2016

An Analysis of Particulate Matter in Central Virginia

Elizabeth Garrett
Virginia Commonwealth University, garrette2@mymail.vcu.edu

Arif Sikder
Virginia Commonwealth University, amsikder@vcu.edu

VCU

An Analysis of Particulate Matter in Central Virginia

Elizabeth Garrett & Arif M. Sikder

Introduction

Virginia is consistently rated as a state with high rates of asthma (Asthma and Allergy Foundation 2014). Although this respiratory disease has many causes, certain air pollutants can be a trigger. The EPA currently identifies, monitors, and regulates seven types of air pollutants. One of these pollutants, particulate matter, can occur both naturally and culturally. The primary anthropogenic cause of particulate matter is fly ash, which is formed during fossil fuel combustion. Different technology installed in the power plant can capture some of the fly ash but these methods are not entirely effective.

The toxic elements in fly ash can increase the frequency of health problems. The elemental contents of fly ash in Virginia have been examined; reports show that nickel, selenium, vanadium, chromium, and manganese are found in excessive amounts (Sikder, personal communication). A study in Eastern Europe found that utility workers have significantly higher arsenic and mercury levels in their blood than non-utility workers from the same area (Silva et al. 2012).

Methods

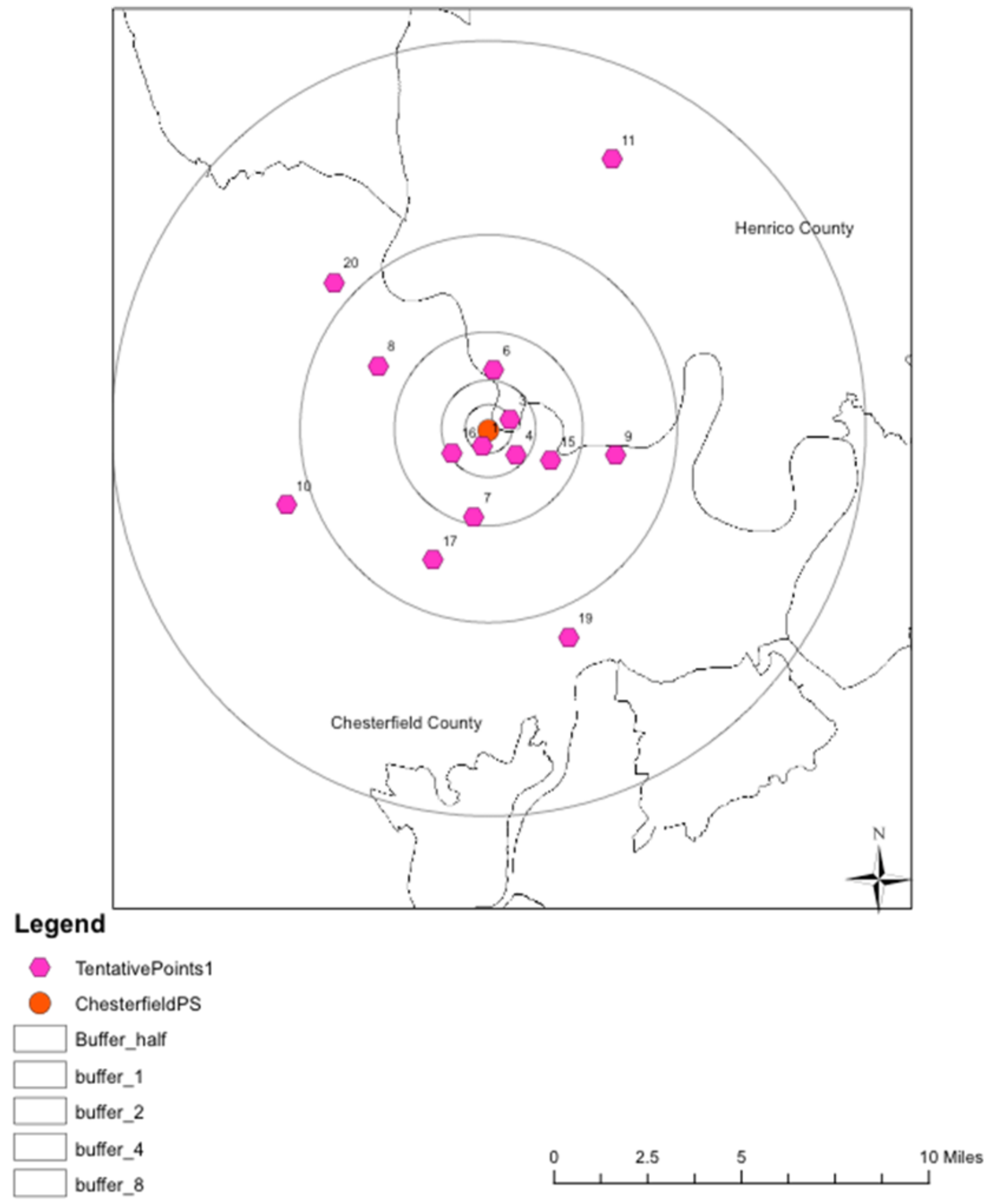
Samples were taken on conservation properties, private residences, and commercial parcels that surround a coal-fired power plant called Chesterfield Power Station, or Dutch Gap, with a SKC Deployable Particulate Sampler (DPS). The sampling sites include one control site and sites within half-mile, 1-mile, 2-mile, 4-mile and 8-mile radius of the power station. arcGIS was used to generate the different radii.

Two types of filters were used to analyze the amount and type of particulate matter in the air. The first was the glass fiber filter, where a difference in weight was recorded. These were statistically analyzed using the Kruskal-Wallis test. The second type was the polycarbonate filter, which was collected over an eight hour span and analyzed using the FIB Scanning Electron Microscope (Zeiss Auriga) at the Nanomaterial Characterization Core Facility (NCCF) of VCU.

Dutch Gap Power Station

Objectives

This study focused on estimating the ratio of natural particulate matter to fly ash in central Virginia with a hypothesis that there will be a greater ratio of fly ash to natural particulate matter closer to the power plant. Determination of the ratio of fly ash and natural particulate matter will demonstrate how much particulate matter can be eliminated.

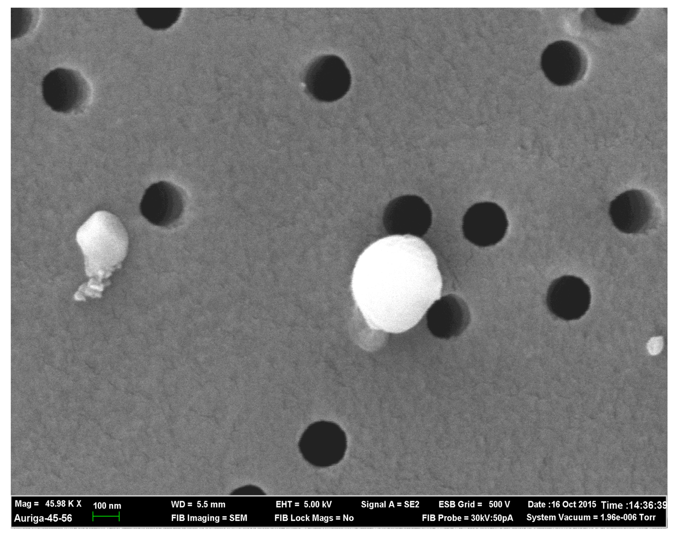


Map of Sites

Results

The null hypothesis that a difference in collection rates among the radii existed was not rejected (p-value = .4139). Although the statistical analysis did not prove that there was a difference in collection rates among the radii, they were all greater than the national standard for PM2.5, which is 15.0 μg/m3.

Sampling Location Radii (mi)	Average Collection Rate (μg/m³)
0.5	99.21
1	28.94
2	44.64
4	26.46
8	74.40
Control	34.72



SEM micrograph of anthropogenic particulate matter from site 41

The scanning electron micrograph of anecdotal evidence of both natural and anthropogenic particulate matter at the Dutch Gap Conservation Area. Texture is used to distinguish between natural and anthropogenic particulate matter.

Conclusions

The statistical analysis did not support the hypothesis that there was a difference in particulate flow among radii. The present study is not congruent with the previous studies on particulate matter and distance from coal-combustion sites. However, there are at least three explanations for this departure. The unaccounted effects could be due to airflow patterns, humidity, and other anthropogenic sources.

Acknowledgments

We would like to thank the Dr. Greg Garman, Director, Center for Environmental Studies (CES), VCU, for providing support and encouragement; VCU Rice Rivers Center for the financial support to conduct the present study.