Daylighting Design: A Daylight Glare Probability based analysis tool

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Overview

▶ Theoretical Background

▶ Method

▶ Tool demonstration: MetaForum

▶ Conclusions and Future development

Daylighting Design: A Daylight Glare Probability based analysis tool

Theoretical Background

Daylighting Design: A Daylight Glare Probability based analysis tool

Theoretical Background

▶ Daylighting Design

    ▶ Availability of daylight for task performance

Theoretical Background

▶ Daylighting Design

   ▶ Availability of daylight for task performance

   ▶ Avoidance of visual discomfort
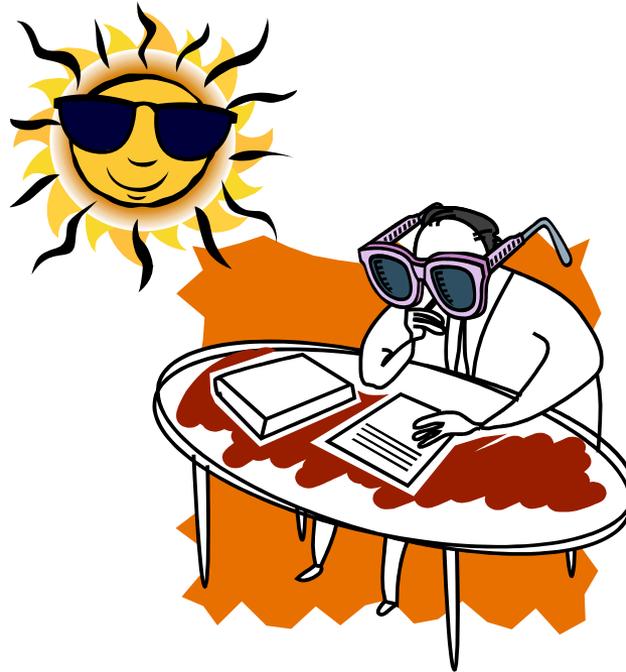
Theoretical Background

▶ ## Glare analysis

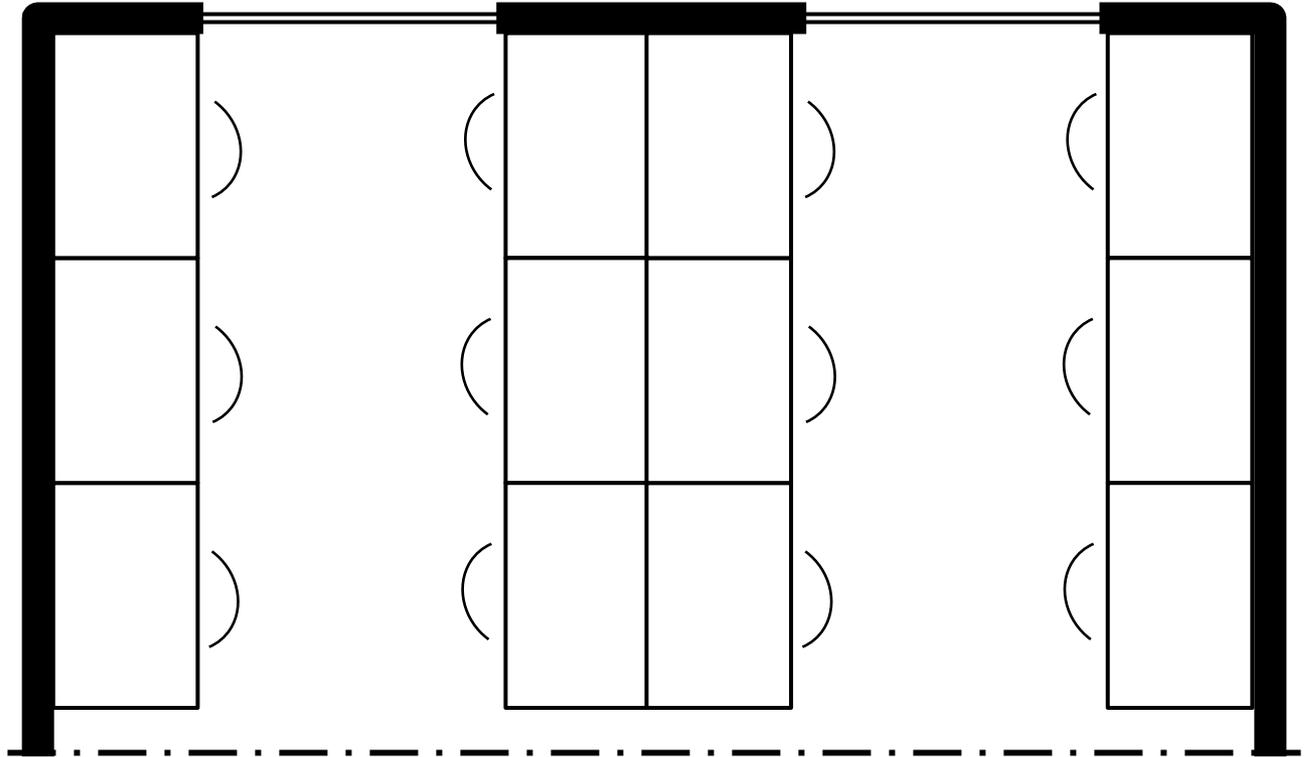▶ ## Maximum Useful Daylight Illuminance

▶ ## Daylight Glare Probability

A. Nabil, J. Mardaljevic. Useful daylight illuminance:
A new paradigm for assessing daylight in buildings.
Lighting Research and Technology 2005;37:41–59.

J. Wienold, J. Christoffersen. Towards a new daylight glare
rating: Proceedings of Lux Europa 2005 - Lumie`re pour
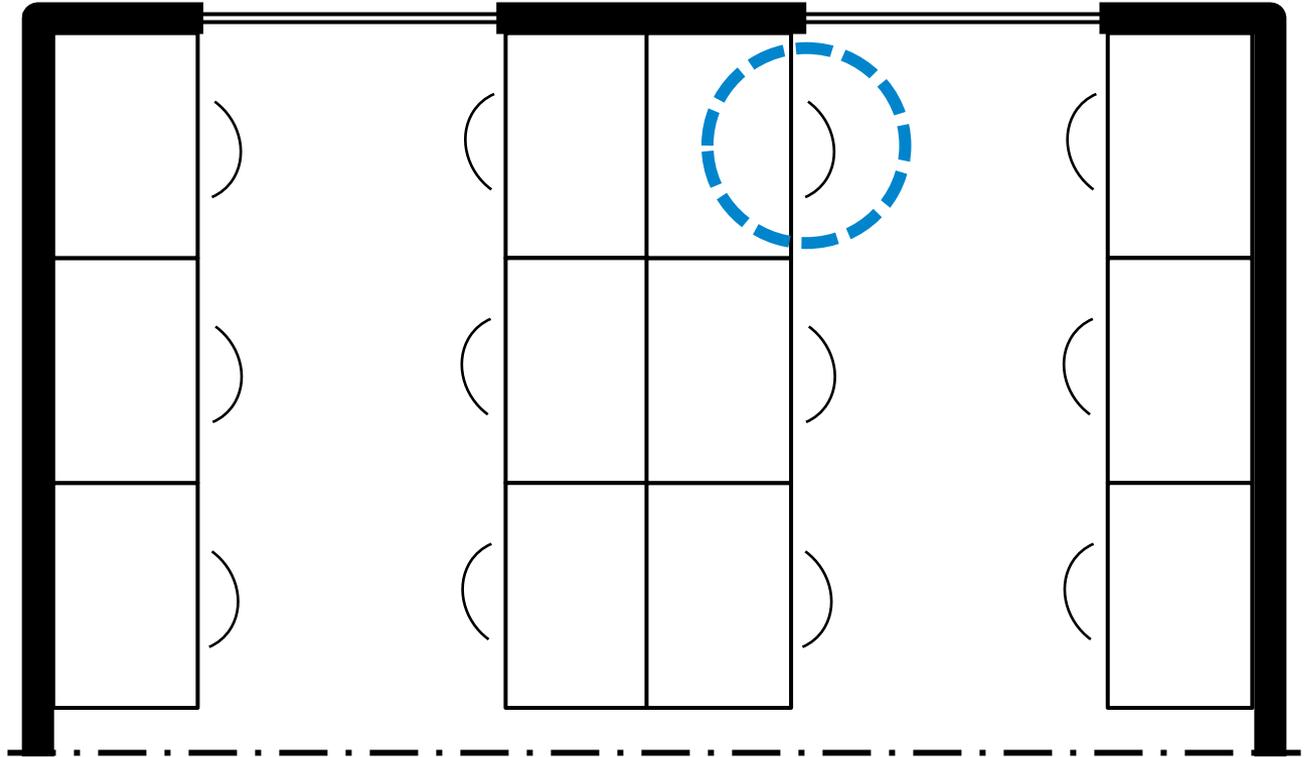l'homme, Sep 19–21. Berlin: 2005.

Theoretical Background

Theoretical Background

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Theoretical Background

Daylighting Design: A Daylight Glare Probability based analysis tool

Theoretical Background

Theoretical Background

▶ UDI_{max}

　　▶ Floor space

　　▶ % of Time

Theoretical Background

▸ UDI$_{max}$

   ▸ Floor space

   ▸ % of Time

▸ DGP

   ▸ Brightness and contrast

Theoretical Background

▶ UDI$_{max}$

  ▶ Floor space

  ▶ % of Time

▶ DGP

  ▶ Brightness and contrast

Method

Method
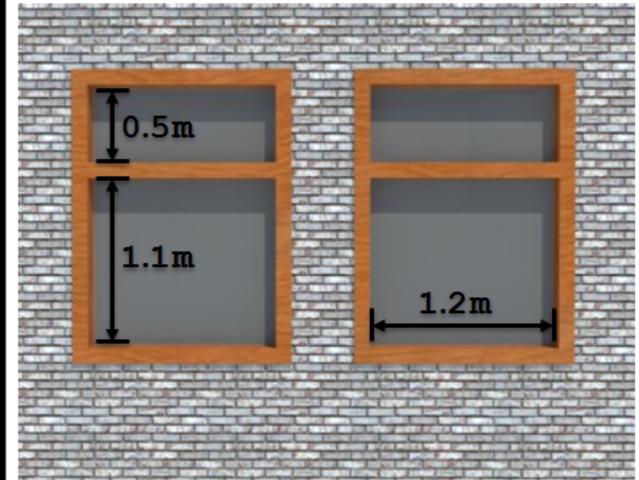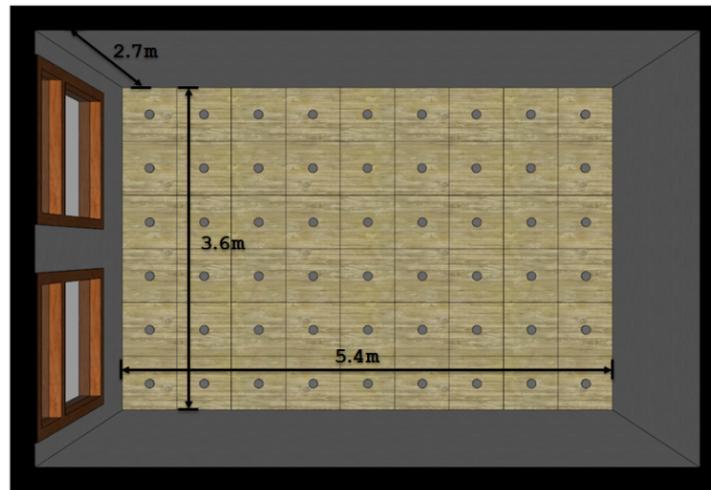
D. van Dijk. Reference office for thermal, solar and lighting calculations; Internal report for IEA SHC Task 27. TNO Building and Construction Research, Department of Sustainable Energy and Buildings, Delft, Netherlands: 2001.

Method

▶ ## Use DGP in grid- and time-based approach

▶ ## Grid

Method

▸ Use DGP in grid- and time-based approach

 ▸ Grid

Method

▸ Use DGP in grid- and time-based approach

▸ Time

Method

▶ Result Presentation

DGP	Sensor 1	Sensor 2	Sensor 3	Sensor 4	Sensor 5	Sensor 6
8:00	0.309187	0.277502	0.260626	0.248367	0.246052	0.244021
9:00	0.356699	0.302541	0.280247	0.261182	0.25379	0.244906
10:00	0.367384	0.335964	0.296979	0.272847	0.259299	0.249434
11:00	0.379443	0.329023	0.318449	0.284569	0.262797	0.253094
12:00	0.390982	0.332575	0.311157	0.291873	0.265985	0.255518
13:00	0.397619	0.335777	0.311035	0.290291	0.266474	0.256383
14:00	0.421127	0.342045	0.311948	0.288458	0.263927	0.254528
15:00	0.45065	0.360717	0.31473	0.286954	0.260403	0.252871
16:00	0.453683	0.395214	0.330749	0.289438	0.264874	0.253755
17:00	0.448965	0.399359	0.36349	0.309666	0.272497	0.256924
18:00	0.439377	0.39807	0.367441	0.336662	0.29863	0.266267

43%	10%	38%	38%	10%	43%
81%	48%	57%	62%	48%	81%
100%	81%	81%	81%	76%	100%
100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%

Method

- Theoretical Background
- <u>Method</u>
  - Grid
  - % of Time
  - <u>Result presentation</u>
  - Tool
- Tool demonstration
- Conclusions and Future development

▸ Result Presentation

Method

- Theoretical Background
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  - Result presentation
  - Tool
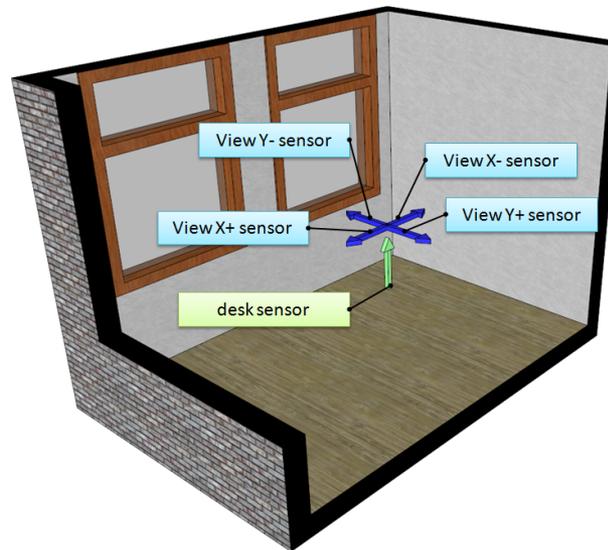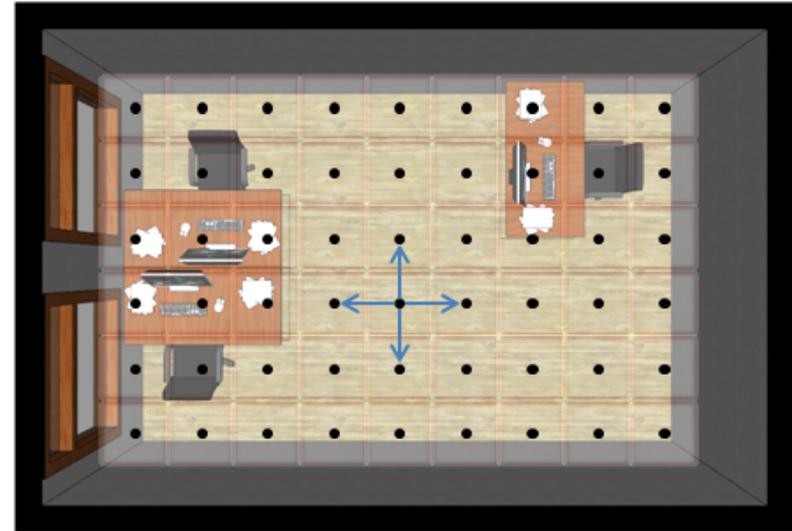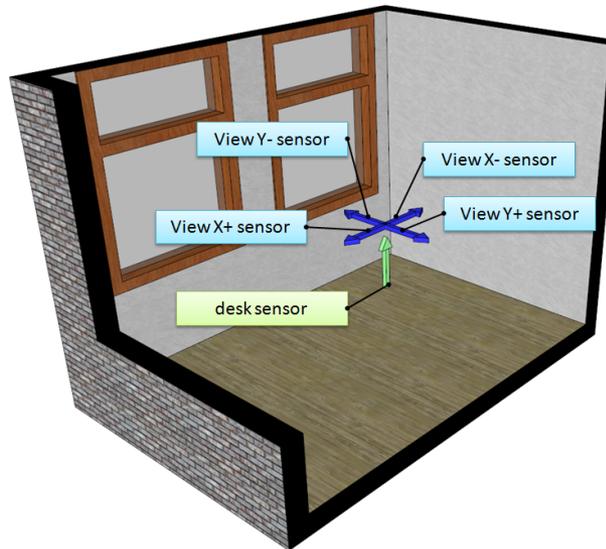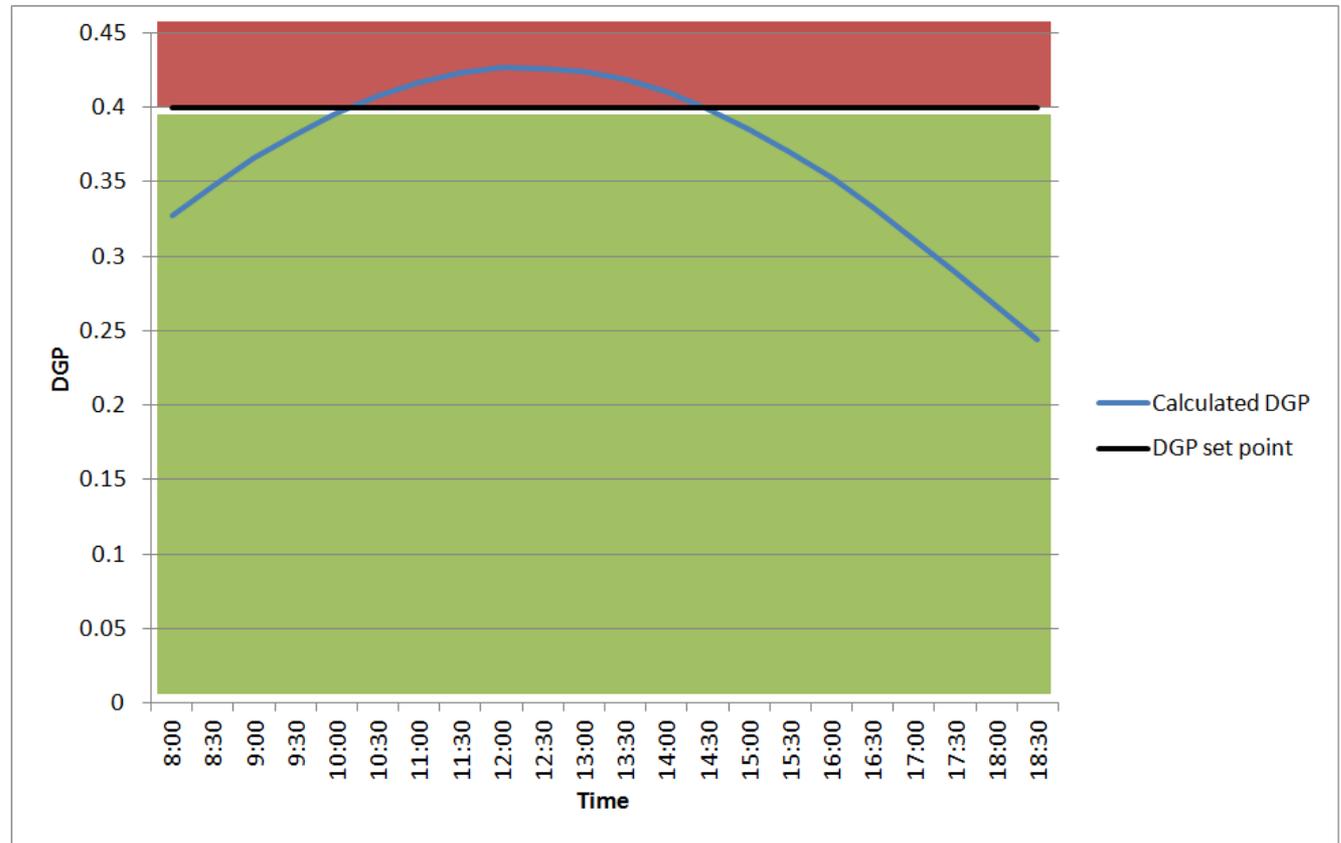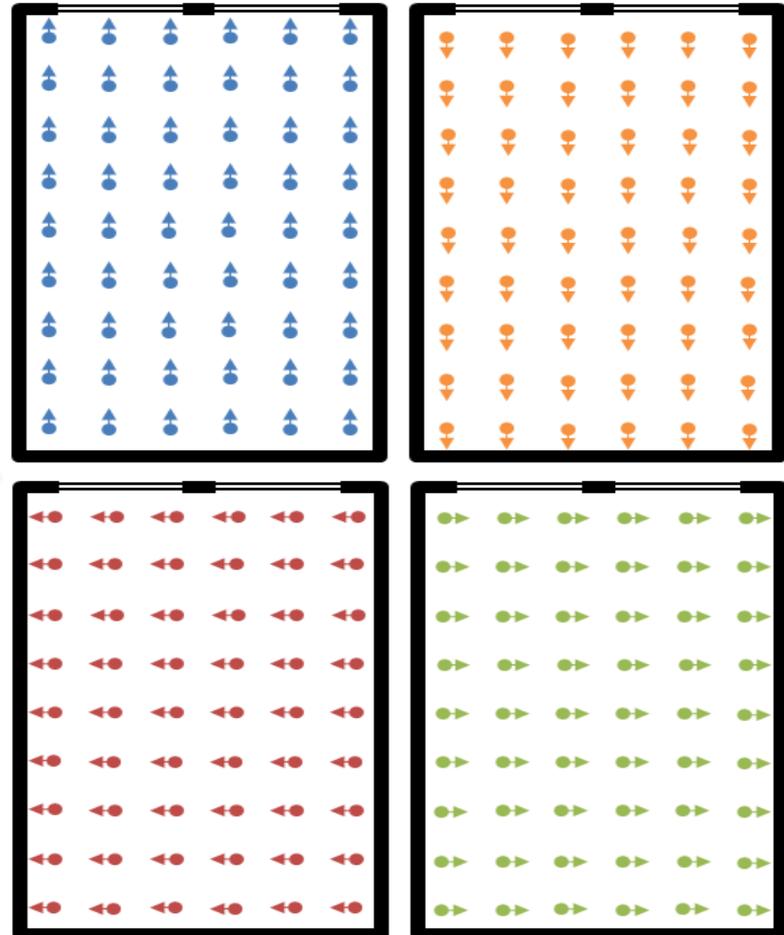- Tool demonstration
- Conclusions and Future development
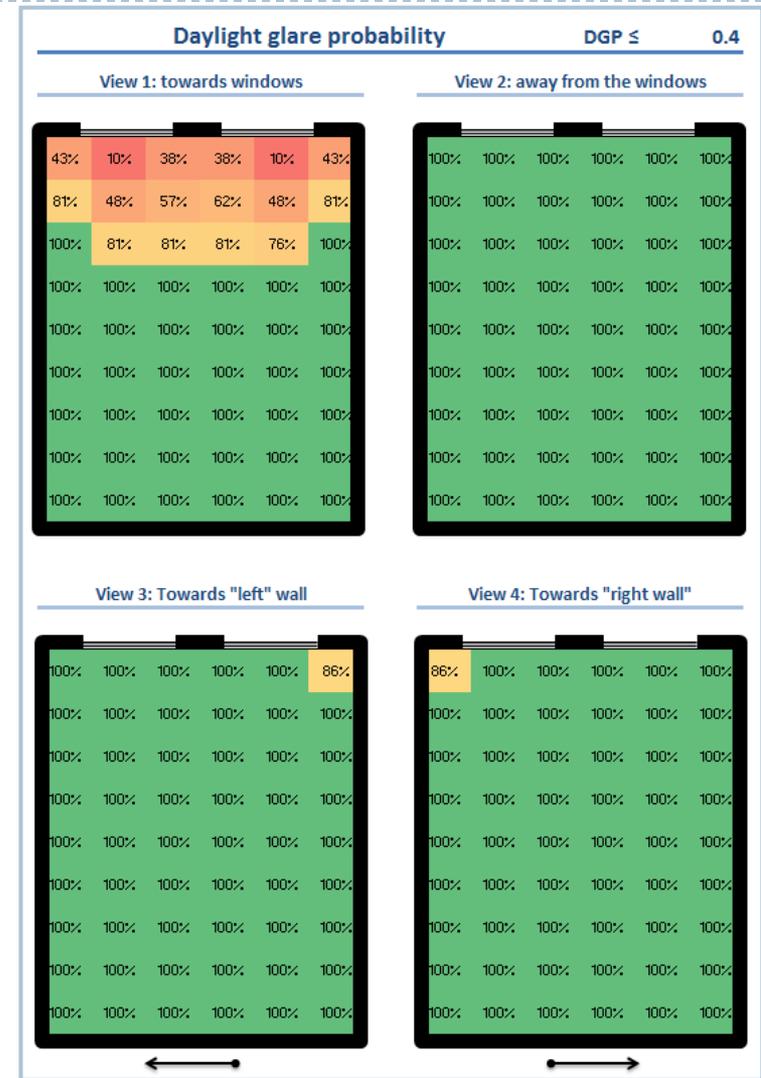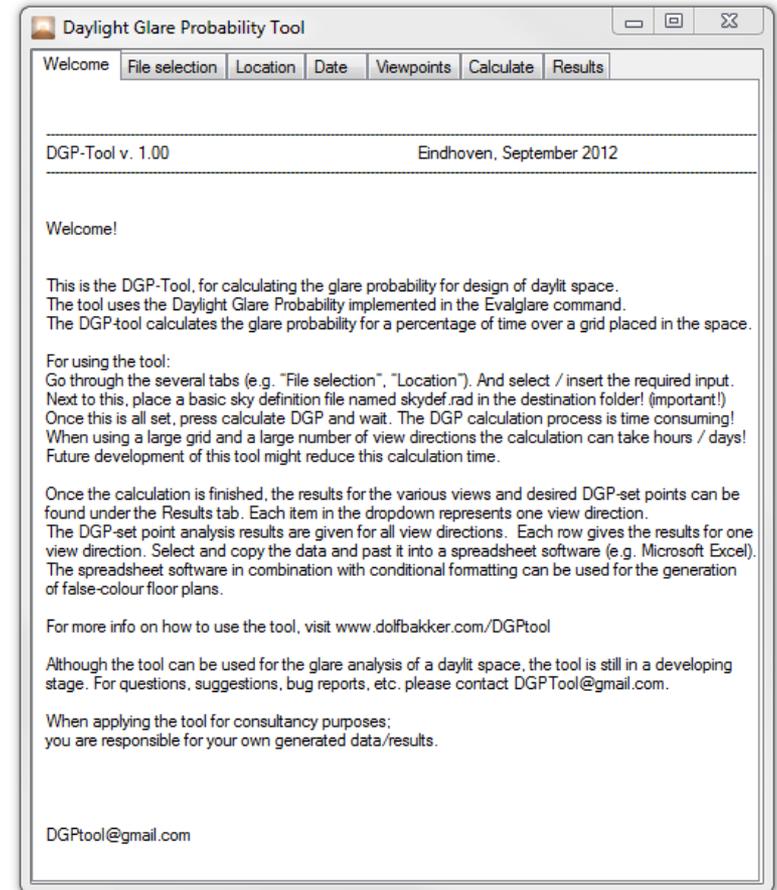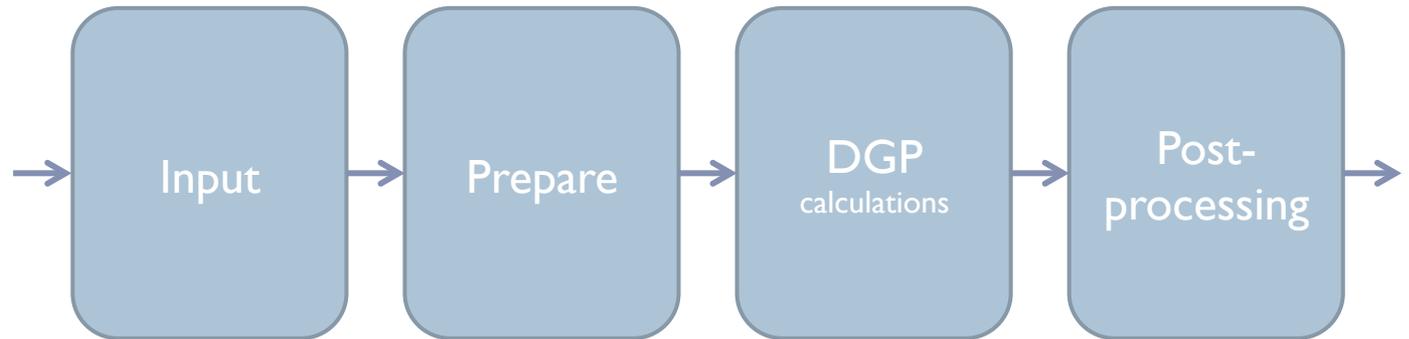
▶ ## Result Presentation

Method

▸ **Tool for Windows**

   ▸ Radiance for Windows

   ▸ DAYSIM

      ▸ **Evalglare**

Tool demonstration: MetaForum

Tool demonstration: MetaForum

Input → Prepare → DGP calculations → Post-processing →

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Tool demonstration: MetaForum

▶ MetaForum

  ▶ Technical University of Eindhoven

  ▶ Flex-Desks for students

Ector Hoogstad Architects

Tool demonstration: MetaForum

Tool demonstration: MetaForum

Tool demonstration: MetaForum

Tool demonstration: MetaForum

- Theoretical Background
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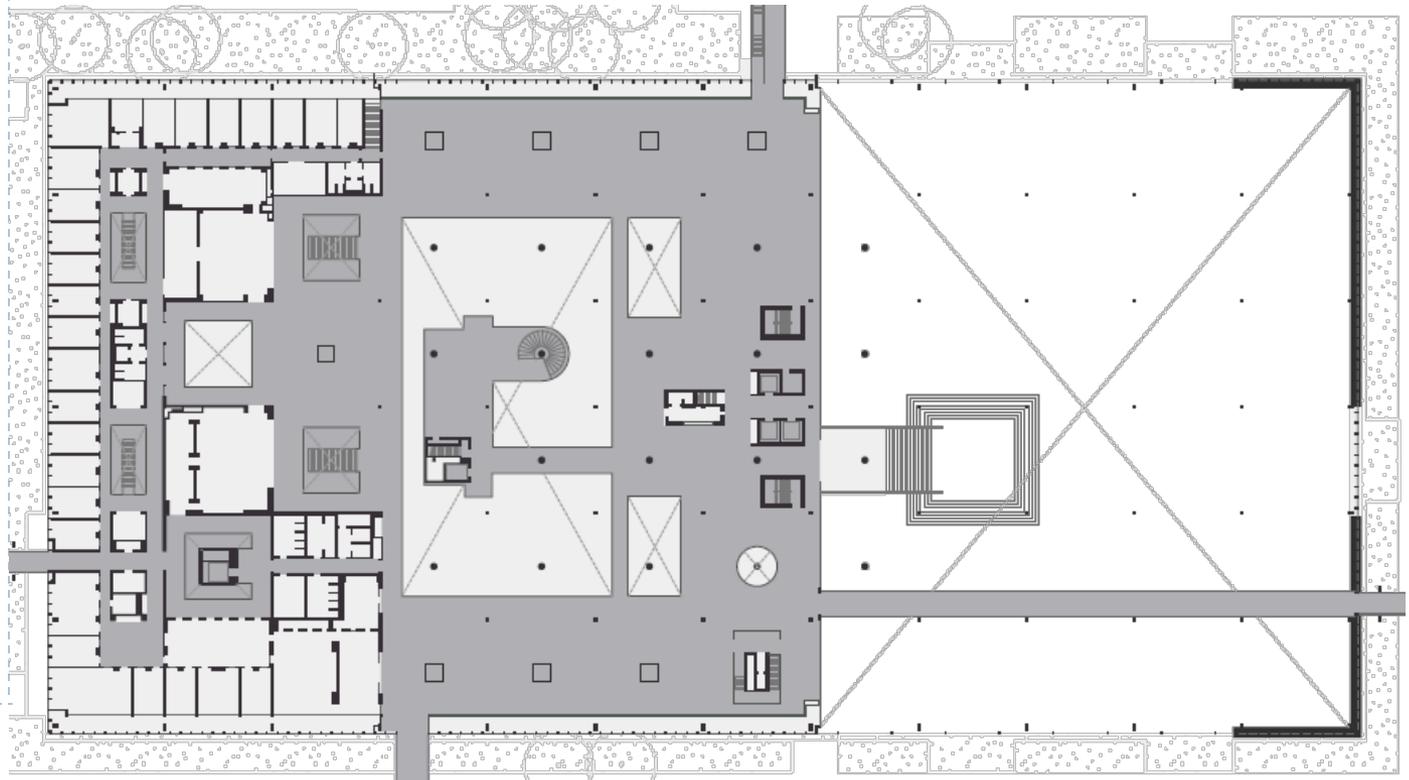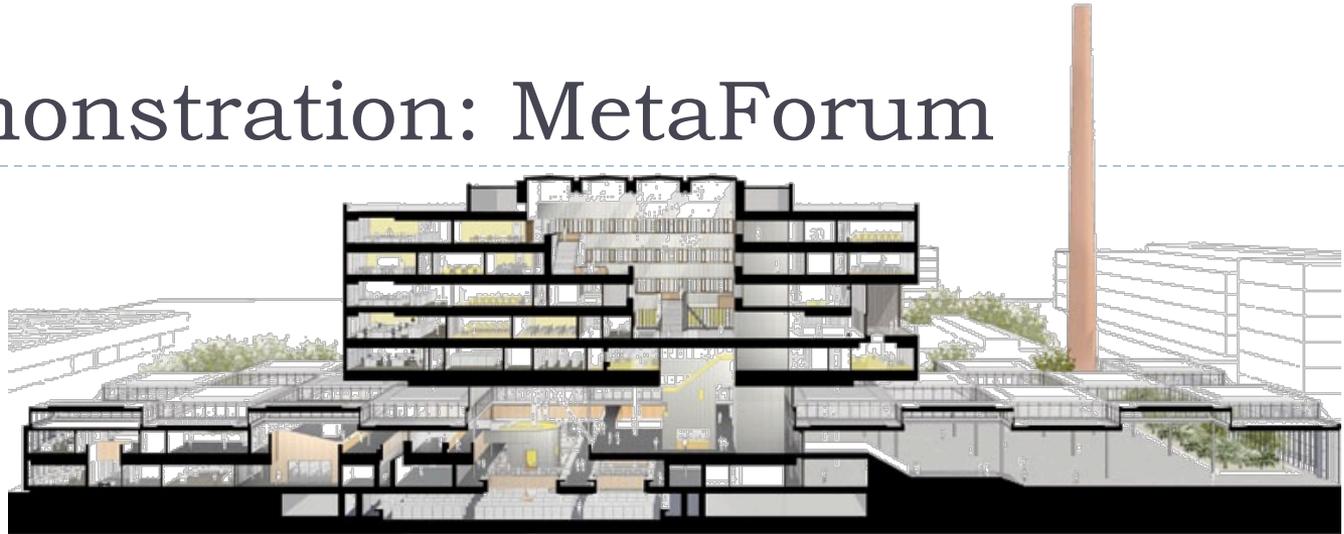
Tool demonstration: MetaForum

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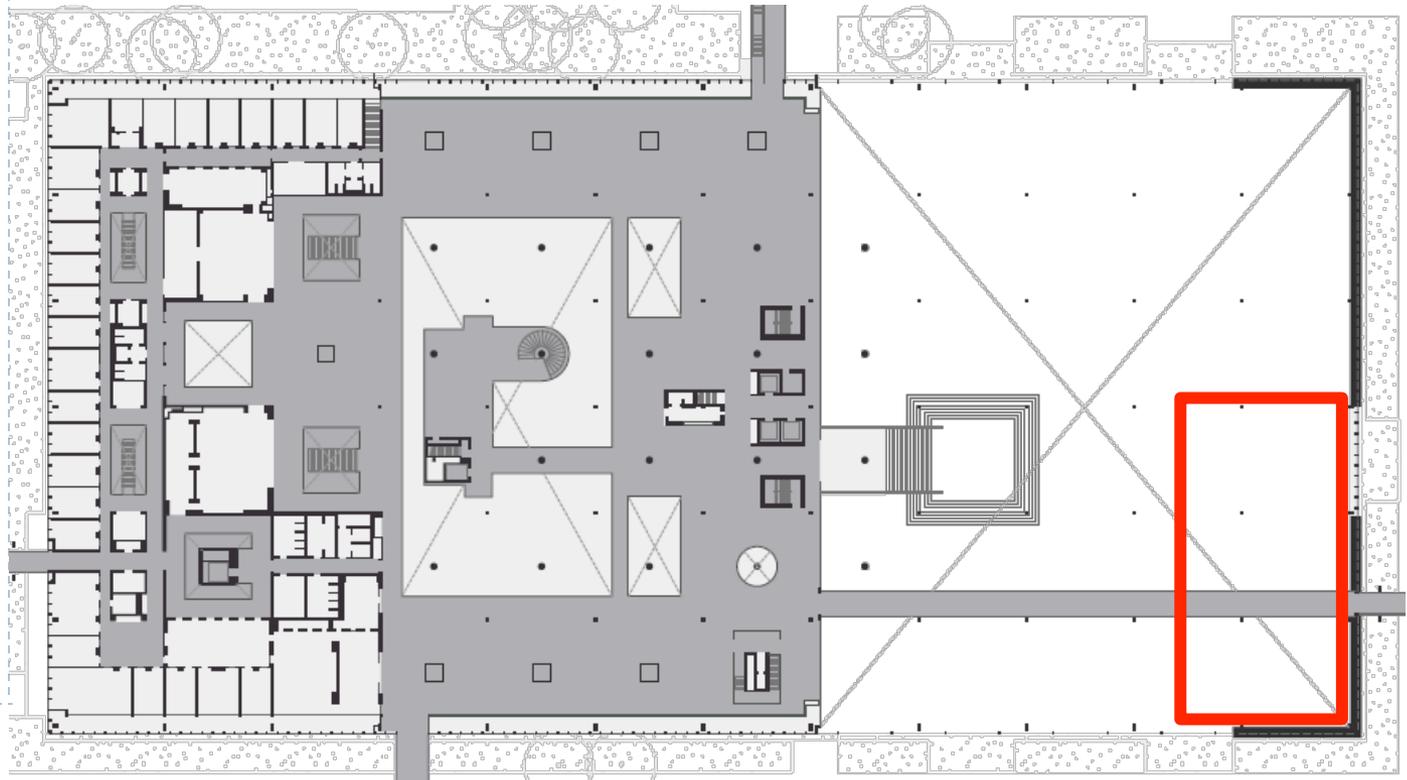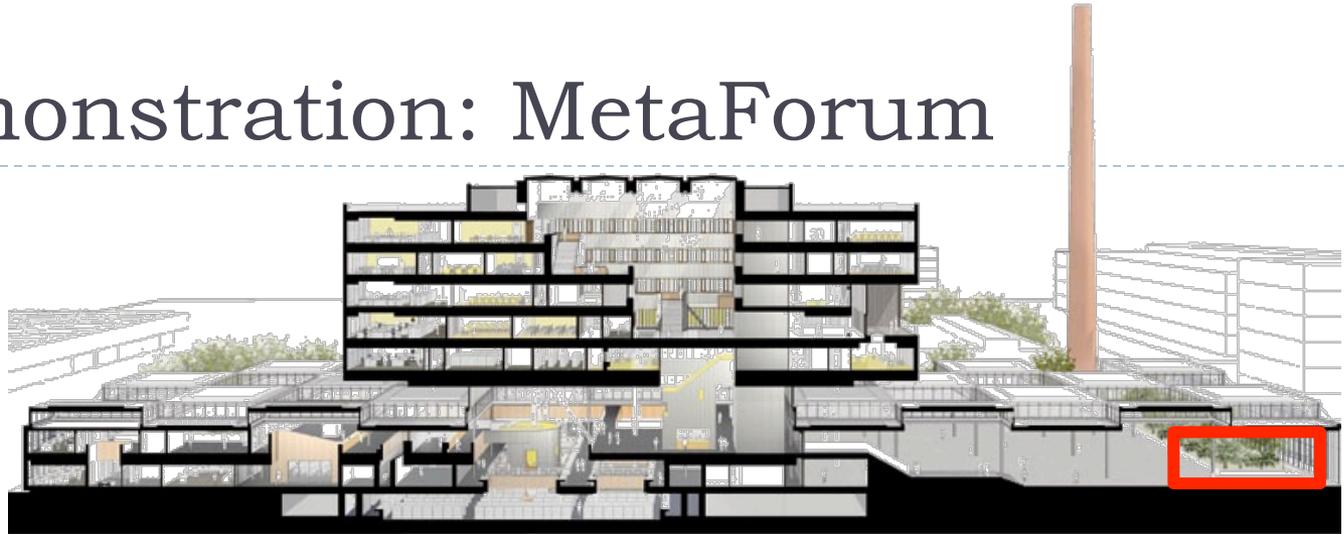- Conclusions and Future development

Tool demonstration: MetaForum

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Input → Prepare → DGP calculations → Post-processing →

C.E. Laudij
Master student Architecture & Building Physics

Daylight Glare Probability Tool

Welcome | File selection | Location | Date | Viewpoints | Calculate | Results

Select Radiance rad (*.rad) file
C:\Users\Bakker D\Documents\Copenhagen2012\Models   Browse

Select destination folder
C:\Users\Bakker D\Documents\Copenhagen2012\Models   Browse

*.Rad file

Including material information
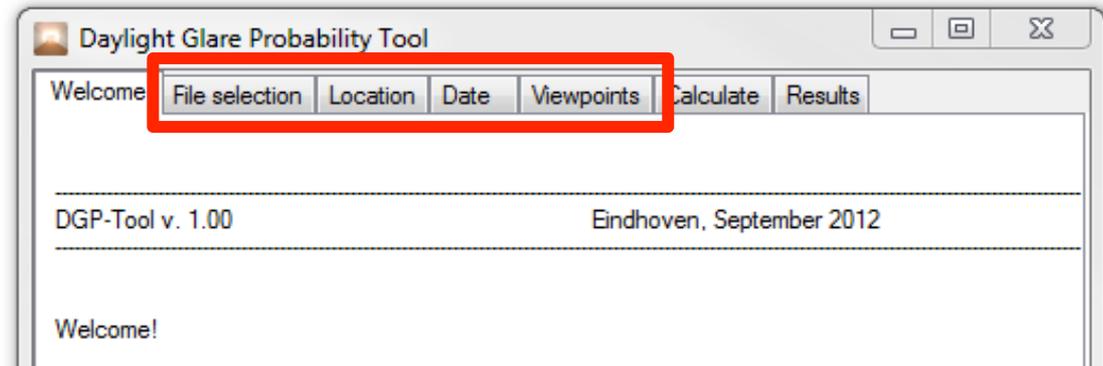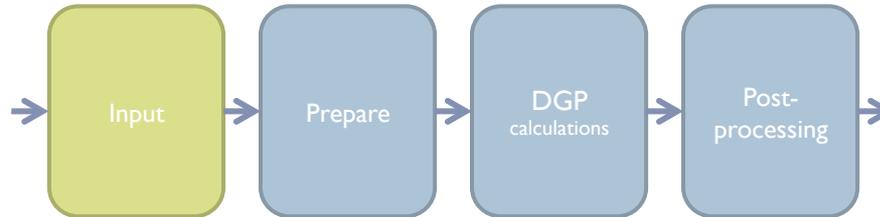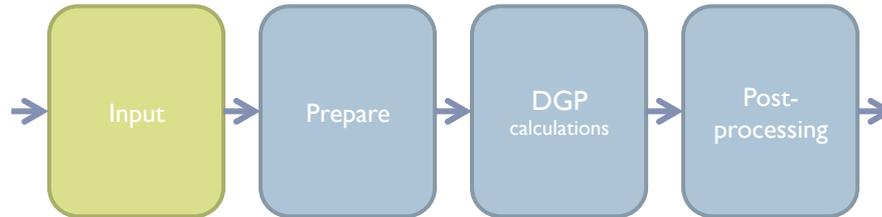
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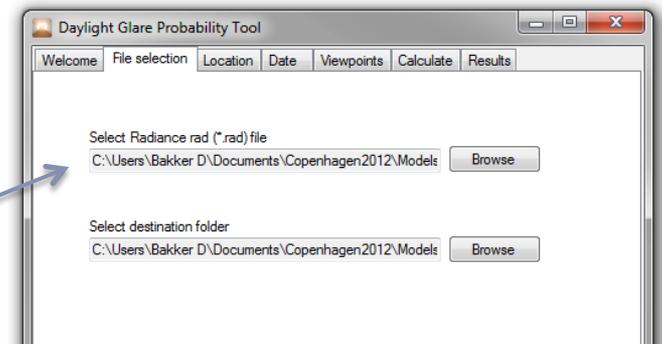- Conclusions and Future development

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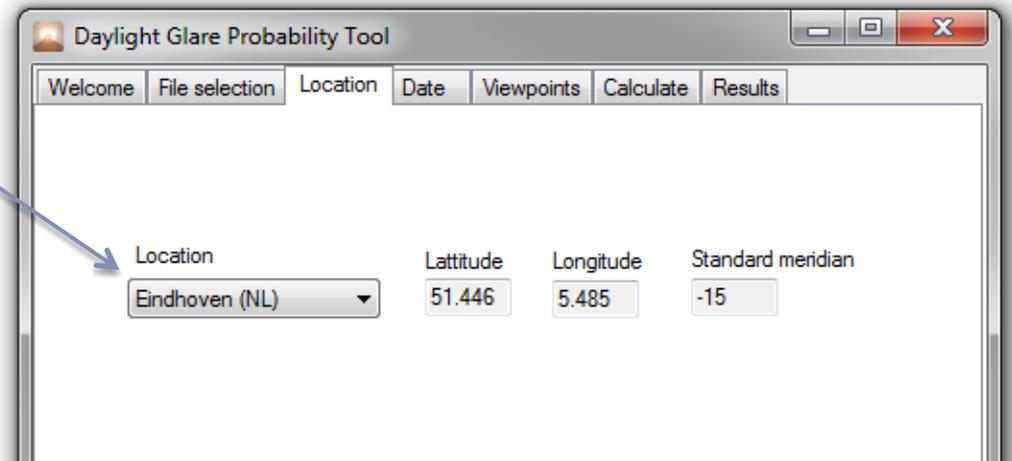 - Results
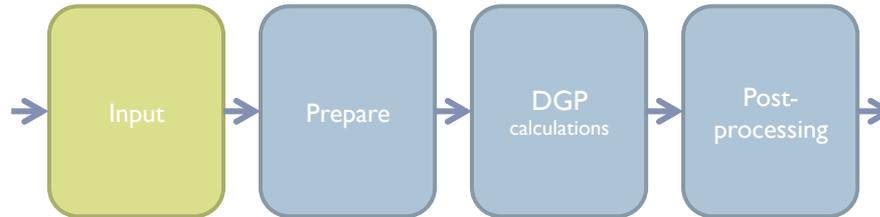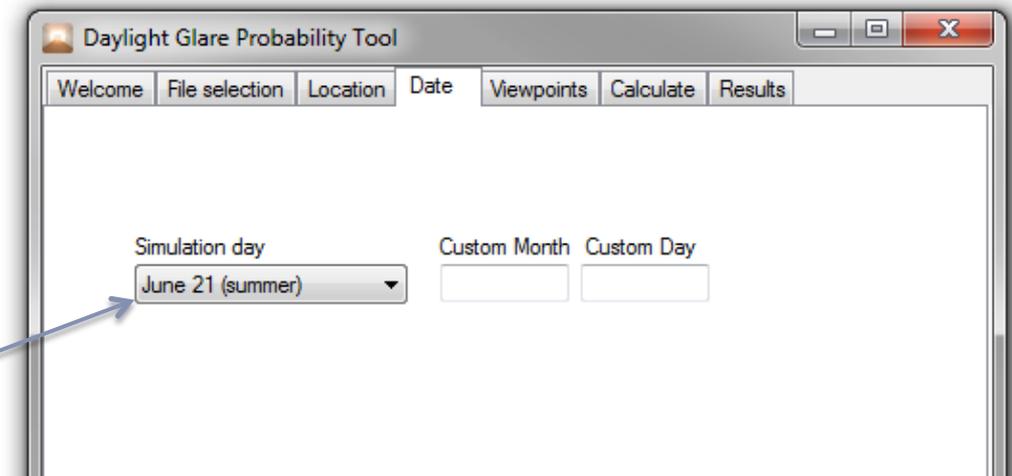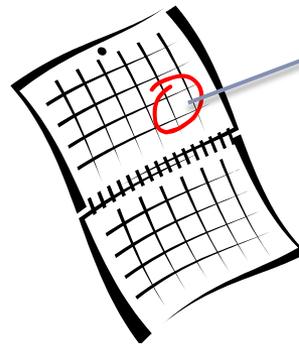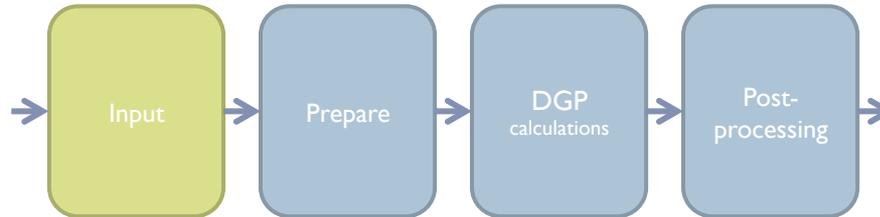- Conclusions and Future development

Input → Prepare → DGP calculations → Post-processing →

Grid-points file
X[space]Y[space]Z

```
1.5 19.5 1.35
4.5 19.5 1.35
7.5 19.5 1.35
10.5 19.5 1.35
13.5 19.5 1.35
16.5 19.5 1.35
19.5 19.5 1.35
…
```

View-directions file
X[space]Y

```
0 1
1 0
0 -1
-1 0
```

Daylight Glare Probability Tool

Welcome | File selection | Location | Date | Viewpoints | Calculate | Results

Select grid-points file

C:\Users\Bakker D\Documents\Copenhagen2012\Models   Browse ←

Select view directions file

C:\Users\Bakker D\Documents\Copenhagen2012\Models   Browse ←

Number of gridpoints   Number of views
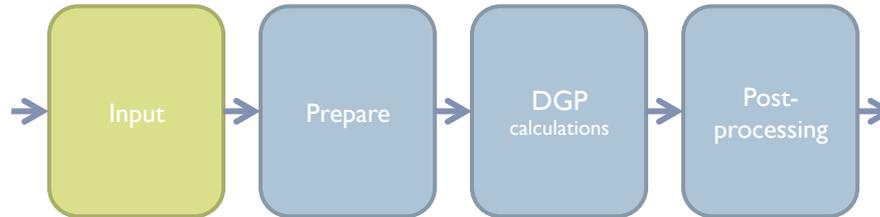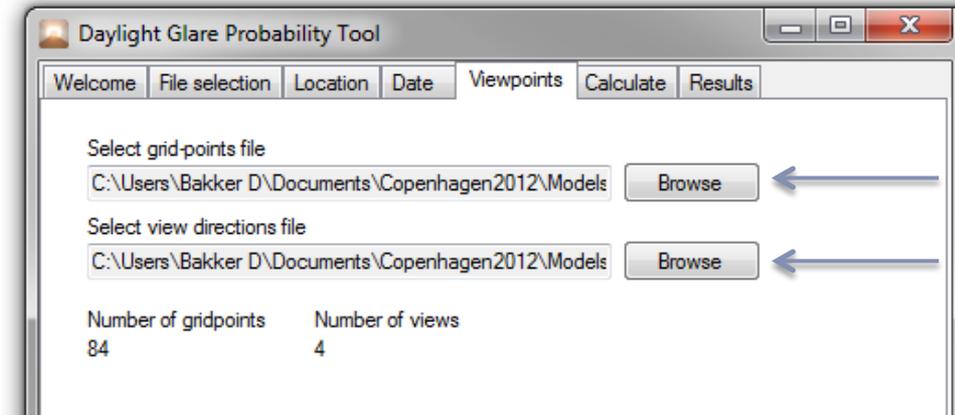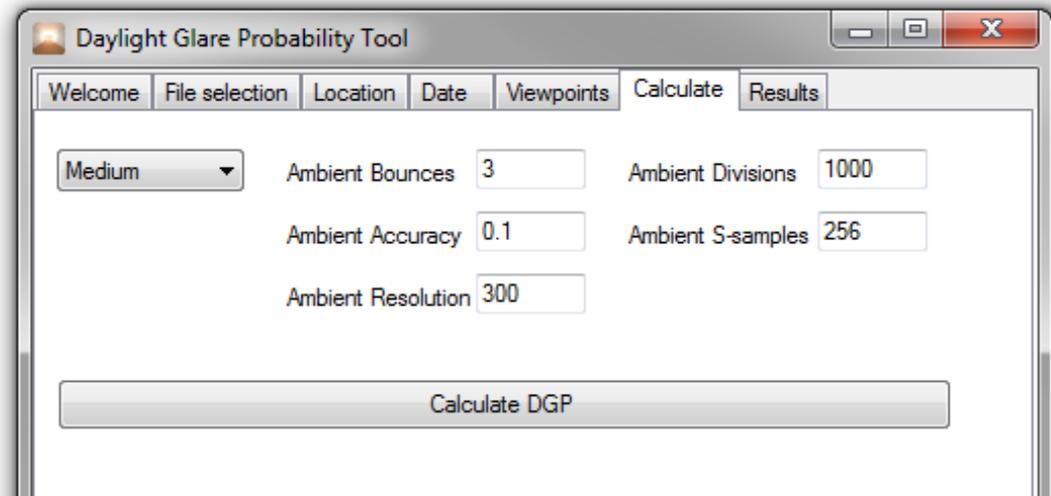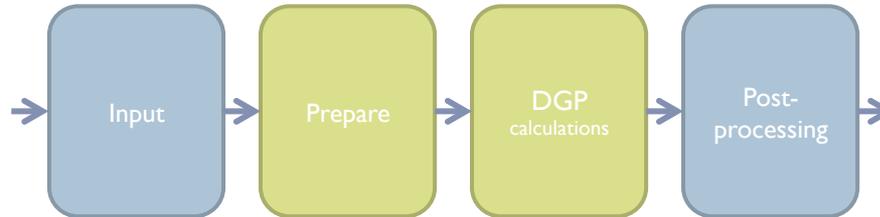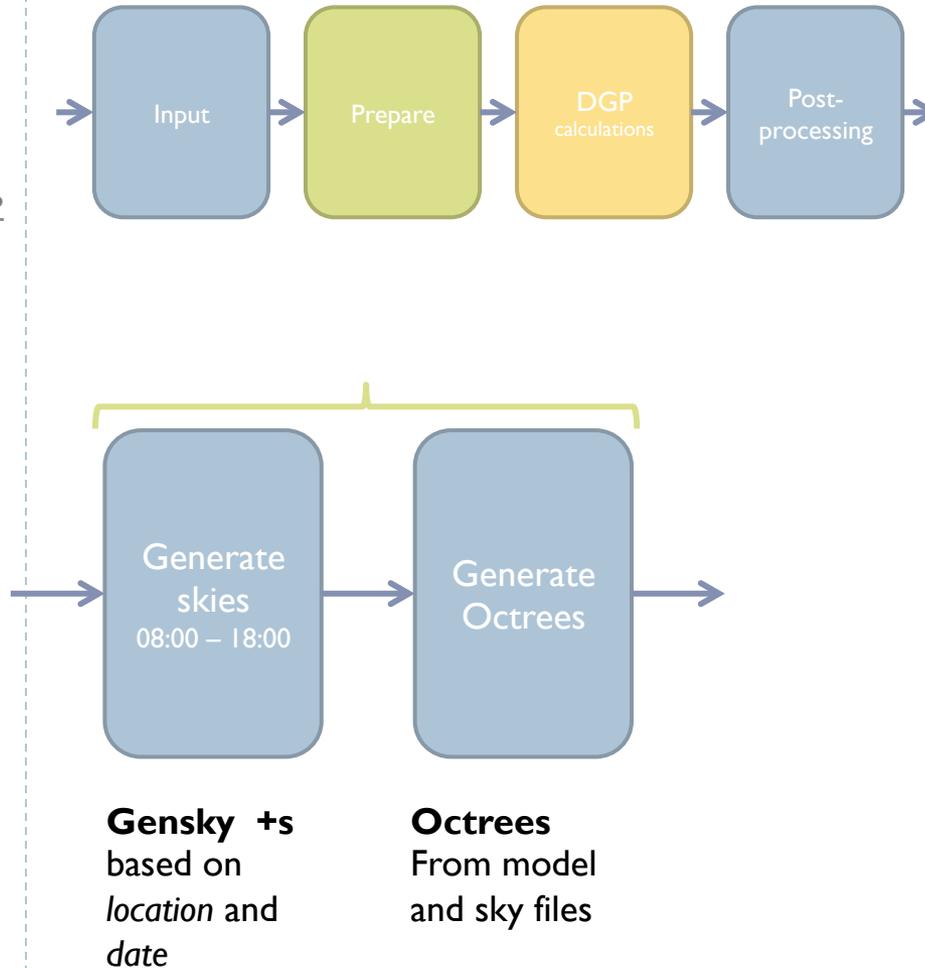84   4

Tool demonstration: MetaForum

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Input → Prepare → DGP calculations → Post-processing →

Daylight Glare Probability Tool

| Welcome | File selection | Location | Date | Viewpoints | Calculate | Results |

Medium ▼

Ambient Bounces 3   Ambient Divisions 1000

Ambient Accuracy 0.1   Ambient S-samples 256

Ambient Resolution 300

Calculate DGP

Tool demonstration: MetaForum

Input → Prepare → DGP calculations → Post-processing →

Generate skies 08:00 – 18:00 → Generate Octrees →

Gensky +s based on *location* and *date*

Octrees From model and sky files
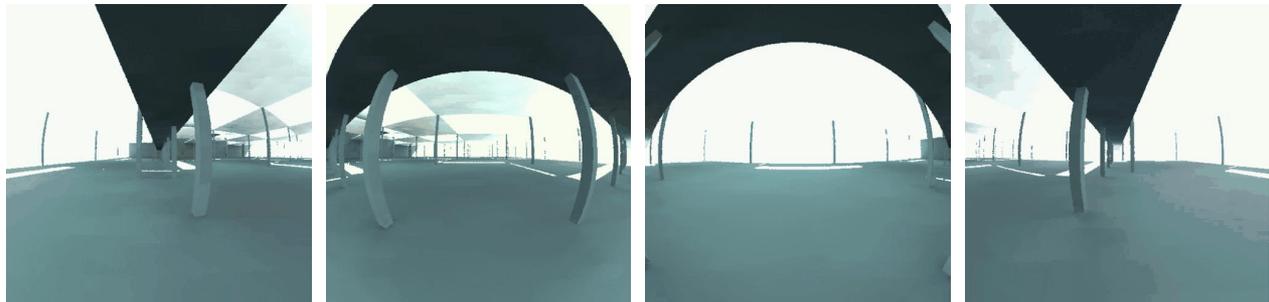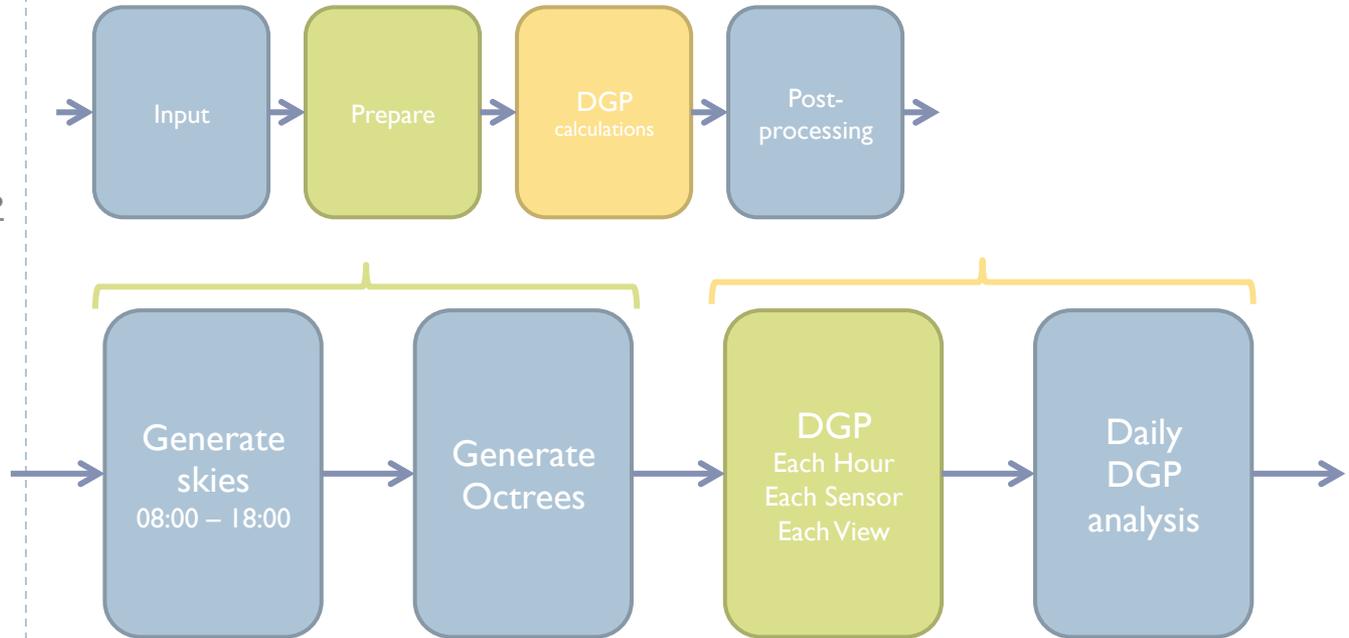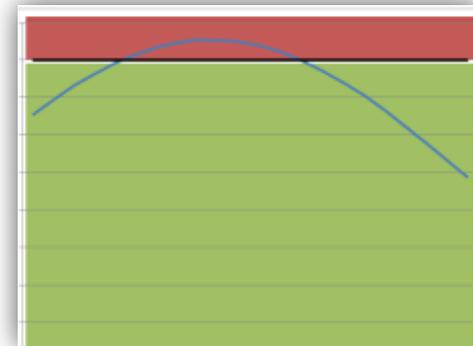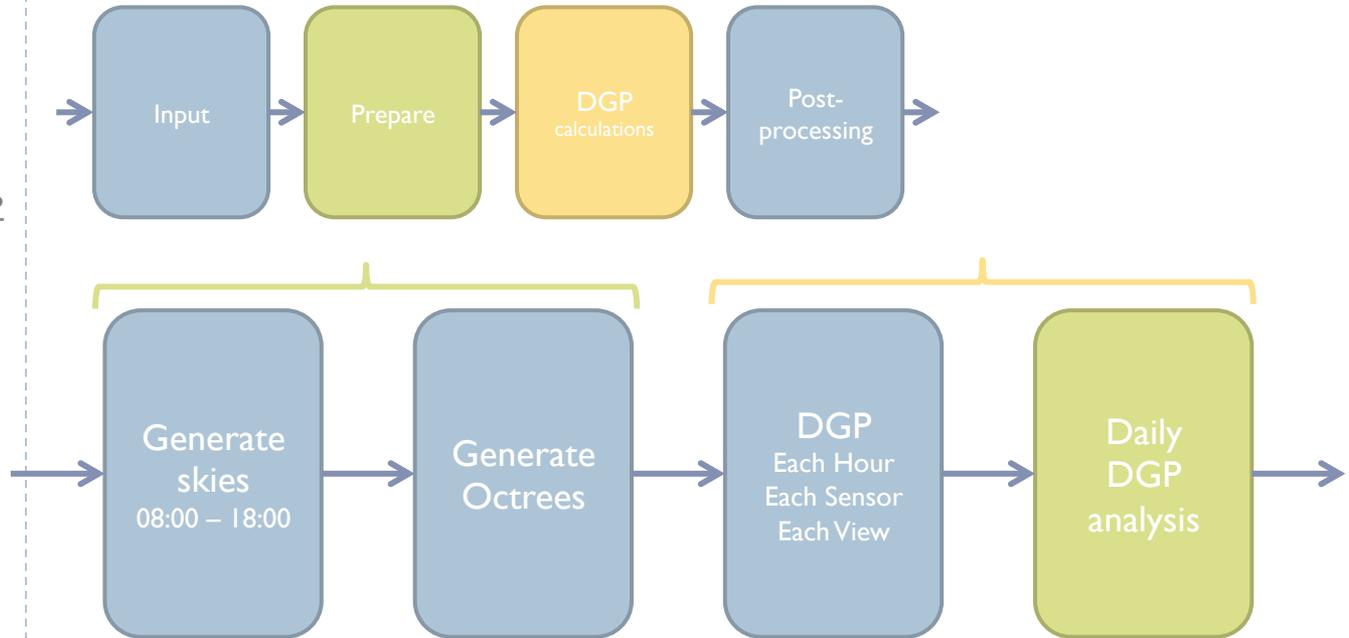
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| Input | Prepare | DGP calculations | Post-processing |

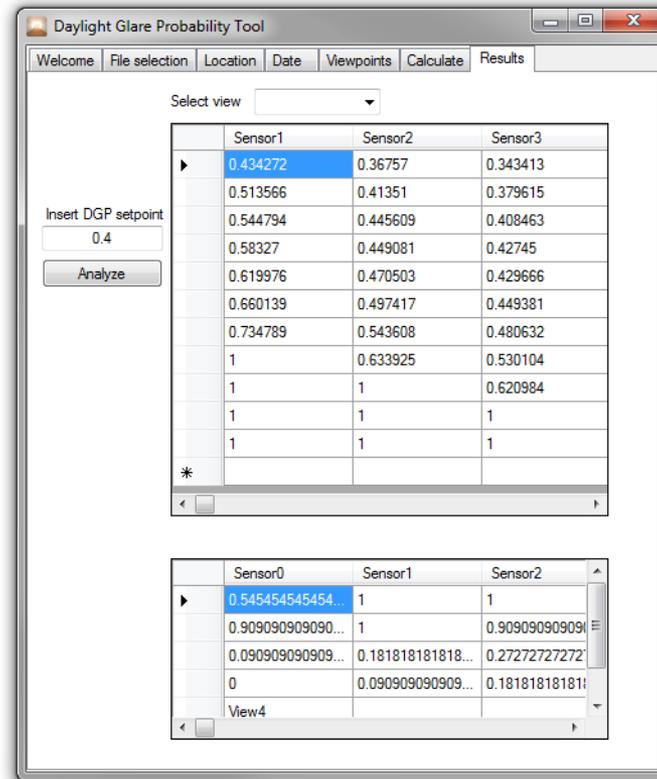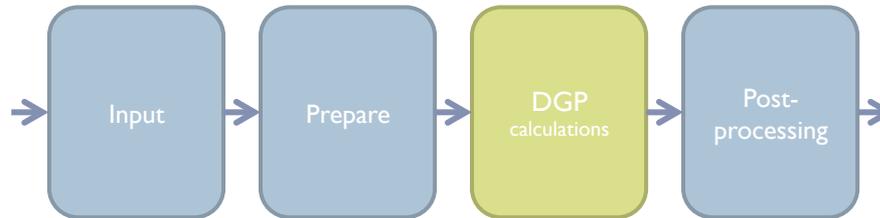| Generate skies 08:00 – 18:00 | Generate Octrees | DGP Each Hour Each Sensor Each View | Daily DGP analysis |

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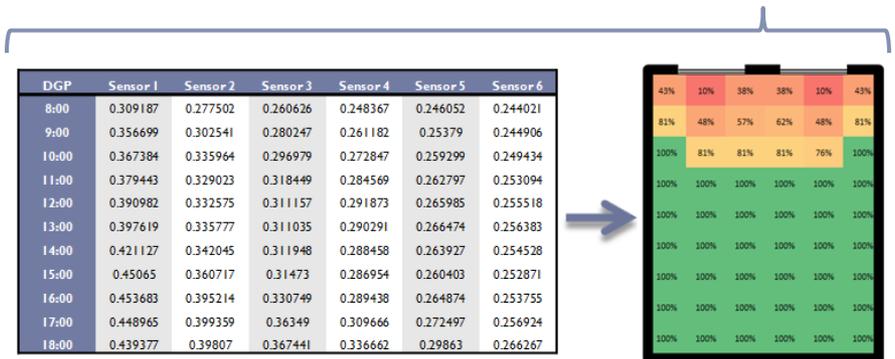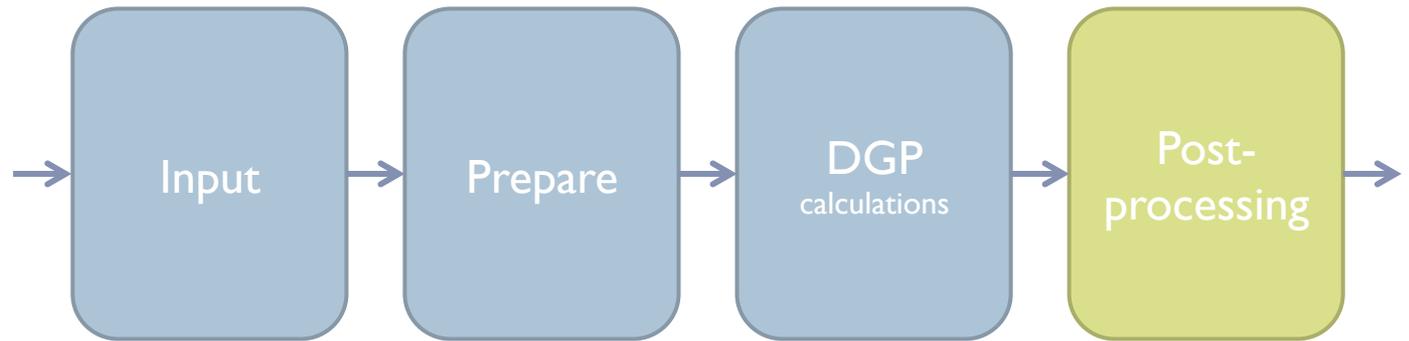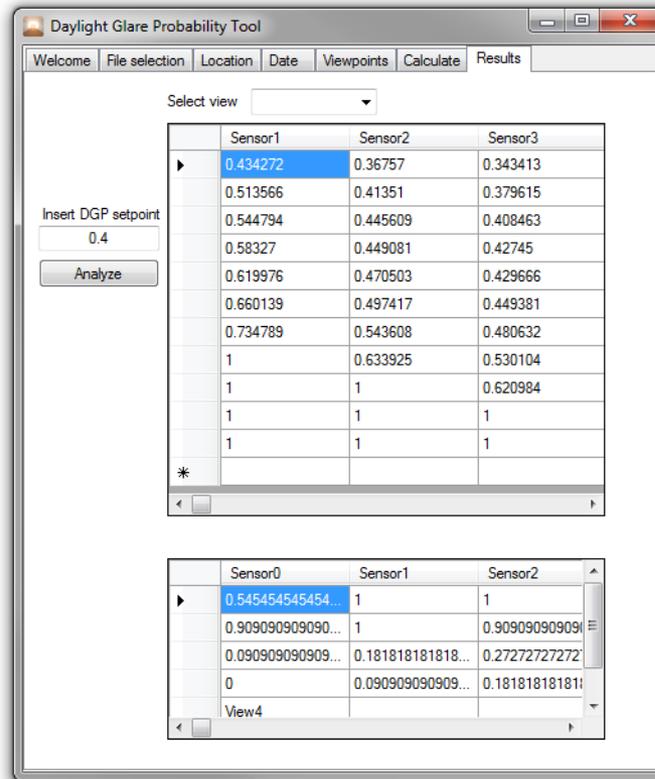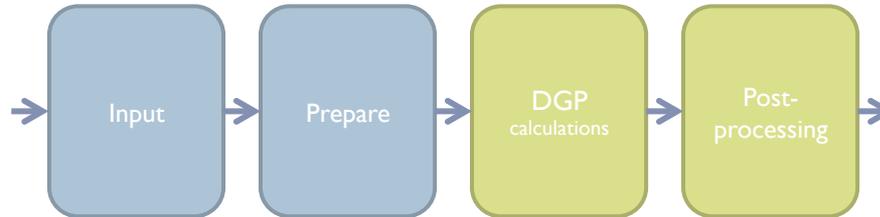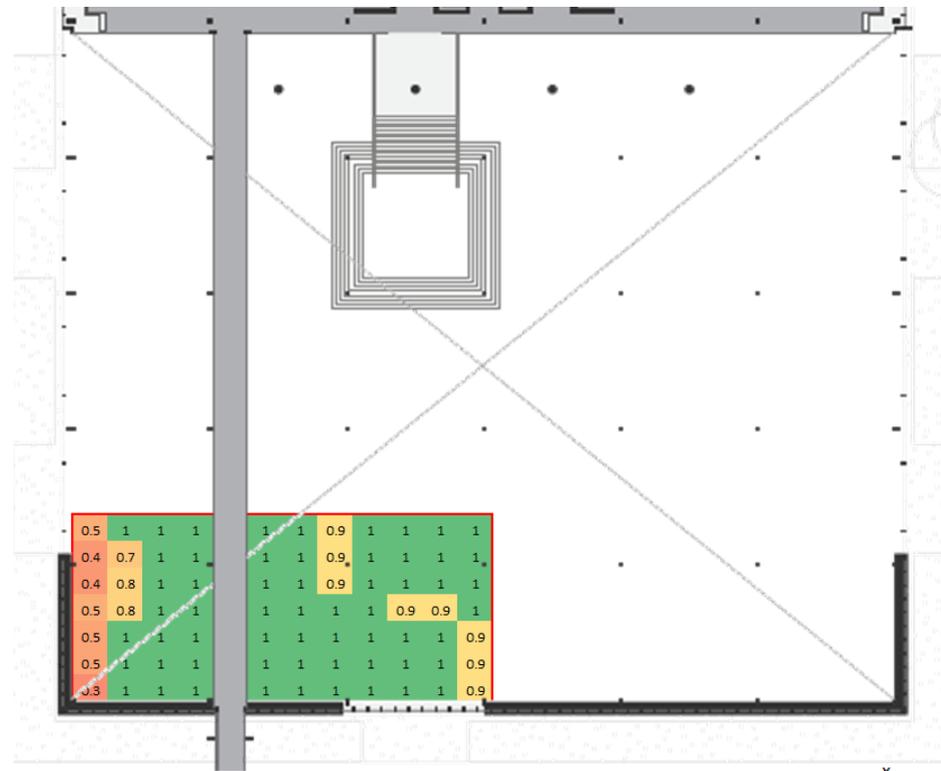
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Tool demonstration: MetaForum

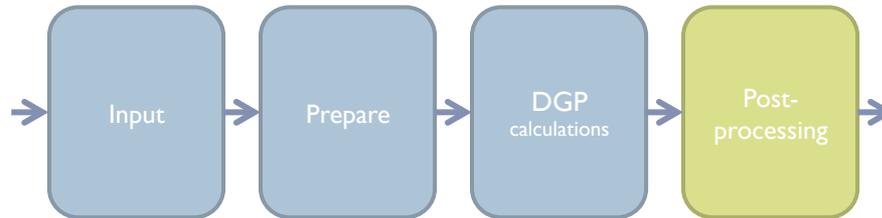| DGP	Sensor 1	Sensor 2	Sensor 3	Sensor 4	Sensor 5	Sensor 6
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UDI$_{max}$

Next...

▶ Interior design?

Daylighting Design: A Daylight Glare Probability based analysis tool

Conclusions and future development

Daylighting Design: A Daylight Glare Probability based analysis tool

Conclusions

▸ Easy applicable glare analysis tool for Microsoft Windows

▸ Easy production of false-colour floor plans

▸ The results differ from UDI$_{max}$ results

▸ Approach includes view direction

Future development

▸ Tool is in development

▸ Time consuming

▸ Small number of test cases

The End

▸ Questions?

□ www.dolfbakker.com/dgptool

□ dolfbakker@gmail.com