Annex IV

NEASPEC as a Bridge between Science and Policy: Transboundary Pollutant Issue in East Asia

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1. Background Overview

In East Asia, several regional research groups have been working collaboratively on managing transboundary air pollutants: LTP (Long-range Transboundary Air Pollutants in Northeast Asia) Project, EANET (the Acid Deposition Monitoring Network in East Asia), MICS-Asia (Model Inter-comparison Study in Asia) and CLRTAP (the Convention on Long-range Transboundary Air Pollution). These groups aim at national studies on environmental impacts of transboundary air pollutions, while striving to establish national policies that seek to improve the environmental health of the larger regional areas affecting neighboring countries. For example, LTP Project was launched by China, Japan, and the Republic of ROK in 1995, and the collaborative research focused on monitoring and modeling transboundary air pollutants. The starting point was the topic of calculating Source-Receptor (S-R) relationships over Northeast Asia using each country's model through the long-term simulations, along with quantification over Northeast Asia during more than decade-long years since 1995.

In 2012, NEASPEC (Northeast Asian Subregional Programme for Environmental Cooperation) member States jointly conducted the "Review of existing and required capacities for addressing adverse environmental impact of transboundary air pollution in North-East Asia." The project also reviewed results from national studies on environmental impacts of air pollution, national policies and the linkages between domestic measures and regional/sub-regional mechanisms. The review showed strong potential for further improvement of national and sub-regional capacity on air pollution issues, and identified existing gaps and possible steps forward. The review recommended the development of a sub-regional framework that promotes a holistic approach covering all components of transboundary air pollutants management, strengthens connections between science and policy, and provides channels for open and effective exchange of knowledge and information on transboundary air pollutants.

As a follow-up to the review, NEASPEC member governments conducted a series of consultations (i.e., SOM-18 in November 2013, and EGM in May 2014) that emphasized technical approaches and activities of the proposed framework and made specific recommendations regarding target pollutants, priorities of the framework, and focus of the current activities. The SOM-19 highlighted the need to focus on modelling work and to seek synergies with existing collaborative group, including the LTP project. Subsequently, the Secretariat held the Consultation Workshop on Modeling of S-R relationship of Transboundary Air Pollution in March 2015 and developed a plan of modeling, including the preparation of an emission data set, the installation and operation of CMAQ (Community Multiscale Air Quality Model) and WRF (Weather Research Forecast Model), and the comparison of modeling results. Many scientific assessment programs, such as modeling works, and monitoring researches should be incorporated for the improvement of transboundary air pollutants, and epistemically linked with national environmental policies.

With this background in mind, the current report suggests NEASPEC operates an epistemic environmental community in Northeast Asia to deal with transboundary air pollution, and also suggests how NEASPEC can effectively establish the scientific research system and its linking to national environmental policies from a protocol point of view. In Northeast Asia, effectively utilizing the existing system of international cooperation (i.e., LTP and EANET) is an effective way to build governance system in East Asia.

In addition, the current report addresses approaches to emission control scenarios from "co-benefit" or "cost-effective" perspectives for the purpose of the cost-effective mitigation, which requires the modeling work frame along with S-R relationship calculation over East Asia. A substantial environmental improvement could be achieved with information on the cost-effective allocation of measures. This improvement will be much more effectively achieved by international cooperation program agreed by multi-countries such as NEASPEC.

2. LTP, EANET and NEASPEC

2.1 Pre-existing Environmental communities: LTP and EANET

As for science-based environmental policy, many scientific assessment programs are needed: modeling, monitoring, and other assessment tools. Modeling works are explained based on emission inventories (what is emitted and how much is emitted), pollution generation mechanism (how different materials that make up air pollutions are generated) and detailed process of movement/processes in the atmosphere. Prior to the application of environmental impact assessment processes, the modeling results are verified by comparing model output against monitored measurement.

Toward this end, multidisciplinary scientific research community is of importance in resolving the issue of transboundary air pollutants, and bridging the gap between relevant multiple national policies. Even if it is possible to infer that transboundary air pollutions are being transported from upstream areas, the scientific assessment research on the quantitative amount of the inflow and its influence on health are still critical. In this sense, we first need to recognize the commonly-shared transboundary issues, establish a science-based community network for dealing with such issues, and then form a policy working-group that strives to bridge the gap between scientific knowledge and research-based-policy. As a first scientific step, the joint scientific research program is a common form, and it can serve as the intellectual basis for the epistemic environmental community, providing collaborative scientific advice for the actual diplomatic activities. This scientific network should be distinguished from the pure science research, which caters to the general academic research and frames national policies.

ROK has been conducting multilateral transboundary air pollution modeling research called LTP, the Northeast Asia Joint Research Project on Transboundary Air Pollutants in Northeast Asia. Through the LTP Project, ROK has been leading the international joint research project on transboundary air pollutants over China, ROK and Japan, and utilizing the emission inventory and computer-based modeling research of air pollutants moving a long distance over Northeast Asia. The LTP project report identified the S-R relationship based on sulfur, nitrogen and particulate matters found over the region and issued the findings that, over Northeast Asia, China is one of the main source regions of transboundary air pollutions toward ROK and Japan. However, LTP data and results are generally considered confidential, and the international scope of this project is not sensitively reflected into national policies. Most of the budget is supported by ROK, which implies that LTP research did not overcome the limitation of connecting scientific research with diplomatic policy in East Asia.

Japan, however, has been strengthening cooperation with China, ROK and several East Asian countries through EANET. In particular, Japan has been monitoring the deposition of acidified substances. EANET seeks to integrate monitoring of acid deposition by detailed observation in order to understand the deposition of acidified substances and concentrations both spatially and temporally. Through EANET program, participating countries are conducting and standardizing monitoring/observational skills. EANET aims to sign up a treaty of transboundary air pollution in the East Asian region through the monitoring of transboundary air pollution, but neighboring countries recognize it as only Japanese program (Atsushi et al., 2016).

In annual LTP meetings, China, ROK and Japan have been taking a passive stance (for example, disclose the research result of LTP), and also the same stance for NEASPEC which has the Secretariat in Incheon. As a result, the environmental cooperation for measuring transboundary air pollutants in Northeast Asia has been suffering a major setback without any diplomatic connection among China, ROK and Japan, despite the ongoing international joint workshops in official capacity. A partial reason for this setback is because of the fact that each of the pre-existing science communities are not recognized as an epistemic community, but considered to be its own program led by one financial-investing country. The concept of epistemic community, based on multilateral relationship, neither led by one country nor restricted to only three countries such as China, Japan, and ROK, has been pursued repeatedly over the last 2~3 years, but the solid result that can be applicable to the current situation of East Asia is still inconspicuous.

2.2 NEASPEC toward a multi-lateral Environmental Community

As a new epistemic scientific research system for transboundary air pollution in East Asia, NEASPEC has the strong potential to serve as an environmental network for diplomacy due to the membership of multiple countries: Russia, Mongolia, Democratic People's Republic of Korea (DPRK), China, Japan, and ROK. NEASPEC is an intergovernmental organization established in 1993 (secretariat is in UNESCAP East and North-East Asia Office in ROK), and, currently Russia, which is the contracting party of CLRTAP in Europe, is making use of the experience to establish a framework for international cooperation on transboundary air pollution in Asia. In May 2014, the NEASPEC expert meeting was held, and the participants agreed on the need to strengthening the cooperative structure of transboundary air pollution based on Russia's proposal. One advantage of NEASPEC is that participant countries are recognizing it as the formal international partnership, including the involvement of DPRK. Consequently, NEASPEC can serve as the driving force for the integration of the existing international cooperation in Northeast Asia. However, to establish a science-based and policy-supported cooperation framework, NEASPEC needs a detailed organization that is responsible for both assessment framework and policy development for mitigation of emissions comprehensively.

The existence of the international cooperation programmes, such as LTP and EANET, is important in fostering intergovernmental cooperation. Moreover, the continuing collaboration of research on S-R relationship in Northeast Asia and the comprehensive air pollution monitoring under EANET established strong credibility as research mechanisms. Therefore, to put these results and system into NEASPEC in a simple way, a close cooperative link between LTP and EANET is necessary to establish and stabilize the governance system (see Figure 1). The following summary may be useful:

- Researcher network: Researchers from the participating nations freely share the results of research for specific tasks: Modeling, monitoring and other assessment research.
- Epistemic community connecting scientific results with policy: Recognition of issues and sharing policy visions based on international joint research, with the goal of addressing tasks directly.
- Effective NEASPEC governance system: Application of new standards through diplomacy aimed at reducing the gap between scientific studies and government policies.

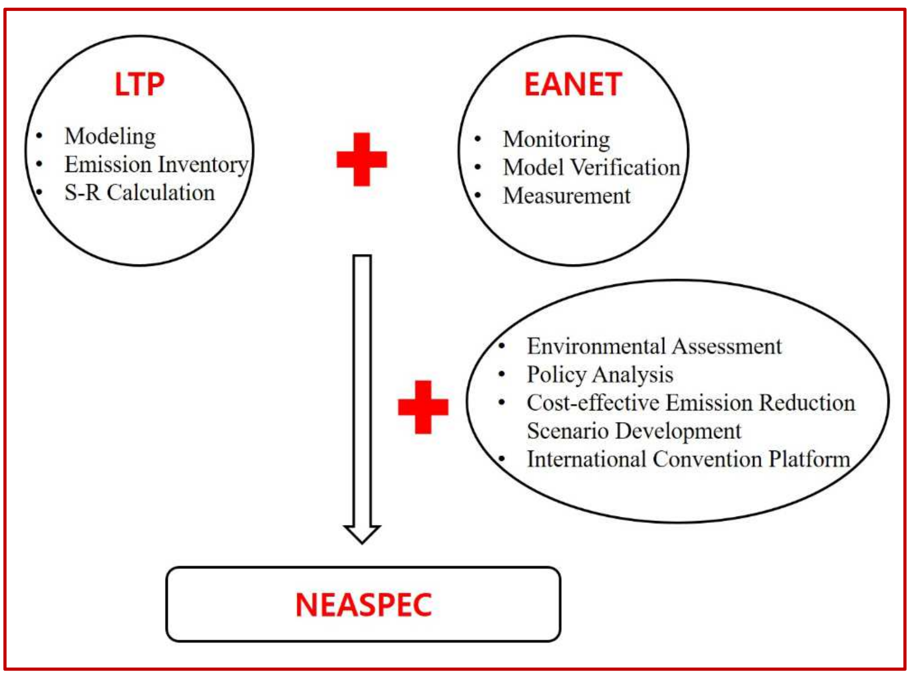


Figure 1: Establishing the epistemic NEASPEC governance system incorporated by Close link of LTP and EANET

3. Modeling Methodology for Cost-Effective Emission Reduction Strategy in East Asia

3.1 Source-Receptor(S-R) estimation methodologies

Estimation of S-R relationship over each of the NEASPEC member countries is a prerequisite for the scientific emission control measures. For S-R calculation, three-dimensional model (i.e., CMAQ: The Community Multi-scale Air Quality) is needed, and many relevant scientific research, such as modeling, monitoring and assessment studies, are all needed. By employing the adequate regional air quality model, various S-R estimation techniques (methods) would be necessary in completing the calculation of S-R relationship in order to assess the source region contributions to the receptor regions. The commonly and widely used three techniques for reliably estimating the S-R relationship over the NEASPEC member countries are explained below: BF (Brute Force) method, HDDM (High-Order Decoupled Direct Method), and the Source Tagging Method.

The BF and HDDM method are called sensitivity methods, which generally measure how pollutants respond to emissions perturbations at source areas. In modeling studies, source contributions are estimated by performing the numerous sensitivity cases minus base case simulation. However, these sensitivity methods will not adequately provide source apportionment if the relationship between model input and output is nonlinear. On the other hand, source tagging method typically tracks target species separately from base model simulations and apportioned fractions of emission sources. This approach of source tagging, however, does not provide sensitivity results by an emission control scenario, because source apportionment seeks to determine the total contribution of each emission source to ambient concentration.

Therefore, the BF method usually calculates the differences between concentrations in simulations with base case and perturbed emission scenarios from each source region or source category, and it provides S-R results except for the case of highly non-linear atmospheric chemistry. In this sense, source apportionment such as BF method is the most suited and convenient way of identifying the sources responsible for conditions present in a model.

To produce data for the calculation of S-R relationship using BF method, source and receptor regions should be identified to derive S-R relationship. When source and receptor regions are determined, then several simulations should be carried out, changing emission rates of target species from a source region. The S-R relationship is calculated using the following equation.

$$R_{i,j} = \frac{H_{i,j}}{\sum_{i=1}^{n} H_{i,j}} \times 100(\%)$$

Where $R_{i,j}$ is the contribution of i-th emission source to j-th receptor, $H_{i,j}$ is the deposition amount over j-th receptor when emission is only from the i-th source.

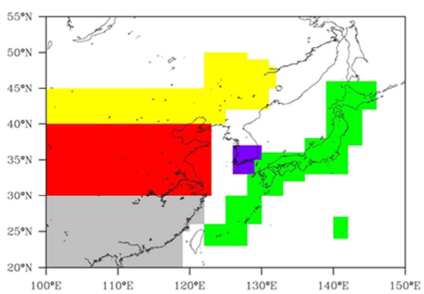
In the LTP project, for the estimation of the S-R relationship, a reverse BF method (a 100% 10 reduction for the selected emissions) was used until 2008 (i.e., the 9th annual report in 2008)

(NIER, 2009), and then a partial emission reduction of BF method (in which emissions from the selected source are reduced by 20% only to consider non-linear effects) with a 20% perturbation on the selected emissions was adopted from the 10th annual report in 2009 (NIER, 2010). In the methods, deposition due to target region emissions from a source region is estimated with the difference between a base model run with all the emissions and a sensitive model run in which the target emissions are excluded or perturbed.

3.2 Emissions and S-R Regions for modeling over NEASPEC member countries

Over the NEASPEC member countries' domain, emission inventories, tentative operation of WRF-CMAQ model has been suggested and some information of modeling techniques has been already shared since 2015 through the joint workshop and other channels between ROK and Russia. Major shared information components are: (1) assessment and technical approaches; (2) modelling of transboundary air pollution in the subregion; (3) formulation of a subregional framework

According to NEASPEC suggestion in 2015, tentative operation of WRF-CMAQ model has been suggested over the extended domain covering NEASPEC countries. The NEASPEC target domain has been discussed and all of preprocesses, such as emission and geographical data, were proposed for modeling within the intended domain. The proposed modeling domain covers almost all of East Asia, with additional 15 Russian Federation regions. The additional 15 Russian Federation regions are (1) Amur oblast, (2) Evreiskaia a.o., (3) Zabaykalye kray, (4) Irkutsk oblast, (5) Kemerovo oblast, (6) Krasnoyarsk kray, (7) Magadan oblast, (8) Primorye kray, (9) Republic Buryat, (10) Republic Sakha, (11) Republic Tuva, (12) Republic Khakass, (13) Sakhalin oblast, (14) Tomsk oblast, and (15) Khabarovsk krays. This domain covers partly Russia with only exception of northwestern parts of Russia, as illustrated in Figure 2.



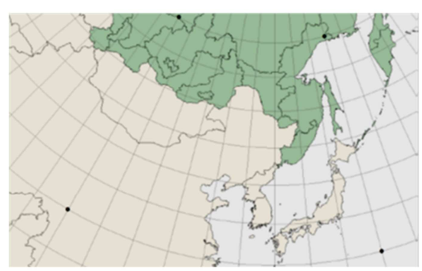


Figure 2: LTP model domain (left) and extended model domain (right) proposed by NEASPEC

Technical assistance for emission inventory has been also discussed for modeling. The emissions for NEASPEC modeling domain range from global/regional scale emission inventories: Global emission inventories such as EDGAR (Emission Database for Global Atmospheric Research), HTAP (Hemispheric Transport of Air Pollution) Emission Inventories, REAS, GAINS, EMEP, UNFCCC, to regional emission inventories: GAINS (Greenhouse Gas-Air Pollution Interactions and

Synergies Asia), MICS-Asia Inventory: MEIC, JEI-DB, CAPSS and REAS, Regional Emission Inventory in Asia (REAS) by Japan, CREATE (Comprehensive Regional Emissions inventory for Atmospheric Transport Experiments) by ROK, and national emission inventories such as MEIC (China Multi-resolution Emission Inventory), JEI-DB (Japan Auto-Oil Program Emission Inventory-Data Base), CAPSS (Clean Air Policy Support System) by ROK. All major inventories and discrepancies between numbers of emissions are reviewed, and EDGAR as the primary source of input data was chosen for modeling over NEASPEC member domain.

3.3 Cost-Effective Emission Reduction Strategy for Multiple pollutants

In general, the S-R analysis with the emission information is a good approach, but it only confirms how much subdivided source regions account for the receptor regions at an aggregate level. There should be integrating requirements into a multiple pollutant control strategy, or a climate friendly air pollution control strategy, which calls for the development of a comprehensive emission control plan, taking into consideration various atmospheric environmental problems, including acid deposition, ozone, fine particles, and greenhouse gases.

In order to generate science-based results for supporting diplomatic dialogue in Northeast Asia, a scientific emission reduction scenario study is required. East Asian countries are suffering from multi-pollutants; primary and secondary pollutants ($PM_{2.5}$, NO_2, and O_3), and other pollutants (CO_2, CH_4 and other greenhouse gases) are relevant to the climate change. Therefore, the most effective and quantitative emission reduction strategies are needed to control multi-air-pollutants in Northeast Asia (Wang and Hao, 2012). Relatedly, the pressing question is that further emission reductions of SO_2, NO_x and particles, as well as reductions of VOCs and possibly CO_2, must occur synchronously in order to address health and environmental impacts of air pollution (Figure 3). Wang and Hao (2012) pointed out the importance of climate friendly air pollution control measures to establish the synchronous control of multi-pollutants, and Akimoto et al. (2015) suggested an effective control strategy, starting with the reduction of SO_2, NO_x, VOC, ammonia (NH_3), and fine particles. However, their co-benefit policy should be undertaken by considering global pollutants such as CO_2. In this sense, focusing more on air pollution mitigation in combination with CO_2 measures seems to be more effective management of policy leading to true “co-benefit,” therefore “cost-effective,” multi-pollutant emission control strategies in Northeast Asia.

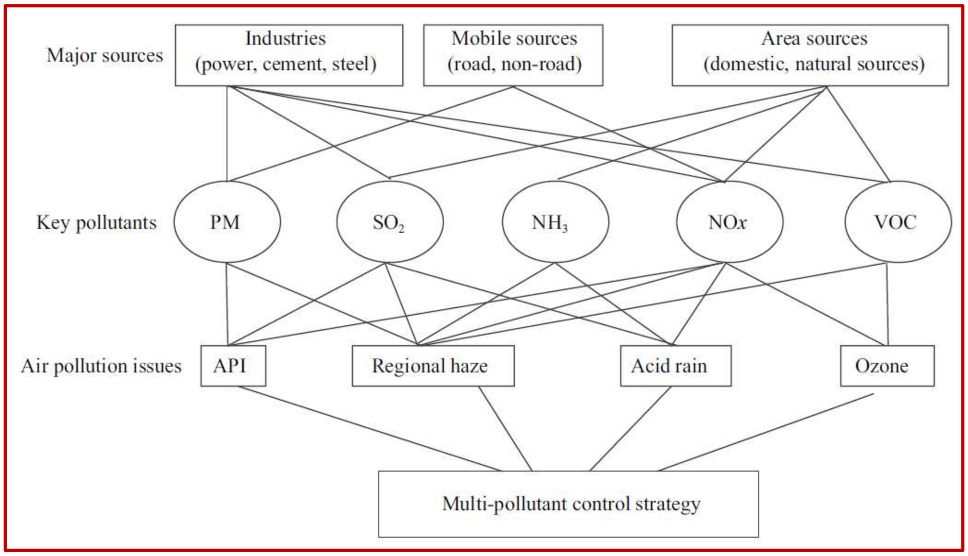


Figure 3: Schematic illustration of the multiple pollutant control strategy (Wang and Hao, 2012)

The scientific research system for studying "Co-benefit" and "Cost-effective" emission reduction strategies is tied to prioritizing pollutant components as emission reduction components. The more detailed studies should be carried out to develop the emission reduction scenarios in Northeast Asia. To foster diplomatic dialogue on transboundary air pollution, we need an organization and research group in which the scientific assessment team is responsible for the co-effective emission reduction strategies by carrying out the relevant research, including monitoring of air pollutants, emission inventory, and development of atmospheric dispersion models and assessment of the harmful effect. Through assessment and verification process, the emission reduction assessment platforms can provide important scientific justifications for establishing priorities of air pollutants for emission reduction.

These approaches have been previously studied. Europe demonstrates an example of an effective methodology for identifying "co-benefit." In Europe, as an S-R calculation model, CIAM (Center for Integrated Assessment Modeling) and IIASA (International Institute for Applied Systems Analysis) employed the GAINS (Greenhouse gas–Air Pollution Interactions and Synergies) model which was developed by IIASA for their own purpose. For each of the 43 countries in Europe, the GAINS model assesses more than 2000 measures to control emissions to the atmospheric pollutants (CIAM and IIASA, 2011).

For this study of co-benefit, the addressed vulnerable areas for assessing the costs were: (1) Human health, (2) Vegetation damage caused by ground level ozone, (3) Acidification of terrestrial and aquatic ecosystems and (4) Soil ecosystem that can be deteriorated by excess of nitrogen deposition, (5) the mitigation of greenhouse gas emissions (Figure 4). As a European example, GAINS describes the interrelations between these multiple effects and the pollutants (SO_2, NO_x, PM, NMVOC, NH_3, CO_2, CH_4, N_2O, F- gases) that contribute to these effects at the European scale (CIAM and IIASA, 2011).

	PM (BC, OC)	SO_2	NO_x	VOC	NH_3	CO	CO_2	CH_4	N_2O	HFCs PFCs SF_6
Health Impacts:										
PM (Loss in life expectancy)	√	√	√	√	√					
O_3 (Premature mortality)			√	√		√		√		
Vegetation damage:										
O_3 (AOT 40/fluxes)			√	√		√		√		
Acidification (Excess of critical loads)		√	√		√					
Eutrophication (Excess of critical loads)			√		√					
Climate Impacts:										
Long-term (GWP 100)							√	√	√	√
Near-term forcing (in Europe and global mean forcing)	√	√	√	√	√	√				
Black carbon deposition (to the artic)	√									

Figure 4: The multi-pollutant and multi-effect approach of the model to find co-benefit solutions to control air pollution and climate impacts (CIAM and IIASA, 2011)

3.4 Decision on target setting for cost-effective emission reductions

While there remains substantial scope for environmental improvement through the technical emission reduction measures, it is clear that such improvements would come at substantial costs. The cost-effectiveness analysis of the model for S-R estimation can identify portfolios of measures that lead to cost-effective environmental improvements. Thereby, such an analysis can highlight those measures that attain a large share of the feasible environmental improvements at a fraction of the overall costs.

For this purpose the optimization feature of S-R estimation model, Europe employed GAINS model to estimate the least-cost portfolio of emission reductions. GAINS computes the atmospheric dispersion of pollutants and analyzes the costs and environmental impacts of pollution control strategies. In its optimization mode, the least-cost balances of emission control measures across pollutants, economic sectors and countries that meet user-specified air quality were suggested by GAINS model.[1]

Ultimately, the choice of a set of environmental targets that could serve as a useful starting point for negotiations will require value judgment, and will therefore always remain a political task for negotiators. According to the report of CIAM and IIASA (2011), the maximum technically

[1] A full documentation of the detailed methodologies is available at http://gains.iiasa.ac.at/index.php/documentation-of-model-methodology/supporting-documentation-europe

feasible reductions emission control costs estimated by GAINS model would increase by 70% compared to the baseline case, i.e., by about 65 billion Euro/yr over the European domain. These costs would represent in the EU-27 about 0.3% of GDP, and 1.1% in the non-EU countries (CIAM and IIASA, 2011). Accepting these choices on impact indicators and target setting options, appropriate ambition levels for the individual effects and their combination into a manageable set of meaningful policy scenarios remain to be decided.

In a similar way, and the key issues can be attainable for the issue pertaining to the emission reduction priority, together with cost-effectiveness for the target pollutants in Northeast Asia. During the SOM-18 (in November 2013) and EGM (in May 2014), similar but basic framework has been recommended by NEASPEC member governments, as set below.

- Target pollutants: $PM_{2.5}$, PM_{10} and Ozone and their linkages with other pollutants including SO_x, NO_x, Black Carbon, NH_3 and VOCs.
- Priorities of the framework: (a) health impact of air pollution, (b) policy scenarios, (c) emission inventory, (d) abatement technology assessment, (e) modeling of source-receptor relationship of transboundary air pollution, policy scenarios, impact assessment, etc.
- Focuses of the activities under the current project: modeling of source-receptor relationship of transboundary air pollution in collaboration with the planned modeling work of LTP and its relevant researches, and by utilizing national emission.

Following the modeling and monitoring study, the next step is to justify priorities in emission reduction in both co-benefit and cost-effective way. Preliminary study showed that among BC and O_3, reduction of BC emission is effective mitigation since it results in reduction of PM_{10} or $PM_{2.5}$. As for ozone, although CH_4 reduction is effective for global warming mitigation since it reduces O_3 in the free troposphere and the southern hemisphere, NO_x/VOC reduction is necessary for the reduction of boundary layer O_3 pollution in Northeast Asia.

However, taking into account the direct and indirect effect of the change of aerosol, overall climate effect is uncertain, and more detailed scientific researcher are required for solid emission reduction plan by narrowing down the uncertainty of scientific understanding in East Asia.

4. NEASPEC as an Epistemic Community in East Asia: Bridge between Science and Policy

In considering the degree of priority of diplomatic styles and environmental policies for each country, the approach from each country would be highly divergent from country to country. Thus, the strategy on how to develop scientific research group and then incorporate the new mitigation policy for the problem of transboundary air pollution is specific challenges in Northeast Asia. The need for the organization which is responsible for the scientific assessment and corresponding policies, and above all, bridging the gap between these results and decision-making process is undoubtedly an important point in many respects.

So far, LTP and EANET hardly persuaded the partner country with the scientific knowledge and formed the common awareness based on scientific knowledge, and hardly developed the diplomacy of realizing the common interest based on that. In this report, as more effective "Epistemic Community", NEASPEC would be one of the candidates as a Northeast Asian version, which could build logics based on the systematic scientific result into 'intellectual foundation', and sharing the epistemic community by bridging the gap between multiple policy visions. It would be contributing to dealing with specific diplomatic tasks relevant to the emission reduction policies over Northeast Asia (Figure 5). It would be also recommendable under the situation that pre-existing international cooperation mechanisms (i.e., LTP and EANET) would be utilized to build governance system, and NEASPEC can take on the complementary role.

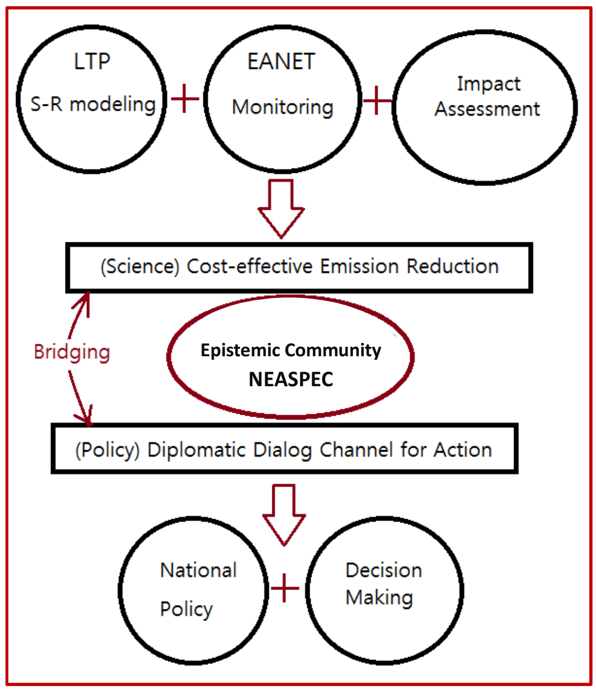


Figure 5: Establishing the NEASPEC epistemic community by close cooperative bridge between scientific researches such as LTP or EANET, and diplomatic dialog

Under the system above, it may be necessary to initiate a Scientific Committee in NEASPEC as the parent body of an epistemic community, and as for members of the Scientific Committee, it may be appropriate to recruit current members of the expert group as its candidates. And it is realistic to decide internal requirements of international joint research in the scientific committee and finally consult for the policy plan in the form of policy scenarios. It is desirable to promote the close link with LTP and EANET for Scientific Committee and take charge of the overall coordination of the international joint researches.

However, NEASPEC also has a weak point. The fact that scientific experiences and knowledge for transboundary air pollution cannot be secured to be integrated functionally. Insufficient budget would be also another weak point to build up the effective multilateral environmental community in Northeast Asia. Therefore, in order to build the intellectual base that provides cost-effective policies, primarily network of researchers should freely discuss the specific environmental issues and share the result. Providing the fund for this international research activity will contribute to both science and policies, and it should considered as something that is connected to secure the bridging the gap between transboundary science and its environmental policies in the broad sense in Northeast Asia.

5. Summary

Effective decision-making support in regional air quality management is urgently needed in Northeast Asia, but all of these relevant programs should be processed based on reliable science. However, at this point, Northeast Asia needs an epistemic organization which is responsible both to the scientific assessment group and for providing the corresponding policies and measures. In the current report, pre-existing environmental research community such as LTP and EANET have been reviewed as a potential for epistemic organization, which showed limitations despite the long history and experiences.

However, it is likely that NEASPEC, as an intergovernmental mechanism established in 1993, is one of the alternatives that have the potential for taking the lead in measuring transboundary air pollution. NEASPEC, as a potential epistemic community, should assume the roles of providing scientific advice and doing international decision-making, while engaging in multilateral diplomatic dialogue by providing channels for effective exchange of knowledge and information.

As a governance system of NEASPEC, there are integrating requirements into a multi-air-pollutant control strategy, which calls for the development of co-benefit and cost-effective strategies between NEASPEC members. Additional studies on assessing the various options for establishing a science-based and policy-supported cooperation framework should be done. It is also recommended because the existing system of LTP and EANET in Northeast Asia can be incorporated by providing the credibility and experiences for a new research organization. In line with this situation, the Russian government, one of the NEASPEC member governments, proposed the scope and approach of the project for carrying out S-R modeling of transboundary air pollution. Through this process, the ongoing work in Northeast Asia, (i.e. LTP Project and EANET), coupled with the work of NEASPEC, can be expected to carry out the role of epistemic community, since countries recognized NEASPEC as a formal international partnership. Considering the above-mentioned issues, NEASPEC can serve as a driving force that seeks to bridge the gap between science and policy regarding transboundary pollutant issues in Northeast Asia.

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