

Charles P. Chen
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Education

University of Illinois at Urbana-Champaign, Urbana, Illinois, USA

2008 Ph.D. Program of Ecology and Evolutionary Biology
Concentration: Environmental Plant Physiology
2001 B.S. Biophysics, *summa cum laude*

Professional experience

Azusa Pacific University (Azusa, USA)

College of Liberal Arts and Sciences, Department of Biology and Chemistry
Associate Professor 2018 - present
Assistant Professor 2013 – 2018

National Institute of Agro-Environmental Sciences (Tsukuba, Japan)

Division of Agro-meteorology, Tsukubamirai FACE Project
Postdoctoral research associate 2012 – 2013

CRASH Love On Japan Quake Relief NGO (Tokyo, Japan)

Section Chief, Planning Division 01/2012 – 06/2012

The University of Tokyo (Tokyo, Japan)

Graduate School of Agricultural and Life Sciences, Institute of Sustainable Agro-ecosystem Services
Postdoctoral research associate 2010 – 2011

Japan International Research Center for Agricultural Sciences (Tsukuba, Japan)

Division of Crop Production and Environment, Abiotic Stress Tolerance Group
JSPS Postdoctoral fellow 2008 – 2010

Max Planck-CAS Partner Institute of Computational Biology (Shanghai, China)

Plant Systems Biology Group
Visiting scholar 08/2008–10/2008

Courses taught

- BIOL 152 - General Biology 2 Lecture
 - Majors course covering foundational concepts in evolution, plant biology, and ecology
- BIOL 152L - General Biology 2 Laboratory
 - Emphasis on diversity of life (kingdom survey) and research techniques in evolutionary biology, plant physiology, and ecology
- BIOL 151L - General Biology 1 Laboratory
 - Emphasis on scientific method, basic laboratory techniques, molecular/cellular biology concepts, and basic mammalian physiology/anatomy
- BIOL 365 - Plant Physiology (lecture and laboratory)
- BIOL 495 Advanced Topics in Biology – Global Change Biology
- BIOL 495 Advanced Topics in Biology – Plants and Environmental Change
- GE 100 – First Year Seminar (STEM version)

- GE course for freshmen in STEM majors, designed to equip students with strategies to succeed and thrive in college as a STEM major, to think and communicate like a scientist, and to develop information literacy skills.

Research interests

Over the past two centuries, the human population on earth has been rapidly increasing and there has been a continual need to increase food production. However, at the same time, we are faced with an increasing frequency of abiotic stresses and various aspects of global change which threaten a decrease in crop yields. In order to ensure food security for the near future, it is essential that we develop crops which are tolerant to environmental stresses. For this reason, I am interested in studying the ecophysiological response of crop and native plant species to global change (e.g. rising [CO₂], air pollution or other changing environmental factors), especially in relation to photosynthesis. I employ a variety of approaches, including ecophysiological measurements in the field or under controlled conditions, biochemical assays, computer modeling, and remote sensing techniques.

My dissertation work focused on characterizing the induction of leaf-level heterogeneity in photosynthesis under exposure to O₃, analyzing the spatial heterogeneity via remote sensing methods and assessing its implications for current biochemical models of photosynthesis. After graduation, I conducted postdoctoral research in Japan, investigating genetic variability and mechanisms of the physiological response of rice plants (*Oryza sativa*) to elevated [O₃], [CO₂], and nitrogen availability. Currently, I am conducting research with undergraduate students investigating the trade-off between water use-efficiency and photoprotection in native Californian plant species, as well as participating in an ongoing collaboration with colleagues at the Institute for Agro-Environmental Sciences in Japan studying intraspecific responses of rice plants to elevated [CO₂] and other environmental factors.

Peer-reviewed academic publications

- Sakai, H., Cheng, W., **Chen, C.P.**, and T. Hasegawa (2022). Short-term high nighttime temperatures pose an emerging risk to rice yields. *Agricultural and Forest Meteorology* **314**: 108779
- Ikawa, H., Kuwagata, T., Haginoya, S., Ishigooka, Y., Ono, K., Maruyama, A., Sakai, H., Fukuoka, M., Yoshimoto, M., Ishida, S., **Chen, C.P.**, Hasegawa, T., and T. Watanabe (2021). Heat-mitigation effects of irrigated rice-paddy fields under changing atmospheric carbon dioxide based on a coupled atmosphere and crop energy-balance model. *Boundary-Layer Meteorology* **179**: 447–476.
- Ikawa, H., Sakai, H., **Chen, C. P.**, Soong, T. H., Yonemura, S., Taniguchi, Y., Yoshimoto, M., Tokida, T., Zhang, G., Kuwagata, T., Nakamura, H., Avenson, T., and Hasegawa, T. (2019). High mesophyll conductance in the high-yielding rice cultivar Takanari quantified with the combined gas exchange and chlorophyll fluorescence measurements under free-air CO₂ enrichment. *Plant Production Science*, **22**: 395-406.
- Hasegawa, T., Sakai, H., Tokida, T., Usui, Y., Nakamura, H., Wakatsuki, H., **Chen, C. P.**, Ikawa, H., Zhang, G., Nakano, H., Matsushima, M. Y., & Hayashi, K. (2019). A high-yielding rice cultivar “Takanari” shows no N constraints on CO₂ fertilization. *Frontiers in Plant Science* **10**: 361.
- Ikawa, H., **Chen, C.P.**, Sikma, M., Yoshimoto, M., Sakai, H., Tokida, T., et al. (2018) Increasing canopy photosynthesis in rice can be achieved without a large increase in water use—A model based on free-air CO₂ enrichment. *Global Change Biology* **24**: 1321-1341.
- Oikawa, S., Ehara, H., Koyama, M., Hirose, T., Hikosaka, K., **Chen, C.P.**, Nakamura, H., Sakai, H., Tokida, T., Usui, Y., and T. Hasegawa (2017). Nitrogen resorption in senescing leaf blades of rice exposed to Free-Air CO₂ Enrichment (FACE) under different N fertilization levels. *Plant and Soil* **418**: 231-240.
- Muryono, M., **Chen, C.P.**, Sakai, H., Tokida, T., Hasegawa, T., Usui, Y., Nakamura, H., and K. Hikosaka (2017). Nitrogen distribution in leaf canopies of a high-yielding rice (*Oryza sativa* L.) cultivar Takanari. *Crop Science* **57**: 2080-2088.
- Chen, C.P.**, Sakai, H., Tokida, T., Usui, Y., Nakamura, H., and T. Hasegawa (2014). Do the rich always become richer? Characterizing the leaf physiological response of the high-yielding rice cultivar Takanari to free-air CO₂ enrichment. *Plant and Cell Physiology* **55**:381-391.

- Wang, Y.X., Yang, L.X., Kobayashi, K., Zhu, J.G., **Chen, C.P.**, Yang, K.F., Tang, H.Y., and Y.L. Wang (2012). Investigations on spikelet formation in hybrid rice as affected by elevated tropospheric ozone concentration in China. *Agriculture, Ecosystems & Environment* **150**:63-71.
- Chen, C.P.**, Frei, M., Tanaka, J.P., Kohno, Y., and M. Wissuwa (2012). Tropospheric ozone poses a rising threat to yield stability in rice: Tolerance mechanisms and underlying genetic factors. *Genes, Genomes, Genomics* **6**:8-15.
- Nouchi, I., Hayashi, K., Hiradate, S., Ishikawa, S., Fukuoka, M., **Chen, C.P.**, and K. Kobayashi (2012). Overcoming the difficulties in collecting apoplastic fluid from rice leaves by the infiltration-centrifugation method. *Plant and Cell Physiology*, **53**:1659-1668.
- Frei, M., Wissuwa, M., Tanaka, J.P., **Chen, C.P.**, Südekum, K.-H., and Y. Kohno (2012). Leaf ascorbic acid level – Is it really important for ozone tolerance in rice? *Plant Physiology and Biochemistry*, **59**:63-70.
- Chen, C.P.**, Frei, M., and M. Wissuwa (2011). The *OzT8* locus in rice protects leaf carbon assimilation rate and photosynthetic capacity under ozone stress. *Plant, Cell and Environment* **34**:1141-1149.
- Frei, M., Tanaka J.P., **Chen, C.P.**, and M. Wissuwa (2010). Mechanisms of ozone tolerance in rice: characterization of two QTLs affecting leaf bronzing by gene expression profiling and biochemical analyses. *Journal of Experimental Botany*, **61**:1405-1417.
- Chen, C.P.**, Frank, T.D., and S.P. Long (2009). Is a short sharp shock equivalent to long-term punishment? Contrasting the spatial pattern of acute and chronic ozone damage to leaves via chlorophyll fluorescence imaging. *Plant Cell and Environment*, **32**:327-335.
- Chen, C.P.**, Zhu, X.-G., and S.P. Long (2008). The effect of leaf-level spatial variability in photosynthetic capacity on biochemical parameter estimates using the Farquhar model: a theoretical approach. *Plant Physiology*, **148**:1148-1158.

Selected conference presentations and invited seminars (asterisks denote undergraduate co-authors)

- Chen, C.P.**, Gailey, T.*, Soong, T.-H.*, Sakai, H., Tokida, T., Usui, Y., & Hasegawa, T. (2020) Rice yield increases under combined elevated [CO₂] and paddy warming are cultivar-specific. *Flash talk given at the 5th Japan-US Science Forum in Boston, hosted by the Japan Society for the Promotion of Science.*
- Chen, C.P.**, Ikawa, H., Mellen, R.*, Morales, K.Y.*, Sakai, H., Tokida, Usui, Y., Nakamura, H. and T. Hasegawa. (2017) Towards the rice plant of the future: Leaf physiology of the rice cultivar Takanari under free-air elevated [CO₂] and varying nitrogen supply. *Poster presentation given at the Japan-US JSPS Science Forum at Cambridge, MA.*
- Ikawa, H., **Chen, C. P.**, Sikma, M., Yoshimoto, M., Sakai, H., Tokida, T., Usui, Y., Nakamura, H., Ono, K., Maruyama, A., Watanabe, T., Kuwagata, T., & Hasegawa, T. (2017). Increasing canopy photosynthesis in rice can be achieved without a large increase in water use. *Poster given at the 2017 Kyoto Prize Workshop in Kyoto, Japan.*
- Hasegawa, T., Sakai, H., Tokida, T., Usui, Y., Nakamura, H, **Chen, C.P.**, Ikawa, H., and K. Hayashi. (2016) High-yielding rice cultivar ‘Takanari’ retains high yield response to Free-Air-CO₂ Enrichment under limited nitrogen supply. *Poster presentation given at the international FACEing the Future: Food Production and Ecosystems conference at Giessen, Germany.*
- Chen, C.P.**, Ikawa, H., Mellen, R.*, Morales, K.Y.*, Sakai, H., Tokida, Usui, Y., Nakamura, H. and T. Hasegawa. (2016) Photosynthetic performance of the rice cultivar Takanari under free-air elevated [CO₂] and nitrogen-deficient conditions. *Poster presentation at the annual meeting of the American Society of Plant Biologists, Austin, TX.*
- Chen, C.P.** (2015) Rice cultivars show variable leaf-level responses to elevated [CO₂] and nitrogen limitation under free-air conditions. *Invited seminar given at the National Institute for Agro-environmental Sciences in Tsukuba, Japan.*
- Chen, C.P.**, Uehara, N., Sasaki, H., and K. Kobayashi. (2014) Accelerated leaf senescence in ozone-stressed rice is not modulated by nitrogen sink-source dynamics. *Presented at the 9th International Symposium on Air Pollution and Global Change in Monterey, USA.*
- Chen, C.P.**, Sakai, H., Usui, Y., Tokida, T., Nakamura, H., and T. Hasegawa. (2013) Contrasting the leaf photosynthetic response of the rice cultivars Takanari and Koshihikari to elevated [CO₂] under free-air conditions. *Invited seminar given at the National Institute for Agro-environmental Sciences in Tsukuba, Japan.*

- Chen, C.P.**, Sakai, H., Usui, Y., Tokida, T., Nakamura, H., and T. Hasegawa. (2013) Intraspecific variation in rice leaf physiological responses to elevated [CO₂]. *Invited presentation given at the annual meeting of the Japan Society for Soil Science and Plant Nutrition in Nagoya, Japan.*
- Hasegawa, T., **Chen, C.P.**, Sakai, H., Usui, Y., Tokida, T., and H. Nakamura. (2013) Response of rice productivity to free-air CO₂ enrichment - Scope for improvement. *Presented at the 16th International Congress of Photosynthesis in St. Louis, USA.*
- Chen, C.P.**, Sakai, H., Usui, Y., Tokida, T., Nakamura, H., and T. Hasegawa. (2013) Photosynthetic response of Takanari and Koshihikari rice cultivars under Free-Air CO₂ Enrichment. *Presented at the International Symposium for Agro-Meteorology in Kanazawa, Japan.*
- Chen, C.P.** Crop responses to tropospheric ozone: mechanisms of ozone damage and tolerance in *Glycine max.* and *Oryza sativa*. (2012) *Invited seminar given at the National Institute for Agro-environmental Sciences in Tsukuba, Japan.*
- Chen, C.P.** (2010) Mechanisms of ozone damage and tolerance in *Glycine max.* and *Oryza sativa*, with particular reference to photosynthesis. *Invited seminar given at the University of Tokyo in Japan.*
- Chen, C.P.**, Frei, M., and M. Wissuwa. (2010) The *OzT8* locus in rice protects leaf carbon assimilation rate and photosynthetic capacity under ozone stress. *Presented at the 15th International Congress of Photosynthesis in Beijing, China.*
- Chen, C.P.** (2008) Introduction to chlorophyll *a* fluorescence: its theory and application. *Invited seminar given at the East China Normal University in Shanghai, China.*
- Chen, C.P.**, Zhu, X.-G., and S.P. Long. (2008) Estimating spatial distributions of $V_{c,max}$ and J_{max} via a novel application of chlorophyll fluorescence imaging. *Presented as a poster at the Joint Annual Meeting of the American Society of Plant Biologists and the Sociedad Mexicana De Bioquimica Rama: Bioquimica y Biologia Molecular de Plantas in Merida, Mexico.*
- Chen, C.P.**, Frank, T.D., and S.P. Long. (2005) Plants and tropospheric ozone - are our model systems the correct ones? *Presented at the annual meeting of the American Society of Plant Biologists in Seattle, Washington.*
- Chen, C.P.**, Frank, T.D., and S.P. Long. (2004) Chlorophyll *a* fluorescence and thermal imaging of leaf-level variation in photosynthetic responses to O₃ exposure. *Presented at the 6th International Symposium on Air Pollution and Global Change in Tsukuba, Japan.*

Student presentations (asterisks denote undergraduate co-authors)

- Aday, A.*, Schricker, A.*, Soong, T.-H.*, Perry, J. M.*, Mellen, R.*, Morales, K.*, & **Chen, C. P.** (2021). Effects of elevated [CO₂] and limited nitrogen supply on leaf physiology and biochemistry in the rice cultivar Koshihikari. *Oral presentation given at the Tri-beta District Convention at the US Air Force Academy in Colorado Springs, CO (virtual).*
- Gailey, T. N.*, Soong, T.-H.*, Sakai, H., Usui, Y., Tokida, T., Nakamura, H., Ikawa, H., Hasegawa, T., & **Chen, C. P.** (2021). Does paddy warming modulate elevated [CO₂] effects on grain yield and biomass in rice plants? *Poster presentation given at the Tri-beta District Convention at the US Air Force Academy in Colorado Springs, CO (virtual).*
- Welge, C. J.*, Paz, A. D.*, & **Chen, C. P.** (2021). Comparison of NPQt values in sun-adapted and shade-adapted sunflower species. *Poster presentation given at the Tri-beta District Convention at the US Air Force Academy in Colorado Springs, CO (virtual).*
- Schricker, A. V.*, Soong, T.-H.*, Perry, J. M.*, Ikawa, H., Sakai, H., & **Chen, C. P.** (2019). Contrasting leaf physiological responses of two rice (*Oryza sativa*) varieties grown under elevated [CO₂] and limited soil nitrogen supply. *Poster presentation given at the Tri-beta District Convention at the University of San Francisco.*
- Vander Schuur, K.*, Ikawa, H., Sakai, H., & **Chen, C. P.** (2019). Estimating leaf physiological parameters in a new high-yielding *Oryza sativa* variety during the vegetative and early reproductive growth stages. *Poster presentation given at the Tri-beta District Convention at the University of San Francisco.*
- Soong, T.-H.*, Vander Schuur, K.*, & **Chen, C. P.** (2018). Improved estimation of photosynthetic parameters of *Sidalcea malviflora* using gas exchange and chlorophyll fluorescence measurements. *Poster presentation given at the Tri-beta District Convention at Concordia University in Irvine, CA.*
- Perry, J. M.*, Schricker, A. V.*, & **Chen, C. P.** (2018). Comparison of Leaf Soluble Protein and Pigment Content in Two Rice Cultivars Grown Under Free-Air CO₂ Enrichment and Varying Nitrogen

Supply. *Poster presentation given at the American Society of Plant Biologists Western Meeting at Cal State Fullerton.*

- Morales, K. Y.*, Mellen, R.*, Ikawa, H., & **Chen, C. P.** (2016). The effect of elevated [CO₂] and nitrogen deficiency on leaf and whole-plant morphological and physiological characteristics of rice grown under free-air paddy conditions. *Poster presentation given at the American Society of Plant Biologists Annual Meeting in Austin, TX.*
- Garnham, C. P.* and **Chen, C.P.** (2016). How does rice flag leaf morphology respond to elevated [CO₂] concentration and soil-water warming? *Oral presentation given at the Tri-Beta National Convention.*
- Morales, K. Y.* and **Chen, C.P.** (2016). The effect of elevated carbon dioxide concentration and nitrogen deficiency on morphological and physiological characteristics of rice grown under free-air paddy conditions. *Oral presentation given at the Tri-Beta District Convention at Cal Poly Pomona.*
- Mellen, R.*, & **Chen, C. P.** (2015). Comparing the Biochemical Limitations to Photosynthesis Between Two Plant Species. *Poster presentation given at the Tri-Beta District Convention at Cal State Monterey Bay.*
- Morales, K. Y.* & **Chen, C. P.** (2015). Comparison of Photosynthetic Rate, Chlorophyll Content, and Protein Concentration of Two Soybean Varieties Grown Under Ozone-stressed Conditions. *Poster presentation given at the Tri-Beta District Convention at Cal State Monterey Bay.*

Science and faith integration-related activities

- Developed and incorporated elements of scholarly integration of science and faith into all the courses that I have taught at APU, and continue to revise the content on a yearly basis.
- Co-wrote the preface to an upcoming Japanese re-issue of The Language of God (provisional title) by Francis Collins, being published by Inochi no kotobasha (Word of Life publishing). Currently in the editorial process.
- Co-led a workshop in Japanese with Yuji Ishitsuka entitled "The relationship between science and theology" at the 2020 Equipper Conference, organized by the Japanese Christian Fellowship Network (JCFN). Updated the workshop with discussion questions and content about constructive ways in which scientists who are believers can uniquely contribute to their faith communities.
- Co-led a workshop in Japanese with Yuji Ishitsuka entitled "Can Science and Christianity Co-exist?" at the 2017 Equipper Conference, organized by JCFN.
- Developed and led a workshop in Japanese entitled "Creationism and evolution: perspectives from a Christian in science" at the 2014 and 2016 Equipper Conference, organized by JCFN.

Grants and funding

As the primary investigator

- Azusa Pacific University, Faculty Research Council Grant (12/2021, \$6,000)
- Azusa Pacific University, Faculty Research Council Grant (12/2018, \$6,000)
- LI-COR Environmental Education Fund Grant (7/2017, \$500)
- Azusa Pacific University, Faculty Research Council Grant (12/2016, \$5,700)
- Azusa Pacific University, Faculty Research Council Grant (12/2014, \$4,700)
- LI-COR Environmental Education Fund Grant (4/2014, \$52,120)

As mentor/advisor to undergraduate research students

- American Society of Plant Biologists, Summer Undergraduate Research Fellowship
 - Karina Morales (3/2015, \$5,275)
- Beta Beta Beta Biological Honor Society Research Grant
 - Halina Liu (11/2021, \$500)
 - Colin Welge (11/2020, \$500)
 - Abbigael Aday (11/2019, \$464)
 - Tik-Hang Soong (11/2017, \$525)
 - Karina Morales (11/2014, \$400; 11/2015, \$950)
 - Carolyn Garnham (11/2015, \$500)

- Russell Mellen (11/2014, \$400)
- California Space Grant Consortium
 - Tonhi Gailey (11/2020, \$1000)
- Azusa Pacific University, CRIS STEM Research Fellowship
 - Abigail Schricker (3/2018, \$500)
 - Kayla Vander Schuur (3/2018, \$500)
 - Tik-Hang Soong (5/2017, \$500)

Undergraduate research student mentoring

- Halina Liu (2021-present)
- Fahed Sayegh (2021-present)
- Kayla Dinh (2021-present)
- Abbigael Aday (2018-2021)
- Tonhi Gailey (2019-2021)
- Colin Welge (2019-2021)
- Tik-Hang Brian Soong (2017-2019) – Ph.D. student at University of Arizona (biochemistry)
- Abigail Schricker (2017-2019)
- Kayla Vander Schuur (2017-2019)
- John Matthew Perry (2016-2018) – M.D. student at UCSD
- Carolyn Garnham (2015-2016)
- Caylee Craycroft (2015-2016)
- Lindsay Namanny (2015-2016) – M.A. student at Univ. of Oregon-Cascades (education)
- Karina Morales (2014-2016) – Ph.D. candidate at Texas A&M (crop breeding)
- Russell Mellen (2014-2015) – Ph.D. student at University of Florida (biomedical sciences)

Honors and awards

Post-graduate

- Japan Society for Promotion of Science Postdoctoral Fellowship (11/ 2008 – 11/ 2010)

Graduate

- National Science Foundation, Graduate Research Fellowship (06/2003 – 05/2006)
- UIUC List of Teachers Ranked Excellent by Their Students (Fall 2006, Spring 2007)
- Department of Energy, Global Change Education Program Fellowship (2003, received but declined)
- UIUC Ecology Enhancement Fellow (08/2001 – 05/2003)

Professional associations and societies

- American Society of Plant Biologists (2002 – present)
- Emerging Scholars Network, Intervarsity USA (2006 – present)
- International Society of Photosynthesis Research (2006 - 2010)

Service and activities

- Azusa Pacific University
 - Dept. of Biology and Chemistry
 - Curriculum Committee (2015 - present)
 - Retention and Diversity Committee (2020 - present)
 - STEM Research Day planning committee
 - Oral session subcommittee lead (2020 - present)
 - General Biology 1 Laboratory, lead lab instructor and coordinator (2016 – 2020)

- General Biology 2 Laboratory, lead lab instructor and coordinator (2016 – present)
 - Academic advising
 - Advising at least 20 students per year in the Biology major (2014 – present)
 - Student recruitment events
 - Engaged prospective students and parents on preview days and gave science building tours (2016 – present)
- Tribeta Biological Honors Society
 - Epsilon Gamma chapter advisor (2018 - present)
- Environmental Studies Minor
 - Oversight board and advisor (2021 – present)
- Segerstrom Science Center Advisory Committee (2020 - present)
 - Facilitates communication between the faculty and staff of STEM departments and various auxiliary or operational units across campus to ensure timely maintenance, problem-solving, and upkeep of the science building.
- Faculty Diversity Council (2016-17; 2018 - present)
- Enrollment Management strategic collaboration working group (5/2021 – 9/2021)
 - Ad-hoc working group that gathered faculty and staff from across the entire university to develop strategies to engage the various constituencies across campus in the process of student recruitment and prospective student engagement.
- Academic journal referee
 - Global Change Biology
 - Plant, Cell and Environment
 - Journal of Experimental Botany
 - Planta
 - Frontiers in Plant Science
- World Crop FACE Workshop (2012), organizing staff
- American Society of Plant Biologists
 - Website Re-design Committee (2009 - 2011)
- LI-COR Biosciences
 - Photosynthesis Focus Group (2010 – 2016)
- International Fellowship Group, University of Illinois
 - President (2002 - 2004)

Certifications

- Azusa Pacific University Diversity Ambassador (2020)
- Japanese Language Proficiency Level 2 certification (日本語能力試験 2級合格) (2009)
- University of Illinois Graduate Teaching Certificate (2007)
- United States FEMA Incident Command System training certification – 100.b, 200.b (2012)