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The Effect Of Outdoor And Indoor Air Pollution On Human Health

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Abstract

Desert dust is a source of mineral aerosols, whose geological and biogeochemical impacts are now recognized, is an important question in the crucial debate on global change. The biogeochemical impact of desert dust also remains a matter of discussion regarding its contribution for different major and minor elements to terrestrial and marine systems and especially its potential fertilizing role for remote oceanic areas by supplying micronutrients as phosphorus and iron [1, 2]. Wheat cultivars fed by irradiated Saharan soil solution gave comparable results to Hewitt nutrient solution [3]. Environmental biophysical environment, climate change, biodiversity and other resources are affected by desert dust aerosol or anthropogenic.

It is recognized that there is a much wider range of compounds in indoor and outdoor air that are of interest because of possible effects on the health of occupants. Depending on the pollutant, the concentration and the duration of exposure some organs are more affected than others. The most frequent disorders are those caused by irritant gases and particulates on the mucous membranes and respiratory organs. Aerosol effects on plants, as well as the air pollutants health effects of the most important pollutants have been discussed.

Key words: Saharan dust events, natural fertilization, anthropogenic aerosol, air pollution and human health.

Introduction

Dust loads transported into the atmosphere have been estimated to range between 500 millions tons to 1 billion tons, annually [4]. We know that West Africa is a major source region for natural and anthropogenic aerosols. Depending on the season aerosols particles are a mixing, in variable proportion, of soil dust coming from the Saharan source. The Mediterranean Basin is often affected by Saharan dust outbreaks (Figure 1), which influence the aerosol load and human health. Urban aerosol has becomes a serious urban problems.

Figure 1. A SeaWiFS visible image capturing Saharan dust transported to the Mediterranean.

1. Transport of natural particles from dry regions

According to *Commission Staff Working Paper* (2008), Re-suspended and transported desert dust can have a strong impact on atmospheric visibility and aerosol composition as well as on particulate matter (PM) levels. For the purpose of this document, two kinds of wind blown dust events are distinguished:

(a) Saharan dust may contribute more than 60% to the total PM10 concentration in Mediterranean countries during a strong dust pollution event. This may lead to exceedances of the daily average concentration of 50 μg/m3. Saharan dust particles can account for a fraction of both PM10 and PM2,5.

(b) Wind blown dust can also be caused by re-suspension from dry or barren grounds in one of the Member States and subsequent atmospheric transport over long distances. Two elements make it difficult to assess the natural component of this contribution:

– Long-term anthropogenic developments have contributed to the current state of land use; therefore the contribution has been influenced by human action;

– The re-suspension process itself might be caused by human action.

1.1. Natural contributions

Primary Biological Aerosol Particles; Material such as spores or pollen that originally derives from biological processes and that is transferred into the atmosphere without change in its chemical composition.

Secondary Organic (Biogenic) Aerosol; Secondary aerosols are formed by complex chemical reactions to which both biogenic VOCs and anthropogenic VOCs contribute. The organic fraction of secondary aerosol, formed in the atmosphere from the chain reaction of volatile organic compounds emitted by soils and vegetation, including trees, and their degradation products.

The definitions under Article 2 of the Directive 2008/50/EC, *Commission Staff Working Paper*, Brussels, 15.02.2011.

1.1.1. Aerosol characteristics

During the Saharan dust storm over the eastern Mediterranean region in February 2006, airborne particulate matter of ≤10 μm in aerodynamic diameter (PM10) started to rise significantly above the urban level, reaching up to 2,800 μg/m^3 (Figure 2) [5].

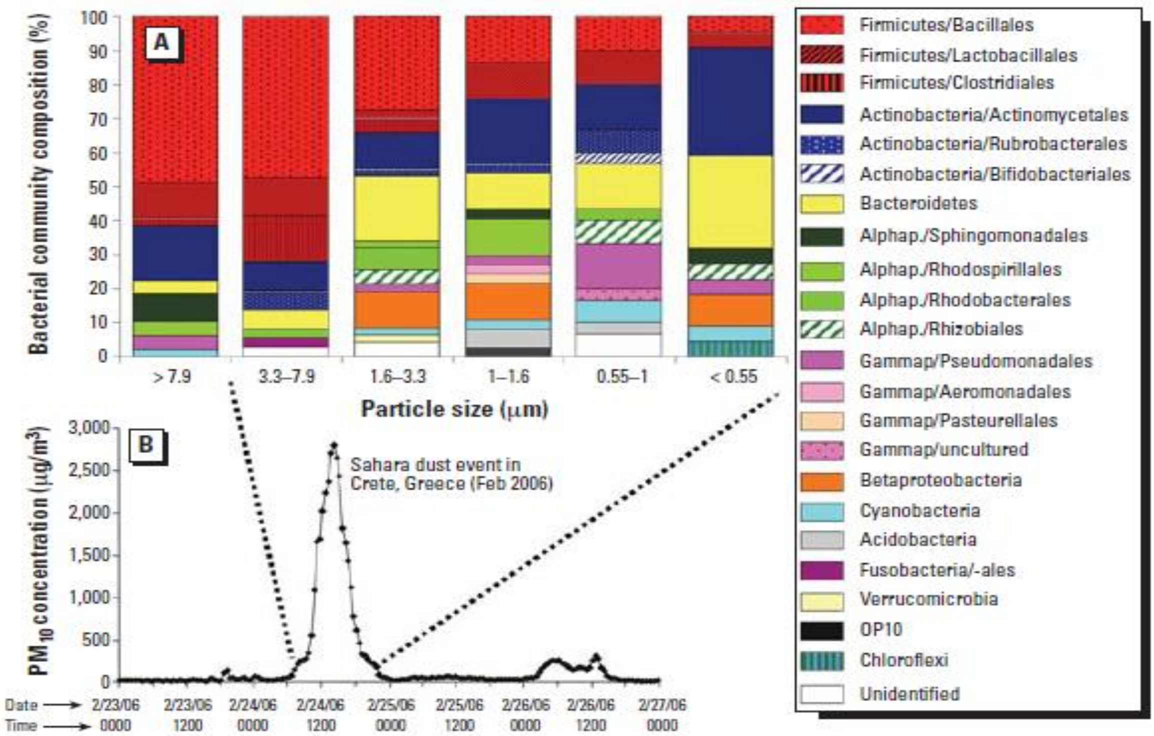

Figure 2. Analysis of dust particles from the Sahara dust event by bacterial community composition and by PM10 concentration at different time points. (**A**) Bacterial community composition in particles of different sizes. (**B**) PM10 concentrations during the Sahara dust event.

1.1.2. Transcontinental transport of micro-organisms

30 percent of the bacteria isolated from airborne soil dust are known pathogens, able to affect plants, animals, or humans [6]. Microbial pathogens can also be associated with African dust. These factors can increase water uptake and facilitate the establishment of microbial organisms having high activity (Figure 3).

Figure 4. Microbial growth on a sample filter collected during an African dust event in the US Virgin Islands, after 96 hours of incubation. Sample collected from Deck Point, St. Thomas, US Virgin Islands on 8 August, 2001 at 1145 am.

Figure 3. Sample filter collected during African dust event in the US Virgin Islands Griffin et al., 2003.

1.2. Human health effects of air pollution

Currently, there exist many efforts directed towards the identification and reduction of ambient concentrations of particulate material as a mechanism for improving human health. However, the biological burden present in Saharan dust has the potential of spreading a wide variety of microorganisms (fungi, virus, and bacteria), and their biologically associated natural products (spores, mycotoxins, endotoxins). These can be pathogenic to plants [7], marine environments [8] and humans [9].

There is growing public awareness regarding the risk associated with poor indoor air quality (IAQ) in the home and workplace. Airborne biological materials (e.g., plant pollen, bacteria, fungi, insect fragments, and soluble bacterial byproducts such as endotoxins) cause a variety of health problems, including allergy, respiratory infection, allergic asthma, and hypersensitivity pneumonitis. Along with particulate matter (PM), gases such as ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), and sulfur dioxide (SO_2); microbial and chemical volatile organic compounds (VOCs); and passive smoke are the most common types of air pollutants encountered indoors. A major limitation of understanding the adverse health effects of these specific air pollutants is the inability directly to equate measurable ambient air concentrations to personal exposure.

2. Material and Methods

2.1. Dust sampling

According to Sinclair et al. (1990), The airborne particles were collected using Sierra Automatic Dichotomous Samplers. Model No. 245. The entrained particles are size fractionated into fine particles smaller than 2.5 μm in diameter and coarse particles between 2.5 and 15/μm by means of virtual impaction. The nomimai flow rate was 16.7 l min $^{-1}$. The particles were collected on 2.0 μm pore size Teflon membrane filters (37 mm diameter) with nonwoven polypropylene backing (GHIA R2PJ03725). The filters were precleaned with methanol followed by water using ultrasonic extractions. The outdoor sampler was located on the roof (approximately 12 m above ground) [10].

3. Discussion

3.1. Health, risk and the indoor environment

Indoor air is a variable complex mixture of chemicals and airborne particles. The toxicity of such a mixture is not only determined by the toxicity of the individual compounds but also by possible combined effects that may increase or decrease the toxicity of the mixture. Thus, by setting a limit value for each compound, the problem of a continuously varying complex mixture with its numerous possible combined actions is still present. Based on these definitions of health and risk some remarks on the current indoor health risk assessment can be made.

4. Conclusion

The clearly demonstrated damaging nature of many aerosol components (acidic species, elemental carbon and of specific carboxylic acids (including oxalate), PaH, POPs, PCBs, VOCs, metals, among others), led many countries to impose limit values enforced by legislation. Saharan dust outbreaks also affect human health [11, 12], because such episodes are closely associated with increases in particulate matter concentrations on the surface, especially when the synoptic conditions favor advection of the dust within the boundary layer. The health burden due to particulate matter air pollution is one of the biggest environmental health concerns, especially over areas directly affected by intense dust storms [13].

The consequences are eye, nose and throat inflammations, diminished lung function, increased susceptibility to respiratory infection and a higher incidence of chronic bronchitis. These disorders and diseases are, of course, influenced by other factors as well, such as immune deficiency, allergies, occupational exposure to pollutants, and particularly smoking.

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