Environmental Pollution Control, Ministry of Environment (MOE)
China	International Cooperation Department, Ministry of Environmental Protection (MEP)	China National Environmental Monitoring Center (CNEMC)
Indonesia	Deputy Minister of Environmental Degradation Control and Climate Change, Ministry of Environment (MOE)	Environmental Impact Control Facility (SARPEDAL)
Japan	Environmental Management Bureau, Ministry of the Environment (MOE)	Asia Center for Air Pollution Research (ACAP)
Lao PDR	Water Resources and Environment Research Institute, Water Resources and Environment Administration (WREA)	Water Resources and Environment Research Institute, Water Resources and Environment Administration (WREA)
Malaysia	Environmental Conservation Department, Ministry of Natural Resources and Environment (NRE)	Malaysian Meteorological Department (MMD), Ministry of Science, Technology and Innovation (MOSTI)
Mongolia	National Agency for Meteorology and Environment Monitoring (NAMEM)	Central Laboratory of Environment and Metrology (CLEM)
Myanmar	Department of Meteorology and Hydrology (DMH), Ministry of Transport	Department of Meteorology and Hydrology (DMH), Ministry of Transport
Philippines	Environmental Management Bureau (EMB), Department of Environment and Natural Resources (DENR)	Environmental Management Bureau (EMB), Department of Environment and Natural Resources (DENR)
R. of Korea	Climate and Air Quality Management Office, Ministry of Environment (MOE)	National Institute of Environmental Research (NIER), Ministry of Environment (MOE)
Russia	Institute of Global Climate and Ecology, Roshydromet and RAS	- Institute of Global Climate and Ecology, Roshydromet and RAS - Limnological Institute, Russian Academy of Sciences/Siberian Branch (RAS/SB)
Thailand	Pollution Control Department (PCD), Ministry of Natural Resources and Environment (MNRE)	Pollution Control Department (PCD), Ministry of Natural Resources and Environment (MNRE)
Vietnam	Institute of Meteorology, Hydrology and Environment (IMHEN), Ministry of Natural Resources and Environment (MONRE)	Institute of Meteorology, Hydrology and Environment (IMHEN), Ministry of Natural Resources and Environment (MONRE)



EANET

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IN EAST ASIA

URL <http://www.eanet.cc>



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REGIONAL RESOURCE CENTRE FOR ASIA AND THE PACIFIC
(UNEP RRCAP)

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