ANNUAL AIR QUALITY REPORT (2007)

1. Introduction

Atmospheric pollution occurs when substances are present at concentrations sufficiently above normal ambient levels to produce a measureable effect on human, animals, plants or materials. These substances may come from natural or man-made sources and may exist as gases, liquids or solid particles. The major man-made sources include transportation, power generation, biomass burning and industrial processes. Once released into the atmosphere, pollutants may then be transported, diluted and physical and chemically transformed.

The Environment Studies Division of the Malaysian Meteorological Department monitors changes in the chemical composition of the atmosphere through the setup of the network of air pollution stations. Realizing the importance of a comprehensive, reliable database for scientific assessments, effort has been put into the development of the monitoring network. Sampling is conducted by a team of experienced observers, trained in basic instrument maintenance and repair.

2. Description of the Network

The Malaysian Meteorological Department of Air Pollution Monitoring Network as shown in Figure 1 comprises a total of 23 stations well distributed over Peninsular Malaysia, Sabah and Sarawak. This network was established in 1976 with only two stations, but gradually over the years the network expanded to cover the whole country. At the same time, as the need arises, more parameters were added to the observation programme at selected stations. Most of the stations are located some distance from urban centres, thus ensuring that only ambient conditions are monitored and co-located with climatological stations so that simultaneous and continuous observation of both meteorological and air pollution parameters are carried out. This would ensure that a comprehensive data set comprising of both air quality and meteorological data would be available for assessment of any air pollution event.

The flagship of the network is the Baseline Global Atmosphere Watch (GAW) Station in Danum Valley, Sabah (Figure 2) established in 2006 primarily to measure chemical composition and selected physical characteristics of the atmosphere in the data-sparse tropics to collectively improve the understanding of processes in an equatorial rainforest. This station is located in the protected primary forest reserve of 438km^2 in north-eastern Borneo. This is one of 23 stations in the World Meteorological Organization network of baseline GAW Stations.

3. Monitoring Results

The Environmental Studies Division carries out monitoring of air quality over the country and assesses the data collected from the network. Data from the network is used to document long-term trends and the detection of significant changes in atmospheric concentration to provide early warnings of environmental disasters.

The measurement programme of the Division includes the following parameters:

- Rainwater Acidity
- Aerosol
- Atmospheric Ozone
- Reactive gases

3.1 RAINWATER ACIDITY

Regular and methodological measurement of rainwater chemical composition through a network of stations over a long period of time provides an indication of air quality including acidification trends in the country and identifies the areas that are currently subjected to elevated amounts of the wet component of acidic deposition. Such measurements will contribute towards the determination of wet and dry deposition fluxes of acidic species at the measurement sites which will eventually lead to a better understanding of the atmospheric acidification issues in the region.

Rain acidity is commonly reported as pH. pH is a measure of the hydrogen ion concentration in a liquid and has a scale ranging from 0 to 14. Rain from even very clean, remote sites is slightly acidic with pH varying between 5.2 to 6.0 due to the presence of dissolved natural acids; therefore rain is only considered acidic if the pH is less than 5.2. Since rainfall amount varies, all values of pH are volume weighted.

The Malaysian Meteorological Service uses either the Automatic Wet and Dry Fallout Collector or the Wet-Only Sampler to collect rainwater in its network. The rainwater samples are accumulated weekly and sent to the Department of Chemistry, Malaysia for chemical analysis of the principal anions and cations. A biocide thymol, is used to prevent biological degradation of the rainwater samples.

Annual pH

Figure 3 shows the volume weighted average pH of rainwater collected during 2007. On an annual basis, the pH of rainwater in northern and northeastern states of Peninsular Malaysia, Sabah and Sarawak is in the normal range of 4.8 to 5.2. However, rainwater in the western and southern states of Peninsular Malaysia is slightly acidic with the average pH of between 4.4 and 4.8.

Monthly variation of pH

Individual maps of the monthly volume-weighted pH are shown in Figure 4. From the sequence of the maps, it was noted that rainwater acidity generally was higher (lower pH) during the months from February to November for Peninsular Malaysia. During these months, most of the areas of Peninsular Malaysia received rainfall of pH between 4.4 – 4.8 except northeastern and northwestern part which recorded normal pH level of between 4.8 – 5.6. While in Sabah and Sarawak East Malaysia received rainfall of pH between 4.8 – 5.6.

3.2 AEROSOLS

Aerosols such as Total Suspended Particulates (TSP) are small airborne particulates with diameters less than 100 micrometers (μ). TSP with an aerodynamic diameter of 10 micrometers or less are called PM10 particulates and are usually of a much greater health concern.

Total Suspended Particulate

TSP was measured using High-Volume Air Sampler at 14 stations. The monthly trends in TSP loads for these stations are shown in Figure 5. Kuala Terengganui, Tanah Rata, Kuching and Labuan showed above normal levels compared to long-term average value while Alor Setar, Perai, Petaling Jaya, Melaka, Bintulu and Tawau showed below normal concentration.

Particulate Matter (PM-10)

PM-10 particulates were measured at eight stations in the monitoring network using the High-Volume PM-10 Air Sampler. The monthly trends in PM-10 concentrations for these stations are shown in Figure 6. Most of the station recorded below normal concentration.

3.3 ATMOSPHERIC OZONE

Ozone, is a very reactive gas found in trace amounts in the atmosphere. Its mean concentration can vary from a few to hundreds of parts per billion (ppb) depending on the location and altitude. At the surface layer, ozone is considered a secondary pollutant which causes oxidant episodes such as haze and smog. In the stratosphere, the layer of ozone reduces harmful ultraviolet radiation reaching the earth's surface. On the global scale, ozone is a greenhouse gas which contributes to global warming.

Total Column Ozone

Daily total column ozone is monitored automatically in Petaling Jaya using the Brewer Spectrophotometer. Direct sun measurements are presented here (Figure 7). The measured amount of total column ozone varied between 227 to 269 Dobson unit (DU). There is a seasonal variation in ozone concentration but it is not as evident as those sites in the middle latitudes.

Vertical Ozone Profile

The vertical ozone profile is measured at KLIA, Sepang using ozonesondes released at the beginning and middle of the month. The monthly mean vertical ozone profile is shown in Figure 8. The ozone profiles show a minimum at about 15 kilometres above mean sea level (MSL) corresponding to the top of the tropical tropopause layer. Above 15 kilometres, ozone levels increased rapidly to a maximum about 27 km above MSL.

3.4 REACTIVE GASES

Currently, the Malaysian Meteorological Department continues to monitor gaseous sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) at the Petaling Jaya sites using passive samplers.

Figure 9 shows the weekly concentration of SO_2 and NO_2 measured at Petaling Jaya. SO_2 values below 3 ppb throughout the year with no seasonal variation. The concentrations of NO_2 are higher and fluctuate between a range of 24 ppb and 47 ppbv.