GEO892 (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

CONFIDENTIAL

Michigan State University
Office of the Registrar
CLASS LIST with Images

CONFIDENTIAL

| Subject | Course | Section | Semester | Course Title | Instructor |
|---|---|---|---|---|---|
| GEO | 892 | 001 | FS17 | Advanced Research In Geography | CHEN |

Baule, Bj

Brooke, Chase Tyler

Lei, Cheyenne India

Shirkey, Gabriela E

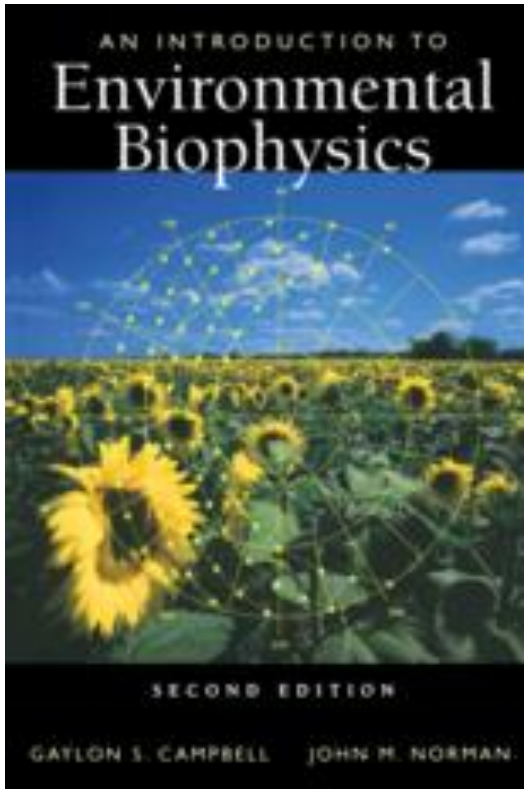
Total Students: 4

Generated: 8/31/2017 8:03:11 AM

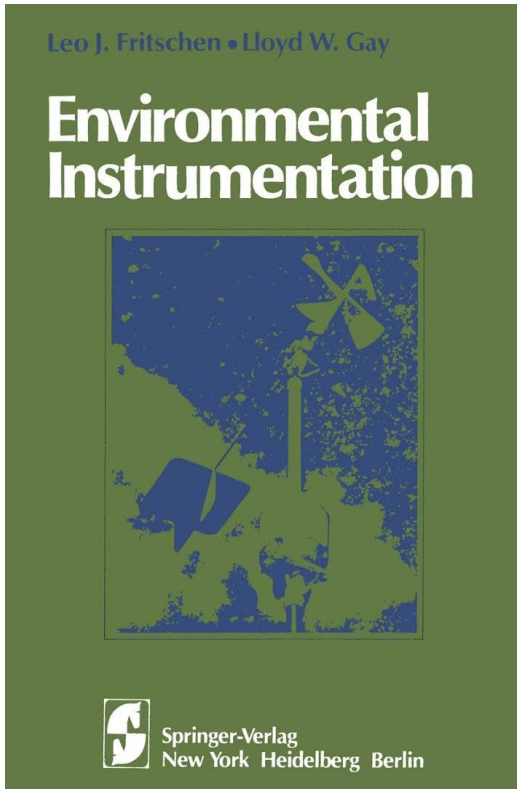
# About:

- 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., $CO_2$) at KBS & *i*SEC 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?

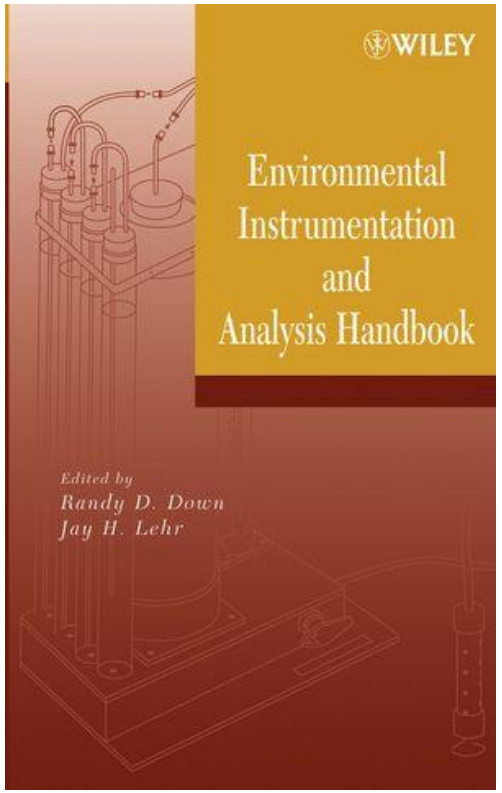
# Key references

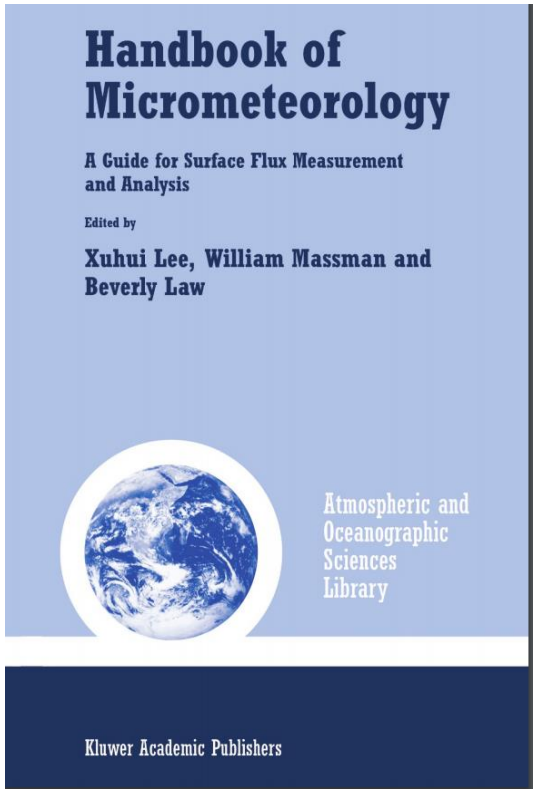



https://ia800500.us.archive.org/26/items/AnIntroductionToEnvironmentalBiophysics/AnIntroductionToEnvironmentalBiophysics-GaylonS.CampbellJohnM.Norman.pdf




https://link.springer.com/content/pdf/10.1007%2F978-1-4612-6205-3.pdf




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 |
| | | |

$$T\,(^oC) = \frac{5}{9}[T(\,^oF) - 32]$$

$$T\,(^oF) = \frac{9}{5}T(\,^oC) + 32$$

$$1\,^oC = 1.8\,^oF$$

$$0\,^oC = 273.15\,^oK$$

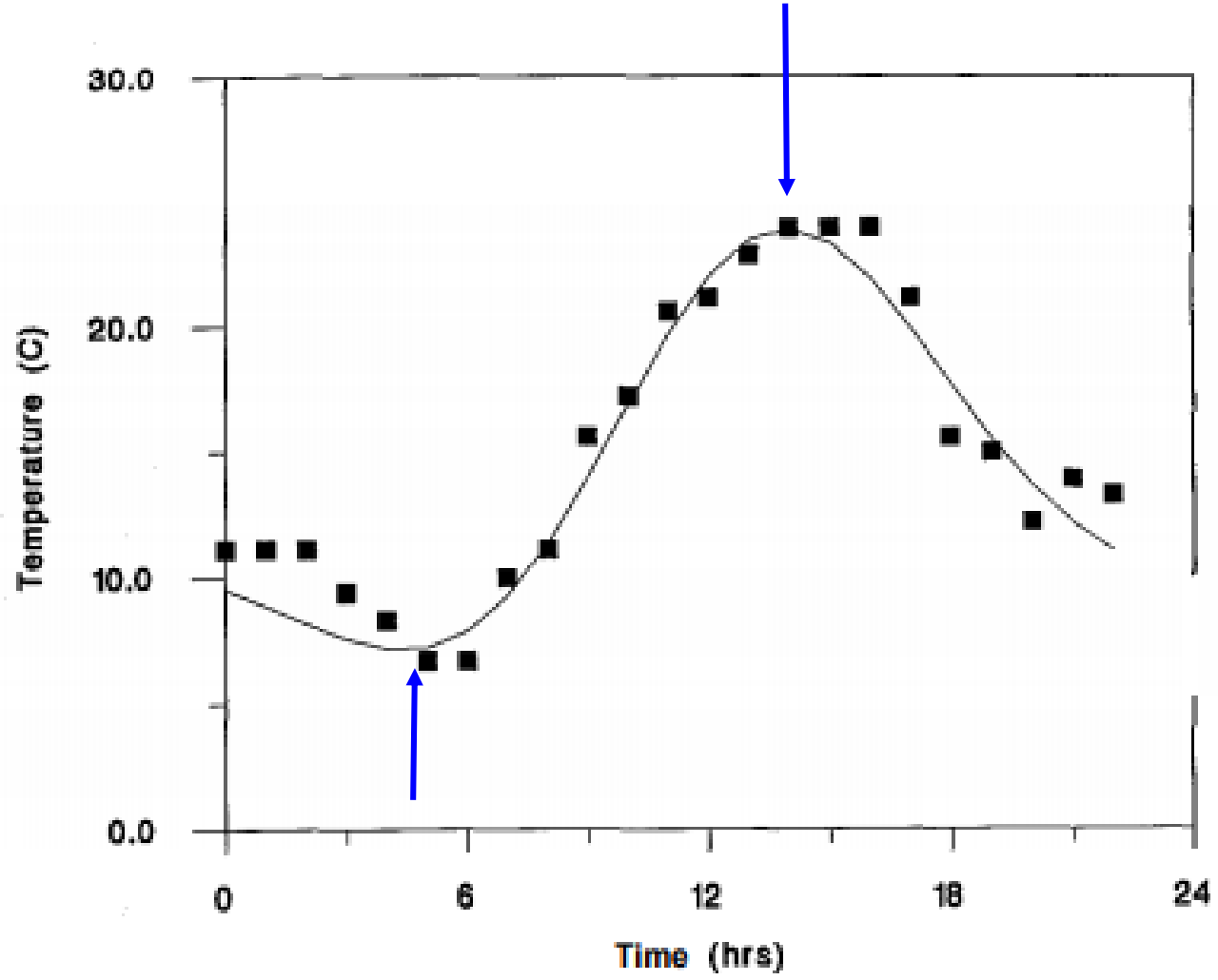
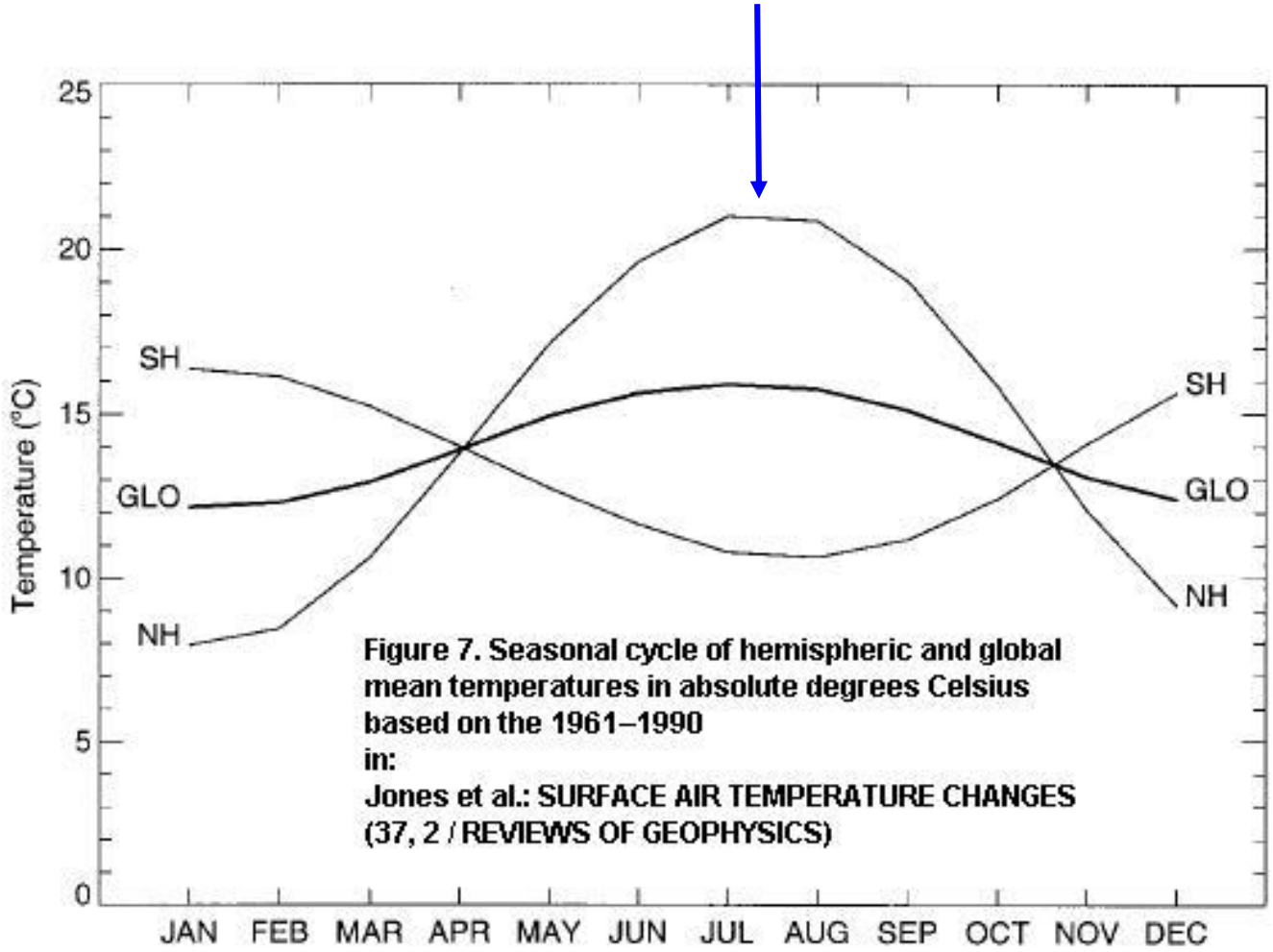



FIGURE 2.2. Hourly air temperature (points) on a clear fall day at Hanford, WA. The curve is used to interpolate daily maximum and minimum temperatures to obtain hourly estimates.




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

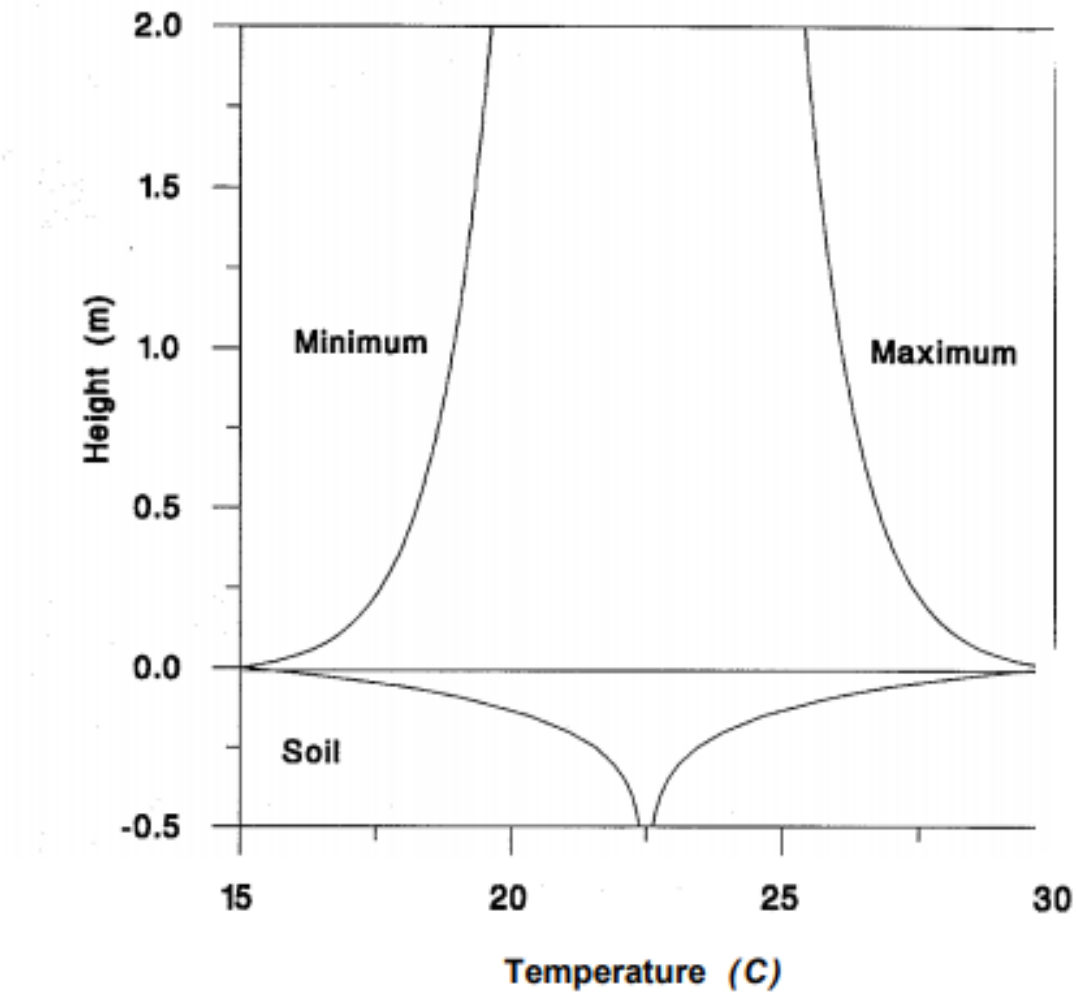
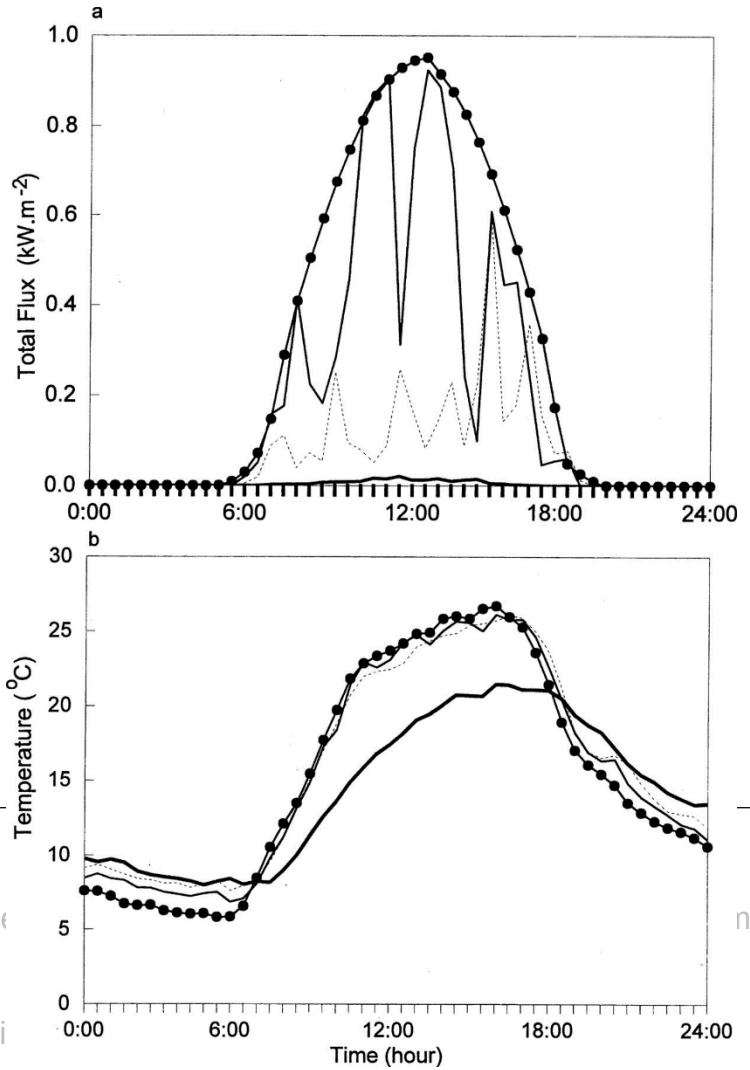
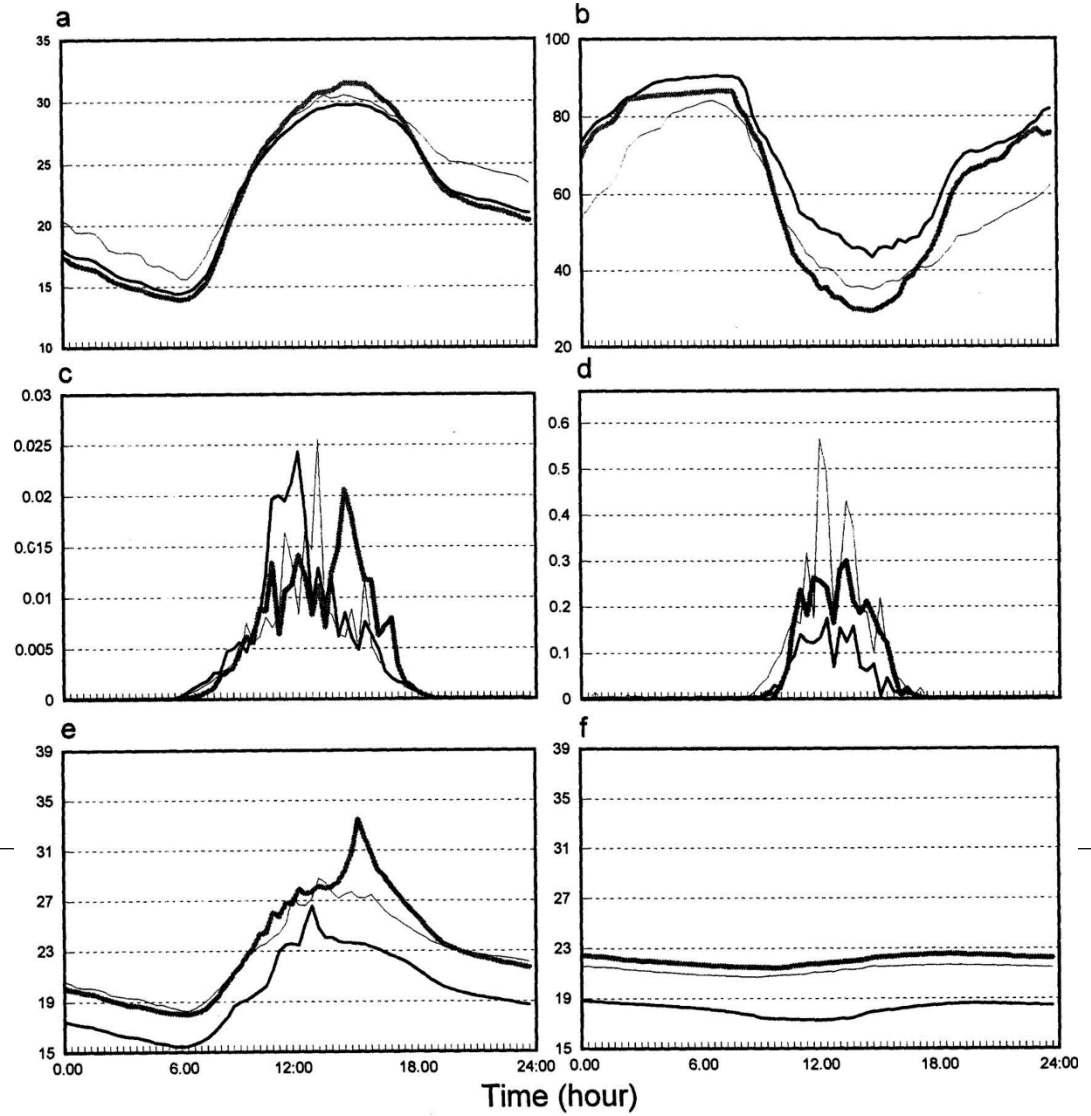



FIGURE 2.1. Hypothetical profiles of maximum and minimum temperature above and below soil surface on a clear, calm day.

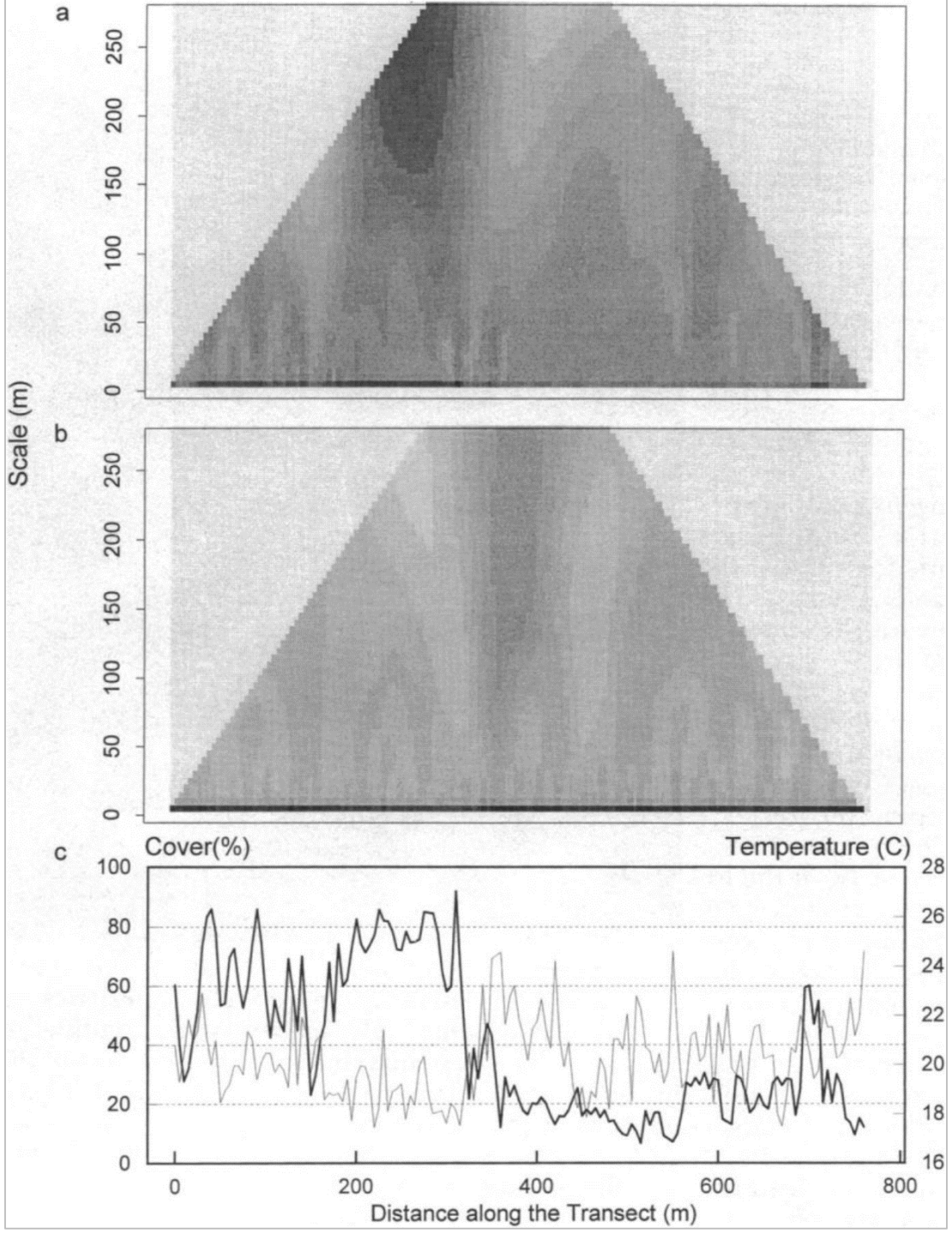
Diurnal changes in microclimate under different harvest regimes, (a) Patterns of shortwave radiation (kW/m$^2$) for a 70-year-old Douglas-fir (*Pseudotsuga menziesii*) forest (thick black line) and three sites recently harvested using clearcut (solid line with circles), dispersed green-tree retention (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).



Diurnal changes in microclimatic variables at three landforms: ridge tops (solid black line), south- and west-facing 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.

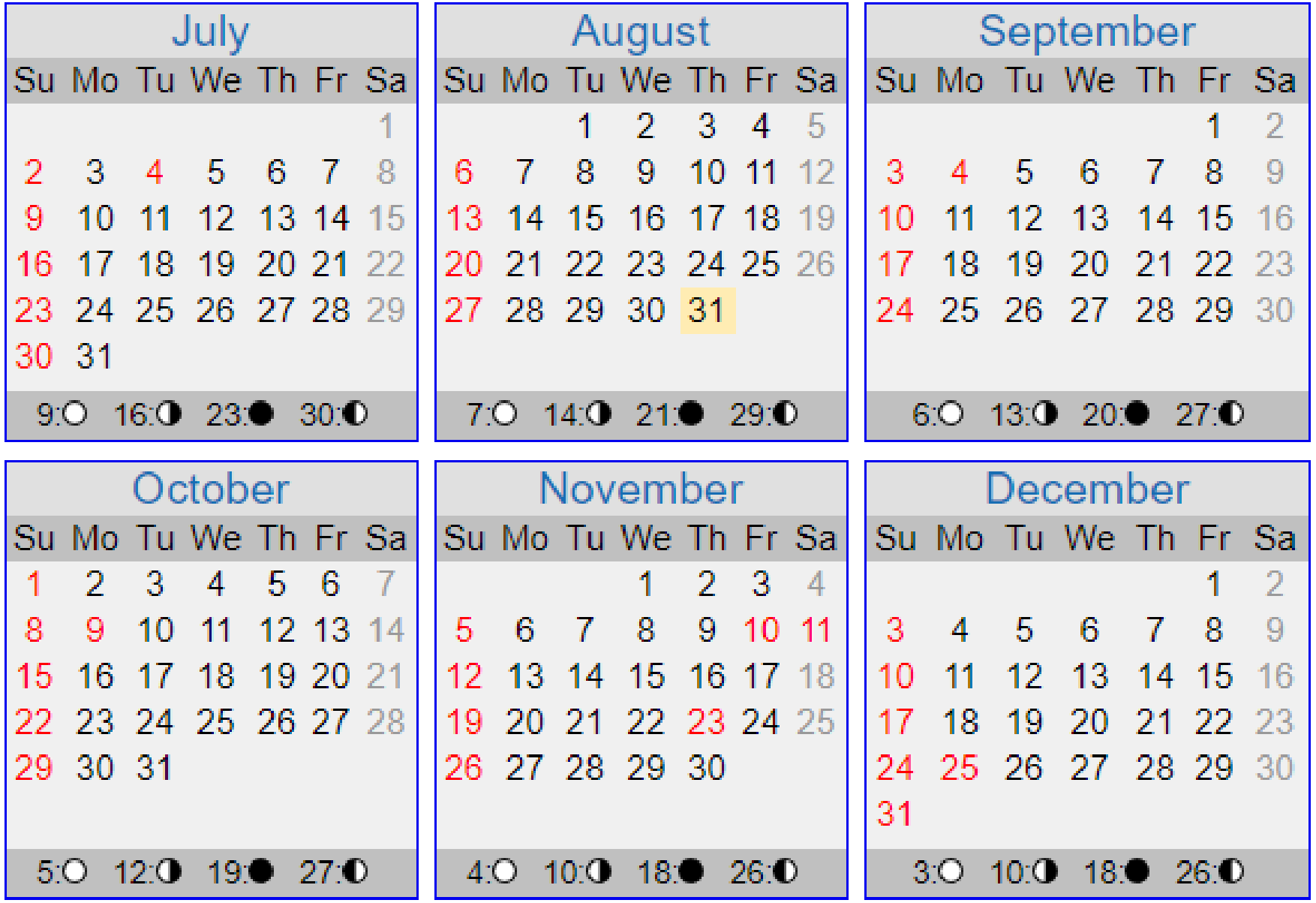


Patterns of overstory cover and air temperature at ground surface along a 760 m transect in a jack and red pine forest landscape in the Chequamegon National Forest, northern Wisconsin. The wavelet transforms for (a) canopy cover and (b) temperature were produced using the Mexican Hat function to reveal 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.



# Geo892: Micrometeorological Instrumentation & Measurements

Schedules



## July

| Su | Mo | Tu | We | Th | Fr | Sa |
|---|---|---|---|---|---|---|
| | | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | | | | | |

9:○ 16:◑ 23:● 30:◐

## August

| Su | Mo | Tu | We | Th | Fr | Sa |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | | |

7:○ 14:◑ 21:● 29:◐

## September

| Su | Mo | Tu | We | Th | Fr | Sa |
|---|---|---|---|---|---|---|
| | | | | | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |

6:○ 13:◑ 20:● 27:◐

## October

| Su | Mo | Tu | We | Th | Fr | Sa |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | | | | |

5:○ 12:◑ 19:● 27:◐

## November

| Su | Mo | Tu | We | Th | Fr | Sa |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | | |

4:○ 10:◑ 18:● 26:◐

## December

| Su | Mo | Tu | We | Th | Fr | Sa |
|---|---|---|---|---|---|---|
| | | | | | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | | | | | | |

3:○ 10:◑ 18:● 26:◐

# Geo892: Micrometeorological Instrumentation & Measurements

Next Class: TBD based on our first meeting