



Teaching

Note to Reader: Since I retired, I am slowly revising and updating my lecture notes; the old version was lost when our college Nature server was hacked. At present, I am starting with the ESPM 129 Biometeorology overheads.

Biometeorology, ESPM 129

This course describes how the physical environment (light, wind, temperature, humidity) of plants and soil affects the physiological status of plants and how plants affect their physical environment. Using experimental data and theory, it examines physical, biological, and chemical processes affecting transfer of momentum, energy, and material (water, CO₂, atmospheric trace gases) between vegetation and the atmosphere. Plant biometeorology instrumentation and measurements are also discussed. Powerpoint slides from the lectures are in the dropdown. ▼





Micrometeorology, ESPM 228

Measurement and modeling of trace gases and energy between the terrestrial biosphere and atmosphere. Micrometeorological flux measurement methods, including eddy covariance, profile, and eddy accumulation methods. A hierarchy of biophysical models are discussed for interpreting flux measurements. Information and theory on big-leaf, two-layer, and multi-layer models that couple energy, water, and carbon to predict trace gas fluxes are presented. How models integrate information from leaf to canopy to landscape scales is discussed.



The Biosphere, ESPM 2

An introduction to the unifying principles and fundamental concepts underlying our scientific understanding of the biosphere. Topics covered include the physical life support system on earth; nutrient cycles and factors regulating the chemical composition of water, air, and soil; the architecture and physiology of life; population biology and community ecology; human dependence on the biosphere; and the magnitude and consequences of human interventions in the biosphere.



Access to lecture overheads are available below

Ecosystem Ecology, ESPM 111



ESPM 100es





Graduate students and Postdocs often ask me for a reading list of key papers to read. In this section is a list of 'classic papers' that have influenced my thinking, research and teaching.

I confess it is skewed to the older papers I relied on when I came to Berkeley and started teaching Biometeorology. So it may omit some newer contributions. But, I also see a tendency for newer scientists to omit these older works from their reading and citations.

Overall, it covers the wide range of topics and pedagogy that I feel that someone working on our type of Biometeorology needs to read. I hope you find it useful and if you have some suggestions I have missed let me know.

Classics

Agriculture and Climate

Lobell, D.B., Schlenker, W. and Costa-Roberts, J., 2011. Climate trends and global crop production since 1980. *Science*, 333(6042): 616-20.

Lobell, D.B. and Gourdji, S.M., 2012. The influence of climate change on global crop productivity. *Plant Physiology*, 160(4): 1686-97.

Foley, J.A. et al., 2011. Solutions for a cultivated planet. *Nature*, 478(7369): 337-42.

Mueller, N. D., et al. (2012). "Closing yield gaps through nutrient and water management." *Nature* 490(7419): 254-257.

Rosenzweig, C. and Parry, M.L., 1994. POTENTIAL IMPACT OF CLIMATE-CHANGE ON WORLD FOOD-SUPPLY. *Nature*, 367(6459): 133-138.

Rigden, A. J., N. D. Mueller, N. M. Holbrook, N. Pillai, and P. Huybers (2020), Combined influence of soil moisture and atmospheric evaporative demand is important for accurately predicting US maize yields, *Nature Food*, 1(2), 127-133, doi:10.1038/s43016-020-0028-7.



Fuentes, J. D., et al. (2000). "Biogenic hydrocarbons in the atmospheric Boundary layer: a review." *Bulletin of the American Meteorological Society*. 81: 1537–1575.

Laothawornkitkul, J., et al. (2009). "Biogenic volatile organic compounds in the Earth system." *The New phytologist* 183(1): 27–51.

Monson, R. K. and E. A. Holland (2001). "Biospheric trace gas fluxes and their control over tropospheric chemistry." *Annual Review of Ecology and Systematics* 32: 547–+.

Sharkey, T.D. and Yeh, S., 2001. Isoprene emission from plants. *Annual Review of Plant Physiology and Plant Molecular Biology*, 52(1): 407-436.

Laothawornkitkul, J., J. E. Taylor, N. D. Paul, and C. N. Hewitt. 2009. Biogenic volatile organic compounds in the Earth system. *The New phytologist* 183:27-51.

Arneth, A., et al. (2010). "From biota to chemistry and climate: towards a comprehensive description of trace gas exchange between the biosphere and atmosphere." *Biogeosciences* 7(1): 121–149.

Biogeochemistry

1. Bolin, B. and H. Rodhe. 1973. Note on Concepts of Age Distribution and Transit-Time in Natural Reservoirs. *Tellus* 25:58-62.

2. Megonigal, J. P., et al. (2003). *Anaerobic Metabolism: Linkages to Trace Gases and Aerobic Processes. Treatise on Geochemistry*. H. D. Holland and K. K. Turekian. Oxford, Pergamon. 8: 317-424.

3. Burgin, A. J., and T. D. Loeckle (2023), The biogeochemical redox paradox: how can we make a foundational concept more predictive of biogeochemical state changes?, *Biogeochemistry*, doi:10.1007/s10533-023-01036-9.

DOI: [10.1007/s10533-023-01036-9](https://doi.org/10.1007/s10533-023-01036-9)

Biogeosciences

1.  Leubauer, S. and J. P. Megonigal (2015). "Moving Beyond Global Warming Potentials to Quantify the Climatic Role of Ecosystems." *Ecosystems* 18(6).



2. Kleidon, A. (2023), Working at the limit: a review of thermodynamics and optimality of the Earth system, *Earth Syst. Dynam.*, 14(4), 861-896, doi:10.5194/esd-14-861-2023.

DOI: [10.5194/esd-14-861-2023](https://doi.org/10.5194/esd-14-861-2023)

Boundary Layer Micrometeorology

Kaimal, J. C., Y. Izumi, J. C. Wyngaard, and R. Cote. 1972. Spectral Characteristics of Surface-Layer Turbulence. *Quarterly Journal of the Royal Meteorological Society* 98:563-&.

Hogstrom, U. 1988. Non-Dimensional Wind and Temperature Profiles in the Atmospheric Surface-Layer - a Re-Evaluation. *Boundary-Layer Meteorology* 42:55-78.

Kaimal, J. C. and J. C. Wyngaard. 1990. The Kansas and Minnesota Experiments. *Boundary-Layer Meteorology* 50:31-47.

Hogstrom, U. 1996. Review of some basic characteristics of the atmospheric surface layer. *Boundary-Layer Meteorology* 78:215-246.

Foken, T., 2006. 50 Years of the Monin Obukhov Similarity Theory. *Boundary-Layer Meteorology*, 119(3): 431-447.

Mahrt, L. (2014). "Stably stratified atmospheric boundary layers." *Annual Review of Fluid Mechanics* 46(1): 23-45.

Vilà-Guerau de Arellano, J., et al. (2015). *Atmospheric Boundary Layer: Integrating Air Chemistry and Land Interactions*. Cambridge, Cambridge University Press.

Stull, R. B. (1988). *Introduction to Boundary Layer Meteorology*. Dordrecht, The Netherlands, Kluwer.

Kaimal, J. C. and J. J. Finnigan (1994). *Atmospheric Boundary Layer Flows*, Oxford University Press.



Wyngaard, J. C. 1990. Scalar Fluxes in the Planetary Boundary-Layer - Theory, Modeling, and Measurement. *Boundary-Layer Meteorology* 50:49-75.

Wyngaard, J. C. (2010). *Turbulence in the Atmosphere*, Cambridge University Press.

Canopy Conductance

Finnigan, J. J. and M. R. Raupach. 1987. Transfer processes in plant canopies in relation to stomatal characteristics. Pages 385-429 in E. Zeiger, editor. *Stomatal Function*. Stanford University Press, Palo Alto, CA.

Raupach, M.R., 1995. Vegetation-atmosphere interaction and surface conductance at leaf, canopy and regional scales. *Agricultural and Forest Meteorology*, 73(3-4): 151-179.

Kelliher, F.M., Leuning, R., Raupach, M.R. and Schulze, E.-D., 1995. Maximum conductances for evaporation from global vegetation types. *Agricultural and Forest Meteorology*, 73(1-2): 1-16.

Canopy micrometeorology and turbulence

Denmead, O. T. and E. F. Bradley. 1987. On Scalar Transport in Plant Canopies. *Irrigation Science* 8:131-149.

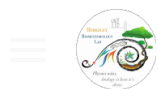
Finnigan, J., 2000. Turbulence in Plant Canopies. *Annu. Rev. Fluid Mech.*, 32(1): 519-571.

Raupach, M.R. and Thom, A.S., 1981. Turbulence in and above Plant Canopies. *Annual Review of Fluid Mechanics*, 13: 97-129.

Raupach, M. R., J. J. Finnigan, and Y. Brunet. 1996. Coherent eddies and turbulence in vegetation canopies: The mixing-layer analogy. *Boundary-Layer Meteorology* 79:351-382.



Brunet, Yves. 2020. 'Turbulent Flow in Plant Canopies: Historical Perspective and



CO2 Fluxes, Pioneering Studies

Monteith, J. L. and G. Szeicz. 1960. The Carbon-Dioxide Flux over a Field of Sugar Beet. *Quarterly Journal of the Royal Meteorological Society* 86:205-214.

Desjardins, R. 1974. Technique to Measure Co2 Exchange under Field Conditions. *International Journal of Biometeorology* 18:76-83.

Anderson, D. E., S. B. Verma, and N. J. Rosenberg. 1984. Eddy-correlation measurements of CO₂, latent-heat, and sensible heat fluxes over a crop surface. *Boundary-Layer Meteorology* 29:263-272.

CO2 Fluxes, syntheses

Baldocchi, D.D., 2008. TURNER REVIEW No. 15. 'Breathing' of the terrestrial biosphere: lessons learned from a global network of carbon dioxide flux measurement systems. *Australian Journal of Botany* 56, 1-26.

Beer, C., Reichstein, M., Tomelleri, E., Ciais, P., Jung, M., Carvalhais, N., Rodenbeck, C., Arain, M.A., Baldocchi, D., Bonan, G.B., Bondeau, A., Cescatti, A., Lasslop, G., Lindroth, A., Lomas, M., Luyssaert, S., Margolis, H., Oleson, K.W., Rouspard, O., Veenendaal, E., Viovy, N., Williams, C., Woodward, F.I., Papale, D., 2010. Terrestrial Gross Carbon Dioxide Uptake: Global Distribution and Covariation with Climate. *Science* 329, 834-838.

Luyssaert, S., Inglis, I., Jung, M., Richardson, A.D., Reichsteins, M., Papale, D., Piao, S.L., Schulzes, E.D., Wingate, L., Matteucci, G., Aragao, L., Aubinet, M., Beers, C., Bernhofer, C., Black, K.G., Bonal, D., Bonnefond, J.M., Chambers, J., Ciais, P., Cook, B., Davis, K.J., Dolman, A.J., Gielen, B., Goulden, M., Grace, J., Granier, A., Grelle, A., Griffis, T., Grunwald, T., Guidolotti, G., Hanson, P.J., Harding, R., Hollinger, D.Y., Hutya, L.R., Kolar, P., Kruijt, B., Kutsch, W., Lagergren, F., Laurila, T., Law, B.E., Le Maire, G., Lindroth, A., Loustau, D., Malhi, Y., Mateus, J., Migliavacca, M., Misson, L., Montagnani, L., Moncrieff, J., Moors, E., Munger, J.W., Nikinmaa, E., Ollinger, S.V., Pita, G., Rebmann, C., Rouspard, O., Saigusa, N., Sanz, M.J., Seufert, G., Sierra, C., Smith, M.L., Tang, J., Valentini, R., Vesala, T., Janssens, I.A., 2007. CO₂ balance of



Baldocchi, D., et al. (2024). "AmeriFlux: Its Impact on our understanding of the 'breathing of the biosphere', after 25 years." *Agricultural and Forest Meteorology* 348: 109929.

Xiao, J., et al. (2025). "Insights into terrestrial carbon and water cycling from the global eddy covariance network." *Nature Reviews Earth & Environment*.

Dry Deposition

Wesely, M. L. and B. B. Hicks. 2000. A review of the current status of knowledge on dry deposition. *Atmospheric Environment* 34:2261-2282.

Wesely, M. L. 1989. PARAMETERIZATION OF SURFACE RESISTANCES TO GASEOUS DRY DEPOSITION IN REGIONAL-SCALE NUMERICAL-MODELS. *Atmospheric Environment* 23:1293-1304.

Wesely, M. L. and B. B. Hicks. 2000. A review of the current status of knowledge on dry deposition. *Atmospheric Environment* 34:2261-2282.

Fowler, D., K. Pilegaard, M. A. Sutton, P. Ambus, M. Raivonen, J. Duyzer, D. Simpson, H. Fagerli, S. Fuzzi, J. K. Schjoerring, C. Granier, A. Nefel, I. S. A. Isaksen, P. Laj, M. Maione, P. S. Monks, J. Burkhardt, U. Daemmgen, J. Neirynck, E. Personne, R. Wichink-Kruit, K. Butterbach-Bahl, C. Flechard, J. P. Tuovinen, M. Coyle, G. Gerosa, B. Loubet, N. Altimir, L. Gruenhage, C. Ammann, S. Cieslik, E. Paoletti, T. N. Mikkelsen, H. Ro-Poulsen, P. Cellier, J. N. Cape, L. Horvath, F. Loreto, A. Niinemets, P. I. Palmer, J. Rinne, P. Misztal, E. Nemitz, D. Nilsson, S. Pryor, M. W. Gallagher, T. Vesala, U. Skiba, N. Brüggemann, S. Zechmeister-Boltenstern, J. Williams, C. O'Dowd, M. C. Facchini, G. de Leeuw, A. Flossman, N. Chaumerliac, and J. W. Erisman. 2009. Atmospheric composition change: Ecosystems-Atmosphere interactions. *Atmospheric Environment* 43:5193-5267.

Clifton, O. E., et al. (2020), Dry Deposition of Ozone Over Land: Processes, Measurement, and Modeling, *Rev. Geophys.*, 58(1), e2019RG000670, doi:10.1029/2019rg000670.



Atmospheric Aerosols: Approaches, Observations, and Mechanisms', Annual Review of Physical Chemistry, 72:

Ecophysiology

Pearcy, R. W. and J. Ehleringer. 1984. Comparative Ecophysiology of C-3 and C-4 Plants. *Plant Cell and Environment* 7:1-13.

Berry, J. and O. Bjorkman. 1980. PHOTOSYNTHETIC RESPONSE AND ADAPTATION TO TEMPERATURE IN HIGHER-PLANTS. *Annual Review of Plant Physiology and Plant Molecular Biology* 31:491-543.

Field, C. B. and H. A. Mooney. 1986. The photosynthesis-nitrogen relationship in wild plants. Pages 25-55 in T. J. Givnish, editor. *On the economy of plant form and function*. Cambridge University Press.

Ecosystem Atmosphere Interactions

Watson, A. and J. Lovelock. 1983. Biological homeostasis of the global environment: the parable of Daisyworld. *Tellus* 35b:286-289.

Odum, E. P. 1969. Strategy of Ecosystem Development. *Science* 164:262-270.

Kleidon, A. (2023), Working at the limit: a review of thermodynamics and optimality of the Earth system, *Earth Syst. Dynam.*, 14(4), 861-896, doi:10.5194/esd-14-861-2023.

DOI: 10.5194/esd-14-861-2023

Arnell, A., et al. (2010). "Terrestrial biogeochemical feedbacks in the climate system." *Nature Geoscience* 3(8): 525–532.

Vilà-Guerau de Arellano, J., Hartogensis, O., Benedict, I., de Boer, H., Bosman, P. J. M., Botía, S., Cecchini, M. A., Faassen, K. A. P., González-Armas, R., van Diepen, K., Heusinkveld, B. G., Janssens, M., Lobos-Roco, F., Luijkx, I. T., Machado, L. A. T., Mangan, M. R., Moene, A. F., Mol, W. B., van der Molen, M., ... van Heerwaarden, C. C. (2023). Advancing understanding of land-atmosphere interactions by breaking discipline and scale barriers. *Ann NY Acad Sci.*, 1522, 74–87. <https://doi.org/10.1111/nyas.14950>



Van Bodegom, P. M., J. C. Douma, J. P. M. Witte, J. C. Ordoñez, R. P. Bartholomeus, and R. Aerts. 2012. Going beyond limitations of plant functional types when predicting global ecosystem-atmosphere fluxes: exploring the merits of traits-based approaches. *Global Ecology and Biogeography* 21:625-636.

Reich, P. B., M. B. Walters, and D. S. Ellsworth. 1997. From tropics to tundra: Global convergence in plant functioning. *PNAS* 94:13730-13734.

Wright, I. J., P. B. Reich, M. Westoby, D. D. Ackerly, Z. Baruch, F. Bongers, J. Cavender-Bares, F. A. Chapin, J. H. C. Cornelissen, M. Diemer, J. Flexas, E. Garnier, P. K. Groom, J. Gulias, K. Hikosaka, B. B. Lamont, T. Lee, W. Lee, C. Lusk, J. J. Midgley, M.-L. Nava, Å. Niinemets, J. Oleksyn, N. Osada, H. Poorter, P. Poot, L. Prior, V. I. Pyankov, C. Roumet, S. C. Thomas, M. G. Tjoelker, E. J. Veneklaas, and R. Villar. 2004. The worldwide leaf economics spectrum. *Nature* 428:821-827.

Kattge, J., et al. (2011). "TRY - a global database of plant traits." *Global Change Biology* 17(9): 2905-2935.

Eddy Covariance Flux measurements

Moore, C. J. 1986. Frequency response corrections for eddy covariance systems. *Boundary Layer Meteorology* 37:17-35.

McMillen, R. T. 1988. An Eddy-Correlation Technique with Extended Applicability to Non-Simple Terrain. *Boundary-Layer Meteorology* 43:231-245.

Baldocchi, D. D., B. B. Hicks, and T. P. Meyers. 1988. Measuring biosphere-atmosphere exchanges of biologically related gases with micrometeorological methods. *Ecology*. 69:1331-1340.

Foken, T. and B. Wichura. 1996. Tools for quality assessment of surface-based flux measurements. *Agricultural and Forest Meteorology* 78:83-105.

Aubinet, M. et al. 2000. Estimates of the annual net carbon and water exchange of



Baldocchi, D.D., 2003. Assessing the eddy covariance technique for evaluating carbon dioxide exchange rates of ecosystems: past, present and future. *Global Change Biol*, 9: 479-492.

Lee, X.H., Massman, W.J., 2011. A Perspective on Thirty Years of the Webb, Pearman and Leuning Density Corrections. *Boundary-Layer Meteorology* 139, 37-59.

Sabbatini, S., et al. (2018), Eddy covariance raw data processing for CO₂ and energy fluxes calculation at ICOS ecosystem stations, *International Agrophysics*, 32(4), 495-+, doi:10.1515/intag-2017-0043.

Rebmann, C., et al. (2018). "ICOS eddy covariance flux-station site setup: a review." *International Agrophysics* 32(4): 471-+.

Energetics of Crop Production and Photosynthetic Efficiency

Monteith, J. L. 1977. Climate and Efficiency of Crop Production in Britain. *Philosophical Transactions of the Royal Society of London Series B-Biological Sciences* 281:277-294.

Loomis, R. S. 1971. Agricultural Productivity. *Annual Review of Plant Physiology* 22:431-&.

Lemon, E., D. W. Stewart, and Shawcroft, R.W.. 1971. SUNS WORK IN A CORNFIELD. *Science* 174:371-&.

Zelitch, Israel. "The close relationship between net photosynthesis and crop yield." *Bioscience* 32.10 (1982): 796-802.

Gifford, Roger M., and L. T. Evans. "Photosynthesis, carbon partitioning, and yield." *Annual Review of Plant Physiology* 32.1 (1981): 485-509.

Zhu, X. G., et al. (2010). Improving Photosynthetic Efficiency for Greater Yield. *Annual Review of Plant Biology*, Vol 61. Palo Alto, ANNUAL REVIEWS. 61: 235-261.



C., Ceulemans, R., Dolman, H., Field, C., 2002. Energy balance closure at FLUXNET sites. *Agricultural and Forest Meteorology* 113, 223-243.

Foken, T. 2008. The energy balance closure problem: An overview. *Ecological Applications* 18:1351-1367.

Leuning, R., van Gorsel, E., Massman, W.J., Isaac, P.R., 2012. Reflections on the surface energy imbalance problem. *Agricultural and Forest Meteorology* 156, 65-74.

Stoy, P. C., et al. (2013), A data-driven analysis of energy balance closure across FLUXNET research sites: The role of landscape scale heterogeneity, *Agricultural and Forest Meteorology*, 171-172, 137-152, doi:10.1016/j.agrformet.2012.11.004.

Mauder, Matthias, Thomas Foken, and Joan Cuxart. 2020. 'Surface-Energy-Balance Closure over Land: A Review', *Boundary-Layer Meteorology*, 177: 395-426.

Evaporation

Monteith, J. L. 1965. Evaporation and Environment. Pages 205-234 Symposium Society of Experimental Biology XIX.

Monteith, J. L. 1981. Evaporation and Surface-Temperature. *Quarterly Journal of the Royal Meteorological Society* 107:1-27.

Jarvis, P.G. and McNaughton, K.G., 1986. Stomatal Control of Transpiration - Scaling up from Leaf to Region. *Advances in Ecological Research*, 15: 1-49.

Raupach, M.R., 2001. Combination theory and equilibrium evaporation. *Quarterly Journal of the Royal Meteorological Society*, 127(574): 1149-1181.

Shuttleworth, W.J., 2007. Putting the 'vap' into evaporation. *Hydrology and Earth System Sciences* 11, 210-244.

Katul, G. G., R. Oren, S. Manzoni, C. Higgins, and M. B. Parlange. 2012.

Evapotranspiration: A process driving mass transport and energy exchange in the soil-plant-atmosphere-climate system. *Reviews of Geophysics* 50.



Riqden, A. J., and G. D. Salvucci. 2015. 'Evapotranspiration based on equilibrated



Stoy, P. C., T. S. El-Madany, J. B. Fisher, P. Gentine, T. Gerken, S. P. Good, A. Klosterhalfen, S. Liu, D. G. Miralles, O. Perez-Priego, A. J. Rigden, T. H. Skaggs, G. Wohlfahrt, R. G. Anderson, A. M. J. Coenders-Gerrits, M. Jung, W. H. Maes, I. Mammarella, M. Mauder, M. Migliavacca, J. A. Nelson, R. Poyatos, M. Reichstein, R. L. Scott, and S. Wolf. 2019. 'Reviews and syntheses: Turning the challenges of partitioning ecosystem evaporation and transpiration into opportunities', *Biogeosciences*, 16: 3747-75.

DOI: [10.5194/bg-2019-85](https://doi.org/10.5194/bg-2019-85)

Flux Footprint

1. Schmid, H. P. 2002. Footprint modeling for vegetation atmosphere exchange studies: a review and perspective. *Agricultural and Forest Meteorology* 113:159-183.
2. Vesala, T., U. Rannik, M. Leclerc, T. Foken, and K. Sabelfeld. 2004. Flux and concentration footprints. *Agricultural and Forest Meteorology* 127:111-116.
3. Hsieh, C. I. and G. Katul. 2009. The Lagrangian stochastic model for estimating footprint and water vapor fluxes over inhomogeneous surfaces. *International Journal of Biometeorology* 53:87-100.
4. Kljun, N., P. Calanca, M. W. Rotach, and H. P. Schmid (2015), A simple two-dimensional parameterisation for Flux Footprint Prediction (FFP), *Geosci. Model Dev.*, 8(11), 3695-3713, doi:10.5194/gmd-8-3695-2015.

Flux Processing, Partitioning and Gap filling

1. Falge, E., D. Baldocchi, R. Olson, P. Anthoni, M. Aubinet, C. Bernhofer, G. Burba, R. Ceulemans, R. Clement, and H. Dolman. 2001. Gap filling strategies for long term energy flux data sets. *Agricultural and Forest Meteorology* 107:71-77.
2. Reichstein, M., Falge, E., Baldocchi, D., Papale, D., Aubinet, M., Berbigier, P., Bernhofer, C., Buchmann, N., Gilmanov, T., Granier, A., Grunwald, T., Havrankova, K., Il  niemi, H., Janous, D., Knohl, A., Laurila, T., Lohila, A., Loustau, D., Matteucci, G., Meyers, T., Miglietta, F., Ourcival, J.-M., Pumpanen, J., Rambal, S., Rotenberg, E.,



respiration: review and improved algorithm. *Global Change Biology* 11, 1424-1429.

3. Moffat, A.M., Papale, D., Reichstein, M., Hollinger, D.Y., Richardson, A.D., Barr, A.G., Beckstein, C., Braswell, B.H., Churkina, G., Desai, A.R., Falge, E., Gove, J.H., Heimann, M., Hui, D., Jarvis, A.J., Kattge, J., Noormets, A., Stauch, V.J., 2007.

Comprehensive comparison of gap-filling techniques for eddy covariance net carbon fluxes. *Agricultural and Forest Meteorology* 147, 209-232.

Global Change and Ecosystems

5. Ainsworth, E. A., and S. P. Long (2005), What have we learned from 15 years of free-air CO₂ enrichment (FACE)? A meta-analytic review of the responses of photosynthesis, canopy properties and plant production to rising CO₂, *New Phytol*, 165(2), 351-371, doi:10.1111/j.1469-8137.2004.01224.x.

6. Norby, R. J., and D. R. Zak (2011), Ecological Lessons from Free-Air CO₂ Enrichment (FACE) Experiments, *Annual Review of Ecology, Evolution, and Systematics*, 42(1), 181-203, doi:10.1146/annurev-ecolsys-102209-144647.

7. Sage, R. F. (2020), *Global Change Biology: A Primer*, *Global Change Biology*, n/a(n/a), doi:10.1111/gcb.14893.

Gross Primary Production from Remote Sensing, Regional and Global Upscaling

1. Running, S. W., D. D. Baldocchi, D. Turner, S. T. Gower, P. Bakwin, and K. Hibbard (1999), A global terrestrial monitoring network, scaling tower fluxes with ecosystem modeling and EOS satellite data, *Remote Sensing of the Environment*, 70, 108-127.

2. Anav, A., P. Friedlingstein, C. Beer, P. Ciais, A. Harper, C. Jones, G. Murray-Tortarolo, D. Papale, N. C. Parazoo, P. Peylin, S. Piao, S. Sitch, N. Viovy, A. Wiltshire, and M. Zhao. 2015. Spatiotemporal patterns of terrestrial gross primary production: A review. *Reviews of Geophysics*: doi 10.1002/2015RG000483.

3. Xiao, X., C. Jin, and J. Dong. 2014. Gross Primary Production of Terrestrial Vegetation. Pages 127-148 in J. M. Hanes, editor. *Biophysical Applications of Satellite Remote Sensing*. Springer Berlin Heidelberg.



Lasslop, G., Lindroth, A., Lomas, M., Luyssaert, S., Margolis, H., Oleson, K.W., Rouspard, O., Veenendaal, E., Viovy, N., Williams, C., Woodward, F.I., Papale, D., 2010. Terrestrial Gross Carbon Dioxide Uptake: Global Distribution and Covariation with Climate. *Science* 329, 834-838.

5. Jung, M., et al. (2011), Global patterns of land-atmosphere fluxes of carbon dioxide, latent heat, and sensible heat derived from eddy covariance, satellite, and meteorological observations, *Journal of Geophysical Research*, 116, doi:10.1029/2010jg001566.

6. Xiao, Jingfeng, Frederic Chevallier, Cecile Gomez, Luis Guanter, Jeffrey A. Hicke, Alfredo R. Huete, Kazuhito Ichii, Wenjian Ni, Yong Pang, Abdullah F. Rahman, Guoqing Sun, Wenping Yuan, Li Zhang, and Xiaoyang Zhang. 2019. 'Remote sensing of the terrestrial carbon cycle: A review of advances over 50 years', *Remote Sensing of Environment*, 233: 111383.

Ryu, Y., Berry, JA Baldocchi, DD. (2019). "What is global photosynthesis? History, uncertainties and opportunities." *Remote Sensing of Environment* 223: 95–114. <https://doi.org/10.1016/j.rse.2019.01.016>

Hyperspectral remote sensing and surface Fluxes

1. Gamon, J. A., et al. (2011), SpecNet revisited: bridging flux and remote sensing communities, *Canadian Journal of Remote Sensing*, 36, S376-S390.

2. Ustin, S. L., D. A. Roberts, J. A. Gamon, G. P. Asner, and R. O. Green. 2004. Using imaging spectroscopy to study ecosystem processes and properties. *Bioscience* 54:523-534.

3. Porcar-Castell, A., E. Tyystjarvi, J. Atherton, C. van der Tol, J. Flexas, E. E. Pfundel, J. Moreno, C. Frankenberg, and J. A. Berry. 2014. Linking chlorophyll a fluorescence to photosynthesis for remote sensing applications: mechanisms and challenges. *Journal of Experimental Botany* 65:4065-4095.

4. ⁱ Badgley, G., L. D. L. Anderegg, J. A. Berry, and C. B. Field (2019), Terrestrial Gross



5. Ustin, Susan L., and Elizabeth M. Middleton. 2021. 'Current and near-term advances in Earth observation for ecological applications', *Ecological Processes*, 10: 1.

6. Ustin, S. L., and E. M. Middleton (2021), Current and near-term advances in Earth observation for ecological applications, *Ecological Processes*, 10(1), 1, doi:10.1186/s13717-020-00255-4.

DOI: [10.1186/s13717-020-00255-4](https://doi.org/10.1186/s13717-020-00255-4)

Instruments

1. Wyngaard, J. C. 1981. Cup, Propeller, Vane, and Sonic Anemometers in Turbulence Research. *Annual Review of Fluid Mechanics* 13:399-423.

2. Werle, P., F. Slemr, K. Maurer, R. Kormann, R. Mücke, and B. Jönker. 2002. Near- and mid-infrared laser-optical sensors for gas analysis. *Optics and Lasers in Engineering* 37:101-114.

3. Long, S. P., P. K. Farage, and R. L. Garcia. 1996. Measurement of leaf and canopy photosynthetic CO₂ exchange in the field. *Journal of Experimental Botany* 47:1629-1642.

Land-Atmosphere-Climate Interactions

1. Dickinson, R. E. 1983. Land surface processes and climate-surface albedos and energy balance. *Advances in Geophysics* 25:305-353.

2. Sellers, P.J. et al., 1997. Modeling the exchanges of energy, water, and carbon between continents and the atmosphere. *Science*, 275(5299): 502-509.

3. Bonan, G. B., K. W. Oleson, M. Vertenstein, S. Levis, X. B. Zeng, Y. J. Dai, R. E. Dickinson, and Z. L. Yang. 2002. The land surface climatology of the community land model coupled to the NCAR community climate model. *Journal of Climate* 15:3123-3149.



4. Bonan, G. B. 2008. Forests and climate change: forcings, feedbacks, and the



5. Jackson, R. B., et al. (2008). "Protecting climate with forests." *Environmental Research Letters* 3(4): 044006.

6. Foley, J. A., R. DeFries, G. P. Asner, C. Barford, G. Bonan, S. R. Carpenter, F. S. Chapin, M. T. Coe, G. C. Daily, H. K. Gibbs, J. H. Helkowski, T. Holloway, E. A. Howard, C. J. Kucharik, C. Monfreda, J. A. Patz, I. C. Prentice, N. Ramankutty, and P. K. Snyder. 2005. Global consequences of land use. *Science* 309:570-574.

7. Fisher, Rosie A., and Charles D. Koven. 2020. 'Perspectives on the Future of Land Surface Models and the Challenges of Representing Complex Terrestrial Systems', *Journal of Advances in Modeling Earth Systems*, 12: e2018MS001453.

Leaf Area Index and Canopy Structure

1. Wilson, J. W. 1965. Stand Structure and Light Penetration. I. Analysis by Point Quadrats. *Journal of Applied Ecology* 2:383-390.

2. Lang, A. R. G. 1987. Simplified estimate of leaf area index from transmittance of the sun's beam. *Agricultural and Forest Meteorology* 41:179-186.

3. Chen, J.M., 1996. Optically-based methods for measuring seasonal variation of leaf area index in boreal conifer stands. *Agricultural and Forest Meteorology*, 80(2-4): 135-163.

4. Lefsky, M. A., W. B. Cohen, G. Parker, and D. J. Harding. 2002. Lidar remote sensing for ecosystem studies. *Bioscience* 52:19-30.

5. Jonckheere, I. et al., 2004. Review of methods for in situ leaf area index determination: Part I. Theories, sensors and hemispherical photography. *Agricultural and Forest Meteorology*, 121(1-2): 19-35.

6. Ryu, Y., Sonnentag, O., Nilson, T., Vargas, R., Kobayashi, H., Wenk, R., Baldocchi, D.D., 2010. How to quantify tree leaf area index in an open savanna ecosystem: A multi-instrument and multi-model approach. *Agricultural and Forest Meteorology* 150, 67-76.

7. Yeo, C. et al. (2010). "Review of indirect optical measurements of leaf area index."



Leaf Boundary Layers

1. Leuning, R. 1983. Transport of Gases into Leaves. Plant Cell and Environment 6:181-194
2. Schuepp, P., 1993. Tansley Review No. 59. Leaf Boundary Layers. New Phytologist 125, 477-507.

Leaf Energy Balance

1. Paw U, K. T. and W. Gao. 1988. Applications of solutions to non-linear energy budget equations. Agricultural and Forest Meteorology 43:121-145.
2. Leuning, R. 1989. Leaf Energy Balances - Developments and Applications. Philosophical Transactions of the Royal Society of London Series B-Biological Sciences 324:191-206.
3. Gates, David M. "Transpiration and leaf temperature." Annual Review of Plant Physiology 19.1 (1968): 211-238.
4. Blonder, Benjamin, and Sean T. Michaletz. 2018. 'A model for leaf temperature decoupling from air temperature', Agricultural and Forest Meteorology, 262: 354-60.

Leaf photosynthesis/transpiration/stomatal conductance models

1. Jarvis, P. G. 1976. Interpretation of Variations in Leaf Water Potential and Stomatal Conductance Found in Canopies in Field. Philosophical Transactions of the Royal Society of London Series B-Biological Sciences 273:593-610.
2. Farquhar, G. D., S. V. Caemmerer, and J. A. Berry. 1980. A Biochemical-Model of Photosynthetic Co₂ Assimilation in Leaves of C-3 Species. Planta 149:78-90.
3. Farquhar, G.D. and Sharkey, T.D., 1982. Stomatal Conductance and Photosynthesis. Annual Review of Plant Physiology and Plant Molecular Biology, 33: 317-345.

4. Collatz, G.L., Ball, J.T., Grivet, C. and Berry, J.A., 1991. Physiological and



a model that includes a laminar boundary layer. *Agricultural and Forest Meteorology*, 54(2-4): 107-136.

5. Leuning, R., 1995. A Critical-Appraisal of a Combined Stomatal-Photosynthesis Model for C-3 Plants. *Plant Cell and Environment*, 18(4): 339-355.

6. Medlyn, B.E., Robinson, A.P., Clement, R. and McMurtrie, R.E., 2005. On the validation of models of forest CO₂ exchange using eddy covariance data: some perils and pitfalls. *Tree Physiology*, 25(7): 839-857.

7. Medlyn, B. E., A. P. Robinson, R. Clement, and R. E. McMurtrie (2005), On the validation of models of forest CO₂ exchange using eddy covariance data: some perils and pitfalls, *Tree Physiol.*, 25(7), 839-857.

8. Busch, F. A., et al. A guide to photosynthetic gas exchange measurements: Fundamental principles, best practice and potential pitfalls, *Plant, Cell & Environment*, doi:<https://doi.org/10.1111/pce.14815>.

DOI: [10.1111/pce.14815](https://doi.org/10.1111/pce.14815)

Leaf-Canopy Modeling, Carbon, Water and Heat Fluxes and Microclimate

1. DeWit, C. T. 1965. Photosynthesis of leaf canopies. Centre for Agricultural Publications and Documentation.

2. Duncan, W. G., R. S. Loomis, W. A. Williams, and R. Hanau. 1967. A Model for Simulating Photosynthesis in Plant Communities. *Hilgardia* 38:181-&.

3. Sinclair, T. R., C. E. Murphy, and K. R. Knoerr. 1976. Development and Evaluation of Simplified Models for Simulating Canopy Photosynthesis and Transpiration. *Journal of Applied Ecology* 13:813-829.

4. Goudriaan, J. 1977. Crop micrometeorology: a simulation study.

5. Norman, J.M., 1979. Modeling the complete crop canopy. In: B.J. Barfield and J.F. Gerber (Editor), *Modification of the aerial environment of plants.* , American Society of Agricultural Engineering, St. Joseph, MI, pp. 249



Useless - Discuss. Australian Journal of Plant Physiology, 15(6): 705-716.

7. Baldocchi, D. D. and P. C. Harley. 1995. Scaling carbon dioxide and water vapor exchange from leaf to canopy in a deciduous forest: model testing and application. Plant, Cell and Environment 8:1157-1173.

8. dePury, D. G. G. and G. D. Farquhar. 1997. Simple scaling of photosynthesis from leaves to canopies without the errors of big-leaf models. Plant Cell and Environment 20:537-557.

9. Amthor, J. S. 1994. Scaling Co₂-Photosynthesis Relationships from the Leaf to the Canopy. Photosynthesis research 39:321-350.

Bonan, G. B., et al. (2021). "Moving beyond the incorrect but useful paradigm: reevaluating big-leaf and multilayer plant canopies to model biosphere-atmosphere fluxes – a review." Agricultural and Forest Meteorology 306: 108435. <https://doi.org/10.1016/j.agrformet.2021.108435>

Machine Learning and Fluxes

5. Reichstein, Markus, Gustau Camps-Valls, Bjorn Stevens, Martin Jung, Joachim Denzler, Nuno Carvalhais, and Prabhat. 2019. 'Deep learning and process understanding for data-driven Earth system science', Nature, 566: 195-204.

Methane

1. Cicerone, R.J. and Oremland, R.S., 1988. Biogeochemical aspects of atmospheric methane. Global Biogeochem. Cycles, 2: 299-327.

2. Conrad, R., 1989. Control of methane production in terrestrial ecosystems. In: M.O. Andreae and D.S. Schimel (Editors), Exchange of Trace Gases between Terrestrial Ecosystems and the Atmosphere. Wiley, Chichester, UK, pp. 39-58.

3. Conrad, R., 1996. Soil microorganisms as controllers of atmospheric trace gases (H₂, CO, CH₄, OCS, N₂O, and NO). Microbiological Reviews, 60(4): 609-+.

4.  halen, S.C., 2005. Biogeochemistry of Methane Exchange between Natural Wetlands and the Atmosphere. Environmental Engineering Science, 22(1): 73-94.



emissions from wetlands: biogeochemical, microbial, and modeling perspectives from local to global scales. *Global Change Biology* 19:1325-1346.

6. McCalley, Carmody K., Ben J. Woodcroft, Suzanne B. Hodgkins, Richard A. Wehr, Eun-Hae Kim, Rhiannon Mondav, Patrick M. Crill, Jeffrey P. Chanton, Virginia I. Rich, Gene W. Tyson, and Scott R. Saleska. 2014. 'Methane dynamics regulated by microbial community response to permafrost thaw', *Nature*, 514: 478-81.

7. Vroom, R. J. E., M. van den Berg, S. R. Pangala, O. E. van der Scheer, and B. K. Sorrell (2022), Physiological processes affecting methane transport by wetland vegetation - a review, *Aquatic Botany*, 103547, doi:<https://doi.org/10.1016/j.aquabot.2022.103547>.

DOI: [10.1016/j.aquabot.2022.103547](https://doi.org/10.1016/j.aquabot.2022.103547)

8. Nisbet, E. G., Manning, M. R., Dlugokencky, E. J., Michel, S. E., Lan, X., Röckmann, T., et al. (2023). Atmospheric methane: Comparison between methane's record in 2006–2022 and during glacial terminations. *Global Biogeochemical Cycles*, 37, e2023GB007875. <https://doi.org/10.1029/2023GB007875>

DOI: [10.1029/2023GB007875](https://doi.org/10.1029/2023GB007875)

Phenology

1. Richardson, A. D., T. F. Keenan, M. Migliavacca, Y. Ryu, O. Sonnentag, and M. Toomey. 2013. Climate change, phenology, and phenological control of vegetation feedbacks to the climate system. *Agricultural and Forest Meteorology* 169:156-173.

2. Kramer, K., I. Leinonen, and D. Loustau. 2000. The importance of phenology for the evaluation of impact of climate change on growth of boreal, temperate and Mediterranean ecosystems, an overview. *International Journal of Biometeorology* 44:67-75.

3. Menzel, A., T. H. Sparks, N. Estrella, E. Koch, A. Aasa, R. Ahas, K. Alm-K€œbler, P. Bissolli, O. G. Braslavsk€Å, A. Briede, F. M. Chmielewski, Z. Crepinsek, Y. Curnel, €Å.... D€™h, C. Defila, A. Donnelly, Y. Filella, K. Jatczak, F. M€Å...Ge, A. Mestre, €Å~. Nordli, J. PeA'Uelas, P. Pirinen, V. Remi€Å Ov€Å, H. Scheifinger, M. Striz, A. Susnik, A. J. H. Van



12:1969-1976.

Planetary Boundary Layer and Surface Flux Feedbacks

1. McNaughton, K.G. and Spriggs, T.W., 1986. A Mixed-Layer Model for Regional Evaporation. *Boundary-Layer Meteorology*, 34(3): 243-262.
2. Raupach, M.R., 1998. Influences of local feedbacks on land-air exchanges of energy and carbon. *Global Change Biology*, 4(5): 477-494.
3. Juang, J.-Y., G. Katul, M. Siqueira, P. Stoy, and K. Novick. 2007. Separating the effects of albedo from eco-physiological changes on surface temperature along a successional chronosequence in the southeastern United States. *Geophysical Research Letters* 34.
4. van Heerwaarden, C. C., J. Vilà -Guerau de Arellano, A. F. Moene, and A. A. M. Holtslag. 2009. Interactions between dry-air entrainment, surface evaporation and convective boundary-layer development. *Quarterly Journal of the Royal Meteorological Society* 135:1277-1291.
5. Juang, J. Y., G. G. Katul, A. Porporato, P. C. Stoy, M. S. Siqueira, M. Detto, H. S. Kim, and R. Oren. 2007. Eco-hydrological controls on summertime convective rainfall triggers. *Global Change Biology* 13:887-896.
6. Juang, J. Y., G. G. Katul, A. Porporato, P. C. Stoy, M. S. Siqueira, M. Detto, H. S. Kim, and R. Oren. 2007. Eco-hydrological controls on summertime convective rainfall triggers. *Global Change Biology* 13:887-896.

Vilà-Guerau de Arellano, J. (2003). "Bridging the Gap Between Atmospheric Physics and Chemistry in Studies of Small-Scale Turbulence." *Bulletin of the American Meteorological Society* 84(1): 51-56.

Radiative Transfer in vegetation (Phytoactinometry)

1. Lemmeur, R. and Blad, B.L., 1974. A critical review of light models for estimating the shortwave radiation regime of plant canopies. *Agricultural Meteorology*, 14(1-2): 255-286.



Vegetation and the Atmosphere, vol 1. Academic Press, London.

3. Ross, J. 1980. The Radiation Regime and Architecture of Plant Stands. Dr. W Junk, The Hague. <http://link.springer.com/book/10.1007%2F978-94-009-8647-3>
4. Myneni, R.B., Ross, J. and Asrar, G., 1989. A review on the theory of photon transport in leaf canopies. *Agricultural and Forest Meteorology*, 45(1-2): 1-153.
5. Ustin, S. L., S. Jacquemoud, and Y. Govaerts. 2001. Simulation of photon transport in a three-dimensional leaf: implications for photosynthesis. *Plant Cell Environ* 24:1095-1103.
6. Jacquemoud, S., W. Verhoef, F. Baret, C. Bacour, P. J. Zarco-Tejada, G. P. Asner, C. Francois, and S. L. Ustin. 2009. PROSPECT plus SAIL models: A review of use for vegetation characterization. *Remote Sensing of Environment* 113:S56-S66.

Scientific Method

1. Tuomivaara, T., P. Hari, H. Rita, and R. Hakkinen. 1994. THE GUIDE-DOG APPROACH: A METHODOLOGY FOR ECOLOGY. Department of Forest Ecology publications.
2. Oreskes, Naomi, Kristin Shrader-Frechette, and Kenneth Belitz. "Verification, validation, and confirmation of numerical models in the earth sciences." *Science* 263.5147 (1994): 641-646.

Soil Respiration

1. Raich, J., Schlesinger, W., 1992. The global carbon dioxide flux in soil respiration and its relationship to vegetation and climate. *Tellus* 44B, 81 - 90.
2. Trumbore, S., 2009. Radiocarbon and Soil Carbon Dynamics. *Annu. Rev. Earth Planet. Sci. Annual Reviews*, Palo Alto, pp. 47-66.
3. Kuzyakov, Y., Gavrichkova, O., 2010. REVIEW: Time lag between photosynthesis and carbon dioxide efflux from soil: a review of mechanisms and controls. *Global Change Biology* 16, 3386-3406.



1. Livingston, G.P. and Hutchinson, G.L., 1995. Enclosure-based measurement of trace gas exchange: Applications and sources of error. In: R.C. Harriss (Editor), Biogenic trace gases: Measuring emissions from soil and water. Blackwell Scientific, London, pp. 14-51.
2. Hutchinson, G.L. and Rochette, P., 2003. Non-Flow-Through Steady-State Chambers for Measuring Soil Respiration: Numerical Evaluation of Their Performance. Soil Sci Soc Am J, 67(1): 166-180.
3. Maier, M., and H. Schack-Kirchner (2014), Using the gradient method to determine soil gas flux: A review, Agricultural and Forest Meteorology, 192

Soil-Plant-Atmosphere Continuum

1. Shawcroft, R. W., E. R. Lemon, L. H. Allen, D. W. Stewart, and S. E. Jensen. 1974. SOIL-PLANT-ATMOSPHERE MODEL AND SOME OF ITS PREDICTIONS. Agricultural Meteorology 14:287-307.
2. Jarvis, P. G., W. R. N. Edwards, and H. Talbot. 1981. Models of Plant and Crop Water Use. Pages 151-193 in D. A. Rose and D. A. Charles-Edwards, editors. Mathematics and Plant Physiology. Academic Press, London.
3. Tuzet, A., A. Perrier, and R. Leuning. 2003. A coupled model of stomatal conductance, photosynthesis and transpiration. Plant Cell and Environment 26:1097-1116.
4. Katul, G., R. Leuning, and R. Oren. 2003. Relationship between plant hydraulic and biochemical properties derived from a steady-state coupled water and carbon transport model. Plant Cell Environ 26:339-350.
5. Sperry, J. S. 2000. Hydraulic constraints on plant gas exchange. Agricultural and Forest Meteorology 104:13-23.
6. Manzoni, S., G. Vico, A. Porporato, and G. Katul. 2013. Biological constraints on water transport in the soil-plant-atmosphere system. Advances in Water Resources 51:292-304.



Reviews-Water 3:327-368.

Soils, moisture, heat, CO₂

1. Clapp, R.B. and Hornberger, G.M., 1978. Empirical Equations for Some Soil Hydraulic-Properties. *Water Resources Research*, 14(4): 601-604.
2. van Genuchten, M.T. and Sudicky, E.A., 1999. Recent advances in Vadose zone flow and transport modeling. In: M. Parlange and J.W. Hopmans (Editors), *Vadose Zone Hydrology*. Oxford Press, New York, pp. 155-193.
3. Simunek, J. and Suarez, D.L., 1993. MODELING OF CARBON-DIOXIDE TRANSPORT AND PRODUCTION IN SOIL .1. MODEL DEVELOPMENT. *Water Resources Research*, 29: 487-497.

Stable isotopes

1. Bowling, D.R., Pataki, D.E., Randerson, J.T., 2008. Carbon isotopes in terrestrial ecosystem pools and CO₂ fluxes. *New Phytologist* 178, 24-40.
2. Dawson, T.E., Mambelli, S., Plamboeck, A.H., Templer, P.H., P.Tu, K., 2002. STABLE ISOTOPES IN PLANT ECOLOGY. *Annual Review Ecology Systematics* 33, 507-559.
3. Griffis, T. J. (2013), Tracing the flow of carbon dioxide and water vapor between the biosphere and atmosphere: A review of optical isotope techniques and their application, *Agricultural and Forest Meteorology*, 174

Stomatal Optimization Models

1. Cowan, I. and G. Farquhar. 1977. Stomatal function in relation to leaf metabolism and environment. *Symposium of the Society of Experimental Biology* 31:471-505.
2. Hari, P., A. Makela, E. Korpilahti, and M. Holmberg. 1986. Optimal control of gas exchange. *Tree Physiology* 2:169-175.
3. Makela, A., F. Berninger, and P. Hari. 1996. Optimal Control of Gas Exchange and Drought: Theoretical Analysis. *Annals of Botany* 77:461-468.



transpiration. *Annals of Botany* 105:431-442

5. Medlyn, B. E., R. A. Duursma, D. Eamus, D. S. Ellsworth, I. C. Prentice, C. V. M. Barton, K. Y. Crous, P. De Angelis, M. Freeman, and L. Wingate (2011), Reconciling the optimal and empirical approaches to modelling stomatal conductance, *Global Change Biology*, 17(6), 2134-2144, doi:10.1111/j.1365-2486.2010.02375.x.

Buckley, Thomas N., Julien Lamour, David M. Barnard, Daniel W. Buckley, Andrew J. Jarvis, Antonio Diaz-Espejo, Alistair Rogers, and Lawren Sack. "A Simple Stomatal Model That Unifies the Metabolic and Hydraulic Control of Carbon and Water Flux." *Global Change Biology* 32, no. 7 (2026): e70999.

Water Use Efficiency

1. Tanner, C. B. and T. R. Sinclair. 1983. Efficient water use in crop production: research or re-search? Limitations to efficient water use in crop production:1-27.

2. Sinclair, T. R., C. B. Tanner, and J. Bennett. 1984. Water use efficiency in crop production. *BioScience* 34:36-40.

3. Hatfield, Jerry L., and Christian Dold. 2019. 'Water-Use Efficiency: Advances and Challenges in a Changing Climate', *Frontiers in Plant Science*, 10.

4. Cowan, Ian, and G. Farquhar. 1977. 'Stomatal function in relation to leaf metabolism and environment', *Symposium of the Society of Experimental Biology*, 31: 471-505.

5. Medlyn, Belinda E., Martin G. De Kauwe, Yan-Shih Lin, Jurgen Knauer, Remko A. Duursma, Christopher A. Williams, Almut Arneth, Rob Clement, Peter Isaac, Jean-Marc Limousin, Maj-Lena Linderson, Patrick Meir, Nicolas Martin-StPaul, and Lisa Wingate. 2017. 'How do leaf and ecosystem measures of water-use efficiency compare?', *The New phytologist*.





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