

Black, Brown, and Organic Carbon Measurement

What is Black Carbon, Organic Carbon and Brown Carbon?

Black carbon "BC" is a solid pollutant which mainly comes from the burning of fossil fuels, wood, tobacco and biomass, such as wood or tobacco.

BC absorbs light completely at all visible wavelengths. Hence its black color. BC is an important driver of global warming, second only to CO₂. It has also been linked to serious human health issues, such as cancer, cardiovascular, and pulmonary disease. BC is almost 100% graphitic carbon and is non-volatile, insoluble, and non-reactive. It is mainly quantified by its absorption in the near-IR spectrum.

Organic Carbon "OC" is another class of solid and semi-volatile pollutant which mainly comes from the combustion of wood, tobacco and other biomass. OC compounds have also been linked to cancer, cardiovascular, and pulmonary disease. OC compounds are colorless in the near-IR, meaning that they do not absorb significantly at that wavelength. However, some OC compounds can absorb, sometimes strongly, at shorter wavelengths near the UV region. OC is comprised mainly of carbon, but can contain significant amounts of hydrogen, oxygen and other elements.

Brown Carbon "BrC" is a subset of OC compounds that don't strongly absorb in the IR, but do at shorter wavelengths. BrC compounds come from biomass combustion and some types of fossil fuel combustion such as coal or 2-cycle engine exhaust.

Why is it important to measure BC, OC, and BrC?

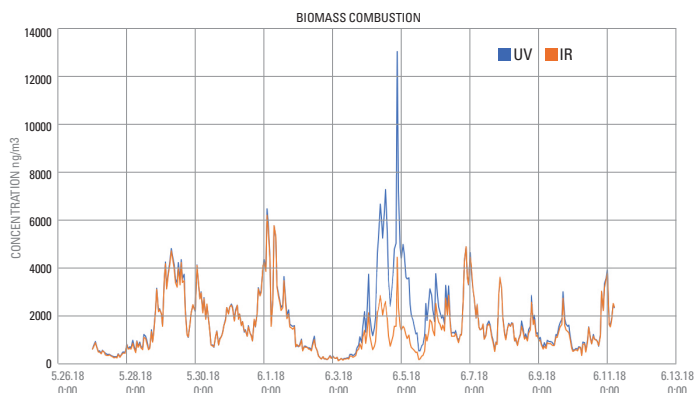
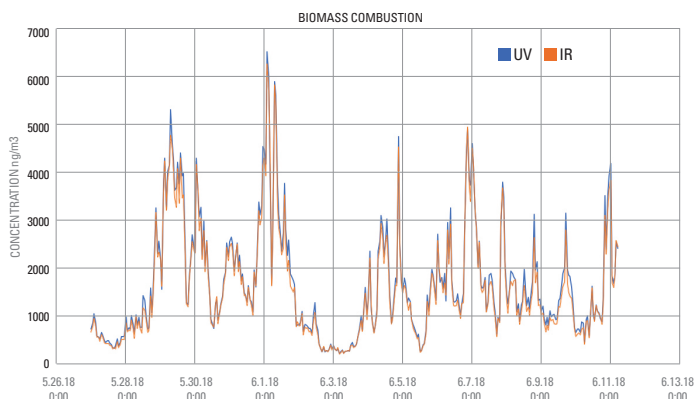
Ambient particulate matter "PM" often contains significant amounts of BC and, depending on the source, may also contain significant amounts of BrC and OC. "Source Apportionment" is the process by which PM arising from the combustion of fossil fuels is differentiated from PM arising from biomass combustion. Source apportionment is of interest to regulators and to emergency responders as it provides an indication of where the PM is coming from. They need to know the sources of PM: are they due to traffic, or are they due to wood burning, for example? Mobile emission sources such as diesel powered vehicles emit only BC. Stationary source emissions arising from the burning of wood, charcoal, coal, dung, agricultural burning, could be sources of OC or BrC. Or they could be sources of BC, such as one might expect in the emissions coming from coal-fired power plants.



The BC 1060 portable black carbon monitor will simultaneously detect the presence of BC and of BrC, thereby allowing for the determination of the source of the PM:

- **Fossil fuel burning**
- **Biomass burning**

Measured concentrations that are the same at the UV and the IR illumination wavelengths indicate the presence of only BC. Measured concentrations showing strong UV enhancement indicate the presence of BrC in addition to BC.



2-Wavelengths or 10-Wavelengths?

The Met One Instruments, Inc. BC-1054 Multispectrum Carbon Monitor has 10 illumination wavelengths between 370 nm and 950 nm. The Met One Instruments, Inc. BC-1060 Portable Carbon Monitor has 2 illumination wavelengths at 370 nm and 880 nm. If all that is desired is high sensitivity measurement of BC over time or basic source-apportionment estimation using BC and “Delta-C”, then the BC-1060 may be an appropriate, cost effective solution. On the other hand, if more complex, comprehensive data for climatological studies such as Absorption Ångström Exponent “AAE” determination is required or if a more robust estimation of BrC is desired, then it is necessary to have the data provided by the additional illumination wavelengths. The BC-1054 provides this capability.

Wavelength (nm)	BC 1054	BC 1060
370	•	•
430	•	
470	•	
525	•	
565	•	
590	•	
660	•	
700	•	
880	•	•
950	•	