Sukambari in Dehradun sub-basin belt along the southwestern flanks of Tamili and Mohand range in Saharanpur district, Uttar Pradesh and Haridwar district, Uttarakhand. Verma also suggested that the use of advance drilling technology in these sites can help in drilling deeper boreholes of 300–400 m depth range that caters to an increased grade and thick mineralization. He also gave stress on the detailed study of tectonic events in the Siwaliks with respect to uranium mineralization.

The afternoon session of the seminar started with a brainstorming lecture by Jayanta Kumar Pati (National Centre of Experimental Mineralogy and Petrology, University of Allahabad) on the confirmation of meteoritic impact structures evidenced in Dhala, Shivpuri district, Madhya Pradesh. They were initially described as crypto-volcanic explosion structure, but are now confirmed to be complex meteoritic impact structure. Ramanathan Bhaskar (Guru Jambheshwar University of Science and Technology, Hisar) discussed a unique aspect of geology in the form of geomicrobiology. He cited examples from Indian caves in order to highlight the role of cave microbes as geochemical agents that contribute to mineral precipitation, diagenesis, lithification and sedimentation. The session also included the burning issue of sustainable water management for mining with the help of community engagement presented by Hishmi Jamil Husain (Rio Tinto, New Delhi). He presented a case study from the water-stressed Bundelkhand region. In consultation with the local communities, Village Water and Sanitation Committees (VWSC) were set up after rigorous surveys at 250 sites in 15 villages every month for a year in order to maintain and sustainably manage the developed water resources. Md Sayad Rahaman (Presidency University, Kolkata) spoke about mantle wedge metasomatic event by citing the example of Neoarchaean–Palaeoproterozoic sanukitoid magmatism of Aravalli craton. The combined results of the whole-rock major oxides trace element and Nd isotopic studies revealed that those sanukitoids were formed by the partial melting of metasomatized mantle wedge in which the latter experienced multiple metasomatic events.

The third technical session consisted of a poster session and four parallel oral sessions comprising 56 talks related to diverse geological fields. Some of them included the facies characterization of the Talchir succession, Gungutta River Section, Son–Mahanadi Gondwana Basin, Chhattisgarh by Meradul Islam (AMU) and geochemistry and stable carbon composition of soil from Nainital Kumaun Himalaya by Imran Khan (Indian Institute of Technology, Kanpur). Taufique Warsi (National Geophysical Research Institute (NGRI), Hyderabad) discussed the possibility of using carbon-based nanoparticles as groundwater tracers. S. M. Wasim (Dharm Samaj College, University of Agra) gave an overview of Callovian to Oxfordian benthic foraminiferal response to palaeo-environmental changes from the Patcham–Chari formation, Jumara Dome, western Kutch, Gujarat. Syed Azharuddin (Birbal Sahni Institute of Palaeosciences, Lucknow) threw light on Holocene productivity collapse recorded from NE Arabian Sea, and also explained the mechanism of its teleconnection with the North Atlantic cold events. Asma Amjad Ghaznavi (AMU) gave an account of heavy mineral studies for the assessment of tectonic setting and provenance of Dhosa Sandstones, Ler Dome, Kachchh, western India. Niranjan Mohanty (NGRI) explained the chrome–spinel geochemistry of Madawara Igneous Complex, Bundelkhand Craton, Central India.

The seminar provided an opportunity to budding researchers of the country to present their research problem, debate issues related to the field as well as share their experiences and exchange perspectives regarding the recent scientific trends of geology. It was a good platform not only to pave the way for interactions among experts and researchers of various disciples and institutions, but also to bring fresh perspectives to the current knowledge and latest changes occurring within the industry.

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MEETING REPORT

Urban meteorology and climate research in Asia*

A conference was held recently to discuss research on urban meteorology and climate in growing Asian cities, especially in relation to air pollution and land-use change and its impact on weather and climate, urban flooding and water availability. According to the United Nations, over half of the world's population has been residing in urban areas since 2008, and the percentage continues to increase. This is especially the case for most Asian countries. More than 50 participants attended the conference, which was a continuation of the previous Asian Network for Climate Science and Technology (ANCST) conference† held at Tsinghua University, China in July 2015.

J. C. R. Hunt (University College London, UK) reviewed the general dependence of urban environments on complex aspects of their built and natural forms, and also the external environment surrounding the cities and the effects of global climate change. He suggested that more research is needed on the effects of tropical and subtropical urban-scale environments on climate processes. Using 35-yr NCEP-Department of Energy (DOE) data, Fang *et al*. (National Central University, Taiwan) demonstrated that the observed surface wind fields have

*A report on the Asian Urban Meteorology and Climate Conference held at the City University of Hong Kong, China in May 2017 under the auspices of Asian Network for Climate Science and Technology (ANCST).

†A special topic study group on urban meteorology and environment has been initiated within ANCST which will organize further meetings and collaboration on data in Asia, under the chairmanship of J. C. L. Chan.

shown a decreasing trend over the past 35 years. Using weather research forecasting (WRF)/CMAQ models, they showed that a reduced land–sea breeze circulation and planetary boundary layer (PBL) height development have restricted the dispersion of air pollution in the area around Taiwan in recent years. Yusop and Ismail (Universiti Teknologi, Malaysia) showed that extreme rainfall is expected to occur more frequently in Malaysia in the future due to global warming. This phenomenon, coupled with rapid development that has transformed vegetated and natural land use into more impervious surfaces, could lead to a more devastating flood impact.

Using the Community Earth System Model, Tai *et al*. (Chinese University of Hong Kong) showed that changes in stomatal conductance affect the partition between latent and sensible heat flux, ultimately modifying the surface temperature, precipitation and other boundary-layer meteorological variables. Therefore, understanding and differentiating between the physiological responses of different types of trees may be crucial for urban climate vegetation interaction studies.

Zhou *et al*. (City University of Hong Kong) showed that the two dominant modes of intra-seasonal oscillation contribute significantly to visibility variation in Hong Kong by modulating the associated atmospheric circulations, and the results could provide useful implications for the development of mitigation strategies associated with visibility impairment and air pollution in Hong Kong. Qiu and Chen (University of Hong Kong) used correlation analysis to detect the possible global teleconnections between precipitation and different climate and ocean variables such as sea surface temperature and sea-level pressure. They showed that the technique can be used to predict precipitation in some regions such as Eastern China.

Aktas (University College London) pointed out that neighborhood-scale modelling tools developed to account for the complex three-dimensional surfaces and volumes within an urban area are now able to predict spatial variations in temperature and humidity within the urban domain at high resolutions. Im (Hong Kong University of Science and Technology) studied the land–atmosphere interaction due to irrigation and its impact on local to regional climate, and showed that irrigation development can consistently modify rainfall patterns in and around irrigated areas, warranting further examination of the potential agricultural, hydrological and economic implications. In response to weather and climate events that pose a potential risk to urban complexes, Lee *et al*. (Hong Kong Observatory) conducted studies to integrate the collected data in high-resolution weather, air quality, urban climate models and other related forecasting systems in support of multi-hazard impact-based forecasts and warnings for the city.

Park *et al*. (Hankuk University, Korea) used the high-resolution urban meteorological observation system networks in the Seoul Metropolitan Area to deliver high-quality meteorological information customized for users' demands for the purpose of urban resilience and sustainability in the area. The data can also be used to solve the meso-γ to micro-β scale meteorological phenomena (*terra incognita* or grey zone problem) scientifically in highly populated urban areas. Roth *et al*. (National University of Singapore) studied the impact of urbanization on the energy and carbon exchange over a residential neighbourhood in a tropical Asian city. This study adds to the global dataset of urban energy fluxes, which can be used to investigate the urban heat island effect, improve the thermal comfort of residents, study extremes of urban weather and evaluate carbon mitigation options. Sun *et al*. (City University of Hong Kong) used a low-cost air-pollution measurement system in a community environment to collect data that can be used to identify pollution sources. This study demonstrated that advances in sensor technology and communication have accelerated the application of sensors in air-quality monitoring to supplement traditional regulatory stations.

Wang *et al*. (Sun Yat-Sen University, China) developed a novel approach to derive an urban canopy parameter database of Guangzhou from Google Earth imagery for an urban WRF model. This study helps to better understand the complex interactions between urban physical systems and urban-growth drivers (social-economical, policy, etc.), which are critical to designing better adaptation and mitigation strategies. M. Mohan (Indian Institute of Technology Delhi) studied the land-use/land-cover (LULC) changes and urban expansion in the mega city of Delhi and highlighted the major impact of LULC changes on local meteorology and air quality. The results emphasize the concepts of urban planning that should be applied to give greater consideration to the preservation and management of natural land-use classes, which will increase the quality of life in an urban environment.

Yuguo Li (University of Hong Kong) studied urban air flows in calm wind conditions, leading to the formation of a heat dome or urban heat island circulation (UHIC). Numerous field studies worldwide have confirmed the existence of UHIC during the day and night in many cities, which can cause heat waves and severe air pollution episodes. Wu (Tsinghua University, China) studied different vehicle emission charging schemes to reduce air pollution and strengthen public environmental awareness. In particular, the study divided the city into different zones according to the intensity of the urban heat island.

Liu *et al*. (University of Hong Kong) reported the results of their recent study on the transport processes over idealized rough surfaces to simulate the flows and transport of pollutants over urban areas in crossflows over urban areas. The study revealed the weakness of conventional practice and presented a new parameterization of the dispersion coefficient for pollutant plume dispersion over urban areas. Mo and Liu (University of Hong Kong) carried out a series of wind-tunnel experiments to characterize the turbulence structure over different types of surface roughness. The results help improve our understanding of the flow structure, which is needed to unveil the essential mechanism of ventilation and pollutant removal over various configurations of surface roughness. Wu and Liu (University of Hong Kong) carried out a budget analysis for reactive plume transport over urban roughness, which showed the correlation between advection, diffusion and chemistry terms, implying the significance of chemistry in pollutant removal.

In another study on street canyons, Ganbat *et al.* (City University of Hong Kong) used the WRF high-resolution mesoscale model and the PALM building-resolving large-eddy simulation model to determine the relative contributions of regional and local sources to particulate concentrations in Hong Kong. The effects of different weather conditions, urban geometries and emission

scenarios were also analysed. Wong *et al.* (Hong Kong University of Science and Technology) evaluated the performance of the WRF model in Hong Kong with the World Urban Database and Access Portal Tools (WUDAPT) input dataset and provided guidance for its implementation. The impacts of different urban morphology changes on the urban boundary layer structure were also discussed. Yeung *et al*. (Hong Kong University of Science and Technology) studied the meteorological impacts of expanding urban areas and increasing building heights in Hong Kong using WRF with the building environment parameterization and building energy model. The results showed that the urban expansion scenario had a more significant impact on temperature than the increase in building heights scenario.

Fan *et al*. (University of Hong Kong) studied the turbulent eddy structures and heat flux distribution above an ideal 'square city' using water-tank experiments. Their results revealed that the non-uniformity of the heat flux was due to the special natural convective flow pattern above the square urban area, and the flow could be characterized in terms of the topology of the mean streamline pattern. You and Fung (Hong Kong University of Science and Technology) studied the characteristics of sea breeze caused by divergent wind in the Pearl River Delta (PRD) region and its response to urbanization. Their findings demonstrated the mechanism by which sea-breeze circulation can be modulated by urbanization.

Holst *et al*. (City University of Hong Kong) compared the parametric numerical simulations of local urban anthropogenic heat forcing with large-scale changes in moisture levels in the PRD region. The results showed that urban environments may significantly affect their local and regional precipitation microclimate. Liu and Chan (City University of Hong Kong) showed that cooking made a greater contribution than vehicles to primary organic aerosol concentrations in an urban area of Hong Kong. The results suggested that restaurant owners and operators should take appropriate pollution-control measures to minimize the emission of air pollutants that cause a variety of respiratory health problems.

Sulong *et al*. (Universiti Kebangsaan, Malaysia) studied PM2.5 concentrations and their composition during haze and non-haze episodes in Kuala Lumpur, Malaysia and the potential impact on human health. During haze periods, the predominant source identified was secondary inorganic aerosol and biomass burning from Sumatra, Indonesia. Erik Velasco (Singapore–MIT Alliance for Research and Technology, Singapore) presented the results of a series of studies designed to evaluate *in situ* the exposure and dosage of particles experienced by city residents during their daily commutes. The findings are expected to contribute to the design of sustainable and clean public transport systems that promote a higher quality of life.

Lau *et al*. (City University of Hong Kong) studied pollutant ventilation within idealized and realistic urban configurations with large-eddy simulations. They showed that variations in building height as well as source release locations significantly influenced the pollutant ventilation. Qin *et al.* (City University of Hong Kong) examined the relationship between brown carbon and aerosol chemical compositions in Guangzhou, China. The study will help to quantitatively predict radiative forcing due to aerosol. He *et al.* (City University of Hong Kong) studied the impacts of biomass burning emissions from Southeast Asia and their contribution to local air pollution in Hong Kong. The results provide a better understanding of how the long-range transportation of the products of Southeast Asian biomass burning affects local air quality in South China.

The major conclusion of this conference was that local levels of pollution and the expansion of urban mega cities may be related to the increasingly frequent occurrence of natural hazards. Detailed studies of urban structures, types of buildings, open spaces and transport systems, together with detailed measurements and modelling of the atmospheric environment, are beginning to provide forecasts and tools to develop policies that minimize the impacts of pollution and natural hazards. However, such approaches must take into consideration the different topographies, building heights, materials and distributions, regional environments and climates of the different areas and geographical latitudes of Asia.

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