Jordan Hillier Environmental Systems

ASSIGNMENT 1: EDITED

In my previous analysis, I highlighted a series of passive design strategies that could be used to mitigate the effects of certain types of weather in Philadelphia. While I still believe that all of these design strategies have merit and could be useful, I think that there are others that might be worth prioritizing for the sake of cost and protecting against the elements.

I've learned over the past few months that the sun plays perhaps the largest role in dictating a building's comfort level for those inside of it. While I initally suggested sun shading of windows as a possibility to mitigate the sun's impact, I think that the orientation of the building could perhaps have a larger benefit. Orienting the building slightly differently on the site, as we saw with our studies of Meyerson Hall and the net solar benefit, can have a large impact on the building's interior comfort levels with zero extra cost to the client. Sun shades, while absolutely beneficial, are an additional cost on top of everything that is already included in the structure, so if the sun shades can be avoided by changing the orientation of the building, that would be preferred.

Besides the benefits of blocking a building from the sun's strong rays, there are also numerous benefits to harnessing the sun's energy particularly when it comes to the heating of the building. While it's important to keep the summer sun at bay during the summer months, using the sun's power to heat a building in the winter can be highly efficient and save a lot of money and energy. While touched on this topic previously in my first submission, I was focusing more on humiditiy and ventilation, whereas here I would like to focus on heating. The Trombe wall, constructed of a exterior glass layer, a heat high interior layer, separated by a small air cavity, essentially absorbs the sun's heat's during the day, heating the air cavity and the interior wall, and then radiates that heat into the rest of the building throughout the night. Given that in the Sun Chart graph for Philadelphia, the majority of days were considered "Cool/Cold" and needing sun, I think that this could be an effective passive design stragety to reduce the dependence on HVAC systems by either replacing them, or helping them by keeping the building at a higher temperature naturally.

Finally, another design strategy to be considered is heat flushing. Again, this does not directly critique any of the previous strategies I mentioned in my first report, but I think it's another valuable, extremely efficient technique. One aspect of these strategies that I find really interesting, both in night flushing and the trombe wall, is that these processes take place at night. If you think about it, many office buildings are fairly unoccupied for approximately 14 hours a day if not more. Those hours should absolutely be utilized to cut down on the building's environmental impact, and used as a cleansing or equalizing period. The concept of night flushing, where windows on opposite sides of a building open automatically to allow the cross ventilation of air, and a wind turbine on the roof helps to stimulate the process, could help with the level of humidity in a building as well as the stale air many offices suffer from. While perhaps based more on human comfort and preference than necessity, I think that this would be a highly efficient way to replace the air in the building with little pressure placed on the HVAC system.

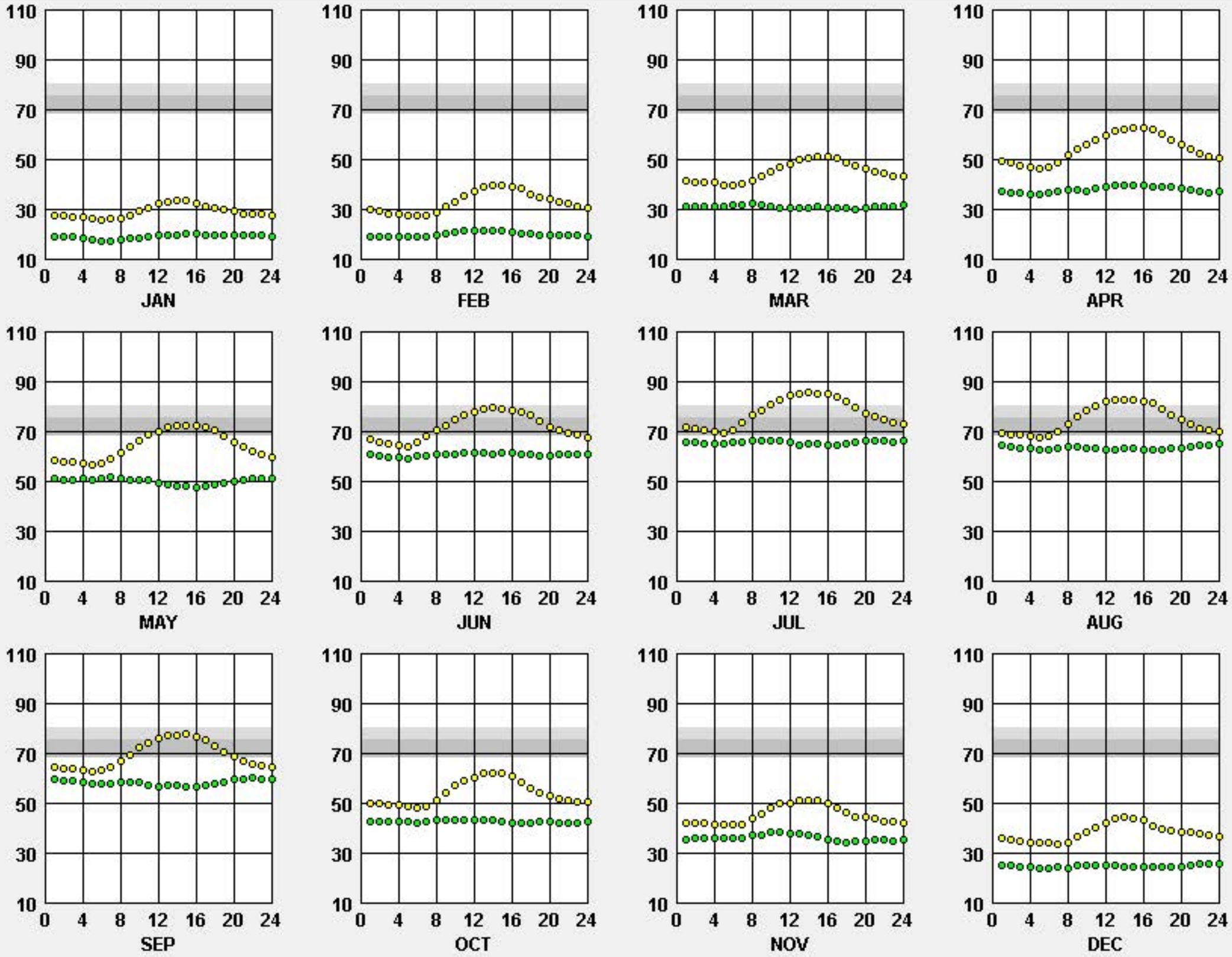
Overall, these strategies are offered in addition to, or in place of, the ones that I mentioned in my previous report. I think that there are still many that could perhaps serve the Philadelphia area just as well. I am extremely supportive of the idea of buildings utilize their "off" hours to perform certain tasks. It treats the building more as a entity in itself, rather than simply a tool for people to use.

DRY BULB X DEW POINT
ASHRAE Standard 55-2004 using PMV

LOCATION: Philadelphia International Ap, PA, USA
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

L E G E N D

Dry Bulb
Dew Point
Comfort Zone
Summer
Winter
At 50%
Relative Humidity



TEMPERATURE RANGE:
- (•) 10 to 110 °F
- ( ) Fit to Data

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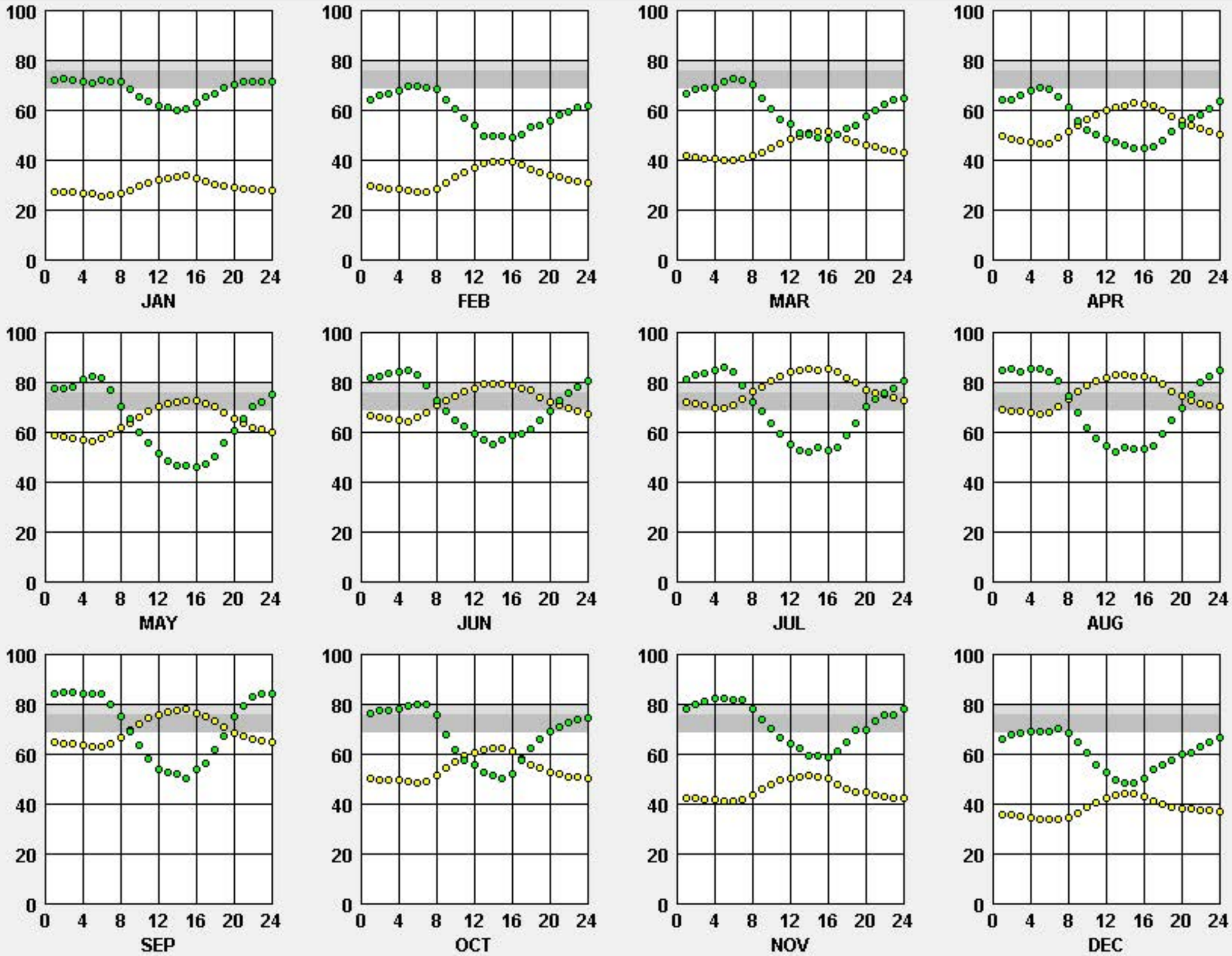
DRY BULB X RELATIVE HUMIDITY
ASHRAE Standard 55-2004 using PMV

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

L E G E N D

Dry Bulb
Humidity
Comfort Zone
Summer
Winter
At 50%
Relative Humidity



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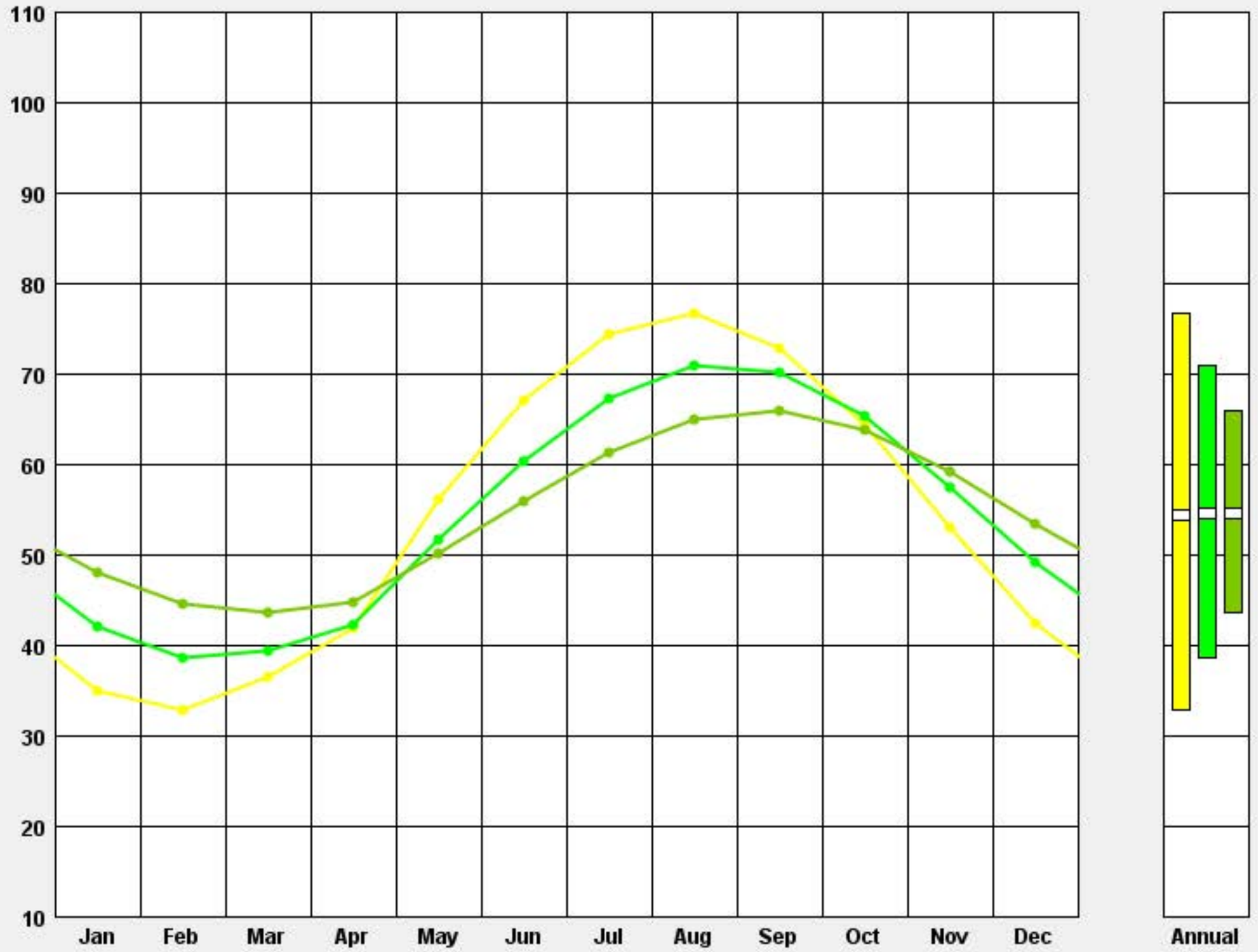
GROUND TEMPERATURE (MONTHLY AVERAGE)

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

DEPTH
(feet)
1.64
6.56
13.12
(Surface is freshly mown grass.)



TEMPERATURE RANGE:
(•) 10 to 110 °F
( ) Fit to Data

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ILLUMINATION RANGE

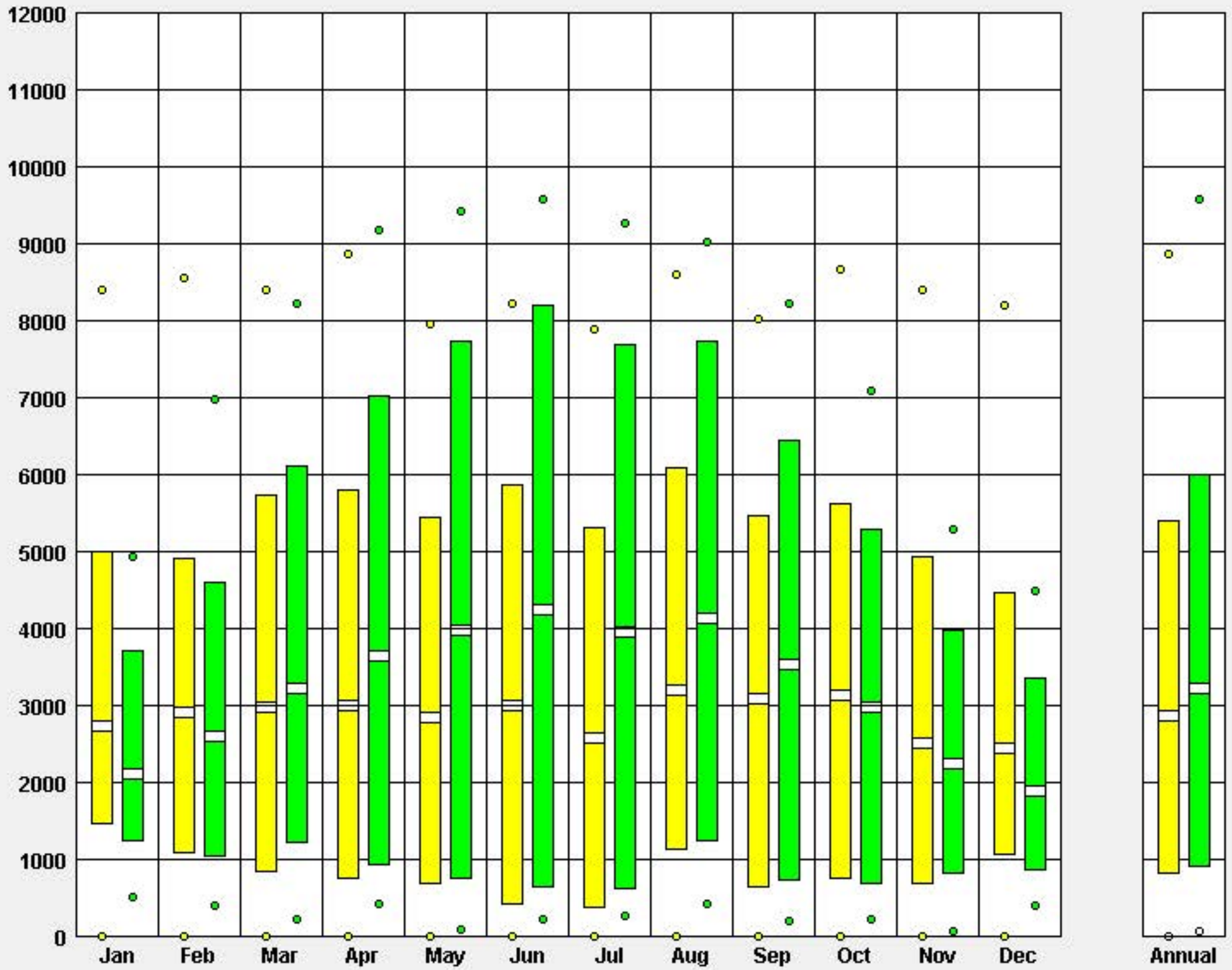
LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

HOURLY ILLUMINATION
DAYLIT HOURS ONLY

RECORDED HIGH -
AVERAGE HIGH -
MEAN -
AVERAGE LOW -
RECORDED LOW -

RECORDED:
DIRECT NORMAL
GLOBAL HORIZONTAL
(footcandles)



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MONTHLY DIURNAL AVERAGES
ASHRAE Standard 55-2004 using PMV

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

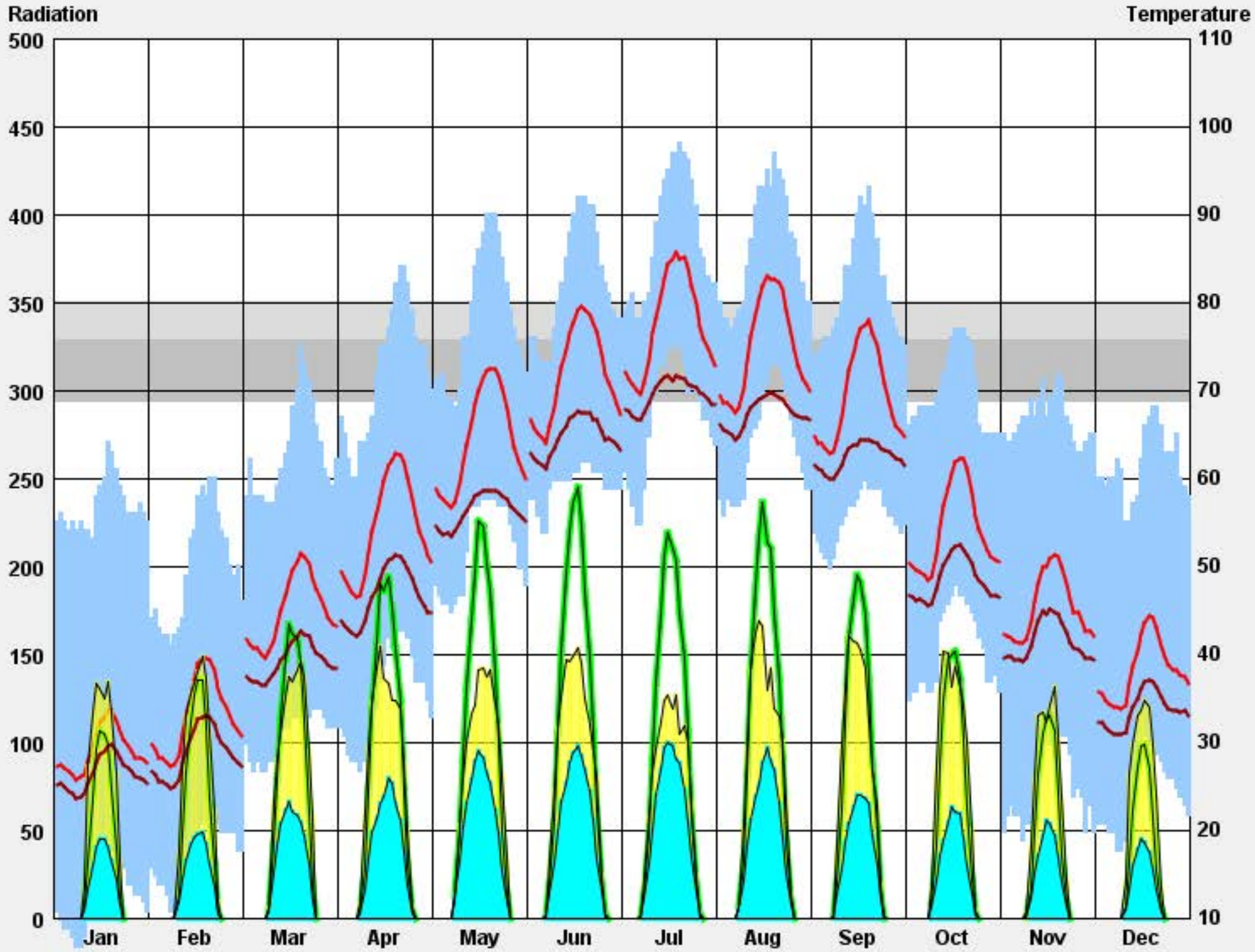
HOURLY AVERAGES

TEMPERATURE: (degrees F)
- DRY BULB MEAN
- WET BULB MEAN
- DRY BULB (all hours)

COMFORT ZONE
- SUMMER
- WINTER

(At 50% Relative Humidity)

RADIATION: (Btu/sq.ft)
- GLOBAL HORIZ
- DIRECT NORMAL
- DIFFUSE



☑ Display Dry Bulb Temp
(all hours)

TEMPERATURE RANGE:
- ◉ 10 to 110 °F
- ○ Fit to Data

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RADIATION RANGE

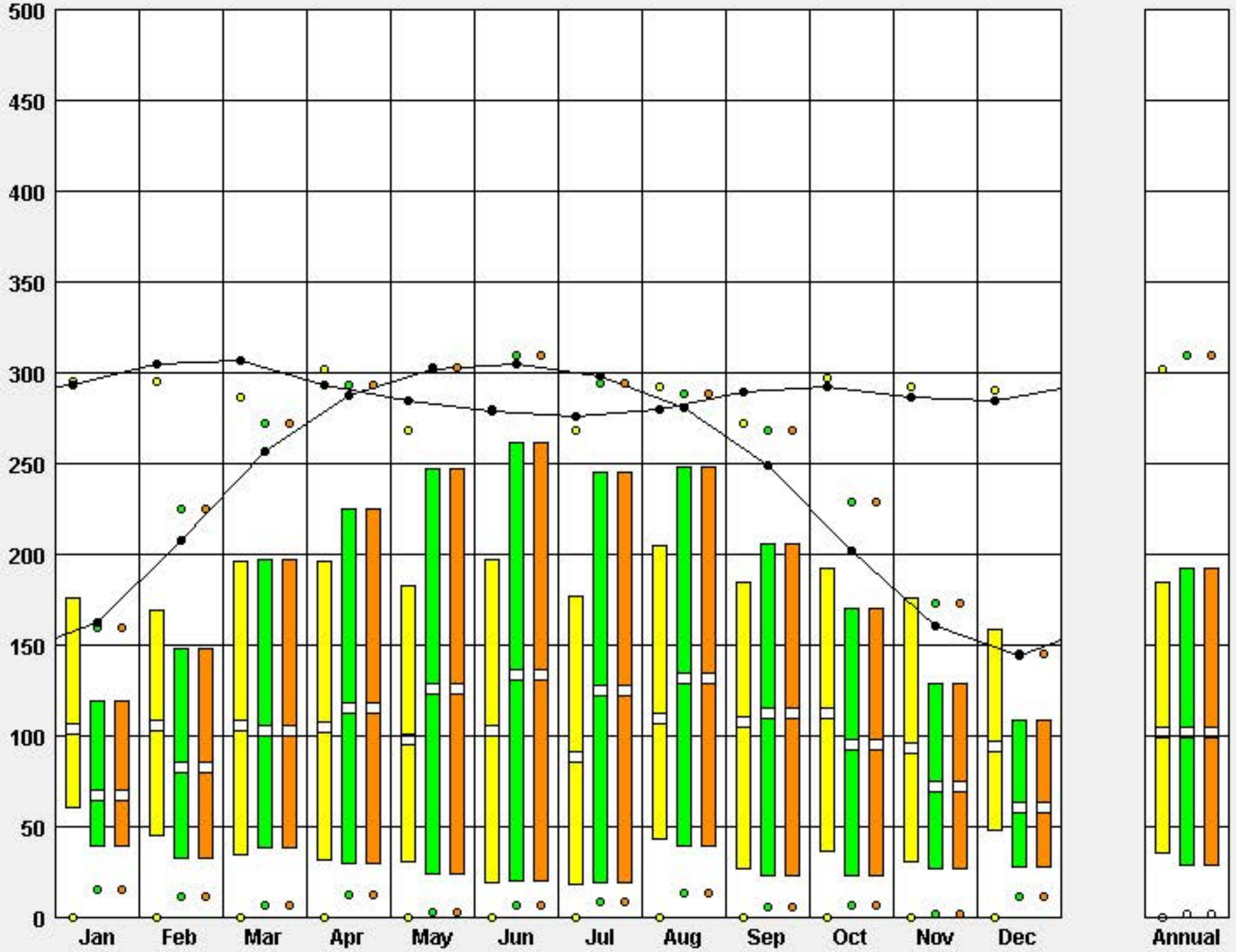
LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

HOURLY AVERAGES
DAYLIT HOURS ONLY

RECORDED HIGH -
AVERAGE HIGH -
MEAN -
AVERAGE LOW -
RECORDED LOW -

RECORDED:
DIRECT NORMAL
GLOBAL HORIZONTAL
TOTAL SURFACE
(Btu/sq.ft per hour)
THEORETICAL:



Tilted Surface Radiation Input:

0.0 Tilt degrees from Horizontal
(Vertical = 90°)

0.0 Bearing degrees from South
(South = 0°,West = +90°)

20.0 % Ground Reflectance
(20% = grass)

PLOT:
(•) Hourly Avg ( ) Daily Total

Hit ENTER to replot if you change Tilted Surface Radiation parameters.

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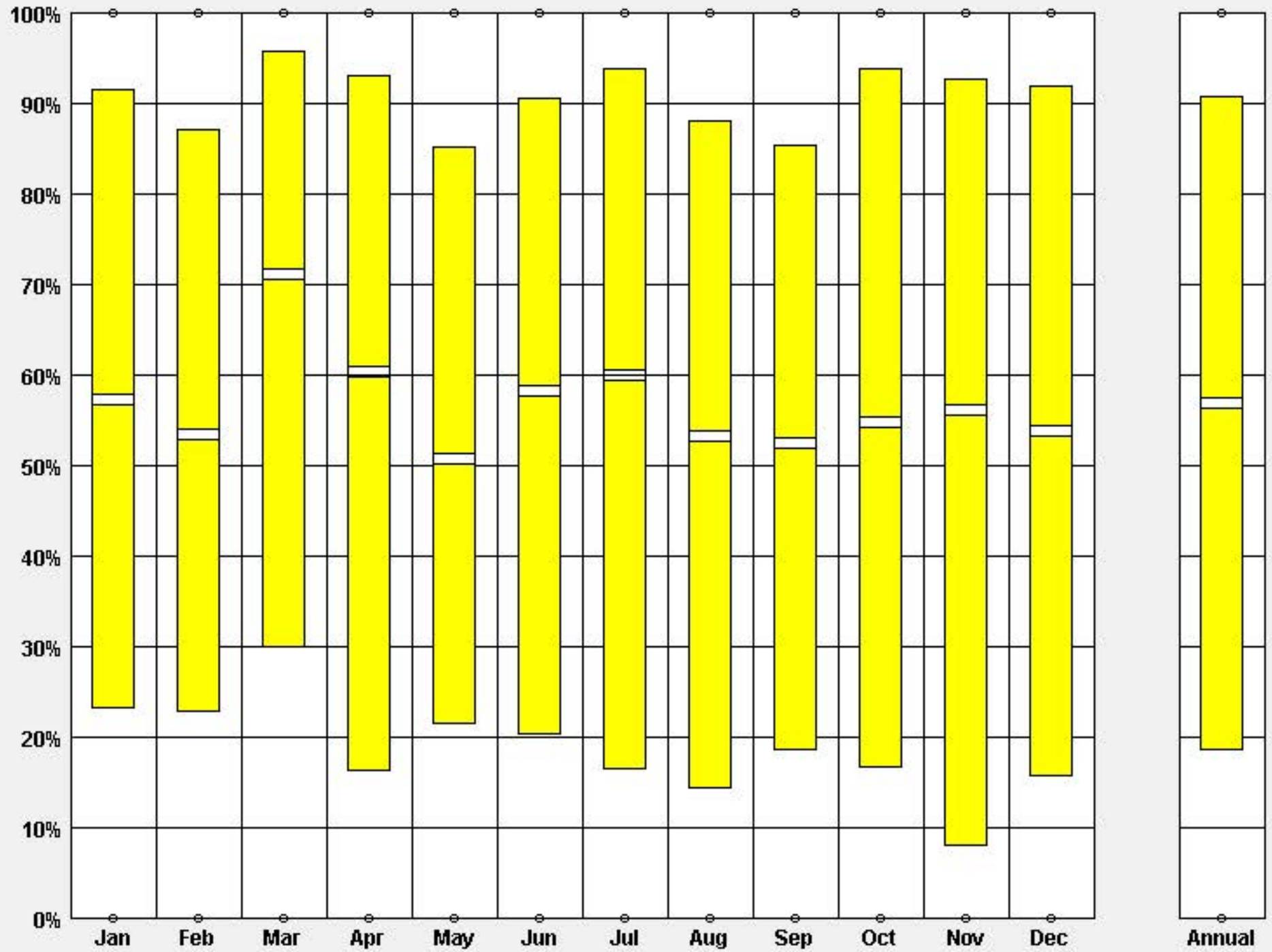
SKY COVER RANGE

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

Total Cloud Cover	100%
RECORDED HIGH -	○
AVERAGE HIGH -	
MEAN -	
AVERAGE LOW -	
RECORDED LOW -	○
Clear Skies	0



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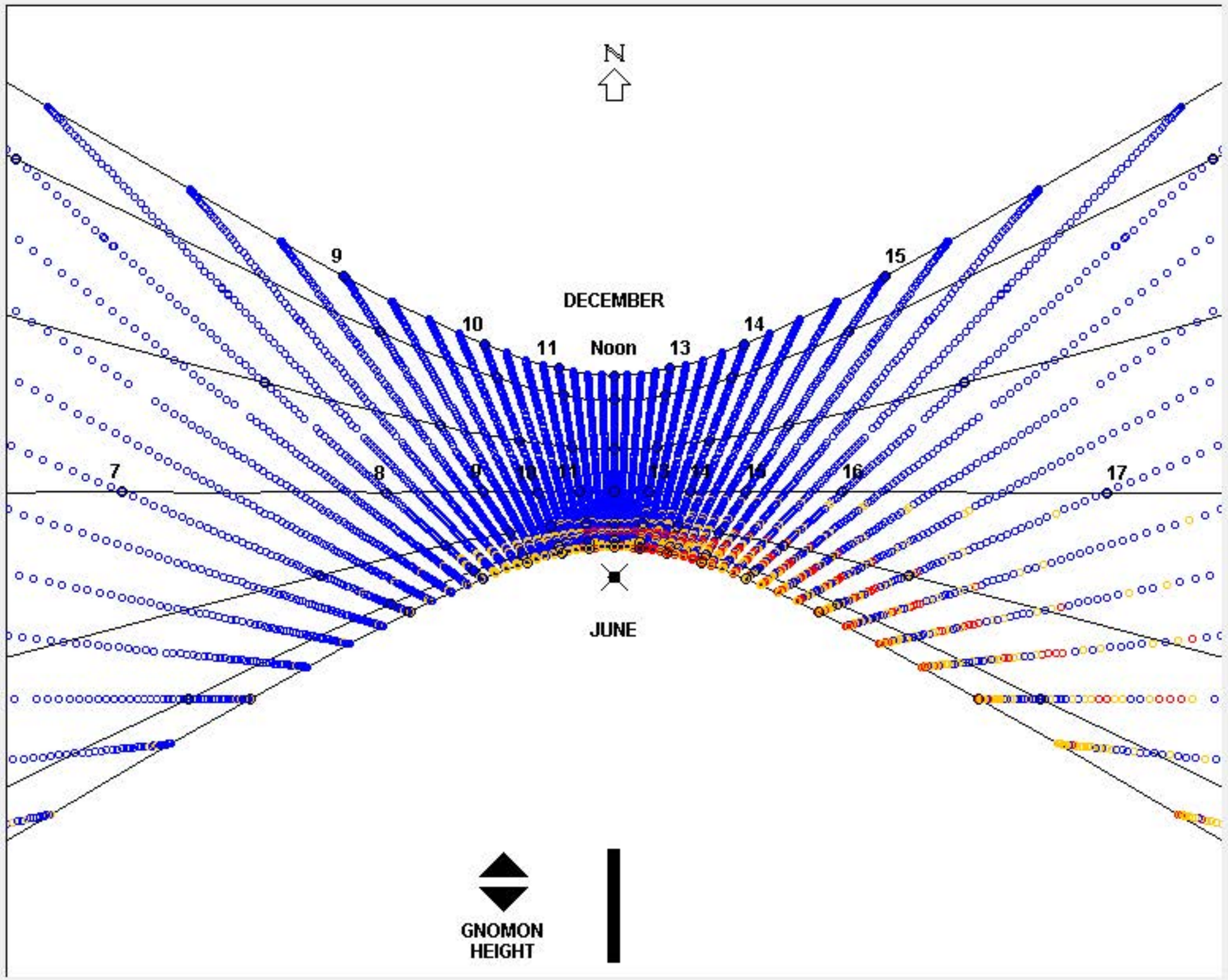
SUN CHART

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

- WARM/HOT > 80°F (SHADE NEEDED)
- COMFORT > 68°F (SHADE HELPS)
- COOL/COLD < 68°F (SUN NEEDED)

GNOMON POSITION



PLOT MONTHS:

WINTER SPRING

(•) December 21 to June 21

SUMMER FALL

( ) June 21 to December 21

Click on arrows to increase or decrease gnomon height.

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SUN SHADING CHART

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

- WARM/HOT > 80°F
  (SHADE NEEDED)
  163 Hours Exposed
  0 Hours Shaded
- COMFORT > 68°F
  (SHADE HELPS)
  433 Hours Exposed
  0 Hours Shaded
- COOL/COLD < 68°F
  (SUN NEEDED)
  1914 Hours Exposed
  0 Hours Shaded

PLOT MONTHS:

WINTER SPRING

(•) December 21 to June 21

SUMMER FALL

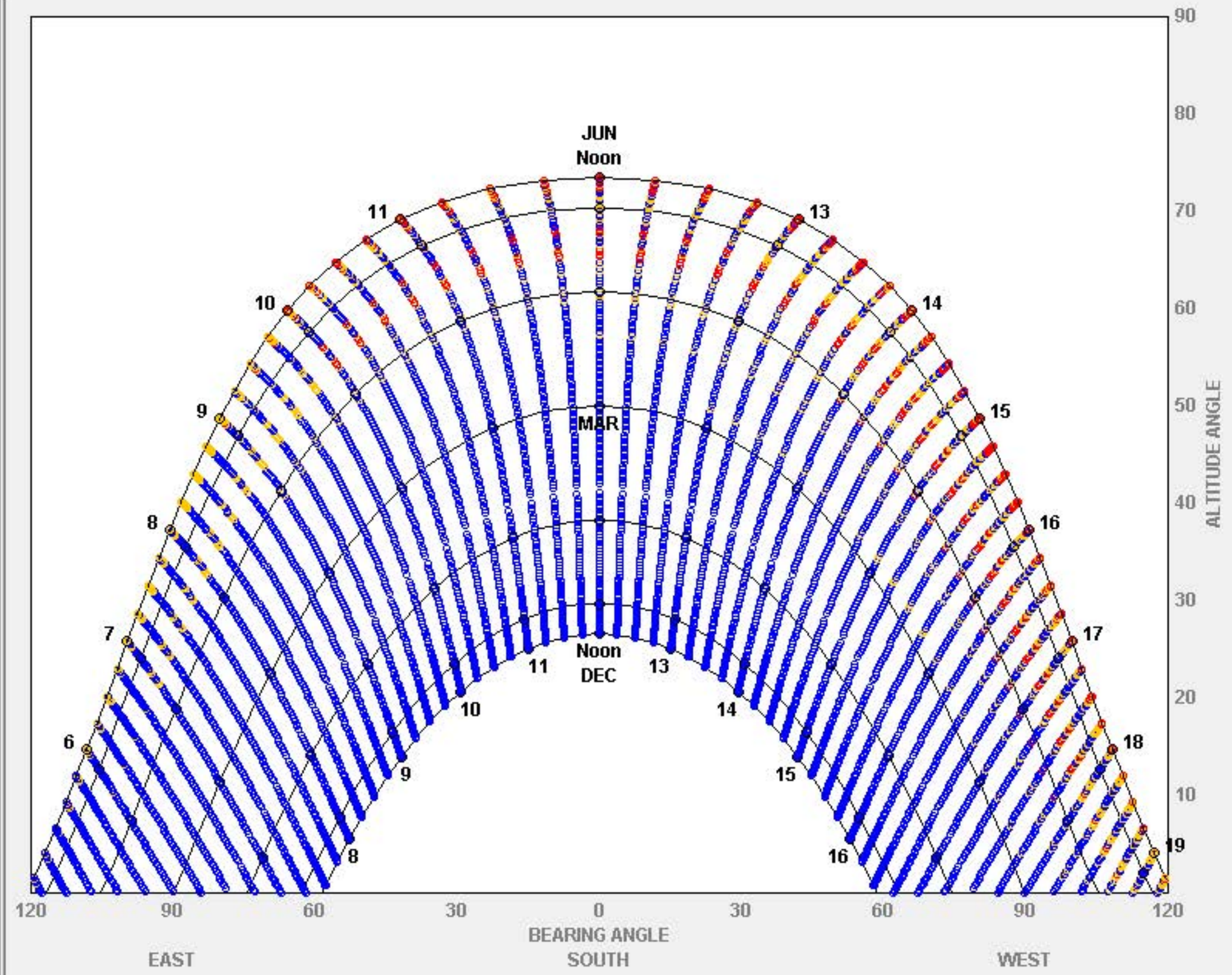
( ) June 21 to December 21

[ ] Display Grid

[ ] Display Shading Calculator

[ ] Display Obstruction Elevation

Input Obstructions



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SUN SHADING CHART

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

- WARM/HOT > 80°F
  (SHADE NEEDED)
  600 Hours Exposed
  0 Hours Shaded
- COMFORT > 68°F
  (SHADE HELPS)
  920 Hours Exposed
  0 Hours Shaded
- COOL/COLD < 68°F
  (SUN NEEDED)
  1080 Hours Exposed
  0 Hours Shaded

PLOT MONTHS:

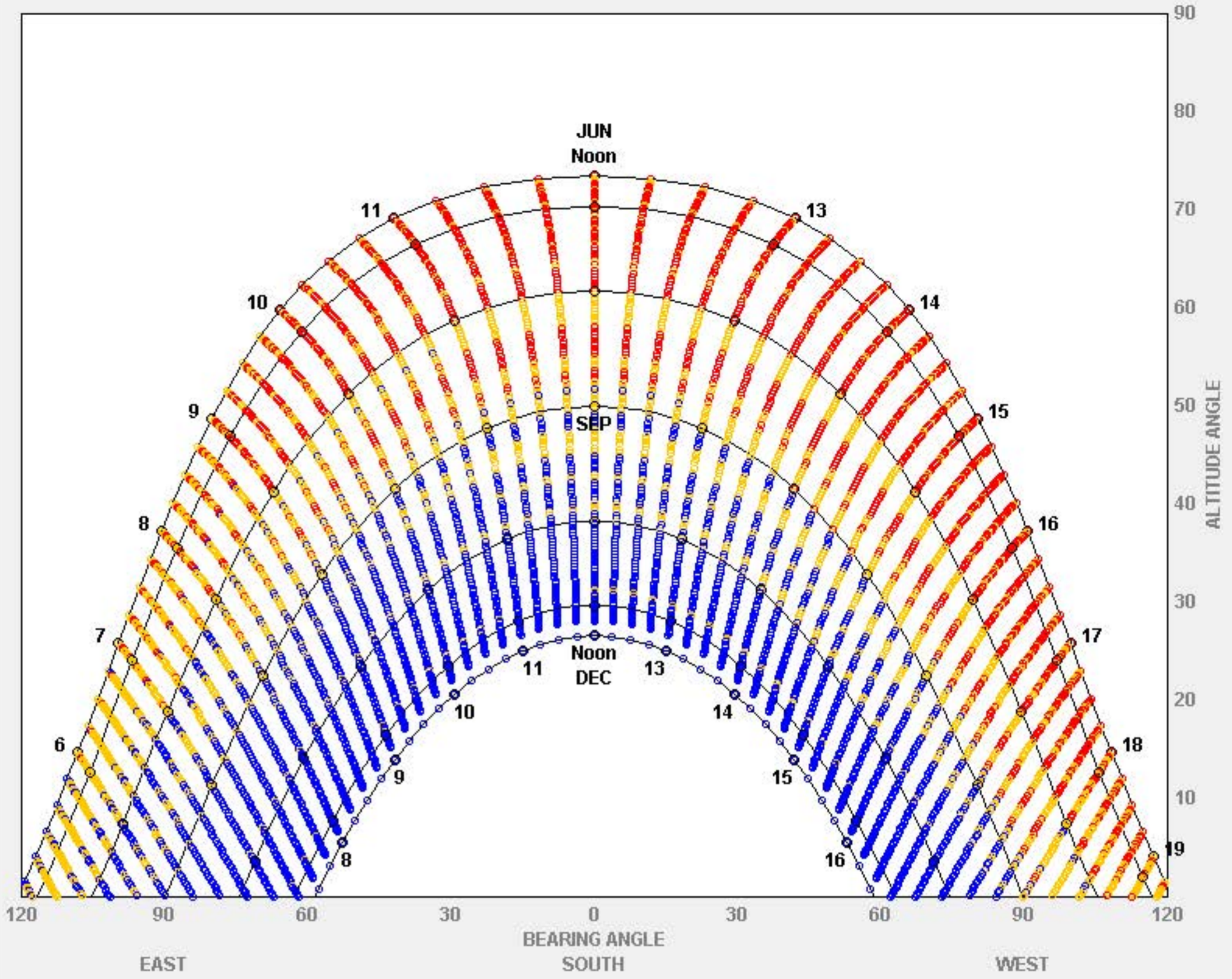
WINTER SPRING

- ○ December 21 to June 21

SUMMER FALL

- ◉ June 21 to December 21

☐ Display Grid
☐ Display Shading Calculator
☐ Display Obstruction Elevation
Input Obstructions



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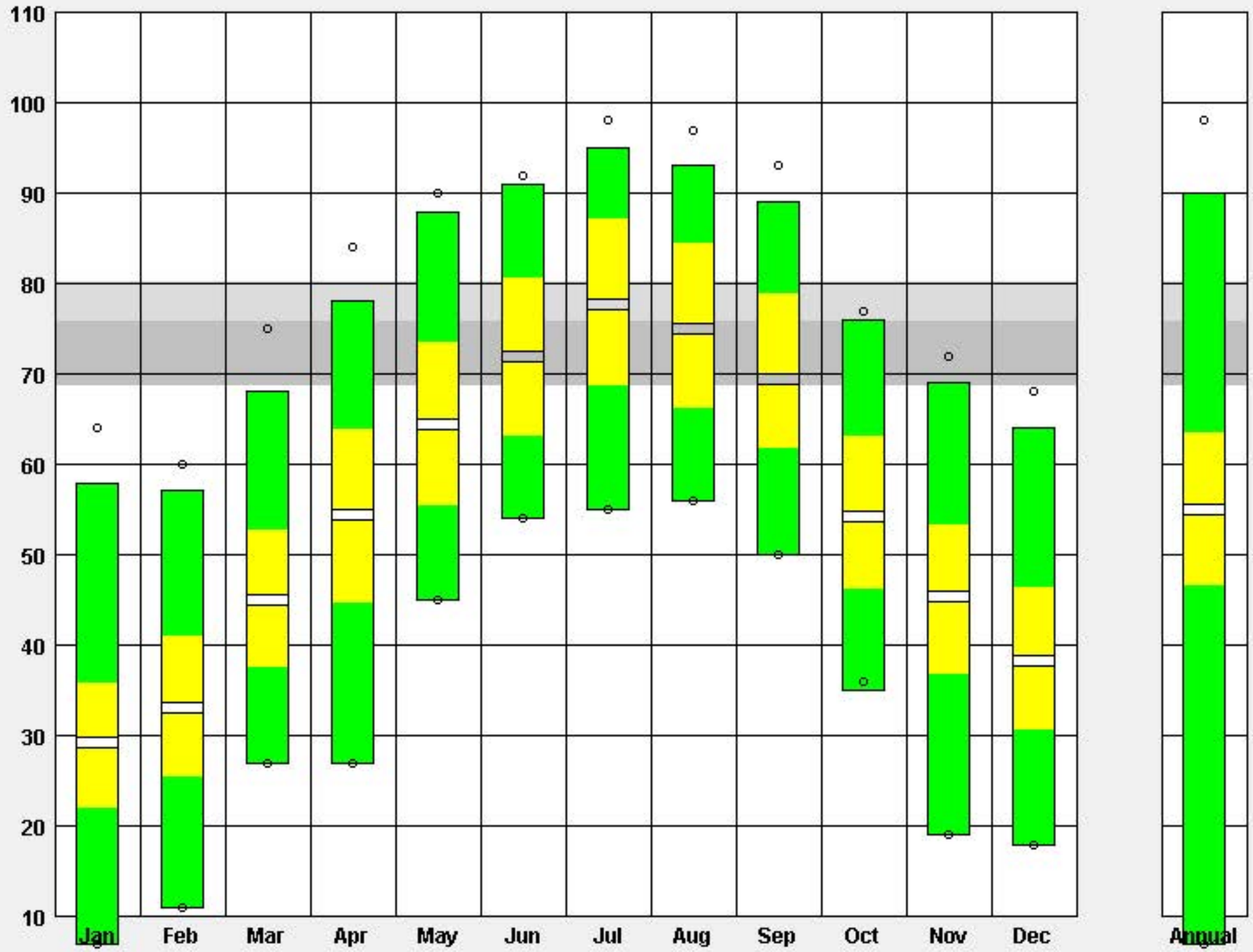
TEMPERATURE RANGE
ASHRAE Standard 55-2004 using PMV

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

RECORDED HIGH -
DESIGN HIGH -
AVERAGE HIGH -
MEAN -
AVERAGE LOW -
DESIGN LOW -
RECORDED LOW -

COMFORT ZONE
SUMMER
WINTER
(At 50% Relative Humidity)



DESIGN HIGH: Residential
- (•) 1% of Hours Above
- ( ) .5% of Hours Above
- ( ) 0% of Hours Above

DESIGN LOW: Residential
- ( ) 1% of Hours Below
- ( ) .5% of Hours Below
- (•) 0% of Hours Below

TEMPERATURE RANGE:
- (•) 10 to 110 °F
- ( ) Fit to Data

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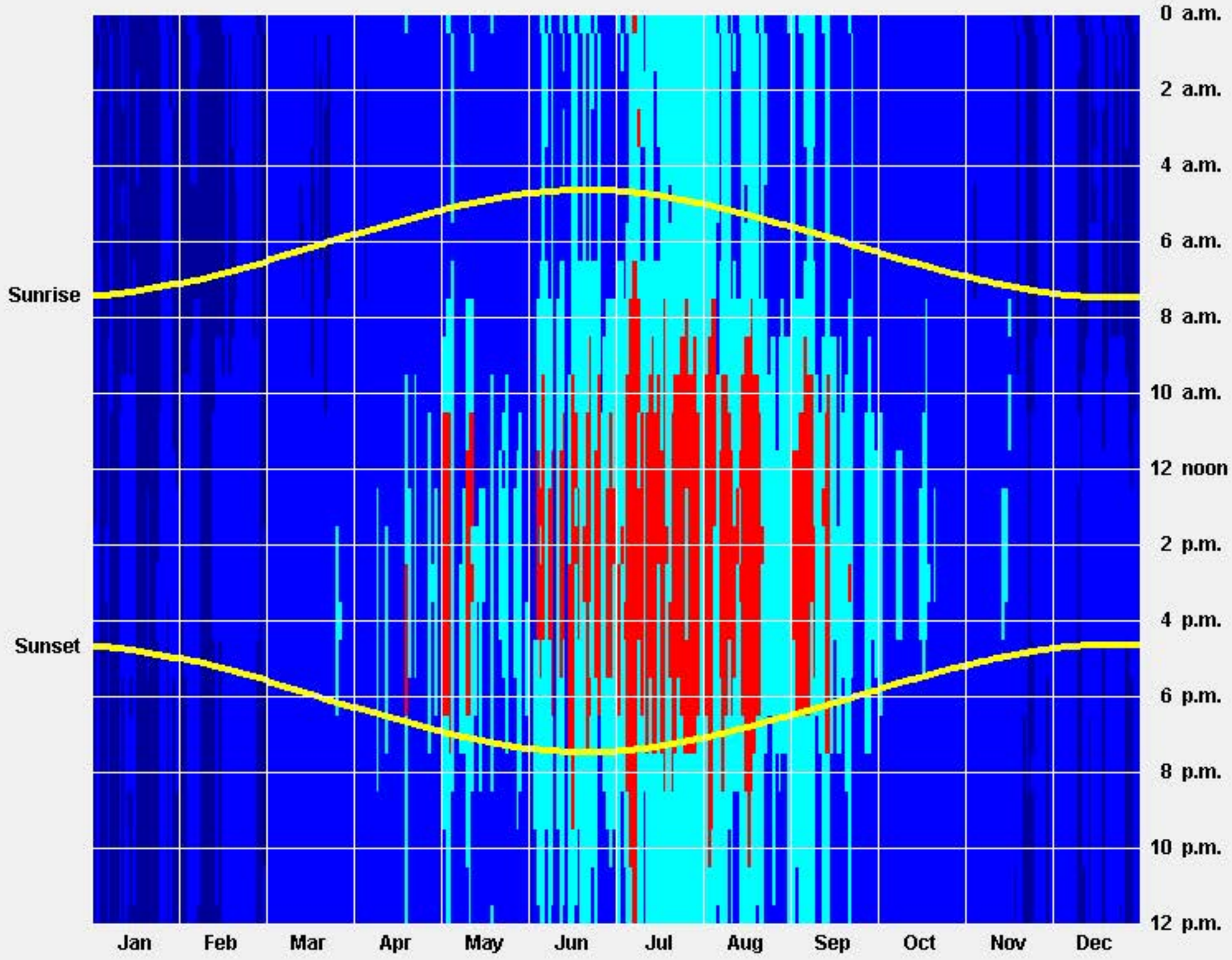
TIMETABLE PLOT

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

LEGEND

DRY BULB TEMP
(degrees F)

12%	< 32	
60%	32 -	69
20%	69 -	81
8%	81 -	100
0%	> 100	



PLOT:

DRY BULB TEMP

Monthly Avg Daily

Select colored squares on LEGEND to change plot colors (see Help).

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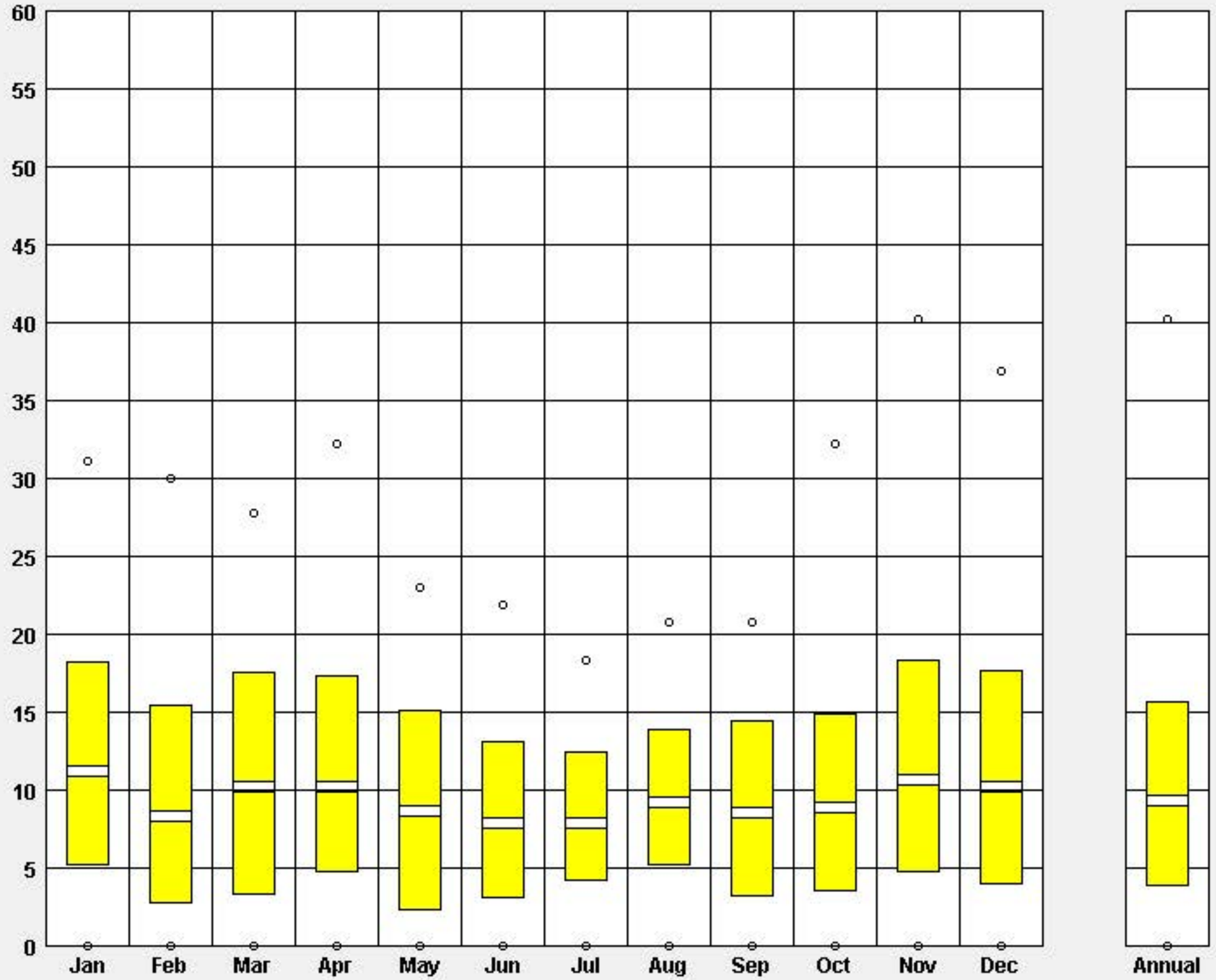
WIND VELOCITY RANGE

LOCATION: **Philadelphia International Ap, PA, USA**
Latitude/Longitude: 39.87° North, 75.23° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724080 WMO Station Number, **Elevation** 6 ft

L E G E N D

RECORDED HIGH -
AVERAGE HIGH -
MEAN -
AVERAGE LOW -
RECORDED LOW -
(mph)



PLOT:
(•) mph ( ) fpm

WIND VELOCITY:
(•) 0 to 60 mph
( ) Fit to Data

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