Science for Environment Policy
DG Environment News Alert Service
European Commission

3 May 2012

Airborne carbon nanoparticles over Mediterranean measured

Researchers have measured the presence of carbon nanoparticles in the air over the Mediterranean Sea. The results revealed that higher concentrations are found in air that has moved over areas of industrial activity, and that the lowest layers of the atmosphere are likely to be responsible for transporting the nanoparticles.

While low levels of atmospheric nanoparticles are emitted by natural sources, such as volcanoes, forest fires and chemical weathering of rock, it is believed that more than 36% of all particulate matter in the atmosphere is made up of 'incidental' nanoparticles created by human activity. These incidental sources are the by-product of manmade industrial processes; for example, diesel exhaust, coal combustion and welding fumes.

The aim of the study was to assess the occurrence of a group of carbon nanoparticles, fullerenes, in airborne particulate matter. Fullerenes have attracted high levels of interest as they can also be engineered for use in numerous applications, including personal care products, textiles and microelectronics.

The researchers developed a new method to analyse selected fullerenes in airborne particulate and applied it to two separate samples collected from the open Mediterranean Sea. The fullerenes C_{60} and C_{70} were measured (these compounds are named according to the number of carbon atoms found in their spherical, ball-like structure). The median ranges for C_{60} and C_{70} fullerenes, detected in 28 out of the 43 samples, were 0.06 nanograms per cubic metre (ng/m^3) and 0.48ng/m^3 respectively.

C_{70} was the more frequent compound found in 36 of the samples. Previous work on C_{60}:C_{70} proportions have revealed that C_{60} is a dominant source in wastewater; this may be because C_{70} has a higher stability in air. A previous study of Barcelona's city atmosphere only detected C_{60}: the presence of C_{70} in this study therefore indicates that other industrial processes beside those found in cities can be considered major contributors of fullerenes to the environment.

When analysing the journey that the sampled air had taken, it was clear to the researchers that air masses that had moved over industrialised areas had the highest concentrations of fullerenes. For example, samples from the Zonguldak province in Turkey, which has an intense port and coal mining activity, had very high levels.

The evidence suggests that the lowest atmospheric layers are responsible for transporting fullerenes. Air masses that had moved over wide sea areas, far from the coast and away from human activity, contained the lowest levels of fullerenes.

The study provides insight into the fate of human generated fullerenes. According to the researchers, fullerenes from human sources are quickly deposited from the atmosphere to the ground and water, and are likely to affect coastal marine zones, as well as continental ecosystems. Although there is no data available for the analysis of fullerenes in marine water, the researchers propose that they would be likely to sink to the bottom of the sea and mix with the sediment, as they have a tendency to stick to organic matter. Further research is needed to understand the full behaviour, transport and fate of fullerenes in order to assess the effects that these nanoparticles have on human health and the environment.

Source: Sanchis, J. Berrojalbiz, N., Caballero G., Dachs, J., Farré*, M., and Barceló, D. (2012) Occurrence of Aerosol-Bound Fullerenes in the Mediterranean Sea Atmosphere. *Environmental Science and Technology.* 46: 1335-1343.

Contact: mfuqam@cid.csic.es

Theme(s): Air pollution