Progress on the Revision of the Technical Manuals for Dry Deposition Flux Estimation and Air Concentration Monitoring

STM 22

1-2 September, 2021

Virtual meeting

Secretariat of the Expert Group on Revision of the Technical Manuals for Dry Deposition Flux estimation and Air Concentration Monitoring

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Back ground(1): 4th Meeting of the Task Force on Monitoring for Dry Deposition (20-21 August 2015)

- The Strategy Paper for Monitoring for Dry Deposition (2016-2020) was developed by the Task Force and submitted to the Tenth Session Scientific Advisory Committee (SAC15) in 2015 for adoption.
- The Strategy Paper will serve as a guide for the Task Force and other related groups for planning and implementing future activities for improving the assessment of acid deposition in EANET.
- The Strategy Paper includes 7 activities to be implemented to achieve the objectives of the Strategy on Monitoring for Dry Deposition from 2016 to 2020.

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Back ground(2): Activities to be implemented to achieve the objectives of the Strategy on Monitoring for Dry Deposition from 2016 to 2020

i) Consideration on feasibility of developing monitoring techniques and review of the Technical Manuals

ii) Further elaborate and develop dry deposition flux estimation methodology

iii) Enhancement of spatial coverage for dry deposition flux estimation

iv) Promotion of an ozone monitoring network and review of its current status in East Asia

v) Promotion of a PM_{10}/$PM_{2.5}$ monitoring network and review of their current status in East Asia

vi) Develop the database for surface resistances of tropical and boreal regions

vii) Further elaborate QA/QC for air concentration monitoring

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Back ground(3): TOR of the Task Force on Monitoring for Dry Deposition (Revised in 2015)

i) To further develop and elaborate the strategy for dry deposition evaluation in the region

ii) To discuss on future direction of dry deposition evaluation and provide guidance on relevant activities based on the strategy

iii) To improve the Technical Manuals for Air Concentration Monitoring and Dry Deposition Flux Estimation

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Back ground(4):Major comments regarding the Technical Manuals in the 4th Meeting of the Task Force

- Technical manuals of dry deposition and air concentrations monitoring should be checked by Task Force meeting before endorsement and adoption. The author of technical manuals should be Task Force member.
- DQOs for detection limit shown in the technical manual for air concentration monitoring should be separated for different automatic monitors and manual methods in each participating countries.
- Both of the Technical Manuals were written by scientists and not friendly for users of engineers and technical staffs. Exact procedure should be more described and emphasized in the Technical Manual.
- Technical manual should describe the criteria of cutoff of PM monitor.

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Membership of the Expert Group on revision of the Technical Manuals for Dry Deposition Flux Estimation and Air Concentration Monitoring (EGRTM) (Approved by SAC in 2016)

Dr. Patcharawadee Suwanathada (Chair)	Director of Ambient Air Quality Division, Air Quality and Noise Management Bureau, Pollution Control Department, Thailand
Prof. Min Hu	Professor, College of Environmental Sciences, Peking University, China
Prof. Kazuhide Matsuda	Professor, Tokyo University of Agriculture and Technology, Japan
TBD	Environmental Management Bureau (EMB), Philippines
Prof. Cho Seog-Yeon	Professor, Inha University, Republic of Korea
Dr. Le Ngoc Cau	Director, Center for Environmental Research, Vietnam Institute of Meteorology, Hydrology, and Environment, Vietnam

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TOR of the Expert Group on revision of the Technical Manuals for Dry Deposition Flux Estimation and Air Concentration Monitoring (EGRTM)

i) To review the current Technical Manual on Dry Deposition Flux Estimation in East Asia and Technical Manual for Air Concentration Monitoring in East Asia

ii) Identification of elaborated methods of dry deposition flux estimation and air concentration monitoring methods in East Asia

iii) Preparation of the revised version of Technical Manual on Dry Deposition Flux Estimation in East Asia and Technical Manual for Air Concentration Monitoring in East Asia

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Schedule of EGRTM during 2020-2022

By April, 2020	Review of the contents of the current Technical Manuals
23 April 2020	1st meeting of the Expert Group to review the 1st draft of revised Technical Manuals
Early 2021	Circulation of the 2nd draft of revised the Technical Manuals and ask for comments
11 May 2021	2nd meeting of the Expert Group to review the 2nd draft of revised Technical Manuals and discuss on elaborated methods of dry deposition flux estimation and air concentration monitoring methods in East Asia
November/December 2021	3rd meeting of the Expert Group to review the 3rd draft of revised Technical Manuals
May/June 2022	4th meeting of the Expert Group to finalize draft of the revised Technical Manuals
September/October 2022	Submitted the final draft of the revised Technical Manuals to the 22th Session of Scientific Advisory Committee for adoption

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Draft contents of the revised TMDDFE (1)

[The contents are followed by the current version.]

(Chapter 1 Introduction)

Try to avoid duplication of TMACM

1.1. Background

→ Several methods of dry deposition flux estimation discussing pros and cons of each method is introduced. These include model simulation, simplified parameterization of deposition velocity

1.2. Objectives of dry deposition flux estimation

→ Description of suitable monitoring site and ultimate object such as investigating a long term adverse effect should be added.

Daily, weekly, monthly ave. will be considered in future

1.3. Outline of the manual for dry deposition flux estimation

(Chapter 2 Fundamental items for dry deposition flux estimation)

2.1. Air quality measurements (Hourly)

→ Siting, Priority chemical species, Instrumentation, Sampling period

→ All the measurement parameters excluding PM should be calculated for dry deposition flux estimation.

2.2. Meteorological measurements (Hourly)

→ Siting, Meteorological parameters, Instrumentation, Sampling period (Minimum parameters: Wind speed, Wind direction, Temperature, Relative humidity, Solar radiation and Precipitation amount)

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Draft contents of the revised TMDDFE (2)

[The contents are followed by the current version.]

(Chapter 2 Fundamental items for dry deposition flux estimation, continued)

2.3. Land use information

Try to avoid duplication of TMACM

→ Soil type, Forest fraction, Soil temperature, Land waters mask, Vegetation type etc.

→ 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.

(Chapter 3 Data reporting)

→ Description of Chapter 3 should be modified in accordance with the discussion in Chapter 2.

Keep to adopt Inferential method

(Chapter 4 Methodology for dry deposition flux estimation in EANET)

4.1. Fundamental items of the Inferential Method in EANET

→ 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.

4.2. Parameterization of dry deposition velocity

→ The description why these equations can be applied to dry deposition flux estimation in EANET should be added in Chapter 4.2.

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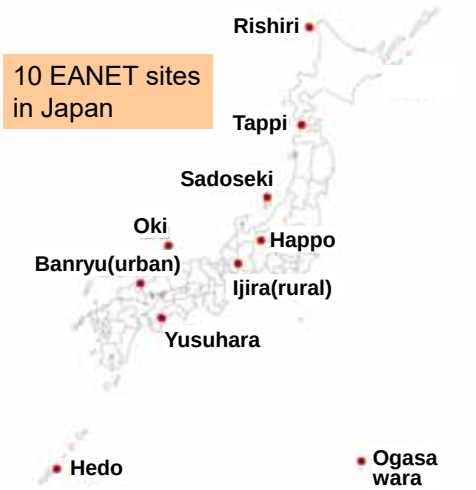
Case study of dry deposition flux estimation



Equation of dry deposition

$$F_{Dry}(i) = C(i) \times V_d(i)$$

Dry Deposition of i species | Conc. of i species | Dep. Velocity of i species

$$V_d^i = (R_a + R_b^i + R_c^i)^{-1}$$

Aero dynamic | Quasi laminar | Surface

- Meteorological parameters was measured at each EANET sites. (Hourly data are available only in Japan.)
- Cloud coverage data at the nearest station were obtained by Japan Meteorological Agency.
- Deposition surface was considered for forest and grass.

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Draft contents of the revised TMDDFE (3)

[The contents are followed by the current version.]

(Chapter 4 Methodology for dry deposition flux estimation in EANET, continued)

4.3. Computation of dry deposition flux

4.4. Evaluation of dry deposition flux determined by the Inferential Method

(Chapter 5 Future direction of dry deposition flux estimation)

i. Determination of stability measurement method.
ii. Selection of suitable site
iii. Reconsidering reference height
iv. Update parameterization in the future
v. Elaboration of setting by using satellite data etc.

(Appendix I Future direction of dry deposition flux estimation)

(Appendix II Use of remotely sensed information)

→ These chapter should be moved to Appendices because they are not currently applied to the parameterization of the inferential method in EANET.

(Appendix III How to use dry deposition calculation software)

→ 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.

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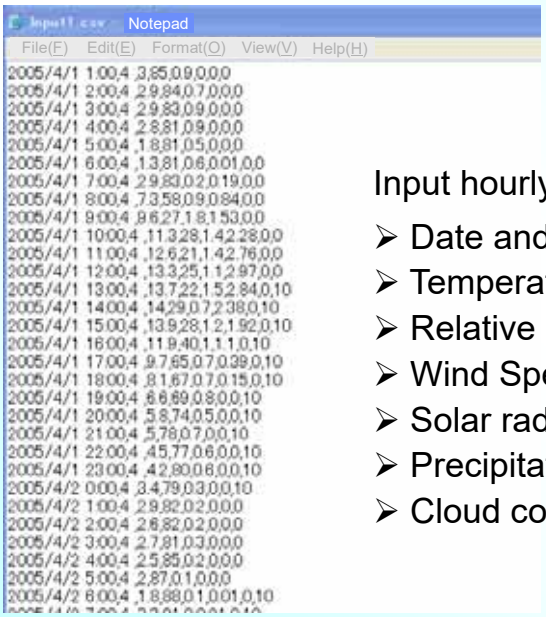
How to use dry deposition calculation software (1)

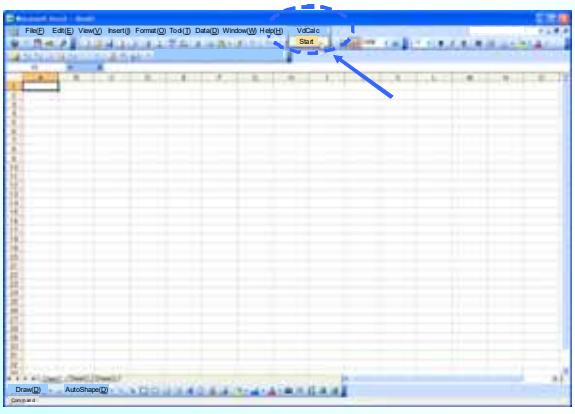


Input hourly meteorological parameter.

- Date and Time
- Temperature [degree]
- Relative Humidity [%]
- Wind Speed [m/s]
- Solar radiation [MJ/m^2]
- Precipitation [mm]
- Cloud coverage [0～10]

How to use dry deposition calculation software (2)

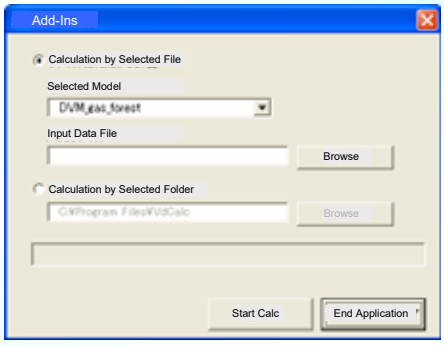
Start of Vd calculation



Instead of macro program, excel calculation sheet will be developed.

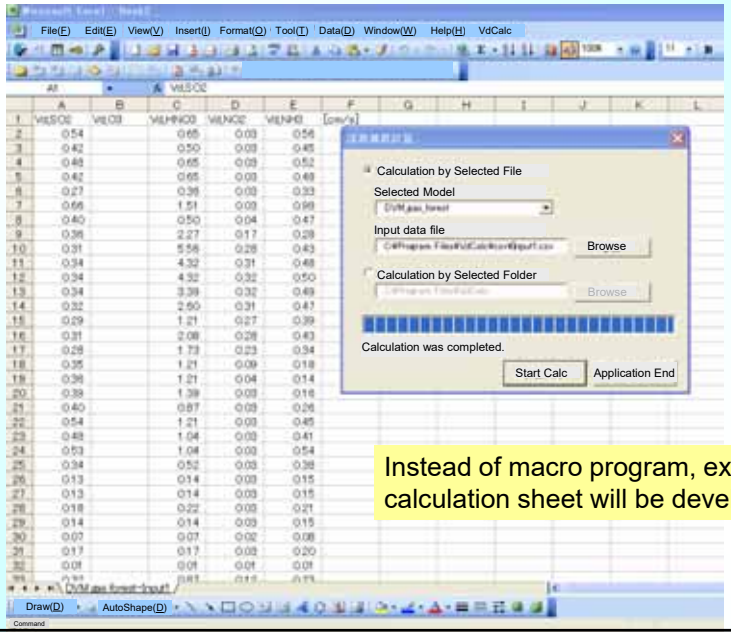
Choose the Vd model, input meteorological data and system definition file

- DVM_gas_forest
- DVM_gas_grass
- DVM_pm_forest
- DVM_pm_grass



How to use dry deposition calculation software (3)

Calculated Vd results (Gas on the forest surface)



Instead of macro program, excel calculation sheet will be developed.

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Draft contents of the revised TMACM (1)

[The contents are followed by the current version.]

The revision of the Guidelines for Acid Deposition Monitoring in East Asia will be linked with the revised Technical Manuals.

(Chapter 1 Introduction)

1.1. Background

- Historical background of air concentration monitoring documents
- Establishment of the expert group

1.2. Objectives

- To provide guideline of air concentration monitoring and to standardize air concentration monitoring methodology

The classification of priority is deleted.

1.3. Priority chemical species in EANET

First priority: SO_2, O_3, NO, NO_2 (urban), HNO_3, HCl, NH_3, Particulate component (SO_4^{2-}, NO_3^-, Cl^-, NH_4^+, Na^+, Mg^{2+}, K^+ and Ca^{2+}), PM_{10}

Second priority: NO_2 (rural and remote), $PM_{2.5}$

1.4. Outline of the manual

- Relationship between the species and the corresponding monitoring methods was described.

Chemical composition measurement of PM_{10} and $PM_{2.5}$ will be described in the future direction.

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Draft contents of the revised TMACM (2)

[The contents are followed by the current version.]

(Chapter 2 Monitoring design)

The description about site criteria in has been simplified and referred the Monitoring Guideline of EANET.

2.1. Siting criteria
- To be consistent with EANET Guideline.
- To consider regional representativeness.
- Refer to the other networks such as WMO/GAW, EMEP CASTNET.

2.2. Site facilities and Instrumentation (Electricity, Housing, Air conditioning, Inlet, Data comminication, monitor arrangement etc.)
- Sampling inlet should be considered to avoid local interference and should refer other international networks.
- To consider humid condition in Southeast Asian region.
- Description of sampling tube is added.

2.3. Monitoring frequency
- Hourly: Automatic monitors and meteorological instruments.
- Weekly or Bi-weekly: Manual monitoring.

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Draft contents of the revised TMACM (3)

[The contents are followed by the current version.]

(Chapter 3 Automatic monitoring)

Manuscript structure was reorganized and minor information will be deleted or moved to appendix.

3.1. Point measurement
- For each instrument, the monitoring principle should be described at first, and then calibration procedure should be described in the following section.
- SO_2: UV (200-240nm) absorption and emission of photons occurs. (300-400nm)
- NOx: Chemiluminescence detection, detecting not only NO and NO_2.
- O_3: UV (254nm) absorption.
- The principle of monitoring apparatus for PM (β-ray and TEOM) described in details.

3.2. DOAS measurement
- The advantage and disadvantage about DOAS were summarized.

3.3. Meteorology
- Instruments necessary for dry deposition flux estimation and local meteorology was described.

In introduction the brief explanation of the historical measurement method and newly advanced method (CAPS, LIF for NO_2 monitoring, Low-cost sensor system for gas and $PM_{2.5}$ monitoring) are described.

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Draft contents of the revised TMACM (4)

[The contents are followed by the current version.]

(Chapter 4 Manual monitoring)

4.1. Filter pack
- To summarize advantage and disadvantage.
- Monitoring of sulfur species and total nitrogen is reliable, but there is artifacts of gaseous and particulate nitrogen compounds.
- Uncertainty of monitoring will be described with reference to previous studies.
- Factors causing errors will be described. (leak check, skillfulness, etc.)

4.2. Annular denuder
- Can avoid artifact artifacts of gaseous and particulate matters.
- High cost compared to filterpack and passive sampler.
- Require skillfulness of laboratory operator.

4.3. Passive sampler
- Low cost method compared to automatic monitors
- May be affected by severe meteorological conditions.
- Intercomparision with automatic intrument is recommended.

The filter pack or other manual sampling are suitable in the place where PM concentration is too low to measure the concentration using the automatic monitors. This is described in the introduction

The section of denuder method has been moved after passive sampler.

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Draft contents of the revised TMACM (5)

[The contents are followed by the current version.]

(Chapter 5 Maintenance)

5.1. Standard operating procedures
- Objective and concept of SRP will described as introduction.
- Example of SRP will be attached in Appendix.

5.2 Maintenance of manual samplers and analytical instruments

Schedule of maintenance (Items and intervals)

5.3. Maintenance of automatic monitors
- Schedule of maintenance (Items and intervals)
- Lifespan of automatic monitors

5.4. Field record
- Record sheet will be keep in station or laboratory.

5.5 Maintenance record
- Example of field record was given.

5.6. Safety management
- Management of gas cylinders and disposal of hazardous wastes

The examples of field record and maintenance record has been added.

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Draft contents of the revised TMACM (6)

[The contents are followed by the current version.]

(Chapter 6 Data reporting and validation)

Will be revises according to the current data report format.

6.1. Site specification
- Information of effects on air concentrations.
- Information on the precision of monitoring results.

6.2. Compilation of raw monitoring data
- Specify time resolution of air concentration monitoring.
- Level of monitoring data were specified. (Raw data, Calculated data, etc.)

6.3. Data validation
- Data completeness should be 75% for automatic and 70% of manual.

6.4. Submission of finalized data
- Three kinds of data form including filter pack, automatic and meteorological parameter were to be prepared.

6.5. Data storage
- Principally, raw data (chart and electronic) should be store for 3 years.
- NC will establish data server and provide upon request.

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Draft contents of the revised TMACM (7)

[The contents are followed by the current version.]

(Chapter 7 Quality Control and Quality Assurance)

At the beginning part, the goal of DQO and data completeness will be clearly described..

7.1. Fundamental matters

7.2. Data Quality Objectives (DQOs)
- Definition of detection/reporting limits was described.

7.3. Monitoring site (Site audit)

7.4. Field and laboratory operations

7.5. Data management
- Routine data check, exclusion of outlier data

7.6. Determination of accuracy and detection limit
- Noise level, precision check, parallel monitoring, etc.

The detection limits for daily sampling and weekly sampling are separately described.

7.7. QA/QC implemented by NC

7.8. Training programs

(Chapter 8 Conclusions)
- The content covers how to use this manual, future issues on $PM_{2.5}$ monitoring, and so on.
- How to use and combine the national manuals and EANET manuals was also described.

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Action required

STM22 participants is invited to consider the report on Progress on the Revision of the Technical Manuals for Dry Deposition Flux Estimation and Air Concentration Monitoring and provide comments on the draft of revised Technical Manuals.