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PM_1 is More Important than $PM_{2.5}$ for Human Health Protection

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I am pleased to share some new research from our authors of this issue of Current World Environment journal. This issue is covering wide range of studies in the form of review articles, research papers and case studies reporting air and water pollution measurements, scenario analyses, trends analyses, biodiversity, extreme events and climate change impacts. This issue of the journal has some very important papers e.g rain water harvesting in Ghana, heavy metal pollution in the Black Sea, bacterial pollution in the sediment of Padma River in Bangladesh, ground water level trends in Uttar Pradesh state of India etc. I hope that you find these contributions very useful.

I have selected the theme of this Editorial on the importance of controlling ambient air PM_1 concentrations for preventing human health problems due to air pollution. Recalling back in 90's, when most of atmospheric aerosol studies used to report total suspended particulate matter (TSPM)[1] which included particles upto 25 µm or even larger. Then after a decade or so, it was realized that the PM_{10} levels matter, not the TSPM levels for health implications. The PM_{10} particles are also known as respirable sized particulate matter (RSPM). Very soon, researchers established that the coarser particles including PM_{10} do not have significant health effects as compared to $PM_{2.5}$ aerosols. In this regard, a large number of studies have been reported but it is not possible to cite all these studies in this brief article. Regulatory bodies have also defined ambient standard limits of $PM_{2.5}$.

However, with the advancement of our knowledge, the latest research findings reveal that it is not the $PM_{2.5}$ but PM_1 which has close relation with human health. The PM_1 basically comprises anthropogenically derived particles directly penetrating into the blood system having harmful effects on our respiratory and cardiovascular systems. Therefore, in order to assess the health impacts of particulates, we need to consider only PM_1 and not the $PM_{2.5}$. Around 70-80% fraction of $PM_{2.5}$ has been reported due to PM_1 aerosols[2]. Infact, smaller and smaller particles (<1µm) pass through the blood barriers in the lungs. This allows their entry into blood stream having severe heath implications. The damage depends on its chemical content.

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The PM_1 particles consist of toxic and harmful chemical components such as black carbon, organic carbon, heavy metals, persistent organic pollutants (POPs). According to a report, PM_1 has higher mass fraction of carbonaceous aerosols as compared to $PM_{2.5}$. Lim *et al.,*[3] found that PM_1 and $PM_{2.5}$ had OC mass fraction as 23.0% and 22.9% while EC mass fractions was 10.4% and 9.8% respectively at ABC super Observatory at Goshan. The heavy metal fractions have also been reported higher in PM_1 in other studies worldwide[2,3,4]. However, the chemical components such as Ca and Mg which are mainly contributed by the crustal sources such as suspension of soil dust, road dust and construction dust, have lower fractions in PM_1 as compared to $PM_{2.5}$ aerosols[5,6]. These characteristics of PM_1 suggest their distinctive identification for harmful sources.

According to a study by Lee *et al.,* PM_1 particles have been found to be associated with nitrate driven haze pollution in Beijing and Xinxiang in the North China Plain region[7]. This study highlights that very high levels of PM_1 nitrate, even higher than the European and North American sites need to be controlled by reducing reactive nitrogen species such as NH_3 and NO_x emissions. Situation during crop residue burning might be similar due to the formation of secondary aerosols. Generally, sulphate aerosols also predominate in the PM_1 range. These have significant impacts on visibility and radiative forcing too. However, more research is needed to understand the impacts of PM_1 on agricultural crops in different agricultural zones.

Therefore, we need to quantify PM_1, its carbonaceous fraction, organic fraction and metallic fraction etc. Accordingly, we need to conduct toxicological and epidemiological research to develop new air quality criteria and related limits. This raises an urgent need to develop certified standards for the accurate chemical analysis of PM_1. Probably, PM_1 concentrations and its chemical characteristics will be more relevant parameters for global comparisons and ranking air quality status of different cities worldwide. Moreover, it will reduce the bias generated by the crustal fraction especially for the sites of dusty regions such as African, middle-east and south Asian. Considering the fact that PM_1 is more important to prevent human health hazards, investing in $PM_{2.5}$ monitoring stations will prove meaningless effort of the regulatory bodies. Also, we need to focus more upon emission control than the measurements. Hence, we need not to have too many sites, rather we should operate limited number of sites and produce good quality data having reliability in public. The location and the number of sites can be decided accordingly with the aim to captur PM_1 levels due to local source variation, seasonal variation, trans-boundary and long range transport of pollution etc.

References

1. Kulshrestha U C, Kumar N, Saxena A, Kumari K M and Srivastava S S. Identification of nature and source of atmospheric aerosols near Taj Mahal (Agra), *Environmental Monitoring and Assessment,* ***34***, 1-11 (1995).
2. Johannesson S, Gustafson P, Molna ´ R P, Barregard L and Llsten G. Exposure to fine particles (PM2.5 and PM1) and black smoke in the general population: personal, indoor, and outdoor levels, *Journal of Exposure Science and Environmental Epidemiology,* ***17***, 613–624 (2007).
3. Lim S, Lee M, Lee G, Kim S, Yoon S and Kang K. Ionic and carbonaceous compositions of PM10, PM2.5 and PM1.0 at Gosan ABC Superstation and their ratios as source signature Atmos. *Chem. Phys.,* ***12***, 2007–2024, doi:10.5194/acp-12-2007-2012 (2012).
4. Alver Sahin U, Onat B and Polat G. Trace element concentrations of size-fractionated particulate matter in the atmosphere of Istanbul, Turkey WIT *Transactions on Ecology and The Environment*, Vol ***174***, WIT Press, pp 137-147 (2013).
5. Andrew D. Venter Pieter G. van Zyl Johan P. Beukes Micky Josipovic Johan Hendriks Ville Vakkari and Lauri Laakso. Atmospheric trace metals measured at a regional background site (Welgegund) in South Africa. *Atmos. Chem. Phys.,* ***17***, 4251–4263 (2017).
6. Perrone R P, Dinoi A, Becagli S and Udisti R. Chemical composition of PM1 and PM2.5 at a suburban site in southern Italy, *International Journal of Environmental Analytical Chemistry*, ***94***, 127-150 (2014).
7. Li H, Zhang Q, Zheng B, Chen C, Wu N, Guo G, Zhang Y, Zheng Y, Li Z, He K. Nitrate-driven haze pollution during 1 summertime over the North China Plain, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-1156 (2017).