Office of Institutional Research and Social Responsibility, NTU
International Degree Program in Climate Change and Sustainable Development, NTU
Research Center for Future Earth, NTU

NEWSLETTER
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SC+NTU

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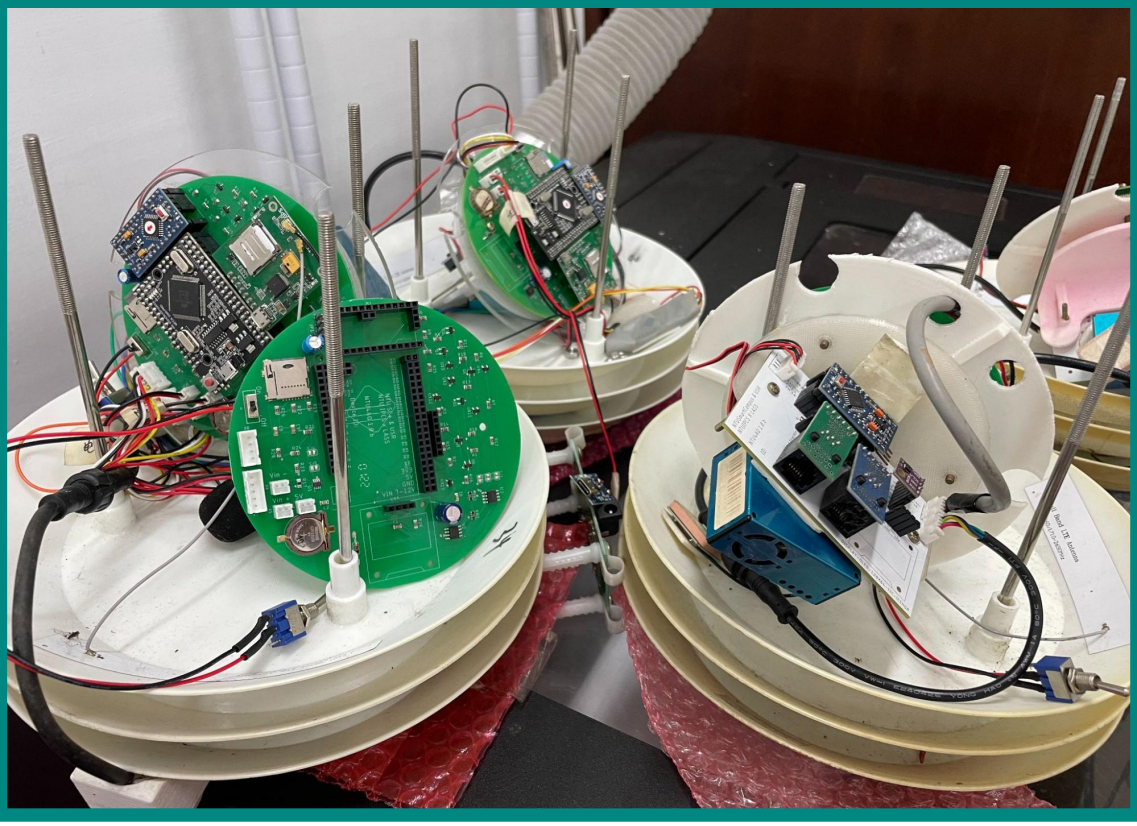
SC+NTU Work Team



As May arrives with gradually rising temperatures, our team continues to work diligently on existing environmental issues. Meanwhile, we have received good news from the Ministry of Education regarding the approval of our university's social responsibility practice plan. In the future, SC+ will continue to deepen our involvement in community issues, aiming to connect the university campus with the local community and make a greater impact in various aspects.

In this issue of the newsletter, we will compare methods for estimating sky openness using ortho-images, aiming to provide reference points for quantifying various urban parameters. Additionally, we will continue the preliminary research on electricity consumption at NTU conducted by the Information Management Department team. This time, we will further analyze the power consumption intensity of the two buildings in the College of Management, contributing to ongoing efforts for campus energy conservation. Lastly, in the Knowledge Sharing section, we will share a guide introduced by the World Meteorological Organization concerning meteorological services.

Issue No.33

Monthly Activities Summary

USR 3rd Phase Project Approved

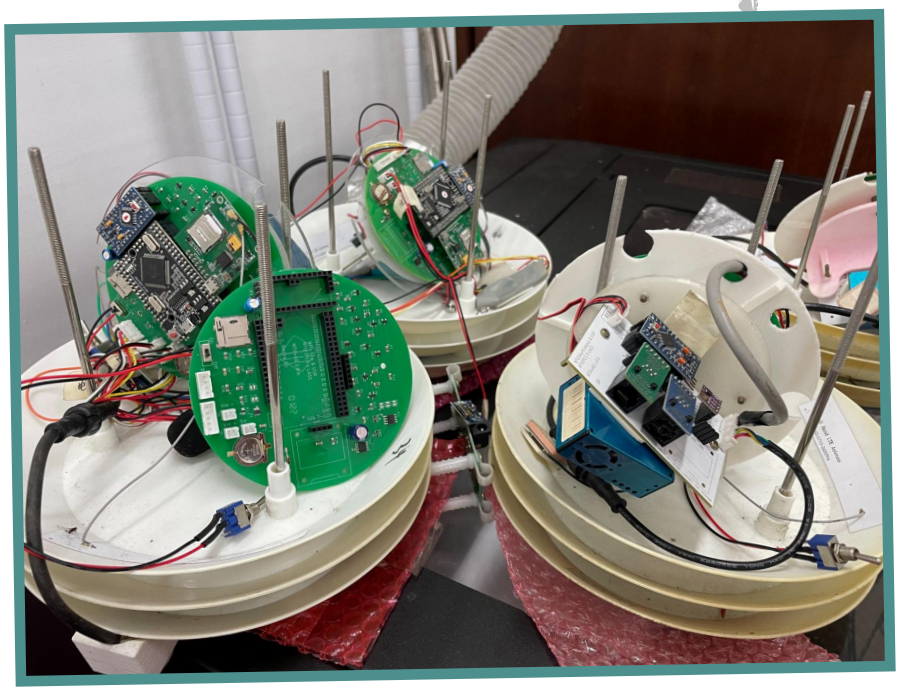
5/8

USR focuses on mutual activities between universities and communities. We are delighted to announce that this project will once again receive funding from the Ministry of Education, allowing it to continue its efforts in community environmental issues and showcasing its impact.

5/22

NTU4AQ Entered for Maintenance

NTU4AQ, which is operating outdoors, is exposed to various weather conditions such as wind, sun, and rain, which inevitably leads to material wear and tear. Before the upcoming rainy season, we plan to bring NTU4AQ back to the laboratory for inspection and maintenance. Our aim is to ensure the sensors are in good condition, allowing us to continue monitoring the microenvironmental data in the community.



Achievements and Announcements

Comparing Different Methods for Estimating Sky View Factor from Orthophotos: A Case Study of National Taiwan University Campus.

Summer Intern Chen, Cong-Syuan

Recently, an increasing number of studies are attempting to explore the micro-environment in urban areas under the influence of environmental changes and human activities. Investigating the physical processes and quantifying various urban morphological parameters is crucial. Among these factors, the sky view factor is determined by the characteristics of the surrounding environment and plays a significant role in influencing wind speed, temperature, and radiation at the street scale. However, the traditional methods of quantifying the sky view factor using fisheye lenses often require a significant amount of human effort and computational resources. To address this issue, this study proposes an alternative method to calculate sky view factor from orthoimages and compares the results obtained from different assumptions and data sources.

In this study, fisheye lens images collected from the newly developed NTU4AQ sensors on the NTU campus were used as samples and compared with the proposed method. By utilizing orthoimages from drones and Geographic Information System (GIS) software, the land types were classified into six categories, including buildings, trees, grasslands, lakes, ground, and others. During the calculations, the study found that a buffer distance of 35 meters was the most suitable for the analysis.

In this study, three different scenarios of data availability were considered to estimate the sky view factor, and three different approaches were proposed for each scenario. The scenarios included S1: using only orthoimages, S2: combining orthoimages with assumed heights for buildings and trees, and S3: utilizing actual Digital Surface Model (DSM) data for buildings and trees. The results indicated that the methods used in S2 and S3 outperformed S1, but there was no statistically significant difference in performance between S2 and S3. However, the S2 method required much fewer resources compared to S3. The findings of this study provide important quantitative references for future estimation of sky view factors in urban areas.

The Analysis of Electricity Usage in NTU Buildings

Chang Yung-Chian; Chen Xin; Jiang Ruo-Hua; Hu; Yao Zhen

According to Taiwan's Net Zero policy, many industries are striving to achieve Carbon Neutrality. NTU is no exception, and last year it announced its goal to reach 100% Carbon Neutrality by 2048. To understand Carbon Neutrality, we need to know that carbon emissions are mainly divided into three scopes. Scope 1 includes direct emissions from the production process of products, Scope 2 covers indirect emissions from electricity usage, and Scope 3 includes other emissions such as transportation. Among these, nearly 90% of carbon emissions come from electricity usage. Therefore, this research aims to further explore the electricity consumption in NTU buildings.

We collected electricity data from all NTU buildings and used K-means clustering to explore whether there are trends in grouping the buildings into different types. As shown in Figure (one), when clustering into three or four categories, there is a stable pattern, indicating that based on the trends of electricity meter data from the buildings, they can be grouped into different clusters for further analysis.

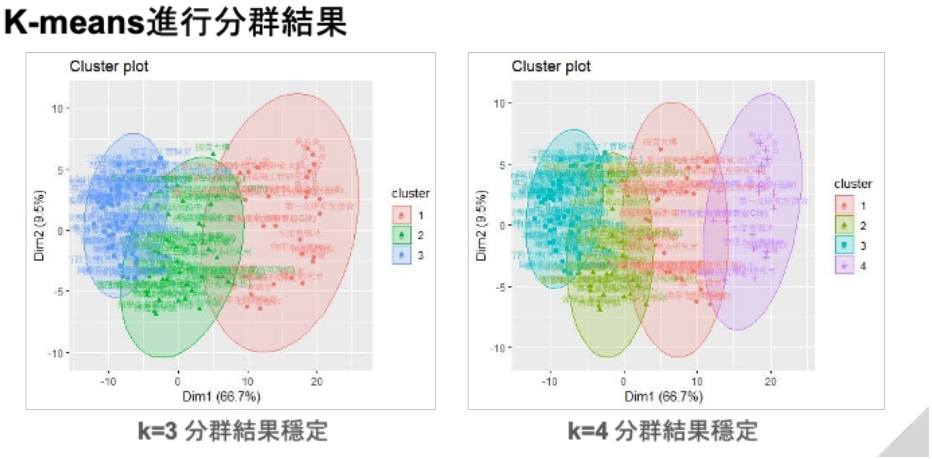


Figure 1: K-means Clustering Results

Based on the preliminary analysis of the NTU electricity data conducted by the Department of Information Management team (Mar 2023), we further investigate two buildings in the NTU College of Management: Building 1 (管一) and Building 2 (管二). Building 1 mainly comprises faculty offices and undergraduate classrooms, while Building 2 serves as the administrative center and hosts graduate and EMBA classes. See Figure (2) for details.

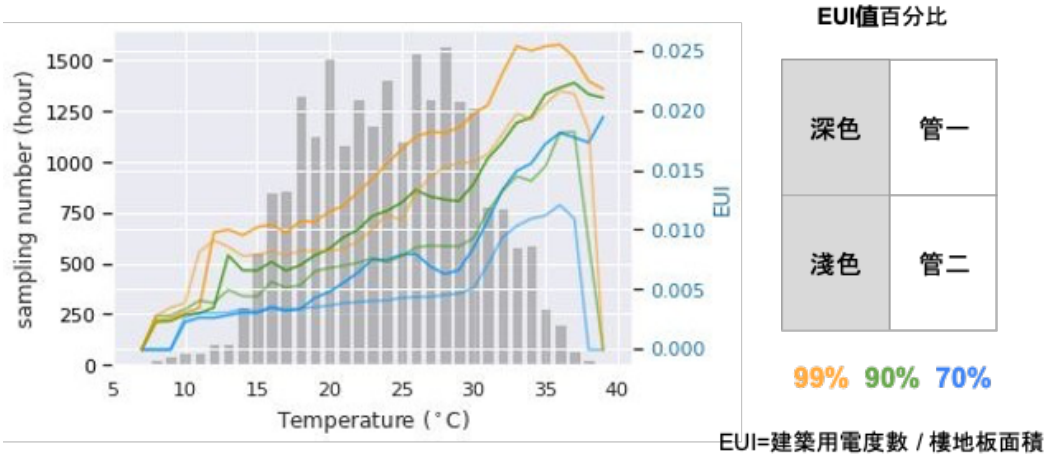


Figure 2: Introduction of Building One and Building Two and the Percentage

The final results show that hourly time and temperature are significant factors in this model. For Building 1, it was observed that the relationship between temperature and electricity consumption is less correlated, and there is a relatively small difference in electricity consumption between weekends and weekdays. In the case of Building 2, the study revealed that the southwest side is less affected by sunlight in the afternoon, while the northeast side experiences sunlight exposure in the morning. These findings provide valuable insights into the environmental conditions and energy usage patterns in both Building 1 and Building 2.

In conclusion, this research successfully developed a model (K-means) capable of simultaneously estimating the energy consumption of multiple buildings with different types. The model can also assess the electricity usage of buildings under various climate change scenarios. Additionally, incorporating human behavior as an evaluation parameter has the potential to enhance the accuracy of the model. Overall, this study provides a valuable framework for estimating energy consumption in diverse buildings, considering climate change impacts, and accounting for human behavior.

Suggestions for future research directions: NTU can evaluate feasible developments and applications in electricity analysis as summarized in the table below, aiming to contribute to the campus energy-saving discussions.

Development and Application	Details	Recommended Research Directions
Management of Campus Building Electricity Consumption	● Estimate next year's electricity consumption ● Categorize building electricity usage and establish reasonable EUI (Energy Use Intensity) standards ● Implement overall energy consumption control	Develop a systematic model that encompasses the entire campus, considering building purposes and utilizing techniques like k-means clustering Further detail the analysis within each building, focusing on internal energy usage patterns
Sustainable Campus Transformation	● Evaluate the adequacy of solar energy generation and energy-saving equipment ● Assess how real-time energy consumption data can contribute to achieving campus carbon neutrality ● Develop a roadmap for the transition towards sustainability	Use of real-time energy consumption as the research focus
Taking Campus Sustainability to the Next Level	● Power Dispatch (Grid Management) ● Campus Electrification of Transportation ● Power Trading (Integration of Renewable Energy Certificates, Demand Response Programs)	Interdisciplinary Research

Table 1: Development and Application of Electricity Analysis at NTU

Science Tips

WMO guidance on good practices for climate services user engagement-I

Preface by Billy Leong

Climate information is increasingly being adopted in decision and policy making at different levels around the world. The key to climate services lies in the effective and proactive involvement of service providers and users, which depends on the use of climate services and the needs of users. This report is a "Guide" edited by the World Meteorological Organization (WMO) for climate services, primarily aimed at national meteorological and hydrological departments as climate service providers. However, it also holds significant reference value for other organizations involved in the development, provision, and use of climate services, especially those engaged in the global climate service framework.

The first part of this guide summarizes the basic framework and types of climate services, while the second part introduces 14 examples of high-quality climate services from around the world. It also derives the essential conditions and elements for high-quality climate services from their successful experiences. This article provides a summary of the content of the first part of the "Guide".

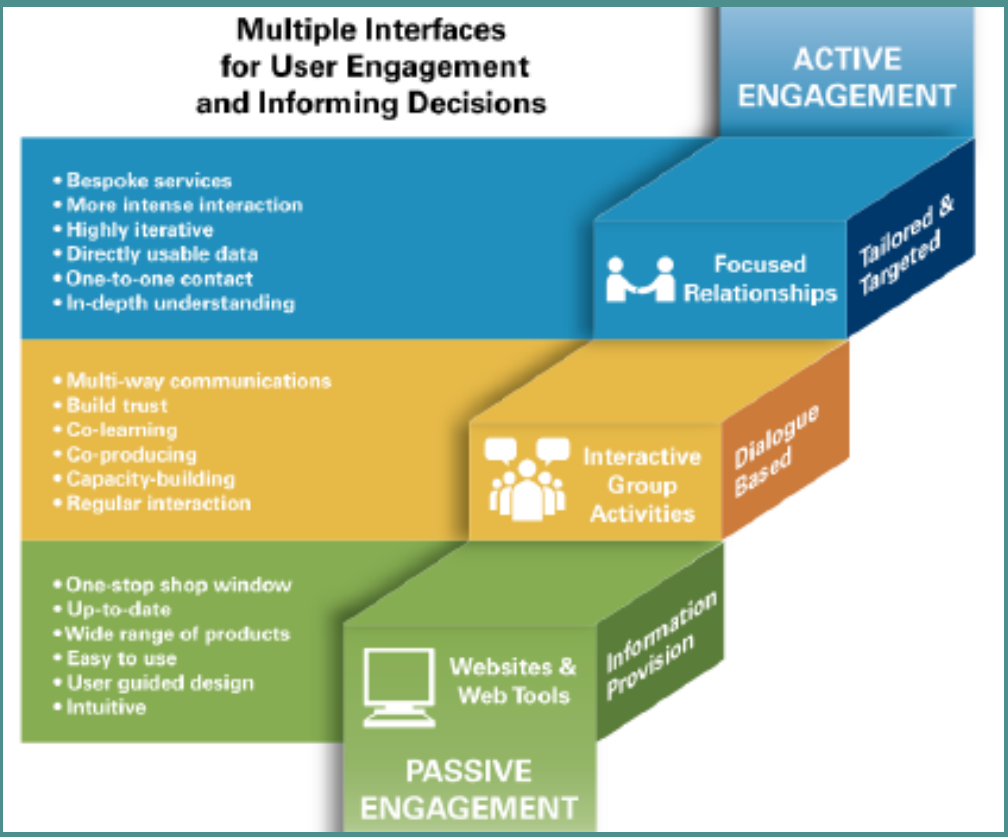


Figure 1: The user interfaces of climate services at different levels. At the lower level, there is passive involvement (such as online data dissemination). In the middle level, there is basic interactive communication (such as lectures and seminars). At the highest level, there are customized climate services.

Science Tips

Part One: Classification of Climate Services

Based on user involvement, climate services can be broadly classified into three categories:

- Websites and Online Tools: Users' involvement is relatively passive, but they can efficiently access a large audience.

Climate service providers, including National Meteorological and Hydrological Services (NMHSs), primarily interact with users through their websites. These websites serve as "storefronts," offering various products and services such as climate data, real-time weather, and climate change information. The design and content layout of these websites should continuously improve based on user feedback and consultations. Ideally, they should also include social media forums and clear contact methods, providing users with clear channels to access further information. Additionally, websites can offer online climate tools to cater to individual users' specific needs. While one-way communication platforms like websites can effectively provide valuable information to a broad audience, more interactive interfaces, such as mobile applications and social media platforms, are emerging to enhance user engagement and interactivity.

- Cross-group interactive activities: Specific interest groups or organizations with higher levels of engagement and interactivity typically participate in this category of climate services, often in the form of lectures and seminars.

Interactive group activities such as workshops, lectures, and seminars facilitate dialogue between climate service providers and users from diverse backgrounds. These activities aim to achieve mutual learning and co-development of products and services through multi-directional communication. Interactivity and communication help build and enhance knowledge, understanding, trust, and technical capabilities among participants, ultimately improving climate literacy and better utilization of climate information while considering the strengths and limitations of all parties involved. Ensuring gender balance among participants, appropriate industry representatives, domain experts, community leaders, and others can be invited to participate in these exchanges.

Well-structured meetings with skilled facilitators are essential for successful seminars. The climate information discussed should be relevant to the decision-making needs of the attending groups. Regular and frequent interactions with participants are also important to ensure that vital climate information is effectively integrated into their decision-making processes. Follow-up or extension of the seminar can be used for data updates and reinforcing information points. The organizers should collect feedback and evaluations from participants before, during, and after the meeting to improve similar activities in the future.

- Personalized Service for Providers and Users: Customized services tailored to specific user groups based on their needs.

Compared to the previous two forms, this relationship is customer-centric and places a strong emphasis on their needs, resulting in the highest level of user engagement. The involved parties need to have a keen sense of decision-making and user needs. Effective communication and data sharing between climate service providers, research teams, and customers are essential to ensure the development of simulation models that cater to specific user requirements. Building a strong sense of ownership and trust in the product during the interaction and development process is crucial for customer satisfaction. For sectors such as agriculture, commodity trading, energy, or water resource management, interdisciplinary teams need to be established to develop products suitable for their complex decision-making systems. It is worth noting that such customized services and products, along with their related projects, can create significant value, but careful consideration of intellectual property management may also be required.

Science Tips

This "guide" summarizes the key success factors of several excellent climate services and also advises other climate service providers to be mindful of potential controversies arising from factors such as gender, language, and culture. When designing websites, products, and organizing climate forums, these considerations should be taken into account, and it may be beneficial to include intermediaries with social science skills in their teams. Additionally, users' groups should be equipped with the ability to interpret climate-related information, such as seasonal climate probability forecasts and regional climate change predictions. Finally, formal partnerships with users can be established through memorandums of understanding or other suitable mechanisms to ensure the continuity of collaborative efforts and formalize the roles and responsibilities of all relevant parties.

Reference

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ABOUT OUR TEAM

SC+NTU Work Team

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International Degree Program in Climate Change and Sustainable Development (IPCS)

The International Degree Program in Climate Change and Sustainable Development, as its name suggests, is an interdisciplinary degree program that encompasses a global perspective. Established by the College of Science, the program is a joint effort among NTU faculty members from both scientific research and humanities backgrounds. In dealing with climate change and sustainable development, we instrument in-depth teaching in a wide range of topics. Students are required to bring their knowledge and skills to the table and approach environmental issues from a multi-angled perspective. They are encouraged to break free from traditional views on sustainability and think outside the box. Students are expected to be motivated learners, thinkers, analysts, and most important of all, practitioners. Our ultimate goal is to cultivate students' ability in interdisciplinary problem-solving in dealing with the complexity of climate change issues.

ABOUT OUR TEAM

Location Aware Sensing System (LASS)

The Location Aware Sensing System (LASS) is an important maker community in Taiwan, and it is also the creator of air boxes, water boxes, and other micro-sensing devices. LASS focuses on the integration of citizen technology and spatial information, aiming to design and implement an environmental sensing system with local characteristics through the integration of hardware and software. The community strives to promote open source and public welfare as the main axis, and to create customers instilled with a 'self-creator' spirit, develop low-cost environmental monitoring equipment with an open software and hardware architecture so that the public may build a set of sensing systems that meet their specific needs through a self-made process. At the same time, LASS also adopts and open attitude towards sensing data and allows volunteers to use environmental monitoring data uploaded to the cloud system by other partners in the community in order to build a real-time monitoring network.

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