2020 Advanced Institute on Health Investigation
and Air Sensing for Asian Pollution (AI on Hi-ASAP)
On-line, October 5, 6, 8 & 15, 2020
Academia Sinica, Taipei, Taiwan

Updates on Health Investigation and Air Sensing for Asian Pollution (Hi-ASAP)

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Overview of Hi-ASAP

- a regional transdisciplinary research initiative which is developed under the umbrella of International Global Atmospheric Chemistry project – Monsoon Asia and Oceania Networking Group (IGAC-MANGO)
  - IGAC is a global research project under Future Earth, a global network of scientists, researchers, and innovators collaborating for a more sustainable planet
  - Future Earth emphasize: international multidisciplinary collaboration, solution-oriented science, and stakeholder engagement
- endorsed by Regional Advisory Committee of Regional Centre for Future Earth in Asia and recognized as a great bottom up initiative that fits well with Future Earth in the region (October 2019)

Overview of Hi-ASAP (2)

- Main goal: **to provide scientific evidences to support effective policy actions to reduce air pollution levels, in particular $PM_{2.5}$, in this region by applying newly developed low-cost sensors**
- The first phase spans five years:
  - preparation (2019), start-up (2020), intensive monitoring (2021), data analysis (2022), and publication (2023)
- With research groups from 12 different areas in the Asia and the Pacific (AP) region **(October 2020)**

Science Steering Committee (SSC)

Study Area	Full Name	Role	Organization
Bangladesh (BD)	Abdus SALAM	Leader / AC	Department of Chemistry, University of Dhaka
	Mahbuba YESMIN	Health	Internal Medicine Department, Apollo Hospital Dhaka
Hong Kong (HK)	Kin-Fai HO	AC &Health	JC School of Public Health and Primary Care, Faculty of Medicine, The Chinese University of Hong Kong
Indonesia (ID)	Puji LESTARI	Leader / AC & Health	Faculty of Civil and Environmental Engineering, Institute Teknology Bandung
	Dwi AGUSTIAN	Health	Department of Public Health, Faculty of Medicine, Universitas Padjadjaran
Korea (KR)	Kiyoung LEE	Leader / AC & Health	Department of Environmental Health Sciences, Seoul National University
Malaysia (MY)	Mohd Talib LATIF	Leader / AC; Co-Chair of SSC	School of Environmental and Natural Resource Sciences, Universiti Kebangsaan Malaysia
	Mazrura SAHANI	Health	Center for Health and applied Sciences, National University of Malaysia
Mongolia (MN)	Chonokhuu SONOMDAGVA	Leader / AC	Department of Environmental Sciences and Forest Engineering, National University of Mongolia
	Enkhjargal ALTANGERE	Health	Public health, Ach Medical University
Myanmar (MM)	Ohnmar May Tin HLAING	Leader / AC & Health; Co-Chair of SSC	Environmental Quality Management Co., Ltd
Philippines (PH)	Maria Obiminda L. CAMBALIZA	Leader / AC	School of Science and Engineering, Ateneo de Manila University
	John Q. WONG	Health	Ateneo De Manila University
Taiwan (TW)	SC Candice LUNG	Leader / AC & Health; Chair of SSC	Research Center for Environmental Changes, Academia Sinica
	Wen-Cheng Vincent WANG	AC	Research Center for Environmental Changes, Academia Sinica
Thailand (TH)	Kim OANH	Leader / AC	School of Environment, Resources and Development, Asian Institute of Technology
	Kraichat TANTRAKARNAPA	Health	Faculty of Tropical Medicine, MAHIDOL Medicine
Vietnam (VE)	Thi Hien TO	Leader / AC	University of Science, Vietnam National University Ho Chi Minh City
	Tran Ngoc DANG	Health	University of Medicine and Pharmacy at Ho Chi Minh City (UMP HCMC)
Australia (AU)	Fabienne REISEN	Analysis	Commonwealth Scientific and Industrial Research Organisation (CSIRO)

* Dr. Ming-Chien Mark Tsou, Research Center for Environmental Changes, Academia Sinica, Taiwan, as Executive Secretary starting on March 1, 2020

Progress report on MOU/MOA with Academia Sinica

Countries	MOU/MOA status			
	MOU/MOA have signed with both sides	MOU be postponed	MOU/MOA mailing	MOU/MOA reviewing
Bangladesh				V
Indonesia			V	
Malaysia	V			
Mongolia		V		
Philippines		V		
Thailand			V	
Vietnam	V (MOU is sending back to AS)			

Research Aspect	Working group	Participating Group	Conveners
Data	1. Data quality	All groups	Kim Oanh & WC Vincent Wang
	2. Sensor QA/QC (fixed location (f) and portable (p))	Bangladesh (f & p)	Abdus Salam & Kin Fai Ho
		Hong Kong (f & p)	
		Taiwan (f & p)	
		Malaysia (f)	
Environmental Monitoring & Chemical Analysis	3. Asian-type cooking (outdoor, indoor)	Taiwan (i & o)	Kraichat Tantrakarnapa
		Vietnam (i & o)	
		Bangladesh (i)	
		Thailand (o)	
	4. Regional $PM_{2.5}$ transport (biomass burning: forest fire, agricultural burning)	Australia	Mohd Talib Latif & Puji Lestari
		Indonesia	
		Malaysia	
		Myanmar	
		Thailand	
		Vietnam	
	5. Community source contributions (Asian-type transportation)	Bangladesh	Maria Obiminda L. Cambaliza & SC Candice Lung
		Malaysia	
		Myanmar	
		Philippines	
		Taiwan	
		Vietnam	

Research Aspect	Working group	Participating Group	Conveners
Exposure-Health Evaluation	6. Lung functions	Indonesia	Ohnmar May tin Hlaing &
		Malaysia	Mazrura Sahani
		Myanmar	
		Vietnam	
	7. Heart indicators with smart watch	Bangladesh	Mahbuba Yesmin &
		Indonesia	SC Candice Lung
		Malaysia	
		Myanmar	
		Taiwan	
		Thailand	
		Vietnam	
	8. Heart indicators with Rooti	Bangladesh	SC Candice Lung
		Indonesia	
		Korea	
		Malaysia	
		Myanmar	
		Philippines	
		Taiwan	
		Thailand	
		Vietnam	
	9. Morbidity records	Bangladeshi	Dwi Agustian
		Indonesia	
		Malaysia	
		Thailand	
		Vietnam	

Research Aspect	Working group	Participating Group	Conveners
Exposure Assessment	10. Exposure	48-hour: Bangladesh	SC Candice Lung &
		Korea	Kiyoung Lee
		Taiwan	
		Thailand	
		Vietnam	
		Shorter-term:	
		Indonesia	
		Malaysia	
		Myanmar	
		Philippines	
Source Characterization (Chemical analysis and Toxicity Evaluation)	11. Filter sample analysis	All Groups	Fabienne Reisen &
		In particular:	Kin Fai Ho
		Australia	
		Bangladeshi	
		Hong Kong	
		Indonesia	
		Malaysia	
		Thailand	
		Vietnam	

Capacity Building for Hi-ASAP

- For international comparison, a common methodology is needed
  - a series of training workshops are needed to transfer the theory, knowledge, and application niches to researchers in H-ASAP to apply these common methodologies which are originally rooted from the developed countries (ex. Harvard T.H. Chan School of Public Health)

Year	Stage	Capacity building (Advanced Institute)
2019	Preparation (apply for funding)	Training on data collection protocols for environment, exposure and health
2020	Start-up (apply for Institution Review Board's approval, IRB)	Training on data cleaning and analysis for environmental and exposure data
2021	Intensive monitoring	Training on data cleaning and analysis for health data and exposure-health evaluation
2022	Data analysis	discussion for comparing exposure patterns and exposure-health relationships
2023	Publication	discussion for chemical analysis and meta analysis

Objectives of Advanced Institute (AI) on Hi-ASAP

- provide young to mid-career practitioners and researchers from the research groups interested in the Hi-ASAP initiative in the AP region with the knowledge, experience, and hands-on practices about the required techniques and methodologies, participants should have
  - Developed an understanding of the concepts, principles, and practices of low-cost sensing technologies for $PM_{2.5}$ and health indicators;
  - Enhanced comprehension of the applications of systems thinking on collaboration focusing on environmental sensing and health evaluation among scientists of different fields and between scientists and stakeholders;
  - Developed capacity on the application of the sensor technology on regional pollution transport, community source contribution quantification, exposure assessment, and health-indicator evaluation to design a study to reduce air pollution health risks

Resources

- Wang, W.C.V.; **Lung, S.C.C.***; Liu, C.H.; Shui, C. K. (2020.06) Laboratory evaluations of correction equations with multiple choices for seed low-cost particle sensing devices in sensor networks. *Sensors,* 20(13): 3661. DOI: 10.3390/s20133661. IF: 3.257 3.531 **(sensor evaluation)**
- **Lung, S. C. C.***; Wang, W.C.V.; Wen, T.Y.J.; Liu, C.H.; Hu, S.C. (2020.05) A versatile low-cost sensing device for assessing $PM_{2.5}$ spatiotemporal variation and quantifying source contribution. *Science of the Total Environment*,716. DOI: 10.1016/j.scitotenv.2020.137145. IF: 6.551 3.531 **(community source evaluation)**
- **Lung, S. C. C.***; Chen, N.; Hwang, J. S. Hu, S.C.; Wang, W.C.V.; Wen, T.Y.J.; Liu, C.H. (2020.08) Panel study using novel sensing devices to assess associations of $PM_{2.5}$ with heart rate variability and exposure sources. *Journal of Exposure Science and Environmental Epidemiology.* DOI: 10.1038/s41370-020-0254-y. IF: 3.531 **(exposure-health evaluation)**
- Sinaga, D.; Setyawati, W.; Cheng, F.Y.; **Lung, S. C. C.*** (2020.08) Investigation on daily exposure to $PM_{2.5}$ in Bandung City, Indonesia using low-cost sensor. *Journal of Exposure Science and Environmental Epidemiology*. DOI: 10.1038/s41370-020-0256-9. IF: 3.531 **(exposure factor evaluation)**

Any question?

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Member inclusion criteria

- (a) each participating research group has to have two partners with one in atmospheric chemistry and one in public health unless the leader has background in both fields;
- (b) this group is working on $PM_{2.5}$ research in the Asia and the Pacific area with necessary training to conduct panel-type epidemiological study to collect first-hand data to evaluate exposure-health relationships;
- (c) this group is passionate about air pollution and health research and ready to conduct research on this topic with the understanding that they will apply for funding to support their own study in their study area;
- (d) this group agrees on adopting common methodologies and observing data policy. The representatives from each research group participating in the meetings and related training workshops should sign confidentiality agreement to refrain from disclosing any information to third parties about the details of the study plan; and
- (e) the research group fails to abide to the aforementioned criteria at any stage of planning and implementation automatically lose the membership of Hi-ASAP

Data Policy

- Details are listed in the "Science and Implementation Plan of Hi-ASAP"
  - Common database
  - Data quality assurance/ quality control (QA/QC)
  - Data collection
  - Data upload
  - Institution review board (IRB) approval
  - Confidentiality
  - Credit sharing
  - Manuscript review
  - Data grace period
  - Publication grace period

Road map (1)

	Phase I (2019-2023)
Targeted population	General public with susceptible population (ex. elderly) with certain high-exposure periods, or high-exposure occupational groups
Anticipated scientific findings	
Exposure-health evaluation	(a) $PM_{2.5}$ damage coefficients for acute impacts in different seasons across Asia and the Pacific (AP) areas for the study population
Exposure assessment	(b) Identify high-exposure activities and high-contribution exposure sources of $PM_{2.5}$ for the study population
Environmental and community monitoring	(c) Quantify $PM_{2.5}$ community source contributions or investigate regional $PM_{2.5}$ transport
Chemical analysis and toxicity evaluation	(d) Evaluate chemical compositions and toxicity potentials for chosen high- exposure sources in different AP areas

Road map (2)

	Phase I (2019-2023)
Practical policy recommendations	1. Corresponding to the above scientific findings (a) Recommendations for short-term $PM_{2.5}$ standard/guidelines (b) Recommendations for priority control for certain high-exposure sources; (c) Recommendations for priority control for certain community sources; Recommendations for control for regional $PM_{2.5}$ pollution sources (a) Recommendations for control for certain sources (based on chemical and toxicity evaluation)
Stakeholder engagement (at different stages: in the beginning, during and in the end of research project)	Local community, occupational groups, Non-governmental organizations (NGOs), local/central policy makers, national and international environment and health agencies (ex. provide health promotion materials for behavior change)

Timetable for Phase I (2019-2020)

Year		Capacity building	Exposure- health Evaluation	Exposure assessment	Environmental and community monitoring	Chemical analysis and toxicity evaluation	Data analysis
2019	Preparation (apply for funding), engaging sensor manufacturers	Training on data collection protocols for environment, exposure and health	(1) provide QA/QC data for the selected $PM_{2.5}$ sensing devices and health devices by the end of year	The same as (1) Prepare questionnaires and Time-activity-diary	The same as (1)	(2) Identify priority	
2020	Start-up						
	First half year; engaging local communities or occupational groups, policy makers	Training on data cleaning and analysis for environmental and exposure data	(1) apply for institution review board (IRB); (2) conduct pilot study for 5 subjects and try out indoor/outdoor/personal monitoring, questionnaire collection, and health evaluation	The same as (2)	(3) set-up environmental sensing devices	(4) collect test samples	
	Second half year; engaging local communities or occupational groups, policy makers		(5) recruit more subjects; (6) carry out field works (questionnaire collection and health evaluation)	(6) carry out field works (indoor/outdoor/ personal monitoring, time-activity diary)	(6) carry out field works (environment and community monitoring)	(7) analyze test samples	(8) data analysis for pilot study; (9) prepare manuscripts for subsets of data, ex. environment and community monitoring

Note: data and associated QA/QC results should be uploaded every half year beginning at June 2020; each research group should submit sample files to databases by June 2020 and submit raw and clean datasets from pilot study starting December 2020

Timetable for Phase I (2021)

Year		Capacity building	Exposure- health Evaluation	Exposure assessment	Environmental and community monitoring	Chemical analysis and toxicity evaluation	Data analysis
2021	Intensive monitoring						
	First half year; engaging study population	Training on data cleaning and analysis for health data and exposure-health evaluation	(1) carry out and finish field works for the first season	The same as (1)	The same (1)	(2) collect filters and analyze key compositions for the first season	(3) Clean data and compile into database
	Second half year; engaging study population		(4) carry out and finish field works for the second season	The same as (4)	The same as (4)	(5) collect filters and analyze key compositions for the second season	The same as (3); (6) integrate environmental, exposure, and health data; (7) prepare manuscripts

Timetable for Phase I (2022)

Year		Capacity building	Exposure- health Evaluation	Exposure assessment	Environmental and community monitoring	Chemical analysis and toxicity evaluation	Data analysis
2022	Data analysis						
	First half year; engaging policy makers and study population		(1) evaluate exposure-health relationships	(2) assess exposure levels, patterns, behaviors, and sources of short-term or peak exposures	(3) assess contribution of community sources and characterize regional $PM_{2.5}$ transport	(4) chemical analysis	
	Second half year; engaging policy makers and study population	discussion for comparing exposure patterns and exposure-health relationships	(6) write up manuscripts for individual study area; (7) compile statistical results (damage coefficients, source contributions, etc.) into databases for meta analysis	The same as left-column (6) (7)	The same as left-column (6) (7)	(8) chemical analysis results	(5) evaluate potential short-term $PM_{2.5}$ levels as a short-term standard; (9) meta analysis and synthesis

Timetable for Phase I (2023)

Year		Capacity building	Exposure- health Evaluation	Exposure assessment	Environmental and community monitoring	Chemical analysis and toxicity evaluation	Data analysis
2023	Publication						
	First half year; engaging policy makers, media, and study population		(1) write up manuscripts	The same as (1)	The same as (1)		(2) meta analysis and synthesis
	Second half year; engaging policy makers, media, and study population	discussion for chemical analysis and meta analysis	(3) conduct data analysis for $PM_{2.5}$ compositions	The same as (3)	The same as (3)	The same as (3)	(4) prepare manuscripts