Asian Dust Early Warning System in Korea

Youngsin Chun
Outline

1. Current status of “Hwangsangsa”
2. Monitoring network
3. Early Warning system in KMA

Operation & Research
1-1 Historical record of dustfall in Korea

dustfall

雨

土
"Heavy dustfall" in Seoul (2002 spring)

Visibility 6.7 km

Visibility 1.2 km

PM10
µg / m³

7~9 April

Graph showing PM10 levels from 7/13 to 9/13 with various markers and lines representing different data sets.
1. Advisory

An advisory is issued when the hourly average dust (PM10) concentration is expected to exceed 400 μg/m³ for over two hours.

- Outdoor activities for the elderly, the young, and those with respiratory diseases are prohibited.
- Kindergarten and elementary school students should stay at home and are advised against doing outdoor activities.
- Strenuous outdoor activities are prohibited.

2. Warning

A warning is issued when the hourly average dust (PM10) concentration is expected to exceed 800 μg/m³ for over two hours.

- The elderly, the young, and those with respiratory diseases are prohibited from going outside.
- Kindergarten and elementary school students are advised against doing outdoor activities, and classes should be dismissed.
- Outdoor activities are prohibited.
- Outdoor sports events should be rescheduled.
2-1 KMA Monitoring Sites
2-2 Aerosol Particle Sizer Network

- Physical properties of aerosol
- 0.25 - 32 µm, 31 channels
- PM10, PM2.5, PM1.0
2-3 Optical Observation

- Detect Asian Dust in the higher altitude
- If Aerosol Optical Thickness $> 0.5$, and Angstrom Component $< 0.5$ then Asian Dust

**Skyradiometer Network**

- Seoul
- Yongin
- Gongju
- Jeju

---

<table>
<thead>
<tr>
<th>Location</th>
<th>TONGSUI (2009-05-17)</th>
<th>SNU (2009-05-17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 7 8 10 11 12 13 15 16 17 18 19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>KONJU (2009-05-17)</th>
<th>HUFS (2009-05-17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 7 8 10 11 12 13 15 16 17 18 19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cooperation with Prof. Sohn BJ (SNU)**
2-4 Seoul Hawngsa Monitoring Center

Asian Dust
(30 May 2008)

Haze
(7 November 2008)

Clear
(26 August 2008)

MOUDI 필터 (3일치: 18~17일 생활형)

15일 20일 31일 49일

1일 6일 11일 17일

15일 19일 27일 30일

Cl⁻, NO₃⁻, SO₄²⁻, Na⁺, NH₄⁺, K⁺, Mg²⁺, Ca²⁺
2-5 Cooperated with China Meteorological Admin.

- Real time data sharing of PM10
Soil temperature: 5, 20, 50 cm
Moisture: 5, 20, 50 cm
Heat flux: 25 cm

Surface: Rain gauge
2m: Wind Speed, Temperature, Humidity, Solar & Net radiation, Pressure
3m: PM10 concentration
4m: Wind Direction, Temperature, Humidity
8m: Sonic anemometer, Temperature, Humidity
16m: Wind Direction, Temperature, Humidity
20m: Wind Speed, Direction

Cooperation with Prof. Soon-Ung Park (CAEM)

Soil temperature: 5, 20, 50 cm
Moisture: 5, 20, 50 cm
Heat flux: 25 cm
2-7 Dust storm monitoring tower in Mongolia (Erdene)

- Real time monitoring of SDS & meteorological condition for forecasting
- Parameterization of Dust Amount from meteorological data for ADAM
3-1 Early Warning system

Asian Dust

Sandstorms and/or duststorms that are affecting the Korean peninsula occur most frequently in the spring season in the arid and semi-arid area of sand deserts including Badainjaran, Tengger, Mu Us, Hunsandakue and Keooolchin, Gobi region and Loess Plateau in the Asian continent. The area of Asian dust source regions cover most of northern China and Mongolia.

- Asian Dust Introduction

- Asian Dust Information

Contact
For further information, contact at:
E-mail: mid_ad@korea.kr / Tel: +82-2-6712-0408 / Fax: +82-2-831-4930

Menu Buttons (4 items)
Time Series / Satellite
Analysis / Forecast

Seoul Hwangsa Monitoring Center
[Hourly average of PM10 concentrations in Korea]

In total, 28 sites
102 Baengnyeongdo
201 Ganghwa
116 Gwanaksan
108 Seoul
229 Gyeonggi-do
132 Anmyeon-do
119 Suwon
094 Gwangdeoksan
101 Chungcheong
232 Cheonnan
399 Geongwon
135 Chupungnyeong
169 Heulsando
140 Gunsan
175 Jindo
146 Jeonju
156 Gwangju
121 Yeongwol
136 Andong
143 Daejeon
192 Jinju
160 Pusan
090 Sokcho
100 Daegwallyeong
152 Ulsan
277 Yeongdeok
115 Ulleungdo
185 Gosan
Dust information obtained through naked eye observation which was collected via WMO GTS every 3 hours.

This is very useful in recognizing the geographical location of dust plume.

The data cannot be correct during the nighttime.
The visibility info in the WMO code in 3 hr intervals
Satellite Images combined with PM10 in Korea

- Dust plumes are not well detected by the satellite observations.
- The dust plume confined in the PB L is seldom observed via satellite detection.
• The backward air trajectories are dramatically changed along with the passage of dust plume.

• The backward trajectory analysis is useful in identifying the source region of dust plume.

• Using NOAA/HSPLIT Model
Asian Dust and Ae rosol Model (ver. 1) is used for dust forecasting in KMA.

ADAM is driven by the KMA's regional operational weather model, RDAPS (Regional Data Assimilation and Prediction System) which was developed based on the MM5, twice a day at 00 and 12 UTC.

The surface chart of PM10 concentrations is provided in 3hr intervals.

Asian Dust concentration Forecast
By early 2010, KMA plans to adopt UKMO's UM (Unified Model) system as the new global and regional weather forecasting system.

Using the Global UM output operated at the KMA, we extend the model domain of ADAM to enable it to cover some parts of Central, South, and Southeast Asia. (UM-ADAM)

We plan to replace the current ADAM with ADAM ver. 2 in the year 2010.
3-2 Early Warning System

Monitoring
- Naked Eye
- PM10
- LIDAR
- Satellite
- Weather Map

Analysis Forecasting
- Back trajectory Model
- Asian Dust Aerosol Model

Broadcasting
- TV & Mass Media
- Forecast Discussion
- Internet, Fax, Mobile Phone

Dust Forecaster
Typical temporal variation of hourly average of PM10 concentrations in Korea during Asian dust and haze period.
Asian Dust (February 19~21, 2009)

Anmyeon-do, Korea
Distinction of “Asian Dust” and “Haze”:

- Asian Dust: 2~6 µm
- Haze: ≤ 1 µm
Haze in April 2009
Asian Dust Early Warning Procedure in KMA

1. Monitoring the Asian Dust episode in source regions with eye measurement and PM10 measurement using the Mongolia and China Joint Asian Dust Monitoring Networks.

2. Investigating the horizontal distribution of Asian Dust using weather charts and satellite images.

3. Estimating the movement of air parcel containing Asian Dust within 72 Hours with 3-hour interval.

4. Simulating the trajectories, and concentrations of Asian Dust with a super computer.

5. Identify the path and vertical distribution of Asian Dust with PM10 concentrations (28 sites)

Finally, We inform the Asian Dust Forecasting results to the public through the mass media, internet, and Short Message Service in order to prevent the Asian Dust damages.
Summary

KMA has started a web site to provide operational and research products related to Asian dust as of October 2009

http://sds-was.nimr.go.kr/support.html

Currently, it contains following items:
- Forecast chart (twice a day at 00 and 12 UTC)
- PM10 concentrations at 28 sites in Korea (Chart & Table, every hour)
- Asian Dust Satellite Images (almost every 30 mins)
- Analysis Charts
  - Asian Dust Weather Chart (every 3 hours)
  - Visibility in GTS code (every 3 hrs)
  - 48hr backward trajectories at observations sites in Korea
  - Satellite images combined with PM10 concentrations

To achieve better understanding of Asian dust and Haze, the cooperative data sharing among the countries is indispensable.
WMO SDS-WAS Asia Node

- 28-30 October 2009 - Seoul, Korea
Proposed integrated monitoring surface network
Model Domain and WMO Synoptic Stations

- **East Asia** (95-150E, 20-60N) → Asia (60-180E, 0-60N)