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Consideration of improvement of data completeness and recommendation for improvement of equipment and their maintenance

Network Center for EANET

I. Introduction

1. The monitoring network of EANET consists of wet deposition monitoring, Dry deposition (air concentration) monitoring, soil and vegetation monitoring, and monitoring on inland aquatic environment. These monitoring activities are carried out continuously considering the latest scientific discussions, such as new monitoring techniques, increase of monitoring parameters, and so on. However, each monitoring has still some problems to be improved in the current activities.

2. As for wet deposition monitoring, data completeness is one of the most important problems. If the data completeness is low, it is difficult to calculate precise monthly/annual wet deposition amounts. Maintenance and management of equipments may be one of key factors to solve this problem. In addition, in some countries, unanalyzed parameters may confuse the data quality and interpretation of the monitoring data. As for dry deposition monitoring, the Filter Pack method is commonly used in EANET as a less expensive method for air concentration measurement. However, the data of several parameters such as O_3 and NO_X, which cannot be measured by the Filter Pack method, are limited. Use of another less expensive method, such as passive samplers, should be discussed to solve this problem.

3. As for monitoring on soil, vegetation, and inland aquatic environment, several problems can also be considered for the current regular monitoring. However, most problems can be solved by efforts of relevant organizations.

4. The "Strategy on EANET Development (2006-2010) (EANET/IG 8/7/1 rev)", which was adopted by the Intergovernmental Meeting at its 8th Session in November 2006, proposed the following activity on this issue:

   - Improvement of implementation of all required monitoring items with necessary data completeness and accuracy: No. (1)

   Consequently, this document summarized the current problems on wet and dry deposition monitoring, especially for improvement of data completeness and monitoring parameters. Moreover, as possible solutions for the problems, maintenance and management of equipments, use of new techniques, and a new function for such works, were discussed.

II. Current problems and possible actions

II-1. Wet deposition monitoring

- *Data completeness*

5. Wet deposition flux can be estimated from the precipitation amount and concentration of ions in the collected rain/snow samples. Data completeness should be evaluated in terms of the precipitation amount ratio of that by precipitation collector to rain gauge. Data completeness describes the fraction of valid data in a certain monitoring period. Two kinds of data completeness measures are used, that is percent precipitation coverage length (%PCL) and percent total precipitation (%TP). Only data with %PCL≥80%, and %TP≥80% is accepted in the EANET QA/QC program. In order to keep high value of those and obtain reliable monitoring data, it should be ensured that Wet-only sampler is operating continuously and the precipitation is collected properly during the monitoring period, and obtained measurement data of a sample have reliability. In addition, the maintenance of the instrument and monitoring sites and management of staffs conducting the analysis in laboratory are important.

6. As an example of the maintenance and management on the sampler for collecting of wet deposition, the current conditions of EANET sites in Japan are described here. **Table 1** shows a ratio of each reason for measurement missing in 2005. The reasons of the missing are occurred by natural disaster or failure by itself.

Table 1. A ratio of each reason for measurement missing at Japanese EANET sites in 2005

Reason	%
Electric system	12
Rain gauge	0
Open/Close motion of lid	18
Turn table	8
Other sampler's troubles	45
Mixture of rinse water	5
Mixture of unidentified substance	7
Others	5
Unidentified	0

7. In other countries, several troubles on the wet-only samplers have been reported. The East Asian region is latitudinally wide and covers various climatic zones from frigid zone to tropical zone. Therefore, types of the troubles were also varied. In case of the frigid zone including Russia and Mongolia, frozen of the lid caused the missing data or changed to bulk sampling. In case of the tropical zone including Indonesia and some countries, a leak and a rust of a metal department in the sampler by heat and high

humidity caused some troubles. The change of voltage of a power unit had caused many troubles on the wet-only sampler. When the open/close sensor and motor part of a lid could not move together by them, load had been applied and damaged in an actuator of lid. In this case, installation of the stabilizer of voltage will be needed for this problem.

8. Moreover, types of the samplers used in the respective monitoring sites were different depending on situations, such as climatic conditions and financial/organizational situations. The manufacturers of sampler may be different to the site also in the same country. For example, the sampler with larger diameter (350 mm) funnel is used in Russia to correct small amount of precipitation effectively. In Indonesia, the sampler with smaller diameter (107mm) funnel is used. The information of the samplers has been reported to NC by the National Centers and is not enough utilized for improvement of the data completeness.

9. Since instrument failures caused by natural disasters are unavoidable, appropriate action must be taken promptly to rectify the problem. Moreover, it is necessary to consider periodic checks, maintenance and replacement of old and outdated instruments with new ones.

10. In addition to the efforts in the respective monitoring sites, more systematic guidance and solutions should be considered as the network. Therefore, it can be suggested that information of the troubles in the respective monitoring sites and the type of the samplers used in the respective monitoring sites should be compiled and referred.

II-2. Dry deposition monitoring

- *Development of air concentration monitoring*

11. Air concentration monitoring has been conducted by Filter Pack method and Automatic monitor. Automatic monitor can measure SO_2, O_3, NOx, PM10 and PM2.5 in high time resolution, but its installation needs high cost and skilled maintenance system. On the other hand, Filter Pack measurement can cover SO_2, HNO_3, HCl, NH_3 and particle components without expensive cost. In this context, Filter Pack method has been mainly installed in the EANET sites.

12. Moreover, the monitoring data of O_3, NOx, PM10 and PM2.5 are really limited in EANET because the Filter Pack method cannot cover these components. In order to cover the priority chemical species recommended in “Strategy Paper for Future Direction of Dry Deposition Monitoring of EANET”, new monitoring methodology should be considered and passive sampler can be recommended as another less expensive monitoring method.

13. As discussed above, EANET covers various climatic zones. Especially in tropical countries, experience on the Filter Pack method as well as the passive sampler is still limited because these methods were

developed mainly in temperate or frigid zones in Europe, Japan and the United States. In case of the Filter Pack method, effects of artifact under high temperature have been pointed out for ammonia sampling. For passive samplers also, effects of sunlight and high temperatures were suggested for NO_X measurement.

14. Therefore it can be suggested that information on these less expensive monitoring methods should be accumulated through relevant research activities with clearer strategy. NC has planned and conducted research activities regarding the evaluation of monitoring methodologies as joint project with participating countries such as Thailand and Republic of Korea.

15. Less expensive monitoring methods, and joint research activities with participating countries on the monitoring methodologies are discussed in the other documents, "Consideration on use of less expensive monitoring methods (EANET/SAC 7/8/3)", and "Consideration of Research Activities for Further Development of EANET (EANET/SAC 7/9/3)".

- *Discussion on the system of calibration method for Automatic monitor in EANET*

16. Automatic instruments are suitable to obtain one-hour averaged values of these species for air quality monitoring. However, the frequency and the methods for the calibration should be unified in EANET. Especially, calibration method of the O_3 monitoring equipment (UV photometric method) is a pending issue to be discusses because there is several calibration method.

17. As for also the automatic instruments, information on types of the samplers and calibration methods used in the respective monitoring sites should be compiled.

18. "Strategy Paper for Future Direction of Dry Deposition Monitoring of EANET" recommends traceability to the international standard of National Institute for Standard and Technology (NIST), USA.

3. Recommendations for further improvement

19. As described above, there are several tasks and problems to be discussed regarding improvement of monitoring data completeness and development of the monitoring network in EANET. In order to deal with the tasks and problems with enough transparency among participating countries, it can be proposed by SAC to IG that **Task Force on Monitoring Instrumentation** should be formed as a new function under SAC and the following activities are expected for the Task Force;

    i) to review the types of instruments existing in the EANET and identify the existing problems,
    ii) to make recommendations on monitoring instrumentation, including the maintenance, calibration, development of instrumentation/technical manual based on the request from SAC,

iii) to coordinate feasibility studies and inter-comparison studies in advance of the application to EANET, particularly involving new instruments.

20. It can be expected for Task Force on Monitoring Instrumentation to make an effort together with NC to promote the improvement and development of EANET monitoring network. In addition, it is required that all of function under SAC, such as Task Forces and Ad Hoc groups and Expert groups, should create close relationship and be harmonized to promote each tasks efficiently.