

## Report for the year 2020 and future activities

### **SOLAS Taiwan**

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**First things first...Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?**

### **PART 1 - Activities from January 2020 to Jan/Feb 2021**

#### **1. Scientific highlight**

Particulate matter (PM) from atmosphere has aroused wide concern, especially for the size between 1  $\mu\text{m}$  (PM1) and 10  $\mu\text{m}$  (PM10). This is because PM could have various adverse effects on human health and on the climate. PM concentration has increased and becomes a very serious air pollution problem in past decades for many cities. Understanding the source to sink of the PM is critical to understand the impacts of PM on the terrestrial and ocean ecosystems, as well as on the global climate. Previous studies show that fossil fuel combustion is one of the major sources releasing PM into the atmosphere. Oceans are a major sink of the atmospheric PM which enters the surface oceans as the suspended particles. Yet, the removal mechanisms in the oceans are still poorly understood. Noting, the presence of PM1 in marine biota has never been reported since this study. Sea anemones are opportunistic suspension feeders which are expected to incorporate and accumulate PM1 in their bodies. Used anemones as an example, this study show for the first time that the PM released from fossil fuel burning accumulates in marine biota. This study shows that PM1 was detected in 21 of the 22 sea anemones collected from Taiwan and Southeast China, with a depth of intertidal zone to 1000m. Most of the PM1 were detected in endodermal layers. It was estimated that 8-24% of the PM1 in the sea anemones came from the fossil fuel burning, and the bioaccumulation factor was between 5 and 7 orders of magnitude. Of note is that, PM1 was detected in sea anemone eggs and in brooding and released juveniles, indicating that PM could be transferred to the offspring. Such result suggests that PM1 accumulation in marine biota is a long-lasting issue once it occurs.

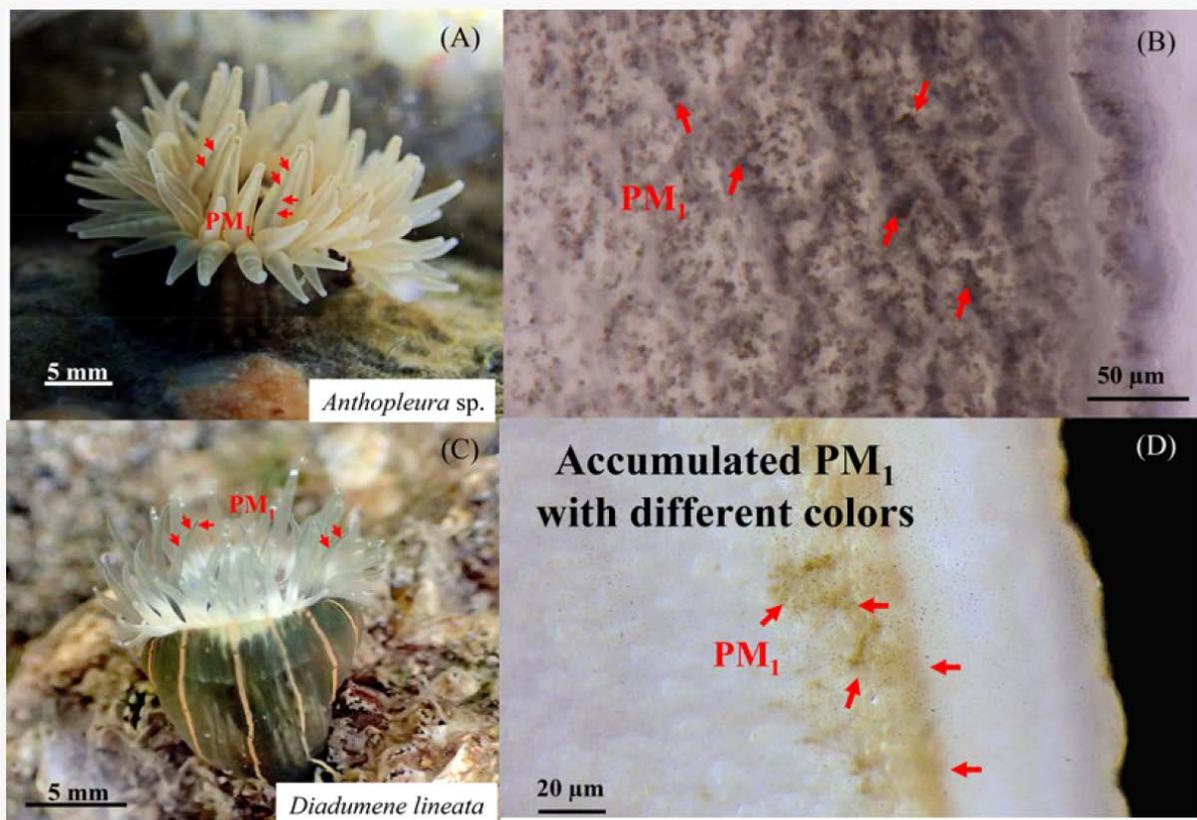


Figure: Particulate matter (PM) in sea anemone bodies. (A) *Anthopleura* sp. From Kuishantao Islet collected in June 2018. (B) PM in a tentacle. (D) *D. lineata* from Taichung Harbor collected in July 2018. (D) PM in a tentacle.

Citation: L.L Liu, C.Y. Hsieh, M.Y. Kuo, C. Chen, Y.H. Shau, H.K. Lui, C.S. Yuan, and C.T.A. Chen. 2020. Evidence for fossil fuel PM<sub>1</sub> accumulation in marine biota, *Environmental Science and Technology*, 54, 4068-4078.

**2. Activities/main accomplishments in 2020 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).**

Three one-year-based proposals related to SOLAS in Taiwan have been funded by the Ministry of Science and Technology (MOST) of Taiwan. The funded projects are as follows (2020/8/1-2021/7/31):

1. Impact of sea spray aerosol on enhancing PM<sub>2.5</sub> formation in a coastal City
2. Characterization of the chemical composition, physico-chemical properties and anthropogenic effects of sea spray aerosols and air-sea microlayer using aerosol spectroscopy and mass spectrometric approaches.
3. Public Promotion of Key Sustainability Competencies through Education for Sustainable Development in the Contexts of Human, Ocean, Land, and Air.

Led by the Taiwan representative and the Aerosol Science Research Center at the National Sun Yat-sen University, an integrated three-year proposal "From aerosols towards understanding of the influences of a harbor-industry city on the air quality, climate changes, environmental ecosystem and their social impacts" was submitted to the Ministry of Science and Technology (MOST) of Taiwan at the

end of 2020. The integrated 3-year proposal covers wide ranges of research interests, such as atmospheric chemistry, marine chemistry, marine ecosystem, management, education...etc.

The titles of the 10 subprojects are as follows:

1. Impact of sea spray aerosol on enhancing PM<sub>2.5</sub> formation in a coastal City
2. Characterizing the chemical composition, physico-chemical properties and anthropogenic effects of sea spray aerosols and air-sea microlayer via novel aerosol spectroscopy and mass spectrometric approaches
3. Public promotion of key sustainability competencies through education for sustainable development in the contexts of human, ocean, land, and air.
4. NSYSU multi-channel aerosol LIDAR for observing spatial distributions of aerosols and exhaust emissions from ships near coastal areas and Kaohsiung harbor.
5. Impact of the sea-air interface on the mass transport, equilibrium partition, and health-risk potential of contaminants in a coastal area of southern Taiwan
6. Using different metal composite graphene quantum dots to upgrade marine oil for pollution emission reduction research
7. Contribution of oceanic efflux of SO<sub>2</sub> precursor and refractory dissolved organic carbon via sea spray aerosol in an industrial waterfront
8. Studying the relevance between biogenic composition of coral reef surface microlayer, sea spray aerosol properties and environmental quality
9. Particle number concentration and nano/micron size distribution of nucleated fresh aerosol and accumulated aged aerosols in the marine and a coastal city
10. Marine chlorine and the production of secondary pollutants in coastal cities

**3. Top 5 publications in 2020 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.**

1. L.L Liu, C.Y. Hsieh, M.Y. Kuo, C. Chen, Y.H. Shau, H.K. Lui, C.S. Yuan, and C.T.A. Chen. 2020. Evidence for fossil fuel PM<sub>1</sub> accumulation in marine biota, *Environmental Science and Technology*, 54, 4068-4078.
2. H.Y. Wang, S.F. Shen, Y.S. Chen, Y.K. Kiang, and M. Heino. 2020. Life histories determine divergent population trends for fishes under climate warming. *Nature Communication*, 11, 4088, doi:10.1038/s41467-020-17937-4.
3. B.S. Wang, and T.Y. Ho, 2020. Aerosol Fe cycling in the surface water of the Northwestern Pacific ocean. *Progress in Oceanography* **183:102291**, doi:10.1016/j.pocean.2020.102291
4. Y.C. Chen, J.L.F. Li, W.L. Lee, D.J. Diner, M.J. Garay, J.H. Jiang, Y.H. Wang, J.Y. Yu, O.V. Kalashnikova. 2020. Evaluation of sea salt aerosols in climate systems: global climate modeling and observation-based analyses. *Environmental Research Letters*, 15, doi:10.1088/1748-9326/ab751c.
5. M.T. Chuang, M.C.G. Ooi, N.H. Lin, J.S. Fu, C.T. Lee, S.H. Wang, M.C. Yen, S.S.K. Kong, W.S. Huang. 2020. Study on the impact of three Asian industrial regions on PM<sub>2.5</sub> in Taiwan and the process analysis during transport. *Atmospheric Chemistry and Physics*, 20, 14947-14967, doi:10.5194/acp-20-14947-2020

**4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2020? If yes, who? How did you engage?**

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<b>PART 2 - Planned activities for 2021 and 2022</b>
<b>1. Planned major national and international field studies and collaborative laboratory and modelling studies (incl. all information possible, dates, locations, teams, work, etc.).</b> An integrated three-year proposal “From aerosols towards understanding of the influences of a harbor-industry city on the air quality, climate changes, environmental ecosystem and their social impacts” was submitted (10 subprojects) to the MOST of Taiwan at the end of 2020. The integrated proposal is expected to start on 1 <sup>st</sup> August, 2021. It covers wide range of research interests, including atmospheric chemistry, marine chemistry, marine ecosystem, management, as well as education. We welcome international collaborations.
<b>2. Events like conferences, workshops, meetings, summer schools, capacity building etc. (incl. all information possible).</b> Two to three regular meetings will be organized by the Taiwan representative in 2021. The upcoming meeting is scheduled in the April of 2021 in the Annual Ocean Science Meeting of Taiwan.
<b>3. Funded national and international projects/activities underway.</b> The funding is expected to come mainly from the MOST of Taiwan, and partly from the National Sun Yat-sen University, as well as different industry-academia cooperative research projects of the participants.
<b>4. Plans / ideas for future national or international projects, programmes, proposals, etc. (please indicate the funding agencies and potential submission dates).</b> SOLAS in Taiwan works closely with the University of California, San Diego (UCSD). Both sides are seeking for the opportunity to have a joint-international project in coming years. The progress is behind schedule in 2020 due to the influence of the pandemic of the COVID-19.
<b>5. Engagements with other international projects, organisations, programmes, etc.</b> The integrated 3-year proposal includes the collaborations between Taiwan SOLAS and UCSD. Parts of the proposal is planned to be conducted with the Atmospheric Aerosol Research Center, UCSD.

<b>Comments</b>
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