GEOG 272 Lab 1 Solar Irradiance

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Theory:

1. **Latitude:** - It affects the solar altitude; a location with lower latitude will receive a greater solar altitude. (2 parts)
   a) Atmospheric path length: higher altitude gives shorter path length, which result in higher solar irradiance
   b) Angle of incidence: more perpendicular the angle with the Earth's surface, the more energy it will received.
   - Latitude also controls the day length. (Shorter days in winter than summer)
2. **Elevation**: Higher elevation gives a shorter atmospheric path length, so there is less atmospheric absorption and reflection of solar radiation.
3. **Clouds**: They reflect and absorb solar radiation. Therefore, the more cloud cover there is, the less solar irradiance reaches the surface. (clouds in general are liquid water [not water vapour] or ice crystals.
4. **Water Vapour**: water vapour is a good absorber of solar radiation. With that being said, higher amounts of water vapour means less irradiance at the surface.
5. **Air Density**: Denser air has more molecules per unit volume to absorb and reflect the solar radiation. This means higher density air means less solar irradiance at the surface.

Data:

Location	Latitude	Longitude	Elevation	Average Vapour Pressure	Average Station Pressure	Cloud amount (hours)
Victoria	48° 38'50.010" N	123° 25'33.000" W	19.50 m	0.8kPa	101.5kPa	0-2 tenths: 95.1 hours 3-7 tenths: 106.8 hours 8-10 tenths: 542 hours
Comox	49° 43'00.000" N	124° 54'00.000" W	25.60 m	0.7kPa	101.3kPa	0-2 tenths: 82.6 hours 3-7 tenths: 96 hours 8-10 tenths: 565.4 hours

Ave. Solar Irradiance pt1	1st	2nd	3rd	4th	5th	6th	7th	9th
Victoria	21.9225w/m^2	9.51333 w/m^2	62.4896 w/m^2	59.6433 w/m^2	61.9596 w/m^2	28.39375 w/m^2	4.77208 w/m^2	12.52458 w/m^2
Comox	8.14708 w/m^2	8.82917 w/m^2	49.9825 w/m^2	42.7854 w/m^2	41.8908 w/m^2	22.25875 w/m^2	5.07333 w/m^2	12.49292 w/m^2
Ave. Solar Irradiance pt2	10th	11th	12th	13th	14th	15th	16th	18th
Victoria	13.9213 w/m^2	14.1654 w/m^2	17.1 w/m^2	19.8604 w/m^2	33.8567 w/m^2	49.27292 w/m^2	32.5667 w/m^2	49.55167 w/m^2
Comox	18.8708 w/m^2	19.3167 w/m^2	11.6965 w/m^2	39.2492 w/m^2	22.8 w/m^2	17.9221 w/m^2	12.7179 w/m^2	15.95667 w/m^2
Ave. Solar Irradiance pt3	19th	20th	21st	22nd	23rd	24th	25th	27th
Victoria	10.4254 w/m^2	58.0996 w/m^2	32.1 w/m^2	76.0136 w/m^2	60.4242 w/m^2	80.80542 w/m^2	30.6875 w/m^2	26.95917 w/m^2
Comox	15.6775 w/m^2	18.7517 w/m^2	19.9133 w/m^2	20.9579 w/m^2	32.3758 w/m^2	67.02792 w/m^2	37.9133 w/m^2	26.88542 w/m^2

Ave. Solar Irradiance pt4	28th	29th	30th	31st	Ave Solar Irradiance (month)	Cloud Cover Percentage
Victoria	20.0521 w/m^2	20.09292 w/m^2	18.9704 w/m^2	88.9788 w/m^2	35.4617kWh/m^2 day	40.32%
Comox	13.0371 w/m^2	69.64583 w/m^2	19.94 w/m^2	84.9546 w/m^2	27.06273 kWh/m^2 day	50.64%

Victoria Day Length- 8 hours and 45 minutes. Has a solar altitude peak at 23 degree.
Comox Day Length- 8 hours and 30 minutes. Has a solar altitude peak at 20 degree.

Case Study:

Latitude: Latitude has an affect on the solar irradiance in these two locations. At

Victoria it will receive more solar irradiance comparing to Comox because it is located further North, which resulting in receiving a lower solar irradiance. This is caused by the latitude factor, further location is North and South of the equator, the less sun it will receive daily. In comparison, the equator has a high level of solar irradiance due to the steady location in relation to the earth's tilt and the axis of the earth as it rotates.
Solar Altitude: This is affected by latitude, similar explanation as to why there is more or less sun based on the location. Comox is located further north than Victoria, which means there is a lower solar altitude. Victoria has a higher solar altitude level is because it is located further south and closer to the equator. However, both location sits on roughly the same latitude, so the solar altitude does not play a heavy factor.
Day Length: This is affected by latitude because further north a location is located; the lower solar altitude is received. With that being said, the sun is in the sky for a shorter time as comparison to a place that is closer to the equator. The two locations we examined in this lab, Comox would have a shorter day length than Victoria.
Elevation: The two location we looked at in this lab are both located at seal level. With that being said, the elevation does not have a significant affect on the incoming solar irradiance.
Cloud Cover: Comox had 565.4 hours with 8-10 tenths of cloud coverage. In comparison, during the month of January in Victoria, there were 542 hours that had 8-10 tenths of cloud coverage. Cloud cover affects the solar irradiance quit heavily because clouds reflect and absorb some of the shortwave lengths that enter the Earth. Comox has a longer time with higher cloud coverage, this decrease the amount of solar irradiance entering this location.
Vapour Pressure: Solar irradiance is affected by vapour pressure because the water particles plays a roll in reflecting and refracting the incoming short wave, causing less solar irradiance reaching the earth's surface. During January in Victoria, the average vapour pressure is 0.8kPa. In comparison to the same month, Comox station has a vapour pressure of 0.7kPa. Comox has a lower vapour pressure then Vicotira because there is less moisture in the air from ocean to act on it.

Air Density: The average station pressure for Victoria and Comox are very similar, with Victoria having an air density of 101.5kPa and Comox of 101.3kPa. The air density affects the solar irradiance because as more particles are packed in the atmosphere, the less radiation will be able to reach the surface. This is because the particles in air play an similar role as the water vapour, it absorbs and reflects the incoming shortwaves. The two location we examined have similar average station pressure, this means similar amount of solar radiation are being absorbed and reflected.

Summary:
Victoria has a higher average solar irradiance comparing to the Comox station. Victoria has average solar irradiance of 35.4617kWh/m^2 day and Comox has average solar irradiance of 27.06273 kWh/m^2 day. Both station are located in a similar latitude, but Victoria has a lower latitude that is closer to the equator, this means more solar irradiance being received. The elevation does not have a significant affect on the irradiance because both station sits on the sea level. Cloud Cover plays a big role in this case because Comox has a way higher cloud cover percentage, this means that more solar radiation are being reflected by the clouds. These two stations also have a similar vapour pressure and air density. This means that roughly the same amount of solar radiation are being reflected and absorbed by the water vapour and the air particles.