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
Jun. 2023

SC+NTU

Shiuh-Shen, Chien. Jen-Ping, Chen. Ling-Jyh, Chen. Jehn-Yih, Juang. Ming-Kung, Chung.Yi-Huan, Hsieh. Po-Hsiung, Lin.
SC+NTU Work Team

Congratulations to the SC+ team for the approval of the National Science Council project in the Yunlin area. In the future, the team will continue conducting relevant research in the community, aiming to assist aging communities in formulating adaptation strategies.

The human five senses, including vision, hearing, smell, taste, and touch, are essential functions that help us understand the world. They also influence how we perceive our environment. In addition to the aspects the team previously focused on, such as temperature and humidity, sound can also affect people's concentration and make them feel uncomfortable or irritated. In this edition of the newsletter, we will explore the impact of environmental sounds on concentration, understand the extent of sound's influence, and discuss the limitations of using decibel levels to quantify sound. Continuing with the campus carbon reduction topic, we will also discuss whether THE rankings reflect the efforts of schools in carbon reduction actions, and delve into the carbon reduction goals of various universities. In the Comfort+Common Sense section, we will continue from the previous newsletter and provide an overview of the second part of the Climate Services Guide.

April Activities Summary

4/6

Taipei City Environmental Education Group Activity I

Led by the Taipei City Environmental Education Group, the team ventured into the Maokong Hiking Trail in the suburban area of Taipei City. Carrying the portable version of MAPS, they started monitoring PM2.5 levels along the route from the Taipei Zoo Station. Dr. Zhong Ming-guang and the SC+ team carefully explained the implementation and measurement methods of the MAPS sensor, and the participants had the opportunity to operate the portable monitoring device themselves. It was also observed that the air quality in the Maokong area was excellent, making it a suitable environment for people to be outdoors and enjoying nature.

4/13

Taipei City Environmental Education Group Activity II

For the second week of the Environmental Education Co-learning Group, the team ventured into the suburban area of Taipei City to explore the Zhangshan Temple Trail. In addition to measuring PM2.5 levels along the route, the team went a step further and calculated the carbon footprint of their journey together with the group members. With a focus on individual calculations, the carbon footprint of transportation and travel throughout the journey was assessed. The participants quickly realized that taking public transportation can effectively reduce their personal carbon footprint.

4/18

Patent Approval Received

The Environmental Comfort Sensing Management System has gone through a long process of handling and review, and finally, we have received good news. The Patent Office has officially issued a notification that the patent has been approved. We hope that this patent can further advance environmental research and development.

May Activities Summary

5/8

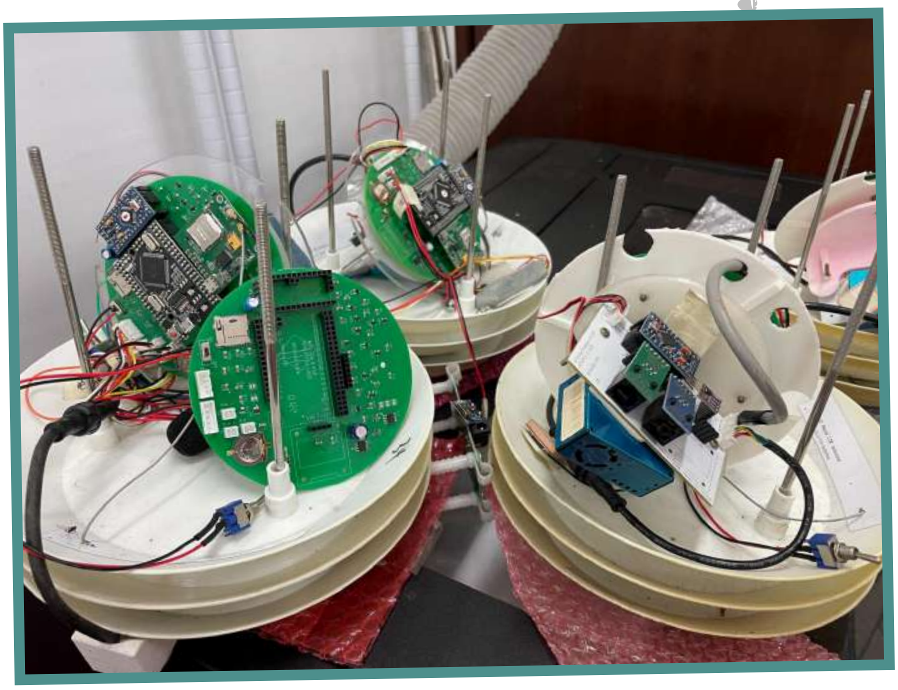
USR 3rd Phase Project Approved

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.

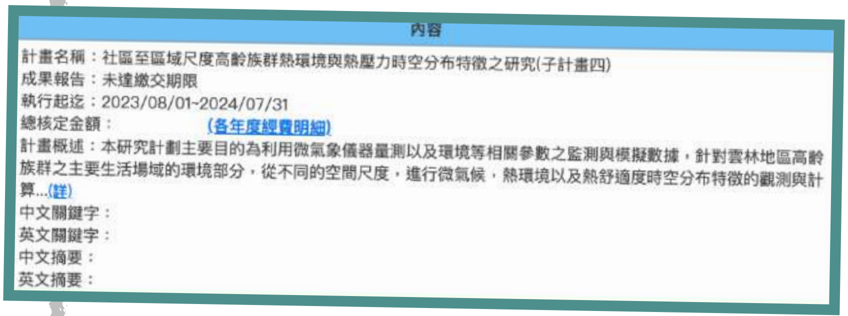


June Activities Summary

6/28

Approval Granted for National Science Council's Yunlin Project

Congratulations on the approval of the National Science Council collaboration project in the Yunlin region. The upcoming research will focus on conducting studies in villages in Yunlin to explore the health environment in aging communities. This will involve investigating environmental parameters and microclimate instruments to understand the spatial and temporal distribution characteristics of indoor and outdoor microclimates and thermal comfort for the elderly population. The aim is to contribute to the development of relevant adaptation strategies for aging communities.



內容

計畫名稱：社區至區域尺度高齡族群熱環境與熱壓力時空分布特徵之研究(子計畫四)
成果報告：未達繳交期限
執行起迄：2023/08/01~2024/07/31
總核定金額：　(各年度經費明細)
計畫概述：本研究計劃主要目的為利用微氣象儀器量測以及環境等相關參數之監測與模擬數據，針對雲林地區高齡族群之主要生活場域的環境部分，從不同的空間尺度，進行微氣候，熱環境以及熱舒適度時空分布特徵的觀測與計算...(詳)
中文關鍵字：
英文關鍵字：
中文摘要：
英文摘要：

6/29

Climate Services Industry Book Club and Summer Interns Meeting

Before the start of the summer internship, we invite new interns to participate in laboratory reading club activities. This helps them become familiar with relevant environmental issues and solutions. By reviewing literature, everyone can acquire the necessary foundational knowledge and build upon the work of experts, enabling us to continue advancing our research as a team.

Achievements and Announcements

The Impact of Environmental Sound on Concentration

Yu,Xin-Yang; Chen,Jun-Wei; Wu,Pei-Jun; Chi,Cai-Wei; Liu,Yu-Lun; Lian,Yan-Bo

Research Motivation:

The portrayal of sound goes beyond shaping the spatial and scenic elements in literary works. In our daily lives, sound is also one of the key factors that differentiate spaces. Spaces are constructed through the actions of individuals, and wherever there's action, there's bound to be "sound." Even complete silence constitutes a form of "sound."

However, contemplating how sensory experiences shape space solely through the perspective of "volume" of sound is not a comprehensive enough measure. For instance, hearing the soft sound of a plate clinking or the squeak of styrofoam rubbing might still evoke irritation or discomfort. Conversely, listening to loud classical music might not necessarily be displeasing. Therefore, we are curious about how the sounds on the NTU campus affect students' concentration levels. Through this exploration, we aim to reflect on the limitations of using "decibels" to quantify sound as mere "volume" and delve into the specific impacts that sound creates.

Literature Review:

In the "Handbook of Music Psychology," the authors explain, "Through the analysis of these musical passages, the results show that tears are largely induced by the sequence and cadence of the sound, and excitement arises from the appearance of new or unexpected harmonies." This indicates that the elements influencing emotions through music extend beyond "volume." It can even be said that aspects such as melody and timbre might be the more critical components. In other words, the factors contributing to the emotional impact of sound on individuals are not limited to its "volume."

Exploring the impact of sound on emotions solely through volume would disregard the ability of sound to shape sensory experiences, as well as the dynamics between individuals and their surroundings and other individuals. This raises further exploration into the limitations of using "decibels," which quantifies sound as "volume," to regulate the way individuals interact with sound. This might not adequately consider the multifaceted nature of sound's effects on perception and human-environment interaction.

Research Method:

1. Survey Design:

- Division of Study Areas:

Select the "General Teaching Building," "New Building for Freshman Teaching," "Bo-Ya Teaching Building," "Integrated Teaching Building and Cooperative Teaching Building," "Main Library," and "Social Science Library" within the National Taiwan University campus as the study areas.

This approach focuses on selecting specific buildings within the National Taiwan University campus for the study. These buildings include the General Teaching Building, New Building for Freshman Teaching, Bo-Ya Teaching Building, Integrated Teaching Building and Cooperative Teaching Building, Main Library, and Social Science Library.

- Sound Classification:

Table 1 - Methods of Sound Differentiation

	Natural	Non-natural
Biological	Animal sounds (birds, dogs)	Vocals (moving chairs, typing)
Non-biological	Natural sounds (rain, wind)	Machine sounds (AC, construction

- Level of Concentration Classification:

Table 1 - Methods of Sound Differentiation

5	State of flow, ego dissolution
4	Can complete goals with good efficiency, able to concentrate on reading text and a degree of thinking
3	Able to complete goals, but process is somewhat affected. Acceptable with no major problem
2	Nearly unable to accomplish goals, urges to fidget and overall difficulty staying focused on the task
1	Cannot accomplish goals, cannot concentrate on work

2. Statistical Methods:

- Decibel Calculation:

Obtain sensor data from the campus and its surroundings for the years 2018 to 2022. Assuming an environment with free-field acoustics, the formula for the distance divergence attenuation of a point source is: $\Delta L = 10log(\frac{1}{4\pi r^2})$

Since the sensor itself is a machine that receives noise and not a point source of sound, a hypothetical point source must be established near the sensor's location. After substituting the formula with the inverse function, assuming a change in quantity $\Delta L = 0$, we derive r = 0.2820948m. This implies that within a distance of r meters near the point source, the theoretical intensity of sound will not decrease. Therefore, a hypothetical point source is defined at a distance of r meters north of all sensors.

- Calculation of Concentration Impact:

In the survey form, the impact level is divided into 6 grades. If the survey respondents did not hear a particular sound, the value is set to 0.

After reorganizing the data from the survey forms, further calculations are performed based on the total impact level values of concentration for the four types of sounds investigated in each area. This calculates the average impact level of environmental sounds on the surveyed subjects in specific spaces. Finally, maps displaying the levels of concentration impact for teaching buildings and libraries are generated.

- Discrepancy between Subjective and Objective Data:

The corrected average decibel levels and the standardized average values of concentration impact (Z-scores) are calculated. The difference between these two Z-values is used to create a map with level contours, illustrating the difference between the objectively received decibel values and the subjective perceptions of the sound impact of NTU students.

Research Results:

Our team will standardize the decibel levels and concentration impact values by subtracting the latter from the former. Then, the resulting values from the difference between the two maps will be divided into 10 levels. This approach aims to reflect the disparity between the objective decibel values received in the study area and the subjective perceptions of the NTU students.

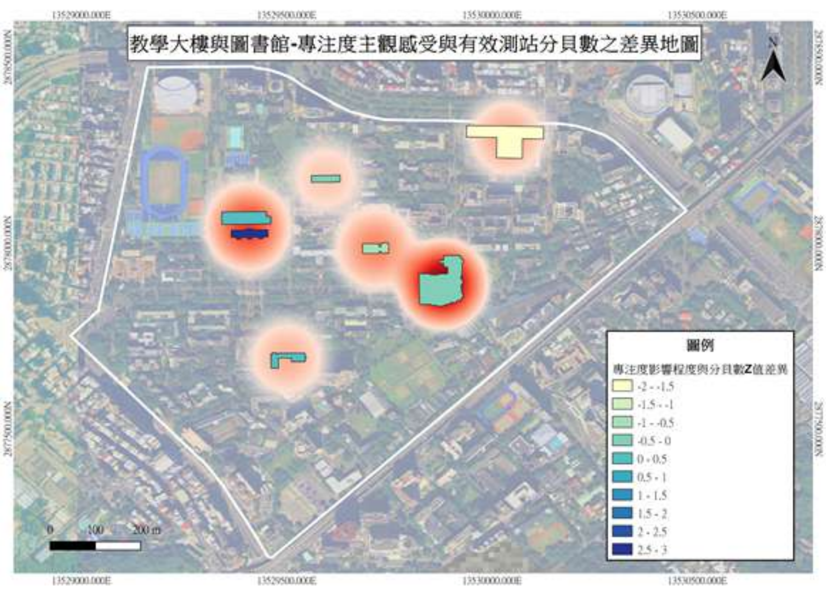


Figure 1: Map of the Impact of Environmental Sounds on Concentration Level

Our team will standardize the decibel levels and concentration impact values by subtracting the latter from the former. Then, the resulting values from the difference between the two maps will be divided into 10 levels. This approach aims to reflect the disparity between the objective decibel values received in the study area and the subjective perceptions of the NTU students.

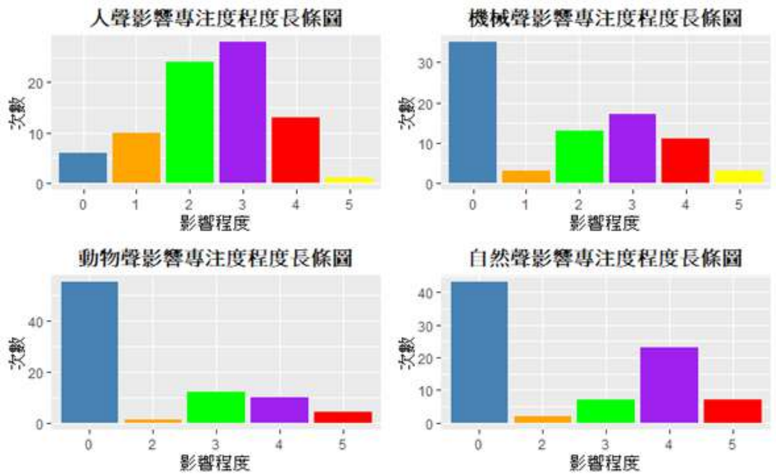


Figure 2: Bar Chart of the Impact of Different Types of Sounds on Concentration Level

The above chart reveals that a higher environmental decibel level does not necessarily result in a more severe impact on users' concentration levels. This challenges the conventional concept of the relationship between sound and concentration.

Conclusion:

In this study, the correlation between sound and concentration was chosen as the main research topic, aiming to explore the extent to which sound affects the concentration of NTU students during academic activities. As shown in Figure 2, higher environmental decibel levels in teaching buildings do not always lead to a more significant impact on users' concentration. This highlights that relying solely on environmental decibel levels as a management reference may not effectively address the factors that impact users the most. Further analysis of the sound components in the space and the control of factors that significantly affect users' concentration levels are necessary to truly mitigate the issue.

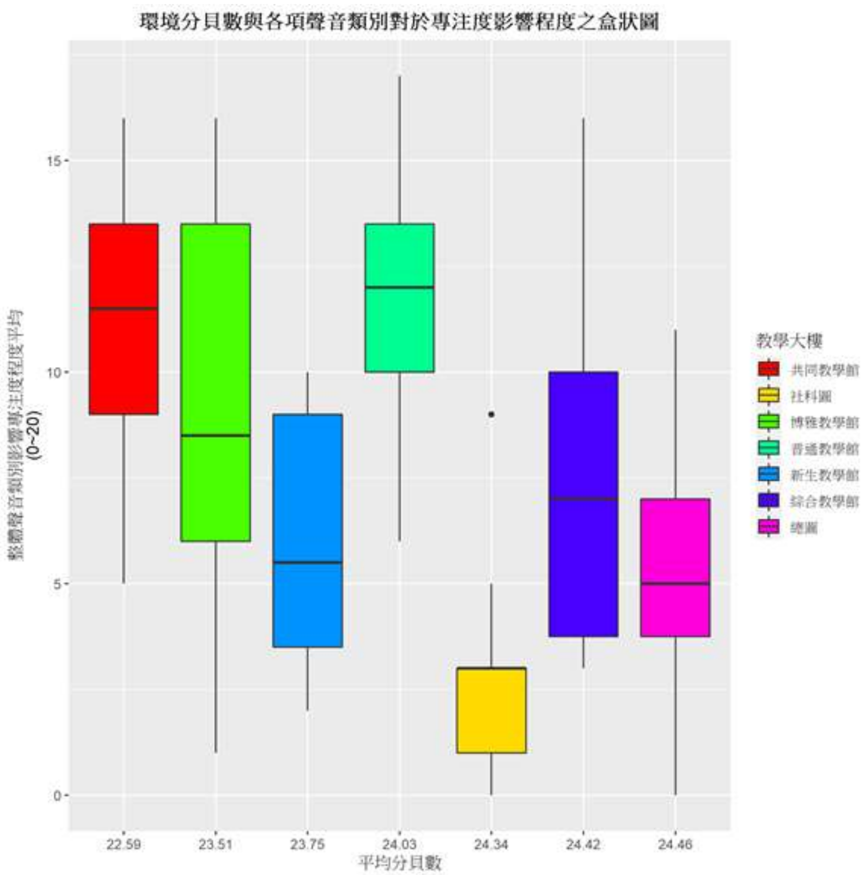


Figure 3: Box Plot of the Relationship Between Environmental Decibel Levels and the Impact of Various Sound Categories on Concentration Level

References:

Environmental Protection Administration, Executive Yuan, Taiwan. Noise Encyclopedia. https://air.epa.gov.tw/EnvTopics/NoisenRadiation_4.aspx (Accessed: June 15, 2023)

New Taipei City Government Environmental Protection Bureau. Introduction to Noise Control. https://www.epd.ntpc.gov.tw/Article?catID=309 (Accessed: June 15, 2023)

Will THE rankings can effectively reflect a university's efforts in carbon reduction actions?

Liu,Zhi-Han; Lin,Jing-Ting; Li,Yi-Jing; Lin,Si-Ying; Huang,Ji-Qing

The annual Times Higher Education (THE) World University Rankings assess the performance of universities in teaching, research, citations, international outlook, and industry collaboration. It primarily emphasizes a university's academic performance. In contrast, the THE World University Impact Rankings focus on the highest scores achieved by universities in three SDGs (Sustainable Development Goals) and also consider SDG 17, which relates to partnerships working towards the goals. This ranking evaluates a university's execution of the United Nations' Sustainable Development Goals.

In this study, we will analyze the top 20 universities from the 2022 THE World University Rankings and World University Impact Rankings, along with National Taiwan University. We will use the latest annual reports, sustainability reports, climate action plans, and carbon footprint reports to understand how each university is progressing with carbon reduction goals such as net-zero or carbon neutrality. Through this analysis, we aim to discuss whether THE rankings can effectively reflect a university's efforts in carbon reduction actions.

2022 THE 世界大學排名	2022 THE impact rankings
1. University of Oxford (UK)	1. Western Sydney University (Australia)
2. California Institute of Technology (US)	2. Arizona State University (US)
2. Harvard University (US)	3. Western University (Canada)
4. Stanford University(US)	4. King Abdulaziz University (Saudi Arabia)
5. University of Cambridge (UK)	4. University Sains Malaysia (Malaysia)
5. Massachusetts Institute of Technology (US)	6. University of Auckland (New Zealand)
7. Princeton University (US)	7. Queen's University (Canada)
8. University of California, Berkeley (US)	8. Newcastle University (UK)
9. Yale University (US)	9. University of Manchester (UK)
10. The University of Chicago (US)	10. Hokkaido University (Japan)

Table 1: The 2022 Times Higher Education (THE) World University Rankings and THE World University Impact Rankings are both assessments that evaluate universities based on different criteria.

The top ten universities in the 2022 THE World University Rankings and THE World University Impact Rankings are listed in Table (1). Starting with the two aspects of carbon neutrality and net zero emissions, we examined the carbon reduction goals of each university. In terms of carbon neutrality, the earliest carbon neutrality target set by THE ranking was achieved by UC Berkeley in 2025, whereas in the Impact Rankings, it was Western Sydney in 2030. Regarding net zero emissions, THE ranking set the earliest target to achieve net zero emissions by Cambridge and Princeton in 2048, while in the Impact Rankings, it was Newcastle in 2030, nearly 20 years earlier than the THE ranking.

Figure 1: Carbon Reduction Goals of Various Universities

Next, we performed a linear regression between THE ranking and per capita emissions. Here, per capita emissions refers to the total emissions of Scope 1 and Scope 2 divided by the population. Basically, there is a positive correlation between THE ranking and per capita emissions, with an R-squared value of about 0.3. It can also be observed that the per capita emissions of the top ten universities in the THE Impact Ranking are generally lower than those in the THE Ranking. This indicates that different universities and rankings prioritize environmental factors differently.

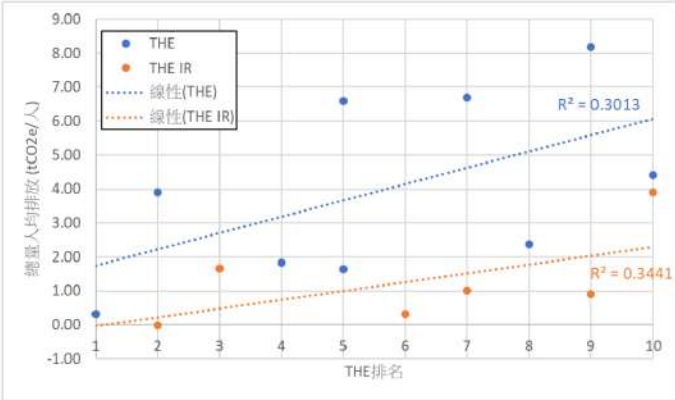


Figure 2: Correlation between Total Per Capita Emissions and THE Ranking

In the Scope 3 category, since the reporting methods are still evolving for all universities, a higher total in Scope 3 emissions may indicate a more comprehensive reporting approach. Looking at Figure (2), it's evident that Stanford's Scope 3 total is significantly higher than other universities. Upon closer examination, the Scope 3 emissions of various universities can be categorized into several types, including business travel, student commuting, employee commuting, upstream transportation distribution, procurement of products and services, capital goods, operational waste disposal, fuel and energy-related activities, and others.

Observing the disclosed Scope 3 data of various universities, the majority seem to have significant emissions in categories like business travel, procurement of products and services, and operational waste disposal. However, for National Taiwan University, categories 4 (Indirect GHG Emissions from Use of Sold Products) and 5 (Indirect GHG Emissions from Use of Services Sold) associated with products used by the organization dominate. This might be related to the scope of reporting and the specific activities of the university.

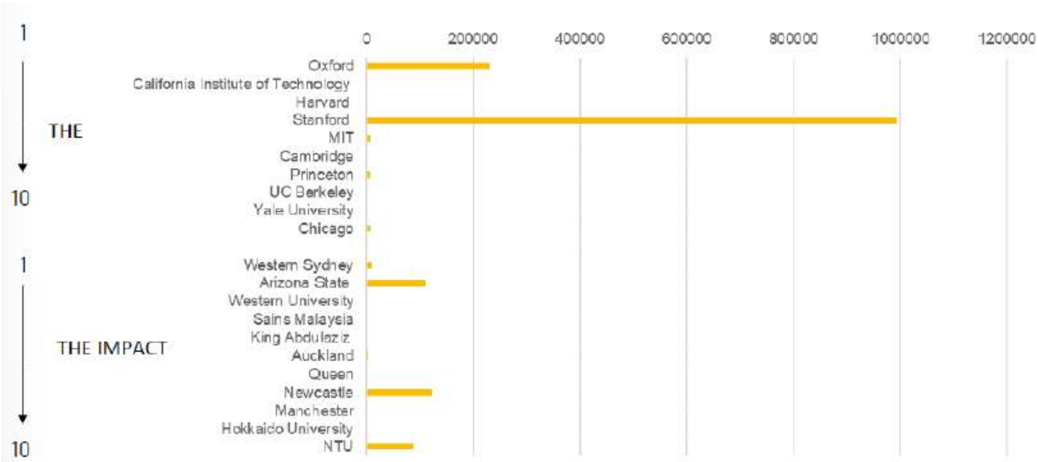


Figure 3: Total emissions in Scope 3 for each university

In summary, when it comes to the carbon emissions of various universities, looking at both THE Ranking and THE Impact Ranking, it's evident that universities have different interpretations and timelines for achieving carbon neutrality and net zero goals. Traditional THE Ranking schools tend to have more comprehensive carbon goals, while THE Impact Ranking schools are more ambitious. Some universities may have lower Scope 2 emissions due to self-generated electricity or campus-wide green energy initiatives.

Since THE Impact Ranking assesses universities based on three SDGs goals, with SDG 9 (Industry, Innovation, and Infrastructure) being the most frequently included, and SDG 3 (Good Health and Well-being), SDG 8 (Decent Work and Economic Growth), and SDG 13 (Climate Action) not being included, it might not effectively reflect the carbon reduction efforts of the schools. To compare universities' carbon reduction awareness, we can attempt to evaluate the completeness of carbon inventories. Schools at the top of traditional rankings might have more comprehensive commitments and inventories due to the scrutiny they face from society.

When comparing universities' carbon reduction efforts, challenges arise from the varying degrees of completeness in Scope 3 emissions and commitment definitions. It's recommended to follow relevant standards to provide a basis for scrutiny from various stakeholders in society.

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(1-a), S2: combining orthoimages with assumed heights for buildings and trees(1-b), and S3: utilizing actual Digital Surface Model (DSM) data for buildings and trees(1-c). The calculated R-value can reflect the degree of correlation in estimating the extent of sky openness under different circumstances. The closer it is to 1 or -1, the higher the correlation. The R-squared value, on the other hand, reflects the proportion of the model that can be explained. Therefore, a larger R-squared indicates a better fit of the model. 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.

Situation (buffer:35meter)		R correction coefficient	R2 coefficient of determination
S1. Orthoimage Only	The fraction of the open area (圖1-a)	0.702	0.493
S2.Orthoimage + w/o DSM (digital surface model) data	Surface roughness (圖1-b)	(-0.743)~(-0.746) when the height is over 15 meter/ the	0.51~0.59
S3. Orthoimage + Actual DSM data (includes details of buildings, trees, streets, etc.)	Surface roughness (圖1-c)	-0.745	0.555

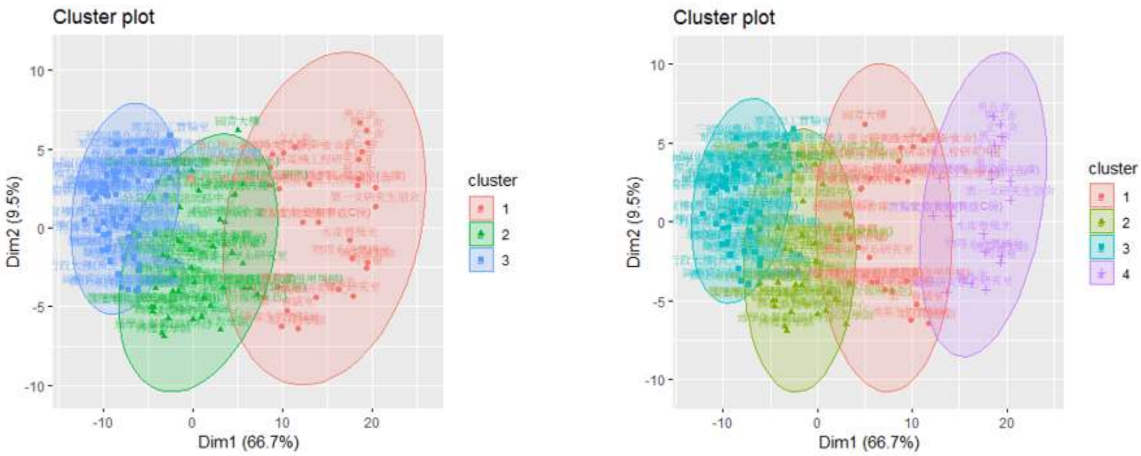
Table 1: Correlation results for estimating sky openness under three different scenarios

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.



K=3 Figure 1: K-means Clustering Results K=4

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.

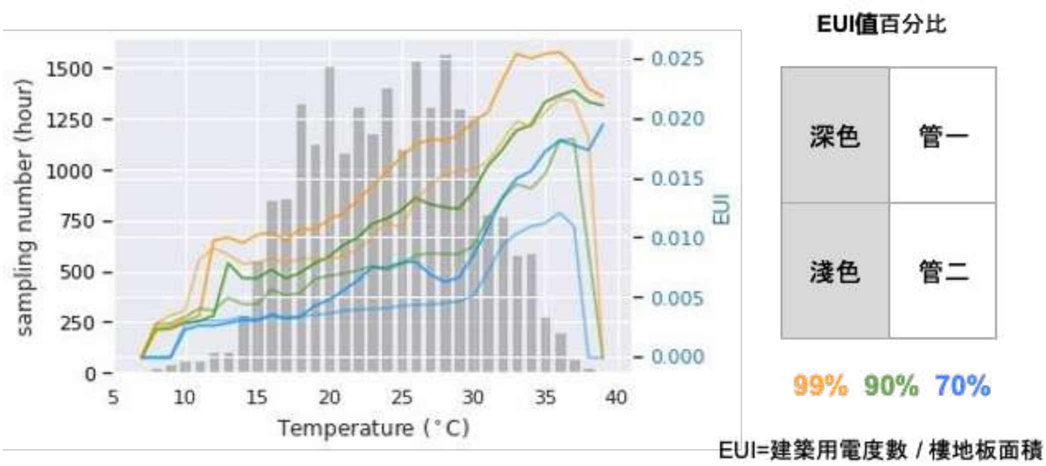


Figure 2: Introduction of Building One and Building Two and the Percentage

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

Automated Indoor Comfort Analysis

SC+ Work Team and Department of Geography Tzu-Ya, Wang

Explanation of the current progress of automated indoor comfort analysis: Figure 1 illustrates the development process of automation. We have completed the integration of data, data organization, and webpage design. The following sections will provide a detailed description of the development process.

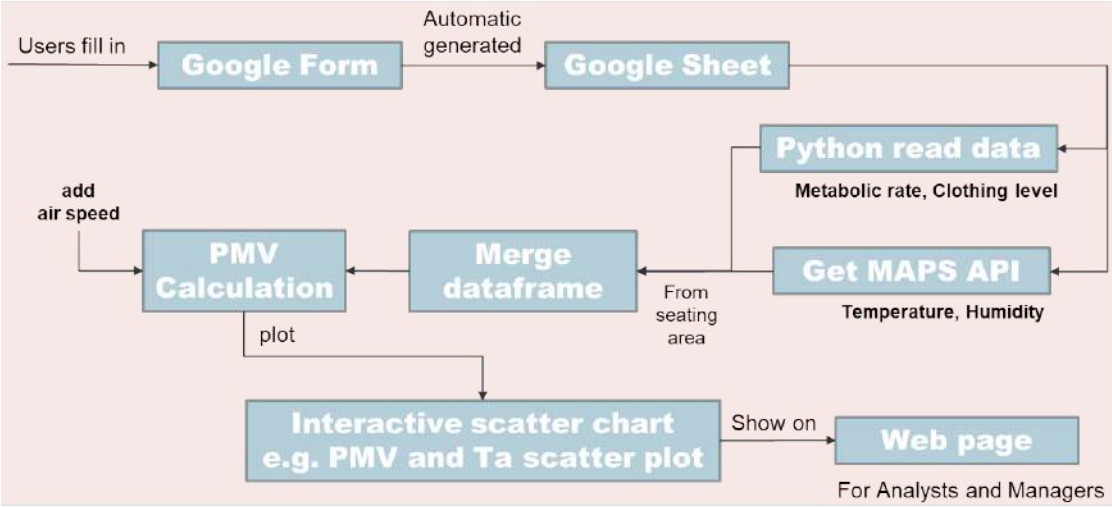


Figure 1: Automated Development Process for Indoor Comfort Analysis

The automation process starts with obtaining the questionnaire responses collected via a Google Form. When using Google Forms, the responses automatically generate a corresponding Google Sheet. The primary goal is to access the data from the Google Sheet using the Google Sheets API. After obtaining the questionnaire responses, data from the MAPS (indoor sensors) is also required. Currently, the connection is established for three specific dates when the questionnaires were distributed: 3/25, 4/1, and 4/26. The ultimate purpose of data processing is to obtain the necessary parameters, which include individual clothing and activity levels, as well as area temperature and relative humidity. These parameters are used to calculate the Personalized Thermal Comfort (PMV) index. However, this process involves several steps, such as standardizing time format (averaging over 5 minutes), converting clothing and activity levels, and temperature calibration, among others. Finally, the data from both sources are merged based on seat number and timestamp. The pythermalcomfort library is utilized to calculate the PMV. This describes the automated process for analyzing comfort data.

Next, the web page is primarily designed for researchers, aiming to help them browse and observe data in real time. The entire web page is built using the Streamlit package in Python. Streamlit is a package that enables fast creation of web pages in Python. It eliminates the need to write HTML, CSS, JavaScript, and other front-end components. With Streamlit, web scraping, data science, machine learning, and other data can be easily presented and shared using simple Python syntax. It is a convenient tool for web development.

The current design of the web page consists of the following sections (Figure 2):

1. Title
2. Dropdown menu (for switching the x-axis parameter of the scatter plot)
3. Average PMV and temperature in the classroom
4. Left: Scatter plot of PMV and other environmental parameters; Right: Average values of parameters in different zones (including PMV) - This section provides the most relevant information for researchers and is the focus of attention.
5. List of all data (highlighted in yellow are the maximum values) - The purpose of this section is to allow users to directly refer to detailed information when observing specific data points of interest or anomalies in the scatter plot.

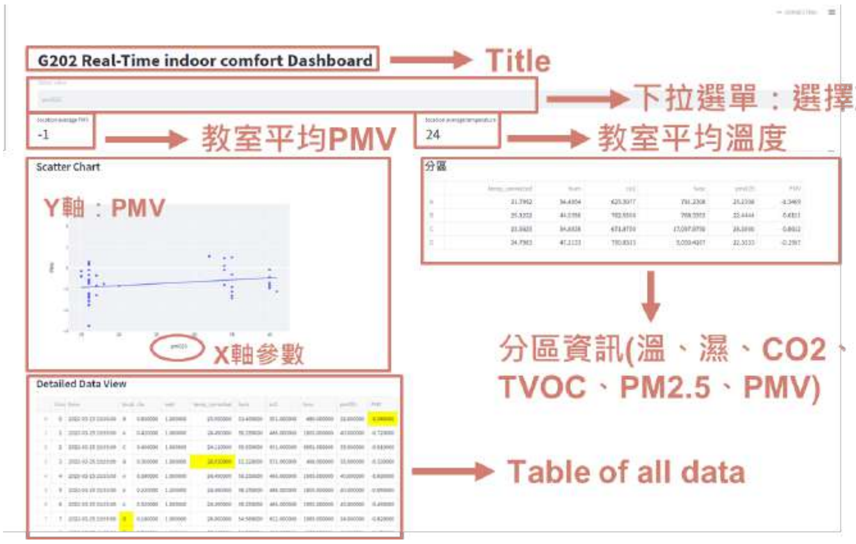


Figure 2: Introduction to the Comfort Dashboard Interface Area

The following are the areas that need improvement and completion in the future:

1. Transitioning web data from static to dynamic: Currently, the data displayed on the web page is imported from CSV files and is static. It is not directly linked to the Python file that consolidates the data. There are still technical issues to be resolved in this aspect.

2. Enhancing interactive charts: Besides obtaining real-time results, the goal of creating this automated analysis web page is to provide more interactivity during browsing. For example, when a particular data point on the scatter plot stands out, it would be desirable to have a functionality where clicking on that point corresponds to the detailed data in the table, allowing instant viewing of more detailed information. There are still many technical challenges to overcome in achieving this, including handling subjective feedback.

3. Determining web content and layout: Ensuring whether the web page requires additional content and how to optimize the UI layout for better user readability.

4. Adding a notes field: Including a notes column in the detailed data table on the web page to provide additional remarks, such as noting any issues with a specific instrument or indicating the utilization of data from a particular device.

5. Addressing minor issues with web page text: Since the current modifications to the web page are based on the examples provided by Streamlit and familiarity with the tool is still being developed, adjustments to the UI aspects will be made in the future.

United Nations Sustainable Development Goals and Campus Implementation - Temperature Measurement in Classroom 102

Meng-Chen Li, Tzu-Chiang Huang, Mei-Hui Chao, Hsuan-Ting Kao

In the context of the United Nations Sustainable Development Goals and campus implementation, an opportunity was taken to carry out a campus comfort project. An experiment was conducted to measure the temperature in Classroom 102 of the New Student Building. The objective was to compare the classroom temperature with the existing standards. Several factors were considered when choosing the measurement location, and ultimately Classroom 102 was selected. One reason was the unique layout of the classroom, with a longer width and shorter depth, and with only a window at the back of the classroom. Another reason was the passive attitude of the administrators. Finally, it was noted that the teaching faculty often felt hot but were unable to turn on the air conditioning.

For this classroom temperature measurement, the MAPS6 was used as the measurement tool. The data collected included temperature and CO2 concentration. Five MAPS6 devices were placed in the classroom: one in each corner and one in the center. Prior to data collection, all five MAPS6 devices were simultaneously placed in a designated calibration area located in the front right of the classroom for calibration. Then, each device was moved to its designated observation point, and this process was repeated three times. The data obtained from the devices placed together in the calibration area were used to establish a regression model for temperature calibration.

The experiment was conducted from November 29th to December 9th. The team members were scheduled to record the classroom occupancy and the status of door and window openings once in the morning and once in the afternoon on class days. However, during data collection, it was discovered that the device located in the front left of the classroom was malfunctioning, so its data was not used for analysis. Additionally, the initially planned temperature data from Drunken Moon Lake could not be obtained due to unfavorable weather conditions. As a result, data from the grass field was used as the outdoor temperature reference. The MAPS6 device in New Student Hall 102 had a previous malfunction and, although it was repaired, it couldn't be disassembled for a unified calibration. Therefore, the data from that device was not used for analysis in this study.

Comparing the data from New Student Hall 102 with the outdoor temperature (as shown in Figure 1), we can observe the temperature difference between the indoor and outdoor environments. It is evident that the indoor temperature remains consistently higher than the outdoor temperature throughout the day. Additionally, the indoor temperature exhibits greater fluctuations compared to the outdoor temperature, indicating more variability in the indoor thermal conditions.

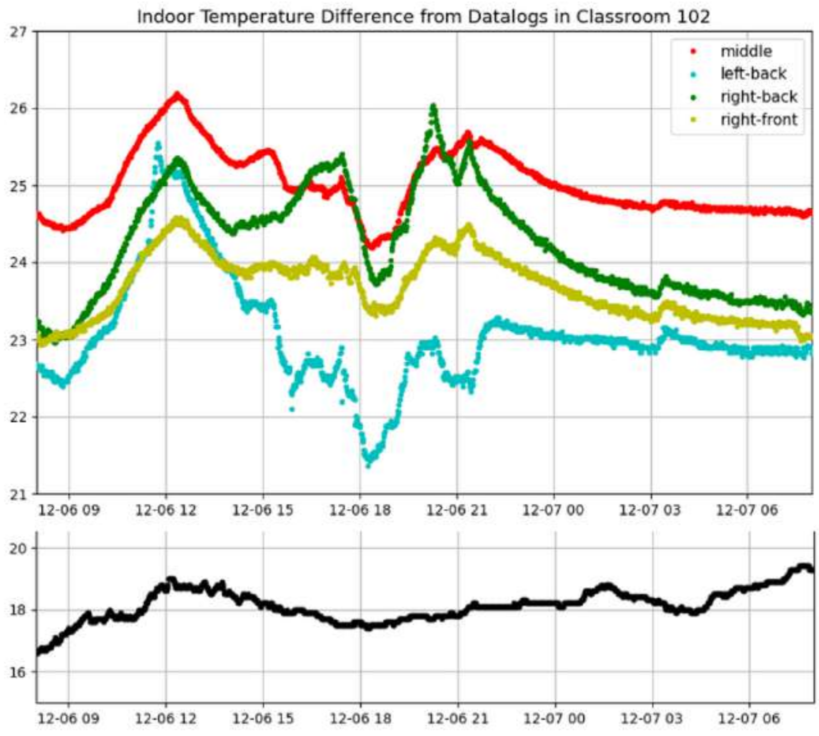


Figure 1: Indoor and Outdoor Temperatures

We also take the center of the classroom as a benchmark, and compare the temperature around the classroom with it (Figure 2), and we can find that the temperature at the corner is slightly lower than the central temperature most of the time.

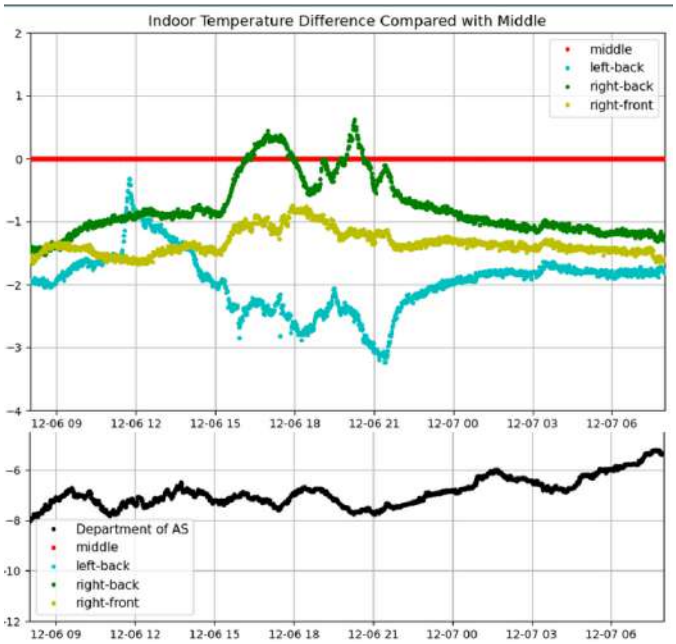


Figure 2: Comparison of Temperatures between the Center and Surroundings of the Classroom

In Figure 3, the CO2 concentration inside the classroom is observed as an indicator of human activity. It can be seen that the concentration gradually increases from the morning until around noon, reaching its peak. However, in the afternoon, despite having a higher number of people in the classroom compared to the morning, the CO2 concentration is lower. This can be attributed to the effect of opening the doors, which effectively reduces the indoor CO2 concentration.

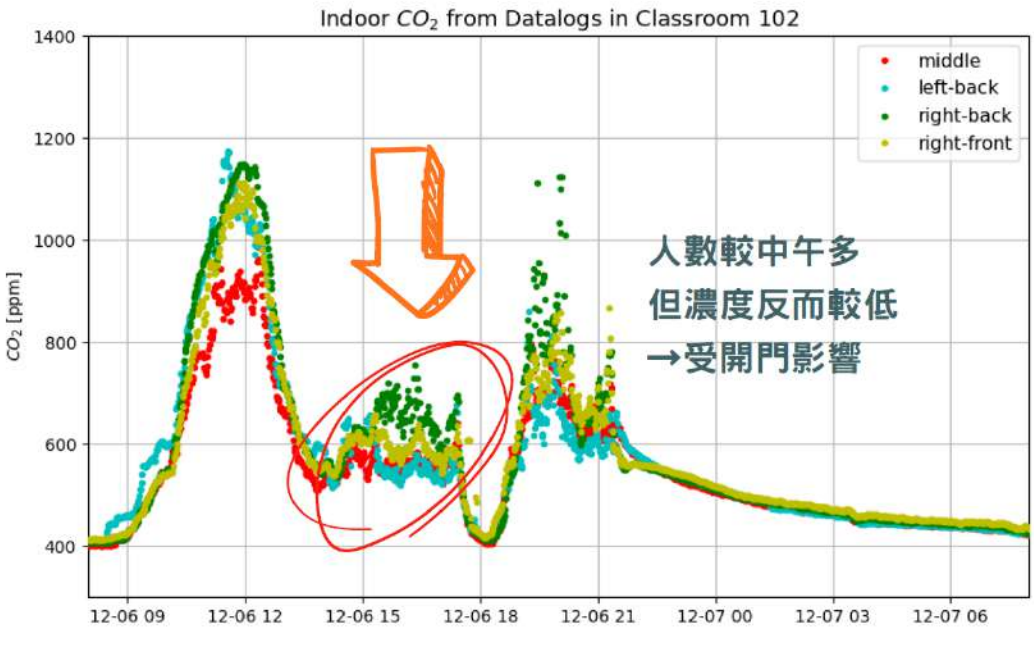


Figure 3: Indoor CO2 Concentration

Science Tips

Weather impact on retail sales: How can weather derivatives help with adverse weather deviations?

IPCS Yu-Hsin Yeh

This paper focuses on the impact of weather on retailers and explains how weather derivatives can be used to mitigate the adverse effects of weather deviations. Weather derivatives are a new type of tool designed to incorporate weather factors into a company's risk management. The most common weather-related product is insurance against weather disasters, such as typhoons and earthquakes, which compensates companies for losses caused by major natural disasters. In addition, there are also products that provide insurance for non-catastrophic weather events, such as temperature and rainfall variations. While these weather changes may not cause significant losses, they pose various risks to businesses, potentially resulting in revenue decline or unmet sales expectations, thereby incurring additional costs. Therefore, the application of weather derivatives involves businesses insuring their products during months when they are highly sensitive to weather conditions in order to stabilize income, cover excess costs, or stimulate sales.

Weather can indeed influence consumer buying behavior, including what to buy, where to buy, when to buy, and how much to buy. These individual purchasing behaviors indirectly affect product sales volume. For example, manufacturers of winter clothing are impacted by a warm winter in terms of their sales. These general effects are already familiar to businesses. However, to address or mitigate the operational impact of weather more comprehensively, more detailed information is needed to formulate strategies or make significant decisions.

This study focuses on the region of Croatia and analyzes the daily sales of non-alcoholic beverages in 60 stores within the research area. The results indicate that beverage sales have significant peaks in April and December. Even when excluding these two months, it is evident that beverage sales gradually increase during the summer. When examining the relationship between daily average temperature and sales throughout the year, there is a moderate correlation. However, when analyzing the data by individual months, noticeable variations between months become apparent. This suggests that non-alcoholic beverage sales have different sensitivities to temperature across different months, particularly during the summer, which is a critical period for sales.

In addition to analyzing the sensitivity of products to temperature, this study also examines the characteristics of products based on lagged and leading temperature indicators. It analyzes the correlation between sales and temperatures of the previous six days and the subsequent six days, aiming to determine whether past and future temperatures influence consumer purchasing behavior. The results show that, for the majority of months, the highest correlation between temperature and sales is observed with the temperature of the same day. This can be interpreted as impulsive purchasing behavior for non-alcoholic beverages, where consumers are primarily influenced by the current ambient temperature to make their purchasing decisions.

When conducting analysis on the relationship between products and environmental factors, it is not possible to apply the same model universally. This is because different geographical climates, business characteristics, and product features all have an impact. For example, cultural festivals in each country can influence consumer purchasing behavior, and the sensitivity of products to climate may vary. Additionally, consumer consumption habits should also be considered in such analysis.

Reference

Štulec, Petljak, & Naletina (2019). Weather impact on retail sales: How can weather derivatives help with adverse weather deviations?. Journal of Retailing and Consumer Services, Volume 49, July 2019, 1-10. https://doi.org/10.1016/j.jretconser.2019.02.025

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".

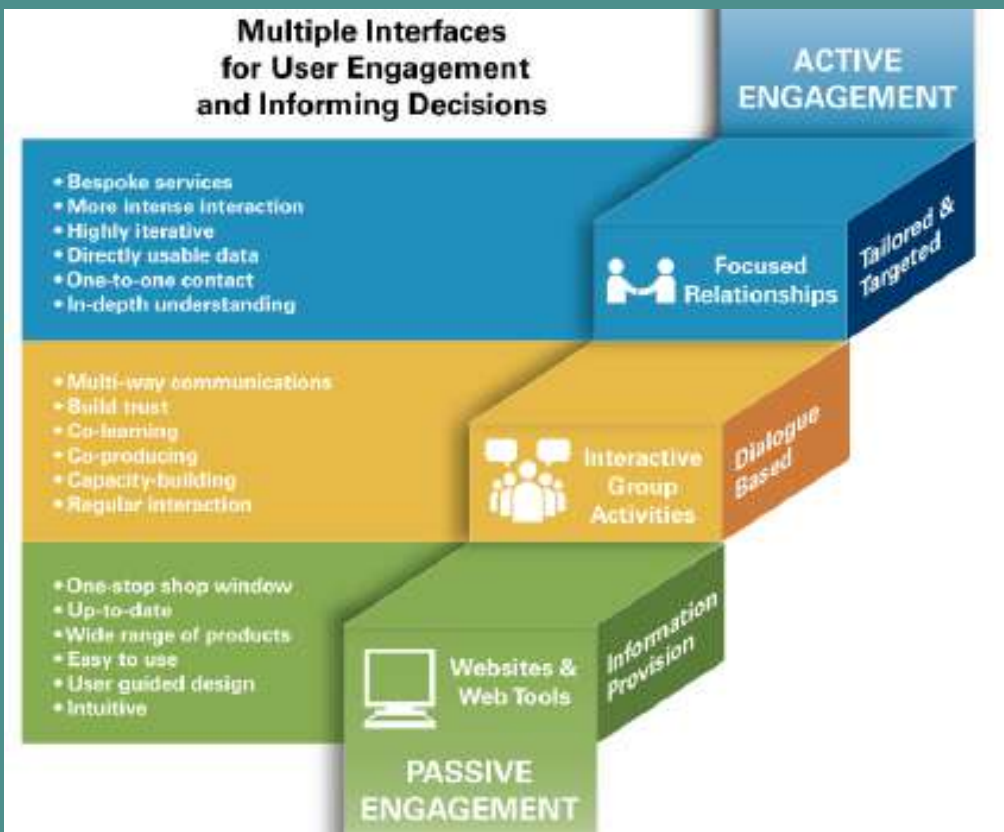


Figure 1: The user interfaces of climate services at different levels. At the lower level, there is passive involvement (such as online data dissemination). In the middle level, there is basic interactive communication (such as lectures and seminars). At the highest level, there are customized climate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

Štulec, Petljak, & Naletina (2019). Weather impact on retail sales: How can weather derivatives help with adverse weather deviations? Journal of Retailing and Consumer Services, Volume 49, July 2019, 1-10. https://doi.org/10.1016/j.jretconser.2019.02.025

Science Tips

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

Preface by Billy Leong

The previous article introduced the first part of the "Guidelines" on Quality Climate Services published by the World Meteorological Organization, which covers the conditions, elements, and categorization of quality climate services. This article will focus on the second part of the "Guidelines," which highlights two unique examples of quality climate services among the 14 global cases.

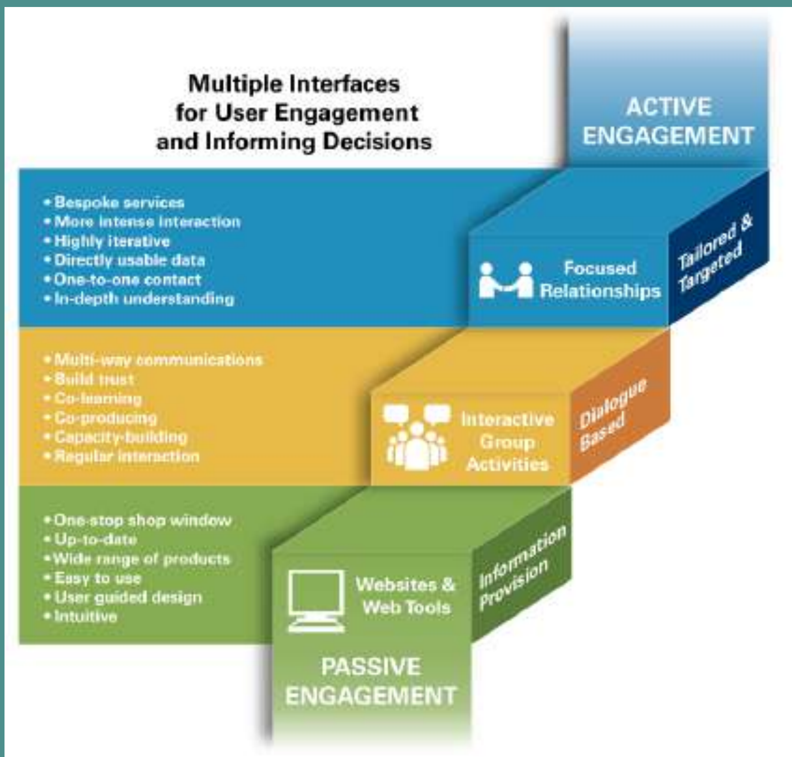


Figure 1: Different User Interfaces in Climate Services. At the lower level, there is passive engagement (such as online data dissemination), at the middle level, there is basic interactive communication (such as lectures and discussions), and at the highest level, there is customized climate services.

1. International and Domestic Coffee Production, Trade Issues, and Global Seasonal Climate Forecasting (Section 4.10)

This section introduces a collaboration between a large company engaged in coffee bean production and export in Vietnam and a climate application research institution. They utilize advanced seasonal climate forecasting for decision-making. The goal of the user interface is to identify seasonal climate forecast information relevant to coffee production on both local and global scales, along with key elements beneficial for management decisions. This process involves meetings, workshops, and interactions with various stakeholders, including coffee companies, agricultural cooperatives, managers, agronomists, and production management.

The interface primarily caters to the forecasting needs of coffee-growing regions in Vietnam and other coffee-producing countries globally. The forecasting requirements encompass not only rainfall but also natural factors such as frost days and severe frost days. Moreover, it distinguishes data flows for predicting the production volume of green coffee beans in specific provinces of Vietnam and other competitor countries and the demand for production. The process involves testing production forecast outputs, retrospective forecasting, real-time verification, and developing integrated coffee production model systems.

Science Tips

The entire interface emphasizes multi-stakeholder communication and engagement, providing updates in a probabilistic format on a regular basis. Participation of key decision-makers and managers is crucial to ensure joint development and a consistent understanding of forecast outputs. Several lessons were learned in this process, including ongoing engagement, clear communication to avoid unnecessary jargon, providing explanations for charts and maps, and being prepared to address stakeholders' questions and concerns. The article underscores the importance of collaboration, maintaining an understanding of global climate models, and keeping communication channels open.

In conclusion, the user interface serves as a framework for integrating seasonal climate forecasting into the decision-making process of the coffee industry. Its aim is to enhance management strategies and predict climate-related risks.

2. Climate Risk Management Research in the Japanese Fashion Industry (Section 4.11)

The Japan Meteorological Agency (JMA) collaborated with the Japan Fashion Industry Council (JAFIC) on a study concerning the relationship between fashion product sales, temperature, and other weather factors. The goal was to promote climate risk management in the fashion industry and encourage other weather-sensitive sectors to adopt this approach by demonstrating its effectiveness.

The research project involved analyzing sales data provided by JAFIC and related companies. Stakeholders discussed the correlation between weather conditions and fashion sales and explored how a two-week weather forecast could be utilized to adjust sales management. Subsequently, JAFIC and JMA organized workshops to share the research findings with the industry and private meteorological companies, aiming to facilitate the application of meteorological/climate information in the sector.

The study primarily discovered that different fashion products have critical threshold temperatures. Sales quantities experience significant changes when the temperature surpasses these threshold points. Additionally, certain weather factors influence the sales of specific fashion items. Sales figures often fluctuate in response to changes in the weekly average temperature. Therefore, the study encourages the industry to leverage forecast products to address climate risks. For instance, when a two-week weather forecast indicates a possibility of temperatures exceeding 15°C, managers in shoe companies can proactively prepare sufficient inventory of sandals and place them prominently in sales areas. Furthermore, in consultation with fashion experts, the research results propose promotional suggestions, including adjusting supply quantities, enhancing visual marketing methods, engaging customers in sales conversations, and organizing store layouts.

In conclusion, the findings of this research project offer valuable insights to the fashion industry. These insights include assisting the industry in arranging alternative products during extremely high-temperature periods, understanding the relationship between temperature and sales at various retail outlets, and designing different sales area layouts based on temperature variations.

References:

Štulec, Petljak, & Naletina (2019). Weather impact on retail sales: How can weather derivatives help with adverse weather deviations?. Journal of Retailing and Consumer Services, Volume 49, July 2019, 1-10. https://doi.org/10.1016/j.jretconser.2019.02.025

ABOUT OUR TEAM

SC+NTU Work Team

Principal Investigator: Shiuh-Shen Chien

Executive Consultant: Ming-Kung Chung; Yi-Huan Hsieh

R&D and Calibration Consultant: Jen-Ping Chen; Ling-Jyh Chen; Jehn-Yih Juang; Po-Hsiung Lin

Taipei Field Consultant: Jen-Ping Chen; Jehn-Yih Juang; Po-Hsiung Lin; Chih-Hao Hsieh; Chin-Lin Wei

THOD Consultant: Jen-Ping Chen; Sheng-Lin Chang; Horng-Huei Liou

Work Team: Miao-Jung Chien; Wei-Jhe Chen; Cheng-En Lin; Xin Yang; Tzu-Chun Chang; Rong-Cih, Chang; Tzu-Ya, Wang; Chieh-Hsiang, Fan

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.

PARTNERS ➤

Wenshan Community College. Daxue Village, Taipei City.

Jianguo Village, Yingge Distrint New Taipei City. Taiwan Mobile Co., Ltd

Transit-Hospital-Oriented Development(THOD) Work Team

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