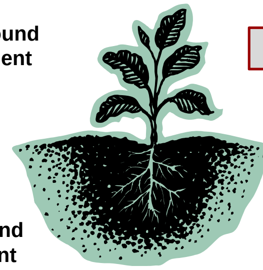
Microenvironments

Microenvironments

Aboveground environment

Microclimate



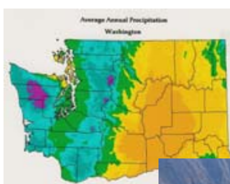
Belowground environment

Edaphic factors – soil environment

Climate & scale

Macroclimate

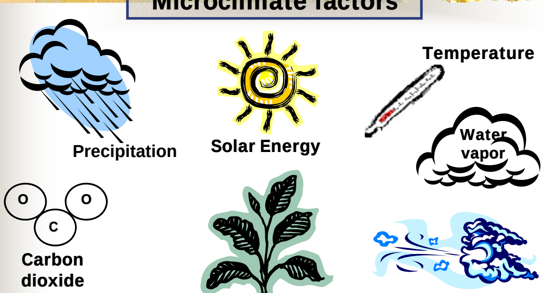
Mesoclimate



Microclimate

Microclimate

Microclimate factors



Measuring a Microclimate

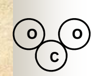
Microclimates VARY

I. In Time

- Long time scales
- Annually
- Seasonally
- Hourly
- Min - Sec

II. In Space

- Factors can change rapidly or gradually through space
- Variation in space often controlled by how “well-mixed” the environment is



Measuring a Microclimate

Mean values of climate factors are often of limited value

Station	Ecoregion	Elevation (ft)	Mean annual (°F)
Tonasket	Doug-fir / Grand fir	960	49.4
Darrington	Western Hemlock	550	49.1
Snoqualmie Falls	Western Hemlock	440	50.4
Republic	Doug-fir / Grand fir	2,600	43.2
Greenwater	Western Hemlock	1,700	45.6
Snoqualmie Pass	Western Hemlock	3,000	42.1

Data from the Western Regional Climate Center http://www.wrcc.dri.edu/

Measuring a Microclimate

Mean values of climate factors are often of limited value

Greater temperature extremes for similar mean values

Air Temperature

Station	Ecoregion	Elevation (ft)	Mean annual (°F)	Mean Jan min (° F)	Mean Jul max (° F)
Tonasket	Doug-fir / Grand fir	960	49.4	22.7	87.2
Darrington	Western Hemlock	550	49.1	27.7	77.3
Snoqualmie Falls	Western Hemlock	440	50.4	32.9	75.4
Republic	Doug-fir / Grand fir	2,600	43.2		
Greenwater	Western Hemlock	1,700	45.6		
Snoqualmie Pass	Western Hemlock	3,000	42.1		

What are the effects of this difference in temperature extremes on precipitation?

Data from the Western Regional Climate Center http://www.wrcc.dri.edu/

Measuring a Microclimate

Which data are more important ?

- **Mean monthly wind speed**
- **Maximum sustained wind speed in a month**

Measuring a Microclimate

Continuous monitoring is important

Datalogger on Snowshoe Mountain

Measuring Temperature

1. General considerations

A. Thermal mass of measurement instrument influences

- Temperature of object being measured
- Speed of measurement response

B. Size & exposure of device influences

- Effects of radiative heating
- Boundary layer impedance to thermal coupling

Okay, in English: larger objects have larger layers of still air around them which causes them to “uncouple” from the temperature of the surrounding air.

C. Measurements of media that are not well mixed require much sampling in space (e.g., soil)

Measuring Temperature

2. Thermometers

- Liquid expansion – Hg or EtOH in glass
- Bimetallic coils
- Max-min thermometers

3. Thermocouples

- Seebeck effect (see handout)

4. Thermistors

- Electronic – variable resistance
- Bulkier but cheaper & easier than thermocouples

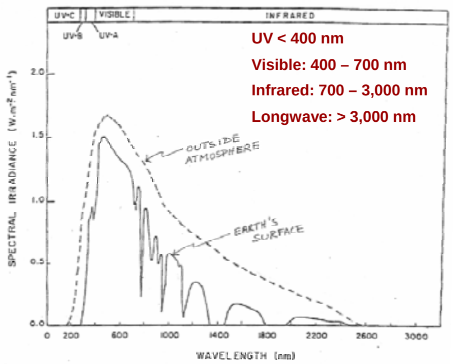
5. Hygrothermographs

- Bimettalic strips – differential thermal expansion

Radiation

The nature of radiation

Solar shortwave radiation



Measuring Radiation

1. Photosensitive Paper Stacks

- Cheap, relative measures of shortwave (blueprint paper)

Measuring Radiation

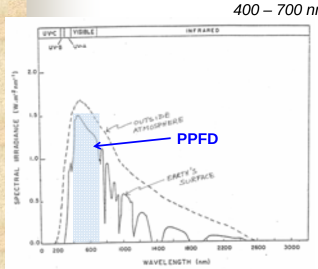
2. Electronic (Current) Cells

Filtered Silicon Cells

Pyranometer: Shortwave solar energy (Thermal Questions)
400 – 2000 nm

Quantum Sensor: PPFD (Photosynthesis, Growth Questions)
400 – 700 nm

PPFD = photosynthetic photon flux density



Measuring Radiation

2. Electronic (Current) Cells

Filtered Silicon Cells

Pyranometer: Shortwave solar energy (Thermal Questions)
400 – 2000 nm

Quantum Sensor: PPFD (Photosynthesis, Growth Questions)
400 – 700 nm

PPFD = photosynthetic photon flux density

Gallium Arsenide Phosphide Photodiodes (GaAsP)

Tiny, leaf-mounted, inexpensive, approximate PPFD

Thermal Gun: Longwave Radiation

Can estimate surface temperature, assuming emissivity

Measuring Radiation

3. Bimetallic Actinograph

Differential absorption of radiation by black & white painted metallic surfaces, produces different metal temperatures and resulting differential metal expansion

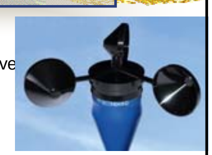
4. Epply Pyranometer

Often weather station standard

5. Spectroradiometer

Diffraction grating and sensitive photomultiplier tubes – precise measures of specific wavelengths

Measuring Wind



1. Cup Anemometers

Inexpensive, standard, but bulky and insensitive inertia problems

2. Vane Anemometers

Inexpensive, but insensitive, inertia problems

3. Hot Wire Anemometers

Micromeasurements, rapid response

4. Venturi Tubes & Pressure Transducers

Usually higher speed laminar fluxes

5. Sonic Anemometers

Complex 3-D wind patterns for canopy CO_2 flux modeling

Measuring Humidity

1. **Wet Bulb / Dry Bulb Psychrometers**
   Sling & Aspirated Types
2. **Hygrothermograph**
   Expansion of blond human hair *(convenient recording, accuracy?)*
3. **Electronic Sensors**
   Capacitance & resistance sensors *(convenient but may need freq. calibration)*
4. **Dew Point Mirrors**
   Optical detection of water formation on cooled mirror *(highly accurate; $$)*

Measuring Precipitation

1. **Standard Rain Gauge**

2. **Recording Rain Gauges**
   Tipping Bucket & Weighing

Measuring Precipitation

3. **Wet Fall/Dry Fall Gauges**
   Precipitation-activated covering mechanism *(nutrient cycling studies)*
4. **Snow Gauges**
   Weighing pillow
   Sonic & optical measures of surface distance

5. **Evapotranspiration**
   Weighing lysimeters

Microclimate analysis can help you understand the effects of logging patterns on remaining habitat

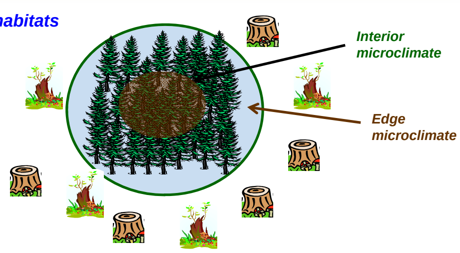
Effects of an opening on forest microclimate

Different microclimates

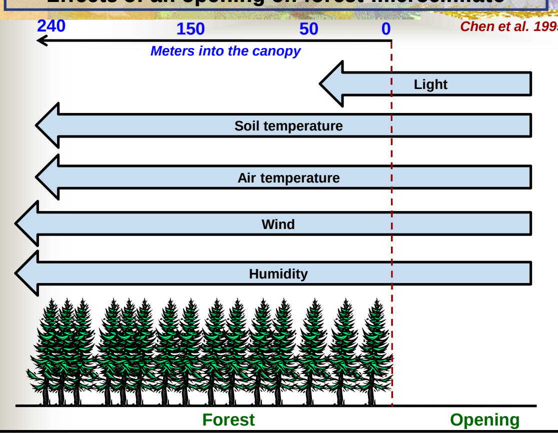
Different habitats

How effective is your forest patch for interior habitat?

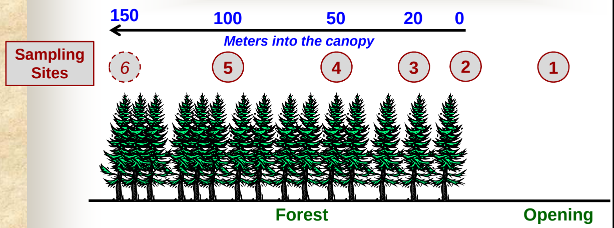
How much true forest habitat is there?



Effects of an opening on forest microclimate

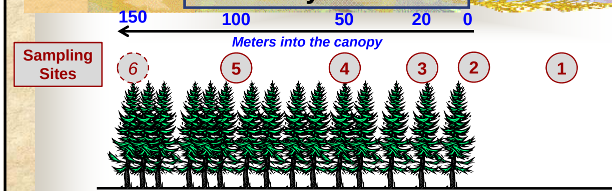


Thursday's Exercise



Each student team of 4 will conduct one transect

Thursday's Exercise



Parameter	Measurement heights	Replicates at each height
Air Temperature	10 cm; 1 m	4
Surface Temperature	0 cm	4
Soil Temperature	-10 cm	4
Wind Speed	10 cm; 1 m	4
RH	10 cm; 1 m	4
PPFD	10 cm; 1 m	4
Leaf Temperature	10 cm; 1 m	4