E-Drone: Assessing Cargo Ship Exhaust Emissions Using Low-Cost Multi-Copter Unmanned Aerial Vehicles

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Nowadays over 80% of the volume of international trade in goods is carried by sea. The majority of the ships still run on fossil fuels, causing high levels of pollutant exhaust emissions. Despite this, shipping remains one of the less regulated anthropogenic emissions. Research estimates that 12% of the total relative external costs of international ship traffic are due to air pollution. Below 10 micrometers [PM10] particles can be inhaled, and, selectively, be retained by bronchioles [PM 2.5] and villi along the airways. There is a scarcity of measurement data related to PM emissions, which may be related to the complex and costly conventional measuring methods. E-Drone aimed at E-Drone research aimed at study the effectiveness of using commercially available low-cost Multi-copter Unmanned Aerial Vehicles [UAV] as shipping exhaust monitoring devices in urban stressful hotspots in coastal areas. A Particulate Collection System [PCS] was developed, to be operated on board, for in situ measurement of Aerosol Particulates in the atmospheric boundary layer [ABL]; the PCS allowed assessing the effectiveness of E-Drones in monitoring cargo ships exhaust, comparing with conventional sampling methods that use gravimetric analysis. Two devices were used to collect PM: quartz filters [QM-A, Whatman] and filterless Air-O-Cell® Sampling Cassettes used for bioaerosols prospection. E-Drone collected 8 642 particles per m3, of extremely small sizes, which tend to be those that are more easily inhaled, and which are neglected in a conventional analysis due to their low mass contribution. E-Drone allows to reduce sampling costs and the inability to operate in difficult circumstances, that have resulted in a lack of information for shipping emissions for decades.