



**Governing Council
of the United Nations
Environment Programme**

Distr.: General
13 February 2004

English only



**Eighth special session of the Governing Council/
Global Ministerial Environment Forum**
Jeju, Republic of Korea, 29–31 March 2004
Item 4 of the provisional agenda*

**Assessment, monitoring and early warning:
State of the environment**

Prevention and control of dust and sandstorms in north-east Asia

Note by the Executive Director

The annex to the present note contains a summary of the progress, as of February 2004, in the implementation of a joint project among the Governments of China, Japan, Mongolia and the Republic of Korea, as well as the Asian Development Bank, the United Nations Economic and Social Commission for Asia and the Pacific, the secretariat of the United Nations Convention to Combat Desertification, and the United Nations Environment Programme, to tackle the problem of dust and sandstorms in north-east Asia. The document is reproduced as submitted to the secretariat and has not been formally edited.

* UNEP/GCSS.VIII/1.

Annex

Prevention and Control of Dust and Sandstorms (DSS) in Northeast Asia

Summary

Dust and Sandstorms (DSS) are considered to be one of the most serious environmental problems in Northeast Asia. DSS cause considerable hardship, loss of income, disrupts communications, affects people's health and, in extreme cases, leads to death of people and their livestock and crops over large areas in the affected countries.

In March 2003, Asian Development Bank (ADB), UN Economic and Social Commission for Asia and the Pacific (ESCAP), UN Convention to Combat Desertification (UNCCD) and UN Environment Programme (UNEP) together with the Governments of People's Republic of China, Japan, Republic of Korea, and Mongolia initiated a joint project with the overall context of promoting sustainable development in Northeast Asia by addressing the issue of DSS.

The objective of the collaborative project is to promote establishment of a regional cooperation mechanism for prevention and control of DSS in Northeast Asia. The main outputs expected are (1) an initial institutional framework for regional cooperation on DSS and (2) a regional master plan to guide regional cooperation to alleviate DSS in Northeast Asia. The regional master plan has two major components: (a) a phased programme to establish a regional monitoring and early warning network for DSS in Northeast Asia and (b) an investment strategy to strengthen mitigation measures to address root cause of DSS in source area. This report summarises the progress in achieving the project objectives as of February 2004.

Prevention and Control of Dust and Sandstorms (DSS) in Northeast Asia

List of Acronyms

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
AVHRR	Advanced Very High Resolution Radiometer
Asia-RCU	Asia-Regional Co-ordination Units
CAA	Civil Aviation Authority
CAS	Chinese Academy of Sciences
CMA	China Meteorological Administration
CMA	Central Meteorological Agency
DSS	Dust and Sandstorms
EANET	East Asia Network on Acid Deposition
ESCAP	Economic and Social Commission for Asia and the Pacific
GEF	Global Environment Facility
GMT	Greenwich Mean Time
GCM	Global Climate Model
GS	Ground Surface
ICC	Information and Computer Center
KMA	Korean Meteorological Administration
LD	Light Detection
MRI	Meteorological Research Institute
MP	Meteorological parameters
NIES	National Institute for Environmental Studies
NAMHEM	National Agency for Meteorology, Hydrology and Environment Monitoring
NOAA	National Oceanic and Atmospheric Administration
PRC	People's Republic of China
PM ₁₀	Particulates with diameter smaller than 10 um
SEPA	State Environment Protection Agency
SFA	State Forestry Agency
SP	Suspended particulate
TSP	Total Suspended Particulate
UNEP/RRC.AP	United Nations Environment Programme / Regional Resource Center for Asia and the Pacific
UNEP	United Nations Environment Programme
UNCCD	UN Convention to Combat Desertification
WMO	World Meteorological Organization

1. Background

Dust and sandstorms (DSS) are natural phenomenon that have occurred for thousands years in the Northeast Asian Region. During the past 50 years, however, the frequency has increased, geographic coverage has expanded, and damage intensity has accelerated. Now, DSS are considered to be among the most serious environmental problems in the region as a man-made disaster. It causes considerable hardship, loss of income, disrupts communications, affects people's health and, in extreme cases, leads to death of people and their livestock and crops over large areas in the affected countries.

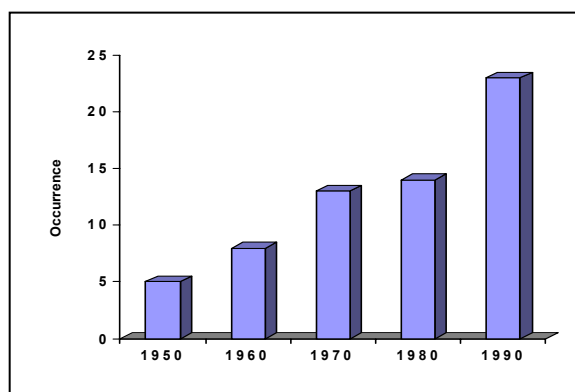


Figure 1. Frequency of Dust and sandstorms in People's Republic of China

United Nations Environment Programme (UNEP) received several requests from governments in the region for assistance to look into the issue of DSS. Asian Development Bank (ADB), UN Economic and Social Commission for Asia and the Pacific (ESCAP), UN Convention to Combat Desertification (UNCCD) and UNEP initiated separate project proposals. Many discussions between the agencies have taken place and a partnership has been established between the agencies to respond positively to the requests from the governments. ADB leads the effort for coordination between the agencies.

2. Outline of the DSS Project

Global Environment Facility (GEF) approved a medium-sized project equivalent of \$500,000 in November 2002 to implement the DSS project. ADB approved a regional technical assistance project equivalent of \$500,000 on "Prevention and Control of Dust and Sandstorms in Northeast Asia" in December 2002. UNEP is the GEF implementing agency for the GEF co-financing resources. ADB is administering the financial resources.

The objective of the collaborative project is to promote establishment of a regional cooperation mechanism for prevention and control of DSS in Northeast Asia. The main outputs expected are (1) an initial institutional framework for regional cooperation on DSS and (2) a regional master plan to guide regional cooperation to alleviate DSS in Northeast Asia. The regional master plan has two major components: (a) a phased programme to establish a regional monitoring and early warning network for DSS in Northeast Asia and (b) an investment strategy to strengthen mitigation measures to address root course of DSS in source area.

UNEP leads the preparation of the phased programme to establish a regional monitoring and early warning network. ESCAP leads the development of an investment strategy to strengthen mitigation measures to address root course of DSS in source area. Overall management of the project is being done by ADB while day-to-day management including public relation activities such as newsletter, poster, web-site, etc. is being done by the project secretariat established at UNCCD/Asia-RCU.

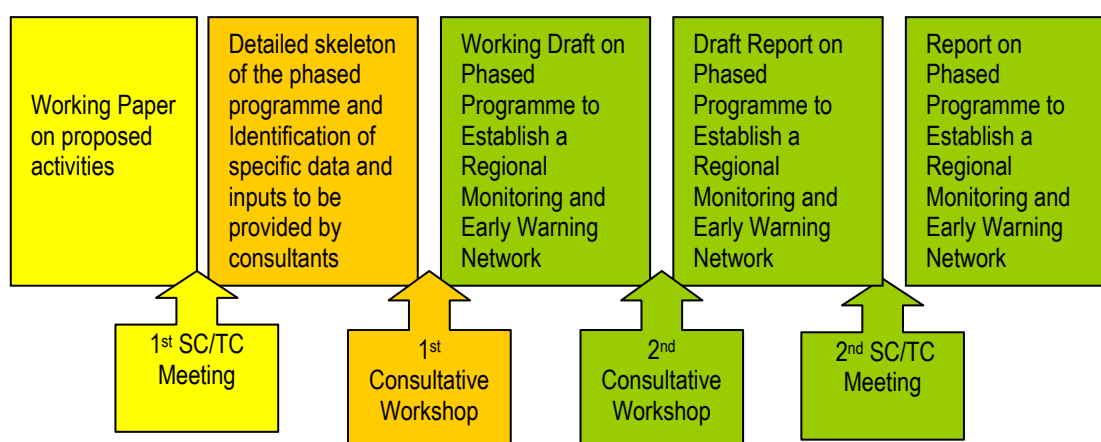
3. Regional Monitoring and Early Warning Network (UNEP Component)

3.1 Objective

The specific objective of the component on “regional monitoring and early warning network” is to formulate a phased programme to establish a monitoring and early warning network for DSS in the Northeast Asian region. The phased programme will consist of structure of the network, monitoring parameters and methodologies, ground monitoring network, laser radar monitoring-dust instrument (Lidar) monitoring network, remote sensing system, framework for simulation and forecasting, data sharing and coordination mechanism, reporting mechanism, early warning mechanism, institutional restructuring required, estimation of hardware and software requirements, cost estimates, and a phased implementation plan.

3.2 Proposed Activities

The implementation is being carried out in 3-phased activities as described in the following diagram:



3.3 Key issues

The perception, definition, monitoring method, current capacity, needs and expectation, etc. are all different from country to country, even from agency to agency within a country. For example, DSS is called “Asian dust” in Republic of Korea and “Yellow sand” or “Kosa” in Japan. Even the definition of DSS is differing from country to country depending not only on monitoring method but also threshold value.

Insufficient coverage of the current monitoring network needs to be addressed. For example, the highest proportion of DSS sources are located in Mongolia, there are no special monitoring sites for DSS and most meteorological stations in Mongolia do not have any direct relation to DSS. Lack of capacities in terms of equipments and skilled manpower to monitor and forecast DSS events in a timely manner is another issue that needs to be addressed.

To further improve regional cooperation in prevention and control of DSS there is a clear need to improve cooperation and data sharing. Recognition of this has led to the development of phased programme of measures that involve actions by all four partner-countries over the next 20 years (and beyond). Upgrading of monitoring sites, the strengthening of bilateral links for data sharing, exchange of scientific knowledge and building on human resources and institutional capacity will be a high priority.

3.4 Progress

A Steering Committee has been set up to provide the overall guidance. Members include: 4 agencies (UNEP, UNCCD, ESCAP and ADB) and 4 governments (People’s Republic of China, Japan, Republic of Korea and Mongolia). A Technical Committee chaired by UNEP has also been set up for the monitoring and early warning component. Experts from 4 agencies and 4 governments are the members

of the Technical Committee. Composition of the expert team is outlined in the Annex 2. The first Steering and Technical Committee meeting was held during 31 March - 1 April 2003. The meeting reviewed and adopted the working paper prepared by UNEP for the implementation of monitoring and early warning component.

‘The First Consultative Workshop on Monitoring and Early Warning’ component held in Beijing, People’s Republic of China on 21-22 August 2003. UNEP chaired the workshop. The workshop reviewed the outline of a regional programme for establishing monitoring and early warning system for DSS in the Northeast Asian region. There was a general agreement on the proposed outline of the network design. ‘The Second Consultative Workshop’ was held in November 2003 in Seoul. The working draft for the phased programme was prepared through these two workshops. A summary of findings and outline of the proposed phased programme for monitoring and early warning is in the Appendix 1.

Parallel to the workshops, fact-finding missions to four participating countries have been conducted. The inception mission to People’s Republic of China took place before the First Workshop with the purpose to meet domestic consultants and concerned government officials and to have an initial discussion on how to implement the UNEP component activities. Other missions to Mongolia, Republic of Korea and Japan were made after the First Workshop to discuss in-depth the preparation of a working draft for the UNEP component.

A phased programme to establish a regional monitoring and early warning network for DSS in Northeast Asia is expected to be finalised and adopted at the Second Joint Steering/Technical Committee Meeting.

3.5 Partnership

A network of experts and policy makers has already been established on DSS in Northeast Asia. Successful implementation of the activities so far shows a stronger partnership between four international agencies (ADB, UNEP, ESCAP and UNCCD) and four governments (recipient countries: People’s Republic of China and Mongolia plus affected countries: Republic of Korea and Japan).

Appendix I

Summary of the findings and outline of the proposed phased programme for monitoring and early warning

I. Current situation

1. Monitoring and forecasting/early warning

People's Republic of China (PRC):

The situation in PRC is complicated as many different agencies and institutions maintain monitoring networks within the nation. Most of them were not specifically set up to monitor DSS but many stations collect data that is relevant to forecasting and early warning. Access to the data within the time frame required by modellers and forecasters is not always possible.

In PRC there are at least four institutions at the central governmental or institutional level directly responsible for the prevention and control of DSS, especially for the monitoring, forecasting and early warning. These are the State Environment Protection Agency (SEPA), The Central Meteorological Agency (CMA), The State Forestry Agency (SFA) and The Chinese Academy of Sciences (CAS), each having its own network.

CMA has since 1st March 2001 decided to input the results on forecasting (for the normal sandstorms) and early warning (for the stronger sandstorms) into the regular meteorological forecasting-system. The first early warning for the stronger dust and sandstorms was issued on 18th March 2001 in the parts of Gansu province and Inner Mongolia and Ningxia Autonomous Areas with some indicators about stronger-wind and lower-temperature. They are now developing the so-called "the state services system for monitoring and early warning sandstorms in the first-stage" which involves a lot of data concerning the formation (outbreak), movement and distribution of dust and sandstorms. CMA issues the forecast of DSS events after analysing the main meteorological indicators such as wind, visibility and radiation collected from about 60 meteorological observation-sites in north and northwest PRC.

SEPA launched a research-programme on dust and sandstorms in August 2000 and set up the first ground-network for monitoring dust and sandstorms covering Inner Mongolia, Hebei, Shanxi, Xinjiang, and Gansu. SEPA had about 40 observation-sites in PRC at the beginning of 2001. The chief tasks for these observation-sites are collecting samples of sands and dust to help identify source areas and reporting meteorological change that is conducive to DSS. SEPA also collects relevant basic data such as the sand-dust's size, mineral composition and chemical composition of sand dust, storm duration and intensity and the path for long-range transport of dust.

SFA is the institution whose mandate is to prevent and control desertification in PRC. It maintains a National Desertification Monitoring facility. It has a network of over 40 monitoring stations in northern and western PRC. In addition, it has a special responsibility to mitigate the impact of DSS in the major east coast cities of PRC.

SFA launched a project on monitoring wind-sand resource in Beijing and Tianjing municipality on 11th April 2002. The monitoring system is different from other systems and consists of ground surface monitoring (soil, vegetation, land use change), onset and spread of desertification, the supervision and evaluation of sand control projects. Recently, SFA has been constructing a new system with the goal of short-term forecasting of DSS events, based on the monitoring the duration, severity and processes of DSS. Disaster-assessment for DSS is also included in SFA's programme. Remote sensing technology and ground monitoring technology are combined.

CAS began in 2002 to establish a monitoring-network on dust and sandstorms in 7 provinces of northern PRC with 12 observation-sites developed since 2002. CAS now plays an important nationwide role in the theoretical field of prevention and control of dust and sandstorms. These observation-sites collect relevant information about DSS and record meteorological change day by day by means of using

some modern equipment e.g. laser radar monitoring-dust instrument (Lidar). CAS scientists now play an important role in understanding the principles required to prevent and control DSS.

In summary, all the institutions mentioned above have their own individual network and whilst they are achieving positive outcomes this approach to a national and regional problem is not so efficient or cost-effective.

Mongolia:

The situation in Mongolia is less complicated because the monitoring stations are maintained by the Ministry of Nature and Environment and data sharing is easier to arrange. Currently, in Mongolia there are 117 weather stations, 219 meteorological posts, 7 upper air sounding stations, 22 air pollution controlling stations, 8 environmental monitoring stations, 1 satellite receiving station and 1 weather radar observation station. All the observation data from these stations is collected in Information Centre (ICC), Ministry of Nature and Environment. After checking, sorting and primary processing the data is transmitted to Institute of Hydrometeorology, provincial meteorological centres and WMO regional centres (through Beijing and Novosibirsk).

The National Agency for Meteorology, Hydrology and Environmental Monitoring (NAMHEM) operates a network for meteorological survey that consists of 117 meteorological stations and 185 meteorological observation posts. Of these, 40 stations report their data to the WMO. The meteorological sites in Mongolia measure the DSS related parameters. However, only 15 stations have wind measurement instrument named "M-63", in other stations wind observation is visual. Visibility is defined by observer's sight. Upper air stations measure wind speed and direction at levels up to 13 km, sounding twice per day at 00 and 24 hrs (GMT).

Although there are 22 air quality-monitoring stations in the country, the measurement of TSP is carried out only at one station in Ulaanbaatar, due to financial constraints. There are no stations for dust monitoring along the path taken by DSS events.

The Civil Aviation Authority (CAA) has its own Airport Surface Meteorological Observation and Data Acquisition System that consists of meteorological data collectors for its airdrome needs in the 18 airports that are located in aimag (province) centres. Seven airdromes at the aimag centres are adjoined to the meteorological observation fields of NAMHEM, therefore the real-time monitoring data of these automatic stations can be used also for weather stations if the communication problem is solved.

The main problem in Mongolia is lack of a good database. Since 1936 the meteorological observation system has been developed and expanded. At present, the existing ground meteorological monitoring network in Mongolia is virtually unavailable to meet the DSS monitoring needs.

Mongolia has only one satellite receiving station that receives SeaWiFs and AVHRR data from SeaDas and NOAA satellites. Methodology of using NOAA data for DSS monitoring is in the developing stage. But they output some information on DSS indicators (desertification and drought, snow cover, land surface temperature).

2. Bilateral Cooperation

WMO worldwide network:

All of the partner countries in the Project are in the World Meteorological Organization's (WMO) worldwide network. Selected monitoring stations in each country supply data at frequent intervals to the WMO centres. Data on visibility, wind direction and strength and other parameters of relevance to DSS are collected routinely as part of the WMO requirement using similar standards and indicators. This is an example of an "official" (government to government) data exchange mechanism. Other mechanisms exist but they have a research focus, rather than having a key role in any network that provides an operational basis for forecasting or early warning.

Japan-China cooperation:

The Meteorological Research Institute (MRI) of Japan has carried out the Japan-China cooperative project ADEC in conjunction with Institutes of the Chinese Academy of Sciences. DSS

monitoring stations have been set up in the DSS source areas in western China and along the transport route of the dust aerosols on their way to Japan. The fully instrumented monitoring site in the Taklamakan desert in Xinjiang provides data on the DSS outbreak and entrainment in eastward air flows. Transport and deposition are also analysed. Numerical experiments using the Global Climate (dust forecast) Model (GCM) have also been carried out to assess the impact of dust aerosols on global climate.

The Sino-Japan Friendship Environmental Protection Centre and National Institute for Environmental Studies (NIES) of the Ministry of Environment of Japan have undertaken joint research on DSS. The principal focus was on DSS transport and the environmental effect of DSS aerosols originating in northern China. A DSS monitoring network was established in NE China and Japan in February 2001. Six stations were established along a transect from Beijing to Erenhot - the source area. Sites were at Beijing, Zhangjiakou, Zhangbei, Huade, Sonid Youqi, and Erenhot over a distance of more than 1000 km. In addition to the sites in PRC three sites were monitored in Japan.

Korea-China cooperation:

The Korea-China Environmental Science and Technology Exchange Centre was established in 1999 in the National Institute of Environmental Research (Seoul). The principal function is to facilitate exchange of environmental information (and personnel) and the promotion of joint research. The Korean Meteorological Administration (KMA) is cooperating with the China Meteorological Administration (CMA) on Asian Dust forecasting. Five DSS monitoring stations will be set up (3 in eastern PRC and 2 in the Asian Dust path). These stations will be operated during the DSS season from February to May with sharing of information and exchange of experts.

II. Proposed phased programme

1. Major Findings

The perception, definition, monitoring method, current capacity, needs and expectation, etc. are all different from country to country. For example, DSS is called "Asian dust" in Republic of Korea and "Yellow sand" or "Kosa" in Japan. The definition of DSS is also different from country to country depending not only on monitoring method but also threshold value. Therefore, harmonisation or standardisation of definitions, classification and monitoring methods is essential for regional cooperation on monitoring and early warning. In addition, needs and expectations are also different from country to country, even from agency to agency within a country. Accordingly, optimisation and step-by-step approach is needed in formulating a programme.

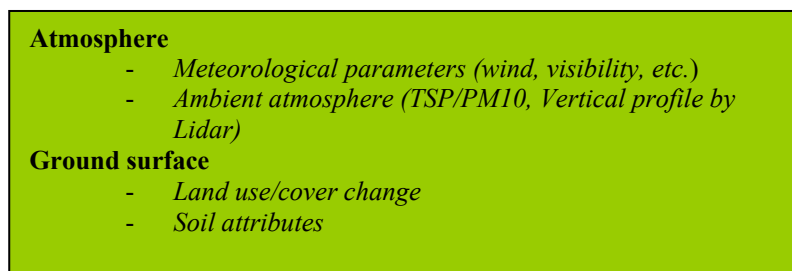
As shown in the above, a few bilateral cooperation projects are being undertaken. However, these cooperation projects are limited to some specific field and national boundary areas. There is a strong need for multi-lateral cooperation mechanism at the regional scale.

Although Mongolia contributes over 30% of the DSS events, there are no special monitoring sites for DSS and most meteorological stations in Mongolia do not have any direct relation to DSS. In this regard, from a regional perspective, helping Mongolia develop its national capacity is one of key points in terms of obtaining data in the source areas.

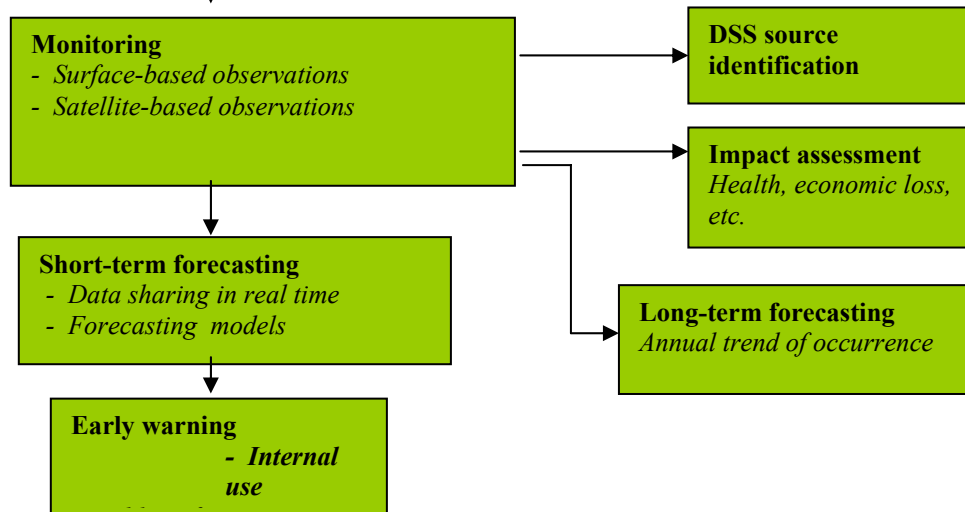
2. Basic Framework

The following figure shows the relationships between indicators, monitoring, forecasting and early warning. In order to establish a regional monitoring network, common indicators for monitoring should be identified. Monitoring is generally conducted for various purposes. One of the purposes of monitoring is for early warning. Early warning based on monitoring data, is usually issued through short-term forecasting of transportation of DSS. Atmospheric monitoring data is more important for short-term forecasting while ground surface monitoring data is essential for long-term forecasting.

Indicators



Monitoring



3. Proposed Network Monitoring Stations

The objective of network monitoring is to have a hierarchy of monitoring stations in a chain from the source areas in Mongolia and northern People’s Republic of China through to Republic of Korea and Japan for effective early warning. Ideally, it should be possible for downstream modellers to provide the outputs of the “rolling” forecasts to those upstream monitoring stations who supply the real time data that forms the basis of prediction. This would be mutually advantageous because the validation of the model will be greatly enhanced if there is progressive feedback as the DSS event unfolds.

Two proposals for network monitoring are being studied. The first one is gradual upgrade of network monitoring stations starting from simple visibility monitoring. This idea relies to large extent on upgrading of existing meteorological stations and existing transmission channels of meteorological data in real time. Under this idea, the hierarchy of network monitoring stations is proposed as follows:

- Level 1 stations: Visibility (instrumented)
- Level 2 stations: Visibility (instrumented) + TSP/PM10
- Level 3 stations: Visibility (instrumented) + TSP/PM10 + Lidar

The second one comes from the criticism that meteorological monitoring including visibility can neither detect nor predict the outbreak of the DSS events with a desired degree of accuracy. Therefore, the principal focus for data sharing in real time is on air quality data such as those obtained by PM10 and Lidar measurements. In this proposal, network monitoring stations are classified into four categories as follows:

- Stations at source areas: Meteorological parameters + Ground surface monitoring
- Key stations: Lidar + TSP/PM10 + Meteorological parameters
- General stations: TSP/PM10 + Meteorological parameters
- Supporting stations: Meteorological parameters

The proposals will be reviewed and further discussed at the 2nd Steering Committee /Technical Committee Meeting in Bangkok.

Note: Explanation of terminology:**Meteorological parameters and Visibility:**

Meteorological parameters include temperature, atmospheric pressure, wind speed and direction, (horizontal) visibility, etc. Visibility has particular importance among them in relation to DSS, however, all the existing visibility data come from naked-eye observation.

TSP (Total Suspended Particle):

TSP is a proxy indicator for DSS because TSP is not pure dust aerosol, including other non-dust aerosol. TSP data cannot be obtained in real time.

PM10 (Particulates with diameter smaller than 10um):

PM10 indicator is less effective than TSP not only because other non-dust aerosol is included but also because lots of DSS with diameter larger than 10um are excluded. But, PM10 data can be obtained in real time (every hour), which means a merit over TSP for early warning.

Lidar (Light Detection and Ranging):

Lidar is a kind of radar using light instead of radio waves. It transmits pulsed laser light to the atmosphere and collects the light reflected from the atmospheric molecules, clouds and aerosols with the help of a receiving microscope. This method can tell dust from aerosol and give an estimation of visibility.

Ground surface monitoring:

Monitoring of land use/cover change and soil attributes such as soil moisture. Ground surface monitoring is more important at source areas for long-term (seasonal) forecasting but cannot be monitored in real time.

4. Proposed Phases

Phase-1 (Short-term): Data sharing with the existing monitoring capacity

In this phase, the network monitoring stations is identified (25 in People's Republic of China and 6 in Mongolia, plus designated stations in Republic of Korea and Japan) and arrangements will be finalised to allow data sharing in real time. A decentralised network is preferred with data sharing for the purpose of short-term forecasting. Priority is given to gathering PM10 data and instrumented visibility reading.

Phase-2 (Medium-term): Strengthening of monitoring capacity

This involves expansion of the number of network monitoring stations, especially in Mongolia and upgrading of the equipment at selected network monitoring stations. The principal focus will be on adding PM₁₀/TSP at many stations and Lidar measurements at a few stations in People's Republic of China and Mongolia.

Phase-3 (Long-term): Strengthening of forecasting and early warning capacity

This phase will focus on improvement in forecasting methods (including software development, training and capacity building) to provide both short-term (early warning) and long-term (seasonal) predictions. Long-term forecasting will depend heavily on data derived from ground surface monitoring and on verification of prediction model output.

5. The Way Forward

a. Implementation of the Regional *Monitoring and Early Warning Network* component of the DSS Prevention and Control Programme in the Northeast Asia

The output of this project component is a phased programme to establish a regional monitoring and early warning network for DSS. How the phased programme should be implemented will be the next important subject and the following key issues should be considered:

- Data sharing mechanism for short-term forecasting in Phase 1
- Donors identification for upgrading the equipment in Phase 2
- Capacity building for improvement in forecasting methods in Phase 3

b. Institutional integration for transboundary air pollution issues

Transboundary air pollution is an issue Asia: acid deposition in East Asia, the atmospheric brown cloud (ABC) in South Asia, haze pollution in Southeast Asia and dust and sandstorm (DSS) in Northeast Asia. Although these four issues are different in geographic coverage, framework of cooperation, funding, etc., they all are atmospheric phenomena closely related to meteorological factors, which means there are common areas such as monitoring and modelling. In order to facilitate such collaboration among them, the possibility of treating them together, at institutional level, should be explored in the future. The secretariat of the Acid Deposition Monitoring Network in East Asia (EANET) is already established at UNEP/RRC.AP. The ASEAN Agreement on Transboundary Haze Pollution (signed by ten ASEAN member countries in June 2002) entered in force November 2003.

Appendix II

Composition of Expert Team for the preparation of phased programme on regional monitoring and early warning network

Chair: UNEP

Team leader:

- International Consultant

Team members:

- Domestic Consultants from People's Republic of China (6 specialists): *Policy and Strategic Planning Specialist, Ground Monitoring Specialist, Remote Sensing Specialist, System Development Specialist, Financial Analyst, and Early Warning and Forecasting Specialist*
 - Domestic Consultants from Mongolia (4 specialists): *Ground Monitoring Specialist, Remote Sensing Specialist, System Development Specialist, and Financial Analyst*
 - National experts from Republic of Korea (3 experts)
 - National experts from Japan (3 experts)
-