The Use of Unmanned Aerial Vehicle in Detection of Pollution Dispersion and Transport Affected by Maritime Emission in Singapore

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Abstract

Maritime transport represents a significant contributor to air pollution, emitting pollutants including SO_x, NO_x, particulate matter (PM), and volatile organic compounds (VOCs). PM emission from ships contain components including organic aerosols, black carbon (BC) and metals. Ship emissions have negative health and climate impact on coastal regions while reported ship emissions in open waters can vary up to 100%. In addition, shipping emission is also a significant contributor to brown carbon (BrC) that affect climate. Singapore is the second busiest port in the world that is affected by substantial ship emissions, where emissions are transported by sea breeze to city. The uncertainties and discrepancies in the ship emissions measurements pose a challenge to evaluate their health and climate impacts. The mixing, dispersion and transport of pollutants are affected by wind, boundary layers and landscapes. Although ground level emission measurements are extensively studied, pollutant vertical distribution remains uncertain. The growing development of unmanned aerial vehicles (UAV) and low cost sensors provide potential to detect real time three-dimensional emission profile and dispersion. Recent studies implemented UAV for environmental measurements including accidental leak, pollution risk assessment, three-dimensional pollution mapping, plume chasing, and routing site checks. Data collected by UAV can provide insights on pollution distribution and transport in space and time, which can bring insights on health implications and improve atmospheric models. This work delves into the complex relationship between maritime pollution and emission dispersion in Singapore. We developed a multi-sensor drone measurement platform that can measure gas and particulate phase ship emissions. Our preliminary results find variations of BC, BrC, and particle number concentration from 0-50m near ship port. Ongoing investigation will explored the transport of primary emissions from ships to shore. The measurement results can help to improve the understanding of ship emissions, and the performance of regional air quality models.

Early Career Scientist

YES, I am an early career scientist.

IGAC Activities

AMIGO: Analysis of eMIssions usinG Observations, ACAM: Atmospheric Chemistry and the Asian Monsoon, CCMi: Chemistry Climate Model Initiative, MAP-AQ: Monitoring, Analysis and Prediction of Air Quality, Allin-Wayra: Small Sensors for Atmospheric Science, BBURNED: Biomass Burning Uncertainty: ReactioNs, Emissions and Dynamics

IGAC Regional Working Groups

MANGO: Monsoon Asia and Oceania Networking Group