Australia-China Centre for Air Quality Science and Management

Annual Report

2019

1. Introduction

The ACC-AQSM was launched at the CRAESs in Beijing, in December 2014.

Our aim is to provide a platform for joint research to further understanding of the multi-dimensional problem of air pollution at all scales and its impact on human health and the environment, to provide technological and innovative solutions to the problem and continued effective monitoring of pollution sources, and to provide input into national policies that enable informed, efficient and regulated management and control.

The Centre operates as a virtual centre based at three offices, the: QUT (QUT), CRAES (CRAES), and Hong Kong University of Science and Technology (HKUST) and manage all research activities under the Centre banner established at each of the partner institutions. The Managing Offices are established to run the day to day activities of the Centre.

The ACC-AQSM was launched on Friday December 5, 2014 at Beijing's Chinese Research Academy for Environmental Sciences (CRAES)

2. The Centre

Board

The Board provides strategic advice to the Executive Committee on the full range of Centre activities and ensure that the Centre has clear objectives and makes the most effective and efficient use of resources in order to achieve these objectives. The Board consists of two Chairs (the inaugural chairs in Australia: Prof. Ian Mackinnon, QUT; and in China, Professor Jiming Hao, Tsinghua University), a Vice-Chair (Professor Joseph Lee, HKUST). It also includes representatives from some of the partner institutions and relevant stakeholders.

Executive Committee

The Executive Committee consists of three Directors (the inaugural Directors in Australia: Professor Lidia Morawska, QUT; in China, Professor Fahe Chai, CRAES; in China HK, Prof. Christopher Chao, HKU). The Deputy-Directors (or Executive Committee Members) will represent the partner institutions. The Executive Committee is established as the primary decision-making forum for the collaborative Centre and maintains close contact with the Board between Board meetings in ways the Executive Committee considers appropriate, or the Board determines. The Executive Committee keeps the Board informed of important issues.

Member Organisations – China

- Chinese Research Academic of Environmental Science (CRAES)
- East China University of Science and Technology (ECUST)
- Fudan University (FDU)
- Hong Kong City University (HK CityU)
- Hong Kong Polytechnic University (HK PolyU)
- Hong Kong University of Science and Technology (HKUST)
- Jinan University (JNU)
- Peking University (PKU)
- Shanghai Research Academy of Environmental Sciences (SAES)
- Tsinghua University (TU)

Member Organisations – Australia

- CSIRO Oceans and Atmosphere (CSIRO)
- Curtin University (CU)
- QUT (QUT)
- University of Sydney (USyd)

Affiliated Member Organisations

- Hong Kong University (HKU)
- University of New South Wales (UNSW)

Key Collaborating Organisations

Australia

- Department of Environmental Science (DES), Queensland Government

China

- Center for Disease Control and Prevention
- Clean Air Asia
- Shanghai Environmental Monitoring Centre

Global

- Clean Air Asia Centre
- World Health Organisation

Research Themes

- Theme 1: **Source Characterization and Emissions**
- Theme 2: **Pollution Sources, Dynamics, & Atmospheric Impacts (or Processes)**
- Theme 3: **Exposure, Health Effects & Wellbeing**
- Theme 4: **Airborne Infection Spread & Control**

Executive Committee / Research Leadership Teams

- Progress in organisation within the Teams:

  - Planning
  - Internal co-ordination
  - Training
  - Research funding
  - External collaboration
  - Communication
  - Implementation

3. Communication

News

News sent to the members of the Centre during the course of 2018:

- **14 January 2019:** Announcement of the 3rd Mini ACC-AQSM Symposium!
- **24 January 2019:** 3rd Mini ACC-AQSM Symposium Success!
- **30 January 2019:** Happy Spring Festival to ACC-AQSM Members!
- **7 March 2019:** University of Cassino Master of Science Opportunity
- **18 March 2019: C**itations of papers from our *STOTEN Special Issue: Air Quality in China: Current and Emerging Challenges*.
- **8 May 2019:** Annual Meeting 2019 Announcement!
- **3 July 2019:** JNU visit at QUT, and establishment of a new joint-lab!
- **26 July 2019:** JNU visit to ILAQH QUT
- **19 August 2019:** Annual Meeting 2019 UPDATE!
- **3 September 2019:** REGISTER for the Annual Meeting 2019!
- **18 October 2019:** Congratulations to Lidia and Wei!
- **11 November 2019:** An international team of experts published a White Paper on "*Ambient ultrafine particle evidence for policy makers*".
- **11 November 2019:** Program is available for the 5th Annual Conference of the ACC-AQSM.
- **22 November 2019:** Program is available for the 4th Mini ACC-AQSM Symposium.
- **25 November 2019:** Annual Meeting 2019 Success!
- **2 December 2020:** Mini Symposium Success!

COMMENT

A woman wears a protective face mask while walking in Beijing.

Face masks could raise pollution risks

People can get a false sense of security from flimsy gauze, and linger too long outdoors in toxic air, argue **Wei Huang** and **Lidia Morawska**.

Across Asia, and increasingly elsewhere, people are wearing medical masks in the street. Young and old, people are tying gauze squares over their noses and mouths when they step outside.

is associated with more than 4 million deaths every year worldwide.

People want ways to protect themselves. They are aware of the health risks of dirty air, and social media is full of images of people

By contrast, there are clear standards for the specialist respirators that professionals working in dirty environments must use, including builders, pavers and traffic police. These are certified for specific situations, and

Web

- The English and Chinese versions are live: http://www.accaqsm.org/

Home 主页

The *Australia-China Centre for Air Quality Science and Management* is hosted by three offices, the:

- Queensland University of Technology, in Brisbane, Australia;
- Chinese Research Academy of Environmental Sciences in Beijing, China;
- Hong Kong University of Science and Technology, in Hong Kong, China.

*中国–澳大利亚空气质量科学与管理中心*有三个办公室，分别为：

- 昆士兰科技大学，布里斯班，澳大利亚
- 中国环境科学研究院，北京，中国
- 香港科技大学，香港，中国

News 新闻

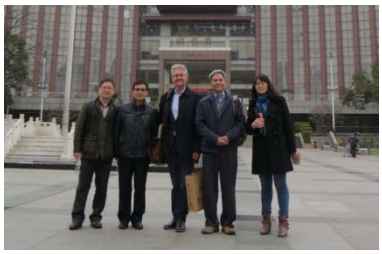
Acknowledgment: A many thanks to Dr Lina Wang and her team at the Fudan University for assisting with the translations of the Centre website!

4. Research Projects & Campaigns *(Current)*

See Appendix I for the list of Project Publications

1. **Extension of the KOALA Network to Beijing 2018 – (Ongoing),** by Fahe Chai (CRAES), Jian Gao (CRAES), Lidia Morawska (QUT), Rohan Jayaratne (QUT), Xiaoting Liu (QUT). The project aims to investigate the comparison between KOALA (***K**nowing* **O***ur* **A***mbient,* **L***ocal* **A***ir*) monitors developed by QUT (for more on how the KOALAs operate), and other instruments measuring air quality. The KOALAs were also installed at the Fifth Ring Road in Beijing, China. This work is continuing.

2. **Oxidative Capacity of Soot from Various Sources 2018 – (Ongoing),** led by Shang Jing (PKU), Zoran Ristovski (QUT), Svetlana Stevanovic (Deakin), Yi Guo (QUT). QUT PhD student Yi Guo visited the PKU in March 2018 for one week; samples were collected, analysis of the data on soot properties together with students from Prof Jing Shang's group, and the first paper titled, *Comparison of Light Absorption and Oxidative Potential of Biodiesel/Diesel and Chemicals/Diesel Blends Soot Particles,* has been submitted to the *Atmospheric Environment* journal. This work is continuing.



3. **Measurement Campaign in the Guangdong province 2018 – (Ongoing),** led by Professors Boguang Wang and Hao Wang (JNU), Zoran Ristovski (QUT), Reece Brown (QUT), Congrong He (QUT). In October 2018 Mr Reece Brown visited the JNU to participate in the measurement campaign in the Guangdong province with the Jinan University. The team are running unique QUT instruments in China, the VH-TDMA and the PINQ. In November 2018, Professor Zoran Ristovski visited the JNU to oversee the campaigns. Data analysis is in progress.

4. **Oxidative potential of PM in Beijing 2018.** Led by Mei Zheng (PKU), Zoran Ristovski (QUT), Svetlana Stevanovic (Deakin University), Reece Brown (QUT). In December 2018, Mr Reece Brown visited the PKU and run the measurements of the oxidative capacity of the atmosphere with QUT equipment, the PINQ. Together with Dr Svetlana Stevanovic, he gave a Seminar with the Environmental Health group titled: *Measurements of oxidative capacity of combustion generated nanoparticles using novel pro fluorescent probes.* This work is continuing.

5. GDST Collaborative Project 2017 **– (Ongoing),** titled, **Characteristics of the Atmospheric Oxidation and Particle Concentration in the Pearl River Delta (PRD) QUT provided real time Reactive Oxygen Species (ROS) measurements, the PINQ.** QUT provided real time Reactive Oxygen Species (ROS) measurements, the PINQ. This work is continuing.

6. **Low-Cost PM Sensors in Beijing and Brisbane, June 2016 – Ongoing 2018.** The Low-cost PM sensors in Beijing and Brisbane campaign was carried out in June 2016 – December 2016, by the QUT and CRAES. The studies included both laboratory and field investigations with two existing PM sensors and a new sensor that was not been tested before. The studies investigated the effects of type of aerosol, particle size, number concentration, temperature and relative humidity. A number of low-cost PM sensors were tested at CRAES and at QUT. PhD student Ms Xiaoting Liu, from the QUT visited the CRAES in March 2017 and in July 2018, and the results are to be presented in a research paper which is currently in preparation for submission to a journal in 2020.

7. Hong Kong Research Grants Council Grant 2017 titled, **Photochemical Air Pollution in Highly Urbanized Subtropical Regions: from Micro-Environments to Urban-Terrestrial-Oceanic Interactions, 2018-2023 (five years)**. Prof Tao Wang (HK PolyU), Prof Guy Brasseur (Max Planck Institute, also a distinguished chair professor at HKPU), Prof Hai Guo (HK PolyU), Dr Kin-fai Ho (Chinese University of HK), Prof Alexis Lau (HKUST), Prof Shuncheng Lee (HK PolyU), Dr Chun-ho Liu (UHK), Dr Peter Louie (Environment Protection Department (EPD) of the Hong Kong Government), Prof Xinming Wang (CAS), Dr Zhe Wang (HK PolyU), Dr Kenneth Leung (HK's EPD), and Dr Yingjun Liu (University of California at Berkeley). This five-year project is currently in its second year. The key activities in the first year included: (1) development of the first high-resolution anthropogenic chloride emission inventory for China, experimental apparatus for soil emissions of HONO and biogenic emissions of VOCs, measurement techniques for radicals and organics, chamber for SOA mechanistic study, and urban LES models; (2) conducting comprehensive atmospheric observations at a

coastal site to study urban-sea interactions in summer-autumn 2018; and (3) assessment of $PM_{2.5}$ health effect in the PRD region. This project is funded until 2023.

8. **A New Hypothesis to Explain the Formation of Haze Events in China involving Charged Particles in the Atmosphere, November 2015 – December 2018 (Ongoing).** Led by Professor Zhaolin Gu and Professor Yan Chen from the Xian Jiaotong University (XJU) in Xian, in collaboration with CRAES in Beijing and QUT. The team is working on a new hypothesis to explain the formation of haze events in China involving charged particles in the atmosphere. QUT provided for this project: charged particle data from QUT/CRAES Neutral Cluster and Air Ion Spectrometer (NAIS) measurements conducted in Beijing, for the modelling studies that are presently on-going. QUT's contributed the NAIS to Xian in the middle of 2017 to conduct more measurements, and in 2018, the team monitored particle charges during the winter season to collect more data. The first research paper is in preparation.

9. Asian Universities Cluster (AUC) Center of Excellence in Civil Engineering grant titled, **Impacts of Megacities on Regional Atmospheric Environment – A comparative study of emission, transformation and effects of urban pollution from Australia, Singapore, Shanghai, and Hong Kong 2017-2020.** Prof Hai Guo (HK PolyU), Prof Lidia Morawska (QUT), A/Prof Rajasekhar Balasubramanian (National University of Singapore) and Prof Yingjun Chen (Tongji University). This project is funded until 2020.

10. Australia Research Council Linkage Projects Grant 2016, titled: **Developing and utilising advanced networks for air quality sensing and analysis**, **2017-2019 (Ongoing).** Led by Lidia Morawska from the QUT, investigators include: Kourosh Kalantar-zadeh (RMIT), Nunzio Motta (QUT), Benjamin Mullins (CU), Godwin Ayoko (QUT), Zoran Ristovski (QUT), Mandana Mazaheri (QUT), Samuel Clifford (QUT), Matthew Dunbabin (QUT), Phong Thai (QUT), Luis Gonzalez (QUT), Dian Tjondronegoro (QUT), Matthew Riley (NSW OEH), Yvonne Scorgie (NSW OEH), David Wainwright (DSITI), Gavin Fisher (VIC EPA), Kelvyn Steer (SA EPA), Elizabeth Ebert (BOM), Jiming HAO (TU). Recent developments in sensor technologies represent a large jump in the ability to harvest atmospheric data. This cross disciplinary project aims to develop, validate and implement novel methods for high sensitivity atmospheric sensing and apply cutting-edge statistical and analytic techniques to the data sets, unprecedented in scope and resolution. The outcomes include an open access database and its utilisation for quantification/visualisation of intra-urban air pollution and human exposure and for developing air quality maps and smoke pollution management tools. The benefits include the advancement in the evidence-based management of air as a resource, increasing economic prosperity and enhancing human health and quality of life. The project is delivering innovative, cost-effective, high-resolution air quality networks, and engages the community in this process. Its impact, a game-changing approach to air quality management in Australia and in China. Research findings have been presented in four journal papers so far, with a number of others currently in preparation, as well as presented at numerous international conferences. This project is continuing in 2020, with the commercialisation of the KOALAs. One paper published by Centre members in 2020, and more papers in preparation for publication in 2020.

11. Hong Kong Research Council Grant 2016-2019, titled: **Thermal desorption aerosol gas chromatograph and time of flight aerosol mass spectrometer**. Led by Hai GUO from the HK PolyU, investigators include: Lidia Morawska (QUT), Xiangdong Li (HK PolyU), Chak Chan (HKUST), Xinming Wang (CAS), Linwei Tian (HKU), Kin-Fei Ho (CUHK), Man-Nin Chan (CUHK), Zi Ning (HK City). Research activities: in relation to the project objectives that were carried out during this reporting period mainly include (1) Purchase of the proposed instrument, i.e., Thermal Desorption Aerosol Gas Chromatograph and Time of Flight Aerosol Mass Spectrometer (TAG-Tof-AMS). (2) Training of research student and research personnel on the use, maintenance and further development of the TAG-Tof-AMS (3) Laboratory tests and experiments of the TAG-Tof-AMS to measure the concentration, size distribution, size-resolved composition of $PM_{1.0}$ (particulate matter with aerodynamic diameter less than 1 μm) in ambient air and the molecular information of secondary organic aerosol (SOA) in PM1.0 and PM2.5 (particulate matter with aerodynamic diameter less than 2.5 μm). (4) Sampling campaigns near the Cross-Harbor Tunnel in November-December 2017, at an urban site in March-April 2018 and at a background site in November-December 2018 in Hong Kong with the application of TAG-Tof-AMS, aiming at understanding the characteristics of organic aerosols (OA) and the SOA formation in subtropical region. Papers are currently in preparation for publication in 2020.

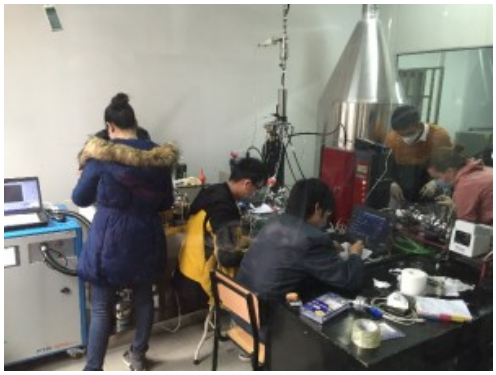
12. SKLOG funded project, **Emissions and impacts of selected semivolatile organic chemicals from biomass burning on air quality and health 2017- (Ongoing),** led by Professor Gan Zhang and Ms Haoyu (Fish) Jiang from the Guangzhou Institute of Geochemistry, and Professor Lidia Morawska from QUT. The project commenced in 2018, data analysis for the first round of samplers is being analysed, and the second campaign commenced in September 2019.

5. Research Projects & Campaigns *(Completed)*

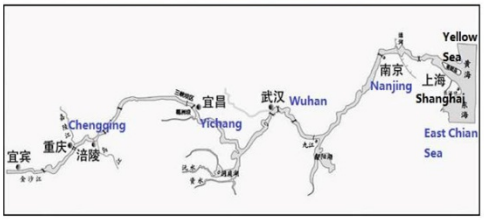
See Appendix I for the list of Project Publications

1. **Components of Ambient Air Fine Particulate Matter and Mechanism of Its Effects on Respiratory Oxidative Stress and Inflammation, 2016 – 2018.** This study was led by Professor Tong Zhu from the PKU in collaboration with the Department of Pulmonary Medicine, Peking University First Hospital in Beijing, China and the ILAQH, QUT. The study was funded by the Ministry of Science and Technology of the People's Republic of China (2016 – 2018). The campaign was conducted in seven communities in Shichahai, Beijing between December 2016 and September 2017. QUT provided two personal monitors (Aerosense Nanotracer) to measure time-series of UFP concentrations and size in real-time. Data collection campaign included measuring pulmonary function and personal UFP exposure from 30 chronic obstructive pulmonary disease (COPD) patients and 30 healthy participants, aged 45 to 70 years old. Dr Mandana Mazaheri, Senior Researcher and Postdoctoral Fellow at QUT, led the personal UFP monitoring design, providing research support and training to the Chinese partners, as well as led the analysis on personal UFP exposure assessments.

2. National Natural Science Foundation of China (NSFC) Grant 2016, titled **Shanghai Cooking Emissions Campaign, December 2016 – January 2018.** The Shanghai Cooking Emissions Campaign was carried out at the Tongji University from December 2016 to January 2017, led by Professor Zoran Ristovski and Dr. Svetlana Stevanovic from QUT, Associate Professor Lina Wang from ECUST, Professor Jun Gao from the Tongji University, Professor Lin Wang from FDU, and Dr. Li Li and Dr. Hongli Wang from the SAES. The project was funded by a National Natural Science Foundation of China (NSFC) Grant, with Dr. Svetlana Stevanovic and Associate Professor Lina Wang as the Chief Investigators. The project focused on the measurement of the physical and chemical properties of cooking aerosols, as well as their ROS profiles and cell toxicity. Chemical analysis of the gaseous compounds was performed by PTR-MS (SAES) and CIMS (FDU, QUT). The laboratory was built by Tongji University just before the measurements commenced, which allowed investigation of some other factors such as different dilution factors, position and heights during cooking processes. The project finished in 2018 and the results were presented in three research papers.



3. **Yangtze River Campaign, November 2017 – 2018.** Led by Jianmin Chen (FUD), Rohan Jayaratne (QUT). The Yangtze River Air Monitoring Campaign was carried out in November – December 2015 by Fudan University and was led by Professor Jianmin Chen from the FDU. Air and water quality measurements were made from a research boat carrying over 60 state of the art, high quality scientific instruments while sailing from Shanghai to Wuhan and back over a period of two weeks. QUT provided one instrument to monitor ultrafine particle concentrations in real time and this was installed on the boat by Dr. Rohan Jayaratne, Senior Research Fellow at QUT. The Project was a success and we are presently analysing the results acquired. We expect this to result in several high-quality scientific publications. The data is being analysed and the first paper is in preparation for submission in 2020.



4. National Natural Science Foundation of China (NSFC) Young Scholar 2017-2018 grant, titled: **Investigation on the role of aging, different aerosol fractions, different sources and different conditions on the formation of SOA and Chemical ROS in urban environments, 2017-2018.** For Dr Svetlana Stevanovic (QUT), hosted by Dr. Lina Wang (ECUST).

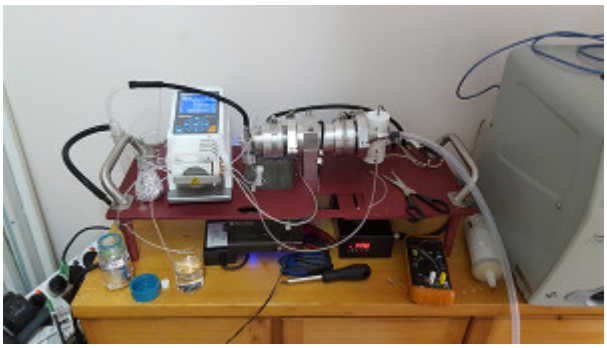
5. Hong Kong Research Council Grant 2016-2018, titled: **Semi-volatile particulate matter (PM) species in roadside environment: Role in gas-particle partitioning and formation of oxidative potential.** Led by Zoran Ristovski (QUT) and Zhi Ning (HK CityU). The Hong Kong Winter-Time ROS Campaign was carried out at the HK CityU in September – October 2016, led by Professor Zhi Ning (HK CityU). The project focused on the measurement of the diurnal profiles of $PM_{2.5}$ and gas-phase ROS concentrations at two different sampling sites. The samples were performed with the latest prototype of the novel real-time PM ROS sampler developed by QUT, the Particle into Nitroxide Quencher (PINQ). Reece Brown, a PhD candidate from QUT, spent two weeks in Hong Kong setting up, calibrating, and performing preliminary samples with the PINQ. The diurnal measurements were then taken over a month-long period by Dr Nirmal Kumar, a Post-Doctoral research fellow

from CityU. The measurements will provide diurnal trends in PM2.5 and gas-phase ROS concentrations for each day of the week at both roadside and rooftop sampling sites. This campaign is the winter-time partner to the summertime campaign “Hong Kong City University Campaign” from September to December of 2015. Both are part of the project “Semi-volatile particulate matter (PM) species in roadside environment: Role in gas-particle partitioning and formation of oxidative potential”. The project completed in 2018, three papers have been published, and one more paper is under review.

6. NSFC Funded Project 2016, titled: **Identification and Evaluation of Key Impact Factors on the Multiple-Time-Resolution Particle Source Apportionment and Its Comprehensive Validation over Beijing-Tianjin-Hebei Region.** Led by Dr. Jian GAO from the CRAESs, investigators include: Jian GAO, YiSheng XU, Shuang DENG, Yingjie SHI, Kai LI, Yingze TIAN, Caiqing YAN, Miikka Ilmari Dal Maso, Lidia MORAWSKA, Zhisheng ZHANG.

7. NSFC Funded Project 2016, titled: **Concentrations and Compositions of Biogenic Volatile Organic Compounds in Forests of Heavy Photochemical Pollution Regions and Their Role in Secondary Pollutant Formation.** Led by Prof Boguang WANG from Jinan University (Guangzhou), investigators include: Boguang WANG, Linyan HE, Wei SONG, Hao WANG, Duohong CHEN, Lei ZHOU, Congrong HE, Peng CHENG, Yunpeng LI, Zhijuan ZHANG.

8. **Real time Measurements of ROS 2016-2018.** Led by Zoran Ristovski (QUT) Svetlana Stevanovic (QUT), Zhi Ning (HK CityU). This Hong Kong campaign was carried out by the HK CityU and was led by Professor Peter Brimblecombe and Professor Zhi Ning from the HK CityU. Dr Svetlana Stevanovic was a Visiting Assistant Professor at City University of Hong Kong in the period September - December 2015. She participated in a research campaign that was a part of a project “Semi-volatile particulate matter (PM) species in roadside environment: Role in gas-particle partitioning and formation of oxidative potential”. This project was a joint project of Professor Zoran Ristovski from QUT and Assistant Professor Zhi Ning from City University of Hong Kong funded by HK Research Grants Council. Measurements were carried out at two locations that represented background and road-side pollution. Evaluation of diurnal profiles of ROS concentrations at different locations in Hong Kong was done for the first time in Australasia. For the measurement of oxidative potential Particle Into Liquid Sampler (PILS) was used. This instrument was designed and made at QUT. Furthermore, PILS was also used to measure the influence of semi-volatile organics to the overall oxidative potential and investigate further gas-particle partitioning. This campaign was done in December and January to characterize winter emissions. Corresponding summer campaign is planned for August in 2016. Professor Zoran Ristovski was supervising the measurements and was a Visiting Professor in the School of Energy and Environment at the HK CityU. This project completed in 2019, the first paper has been published, and the second is in preparation for submission in 2020.



9. **Air Quality Monitoring in Hong Kong, September – November 2016.** This sampling campaign is led by Professor Hai Guo from HK PolyU in collaboration with the Sun Yat-Sen University, National Central University, QUT, Jinan University and HKUST. It was conducted simultaneously at two sites: a sub-urban site in Tung Chung, Hong Kong and a rural island site in Zhuhai, China. The measurements included canister sampling, real-time monitoring of weather conditions, trace gases, volatile organic compounds (VOCs), as well as other precursors of photochemical ozone production. This was followed by a comprehensive analysis of the chemical database using a combination of statistical analysis of field observations, mesoscale meteorological simulations, diagnostic and prognostic box models, for example, an observation-based box model, an emission-based model, and chemical transport models. The proposed study significantly improved our understanding of photochemical formation and transport mechanisms for subtropical coastal regions with complex coupling of meteorology and chemistry and advanced our knowledge of the atmospheric chemistry in the marine boundary and have wide implications for other subtropical coastal regions. The scientific findings will have direct policy implications for reducing O_3 pollution and visibility degradation in subtropical South China. This project completed in September 2018, and seven journal papers were published.

10. **New particle formation in Beijing air – winter campaign, measurements and modelling.** Jian Gao (CRAES), Rohan Jayaratne (QUT), Buddhi Pushpawela (QUT), Min Hu (PKU), Melita Keywood (CSIRO), Congrong He (QUT).

11. **Impact of autumn agricultural burning on air quality in Beijing.** Jian Gao (CRAES), Congrong He (QUT).

12. **Application of the camera for atmospheric PM measurements.** Lidia Morawska (QUT), Rohan Jayaratne (QUT), Jian Gao (CRAES), Lina Wang (ECUST), Md Mahmudur Rahman (QUT).

13. **School children personal exposure to Ultrafine Particles, April 2016.** Led by Zhu Tong (PKU), Lidia Morawska (QUT), Mandana Mazaheri (QUT), WeiWei Lin (Sun Yat-Sen University). School children personal UFP exposure monitoring in Hehsan Campaign was carried out in April 2016, as part of a children's panel study funded by the National Natural Science Foundation of China (NSFC), led by Associate Professor Weiwei Lin from the Sun Yat-Sen University (SYSU) in Guangzhou, China. QUT provided three personal monitors (Aerosense Nanotracer) to measure time-series of UFP concentrations and size in real-time. The monitoring campaign was conducted in a primary school in Heshan County, the city of Jiangmen within the Pearl River Delta region in China between 18 and 29 April 2016. Health (cardiopulmonary testings) and personal UFP monitoring data were collected from 59 participating school children. Dr Mandana Mazaheri, a senior researcher and Postdoctoral Fellow at QUT, led the personal UFP monitoring design, provided training to the SYSU team and participated in the first week of the campaign in Heshan. Data analysis was completed, and one paper has been published.

14. **Temperature, air quality and health effects.** Haidong Kan (FDU), Adrian Barnett (QUT), Lidia Morawska (QUT), Phong Thai (QUT), Yuming Guo (Monash).

15. **Beijing Air Quality Monitoring Project, November 2015 – December 2018.** Led by Fahe Chai (CRAES), Congrong He (QUT), Rohan Jayaratne (QUT), Buddhi Pushpawela (QUT).

6. Events

Mini Symposia

In 2018, we introduced a series of mini Symposia to allow broader participation of all members of the Centre in all of the cities. Mini Symposia held in 2019 include:

3rd Mini ACC-AQSM Symposium, Fudan University, Shanghai, China, 15th January 2019

A very successful 3rd Mini ACC-AQSM Symposium took place in Shanghai on the 15th January 2019 and was hosted by Professor Jianmin Chen at the Fudan University. This symposium continued to build on and extend the work of the mini symposiums held in Beijing in April and in Guangzhou in July 2018 and provided an opportunity for more members to participate. The Symposium focused on a **new topic, *Discussion on air pollution in a broader context of urbanization*** and continued reviewing the progress in addressing the seven Big Questions.

4rd Mini ACC-AQSM Symposium, Jinan University, Guangzhou, China, 23rd November 2019

A successful Mini ACC-AQSM Symposium took place last Tuesday, 26th November 2019, and was hosted by the Institute for Environmental and Climate Research (ECI), Jinan University in Guangzhou.

The Mini Symposium focussed on developing plans for short- and long-term collaborations between the partners, building up on the existing programs and activities; as well as included the Establishing Ceremony of the ACC-AQSM in Guangdong, where a Plaque of the ACC-AQSM was unveiled, and a review of the existing joint programs and joint activities between partners from the Guangzhou, Hong Kong Universities, and the Queensland University of Technology.

Annual Meeting

5th Annual Meeting, Chengdu, China, 18-19th November 2019

The Annual Meeting is hosted at rotating partner sites in Australia and China to provide an opportunity for member researchers to present and discuss findings, workshop future initiatives and exchange information.

The fifth Annual Conference of the ACC-AQSM was held in Chengdu, China from the 18-19th November 2019, and hosted by the CRAES and Atmospheric Environmental Society. The focus of this meeting was: *Changing atmosphere with the changing energy sources and changing climate.* This was a multi-faceted Annual Meeting, running along-side the 25th China Atmospheric Environment Science and Technology Conference, the theme of which was: *$PM_{2.5}$ and ozone coordinated control, precise management*.

This was a particularly exciting and important multi-facial Annual Meeting, because it ran alongside the alongside the Annual Conference of the Atmospheric Environmental Society, as well as Sino-Korea-Japan and Sino-France Conferences.

An interesting program for the conference, the focus of our Annual Meeting on the “Changing atmosphere with the changing energy sources and changing climate”, as well as a trip to Emei Mountain to explore the next round of scientific challenges that we can jointly tackle..

The program included sessions on the following topics:

- Science of air pollution: what is missing?
- Energy transition and source control: the biggest challenges
- Exposure control: the biggest challenges

Overall, the Annual Meeting has further refined our research collaborations, longer term opportunities for staff and student exchange, professional development collaborations, and research developments that combine the expertise of several Chinese and Australian Universities and Institutes.

7. Visits and Exchanges (Staff and Students)

January

- Professor Lidia Morawska (QUT), hosted by FDU in Shanghai

April

- Professor Lidia Morawska (QUT), hosted by JNU and SYSU in Guangzhou

May

- Professor Song Xianzhong (President, JNU), hosted by QUT
- Professor Pu Ruoqian (Director, International Office, JNU), hosted by QUT
- Professor Ding Ke (Dean, College of Pharmacy, JNU), hosted by QUT
- Professor Chen Zhenqian (Dean, College of Science and Technology, JNU), hosted by QUT
- Professor Feng Shuaizhang (Dean, Institute for Economic and Social Research, JNU), hosted by QUT
- Professor Wang Boguang (Deputy Dean, Institute for Environmental and Climate Research, JNU), hosted by QUT

July

- Professor Sasho Gligorovski (Guangzhou Institute of Geochemistry - GIG, Chinese Academy of Science), hosted by QUT
- Professor Hao Wang (JNU), hosted by QUT

November

- Professor Lidia Morawska (QUT), hosted by JNU in Guangzhou
- Professor Zoran Ristovski (QUT), hosted by JNU in Guangzhou
- Ms Johanna Horchler (QUT), hosted by JNU in Guangzhou

8. Big Questions

Big Question 1: **The quest for improved air quality may push China to fulfil the Paris Commitment.**

The past few years have witnessed a significant change in the approach to air quality management in China. Is, what has been done, a model for other emerging economies, and sufficient for clearing air over China in the foreseeable future – and thus protecting health and halting broader global environmental impacts? How data from the monitoring stations, supersites and satellites enable quantitative understanding of the source emission trends which occurred, and what is the forecast for the future. A paper titled "The quest for improved air quality may push China to fulfil the Paris Commitment" is in preparation for submission for publication in 2020.

Co-Leaders: Shuxiao Wang (TU), Jianmin Chen (FDU), Hai Guo (HK PolyU), Qingyan (Jackie) Fu (SEMC), Jinhan Mo (TU)

Big Question 2: **Children born to cleaner air over China are healthier.**

Shipping and aircraft technologies are very far behind as it comes to lowering emissions, are already emerging as major contributor to air pollution, and their impact is set to grow.

Co-Leaders: Xin Yang (FDU), Yan Zhang (FDU), Haidong Kan (FD), Lidia Morawska (QUT), Shuiyuan Cheng (BJTU)

Big Question 3: **Severe urban air pollution episodes: can we prevent them?**

There have been numerous studies on haze over China, but it is not only a Chinese phenomenon, with haze frequently blanketing the whole of the Asian continent, as well as many parts of Europe. How advanced is science of haze formation and what is missing? A paper titled "Will the plague of severe urban air pollution episodes continue?" is in preparation for submission for publication in 2020.

Co-Leaders: Yan Cheng (XJTU), Tong Zhu (PKU), Min Hu (PKU), Mei Zheng (PKU), Lin Wang (FDU), Lina Wang (ECUST), Zoran Ristovski (QUT)

Big Question 4: **Ozone: the growing treat and how to control it?**

While emissions and concentrations of some of the primary pollutants have declined, however, not necessarily of the precursors for ozone formation, originating from biomass or industrial emissions. Increasing ozone concentration has been seen in China and elsewhere: do we fully understand its mechanisms? A paper titled "Tropospheric ozone: a growing global threat and how to control it?" is in preparation for submission for publication in 2020.

Co-Leaders: Hai Guo (HK PolyU), Tao Wang (HK PolyU), Guangli Xiu (ECUST), Melita Keywood (CSIRO)

Big Question 5: **Sensors: the technology of the future or a passing trend?**

Networks of low-cost sensors have been mushrooming around the world, with over 30 thousand of sensors operating in China alone. Are the data they generate contributing to new knowledge, and will they constitute an intrinsic part of future smart and healthy cities?

Co-Leaders: Lidia Morawska (QUT), Jian Go (CRAES), Zoran Ristovski (QUT), Christopher Chao (HKUST), Zhi Ning (HK CityU), Mei Zheng (PKU)

Big Question 6: **Indoor air: a neglected element in the puzzle of the quest for clean air.**

Global urbanization means that indoors is the main human habitat. Yet, it is far less understood than outdoor air, and ever-changing with new approaches to energy conservation, new products and evolving building biome. How will future urban and building designs ensure that indoor air is healthy? A paper titled "Face masks could raise pollution risks" was published by Dr. Wei Huang (PKU) and Professor Lidia Morawska (QUT) in Nature Comment, 574: 29-30, 2019.

Co-Leaders: Wei Huang (PKU BJMU), Maosheng Yao (PKU), Frank Shun-Cheng Lee (HK PolyU), Krassi Rumchev (CU), Yinping Zhang (TU), Ying Xu (U. Austin)

9. Grant Applications

Commercialisation

- **Commercialisation of the *K*nowing *O*ur *A*mbient *L*ocal *A*ir-quality (*KOALA*) Monitors with the company Etran in Guangzhou, China.** The KOALA monitor includes two low-cost air quality sensors that monitor particles ($PM_{2.5}$) and carbon monoxide (CO) concentrations in the air. Airborne particles and carbon monoxide are two key products of combustion sources such as motor vehicles and industry. Larger particles are also generated by mechanical process such as dust re-suspension.

Applied / Pending

- **Guangdong Province Natural Science Foundation**. Programme led by Prof Guang-Hui Dong, Sun Yat-sen University, Co-PI is Lidia Morawska (QUT). **Project Title:** *The Prediction and Alarm System of Adverse Effects of Environmental Pollution on Adverse Birth Outcomes Based on AOP Framework and Biomonitoring Equivalents-Precise Birth Cohort Study*.
- **Plantower** led by CRAES, Beijing, China. **Project Title:** *Literature Review for Plantower $PM_{2.5}$ Sensors Development.*

In Preparation, to be submitted in the next round

- **RGC Collaborative Research Grant focusing on indoor organics and bioaerosols,** led by HK PolyU and QUT.

Appendix 1 – Project Publications

Air Quality Monitoring in Hong Kong (September – November 2016)

This project completed in September 2018, and seven journal papers were published:

Surface O_3 photochemistry over the South China Sea: Application of a near-explicit chemical mechanism box model.
Yu Wang (HK PolyU), Hai Guo (HK PolyU), Shichun Zou (SYSU), Xiaopu Lyu (HK PolyU), Zenhao Ling (SYSY), Hairong Cheng (Wuhan University), Yangzong Zeren (HK PolyU)
Environmental Pollution, 234: 155-166, 2018.

Ozone pollution around a coastal region of South China Sea: interaction between marine and continental air.
Hao Wang (JNU), Xiaopu Lyu (HK PolyU), Hai Guo (HK PolyU), Yu Wang (HK PolyU), Shichun Zou (SYSU), Zenhao Ling (SYSY), Xinming Wang (SYSU) F. Jiang (SYSU), Y. Zeren (SYSU), W. Pan (SYSU), X. Huang (SYSU)
Atmospheric Chemistry & Physics, 18(6): 4277-4295, 2018.

Photochemical Formation of C1–C5 Alkyl Nitrates in Suburban Hong Kong and over the South China Sea.
Lewei Zeng (HK PolyU), Xiaopu Lyu (HK PolyU), Hai Guo (HK PolyU), Shichun Zou (SYSU), Zhenhao Ling (SYSU)
Environmental Science & Technology, 52(10): 5581-5589, 2018.

Evaluation of the effectiveness of air pollution control measures in Hong Kong.
Xiaopu Lyu (HK PolyU), L.W. Zeng (HK PolyU), Hai Guo, Isobel Jane Simpson (University of California at Irvine), Z.H. Ling (HK PolyU), Y. Wang (HK PolyU), F. Murray (Murdoch), Peter Louise (HK EPD), Maria Saunders (UWA), Sean Ho Man Lam (UWA), Donald R. Blake (University of California at Irvine)
Environmental Pollution, 220: 87-94, 2017.

Effectiveness of replacing catalytic converters in LPG-fueled vehicles in Hong Kong.
Xiaopu Lyu (HK PolyU), Hai Guo (HK PolyU), Isobel J. Simpson (University of California at Irvine), Simone Meinardi (University of California at Irvine), Peter K. K. Louie (HK EPD), Zhenhao Ling (SYSU), Yu Wang, Ming Liu (HK PolyU), Connie W.Y. Luk (HK EPD), Nan Wang (HK PolyU), Donald R. Blake (University of California at Irvine)
Atmospheric Chemistry and Physics, 16(10): 6609-6626, 2016.

New insight into the spatiotemporal variability and source apportionments of C_1–C_4 alkyl nitrates in Hong Kong.
Zhenhao Ling (SYSU), Hai Guo (HK PolyU), Isobel Jane Simpson (University of California at Irvine), Sandra Maria Saunders (UWA), Sean Ho Man Lam (UWA), Xiaopu Lyu (HK PolyU), Donald Ray Blake (University of California at Irvine)
Atmospheric Chemistry and Physics, 16(13): 8141-8156, 2016.

Spatiotemporal variation of ozone precursors and ozone formation in Hong Kong: Grid field measurement and modelling study.
X.P. Lyu (HK PolyU), M. Liu (HK PolyU), Hai Guo (HK PolyU), Z.H. Ling (HK PolyU), Y. Wang (HK PolyU), Peter Louise (HK EPD), C.W.Y. Luk (HK EPD)
Science of The Total Environment, 569: 1341-1349, 2016.

Developing and utilising advanced networks for air quality sensing and analysis, 2017-2019

Low-cost $PM_{2.5}$ sensors: an assessment of their suitability for various applications.

Rohan Jayaratne (QUT), Xiaoting Liu (QUT), Kang-Ho Ahn (Hanyang University, Seoul), Akwasi Asumadu-Sakyi (QUT), Gavin Fisher (CU), Jian Gao CRAES) , Adrian Mabon (QUT), Mandana Mazaheri (QUT), Benjamin Mullins (CU), Mawutorli Nyaku (QUT) , Zoran Ristovski (QUT), Yvonne Scorgie (NSW OEH), Phong Thai (QUT), Matthew Dunbabin (QUT), Lidia Morawska (QUT)

Aerosol and Air Quality Research (AAQR), 20: 520–532, 2020.

Real time Measurements of ROS (2016-2018)

This project completed in 2019, the first paper has been published (below), and the second is in preparation for submission in 2020.

Comparison of light absorption and oxidative potential of biodiesel/diesel and chemicals/diesel blends soot particles.
Yu Kuang (PKU), Yi Guo (QUT), Jiaqi Chai (PKU), Jing Shang (PKU), Jiali Zhu (PKU), Svetlana Stevanovic (QUT), Zoran Ristovski (QUT)
Journal of Environmental Sciences, 87: 184-193, 2020.

School children personal exposure to Ultrafine Particles (April 2016)

Characteristics of school children's personal exposure to ultrafine particles in Heshan, Pearl River Delta, China – A pilot study.
Mandana Mazaheri (QUT), Weiwei Lin (SYSU), Samuel Clifford (QUT), Dingli Yue (GEMC), Yuhong Zhai (GEMC), Muwu Xu (SYSU), Valeria Rizza (U Cassino and Southern Lazio, Italy), Lidia Morawska (QUT)
Environment international, *132*: 105-134, 2019.

Semi-volatile particulate matter (PM) species in roadside environment: Role in gas-particle partitioning and formation of oxidative potential (Hong Kong Research Council Grant 2016-2018)

The project completed in 2018, three papers have been published, and one more paper is currently under review.

Diurnal profiles of particle-bound ROS of $PM_{2.5}$ in urban environment of Hong Kong and their association with $PM_{2.5}$, black carbon, ozone and PAHs.
Svetlana Stevanovic (QUT), N.K. Gali (HKUST), Farhad Salimi (QUT), Richard Brown (QUT), Zhi Ning (HK CityU), Luke Cravigan (QUT), Peter Brimblecombe (HK CituY), Steven Bottle (QUT), Zoran Ristovski (QUT)
Atmospheric Environment, 219, p.117023

Elevated levels of glyoxal and methylglyoxal at a remote mountain site in southern China: Prompt in-situ formation combined with strong regional transport.
Shaojun Lv (JNU), Daocheng Gong (JNU), Yaozhou Ding (JNU), Youjing Lin (JNU), Hao Wang (JNU), Hang Ding (JNU), Gengchen Wu (JNU), Chunqian He (JNU), Lei Zhou (JNU), Shawchen Liu (JNU), Zoran Ristovski (QUT), Duohong Chen (SEMC), Min Shao (PKU), Yuanhang Zhang (PKU), Boguang Wang (JNU)
Science of The Total Environment, 672: 869-882, 2019.

Application of a Fluorescent Probe for the Online Measurement of PM-Bound Reactive Oxygen Species in Chamber and Ambient Studies.
Reece Brown (QUT), Svetlana Stevanovic (QUT), Zachary Brown (QUT), Mingfu Cai (SYSU), Shengzhen Zhou SYSU), Wei Song (GIG), Xinming Wang (GIG), Branka Miljevic (QUT), Jun Zhao (SYSU), Steven Bottle (QUT), Zoran Ristovski (QUT)
Sensors, 19(20), p. 4564

Shanghai Cooking Emissions (December 2016 – January 2018)

Characterization particulate matter from several Chinese cooking dishes and implications in health effects.
Lina Wang (ECUST), Xinran Zheng (ECUST), Svetlana Stevanovic (QUT), Xin Wu (Ningbo Protection Bureau), Zhiyuan Xiang (ECUST), Mingzhou Yu (Jiliang University), Jing Liu (Harbin Institute of Technology)
Journal of Environmental Sciences, 72: 98-106, 2018.

Review: Role of Chinese Cooking Emissions on Ambient Air Quality and Human Health.
Lina Wang (ECUST), Zhiyuan Xiang (ECUST), Svetlana Stevanovic (QUT), Zoran Ristovski (QUT), Jun Gao (Tongji U) Hongli Wang (SAES), Ly Li (SAES)
Science of the Total Environment: Special Issue on Air Quality in China: Current and Emerging Challenges, 589: 173-181, 2017.

Assessing impacts of factors on carbonyl compounds emissions produced from several typical Chinese cooking.
Zhiyuan Xiang (SAES), Hongli Wang (SAES), Svetlana Stevanovic (QUT), Shengao Jing (SAES), Shengrong Lou (SAES), Shikang Tak (SAES), Li Li (SAES), Jing Liu (Harbin Institute of Technology), Mingzhou Yu (Jiliang University), Lina Wang (ECUST)
Building and Environment, 125: 348-355, 2017.

Yangtze River Campaign (November 2017-2018)

The data is being analysed and the first paper is in preparation for submission in 2020.