Met One Instruments C-12 Portable Low-Cost Carbon Monitor

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Outline

- Definitions
- Physical and Chemical Characteristics of BC
- Sources of BC
- Motivation for Monitoring Black Carbon
- C-12 Portable Carbon Sensor
- Applications of Low-Cost Carbon Sensors
  - China
  - Grants Pass Oregon
- Summary

What is Black Carbon?

- BC is a solid soot-like pollutant
  - Arises from the combustion of fossil fuels
  - Arises from the combustion of biomass
- BC is not a single substance:
  - A complex array of combustion particulate dominated by sp^2 (graphite-like) carbon (~90% by weight), oxygen, hydrogen, and other elements
  - Its nature depends on what is burned and how it is burned

Physical and Chemical Properties of Black Carbon

- Refractory
- Insoluble in water, all organic solvents
- Relatively inert chemically
- Absorbs across the entire NIR-NUV spectrum
- No consensus on calibration standard
- Results are method dependent

Where Does Black Carbon Come From?

- Incomplete combustion of fossil fuels
- Incomplete combustion of biomass
  - Often accompanied by polycyclic aromatic hydrocarbons, lower molecular weight organic substances (which are often soluble in organic solvents).
  - Accompanying PAH compounds often have enhanced absorption properties in UV-region

Why is Ambient Monitoring of Black Carbon Important?

- BC a driver of global warming
- BC has been linked to cancer and pulmonary disease
- Urban BC often originates near roadways, factories, industrial processes often in disadvantaged areas.

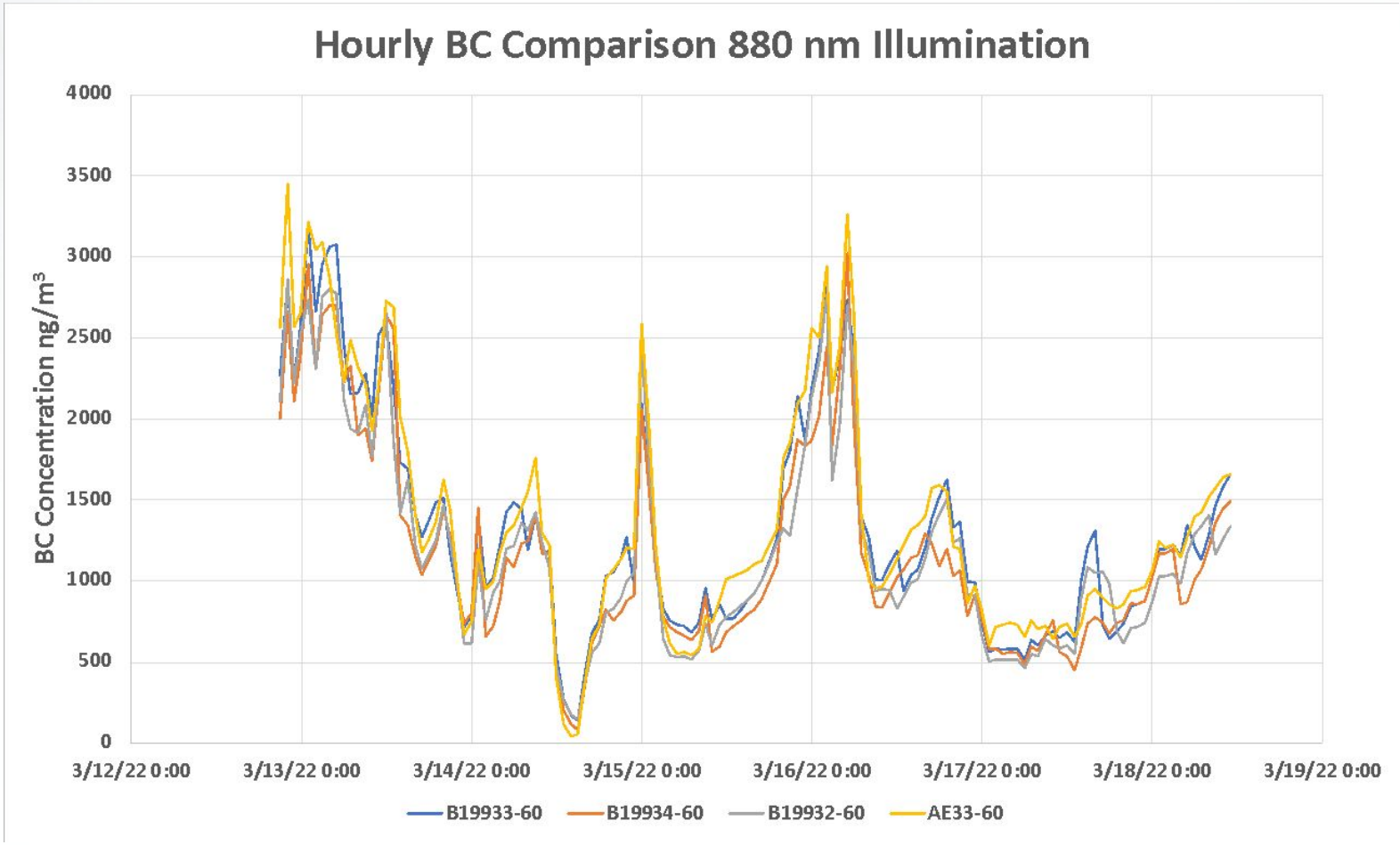
How is Black Carbon Monitored?

- Thermo-optical reflectance (TOR) or thermo-optical transmission (TOT)
  - Sunset Labs OC-EC
  - DRI/Magee Model 2015
  - Magee Total Carbon Analyzer
- Filter-based optical absorption
  - MOI BC-1054, BC-1060 Portable
  - C-12 Low-Cost Carbon Sensor

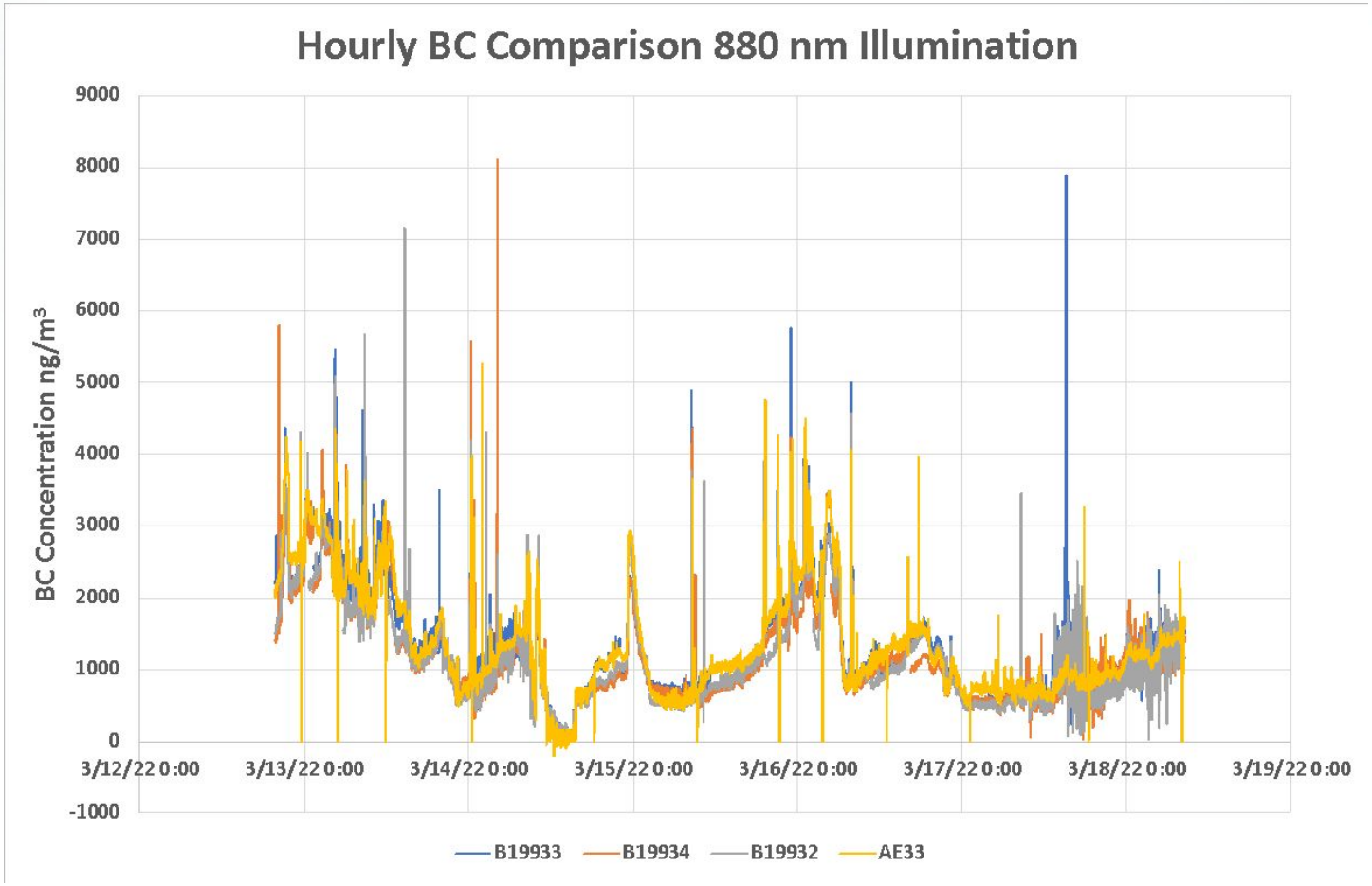
Met One Instruments C-12 Portable Carbon Sensor

Parameter	Specification
Principle of Operation	Optical attenuation across filter media
Illumination Wavelength	880 nm standard 880 nm and 370 nm optional
Cut Point	TSP
Sampling Rate	1 LPM
LDL (2 σ)	< 80 ng/m3 (1-minute time scale)
Communications	USB, Built in CCS+ COMET Cloud Modem 4G LTE
Input Power	100-240 VAC 50/60 Hz Optional Solar Panel
Power Consumption	6 W
Operating Temperature Range	-20 C to +50 C
Ambient Humidity	0-90% non-condensing
Weight	7.6 kg
Size	38.1 x 30.5 x 30.5 cm

C-12 China Comparative Test

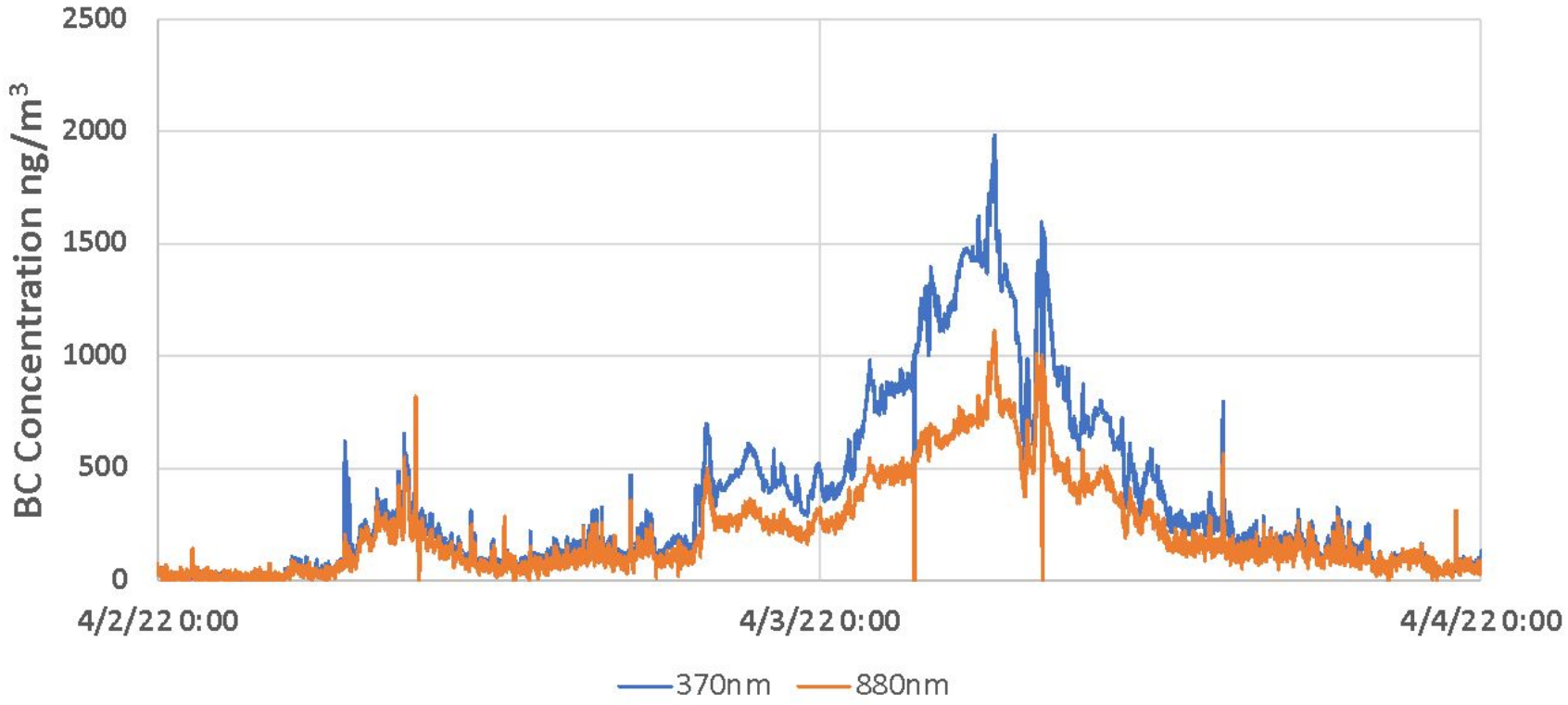


C-12 China Comparative Test



Beijing China Test Site

C-12 Grants Pass Oregon Controlled Burn 1-Minute Data



Summary

- C-12 output compares well to AE33, which is the de facto standard, although the instrument costs 1/10th as much
- C-12 retains much of the functionality of more expensive tape-based monitors
- Sensitivity is consistent with other tape-based BC monitors
- C-12 may be easily deployed in a matter of minutes in any area with cellular reception