GE0892 (Section 001), Fall 2017, 3 credits; Tu & Th 5:00-6:20 pm; Geography 126 **Micrometeorological Instrumentation & Measurements** Dr. Jiquan Chen (Geography) Email: jqchen@msu.edu

Class Webpage: http://lees.geo.msu.edu/courses/Geo892



About:

- Go Green! No textbook. Reading materials will be posted at the class webpage;
- Hands-on experience in building own sensors, weather stations, and flux towers;
- Programming for dataloggers (Loggernet) & data processing through homework and group term paper;
- Fundamental terminology, concepts, principles, and process of environmental biophysics, as well as applications in natural science;
- Introduction of eddy-covariance method and flux measurement (e.g., CO₂) at KBS & iSEC sites (Dates?);
- Biophysical models: Penman-Monteith, Farquhar Photosynthesis & Ball-Berry model, Priestley-Taylor, Q10, LUE, etc.;
- Scaling up by integrating in situ measurements with satellite data;
- Aggregated field trips and lab.
- Group term paper for installing a EC tower on MSU campus?

Key references





SECOND EDITION GATLON S. CAMPBELL JOHN M. NORMAN

https://ia800500.us.archive.org/26/ite ms/AnIntroductionToEnvironmentalBio physics/AnIntroductionToEnvironmenta **IBiophysics-**GaylonS.CampbellJohnM.Norman.pdf

Leo J. Fritschen • Lloyd W. Gay

Environmental Instrumentation



Springer-Verlag New York Heidelberg Berlin

https://link.springer.com/content/pdf/10 .1007%2F978-1-4612-6205-3.pdf



Jay H. Lehr



Handbook of **Micrometeorology**

A Guide for Surface Flux Measurement and Analysis

Edited by

Xuhui Lee, William Massman and **Beverly Law**



Atmospheric and Oceanographic

Kluwer Academic Publishers

https://link.springer.com/content/pdf /10.1007%2F1-4020-2265-4.pdf

Geo892: Micrometeorological Instrumentation & Measurements

- Self-Introduction
- Schedule for the term (group discussion!)
- Homework and term paper(s) (group discussion!)
- A few basics on temperature, relative humidity, radiation
- Microclimate in terrestrial ecosystems
- An introduction of Loggernet (bring your laptops)

Reading:

Chen, J. S.D. Saunders, T. R. Crow, R.J. Naiman, K.D. Brosofske, G. R. Mroz, B. Brookshire, and J. Franklin. 1999. Microclimate in forest ecosystems and landscapes. *Bioscience* 49(4): 288-297.

A few Basics

Temperature: The thermal energy level of a body!

Temperature	Fahrenheit (°F)	Celsius (°C)
Ice point	32	0
Steam point	212	100
Human body	97.7	36.5
Reference	~70	21
Reference	41	5
Reference	95	35

$$T(^{o}C) = \frac{5}{9}[T(^{o}F) - 32]$$
$$T(^{o}F) = \frac{9}{5}T(^{o}C) + 32$$

 $1 \,{}^{o}C = 1.8 \,{}^{o}F$

 $0 \,{}^{o}C = 273.15 \,{}^{\circ}K$



FIGURE 2.2. Hourly air temperature (points) on a clear fall day at Hanford, WA. The curve is used to interpolate daily maximum and minimum temperatures to obtain hourly estimates.



P. D. Jones et. al.: SURFACE AIR TEMPERATURE AND ITS CHANGES OVER THE PAST 150 YEARS (Seite 24 von 28 der PDF-Datei), CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=9695907



FIGURE 2.1. Hypothetical profiles of maximum and minimum temperature above and below soil surface on a clear, calm day.

Diurnal changes in microclimate under different harvest regimes, (a) Patterns of shortwave radiation (kW/m²) for a 70-year-old Douglas-fir (*Pseudotsuga menziesii*) forest (thick black line) and three sites recently harvested using clearcut (solid line with circles), dispersed green-tree retention (partial cut; solid line), and aggregated green-tree retention (patch; dashed line) techniques, (b) Patterns of air temperature (°C) at 2 m above the ground for the same sites. Data were collected in western Washington on 25 August 1992 (the study sites are shown in Figure 2).



regimes

Diurnal changes in microclimatic variables at three landforms: ridge tops (solid black line), south- and westfacing slopes (thick gray line), and north- and east-facing slopes (thin black line). Variables monitored included (a) air temperature at 2 m height, (b) relative humidity, (c) shortwave radiation, (d) wind velocity, (e) air temperature at ground surface, and (f) soil temperature at 5 cm depth. Data were collected on 24 August 1995.



Patterns of overstory cover and air temperature at ground surface along a 760 m transect in a jack and red pine forest landscape in the Chequamegon National Forest, northern Wisconsin. The wavelet transforms for (a) canopy cover and (b) temperature were produced using the Mexican Hat function to reveal patterns at multiple resolutions (5–250 m) that are not apparent from the original data for (c) overstory (% cover; bold line) and air temperature (°C; thin line). Data were collected from 30 June 1995 through 3 July 1995.



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Schedules

July						August							September							
Su	Мо	Tu	We	Th	Fr	Sa	Su	Мо	Tu	We	Th	Fr	Sa	Su	Мо	Tu	We	Th	Fr	Sa
						1			1	2	3	4	5						1	2
2	3	4	5	6	7	8	6	7	8	9	10	11	12	3	4	5	6	7	8	9
9	10	11	12	13	14	15	13	14	15	16	17	18	19	10	11	12	13	14	15	16
16	17	18	19	20	21	22	20	21	22	23	24	25	26	17	18	19	20	21	22	23
23	24	25	26	27	28	29	27	28	29	30	31			24	25	26	27	28	29	30
30	31																			
9:	01	6:0	23:	•	30: (D	7:	01	4:0	21:	• :	29:	D	(5:O	13: 0	20:	• 2	27: O)
October					November							December								
		Oc	tob	er				Ν	lov	em	be	r				Dec	cem	ber	-	
Su	Мо	Oc Tu	tob We	er Th	Fr	Sa	Su	No Mo	lov Tu	'em We	be Th	r Fr	Sa	Su	Мо	Dec Tu	cem We	ber Th	- Fr	Sa
Su 1	Мо 2	Oc Tu 3	tob We 4	er Th 5	Fr 6	Sa 7	Su	N Mo	√ov Tu	vem We 1	be Th 2	r Fr 3	Sa 4	Su	Мо	Dec Tu	cem We	ber Th	Fr 1	Sa 2
Su 1 8	Mo 2 9	Oc Tu 3 10	tob We 4 11	er Th 5 12	Fr 6 13	Sa 7 14	Su 5	Mo 6	Vov Tu 7	vem We 1 8	be Th 2 9	r Fr 3 10	Sa 4 11	Su 3	Mo 4	Dec Tu 5	Cem We 6	ber Th 7	- Fr 1 8	Sa 2 9
Su 1 8 15	Mo 2 9 16	Oc Tu 3 10 17	tob We 4 11 18	er Th 5 12 19	Fr 6 13 20	Sa 7 14 21	Su 5 12	Mo 6 13	Vov Tu 7 14	we We 1 8 15	ber Th 2 9 16	r Fr 3 10 17	Sa 4 11 18	Su 3 10	Mo 4 11	Dec Tu 5 12	We 6 13	ber Th 7 14	Fr 1 8 15	Sa 2 9 16
Su 1 8 15 22	Mo 2 9 16 23	Oc Tu 3 10 17 24	tob We 4 11 18 25	er Th 5 12 19 26	Fr 6 13 20 27	Sa 7 14 21 28	Su 5 12 19	Mo 6 13 20	Vov Tu 7 14 21	em We 1 8 15 22	be Th 2 9 16 23	r Fr 3 10 17 24	Sa 4 11 18 25	Su 3 10 17	Mo 4 11 18	Dec Tu 5 12 19	We 6 13 20	ber Th 7 14 21	Fr 1 8 15 22	Sa 2 9 16 23
Su 1 8 15 22 29	Mo 2 9 16 23 30	Oc Tu 3 10 17 24 31	tob We 4 11 18 25	er Th 5 12 19 26	Fr 6 13 20 27	Sa 7 14 21 28	Su 5 12 19 26	Mo 6 13 20 27	Vov Tu 7 14 21 28	em We 1 8 15 22 29	be Th 2 9 16 23 30	r Fr 3 10 17 24	Sa 4 11 18 25	Su 3 10 17 24	Mo 4 11 18 25	Dec Tu 5 12 19 26	We 6 13 20 27	ber Th 7 14 21 28	Fr 1 8 15 22 29	Sa 2 9 16 23 30
Su 1 8 15 22 29	Mo 2 9 16 23 30	Oc Tu 3 10 17 24 31	tob We 4 11 18 25	er Th 5 12 19 26	Fr 6 13 20 27	Sa 7 14 21 28	Su 5 12 19 26	Mo 6 13 20 27	Vov Tu 7 14 21 28	em We 1 8 15 22 29	be Th 2 9 16 23 30	r Fr 10 17 24	Sa 4 11 18 25	Su 3 10 17 24 31	Mo 4 11 18 25	Dec Tu 5 12 19 26	We 6 13 20 27	ber Th 7 14 21 28	Fr 1 8 15 22 29	Sa 2 9 16 23 30

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Next Class: TBD based on our first meeting