# THE UNIVERSITY OF HONG KONG
# SCHOOL OF BIOLOGICAL SCIENCES

***Postgraduate Student Public Seminar***

## "EXPLORING THE SPATIO-TEMPORAL PATTERNS AND DRIVERS OF PLANT THERMOREGULATION CAPABILITY ON A GLOBAL SCALE"

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**on Thursday 14 September, 2023 at 2:30 pm**
**Room 6N-11, Kadoorie Biological Sciences Building**

### Abstract

Temperature plays an important role in regulating plant metabolisms and growth. The widespread increase in air temperature (known as global warming) has had and is expected to continue to have a significant impact on the functioning of terrestrial ecosystems and associated biogeochemical cycles. While, it is the temperature of plant tissues, not the air temperature, that directly determines plant metabolic rates, and in some cases, the two have been observed to deviate from each other over 20 $^{o}$C, which is thought to be the result of active or passive plant thermoregulation. A better understanding of the magnitudes and mechanisms of plant thermoregulation capability (PTC) determines the prediction accuracy of ecosystems' response to climate change. Currently, however, the topic surrounding plant thermoregulation is controversial, with opinions ranging from no to moderate thermoregulation capability. To address the issue, this study aims to answer three fundamental questions:

1. What are the most important leaf traits that regulate deviation between leaf and air temperature ($\Delta T$), and how do their relative roles vary over diurnal timescales?
2. Whether plant ecosystems show different PTCs across timescales?
3. What are the patterns and drivers of PTC across the global ecosystems?

To address question 1, a trait-based leaf energy balance model was developed to explore how six leaf traits, directly linked with leaf energy balance, regulate $\Delta T$ variability across diurnal timescales. The results showed that 1) the variability in $\Delta T$ is largely regulated by leaf traits, and the noon-time trait-regulated $\Delta T$ variability reaches *c*. 15.0 $^{o}$C; 2) Photosynthetic capacity, stomatal slope, and leaf width are the three most important factors in regulating $\Delta T$, and their relative importance varies considerably across throughout the day.

To address question 2 (temporal scale), diurnal and seasonal datasets of $T_c$, $T_a$, and other biotic and abiotic factors were constructed from global hourly FLUXNET data, to explore diurnal and seasonal variations in PTC. The analysis revealed that PTC is higher at the seasonal than diurnal timescales, primarily due to their divergent cooling effect at high $T_a$: across a day, transpiration rates decrease with $T_a$ after a certain high-temperature range (related to midday stomatal depression); whereas across seasons, transpiration rates always keep increasing with $T_a$ (related to the coincidence between high water availability and the peak annual $T_a$).

To address question 3 (spatial scale), the 'limited homeothermy' hypothesis was tested across global extratropics based on global datasets from FLUXNET and satellites. The results demonstrated that across global plant ecosystems, over 80% of sites/ecosystems have slopes $\geq$1 or $T_c > T_a$ around midday, providing evidence against the 'limited homeothermy' hypothesis. Additionally, the site-mean $\Delta T$ exhibits considerable variations from 0 to 6°C, mainly attributed to environmental variables (38%) and secondarily to biotic factors (15%).

Overall, this study enhances the comprehension of plant thermoregulation in terms of its occurrence and magnitudes across space and time. It sheds light on the fundamental biophysical mechanisms that underlie various plant thermoregulation strategies worldwide. The findings have significant implications for predicting plant ecosystems' response to climate change.

--- ALL ARE WELCOME ---