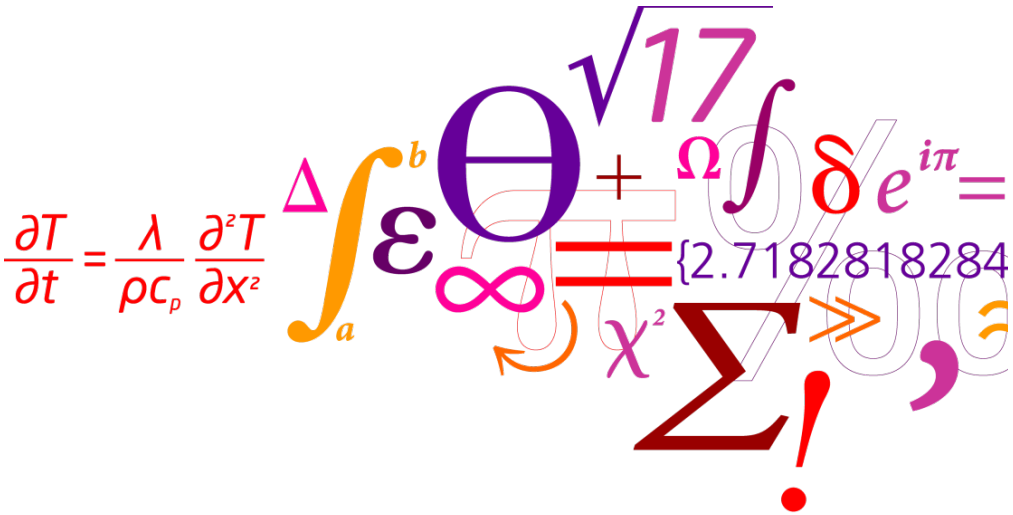
# The effect of different weather data sets and their resolution in climate-based daylight modeling for the location of Copenhagen

Anne Iversen, Technical University of Denmark




DTU Civil Engineering
Department of Civil Engineering

# Why??

- The climate-based daylight modeling approach is based on available weather data, which means that the climate/weather data used as input to the daylight simulations are of huge importance

- Investigate the effect of simulating with different weather data sets

- Investigate the effect of simulating with weather data sets of an hourly resolution compared to a 1 min resolution

# Radiance

- Three Phase Method, changing the timesteps

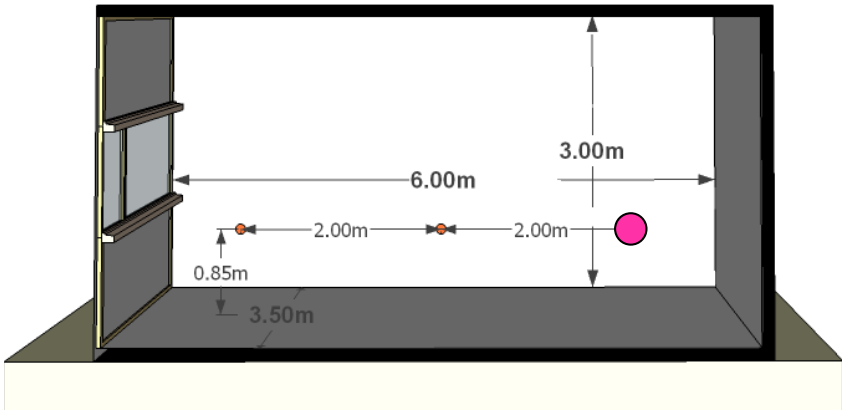
$$i = VTD\mathbf{s}$$

# Evaluation method

- Lighting Dependency (reverse of DA) - the percentage of occupied hours per year when artificial light has to be added to the lighting scene to maintain a workplane threshold illuminance level

- Continous Lighting Dependency (~DAcon) –
  describing the artificial light contribution in an ideal photoelectric dimming system when the daylight threshold is not maintained during working hours

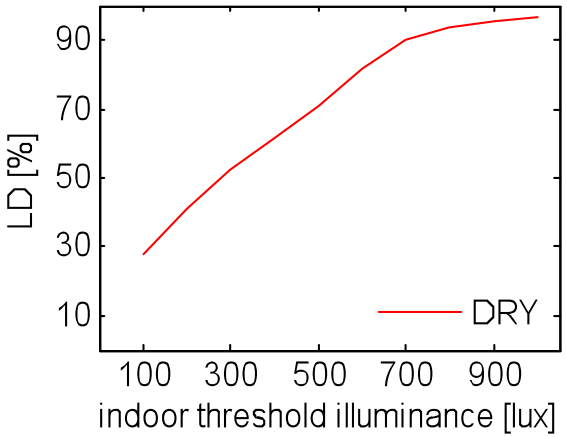
# Evaluation method



# Evaluation method - Weather data

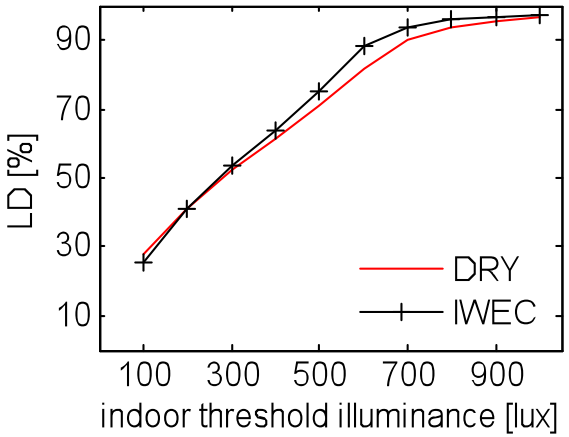
- Meteonorm (MET)
- Energy Plus, International Weather for Energy Calculations (IWEC)
- Design Reference Year (DRY)

# Simulations of hourly means

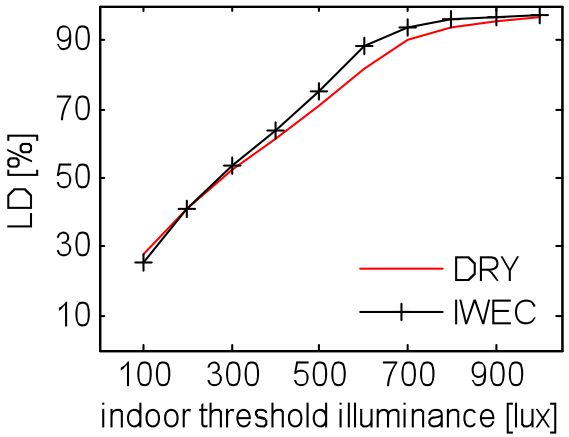


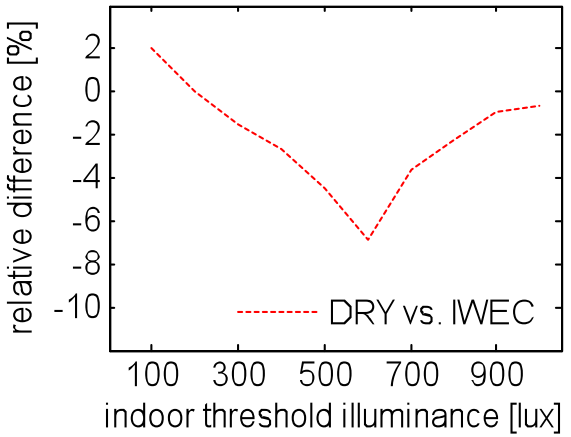

$$E = LD \cdot P_{installed} \cdot n_{hours\ of\ usage} \quad [Wh/m^2]$$

# Simulations of hourly means



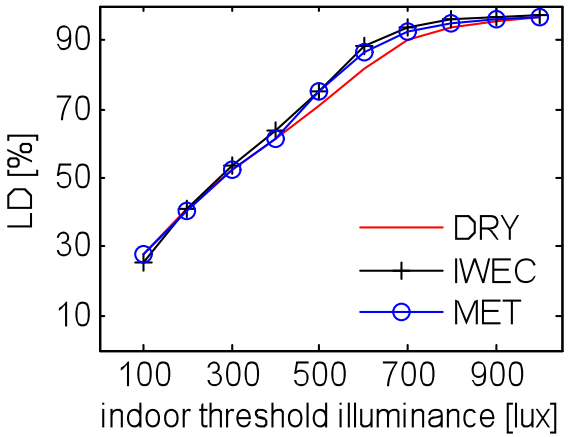
# Simulations of hourly means

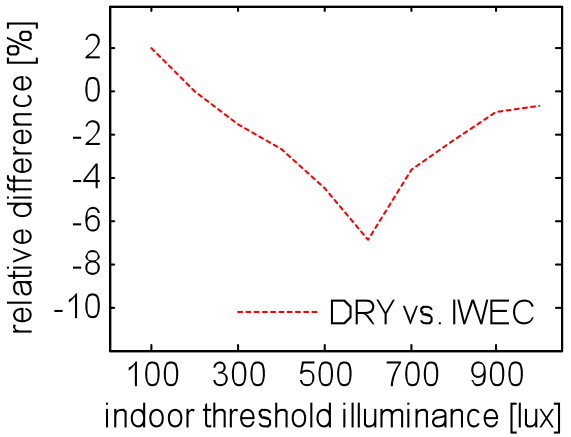



relative difference (LDdry-LDx)/LDdry for the daylight simulations of hourly means

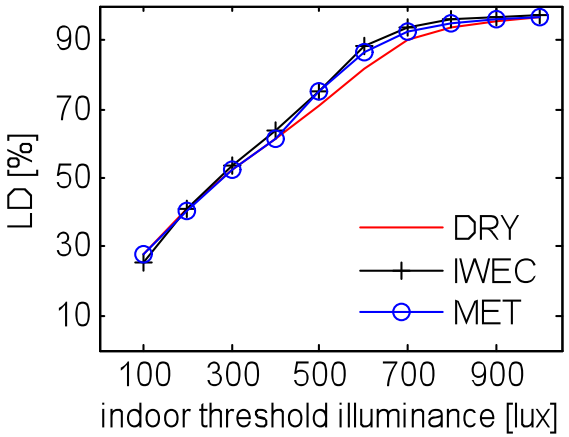
# Simulations of hourly means

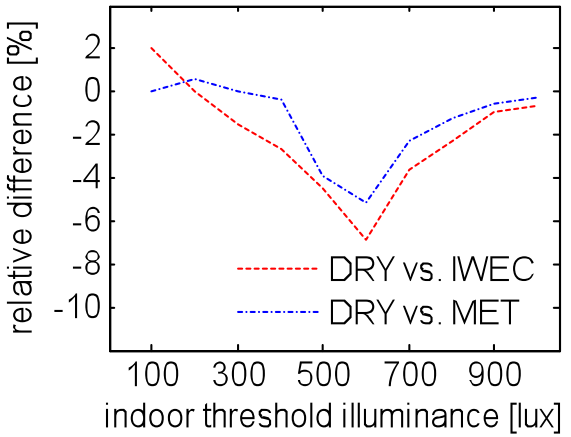



relative difference (LDdry-LDx)/LDdry for the daylight simulations of hourly means

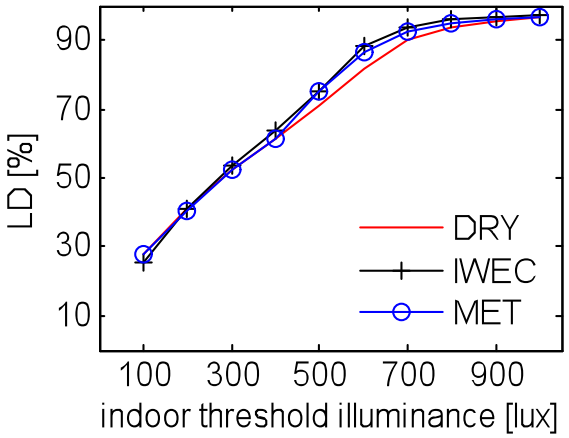
# Simulations of hourly means

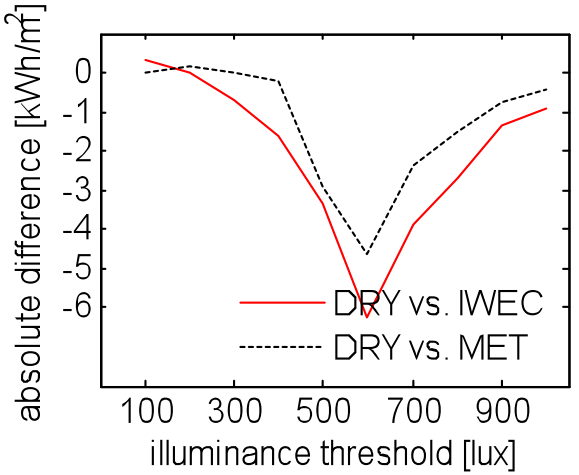



relative difference (LDdry-LDx)/LDdry for the daylight simulations of hourly means

# Simulations of hourly means

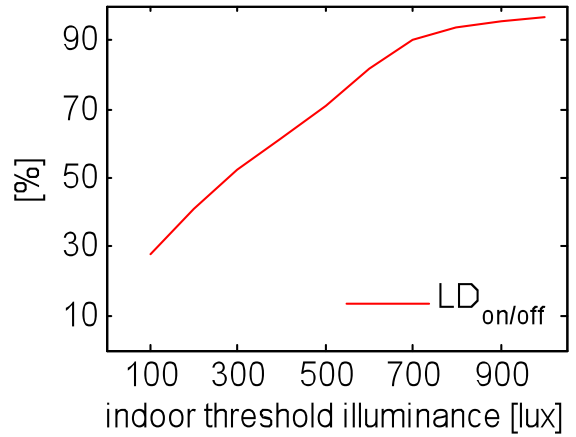



Normalized Power Density (NPD) 1.9W/(m²·100lux)

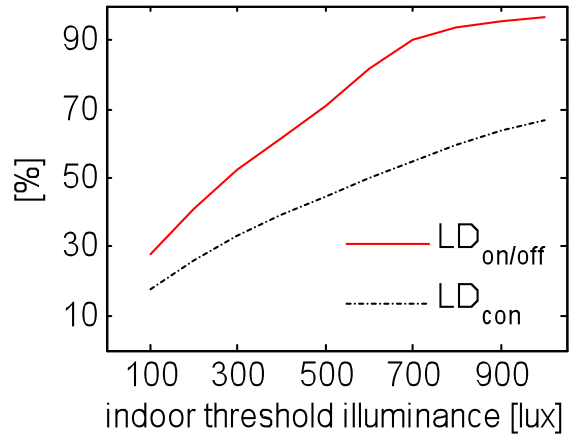
# Light Dependency and Continuous Light Dependency

Hourly resolution



# Light Dependency and Continuous Light Dependency

Hourly resolution

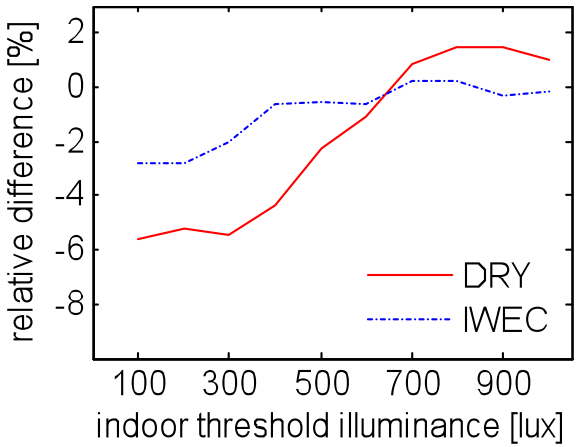


# Generation of 1 min irradiance datasets

- Stochastic Skartveit-Olseth model implemented in Daysim (Walkenhorst et al., 2002)

- Non-deterministic influence of the stochastic model on the simulation outcome = negligible

# Hourly means vs 1-min resolution




Relative difference in lighting dependency for 1h means and 1-min (1h-1min)/1h

# Dynamic control

Four different control strategies investigated

1) Photoelectric switch on/off for each time step, as illustrated by LD,

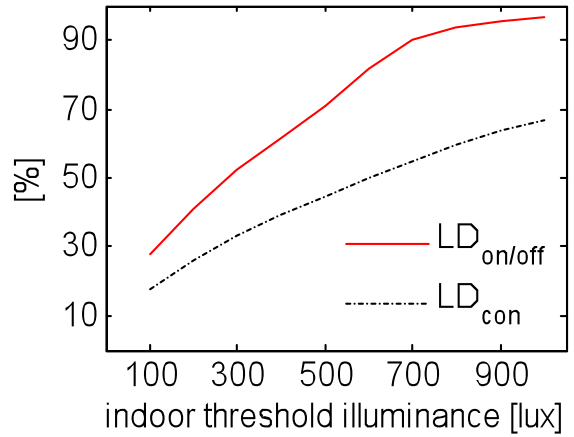
2) Photoelectric dimming, as illustrated by $LD_{con}$ (Proportional response),

3) Photoelectric dimming for every 10 min, $LD_{con\text{-}10min}$ and

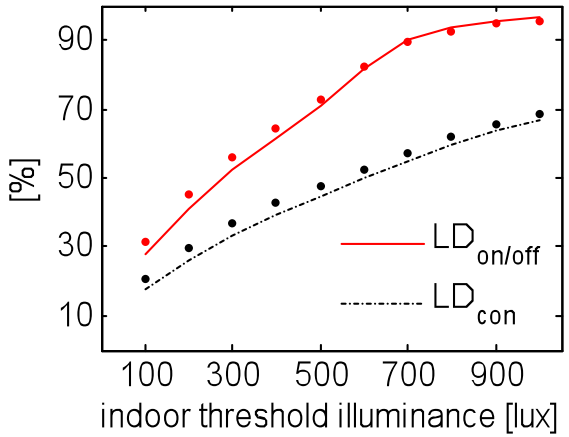
4) Proportional integral dimming, where the response is averaged over the past 10 min ($LD_{PI}$).

It is assumed that the relationship between the light output and sensor signal is linear.

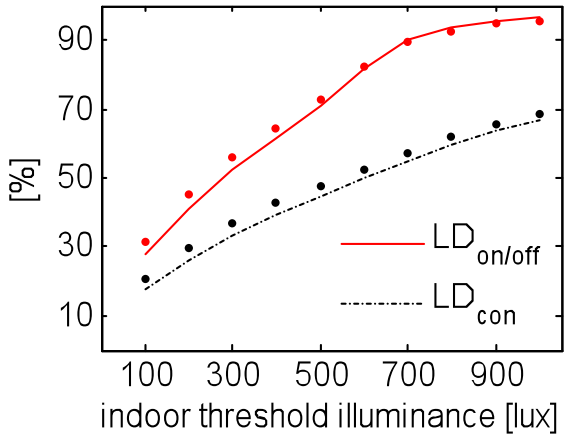
# Hourly means vs 1-min resolution

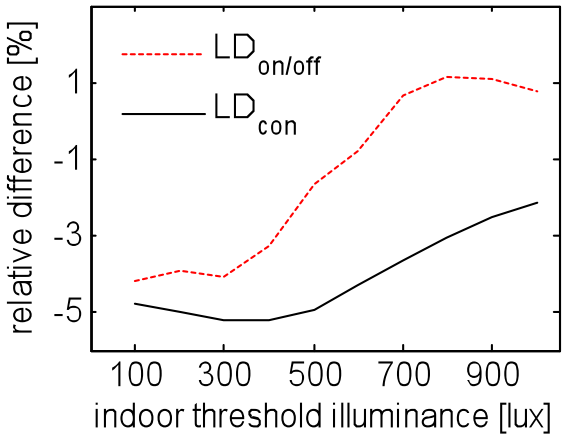


# Hourly means vs 1-min resolution



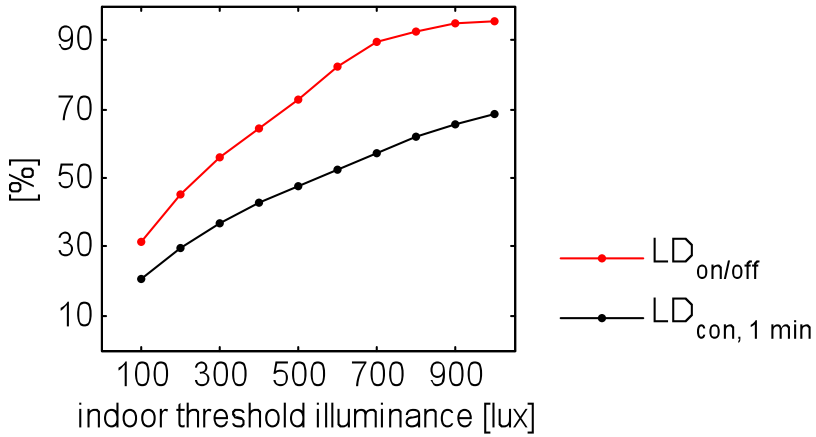
# Hourly means vs 1-min resolution



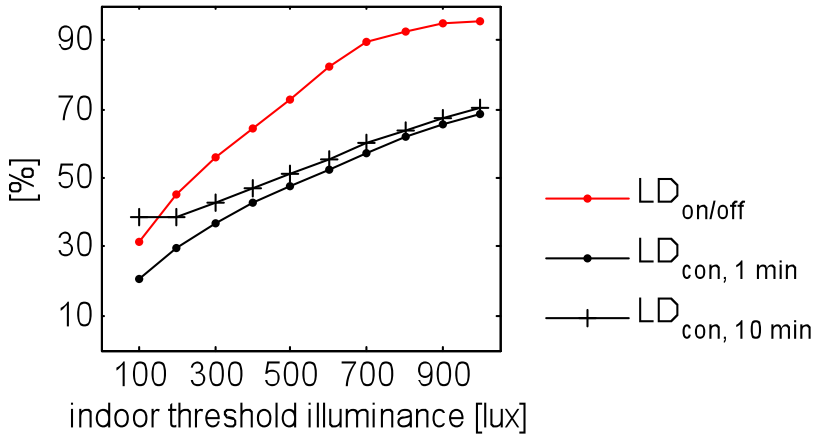




Relative difference in for 1h means and 1-min (1h-1min)/1h

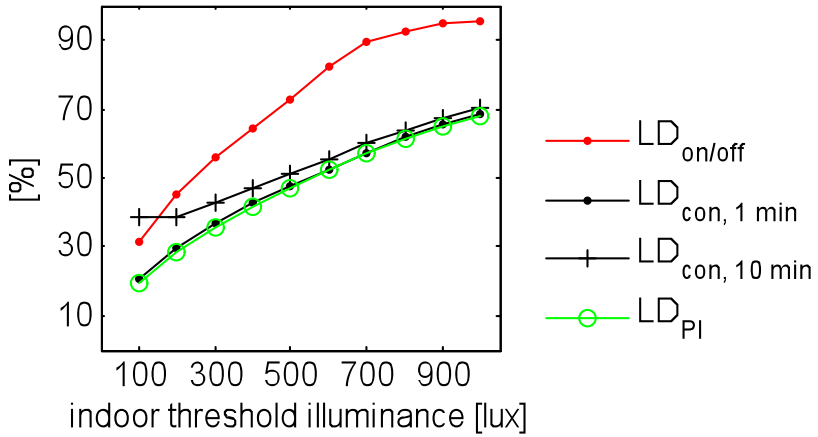
# Dynamic control



# Dynamic control



# Dynamic control



# Conclusion

- In contrast to the study by Walkenhorst et al. (2002) it is not possible to conclude that the daylight availability is overestimated by applying data of hourly means compared to data of 1 min resolution.

- The findings from these comparisons show that the hourly resolution does overestimate and underestimate the daylight availability.

- For simulations of control of artificial lights values of hourly means are a reasonable predictor for the daylight availability for a location as Copenhagen.