

AEROSE 2021 Research Campaign on the Atlantic Ocean with the NOAA Ron Brown Ship

Christopher Thompson¹, Arianna Burford¹, Jordan Porter¹, Francis Mensah¹, Nick Nalli³, Vernon Morris²

¹Department of Natural Sciences, Virginia Union University, Richmond VA, ²Arizona State University, AZ, ³NOAA NESDIS STAR, College Park, MD.



Introduction

The fourteenth Saharan Dust Aerosol and Ocean Science Expedition (AEROSE-XIV) occurred on January 15 – February 24, 2021, aboard the NOAA Ronald H. Brown ship. Three (3) VUU students and one faculty member has participated in the research cruise. The AEROSE-XIV scientific team performed a variety of tasks including daily weather briefing, sunphotometer measurements with the Microtops II, and monitoring Ozone, Carbon Monoxide and Sulfur gases' trace. Several days of dust activities were observed and preliminary analysis includes in situ data and satellite images. In addition to providing active hands-on research campaign, AEROSE-XIV was also a rich educational experience and has positive impacts on research capacity at Virginia Union University.

Methods

Instruments used include the Thermo Scientific Model 49i, Ozone Analyzer O₃, the Model 48c, CO Analyzer and the Model 43c, SO₂ Analyzer. To gather Aerosol Optical Depth, Microtops II sunphotometer was used.



The VUU/AEROSE 2021 team. From left to right Jordan Porter, Arianna Burford, Christopher Thompson and Dr. Francis Mensah.



Jordan collecting Microtops data



Christopher in the wet lab



Arianna presenting a weather briefing

Results and Discussions

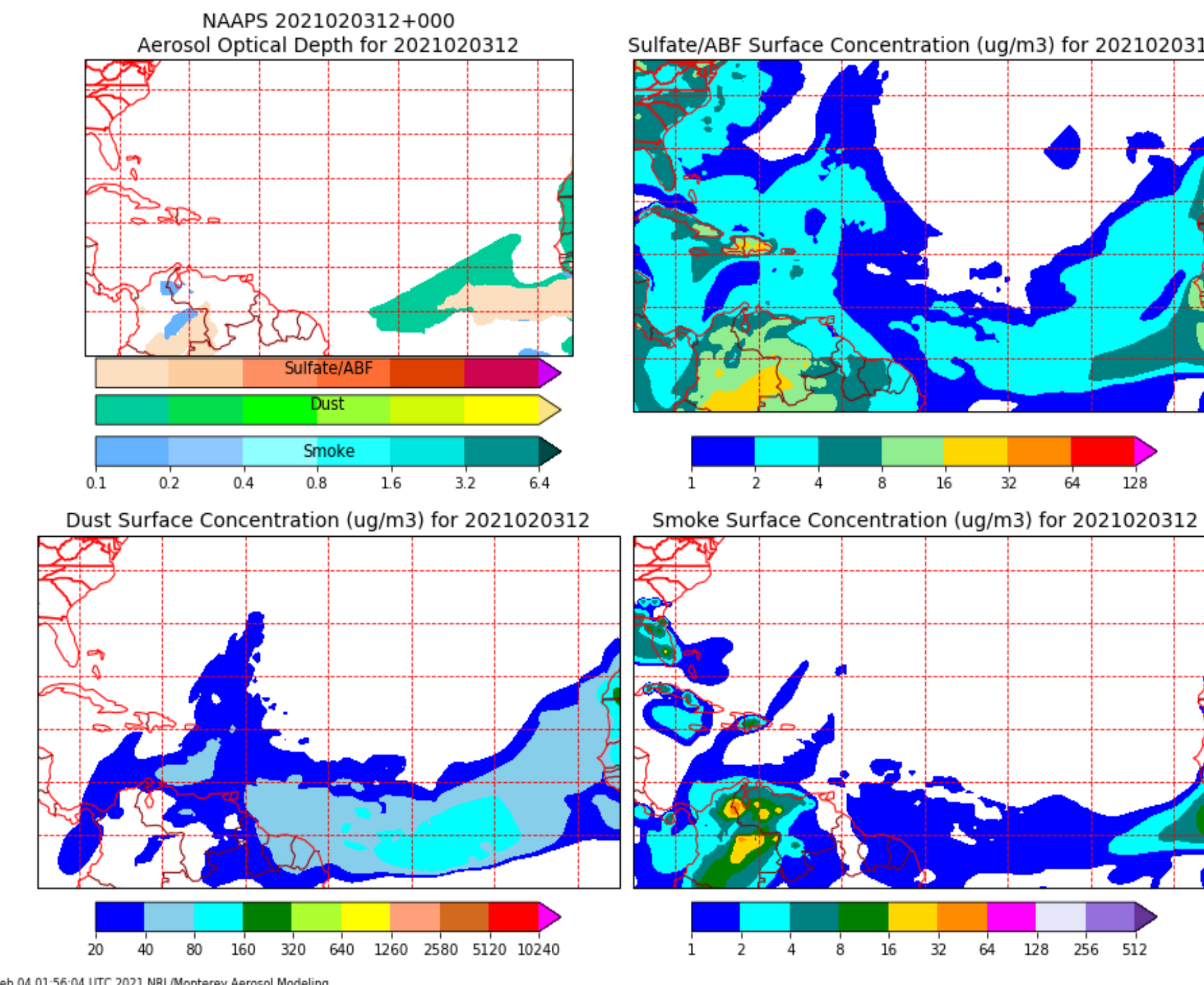
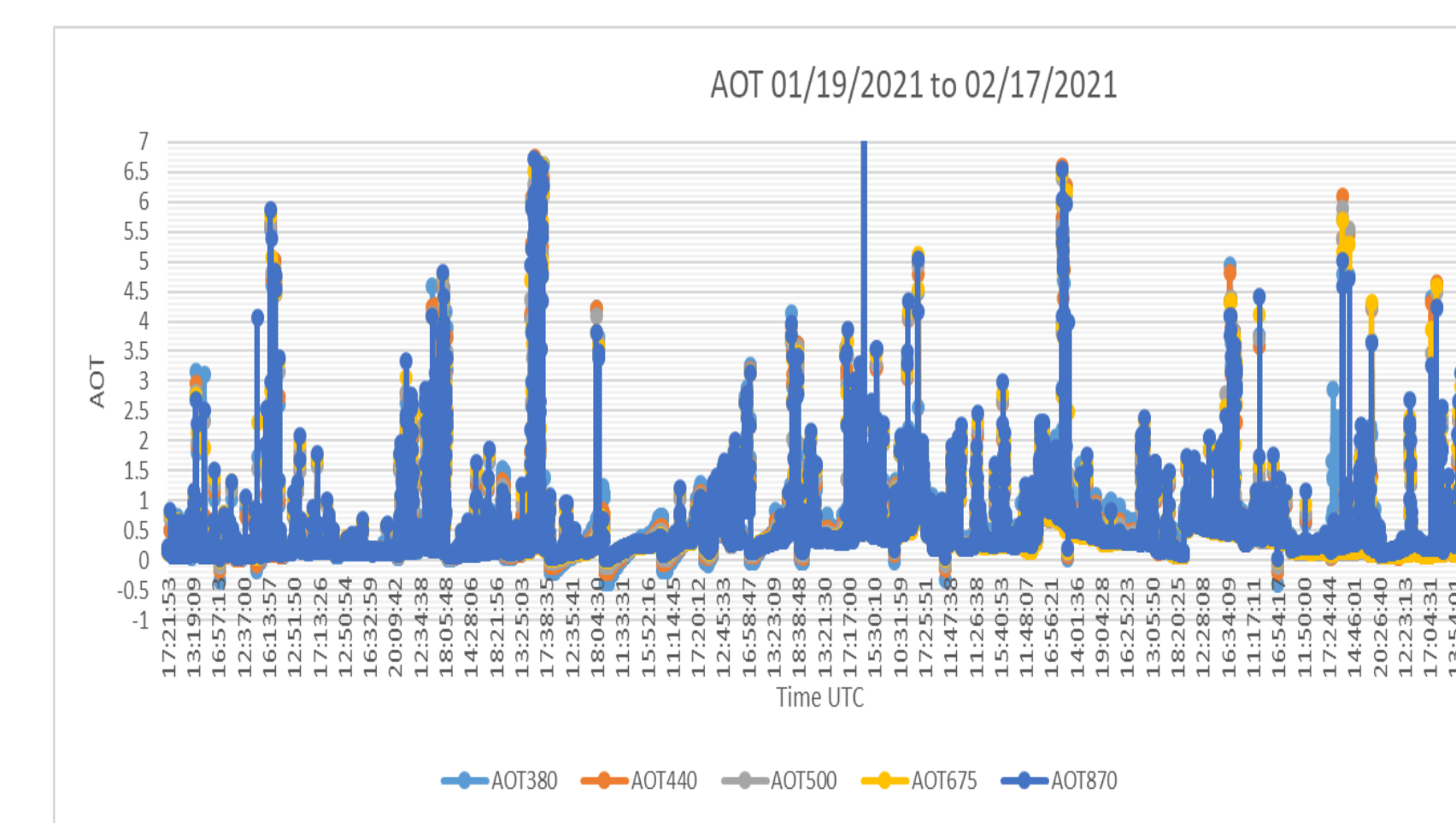


Figure 1: Navy Atmospheric Aerosol Prediction System forecasts for AOT, Sulfate, Dust, and Smoke 02/03/2021



Microtops data showing AOT response to dust events on several wavelengths from January 19, 2021 to February 17, 2021. The 870 nm was the most sensitive wavelength for dust.

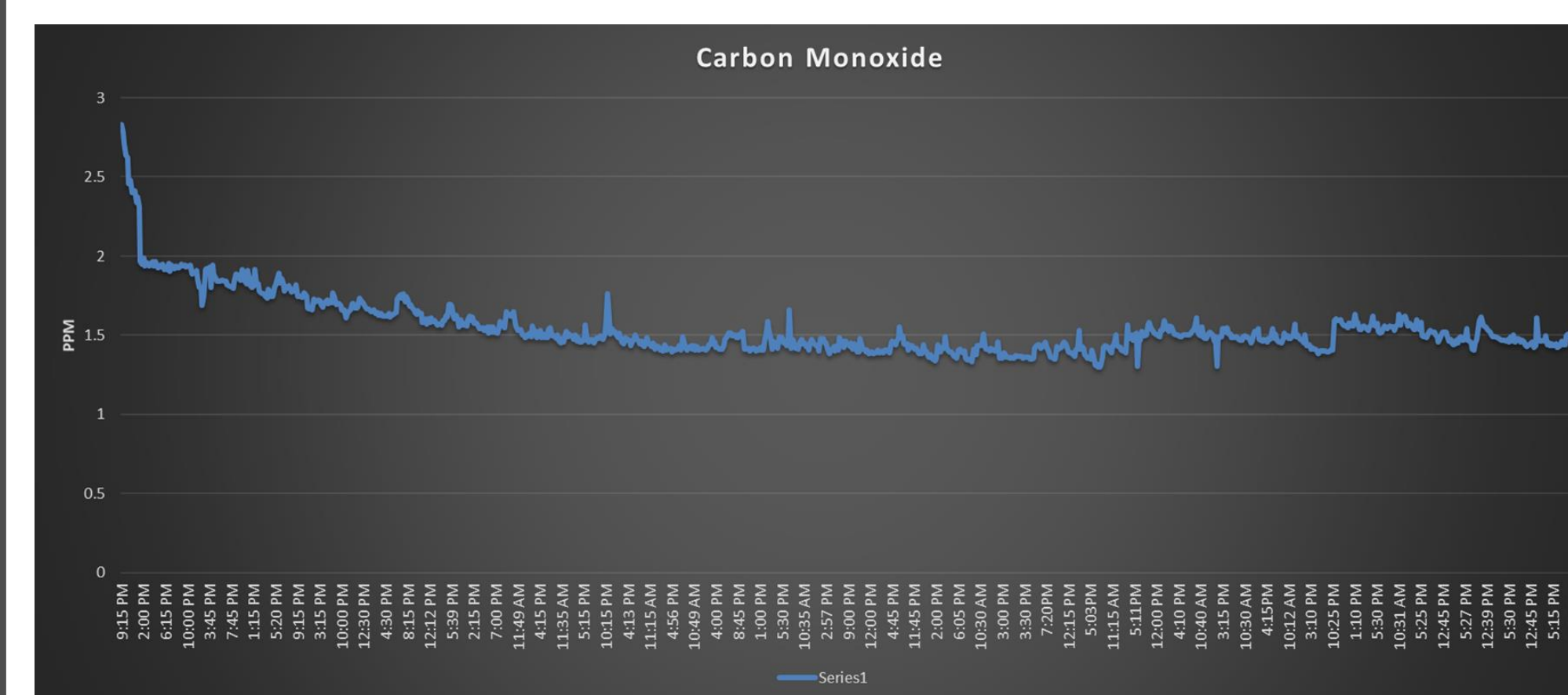
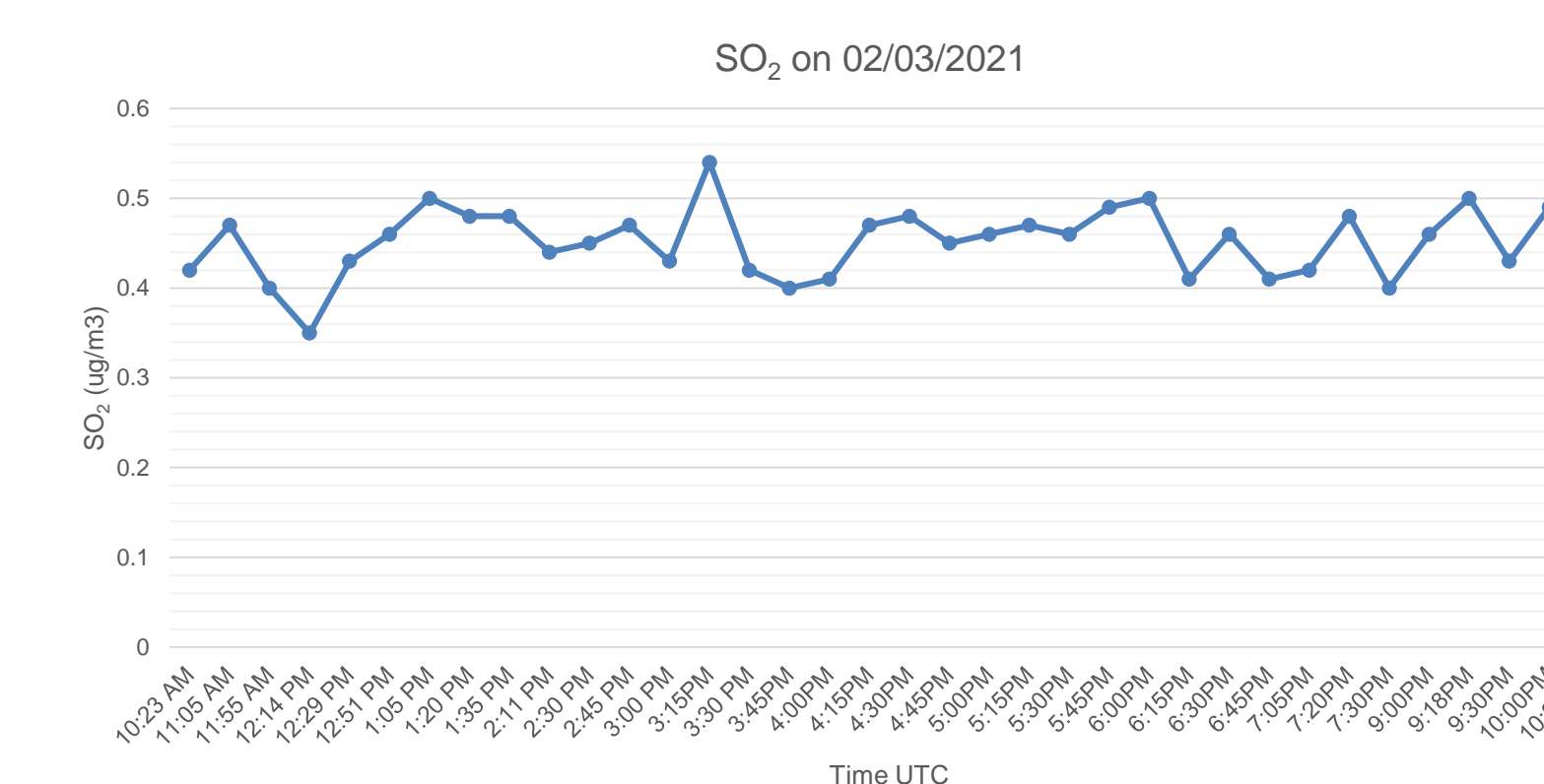
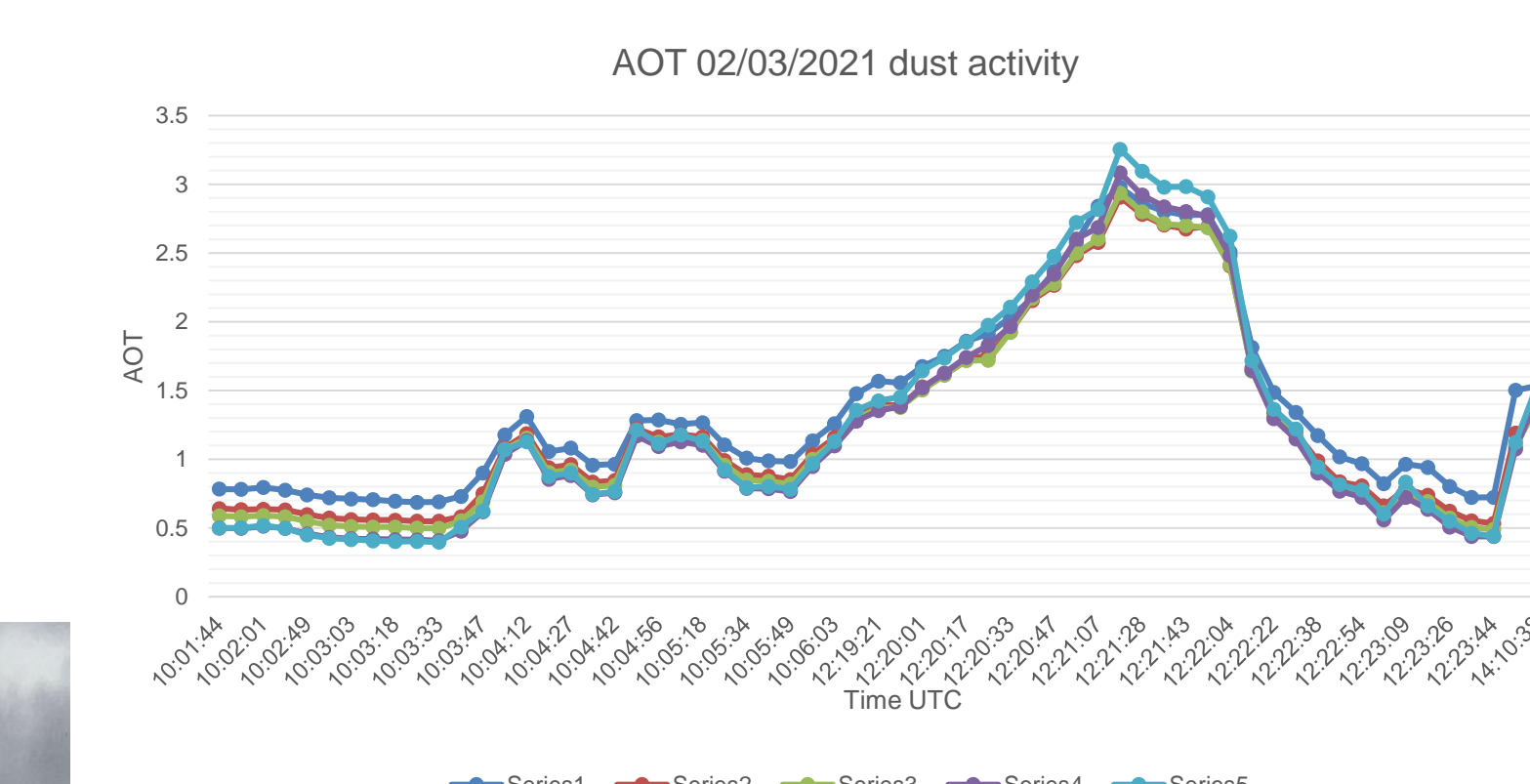


Figure 2: The figure shows carbon monoxide levels over a span of 40 days. The average level carbon monoxide emitted was 1.548 ppm. Towards the beginning of the trip, high levels of carbon monoxide were coming off the coast of the United States.



Sulfur Dioxide observed on 02/03/2021



AOT on the day 02/03/2021

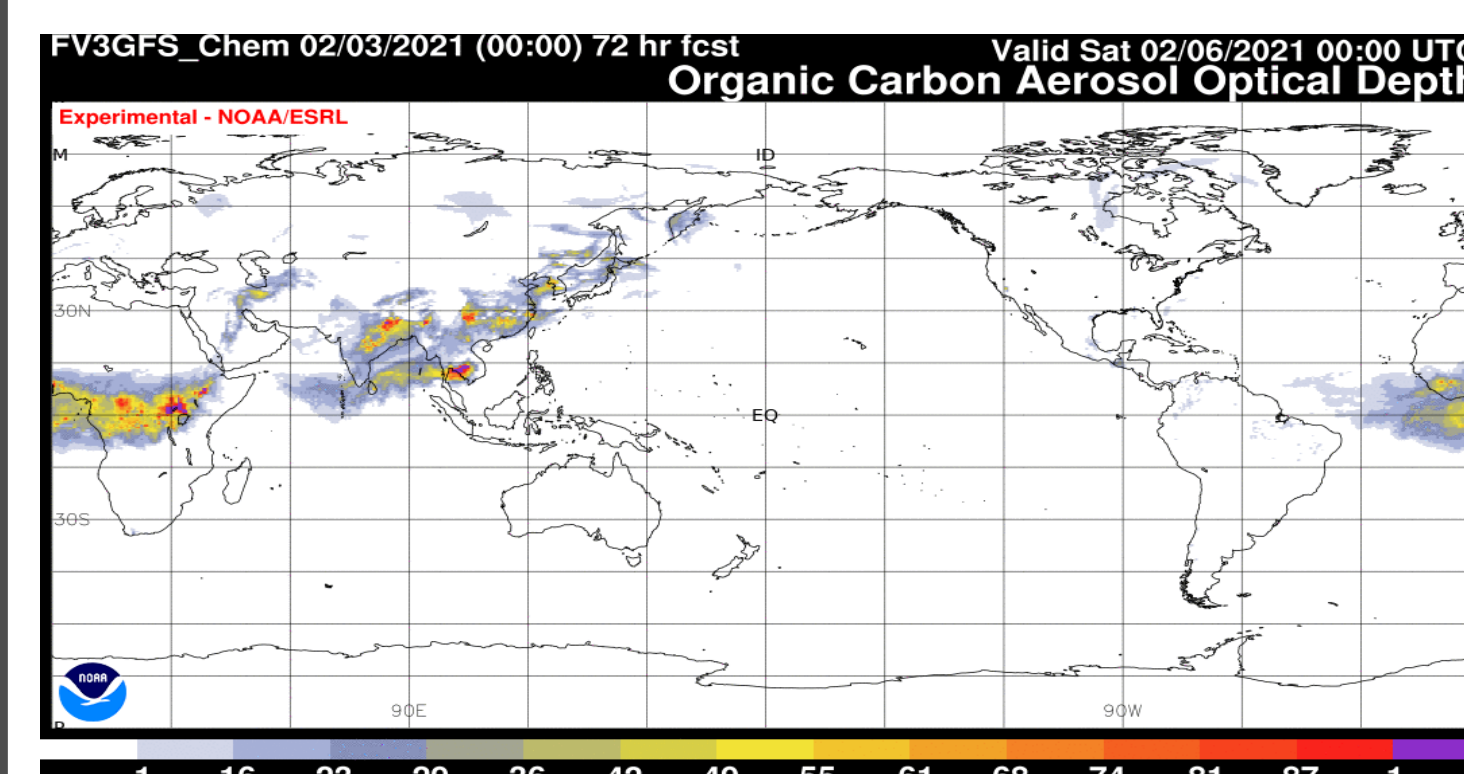


Figure 1a: NOAA Global Forecast System prediction of Organic Carbon Aerosol on 02/06/2021



Figure 1b: Dust photograph taken from the ship on 02/03/2021

Summary

The cruise provided the opportunity to collect air composition measurements in multiple trans-Atlantic dust events. The observations were compared to NWS and NAAPS forecasts. In the remote regions of the Atlantic Ocean, all trace gas concentrations were much lower than their typical continental mean values. The maximum AOT (Aerosol Optical Depth) was observed on 02/03/2021 but without significant increase in sulfur dioxide. On the 3rd of February, we were in a dusty environment which contained not only dust, but also forecasts predicted much greater concentrations of smoke and sulfate. Chemical analysis of the dust samples collected during the cruise will inform our understanding of any smoke-dust mixing that occurred.

References

1. Sulfur dioxide over the western North Atlantic Ocean during GCE/CASE/WATOX. Global Geochemical Cycle M. Luria C. C. Van Valin R. L. Gunter D. L. Wellman W. C. Keene J. N. Galloway H. Sievering J. F. Boatman, December 1990
2. https://aeronet.gsfc.nasa.gov/new_web/Documents/Aerosol1_Optical_Depth.pdf
3. Influence of intentionally mis-pointing on Microtops II readings, mtoperrors01.html, version 1.1b, 30 May 2003/06May2004/05Jan2005. Francis Massen
4. Increasing Ozone over the Atlantic Ocean J. Lelieveld, J. van Aardenne, H. Fischer, M. de Reus, J. Williams, P. Winkler Science 04 Jun 2004: Vol. 304, Issue 5676, pp. 1483-1487 DOI: 10.1126/science.1096777

Acknowledgements

NSF HBCU-UP Grant award # 1923771 Virginia Union University, NASA, Arizona State University, NCAS-M at Howard University provided instrumentation. NCAS-M is funded by NOAA/EPP Cooperative Agreement #NA16SEC4810006." Colour of Weather (CoWx) provided support for student travel