

Institute of Urban Environment, Chinese Academy of Sciences (IUE-CAS)

<http://english.iue.cas.cn>



IUE-CAS: studying the world's urban environment

The Institute of Urban Environment (IUE), Chinese Academy of Sciences (CAS) was established on 4 July 2006.

IUE-CAS is a unique national research institute engaged in comprehensive studies on the world's urban environment. The vision of the institute is to support rapid urbanization in China and to become a center of excellence in urban environmental research in the Asia-Pacific region. The missions of the institute include: to understand the impacts of rapid urbanization; to develop science-based technologies for urban pollution control; to integrate technologies for urban environmental systems and policies; to establish a platform for urban environmental technology transfer; and to foster talents for sustainable urban environmental conservation. IUE is located in Xiamen, a beautiful coastal city in southeast China. IUE-CAS established Ningbo Urban Environment Observation and Research Station (NUEORS), CAS in Beilun District, Ningbo, China. As IUE's field research base, NUEORS is dedicated to investigate the long-term evolution of urban environment and ecology as well as environmental remediation technology, with its ideally placed site in the Yangtze Delta area which is highly developed and rapidly urbanized.

The IUE team includes a group of renowned principal investigators, four of whom have been granted the Outstanding Young Scientists award from the Natural Science Foundation of China. Another eleven were recruited through the "Hundred Talent Program" of CAS, and a further two have been awarded with the title of "National Young Scientists". Some scientists in IUE serve in international academic societies and journal editorial boards.

IUE is a comprehensive and multi-disciplinary institution engaged in fundamental and applied research on the cutting edge of environmental and resource sciences, as well as the development of new technologies for environmental remediation and waste management, that encompasses the impacts of urbanization on ecosystems and the social economy. The institution also focuses on the integration of technologies and pilot engineering projects for combined pollution control and remediation in regional environments, innovative technologies related to the ecological industry, cleaner production and circular economy, risk assessment and management of environmental

pollution in urban centers. IUE comprises four research centers with different research emphases.

Center for Urban Environmental Planning and Management

KEY RESEARCH FIELDS:

- Urban environment and global change
- Urban development and safety
- Spatial technologies and digital city
- Theory and application of the digital environmental technology
- Urban environmental management and policies

Center for Urban Ecosystem Health and Environmental Safety

KEY RESEARCH FIELDS:

- Systems analysis and monitoring of urban ecosystem health
- Combined pollution in urban and peri-urban environments and its health risks
- Safety assessment and early warning systems in urban and peri-urban environments
- Analytical techniques and methodologies for urban and peri-urban environments

Center for Urban Pollution Control and Restoration

KEY RESEARCH FIELDS:

- Urban water pollution and restoration
- Technology for the safety of urban drinking water
- Urban air pollution control
- Urban solid waste treatment
- Environmental biotechnology
- Environment-friendly materials and production

Center for Urban Environmental Engineering and Circular Economy

KEY RESEARCH FIELDS:

- Urban pollution control engineering and demonstration
- Ecological industry and practice
- Integrative urban ecological engineering and practice
- Development of urban circular economy and demonstration

Scientific research platform

At present, IUE hosts the ICSU programme, and has an Innovation Center for Excellence in Urban Atmospheric Environment of CAS, two key labs

of CAS, three national platforms, one provincial level platform, and two key labs: an engineering research center and a public service utility platform certificated by the Xiamen municipal government.

- Innovation Center for Excellence in Urban Atmospheric Environment, CAS
- Key Lab of Urban Environment and Health, CAS
- Key Lab of Urban Pollutant Conversion, CAS
- Key Lab of Urban Metabolism, Xiamen City
- Key Lab of Indoor Air Quality and Health, Xiamen City
- Engineering Center for Water Safety and Quality, Xiamen City
- International Programme Office for Urban Health and Wellbeing, International Council of Science (ICSU)
- Center for International Cooperation in Science and Technology, Ministry of Science and Technology of the People's Republic of China
- National Scientific and Technological Cooperation Base to Taiwan
- Public Service R&D Center for Biological Industry Technology, National Development and Reform Commission of the People's Republic of China
- Center for International Cooperation in Science and Technology, Fujian Province
- Public Service R&D Platform for Identification of Hazardous Waste and Disposal Technology, Xiamen City

Innovation Center for Excellence in Urban Atmospheric Environment of CAS

The Innovation Center for Excellence in Urban Atmospheric Environment of CAS (ICEUAE-CAS) focuses on research surrounding the atmosphere in urban environments, and was founded on the basis of CAS's Pioneer Plan, Innovation 2020.

This center is built and operated under IUE-CAS according to the principle of multipartite investment/cooperation and sharing, which collaborates with other 5 CAS institutes; Research Center for Eco-Environmental Sciences (RCEES), Institute of Atmospheric Physics (IAP), Hefei Institutes of Physical Science (HIPS), Institute of Process Engineering (IPE) and Guangzhou Institute of Geochemistry (GIG). It focuses on the cutting-edge disciplines of atmospheric environmental science, and works



to find solutions to regional and various urban atmospheric pollutions which have resulted from rapid national development. Researchers have produced original and high-impact scientific accomplishments in the areas of urban atmospheric pollution formation mechanism, origin and migration patterns and regional smog control, and further developments in atmospheric environmental scientific theory and methodology. They have also provided a theoretical framework and technological guarantee to air quality amelioration and air pollution control practices. The center boasts excellent teams in atmospheric physics, atmospheric chemistry, environmental optics, satellite remote sensing, atmospheric pollution control and environmental policies from all over China. It fully exerts the advantages of each utility, effectively integrates preponderant research resources in atmospheric science, boosts establishment of national atmospheric research foundation and groups, and promotes the international influence in the atmospheric science and research discipline.

Highlights of three major research fields

Impacts of urbanization on watershed environmental quality and related health risks

The ongoing rapid urbanization process in China brought not only the benefit of an extraordinary economic boom and made everyday life more convenient for people in urban areas, but also various strains of what's known as "city disease", such as environmental pollution and high traffic congestion, both of which may result in actual disease and/or other health risks for urban dwellers. The scientists in IUE strive to investigate the relationships between urban environmental problems and human health using tools from different dimensions. An evident advantage at IUE is the multidisciplinary background of its faculty members. Their study scope covers everything from macromolecules such as DNA and RNA to watershed ecosystems, encompassing urban conurbations and their nearby rivers and lakes. Correspondingly, the research methodologies vary from molecular

tools (such as polymerase chain reaction, PCR) to remote sensing.

For example, antibiotic resistance in environmental bacteria is a global emerging public health problem. Several research teams at IUE focus on this issue. They use a novel high throughput quantitative PCR to unveil the diversity and abundance of antibiotic resistance genes (ARGs), and use genomics tools to investigate the ecology of the spread of ARGs in the environment at watershed scale, and their risks to humans. IUE is also developing novel technologies to mitigate the spread of ARGs from wastewater treatment plants and intensive animal farming systems. These studies aim to bridge the gap between fundamental understanding and engineering challenges, and help define the direction of future technological innovation for pollution control and remediation of environmental damage.

R&D on resources recovery through synergetic treatment of urban sewage sludge and food waste

With rapid urbanization, the production of urban organic solid wastes is quickly increasing, especially the sewage sludge and domestic garbage (including food waste) in China. Their effective treatment has become an emergent environmental and social problem. IUE is developing a novel strategy on synergetic resource recovery from sewage sludge and food waste.

Under this strategy, sewage sludge and food waste will be pretreated in a process where the sludge is dehydrated by hydrothermal and mechanical methods and grease is separated from food waste. The grease will be converted to bioplastics such as PHA by microbial technology, the residual organic matters in food waste and liquid from sludge will be co-converted to methane-rich biogas by anaerobic and electrochemical fermentation. Dehydrated sludge and anaerobic solid residues are converted to biochar by pyrolysis, and then biochar is modified as adsorbents directly or as seedling matrix raw materials after adsorption of nitrogen and phosphorus in the fermentation liquid. Further,

the P and N in the fermentation liquid adsorbed by biochar are recovered by granular struvite and anammox techniques. A pilot plant with a scale of treatment capacity of 20 tons of sludge and 1–3 tons of food waste per day is in operation, with promising results. In the next stage, the technical and economical feasibilities of the whole process will be assessed.

Digital city network environment

The Internet of Things (IoT) provides the necessary infrastructure to enable us to access sensors, processors, and actuators using standard protocols and ignore differences in hardware, operating systems, or location.

IoT can be used for environmental monitoring and protection in a variety of ways. IUE has developed an Environmental Internet of Things (EIoT), which integrates stationary and mobile sensors, geographic information system (GIS), global positioning system (GPS), and remote-sensing technology into urban environments. The EIoT framework was proposed to describe the key technologies involved, including wireless sensor networks (WSN), network techniques, GIS, WebGIS, and distributed database techniques. EIoT is often used to monitor aquatic and atmospheric environments, soil, sound, and wind. Data of various environmental parameters can be collected, transmitted, processed, and applied to environmental models, forecasts, and early warning systems, thereby enabling in-situ, real-time, remote environmental monitoring. The application of EIoT can greatly improve the performance and effectiveness of ecological and environmental management.

International and regional cooperation

IUE conducts frequent exchanges and maintains close cooperation with many universities and research institutions in the USA, UK, Germany, France, Japan, Canada, Australia, Netherlands, South Korea and Singapore. In addition to extensive international collaborations, domestically we have forged close academic links with universities and research institutions in mainland China, and in Hong Kong and Taiwan.