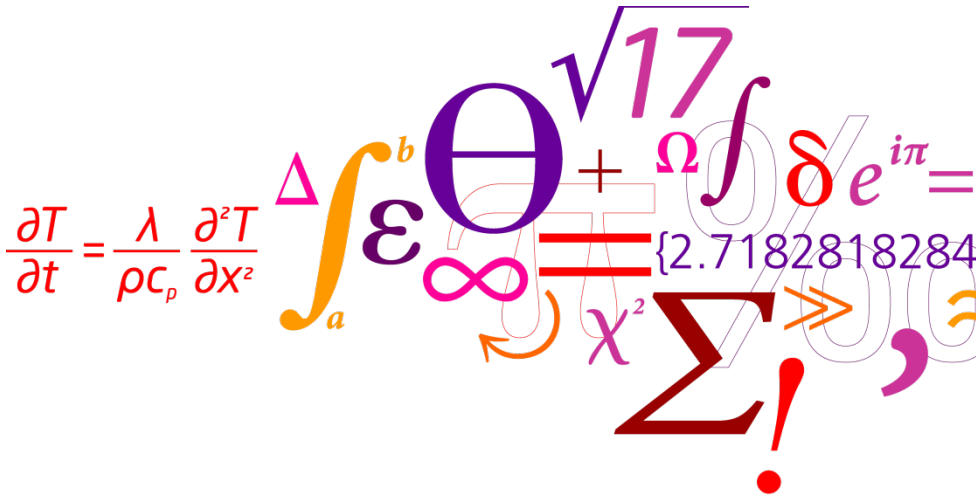
Simulation of BSDFs generated with Window6 and TracePro – prelimenary results

Anne Iversen, Technical University of Denmark
Annica Nilsson, Uppsala University, Sweden



DTU Civil Engineering
Department of Civil Engineering

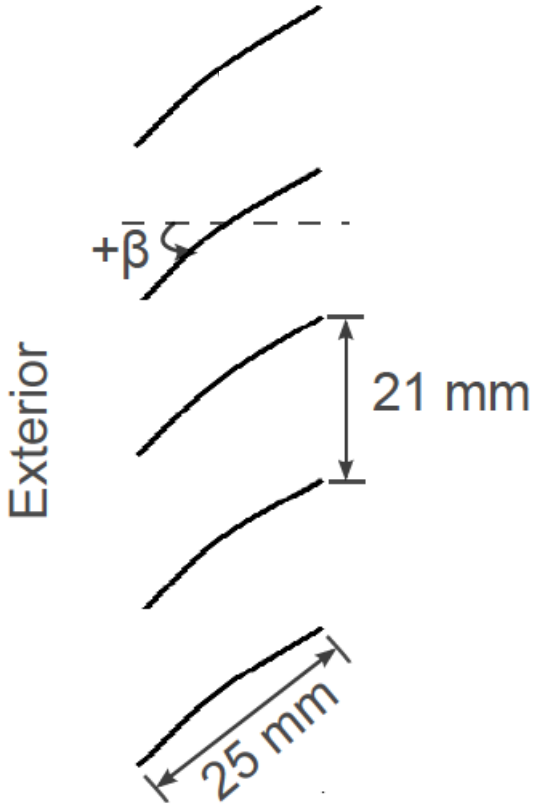
Goal: Simulate with full directional properties

- Three phase method opens possibility to easily simulate complex fenestration systems. The method accepts BSDF descriptions in Klems coordinates
- Baseline: Window6 – Radiosity
- Simulate with full directional properties (specular systems) – Raytracing

Status:

- Comparison between diffuse venetian blind:
  - Ideal properties, perfectly diffuse, 70% reflectance (Window6, slat material A)

- Compared by applying annual simulations



Window6 - Radiosity

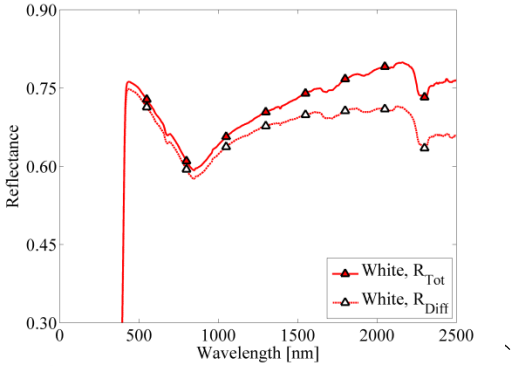
- Accurate method for predicting the hemispherical transmission and reflection of slat shading systems.

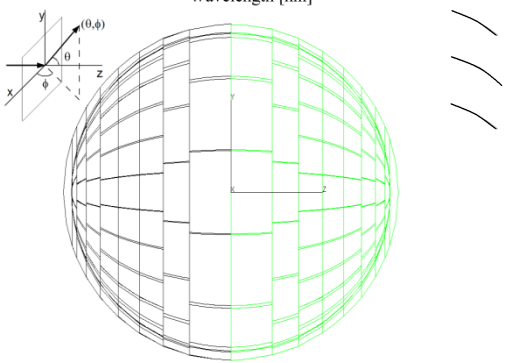
- *Limitation:*

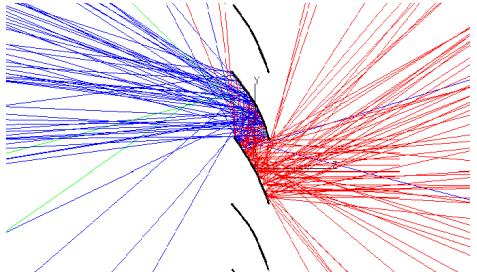
  One exception is the use of slat materials with a strong specular component of reflectance. In these cases even the hemispherical transmittance and reflectance can be significantly in error and the directional behavior will be poorly represented. For specular blinds we must rely on raytracing to generate full bidirectional properties, (Rubin et al., 2007).

TracePro - Raytracing

- The optical properties are assigned to the slats
- The Venetian blind system is ”placed” in a virtual sphere, which is used as light source and detector
- Transmittance and reflectance for the Venetian blind system is simulated for a few different slat angles

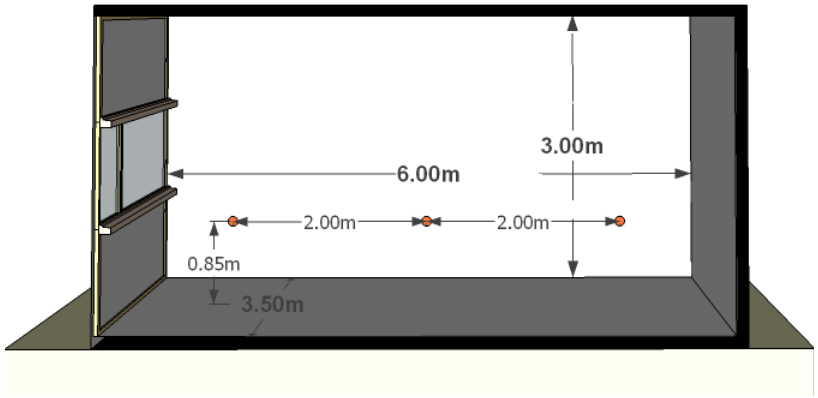






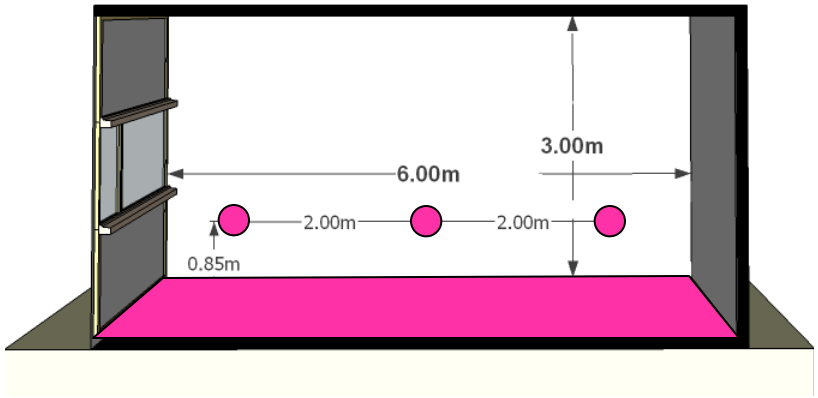
Three Phase Method

$$i = VTDs$$



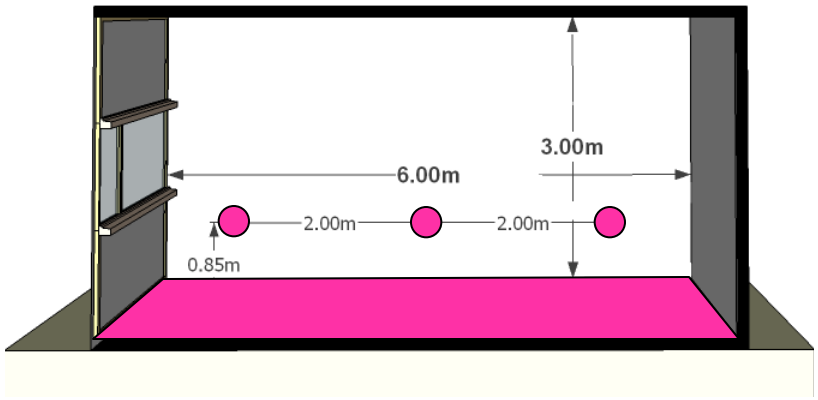
Three Phase Method

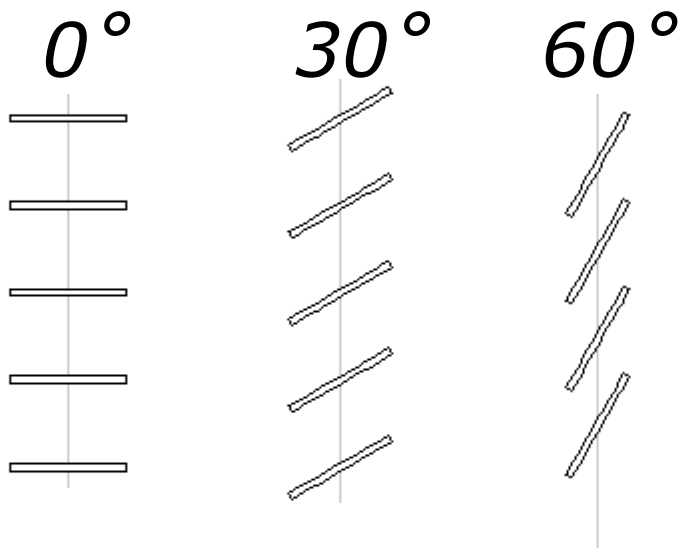
$$i = VTDs$$



Three Phase Method

$$i = V\mathbf{T}Ds$$

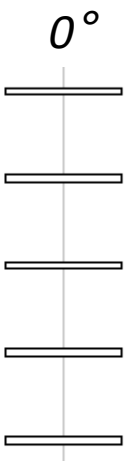


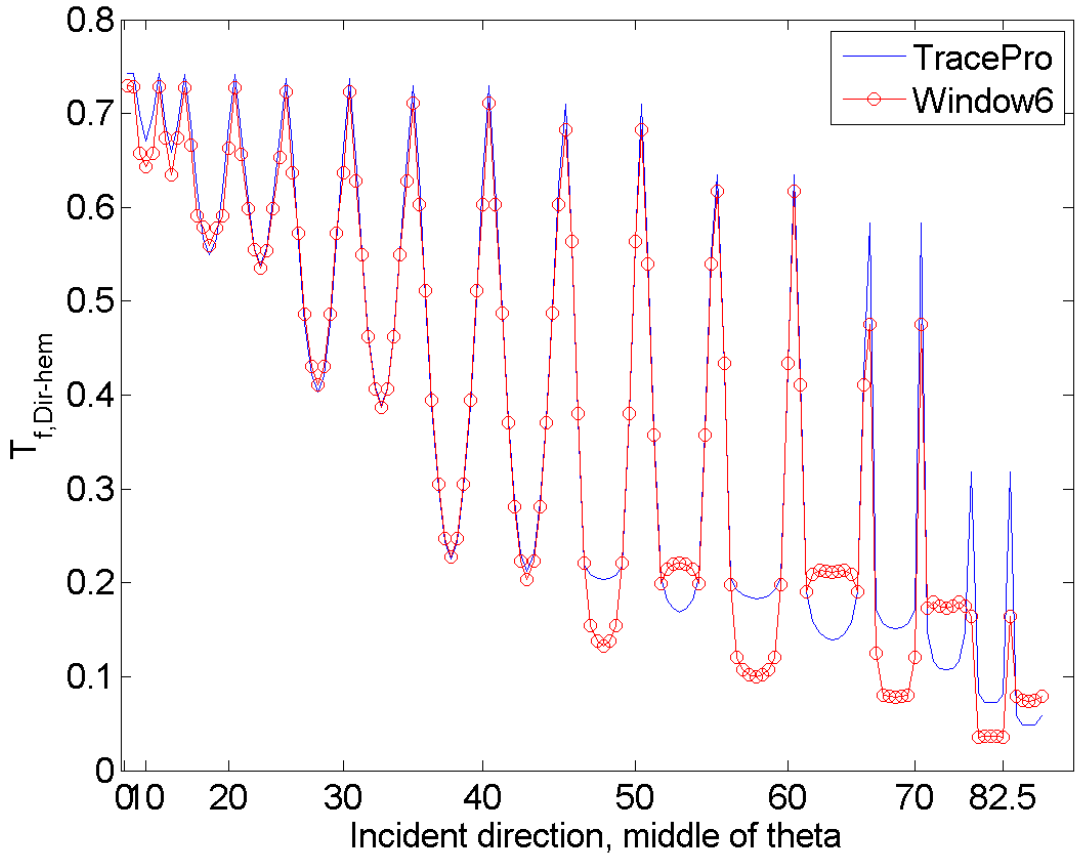


Results

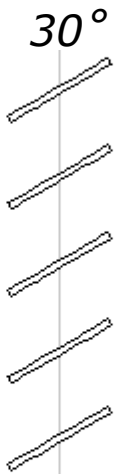
- Hemispherical transmittance
- Light distribution in the room - Accumulated annual luminance distribution
- Annual time series of illuminance level with time resolution of 1 hour

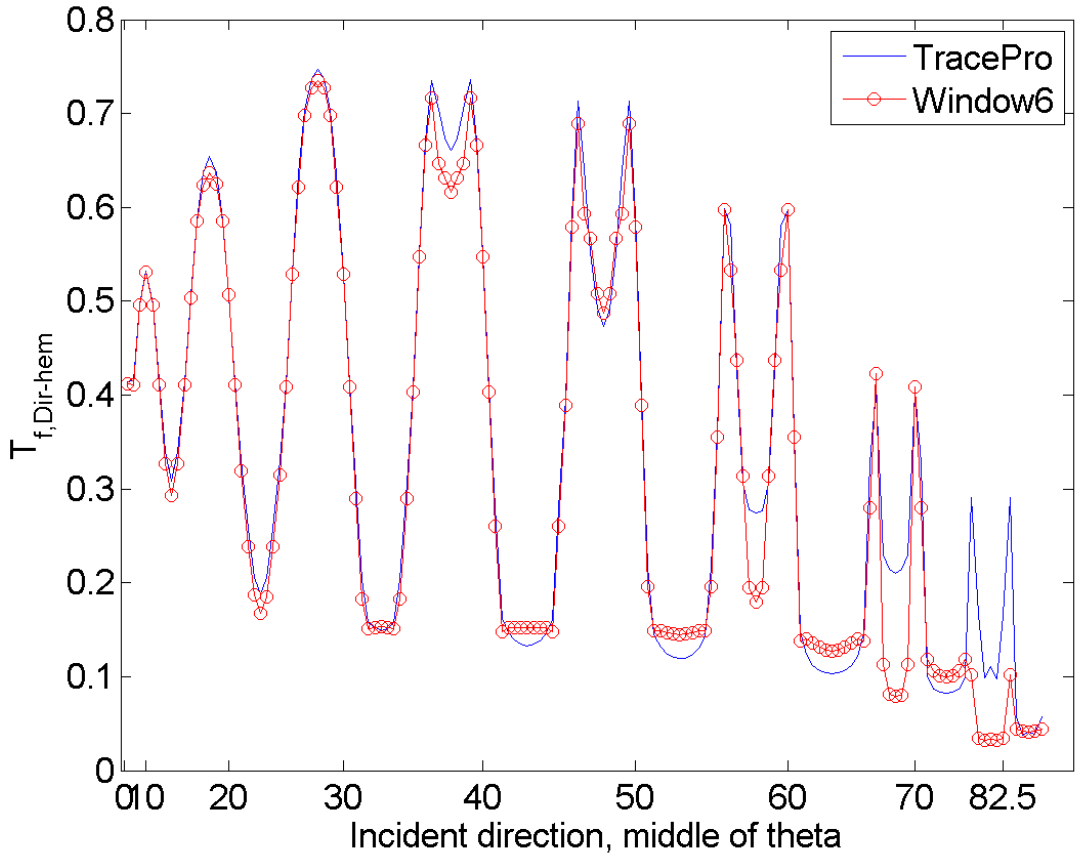
Hemispherical transmittance



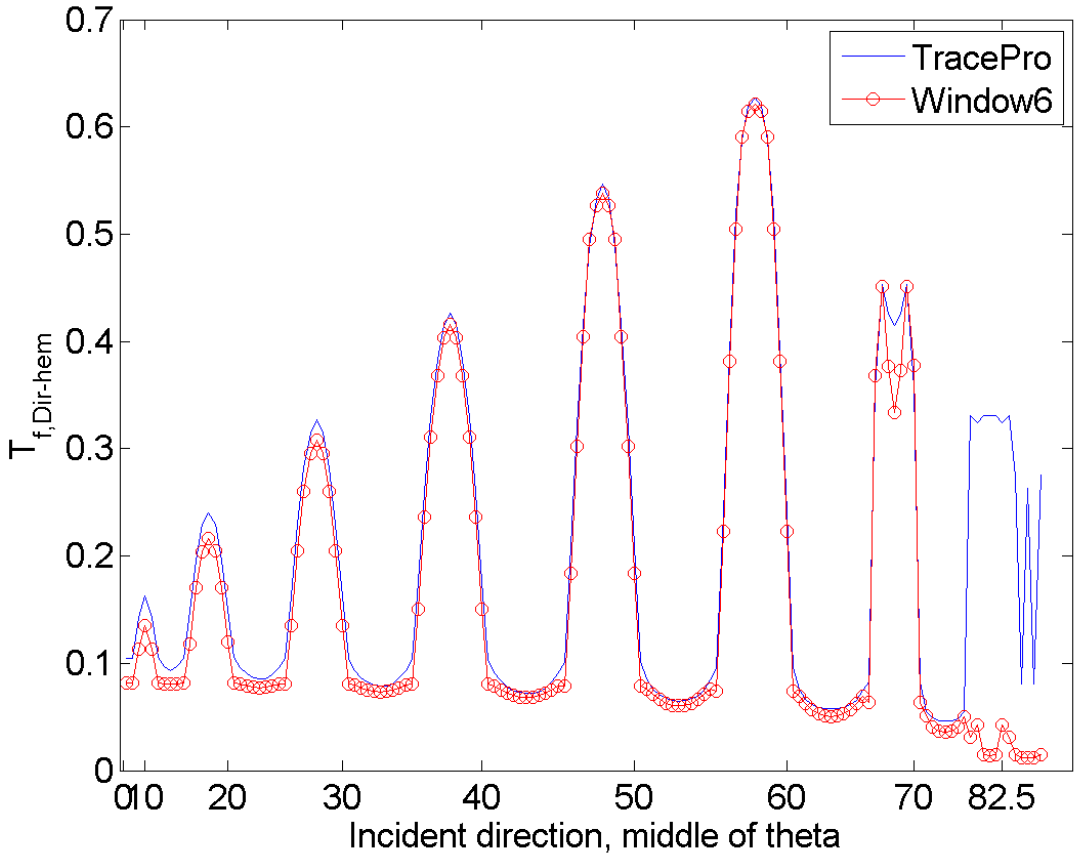


Hemispherical transmittance

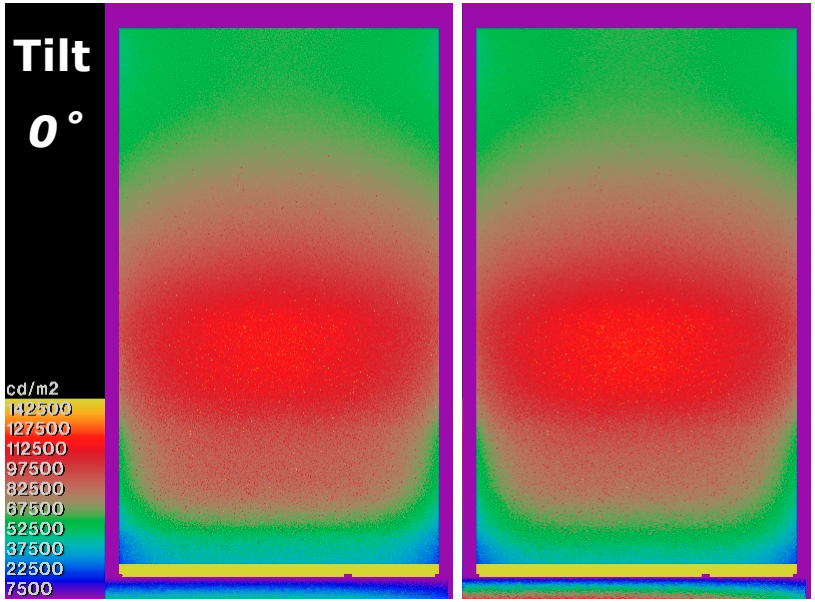


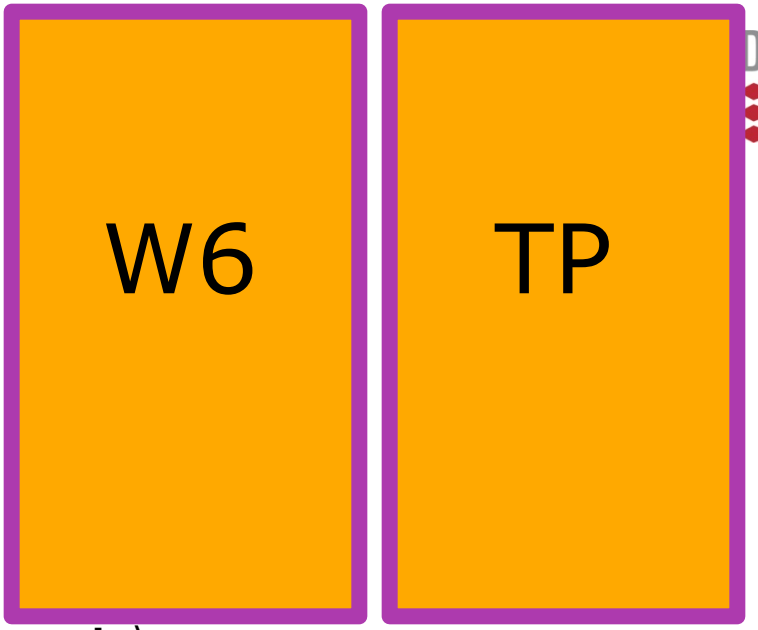


Hemispherical transmittance



Light distribution in the room





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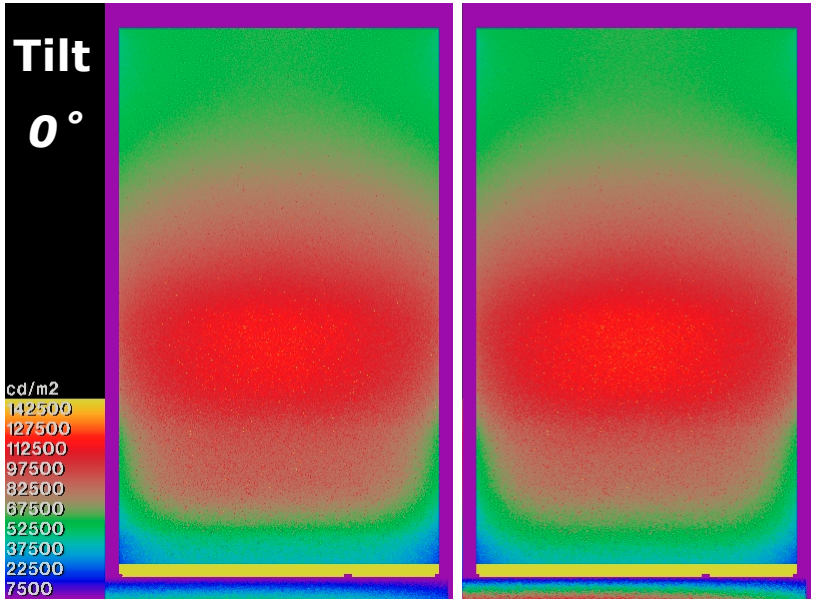

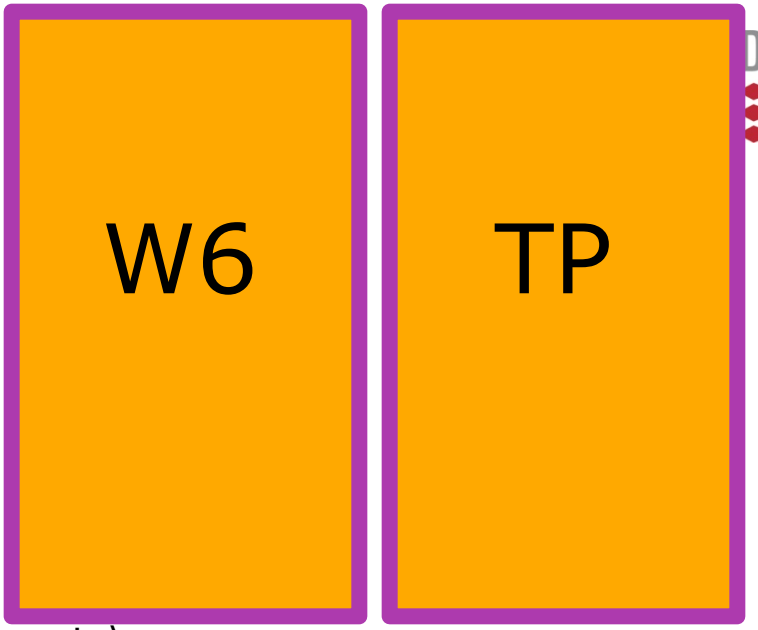

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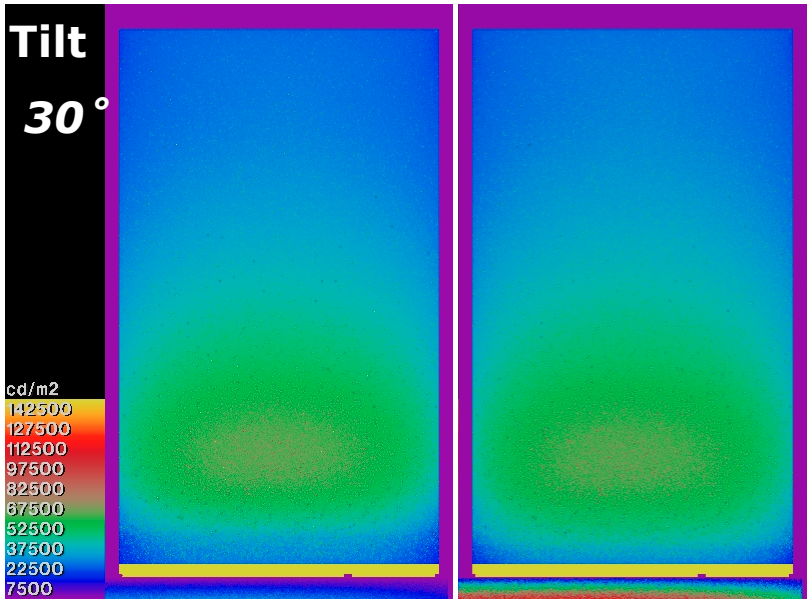

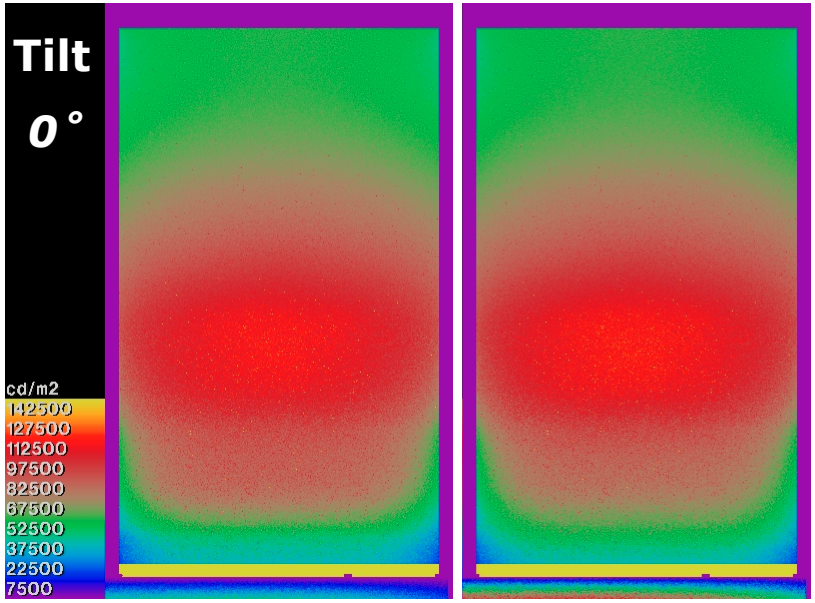

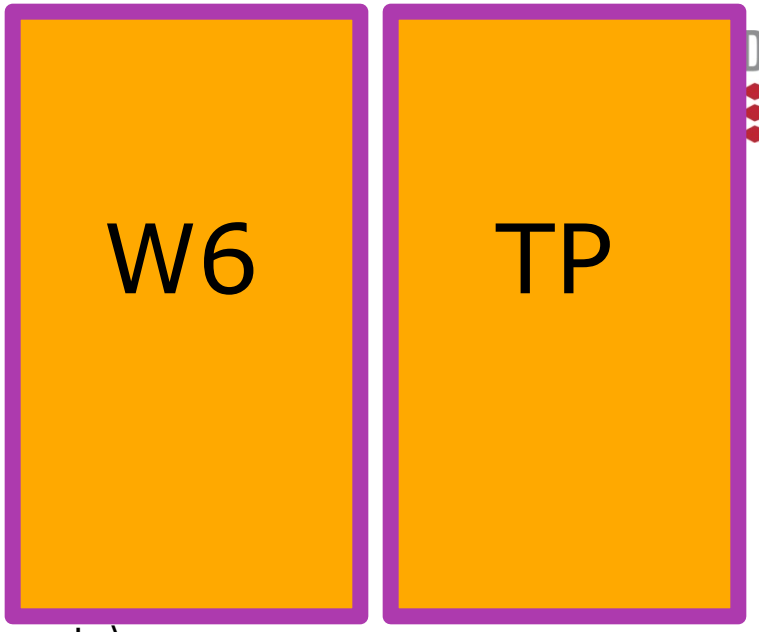

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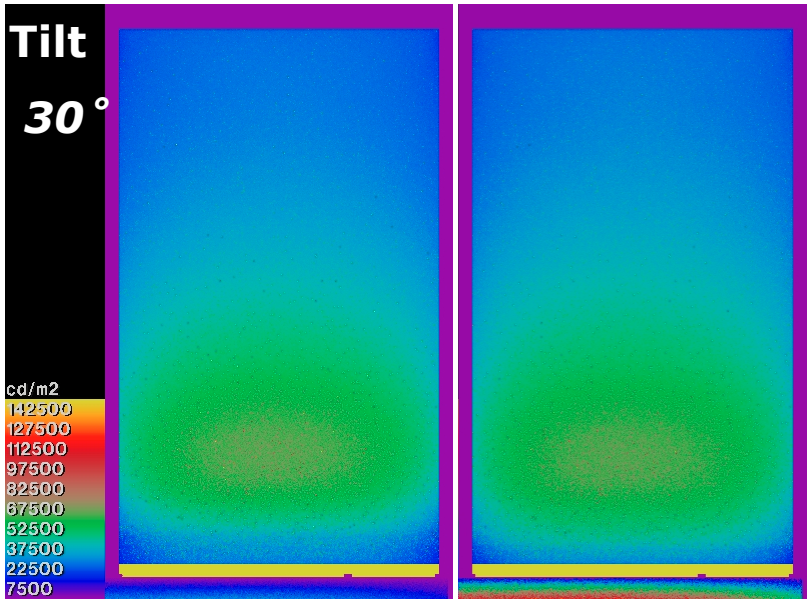
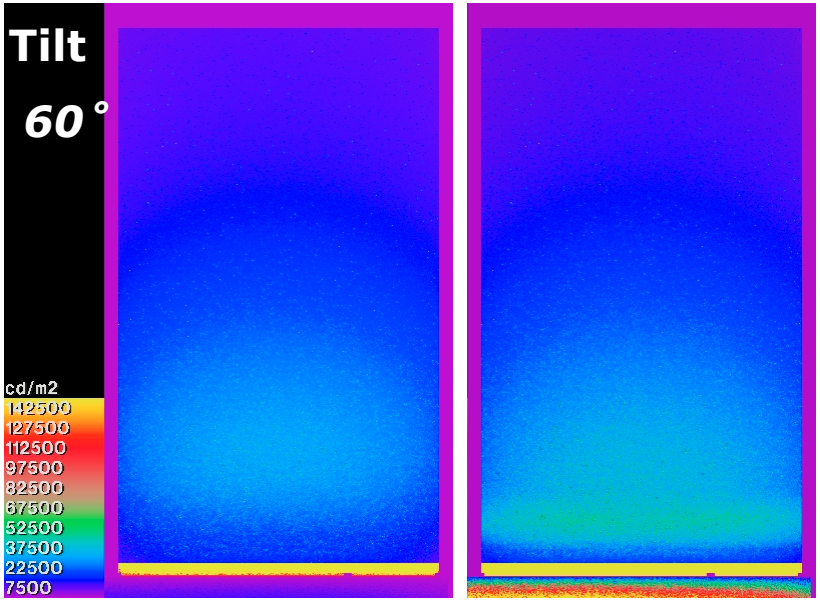
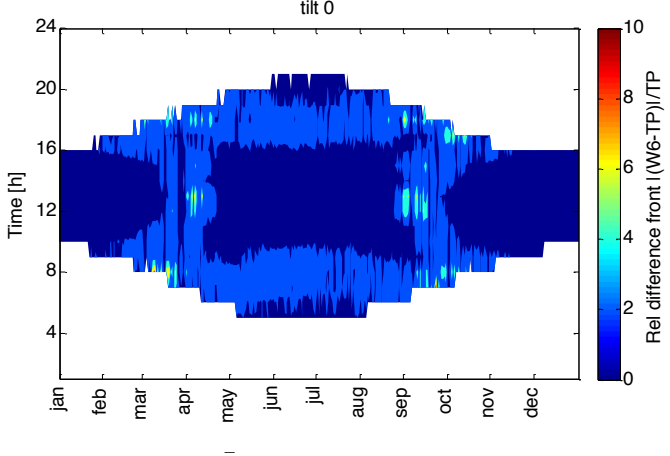




Time series

Tilt 0°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Time [h]
24
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Rel difference front I(W6-TP)I/TP
10
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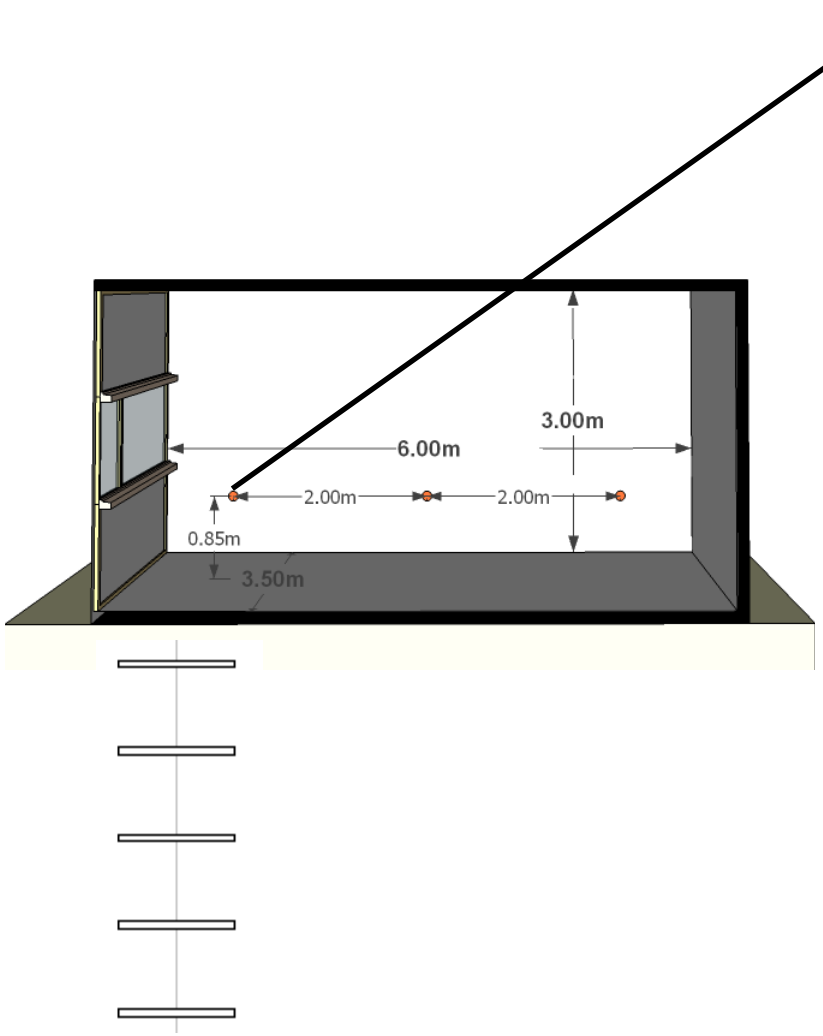
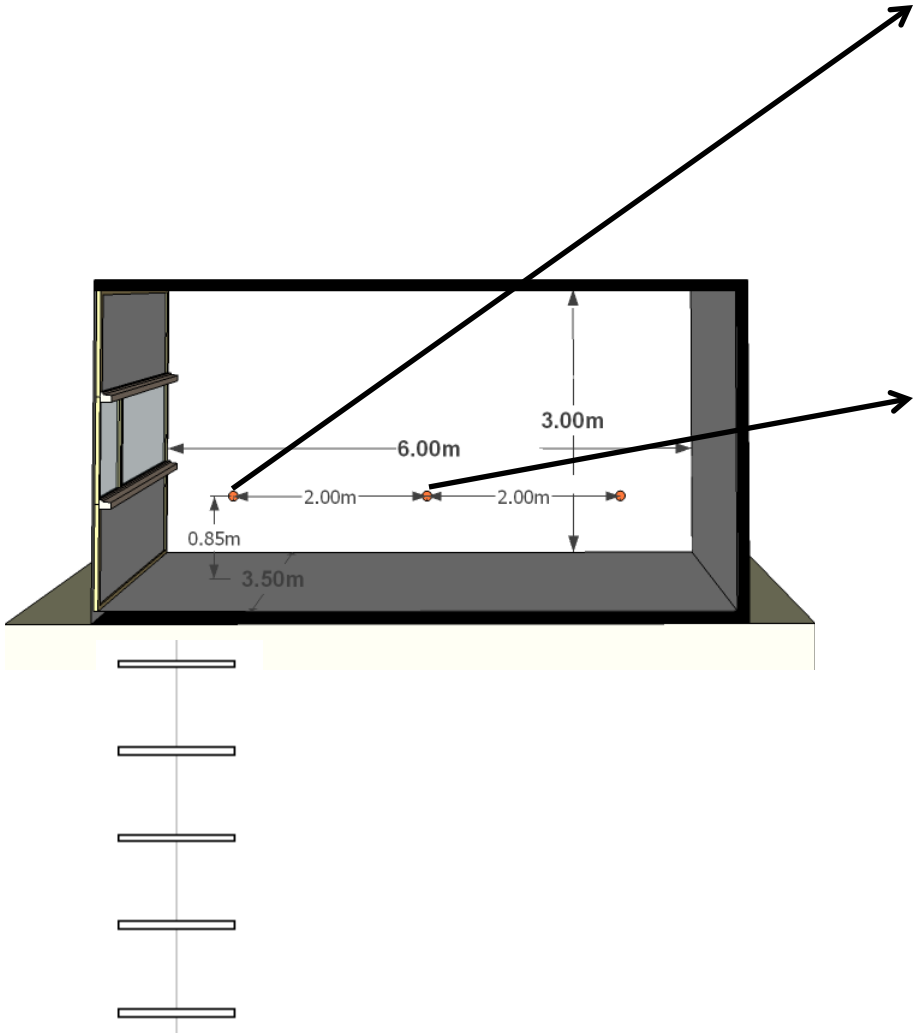
2
0


3.00m
6.00m
2.00m
2.00m
0.85m
3.50m

Tilt 0°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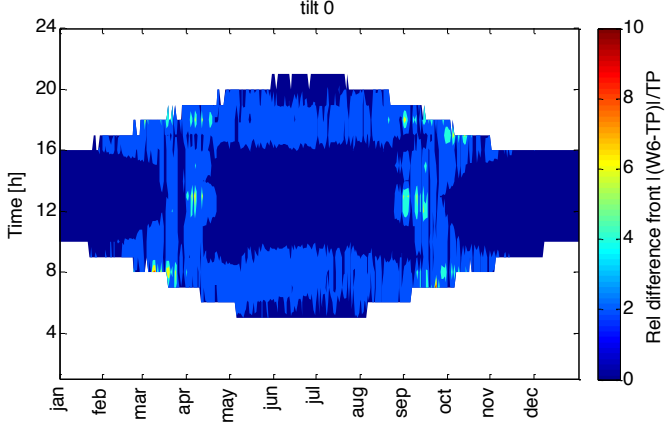
tilt 0
Time [h]
Rel difference front I(W6-TP)I/TP
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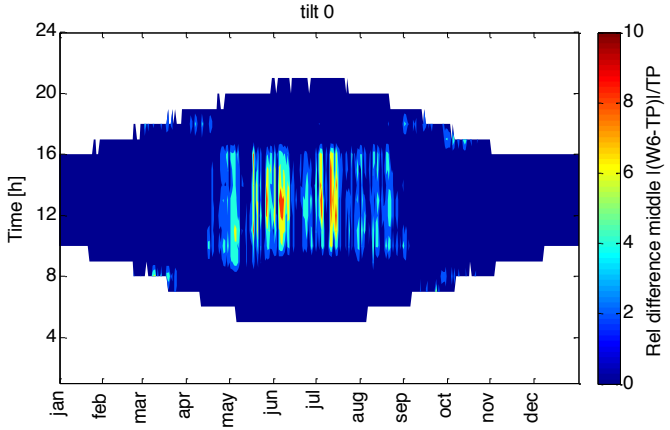
tilt 0
Time [h]
Rel difference middle I(W6-TP)I/TP
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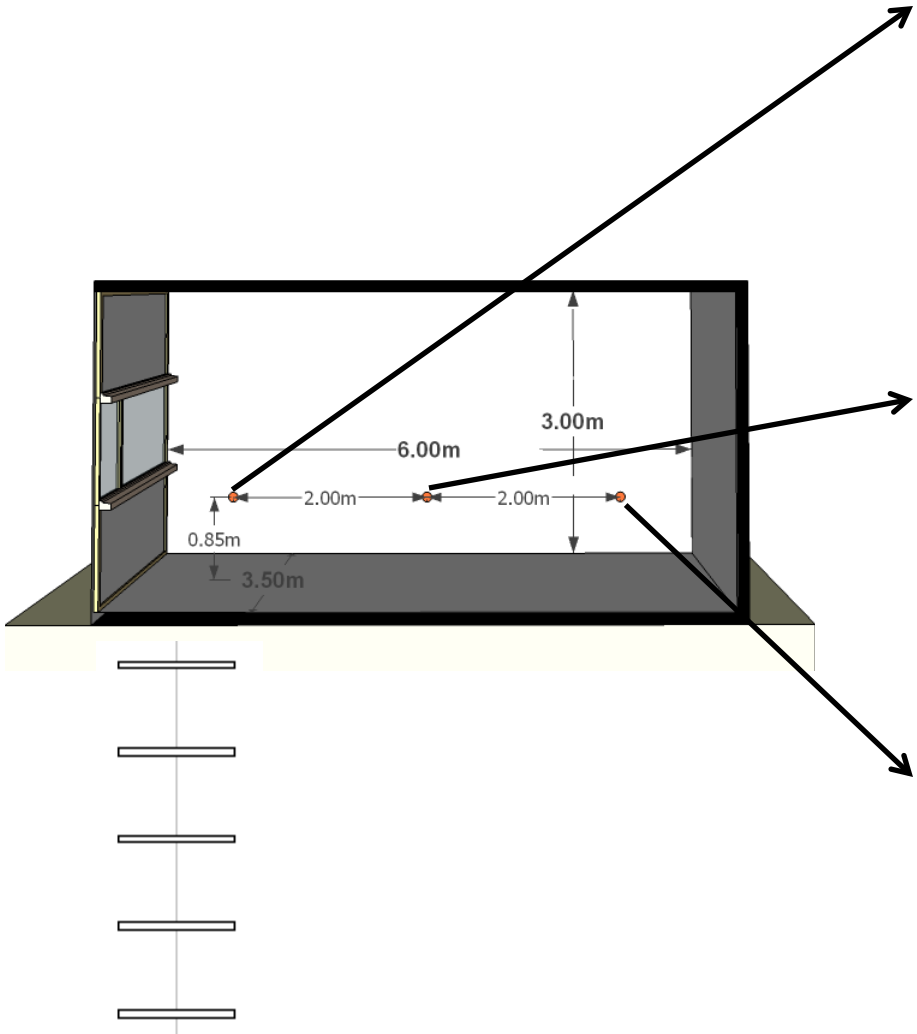
dec

Tilt 0°


3.00m
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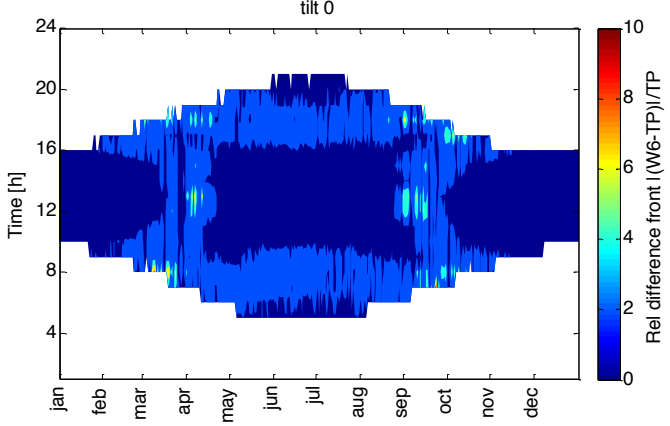
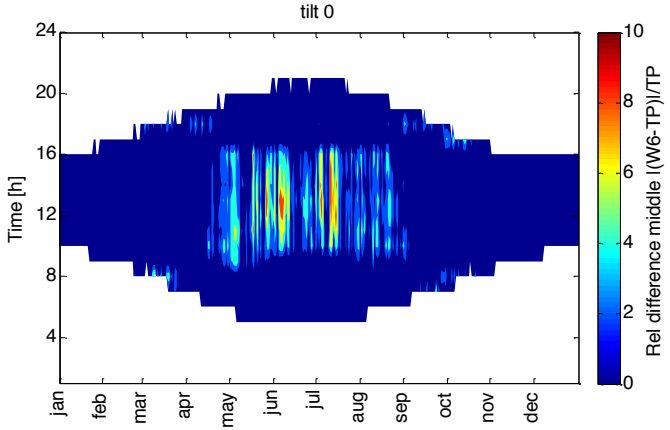
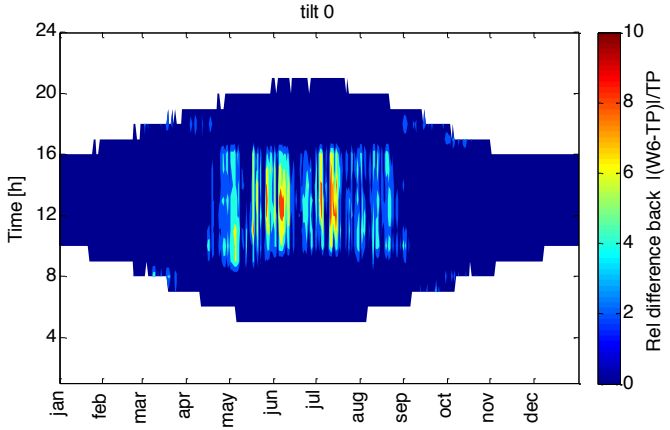
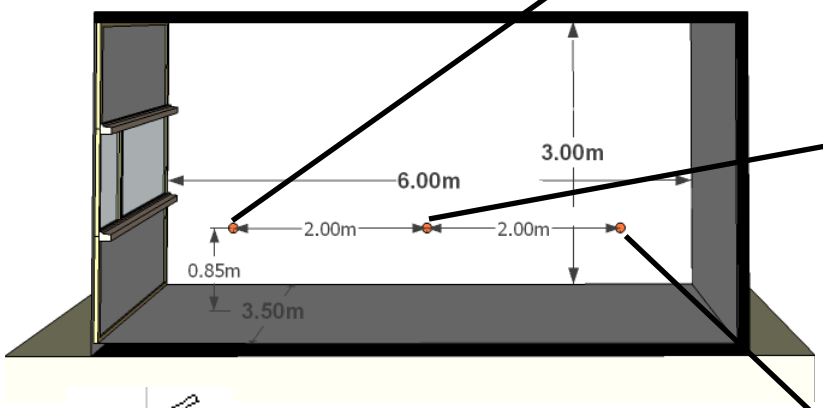
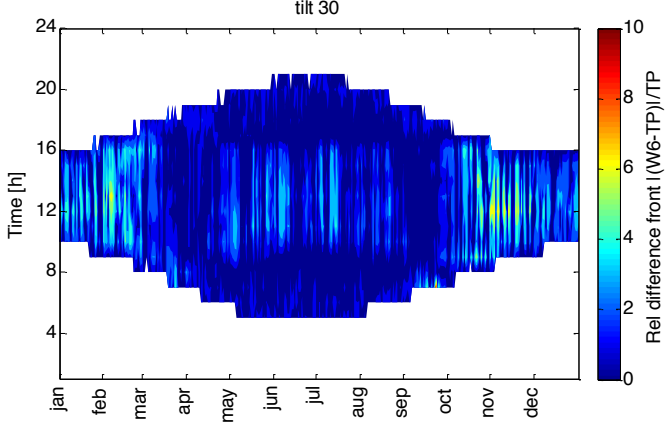

tilt 0
Time [h]
jan feb mar apr may jun jul aug sep oct nov dec
Rel difference front I(W6-TP)I/TP


tilt 0
Time [h]
jan feb mar apr may jun jul aug sep oct nov dec
Rel difference middle I(W6-TP)I/TP


tilt 0
Time [h]
jan feb mar apr may jun jul aug sep oct nov dec
Rel difference back I(W6-TP)I/TP

Tilt 30°


6.00m
3.00m
2.00m
2.00m
0.85m
3.50m


tilt 30
Time [h]
Rel difference front I(W6-TP)I/TP
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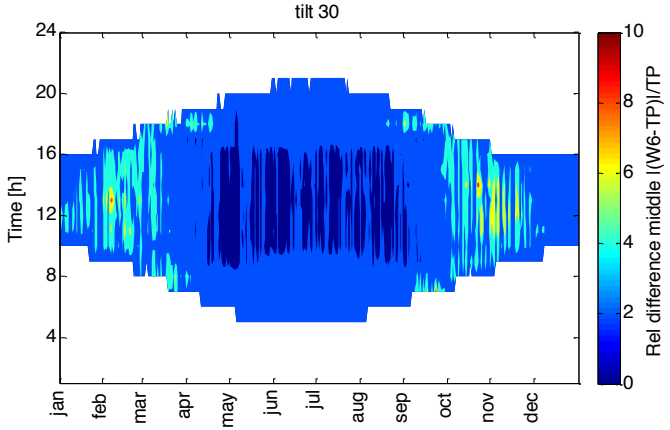
tilt 30
Time [h]
Rel difference middle I(W6-TP)I/TP
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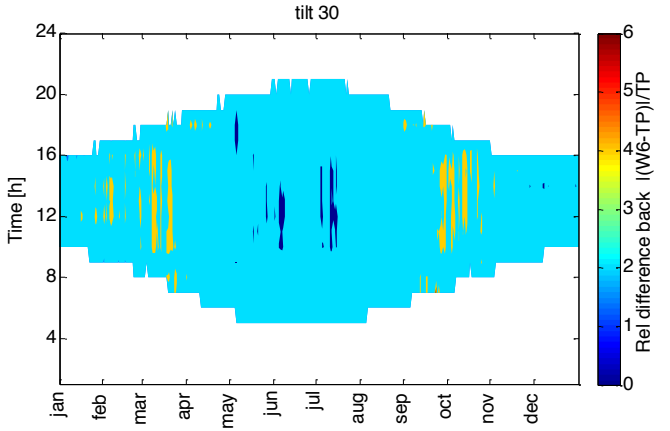
tilt 30
Time [h]
Rel difference back I(W6-TP)I/TP
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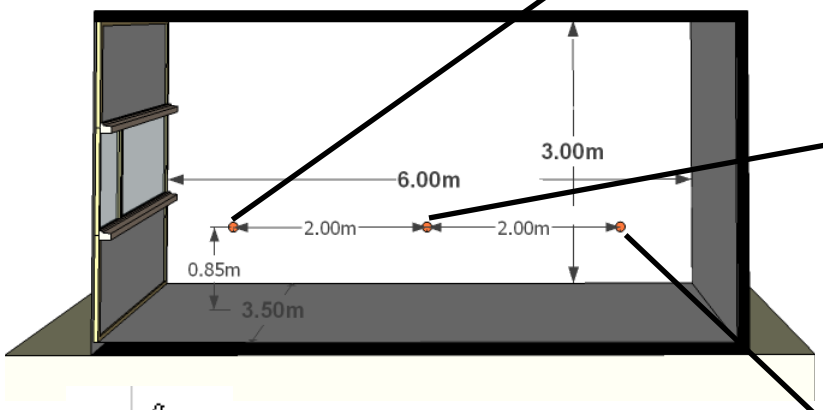
Tilt 60°


6.00m
3.00m
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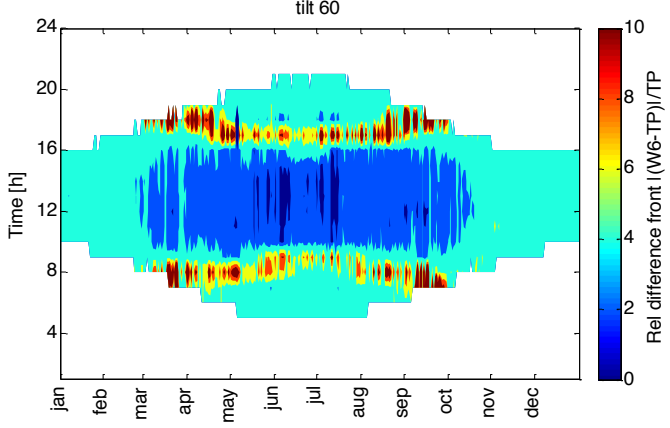
tilt 60
Time [h]
Rel difference front I(W6-TP)I/TP
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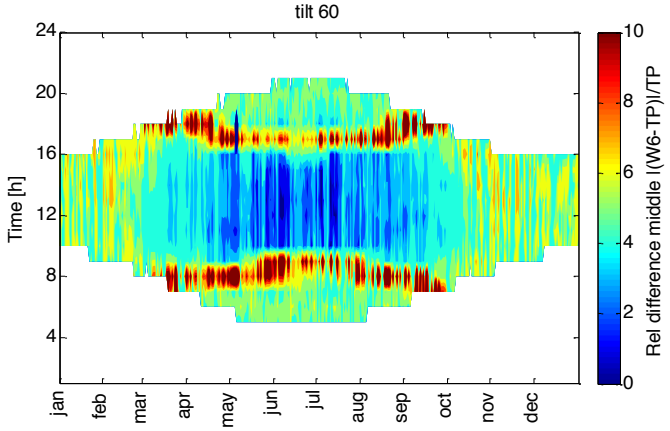
tilt 60
Time [h]
Rel difference middle I(W6-TP)I/TP
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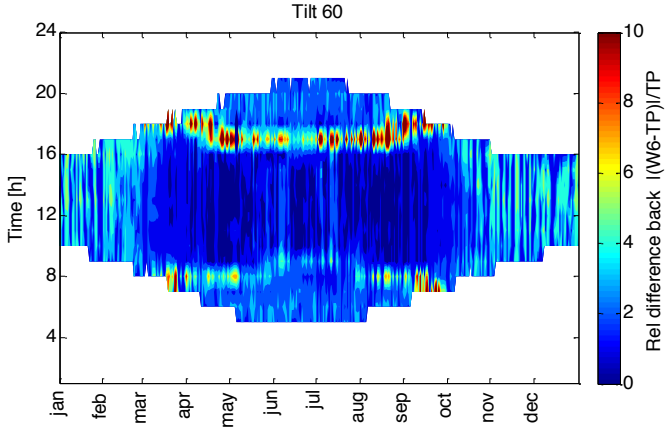
Tilt 60
Time [h]
Rel difference back I(W6-TP)I/TP
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Conclusion

- OK agreement between simulations with Window6 BSDF and TracePro BSDF

- Highest discrepancy for tilt 60° caused by
  -> light being re-reflected in the blinds

Future work

- Simulation of a more complex material
- Comparison to full scale measurements