

The Eighth Senior Technical Managers' Meeting
of the Acid Deposition Monitoring Network in East Asia
1-3 August 2007, Bogor, Indonesia

Discussion paper on the establishment of a transparent framework to select and review priority substances to be assessed including their monitoring requirements

1. INTRODUCTION

1. Since the Acid Deposition Monitoring Network in East Asia (EANET) started its regular-phase activities in January 2001, it has focused on monitoring acid deposition and assessing its impacts. However, acid deposition is interlinked with other air pollutants, and in order to comprehensively assess the state of acid deposition and impacts of regional air pollution including acid deposition in the East Asian region, it is necessary to adopt a more comprehensive approach on monitoring the atmospheric and ecological environment, taking other chemical species into account besides acidic and basic substances. Such an approach will provide more beneficial information for enhancing regional management of the atmospheric environment in East Asia.
2. It is perhaps timely that EANET consider other important monitoring parameters that are informative for air quality assessment in the EANET framework. Recent initiatives to address regional environmental health challenges, such as the Regional Forum on Environment and Health led by WHO-UNEP, and current concerns on effects of transboundary photochemical smog (ground level ozone) on health, look towards EANET to play a leading role in gathering relevant data that can ably support the health assessments.
3. On the basis of the above, the necessity to review the list of priority substances has been raised by member countries at discussions during previous Senior Technical Managers' meetings and sessions of the Scientific Advisory Committee. An activity proposing the establishment of a framework for reviewing substances to be monitored including other air pollutants and monitoring parameters was introduced in the Strategy for EANET Development (2006-2010) under the category of "Other relevant activities including those for future development and new researches of EANET".
4. This activity should be implemented during the period 2006 – 2007 with two outputs:
 - i) A transparent framework for reviewing substances to be monitored
 - ii) Recommendations on monitoring parameters, measurements and equipment for EANET sites

II. CURRENT STATUS OF MONITORING IN EANET COUNTRIES

5. The Guidelines for Acid Deposition Monitoring in East Asia, adopted at the Second Interim Scientific Advisory Group Meeting in March 2000 recommended a range of monitoring parameters of which some are mandatory and others are optional parameters. The recommended parameters for wet deposition monitoring, dry deposition (air concentration) monitoring, soil and vegetation monitoring and monitoring of inland and aquatic environments, as described in the Guidelines are summarized in Annex 1.
6. In the second edition of the Strategy Paper for Future Direction of Dry Deposition Monitoring of EANET endorsed by the Fifth Session of the Scientific Advisory Committee in September 2005, the recommended chemical species for EANET dry deposition monitoring were further prioritized as followed:
 - First priority: SO₂, O₃, NO, NO₂ (urban), HNO₃, HCl, NH₃
Particulate component (SO₄²⁻, NO₃⁻, Cl⁻, NH₄⁺, Na⁺, Mg²⁺, K⁺, and Ca²⁺),
PM10
 - Second priority: NO₂ (rural and remote), PM2.5
7. At present there are 50 EANET sites sampling rainwater and conducting analysis for the mandatory precipitation chemistry parameters stated in Annex 1. Not all the sites are analyzing the optional parameters for wet deposition monitoring which are: HCO₃⁻, F⁻, PO₄³⁻, heavy metals, Al, Hg, and organic acids. In the case when ion balance as required by the QA/QC program is not systematically attained by measuring the major ions, the measurement of some additional ions such as HCO₃⁻, F⁻, PO₄³⁻ and organic acids may be required. Heavy metals may also be measured to characterize precipitation.
8. With regard to dry deposition (air concentration) monitoring, there are only 37 sites in the EANET region monitoring dry deposition (Annex 2) and not all the recommended parameters are monitored at all the sites. Japan, Republic of Korea and some sites in Thailand are monitoring the parameters using both automatic instruments and filter packs while some other sites are using automatic instruments for some parameters only and others are using filter packs only. One of the reasons for the limited number of sites using automatic instruments is the high cost of purchase and maintenance of the automatic instruments.
9. There are two types of automatic instruments for measurement of gaseous nitrogen oxide compounds which uses different methods: Differential Optical Absorption Spectroscopy method (DOAS) and ChemiLuminescence Detection method (CLD). In addition to its use for

SO₂ measurements, the DOAS type is used for monitoring NO₂ while the CLD type is used to monitor NO_x (urban), NO_{x*} (Rural/Remote), NO and NO₂ (NO_x-NO).

10. There is also a need to unify the measurements of gaseous nitrogen oxide compounds monitored and reported in the participating countries of EANET. It is suggested that NO₂ be measured and either NO_x, NO_{x*} or NO_y. Because of non-unified reporting on these monitored data, their behaviors on the regional-scale have not been assessed in the first Periodic Report on State of Acid Deposition in East Asia (PRSAD). Comparison of these chemical species with SO_x is essential to understand the regional status of acid deposition in East Asia.
11. Although the concentration of heavy metals in the atmosphere has been on a declining trend in Europe, there have been no coordinated regional efforts to monitor trends of heavy metals in East Asia. In view of the relationship between mercury and atmospheric acidification, EANET may wish to consider recommending the monitoring of selected heavy metals as second priority parameters.
12. The serious impacts of high concentrations of ozone and fine particulate matter on human health and vegetation have been well documented in many countries and is an issue of current concern in the Northeast and Southeast Asian countries in view of increasing emissions of NO_x and VOCs from industries, motor vehicles and from biomass burning activities. Transboundary transport of the resulting ground level ozone in the atmosphere on hemispheric scale affecting the Northeast Asian countries, and affecting the Southeast Asian countries during the dry months, is an emerging environmental issue. EANET may wish to consider placing higher priority to the monitoring of ozone and PM_{2.5}. More comprehensive measurements of particulate matter in various size ranges will also provide additional input for regional/hemispheric studies on the impacts of yellow sand transport from central Asia. Additional chemical species such as VOCs and NMHCs could also be considered as their effects are interlinked.
13. As for monitoring on soil, vegetation, and inland aquatic environment, the need to carry out monitoring of the optional parameters depend on the respective monitoring plots. The future direction of ecological monitoring will be discussed in the review of the Strategy Paper for Future Directions of Soil and Vegetation monitoring of EANET.

III. PARAMETERS MONITORED BY OTHER NETWORKS

14. The monitored parameters in other regional air quality networks are mentioned in the

following paragraphs for the purpose of comparison with the EANET monitoring program. The situation in the case of networks that involve many countries is quite similar to EANET, that is, countries are requested to make some mandatory measurements to support regional agreements/protocols but other measurements that would permit more detailed assessments are encouraged.

Convention on Long-range Transboundary Air Pollution (CLRTAP), UNECE

15. The measurement program of Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) under CLRTAP includes measurements of acidifying and eutrophying compounds, ozone, heavy metals, persistent organic pollutants, particulate matter and VOC. As for acidifying and eutrophying compounds (such as S, H⁺ and nutrient N) and heavy metals, critical loads approach was applied in cooperation of Working Group on Effects (WGE) and its International Cooperative Programmes (ICPs: ICP Forests, ICP Mapping and Modeling, etc.). As for ozone, effects of its direct exposure on plants are assessed in ICP Forests and ICP Vegetations. Based on these scientific evaluations, several protocols were adopted under CLRTAP (e.g. Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone in 1999; Oslo Protocol on Further Reduction of Sulphur Emissions in 1994).

CASTNET (US)

16. CATNET concentrates on the monitoring of ground-level ozone and total acid deposition using both wet and dry deposition measurements. The chemical components measured in wet deposition include sulfate, nitrate, and ammonium. The dry chemical components of acid deposition monitored include particulate matter (sulfate (SO₄²⁻) and nitrate (NO₃⁻)), gaseous nitric acid (HNO₃), sulfur dioxide (SO₂), and ammonium (NH₄⁺).

IV. ACTIONS REQUIRED

17. The session is invited take note of the status of monitoring in the current EANET program and deliberate on the following:
 - i) Strengthening the monitoring of some of the recommended parameters in the current list, including a review of the current priorities
 - ii) The necessity to include additional parameters into the current monitoring list
 - iii) The necessity to establish a Task Force comprising of suitable experts to conduct the review as well as to recommend suitable methodologies for sampling, sample preservation and chemical analysis for the new species.

Recommended Parameters for EANET Monitoring

➤ Wet deposition (Rainwater):

Rainwater acidity and concentrations of ions due to acids and bases.

- pH, electric conductivity (EC), Cl⁻, NO₃⁻, SO₄²⁻, NH₄⁺, Na⁺, K⁺, Ca²⁺, Mg²⁺, NO₂⁻, HCO₃⁻, F⁻, PO₄³⁻, heavy metals, Al, Hg, and organic acids

➤ Dry deposition (Air concentration):

Air concentrations of gaseous and particulate forms of acidic and basic compounds as well as ozone

- **Gases:** SO₂, O₃, NO, NO₂, HNO₃, and NH₃,
- **Aerosols:** particulate mass concentration (PM) and concentrations of ions (SO₄²⁻, NO₃⁻, NH₄⁺, and Ca²⁺)

➤ Soil and vegetation (in forest area):

Chemical and physical properties of soil, forest vegetation characteristics, and condition of tree decline

- **Soil:** moisture content, pH (H₂O), pH (KCl), exchangeable base cations (Ca, Mg, K and Na), exchangeable acidity, exchangeable Al, exchangeable H, effective cation exchange capacity (ECEC), carbonate content (for calcareous soil), total carbon content, total nitrogen content, fine earth bulk density, penetration resistance, available phosphate, sulfate
- **Forest vegetation:** description of trees (name of species, diameter at breast height, and height of tree), understory vegetation survey, survey of tree decline (observation of tree decline, photographic record of tree decline, and estimation of decline causes)

➤ Inland aquatic environment (lake and river water):

Concentrations of ions due to acids and bases, and some chemical and biological parameters

- Water temperature, pH, EC, alkalinity (at pH 4.8 baseline), NH₄⁺, Ca²⁺, Mg²⁺, Na⁺, K⁺, SO₄²⁻, NO₃⁻, Cl⁻, NO₂⁻, PO₄³⁻, transparency, water color, DOC (if impossible, COD), pore water of sediment (SO₄²⁻, NO₃⁻ and NH₄⁺), total Al, phytoplankton (diatom species), living organisms other than phytoplankton, epilithic algae, sediment (Pb, Pb-210 and stable isotope of S)

Based on the Guidelines for Acid Deposition Monitoring in East Asia (2000)

Note: Underline indicates optional parameters; Italic indicates voluntary parameters for soil monitoring

Annex 2

Status of Air Concentration Measurements at Dry Deposition Monitoring Sites

Country	Name of sites	Characteristics of sites	Automatic			Filter Pack	Other Method
			SO ₂ ,NO _x	O ₃	PM		
China	Chongqing-Jinyunshan	Rural	✓	None	✓	None	None
	Xi ' an - Weishuiyua	Rural	✓	None	✓	None	None
	Xiamen - Hongwen	Urban	✓	None	✓	None	None
	Zhuhai - Xiang Zhou	Urban	✓	None	✓	None	None
Indonesia	Serpong	Rural	None	None	None	✓	None
Japan	Rishiri	Remote	✓	✓	✓	✓	None
	Tappi	Remote	✓	✓	✓	✓	None
	Ogasawara	Remote	✓	✓	✓	✓	None
	Sado-seki	Remote	✓	✓	✓	✓	None
	Happo	Remote	✓	✓	✓	✓	None
	Oki	Remote	✓	✓	✓	✓	None
	Yusuhara	Remote	✓	✓	✓	✓	None
	Hedo	Remote	✓	✓	✓	✓	None
	Ijira	Rural	✓	✓	✓	✓	None
	Banryu	Urban	✓	✓	✓	✓	None
Malaysia	Petaling Jaya	Urban	None	None	None	✓	LV,PS
	Tanah Rata	Remote	None	None	None	✓	LV,PS
Mongolia	Ulaanbaatar	Urban	None	None	None	✓	None
	Terelj	Remote	None	None	None	✓	None
Philippines	Metro Manila	Urban	None	None	None	✓	None
	Los Banos	Rural	None	None	None	✓	None
Republic of Korea	Kanghwa	Rural	✓	✓	✓	✓	None
	Cheju(Koson)	Remote	✓	✓	✓	✓	None
	Imsil	Rural	✓	✓	✓	✓	None
Russia	Mondy	Remote	None	✓	None	✓	None
	Listvyanka	Rural	None	None	None	✓	None
	Irkutsk	Urban	None	None	None	✓	None
	Primorskaya	Rural	None	None	None	✓	None
Thailand	Bangkok	Urban	✓	None	✓	✓	AS
	Samutprakarn	Urban	✓	✓	None	None	AS
	Patumthani	Rural	None	None	None	✓	None
	Khanchanaburi	Remote	✓	✓	✓	✓	None
	Chiang Mai (Mae Hia)	Rural	✓	✓	✓	✓	None
Vietnam	Hanoi	Urban	None	None	None	✓	None
	Hoa Binh	Rural	None	None	None	✓	None

(Note) LV: Low Volume Air Sampler, PS: Passive Sampler, AS: Aerosol Sampler