

## Overview

- The SRML is the Pacific Northwest's regional solar radiation data center
- We measure the amount of power in sunlight.
- Developing information for the solar-powered future

## Key Terms and Equations

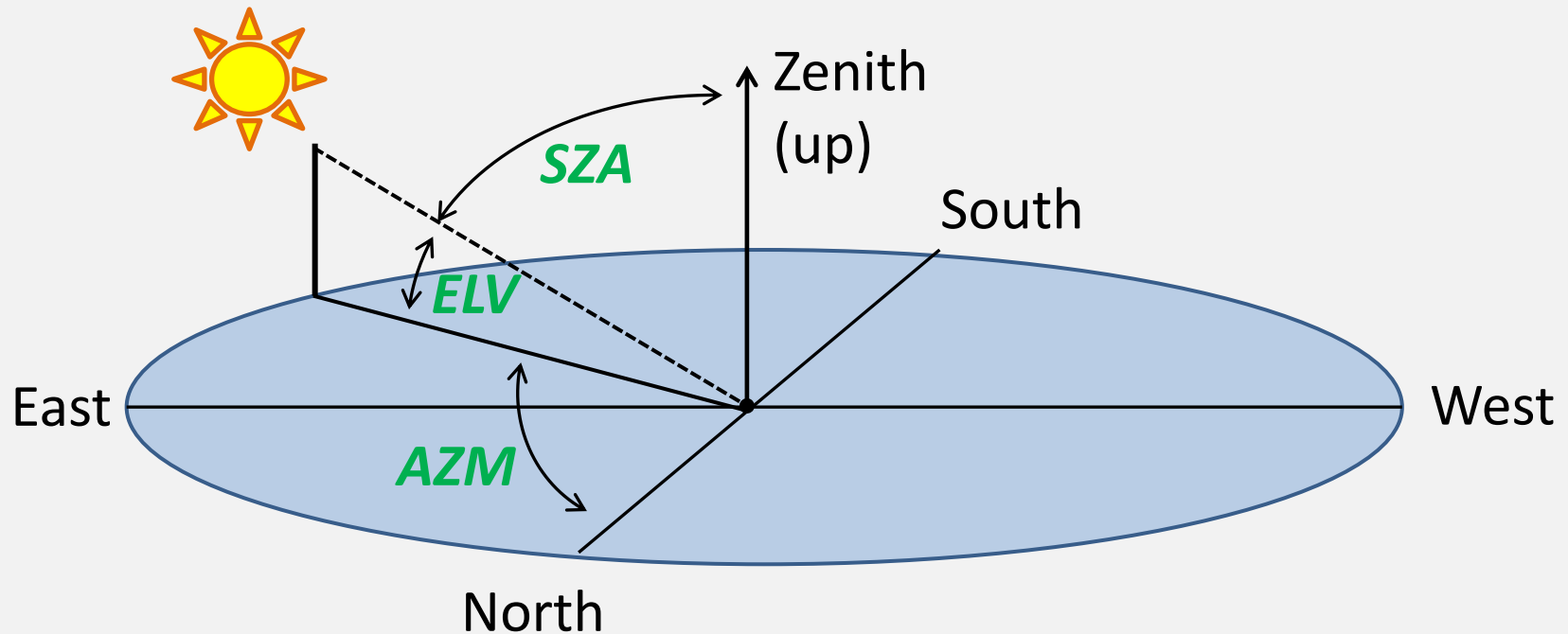
- **Irradiance**: Amount of power in sunlight per unit area. ( $\text{W}/\text{m}^2$ )
- **Direct Normal Irradiance (DNI)**: Solar radiation coming directly from the sun.
- **Diffuse Horizontal Irradiance (DHI)**: The solar radiation that does not come directly from the sun.
- **Global Horizontal Irradiance (GHI)**: The total amount of solar radiation on a horizontal surface.

# Solar Positioning

**Azimuthal Angle (AZM):** Angle measured clockwise from North

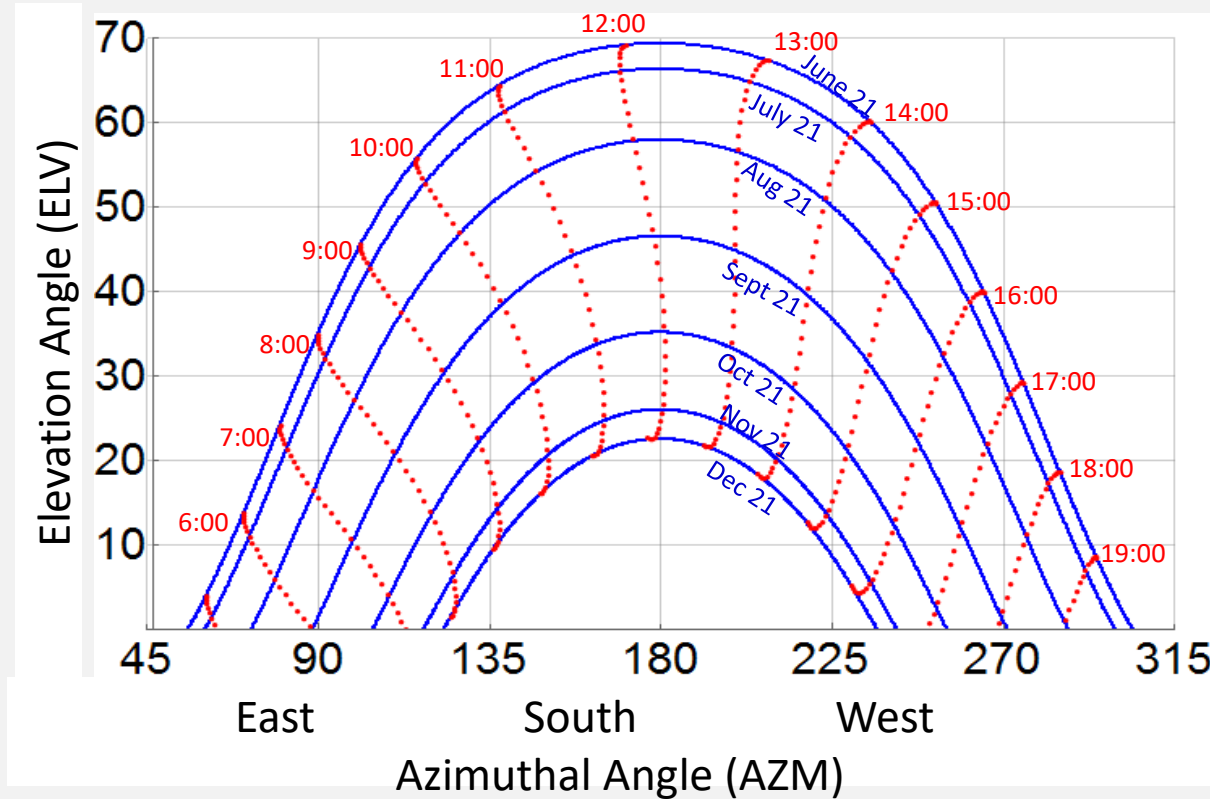
**Elevation Angle (ELV):** Angle measured up from the horizon

**Solar Zenith Angle (SZA):** Angle measured down from vertical



# Sun Path Chart

- The **blue** curves show the location of the sun on specific days.
- The **red** curves show the location of the sun at specific hours.
- The vertical axis is the height of the sun above the horizon.
- The horizontal axis is the east/west location of the sun

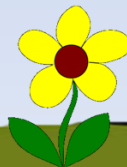
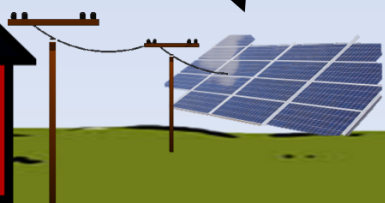


# Applications and Terminology



Solar radiation data is useful in:

- Photovoltaic (solar panels)
- Architecture (Temperature control of buildings)
- Agriculture



**Direct Radiation (DNI)**

- Light directly from Sun

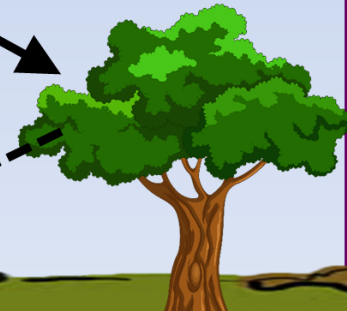
**Diffuse Radiation (DHI)**

Light that coming from:

- Clouds
- Air molecules in the sky
- Ground reflection (buildings, trees, ground)



Solar radiation monitoring sensor



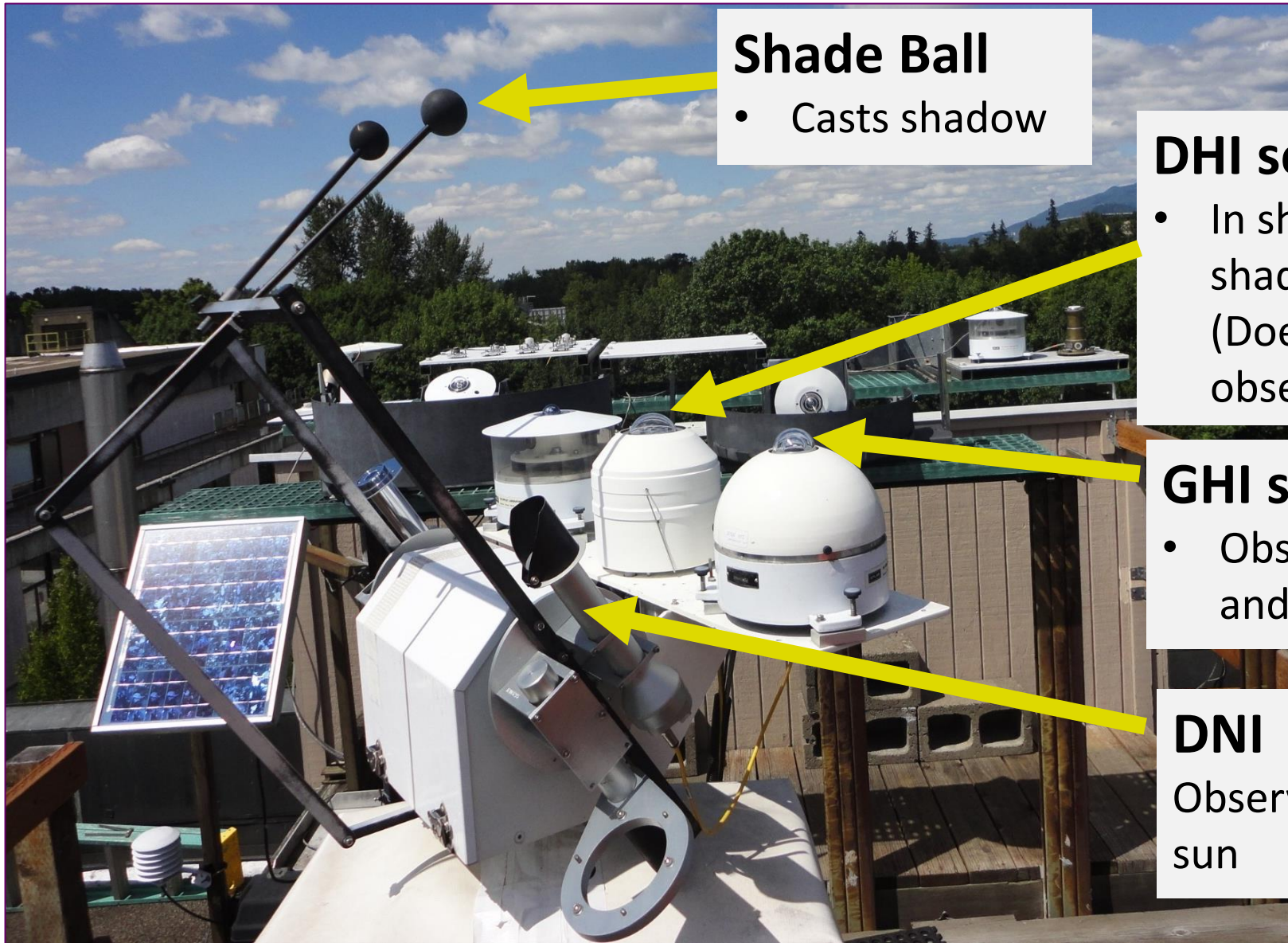
# Monitoring Station in Eugene Oregon (Roof of Pacific Hall)



## Solar Tracker

- Follows the sun East/West and Up/Down

# Monitoring Station in Eugene Oregon (Roof of Pacific Hall)



## Shade Ball

- Casts shadow

## DHI sensor

- In shadow of shade ball  
(Does not observe sun)

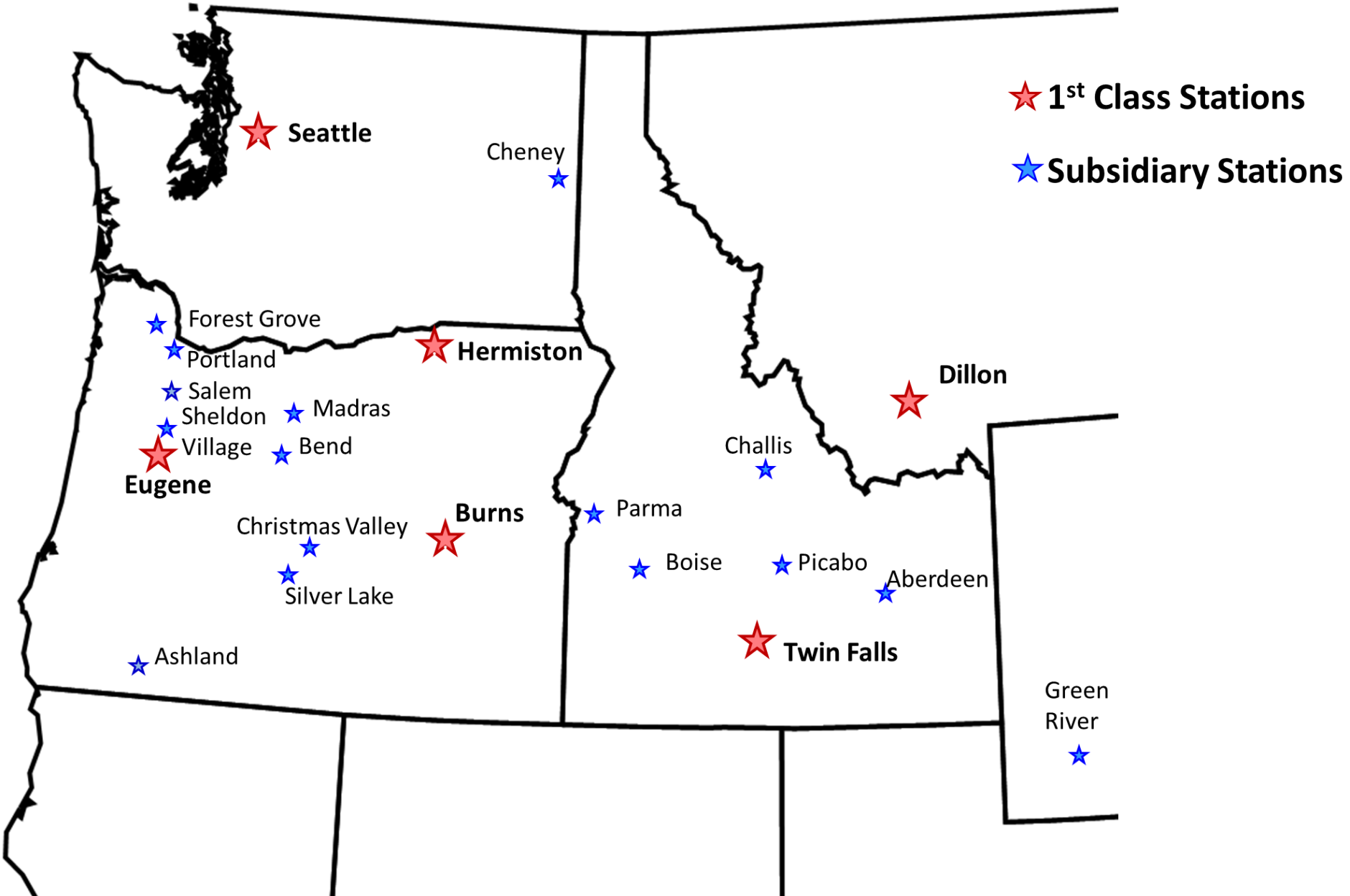
## GHI sensor

- Observes sky and sun

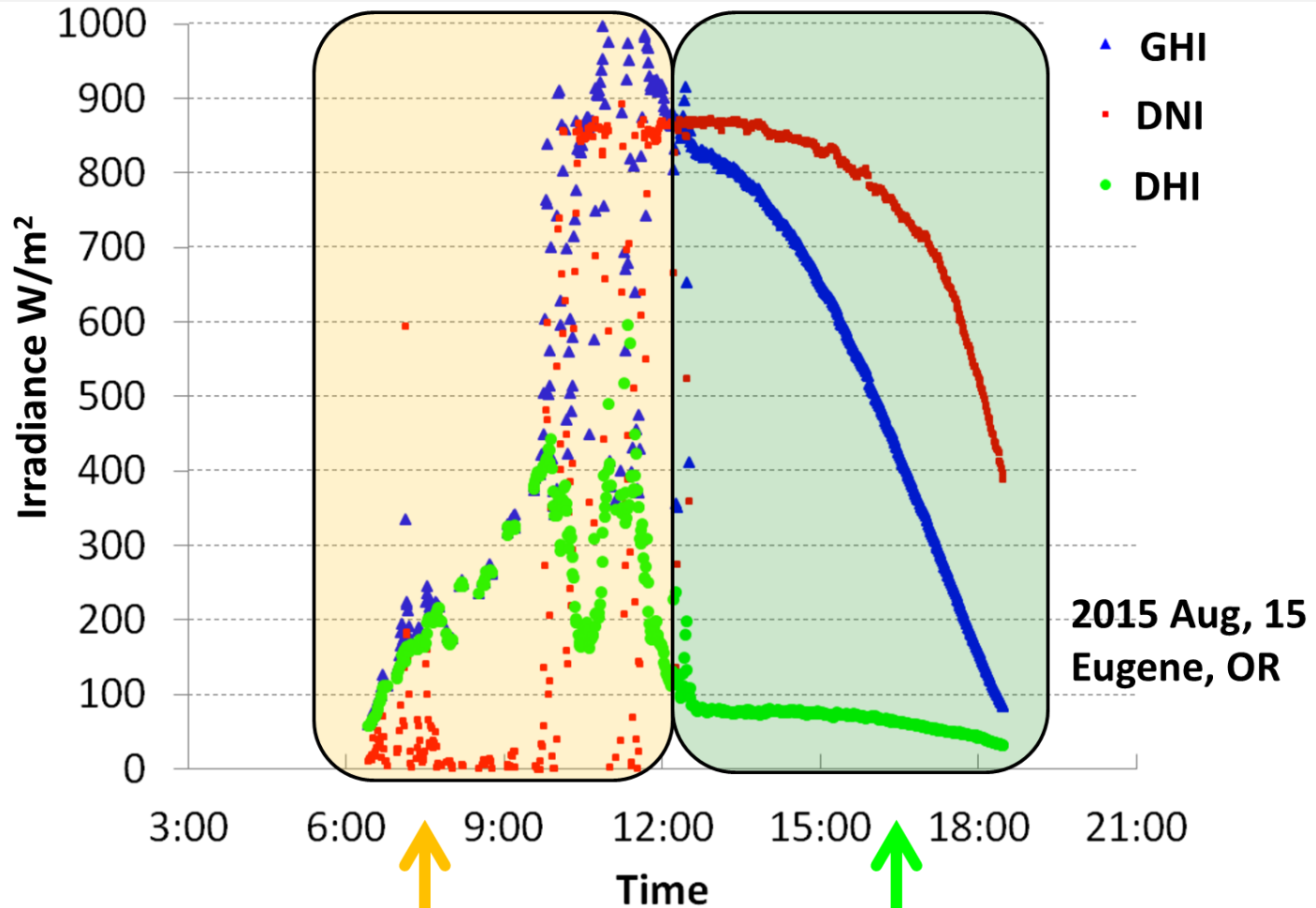
## DNI

- Observes only the sun

# SRML Network of Monitoring Stations



# Irradiance vs Time of day



## Clouds in the morning.

- No direct sunlight (DNI = 0)
- All light is diffuse (GHI = DHI)

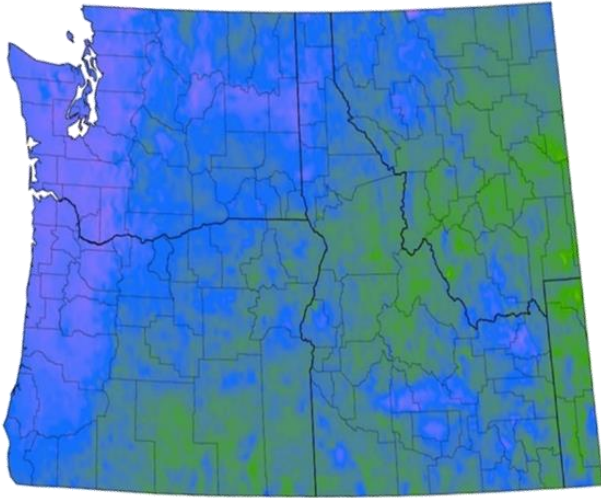
## Clear sky in the afternoon.

$$\text{GHI} = \text{DNI} * \text{Cos}(\text{SZA}) + \text{DHI}$$

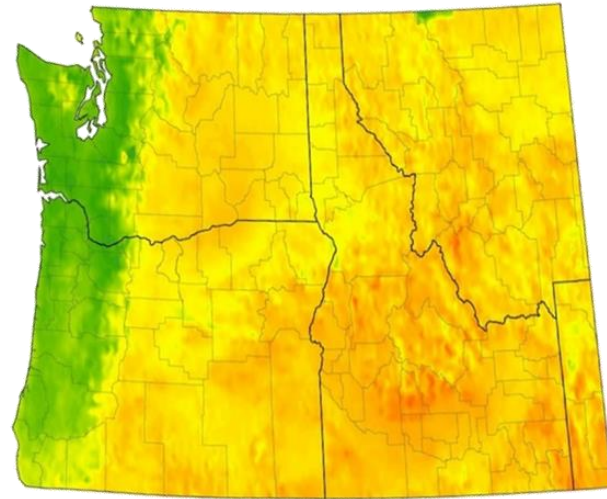


# Direct Normal Radiation by Season

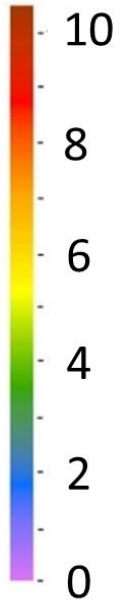
Winter



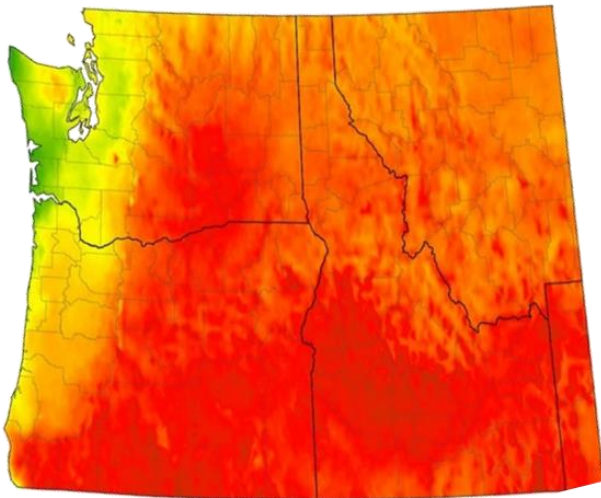
Spring



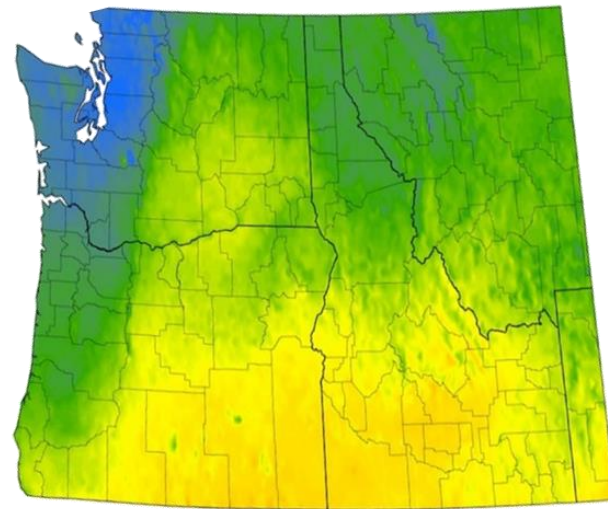
kWhr  
m<sup>2</sup> day



Summer

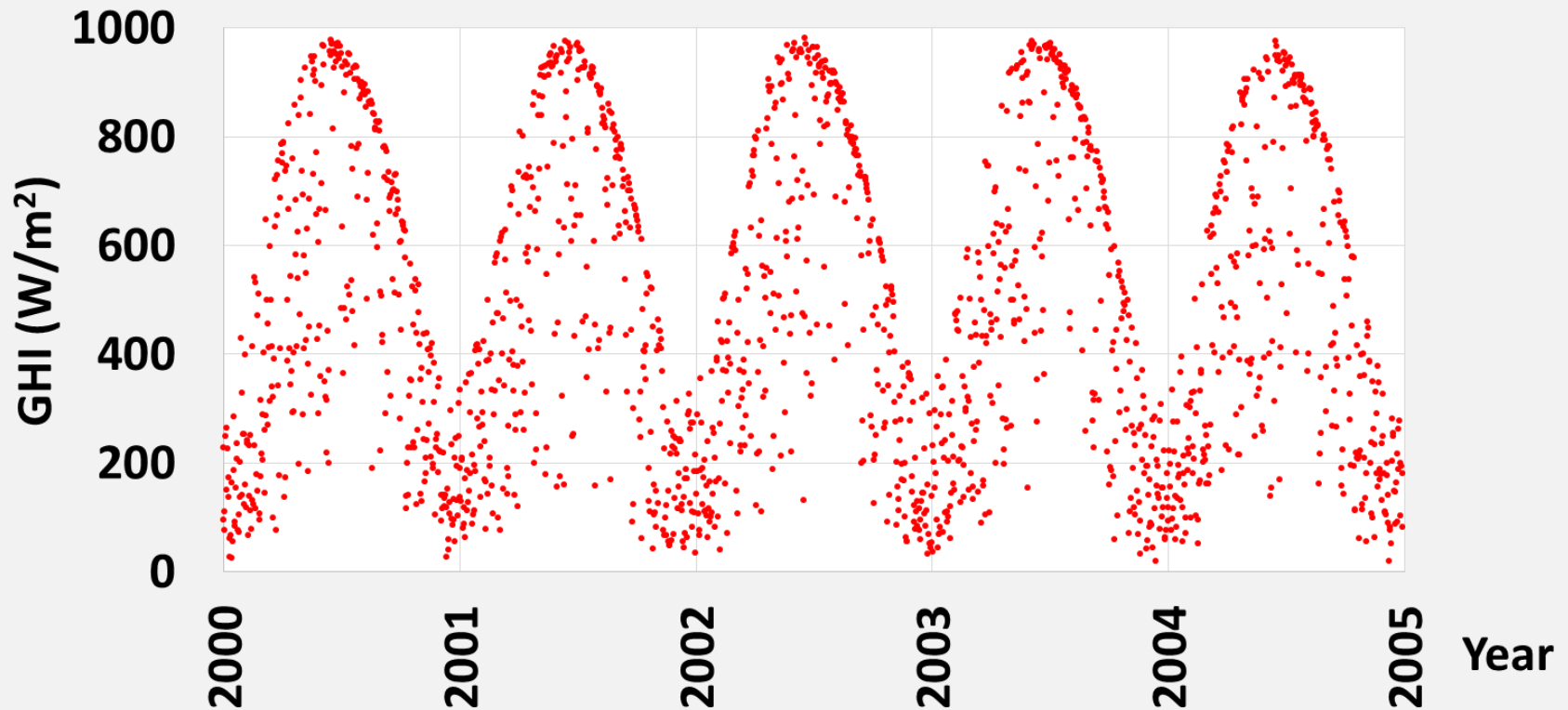


Fall

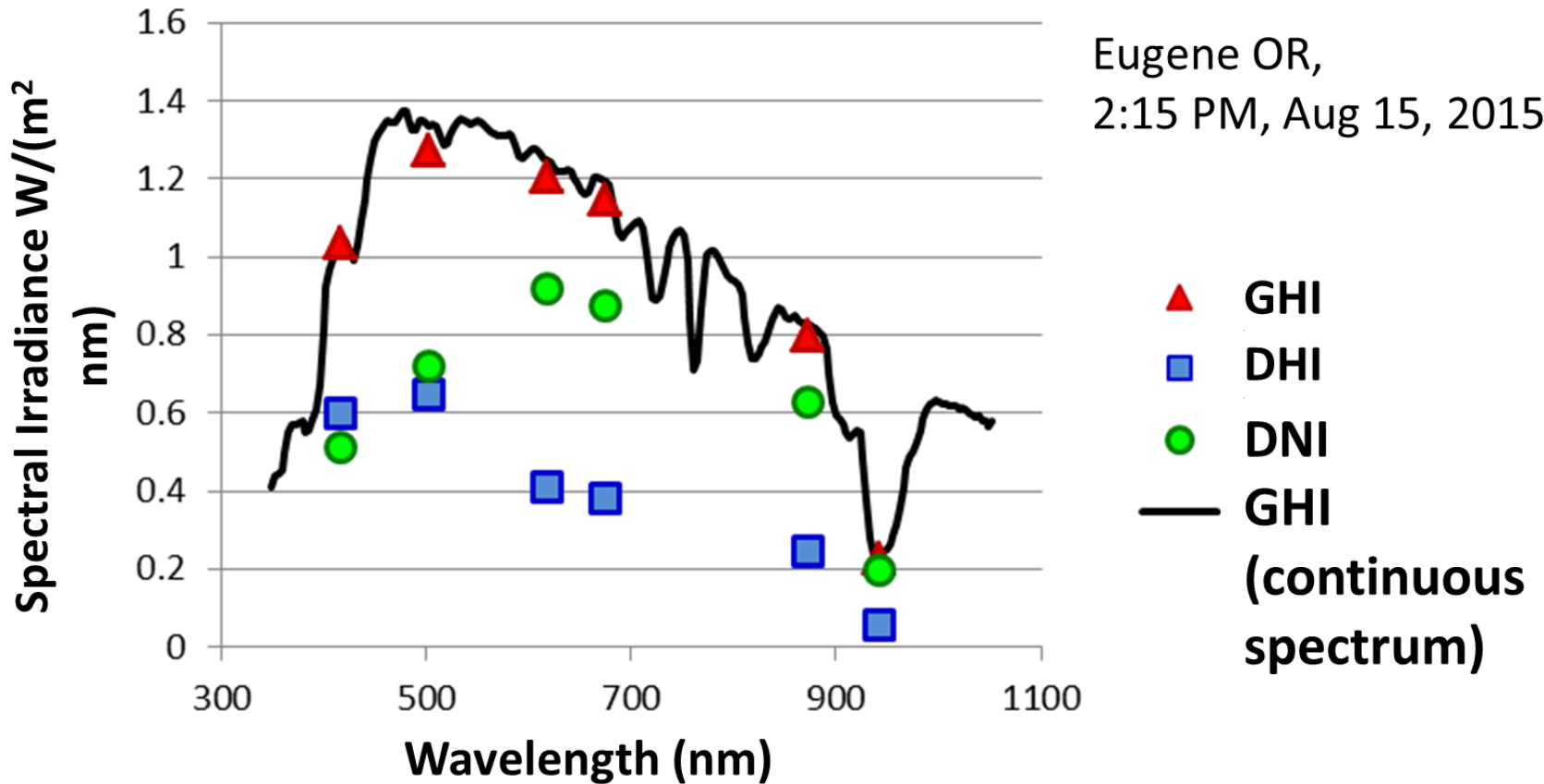


# Yearly fluctuations in irradiance due to seasonal changes.

GHI at 12 PM, 2000 – 2005, Eugene, OR



# Spectral irradiance of light



# Staff and Contact Information

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