The Eleventh Senior Technical Managers' Meeting
of the Acid Deposition Monitoring Network in East Asia
2-3 September 2010, Niigata, Japan

Progress report on the preparation of the technical manual on dry deposition flux estimation

Secretariat of the Expert Group
on Dry Deposition Flux Estimation

I. Introduction

1. The Strategy Paper for Future Direction of Dry Deposition Monitoring of EANET (2nd edition, endorsed in 2005) presents the status quo of dry deposition monitoring, a revised list of major chemical species for dry deposition monitoring in EANET and included a step-by-step future strategy on dry deposition monitoring. However, it did not identify a method for estimating dry deposition flux in the EANET region. On the basis of this background, establishment of the Expert Group on Dry Deposition Flux Estimation was approved in 2007 to develop a method for estimating dry deposition fluxes in the EANET region and produce a Technical Manual on Dry Deposition Flux Estimation.

II. First and Second Meeting of the Expert Group

2. The First Meeting of the Expert Group was held at ADORC (Acid Deposition and Oxidant Research Center), Niigata, Japan from 23 to 24 June 2008. At the 1st meeting, the lead authors for each chapter of the Technical Manual were determined, and the respective authors agreed to prepare the 1st draft of the Technical Manual until the Second Meeting of the Expert Group.

3. The draft table of contents of the Technical Manual on Dry Deposition Flux Estimation was approved by the Eighth Session of the Scientific Advisory Committee (SAC8) held in October 2008, and then each authors started to prepare the draft Technical Manual. The Second Meeting of the Expert Group was held at Meisei University, Tokyo, Japan on 19 February 2008. At the 2nd Meeting, the draft contents of each chapter of the manual were reviewed based on the submitted 1st draft by the respective authors. In addition, the outline of the EANET High Priority Research Project (Aerosol Deposition Studies in Forests for Improvement on Estimate Method for Dry Deposition) was introduced by Dr. Pojanie Khummongkol. The 1st draft of the Technical Manual was submitted to the Second Meeting of the Task Force on Monitoring for Dry Deposition (TFMDD) and the Ninth Session of the Scientific Advisory Committee (SAC9) in October, 2009.

III. Third Meeting of the Expert Group

4. Based on the comments made by the TFMDD and the SAC9, the respective authors revised to prepare 2nd draft of the Technical Manual until the Third Meeting of the Expert Group. The Third Meeting of the Expert Group was held at ADORC from 24 to 25 June 2010. At the 3rd meeting, the 2nd draft of the Technical Manual and the progress on the EANET High Priority Research Project were reviewed. The meeting minutes was attached as the Annex. Based on the discussion at the meeting, each member and the Secretariat revised the 2nd draft of Technical Manual. Then, the revised 2nd draft was reviewed again, and necessary revision was made. The secretary asked each member to check the 2nd draft thoroughly and modify the draft to prepare the 3rd draft. The contents of the 3rd draft is also attached as the Annex.

5. The meeting agreed that the future activities of the Expert Group will be according to the schedule of activities shown below. The major decisions of the Third Meeting are as follows:
   - The Secretariat will try to finalize the Technical Manual with a strong association with the members. The draft Technical Manual will be submitted to the 3rd Meeting of the Task Force on Monitoring for Dry Deposition (26-27 July, 2010), the 11th Senior Technical Managers' Meeting (STM11; 1-3 September, 2010) for comments. According to the feedbacks, the Technical Manual will be revised as needed
   - The final draft will be submitted to the 10th Session of Scientific Advisory Committee (SAC10; 13-15 October, 2010) for endorsement.

IV. Schedule of activities until adoption of the Technical Manual

June – July, 2010	Revise of the 2nd draft of the Technical Manual
July 26 – 27, 2010	Report activity of the Expert Group at the 3rd Meeting of the Task Force on Monitoring for Dry Deposition for comments
September 2 – 3, 2010	Report activity of the Expert Group at STM 11 for comments
middle of September, 2010	Circulate the draft Technical Manual to the participants of STM11 for comments
end of September, 2010	Preparation of the final draft of the Technical Manual
October 13-15, 2010	Submission of the draft Technical Manual to SAC10 for adoption

ACID DEPOSITION MONITORING NETWORK IN EAST ASIA (EANET)

THIRD MEETING OF THE EXPERT GROUP ON DRY DEPOSITION FLUX ESTIMATION OF THE TASK FORCE ON DRY DEPOSITION MONITORING SCIENTIFIC ADVISORY COMMITTEE (SAC) OF EANET

(Niigata, 24-25 June 2010)

PROVISIONAL AGENDA

June 24

09:00-09:10

1. Opening and Introductory remarks — Dr. Akimoto, Chairperson

09:10-09:30

2. Report on the progress of the Expert Group — Dr. Sato

09:30-10:30

3. Review of the 2nd draft of Chapters 1, 2 and 3

Chapter 1	Introduction	Dr. Pojanie
Chapter 2.1	Air Quality Measurements	Dr. Chang
Chapter 2.2	Meteorological Measurements	Dr. Takahashi
Chapter 2.3	Land Use Information	Dr. Ueda
Chapter 3	Data reporting	NC

10:30-10:45 Coffee Break

10:45-12:00

Review of the 2nd draft of Chapter 3 (Continued)

12:00-13:30 Lunch

13:30-15:30

Review of the 2nd draft of Chapter 4 and 5

Chapter 4	Methodology for dry deposition flux estimation in EANET	Dr. Matsuda
Chapter 5	Evaluation of dry deposition flux determined by the Inferential Method	Dr. Hayashi

15:30-15:45 Coffee Break

15:45-17:30
Review of the 2nd draft of Chapters 6, 7 and 8

Chapter 6	Direct measurement for determining dry deposition flux	Dr. Pojanie
Chapter 7	Use of remotely sensed information	Dr. Ueda
Chapter 8	Future direction of dry deposition flux estimation	Dr. Matsuda

17:30 Departure to the hotel

June 25
09:00-10:30
4. Revision work of the 2nd draft — All Members

10:30-10:45 Coffee Break

10:45-12:00
Revision work of the 2nd draft (Continued) — All Members

12:00-13:30 Lunch

13:30-14:45
5. Wrap up of the revised draft Technical Manual — All Members

14:45-15:00 Coffee Break

15:00-15:30
6. Discussion on High Priority Research Project (Aerosol deposition studies in forests for improvement of estimation method for dry deposition) — Dr. Pojanie

15:30-16:00
7. Future schedule — Discussion

16:00 Closing

MEETING MINUTES

I. Agenda

The Meeting followed the issues as listed in the Provisional Agenda.

II. Opening and Introductory remarks

Dr. Hajime Akimoto, Director General of Acid Deposition and Oxidant Research Center (ADORC) made a welcome remark, and Dr. Pojanie Khummongkol, the chairperson of the Expert Group, made introductory remark to the members of the Expert Group on Dry Deposition Flux Estimation (EGDDFE). They emphasized that this meeting is so important because the draft Technical Manual on Dry Deposition Flux Estimation will be finalized at the moment. In addition to the introduction of original members, Dr. Lim-Seok Chang, the alternative member of Dr. Hong You-Deog, was introduced for the first time. The list of participants is attached as Annex 1.

III. Report on the progress of the Expert Group

Dr. Keiichi Sato, a secretary of the Expert Group, reported the progress of the EGDDFE. He introduced major discussions at the 1st and 2nd meetings and SAC9.

IV. Review of the 2nd draft of the Technical Manual on Dry Deposition Flux Estimation

Chapter 1 Introduction (written by Dr. Pojanie)
Chapter 1 consists of three parts (Background, Objectives of dry deposition flux estimation and Outline of the manual for dry deposition flux estimation). Major comments are shown as follows:

Chapter 1.1 Background

i) Since the description of 1st paragraph contained the objective of dry deposition flux estimation, such description should be moved to Chapter 1.2;
ii) Several methods of dry deposition flux estimation discussing pros and cons of each method should be introduced. Then, the adoption of inferential method as an EANET methodology should be described. Appropriate citation is necessary.

Chapter 1.2 Objectives of dry deposition flux estimation

i) The objectives should be more clearly described. Description of suitable monitoring site and ultimate object such as investigating a long term adverse effect should be added.

Chapter 1.3 Outline of the manual for dry deposition flux estimation

i) Outline of each chapter should be written by keeping same format;
ii) To show the reason of invalid data described in this section, examples of the flagged data should be added in Chapter 3.3

Chapter 2 Fundamental items for dry deposition flux estimation

Chapter 2.1 Air Quality Measurements (written by Dr. Chang and Dr. Hong)
Dr. Chang introduced the draft originally prepared by Dr. Hong, and the members discussed the contents of Chapter 2.1. Major comments are shown as follows:

i) The title of Chapter 2.1.1 should be changed as “Siting of air quality monitoring”;

ii) In Chapter 2.1.2.1, the sentence “For these purpose, the concerned chemicals are primarily gaseous SO_2, NO, NO_2, O_3, HNO_3, HCl, NH_3, and particulate SO_4^{2-}, NO_3^-, Cl^-, NH_4^+, Na^+, and Ca^{2+}.” should be moved to after the first sentence in the same paragraph;
iii) Since this technical manual is the first attempt for dry deposition flux estimation, all the measurement parameters excluding PM_{10} and $PM_{2.5}$ should be calculated for dry deposition flux estimation. After that, important parameters should be selected by evaluating calculation data. Unimportant parameters should be removed from the technical manual in the next version;
iv) In Chapter 2.1.3, Passive sampler for O_3 should be used in remote and rural area for the monitoring because passive sampler can not capture high concentration of O_3. Some description that passive sampler for O_3 can be used in remote and rural area should be added to the Table 1;
v) In the Table1, chemiluminescence detection method (urban) and passive method should be listed as the monitoring method of NO_2;
vi) In the Table 1, “Concentrations of Ions” should be changed as “Particulate Matter Components”;
vii) It was confirmed that PM_{10} and $PM_{2.5}$ are not necessary for dry deposition flux estimation.

Chapter 2.2 Meteorological measurements (written by Dr. Takahashi)
Dr. Takahashi explained the revised draft of Chapter 2.2, and the members discussed the contents. Major comments are shown as follows:

i) In Chapter 2.2.1, description of measurement height (usually 10 m above the ground) should be identified;
ii) In Chapter 2.2.2, standard deviation of wind direction, Net radiation and Cloud cover and Surface wetness should be listed as optional parameters. Because atmospheric stability can be determined by using one of four parameters, it is not necessary to measure all of four parameters;
iii) Sonic anemometer should be removed from the Table 2.1 because the instrument is too expensive to install all EANET sites;
iv) In the Table 2.1, meteorological parameters of Net radiation and Surface wetness should be separated as optional parameters;
v) The description of Chapter 2.2.4 should be separated according to mandatory and optional parameter;
vi) The appendix part (Estimation Methods for Atmospheric Stability by Measured Parameters) should be moved to new Chapter 2.2.5 “Atmospheric Stability”;
vii) To determine the atmospheric stability and the Monin-Obukhov length (L) there are three estimation methods. In the future, one method should be decided based on the experiences;
viii) The description about the empirical formulas for the aerodynamic resistance (R_a) and the quasi-laminar layer resistance (R_b) should be moved to Chapter 4.

Chapter 2.3 Land use information (written by Dr. Ueda)
Dr. Ueda introduced the revised draft and concept of the land use category in a previous study (Zhang et al., 2001). Major comments are shown as follows:

i) The site information reported by the national monitoring plan of each country will be primarily used. If domestic land use data is available in each country, the data can be

used. Otherwise, the global land cover characteristic data from the USGS Web site is also useful. The Web site address should be added in this chapter;

ii) Practical means of collection and use of the land use data should be described;

iii) The NC can provide land use database to be distributed to participating countries;

iv) Roughness length (Z_0) and characteristic radius of plants (A) are identified by 15 types of land use categories and 5 types of seasonal categories. Application to tropical region will be consider in future direction and also described in Chapter 4;

v) Description of LAI, which is important parameter relevant to the vegetation should be added in this chapter. Detailed procedure is presented in the Appendix II in this first manual, which will be described in the main text when LAI can be practically used.

Chapter 3 Data reporting (written by NC)

The Secretariat explained the revised draft of Chapter 3. Major comments are shown as follows:

i) Description of Chapter 3.1.1 should be modified according to the discussion in chapter 2.1.2. Description of PM mass concentration is removed from this chapter;

ii) Optional parameters such as LAI will be described in this chapter;

iii) Description of Chapter 3.2 should be referred from the Technical Manual for Wet Deposition Monitoring in East Asia;

iv) The description of “Relationships between chemical components in air and those in precipitation”, “Comparisons between measurements and estimates from theory or model” and “Ion balance check for particulate matter components” should be removed;

v) In Chapter 3.2.3, the definition of data completeness should be clearly identified;

vi) In Chapter 3.3, code number and type of data flags should be described followed by the case of the Technical Manual for Wet Deposition Monitoring in East Asia;

vii) Duration time of meteorological measurement should be added in Chapter 3.4.3;

viii) The description of “Particulate matter concentrations with the unit of μg m^{-3} (PM_{10} and $PM_{2.5}$)” should be removed.

Chapter 4 Methodology for dry deposition flux estimation in EANET (written by Dr. Matsuda)

Dr. Matsuda explained the revised draft of Chapter 4, and the members discussed the contents. Major comments are shown as follows:

i) Dr. Matsuda revised Chapter 4.1 and renamed as “Fundamental items of the inferential method in EANET”. This chapter describes that the recommended target area (1 km around the monitoring site) and the reference height to estimate deposition velocity (10 m above the ground level) are applied to every monitoring site. To estimate deposition velocity at EANET sites, a 10 m height mast which is used for meteorological observation data will be adopted;

ii) Dr. Akimoto mentioned that because the inferential method is the only method which is used for calculation in EANET, more description should be made focused on the inferential method in chapter 4.1;

iii) The description why these equations can be applied to dry deposition flux estimation in EANET should be added in Chapter 4.2 with citation of previous studies;

iv) Suitable monitoring site for estimating dry deposition velocity will be selected after calculation of dry deposition flux based on the 1st version of the Technical Manual. The calculation will be conducted in all the monitoring site in which necessary data are available, and then the validity of the results will be evaluated;

v) Dr. Matsuda revised Chapter 4.3.1. Land use type around 1 km from site, seasonal category based on the climate at each site, roughness length, zero-plane displacement height and how to use land use data are described in this chapter;
vi) In Chapter 4.3.2, an example of typical Vd calculation should be given;
vii) Dry deposition velocities and dry deposition fluxes for respective components will be automatically calculated by inputting the necessary data into macro program Excel file developed by the NC with the help of Dr. Matsuda. How to obtain the file should be described in Chapter 4.3.3.

Chapter 5 Evaluation of dry deposition flux determined by the Inferential Method (written by Dr. Hayashi)

Dr. Hayashi explained the revised draft of Chapter 5 and mentioned that most of description in this chapter becomes conceptual. Major comments are shown as follows:

i) This Chapter should be merged into Chapter 4 and the number of this chapter should be changed to Chapter 4.4;
ii) The uncertainties of inferential method was same as the previous version, but were largely divided by air concentration, deposition velocity and averaging factors;
iii) Dr. Hayashi rewrote the evaluation of inferential method for gaseous species and particulate matter;
iv) Throughfall & Stemflow method was newly added in Chapter 5.4 “Evaluation of the inferential method for total deposition”;
v) In Chapter 5.2, evaluation of sulfur species and O_3 should be highlighted;
vi) In Chapter 5.3, evaluation of inferential method for size classified PM or TSP should be clearly described.

Chapter 6 Direct measurement for determining dry deposition flux (written by Dr. Pojanie)

Dr. Pojanie explained the revised draft of Chapter 6. More detailed information and descriptive pictures are added. Major comments are shown as follows:

i) This chapter should be moved to Appendix I because the direct measurement methods are not currently applied to the parameterization of the inferential method in EANET.
ii) The Strategy Paper for Future Direction of Dry Deposition Monitoring of EANET described selection of specific sites suitable for dry deposition computation among the concentration monitoring sites as the 3rd step of the establishment of dry deposition monitoring. The information on direct measurement methodology is important to future direction of dry deposition flux estimation, and thus the direct measurement should be described in future direction.

Chapter 7 Use of remotely sensed information (written by NC)

The Secretariat explained the outline of Chapter 7, which is the almost same as the 1st draft. Major comments are shown as follows:

i) There are three options to obtain the land use information. One is the site information reported by the each participating country, the second is the land use data provided by each country or USGS, and the third one is utilization of satellite data, which can cover all EANET regions. As for the option of using the satellite data, it is necessary to use AVHRR, MODIS and LAI data as a routine work, which may be difficult to in all participating countries. For this reason, this chapter should be moved to Appendix II. The other two options should be described in Chapter 2.3.

ii) Since remote sensing information is important to determine LAI which is used to elaborate setting of seasonal categories, roughness length and zero-plane displacement height, the remote sensing should be described in future direction.

Chapter 8 Future direction of dry deposition flux estimation (written by Dr. Matsuda)
Dr. Matsuda prepared the draft of Chapter 8 according to summary of discussions from Chapter 1 to 7. Also the number of this chapter should be changed to Chapter 5. The items to be described in Chapter 5 are shown below:

i. Determination of stability measurement method.
ii. Selection of suitable site
iii. Reconsidering reference height
iv. Update parameterization in the future, compared with direct measurement method, special study on aerosol and nitrogen compound and numerical model
v. Elaboration of setting of seasonal category, roughness length and displacement height by using LAI satellite data

As for the item I, three recommended methods are described to estimate atmospheric stability. In the future, the most practical method should be decided based on the first attempt and experiences. As for the item iv, the description referred to the strategy paper. In this first attempt, dry deposition flux estimation at all available monitoring sites should be tried. Then, suitable site to estimate dry deposition flux will be selected. Because parameterization of deposition velocity of aerosol and nitrogen compound has large uncertainties for current version, elaboration by direct measurement should be done at special site in future. In this first attempt, the inferential method will be applied to available EANET sites in order to estimate dry deposition flux near the monitoring site. In the future, to estimate dry deposition flux over a wide range, numerical model estimation will be considered. The road map for these items will be described in the newly devised strategy paper.

V. Revision work of the 2nd draft of the Technical Manual

Based on the discussion at the meeting, each member and the Secretariat revised the 2nd draft of Technical Manual. Then, the revised 2nd draft was reviewed again, and necessary revision was made. The secretary asked each member to check the 2nd draft thoroughly and modify the draft to prepare the 3rd draft. The 3rd draft is attached as Annex 2.

VI. Discussion on High Priority Research Project

Dr. Pojanie introduced progress on the High Priority Research Project (Aerosol Deposition Studies in Forests for Improvement on Estimate Method for Dry Deposition) that will be implemented at a site in Ratchaburi, Thailand since 2009. The 1st year progress report is attached as Annex 3. Major comments are shown as follows:

i) A microcontroller to switch the filter pack monitoring between downward and upward convection is devised to control flow rate;
ii) Because deposition velocity of nitrate in December 2009 rapidly increased, the validity of this data should be considered;
iii) Since aerosol size separation was not so good, it is better to monitor by 3 filterpack lines continuously;

iv) Further investigation will be conducted, and the outcomes of this study are expected to present at EANET meetings and publish in a peer reviewed journal.

VII. Future Schedule

The Meeting agreed that the draft Technical Manual will be finalized according to the Schedule of Technical Manual Preparation (see Annex 4). Major comments are shown as follows:

i) The Secretariat will try to finalize the Technical Manual with a strong association with the members. The draft Technical Manual will be submitted to the 3rd Meeting of the Task Force on Monitoring for Dry Deposition (26-27 July, 2010), the 11th Senior Technical Managers' Meeting (STM11; 1-3 September, 2010) for comments. According to the feedbacks, the Technical Manual will be revised as needed;
ii) The final draft will be submitted to the 10th Session of Scientific Advisory Committee (SAC10; 13-15 October, 2010) for endorsement.

The secretariat will circulate the minutes of the meeting and the revised 3rd draft of Technical Manual to all members by the middle of July, 2010.

(Minutes of the 3rd meeting of EGDDFE Annex 1)

**THIRD MEETING OF THE
EXPERT GROUP ON DRY DEPOSITION FLUX ESTIMATION**

(Niigata, 24-25 June 2010)

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THIRD MEETING OF THE
EXPERT GROUP ON DRY DEPOSITION FLUX ESTIMATION

(Niigata, 24-25 June 2010)

Technical Manual
on
Dry Deposition Flux Estimation
(Third Draft)

Prepared by the Expert Group on Dry Deposition Flux Estimation, Scientific Advisory Committee of Acid Deposition Monitoring Network in East Asia (EANET)

Table of Contents

(Minutes of the 3rd meeting of EGDDFE Annex 3)

**THIRD MEETING OF THE
EXPERT GROUP ON DRY DEPOSITION FLUX ESTIMATION**

(Niigata, 24-25 June 2010)

Aerosol Deposition Studies in Forests for Improvement of Estimation Method for Dry Deposition

Objectives

A direct measurement method is applied to determine the aerosol deposition flux and velocity over the forest canopy in the tropical region.

Background Information

The process of dry deposition has been studied over decades in an attempt to estimate quantitatively the removal rate of atmospheric aerosols. Although many different turbulent and chemical mechanisms that can contribute to the processes of deposition have been discussed extensively in the literature over the years, our knowledge remains incomplete. Progress has essentially been limited to bulk estimates of the dry deposition flux. This has been mainly due to the complies interdependence of many different variables that can control the exchange process of atmospheric condensates to surfaces that are complex both at the microscale in terms of morphology and at the terrain scale. Although there have been many models that seek to explain the deposition process to complex surfaces by taking into account variables such as particle size, composition, surface morphology, meteorology, and turbulence, their predictions vary widely. The studies, although providing valuable insights into exchange processes, are not fully representative of atmospheric surface layer turbulent exchange processes, specifically the influence of atmospheric stability. The relative humidity on particle equilibrium size as a function of dry particle size and composition may also cause sizing artifacts in sample collected. This deliquescence effects on the deposition fluxes should receive attention. Buzorius et al. [1998] has suggested that the errors induced in deposition velocity may be large, causing an underestimate in deposition velocity under warm humid conditions.

The scientific information on the aerosol deposition flux in the tropical region where climatology is humid, are non existent while substantial data for the northern hemisphere are available in publications. As indicated in the objective of this project, the outcome of this study will supplement the EANET countries in the tropical regions to estimate the dry aerosol depositions. Hence, the total depositions which include both the wet and dry depositions can be determined.

Scope of Activities

1. Direct measurement of aerosol deposition flux and velocity will be conducted in the forest in Thailand,
2. Principal aerosols to be study consist of SO_4^- and NO_3^-
3. Seasonal effects on the deposition velocity will be determined,

4. Seasonal differences in the tropical region will be compared with the available inferential model applied for the sub-temperate region.

Methodology

The eddy accumulation method which is a variation of the standard eddy correlation is to be applied for this study. It is a suitable technique for determining the deposition flux using the filter packs. The technique involves sampling the air onto two separate filters, with the velocity determining which filter receives the sampled air. One filter is used for positive vertical velocities and the second is used for negative vertical velocities; the instantaneous sampling rate for each filter is proportional to the magnitude of the velocity. The deposition flux of the aerosol can be calculated by

$$F = b\sigma_w\left(C_{up} - C_{down}\right) \qquad (1)$$

where b is the experimental coefficient obtained from the probability distribution of vertical wind velocity, σ is the standard deviation of the vertical wind velocity and C_{up} and C_{down} are the average concentration of the pollutant depending on the wind velocity is upflow or downflow.

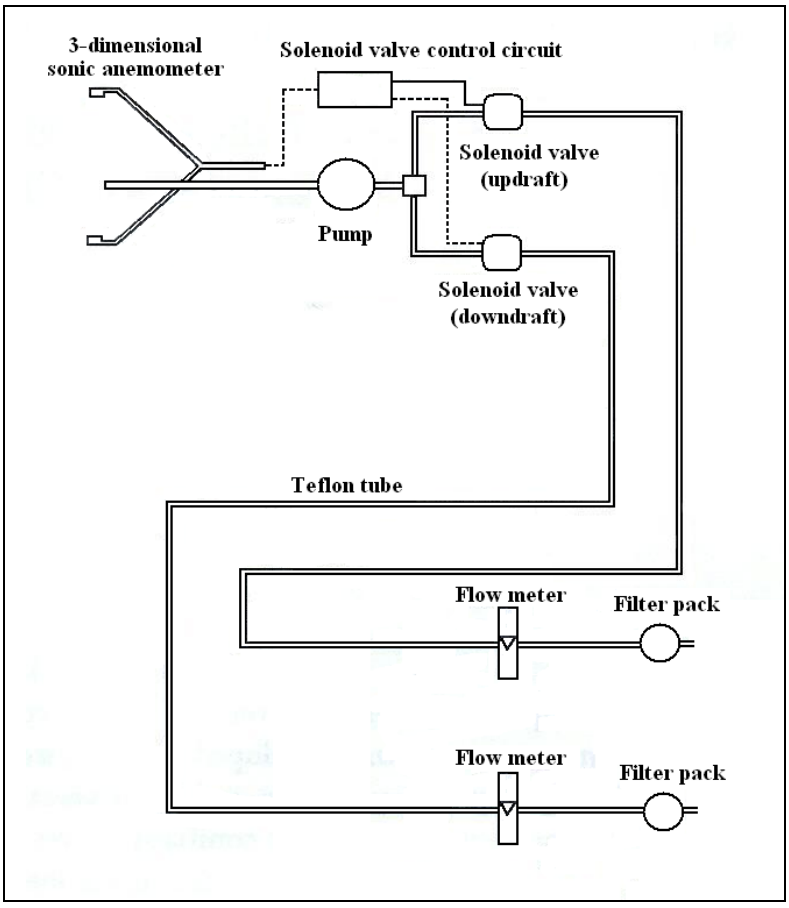

Figure 1. A schematic diagram of the eddy accumulation sampling system.

Experimental

The experimental site is a forest type of Dipterocarp plantation located in Ratchaburi province (approximately 200 km from Bangkok). See Figure 2.

Figure 2. The experimental site covering with Dipterocarp plantation

The micrometeorological instruments were installed on a tower 10 m high with 3 m above the trees The climate in Thailand can be broadly classified into wet or dry. The wet season covers a period of May to October and the dry season covers a period of November to April. The 10 year average amount of rainfall from the beginning of the wet season to the peak is in the range of 60-250 mm. In the dry season, the 10 year average rainfall is in the range of 0-60 mm. The average temperature is 28.7 ºC and 26.7 ºC for the wet and dry seasons, respectively.

Figure 3 shows the experimental tower equipped with meteorological instruments consisting of 3D ultrasonic anemometer, filter packs, Temperature and relative humidity sensor, vacuum pump, flow meter and solenoid valves. Figure 4 shows a set of data logger and computer to record the meteorological values.

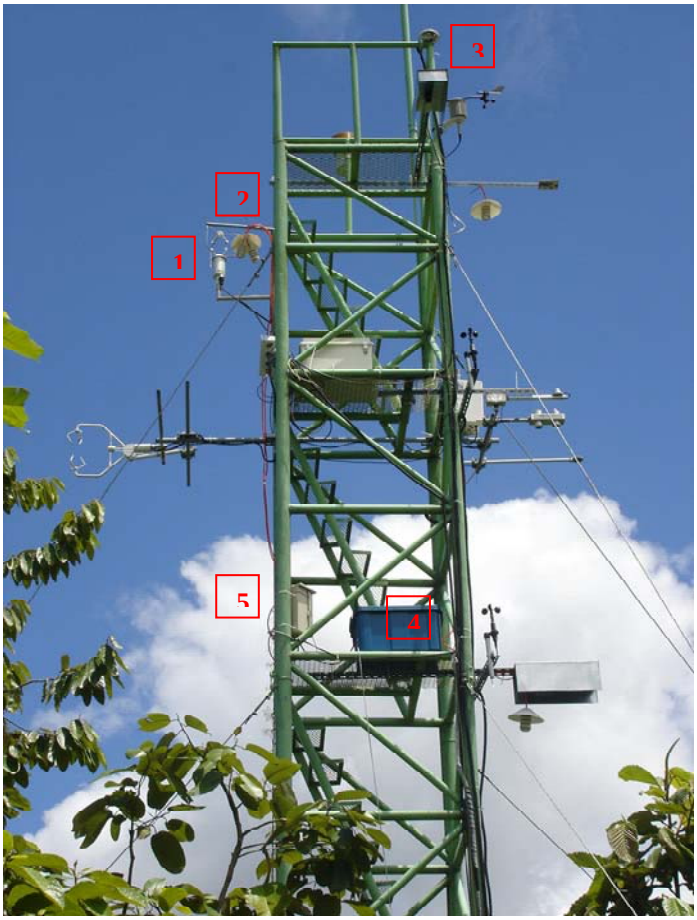

Figure 3. The experimental tower equipped with meteorological instruments consisting of 1. 3D ultrasonic anemometer, 2. filter packs, 3. Temperature and relative humidity sensor, 4. vacuum pump and 5. flow meter and solenoid valves.

Figure 4 A set of data logger and computer to record meteorological values.

Result and Discussion

The results show the higher concentration of nitrate than sulfate (Figure 4). It is probably caused by the reaction between nitric acid and ammonia in the atmosphere. The ammonia concentration was high also in the area of measurement.

The ambient temperature and the relative humidity show relative effects on the sulfate and nitrate formations. The measurements show that sulfate and nitrate concentrations tend to increase when the temperature and the relative humidity decrease (during the dry season). See Figures 5 and 6.

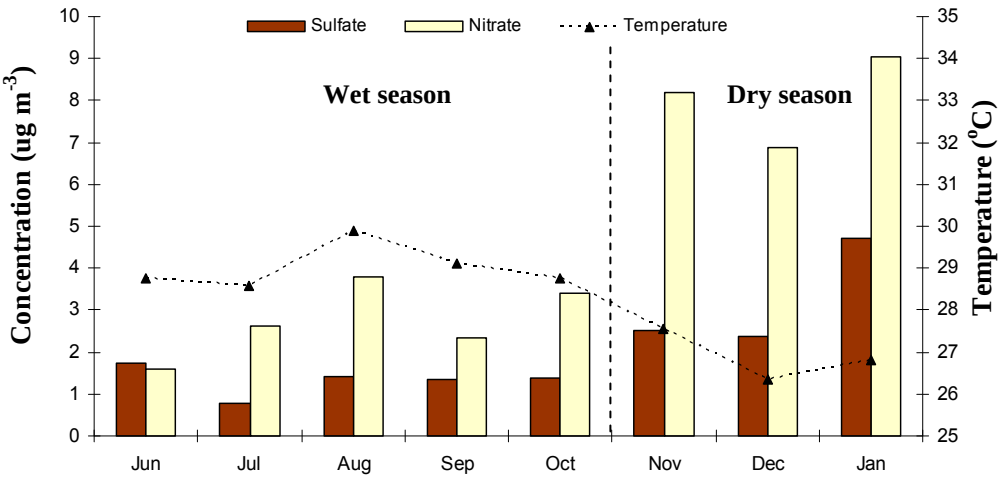

Figure 5. Measurement values of ambient temperature and sulfate and nitrate concentrations.

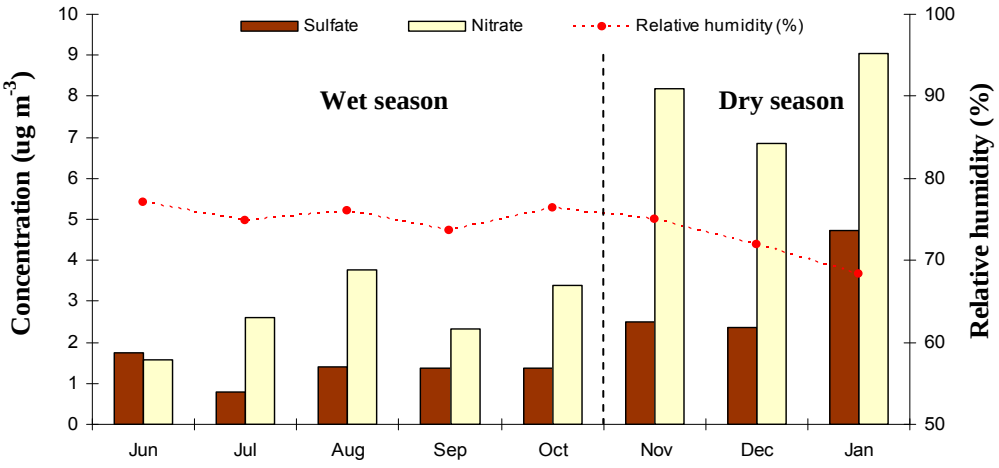

Figure 6. Measurement values of humidity and sulfate and nitrate concentrations.

As shown in Figure 7, the flux of sulfate tends to increase in the dry seasons. The flux values were in ranges from 0.002 to 0.011 μg/m^2.s (172.8 μg/m^2.day – 950.4 μg/m^2.day). Flux of nitrate is significantly higher than sulfate in the area of measurements. See Figure 7 and Figure 8 for comparison. The values were found in ranges from 0.01 μg/m^2.s to 0.10 μg/m^2.s (864 μg/m^2.day – 8,640 μg/m^2.day). The higher value of nitrate flux is conformed with its higher concentration

comparing with sulfate. However, it should be noted that the nitrate concentration is doubling the value of sulfate concentration but the nitrate flux is 10 times higher than the sulfate flux. Further investigation on the influence of other parameters such as the molecular sizes, temperature, humidity, etc. will be carried out.

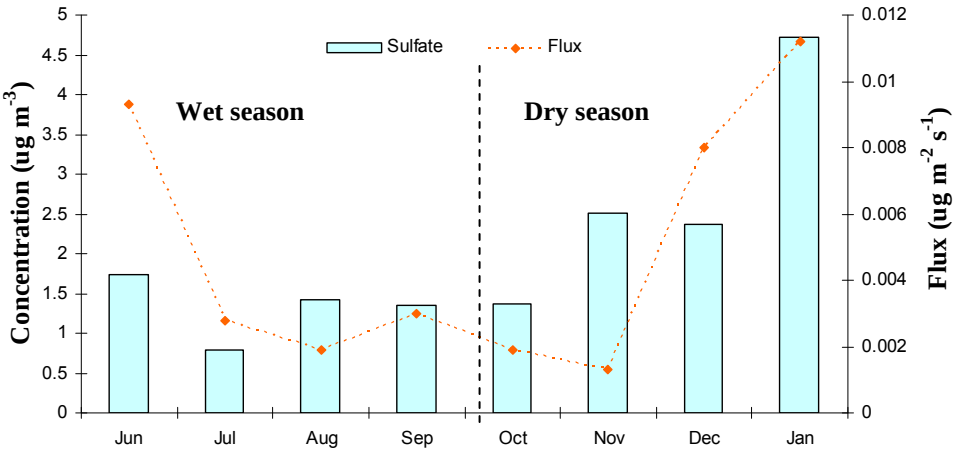

Figure 7. Flux of sulfate in the wet and the dry seasons.

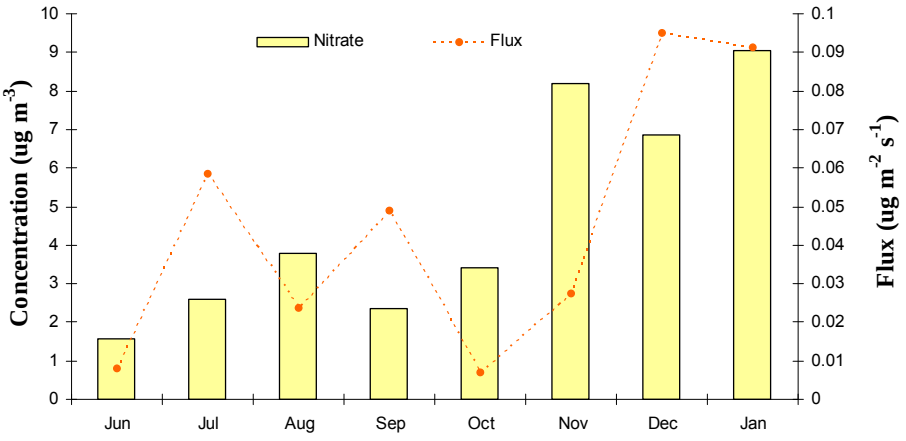

Figure 8. Flux of nitrate in the wet and the dry seasons.

The next work plan

The work to be performed include:

- Calculate the deposition velocities of sulfate and nitrate
- Determine the aerosol size distribution over the forest canopy
- Indicate parameters affecting the aerosol fluxes and deposition velocities
- Fitting the Resistance model with the experimental data.
- Paper for publication

(Minutes of the 3rd meeting of EGDDFE Annex 4)

**THIRD MEETING OF THE
EXPERT GROUP ON DRY DEPOSITION FLUX ESTIMATION**

(Niigata, 24-25 June 2010)

Schedule of the Technical Manual Preparation

June 30, 2010	Send the 2nd draft of the Technical Manual (With some necessary minor revisions)
July 12, 2010	Send the minutes of the 3rd meeting of the Expert Group on Dry Deposition Flux Estimation
July 19, 2010	**Deadline of the submission of the 3rd draft of the Technical Manual**
July 26-27, 2010	Submit the 3rd draft to the 3rd meeting of the Task Force on Monitoring for Dry Deposition for comments
August 6, 2010	Send the comments made by the 3rd meeting of the Task Force on Monitoring for Dry Deposition
September 1-3, 2010	Submit the 3rd draft to the 11th Senior Technical Managers' Meeting of EANET (STM11) for comments
September 6, 2010	Send the comments made by the 11th Senior Technical Managers' Meeting of EANET (STM11)
September 17, 2010	**Deadline of the submission of the final draft of the Technical Manual**
late September, 2010	English proof of the final draft of the Technical Manual (if possible)
October 13-15, 2010	Submit the final draft to the 10th session of the Scientific Advisory Committee of EANET (SAC10) for endorsement