

# THERMAL AND VISUAL COMFORT MAXIMIZATION OF DREAM BEDROOM

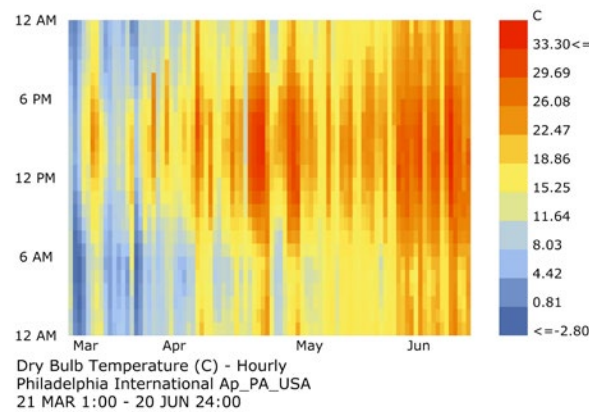
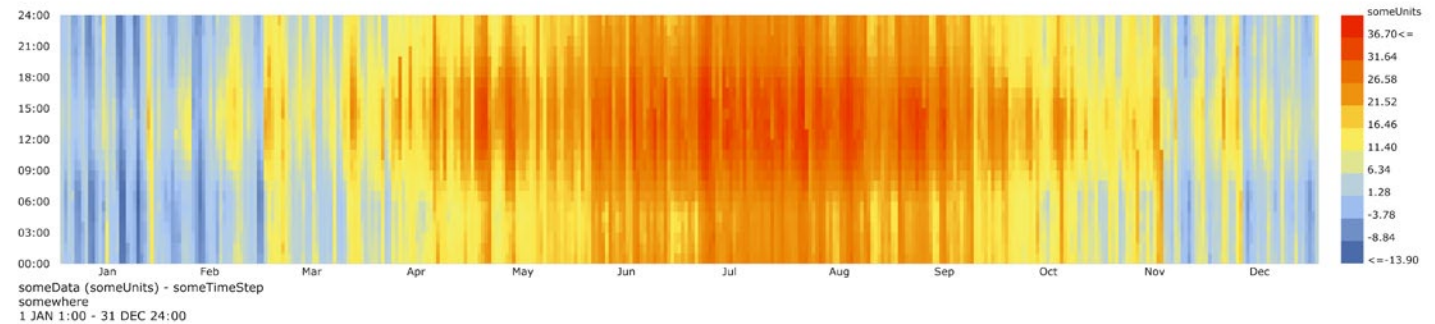
Philadelphia, PA

XIAORAN LIU

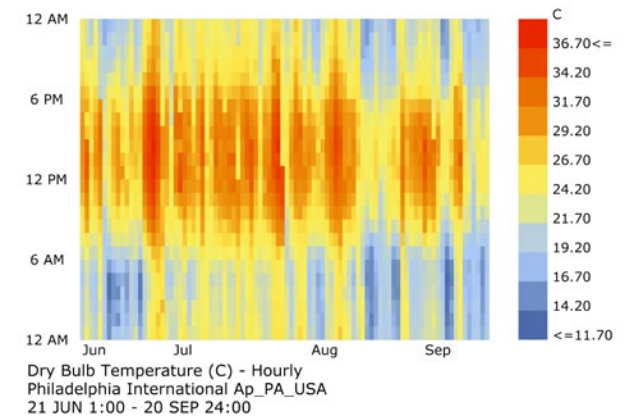
Fall 2016 | ARCH 753 Building Performance Simulation  
Penndesign | University of Pennsylvania

By looking at TMY3 data, temperature in Philadelphia is mainly between 12 to 20 throughout the whole year, during which the average temperature is 12.7. The average temperature of each season is 16, 24, 9.5, 1.1.

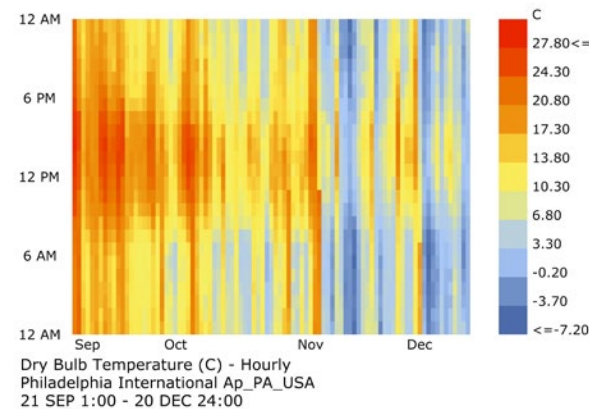
Concluded from data above, the climate of Philly will be cooler and uncomfortable for people during the autumn and the winter. Also, I assume at this time people would like more stay at home than going outside.



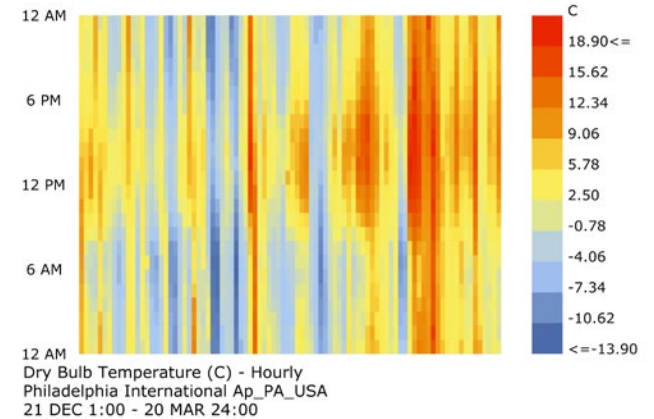
**SPRING**



**SUMMER**



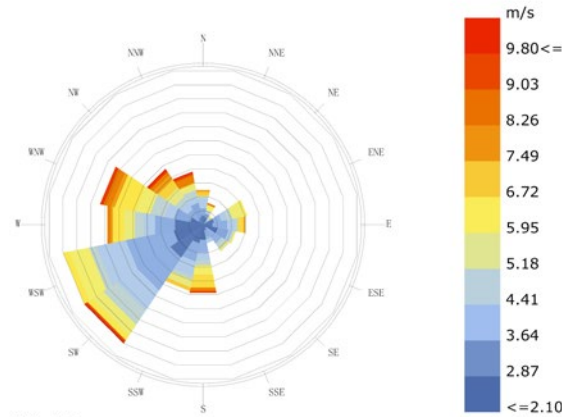
**AUTUMN**



**WINTER**

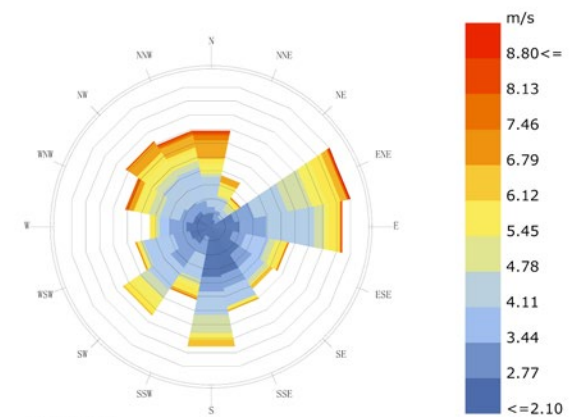
Take the standard of wind speed (2-10m/s) and Dry Bulb Temperature (18-24) as comfortable references, we know that each season is totally different. There are 527 hours satisfied for Spring, 848 hours for Summer, 179 hours for Autumn, and 5 hours for Winter.

These windrose graphics are supplements to the previous page.



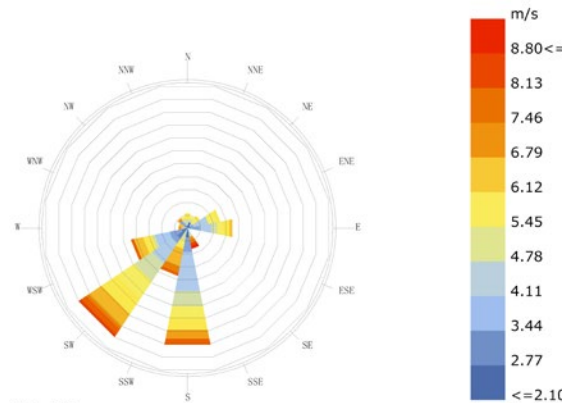
Wind-Rose  
Philadelphia International Ap\_PA\_USA  
21 MAR 1:00 - 20 JUN 24:00  
Hourly Data: Wind Speed (m/s)  
Calm for 0.00% of the time = 0 hours.  
Each closed polyline shows frequency of 0.3%. = 7 hours.  
...  
Conditional Selection Applied:  
2 < Wind Speed < 10  
and 18 < Dry Bulb Temperature < 24  
527.0 hours of total 8760.0 hours (6.02%).  
527.0 hours of analysis period 2208.0 hours (23.87%).

## SPRING



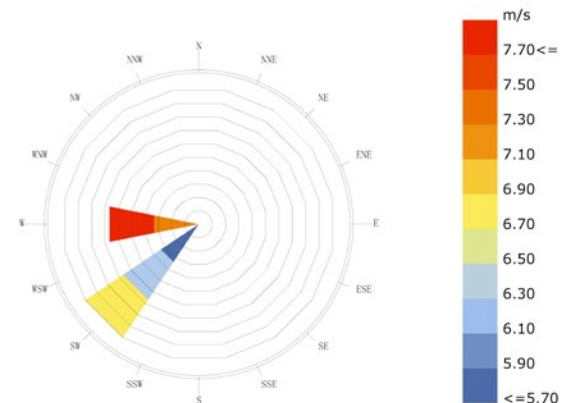
Wind-Rose  
Philadelphia International Ap\_PA\_USA  
21 JUN 1:00 - 20 SEP 24:00  
Hourly Data: Wind Speed (m/s)  
Calm for 0.00% of the time = 0 hours.  
Each closed polyline shows frequency of 0.4%. = 8 hours.  
...  
Conditional Selection Applied:  
2 < Wind Speed < 10  
and 18 < Dry Bulb Temperature < 24  
848.0 hours of total 8760.0 hours (9.68%).  
848.0 hours of analysis period 2208.0 hours (38.41%).

## SUMMER



Wind-Rose  
Philadelphia International Ap\_PA\_USA  
21 SEP 1:00 - 20 DEC 24:00  
Hourly Data: Wind Speed (m/s)  
Calm for 0.00% of the time = 0 hours.  
Each closed polyline shows frequency of 0.2%. = 4 hours.  
...  
Conditional Selection Applied:  
2 < Wind Speed < 10  
and 18 < Dry Bulb Temperature < 24  
179.0 hours of total 8760.0 hours (2.04%).  
179.0 hours of analysis period 2184.0 hours (8.20%).

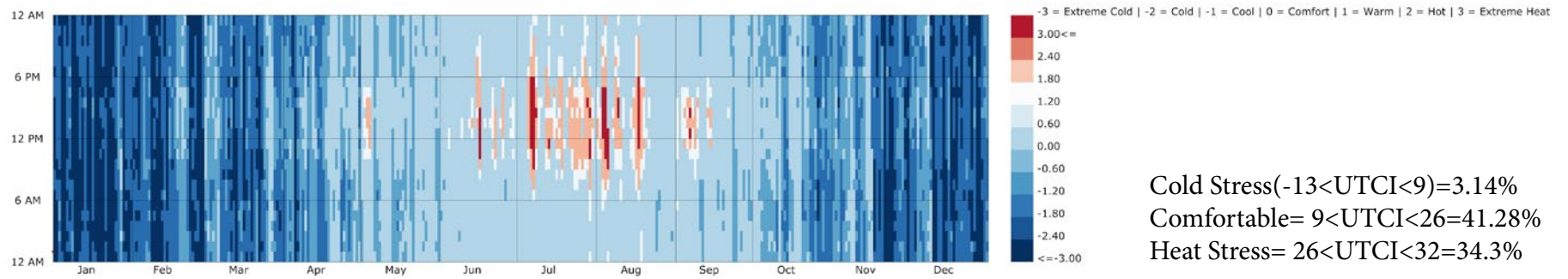
## AUTUMN



Wind-Rose  
Philadelphia International Ap\_PA\_USA  
21 DEC 1:00 - 20 MAR 24:00  
Hourly Data: Wind Speed (m/s)  
Calm for 0.00% of the time = 0 hours.  
Each closed polyline shows frequency of 0.0%. = 0 hours.  
...  
Conditional Selection Applied:  
2 < Wind Speed < 10  
and 18 < Dry Bulb Temperature < 24  
5.0 hours of total 8760.0 hours (0.06%).  
5.0 hours of analysis period 2160.0 hours (0.23%).

## WINTER

## UTCI(Universal Thermal Climate Index of Philadelphia)

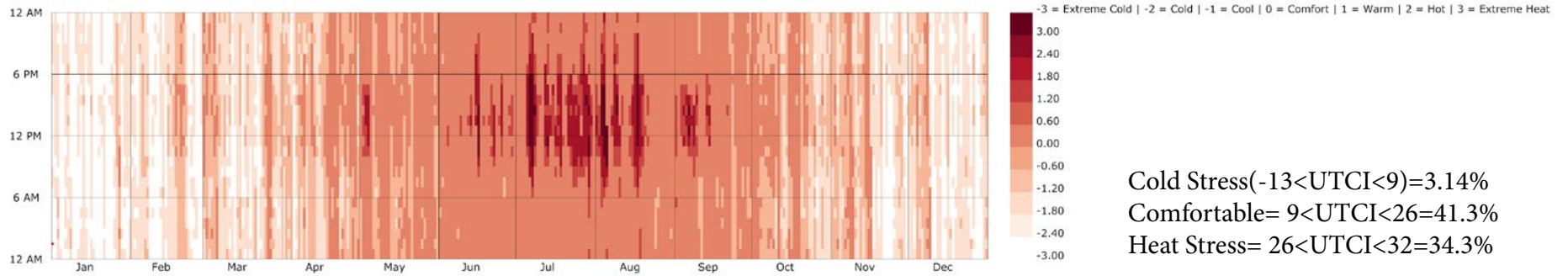


- 3 - Strong Cold Stress - potential public health hazard with higher-than-normal mortality rates (UTCI < -13C).
- 2 - Moderate Cold Stress - cold but no public health hazard (-13C < UTCI < 0C).
- 1 - Slight Cold Stress - cool but comfortable for short periods of time (0C < UTCI < 9C)
- 0 - No Thermal Stress - comfortable conditions (9C < UTCI < 26C).
- +1 - Slight Heat Stress - warm but comfortable for short periods of time (26C < UTCI < 28C).
- +2 - Moderate Heat Stress - hot but no public health hazard (28C < UTCI < 32C).
- +3 - Strong Heat Stress - potential public health hazard with higher-than-normal mortality rates (UTCI > 32C).

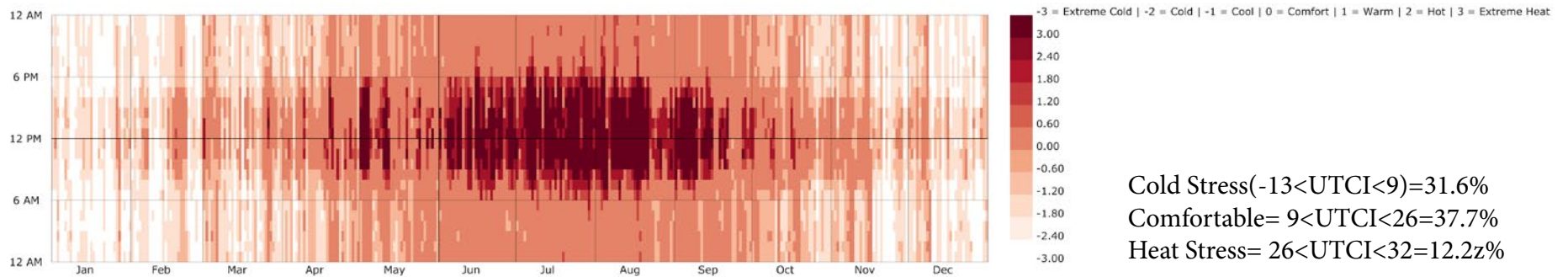


## Compare Comfort between in Sun and Shade

### In Sun



### Shade



- 3 - Strong Cold Stress - potential public health hazard with higher-than-normal mortality rates (UTCI < -13C).
- 2 - Moderate Cold Stress - cold but no public health hazard (-13C < UTCI < 0C).
- 1 - Slight Cold Stress - cool but comfortable for short periods of time (0C < UTCI < 9C)
- 0 - No Thermal Stress - comfortable conditions (9C < UTCI < 26C).
- +1 - Slight Heat Stress - warm but comfortable for short periods of time (26C < UTCI < 28C).
- +2 - Moderate Heat Stress - hot but no public health hazard (28C < UTCI < 32C).
- +3 - Strong Heat Stress - potential public health hazard with higher-than-normal mortality rates (UTCI > 32C).

According to the basic climate analysis of Philadelphia, the conditions for dream room would be really cold and lack of enough sunlight during the Autumn and Winter.

Additional issues

1. humid in the dream room

Passive Strategies

1. Add some plates to the window that towards outside to direct the air, to increase the windflow at home where should be less humid.
2. Modify the size of inner window to improve the condition of solar gain.

