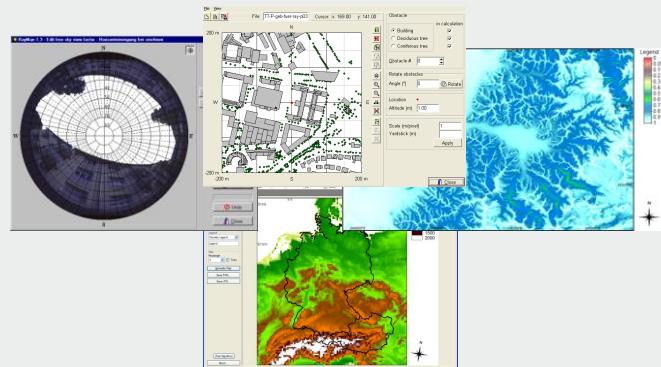


# Linking urban micro scale models for human-biometeorological assessment

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## RayMan and SkyHelios



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UNI  
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# Contents



## RayMan

Radiation fluxes, shade, thermal indices, sunshine duration, etc.



## SkyHelios

sunshine duration, shade, SVF, ...



## Interfaces

SVF 1 and geodata file types (shp, raster)

**Where and how to apply these models?**



# RayMan Pro - A Tool for Applied Climatology

(urban climatology, human-biometeorology, tourism climatology, ...)



-  Sunshine duration
-  Sun paths
-  Shadow
-  Global radiation
-  Mean radiant temperature
-  Predicted Mean Vote (PMV)
-  Phys. Equiv. Temp. (PET)
-  Stand. Effec. Temp. (SET\*)
-  Universal Thermal Climate Index (UTCI)
-  Perceived Temperature (pT)
-  new: (mPET)

-  Simple environments
-  Complex environments
-  Topography
-  Fish-Eye
-  Hemisph. input/SVF
-  Meteo data
-  Climate data
-  ....

# Input possibilities RayMan

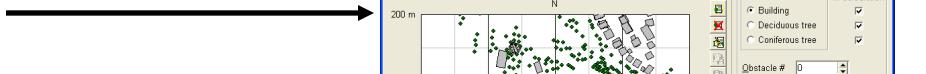


File    **Input**    Output    Table    Language    ?

Topography



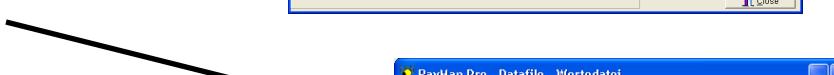
Obstacles



Sky view factor



Data import

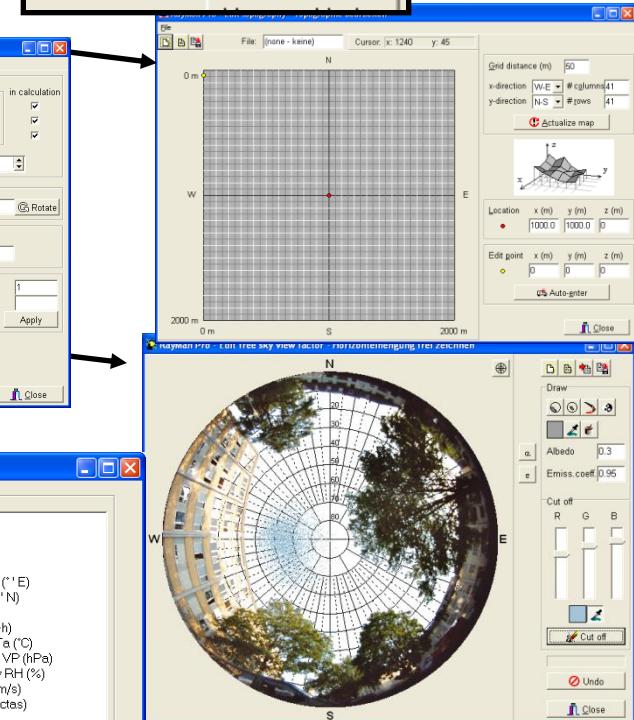
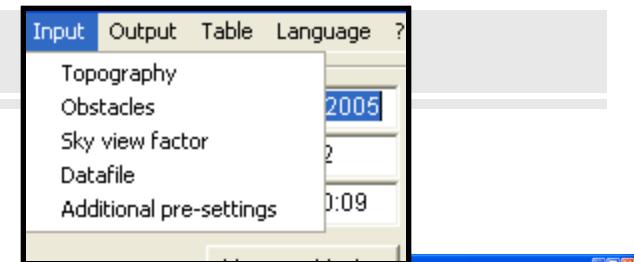


Additional presettings

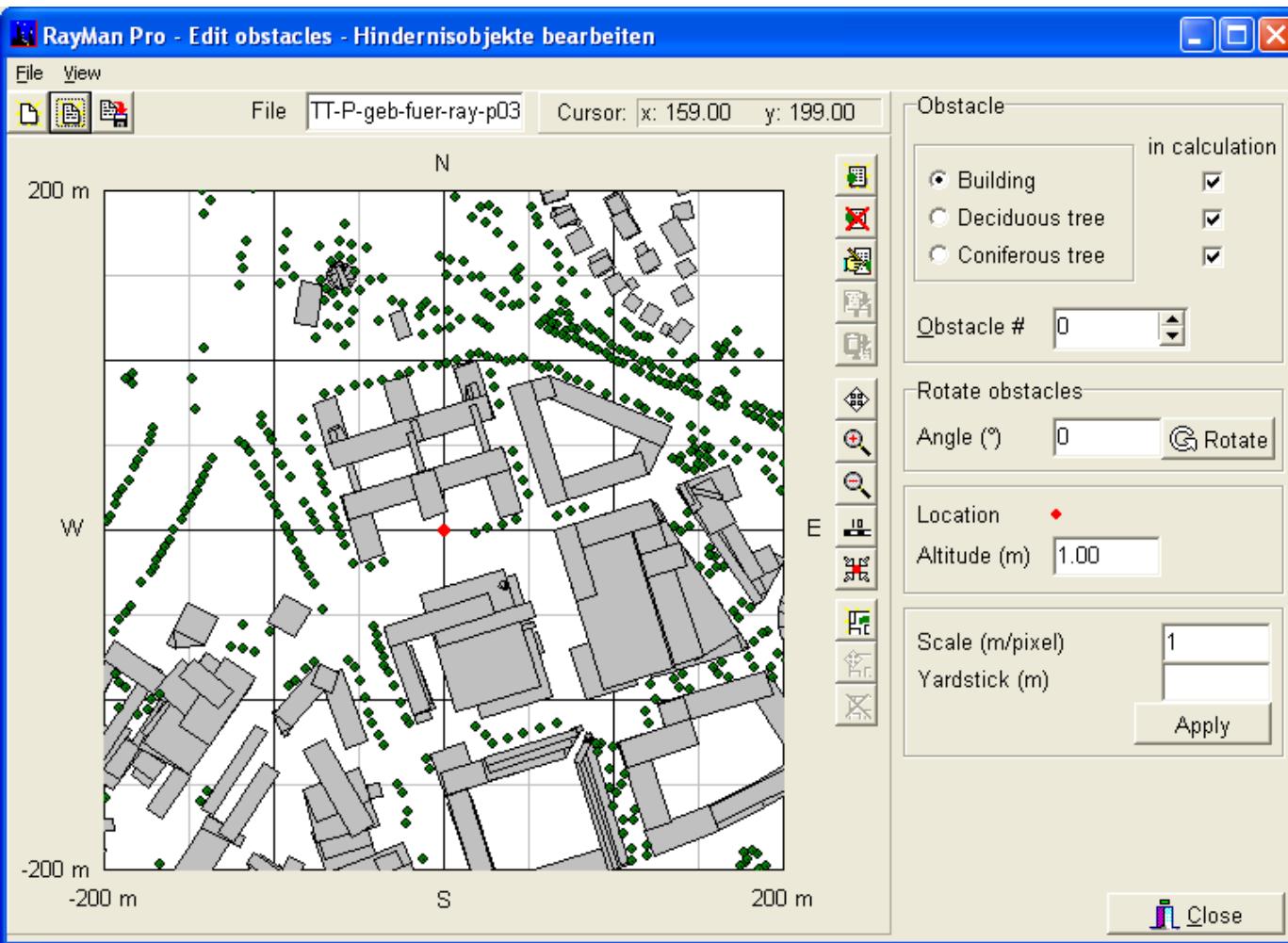
RayMan Pro - Pre-settings - Vorgaben

Output date format: d.m.yyyy  
Output time format: h:mm  
Bowen-ratio: 1.00  
Albedo: 0.30  
Lanke turbidity: auto  
Ratio of diffuse and preset global radiation: auto  
Lower limit of rel. humidity (%) for full diffuse radiation: 90  
 Reduction of G presetting by obstacles

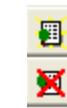
✓ Apply



# Input: Obstacles (Buildings/Trees)



Clear/new  
Open new file  
Save file



Add new obstacles  
Remove obstacles



Edit obstacles  
Copy obstacle



Paste obstacle  
Move everything



Move everything  
Zoom in



Zoom out



Set yardstick  
Move location



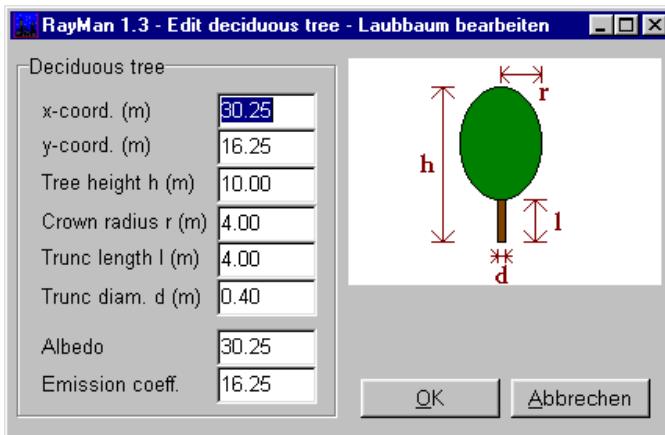
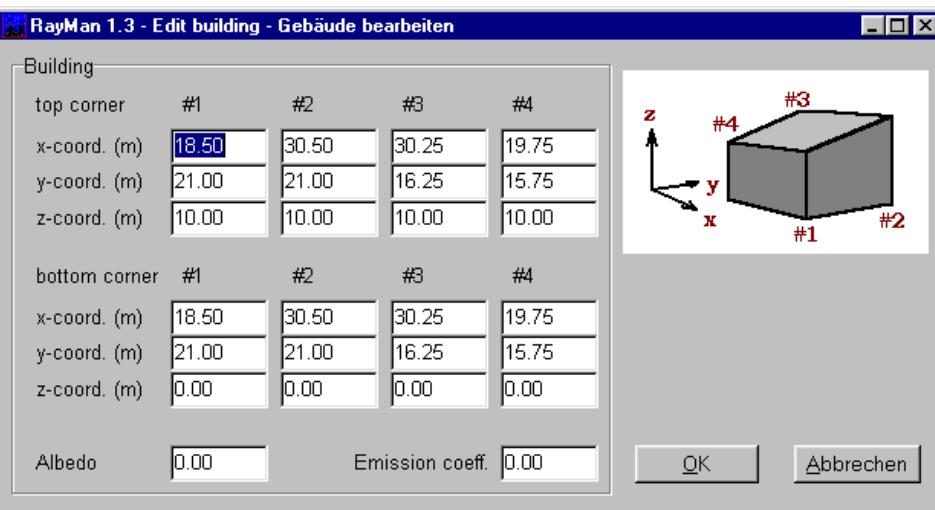
Import map image  
Move template



Remove template

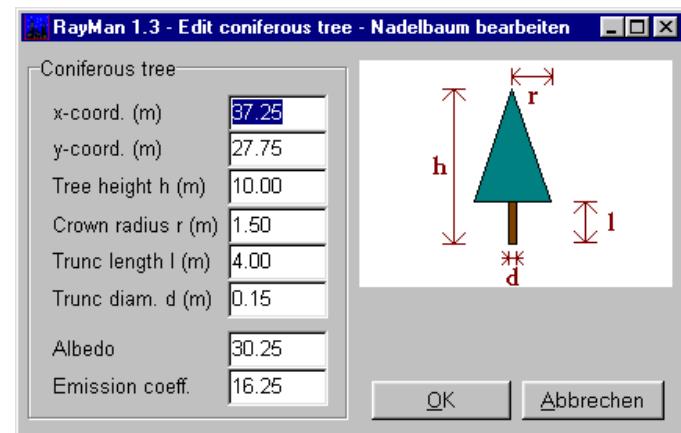
# Input: Obstacles (Buildings/Trees)

**Input coordinates  
buildings/solid surfaces**



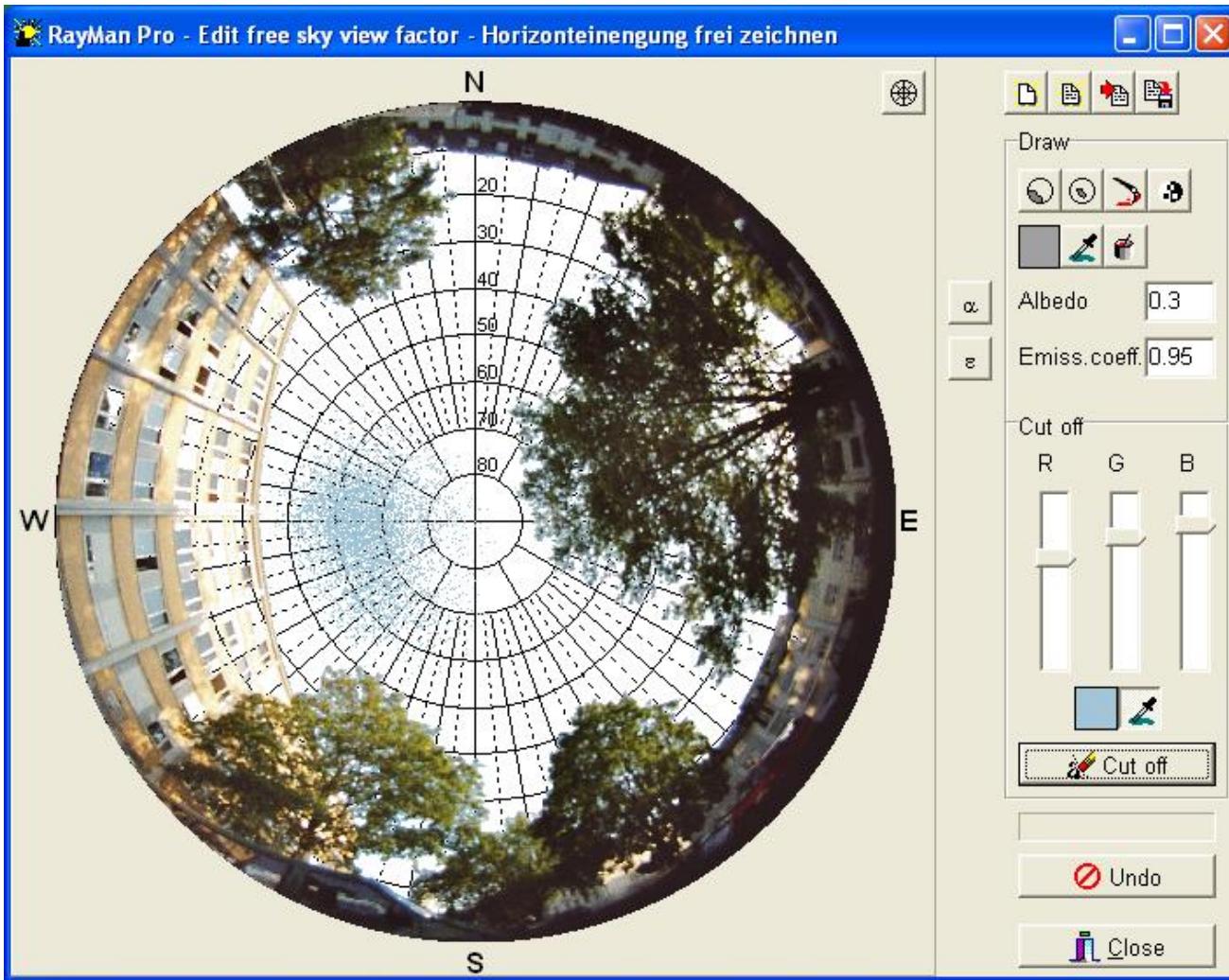
## Vegetation:

**Differentiation between deciduous and coniferous trees**



# Import of fish-eye photos/free drawing

## Input: albedo and emission



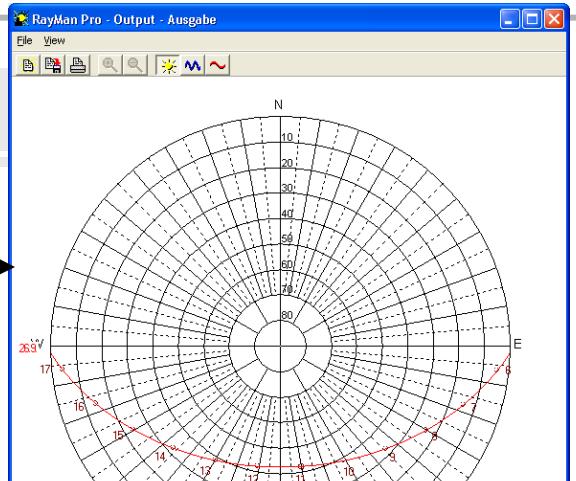
- Grid in foreground
- Clear/new
- Open new file
- Save file
  
- Limit edges
- Limit clouds
- Fill colour
- Monochrome
- Brush color
  
- Select color
- Albedo
- Epsilon
  
- Color of selected RGB
- Cut off
- Run changes

# Output possibilities

File   Input   **Output**   Table

Polar diagrams

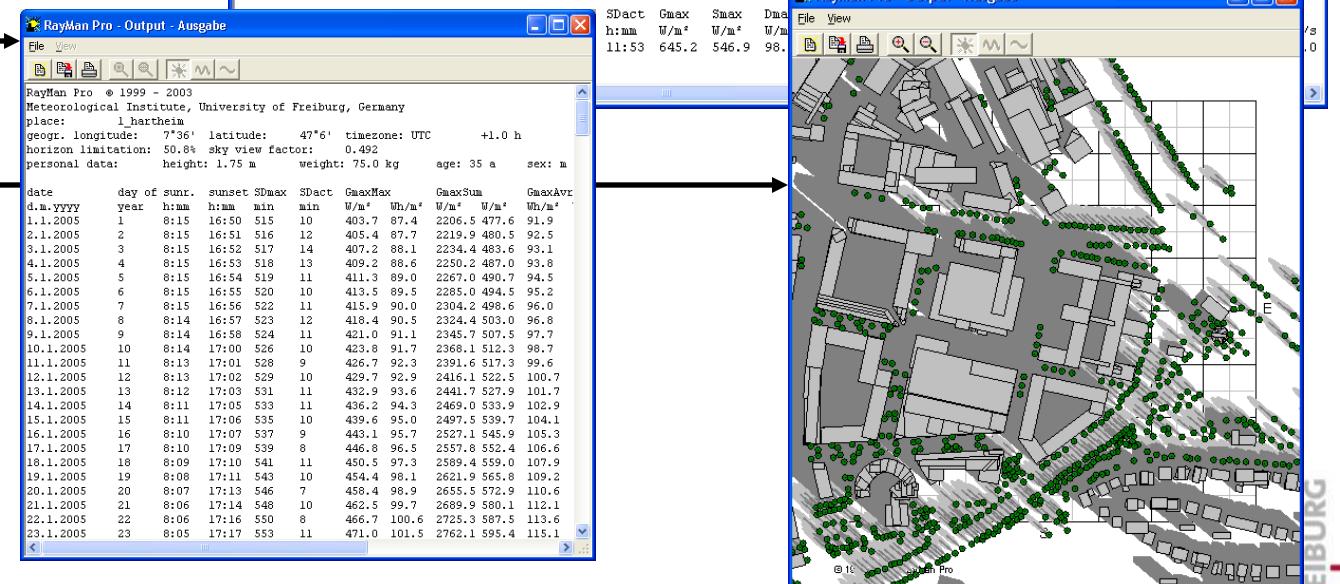
- Output**
- Table
- Language
- Diagram (polar)
- Diagram (cylindrical)
- Data table
- Daily data
- Shadows



Data table

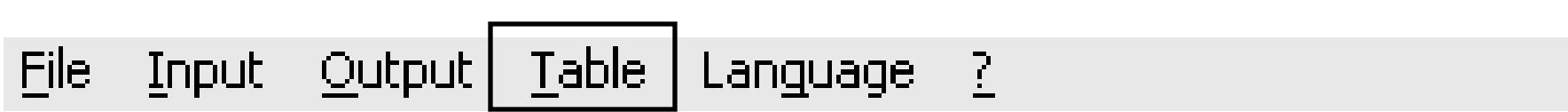


Daily data



Shade

# Output: data tables



## Output: Standard sheet

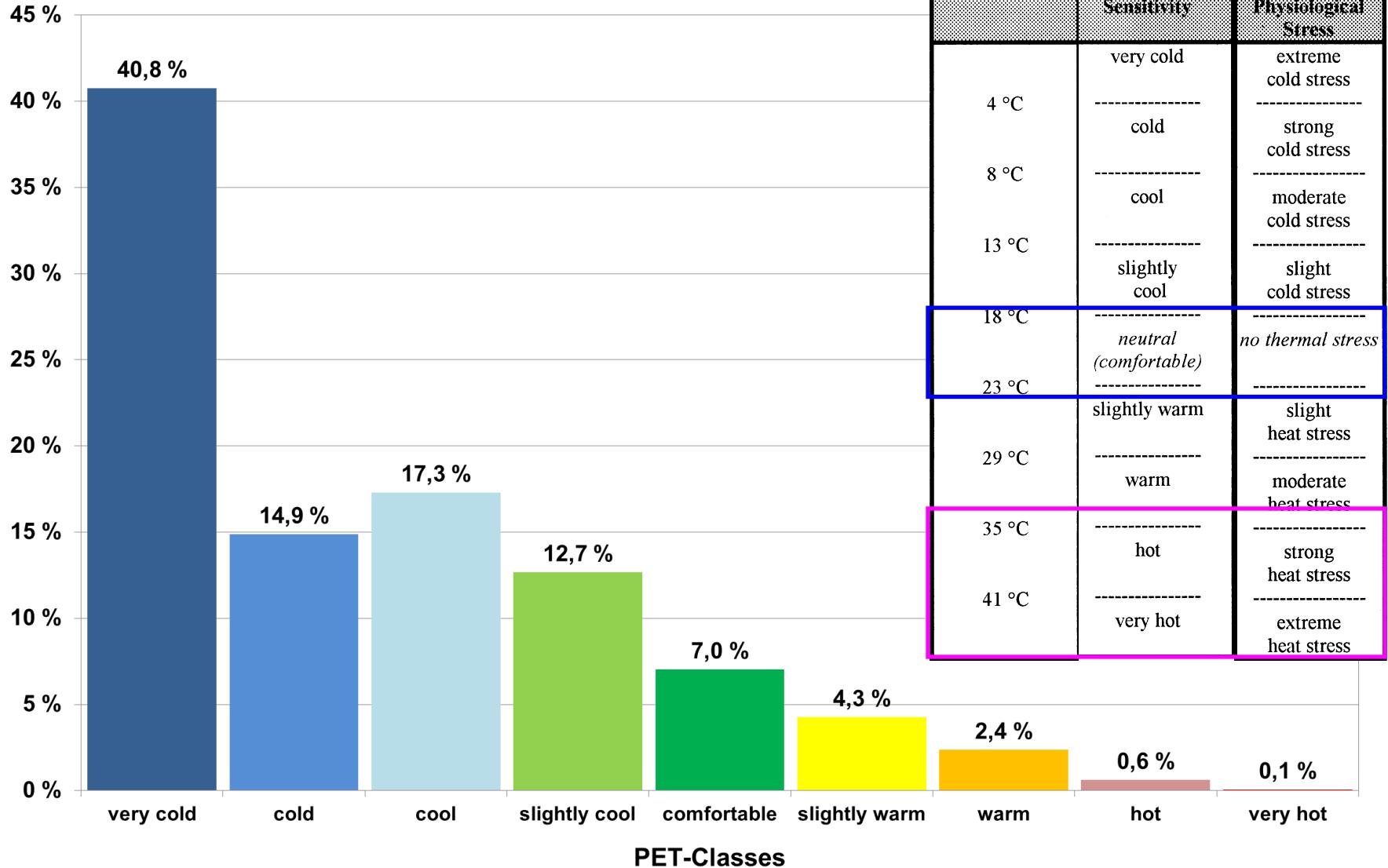
| RayMan Pro - Output - Ausgabe  |  |
|--|--|
| RayMan Pro © 1999 - 2003<br>Meteorological Institute, University of Freiburg, Germany<br>place: 1_Szeged<br>geogr. longitude: 20°16' latitude: 46°15' timezone: UTC +1.0 h<br>horizon limitation: 0.0% sky view factor: 1.000<br>personal data: height: 1.75 m weight: 75.0 kg age: 35 a sex: m clothing: 0.9 clo activity: 80.0 W |  |
| date day of time sunr. sunset SDmax SDact Gmax Smax Dmax Gact Sact Dact A E Os Ts VF RH v<br>d.m.yyyy year h:mm h:mm h:mm h:mm h:mm W/m² W/m² W/m² W/m² W/m² W/m² °C °C hPa % m/s  |  |
| 26.9.2003 269 12:34 5:29 17:29 11:59 11:53 645.2 546.9 98.4 645.2 546.9 98.4 336.5 495.2 33.8 20.0 12.5 53.5 1.0   |  |
| < >  |  |

## Additional Output: MEMI sheet

| RayMan Pro - MEMI   |  |
|---|--|
| personal data: height: 1.75 m weight: 75.0 kg age: 35 a sex: m clothing: 0.9 clo activity: 80.0 W   |  |
| date day of time Ta VP v C<br>dd.mm.yyyy year h:mm °C hPa m/s /8 °C °C g/h SWt H Rnb C Evpd Esw PET<br>21.2.2005 52 9:33 20.0 12.5 1.0 0.0 25.1 36.9 33.0 49.4 0.0 164.5 -64.6 -64.1 -22.5 0.0 18.8 |  |
| < >   |  |

New: mPET

# Urban Climate Station Freiburg

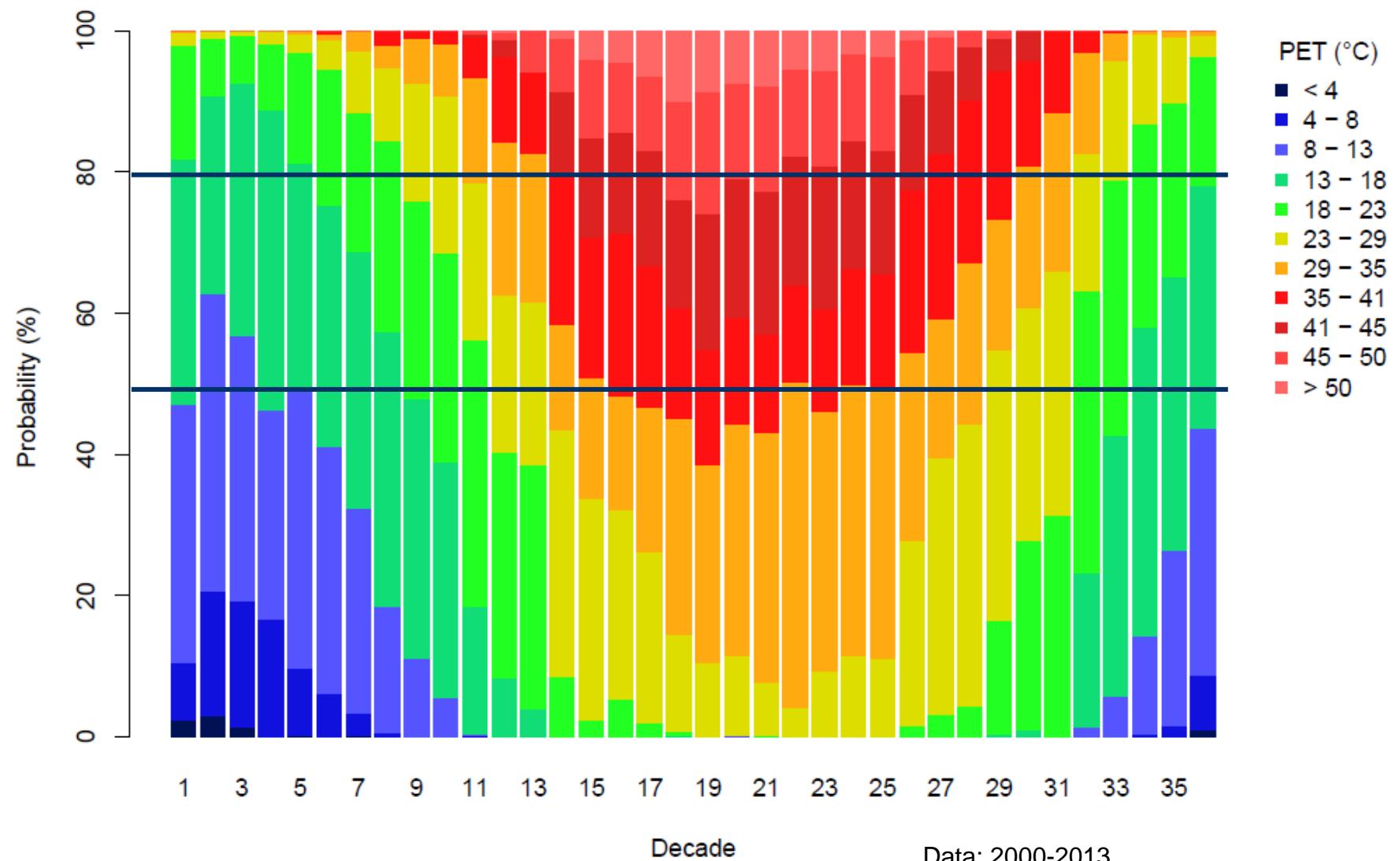


**PET-classes**

Matzarakis and Herrmann, 2012



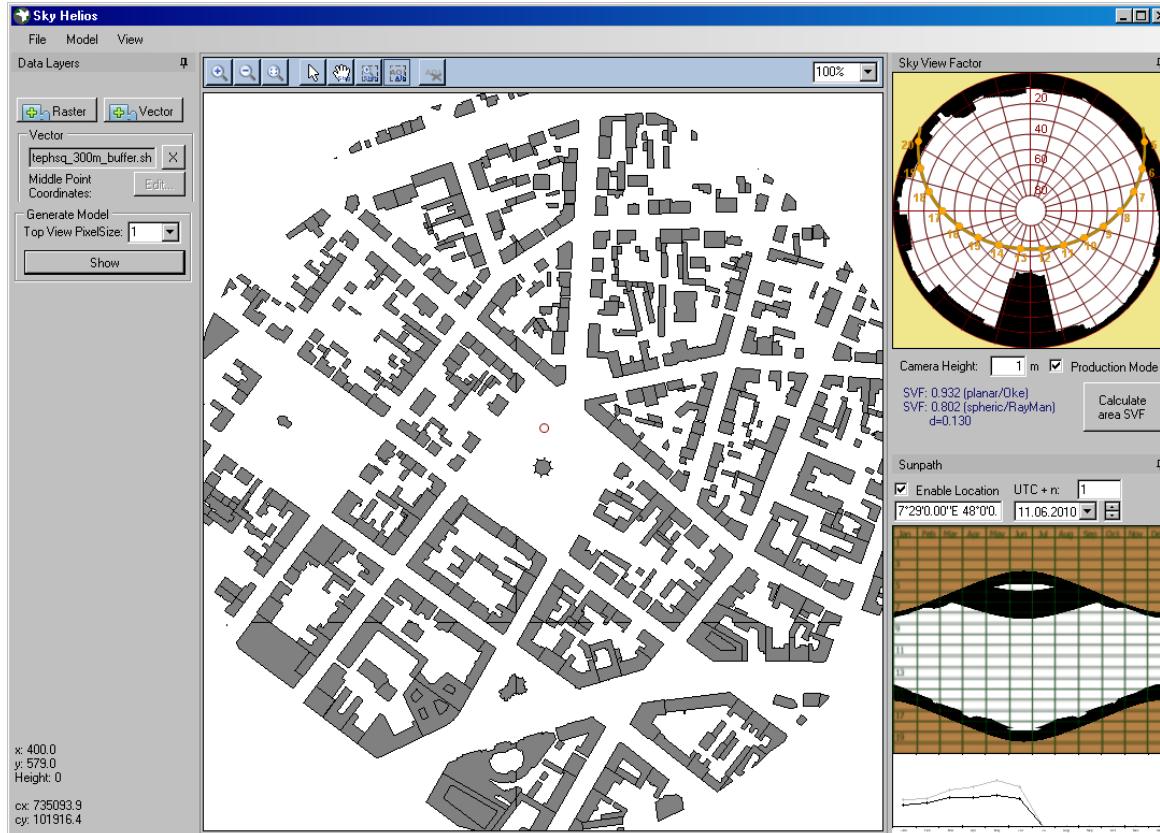
# PET-classes – frequency diagram for Doha



FIFA 2022

Matzarakis and Fröhlich, 2014, submitted

# SkyHelios

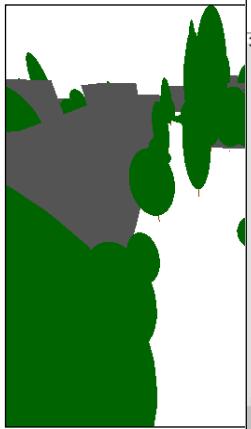
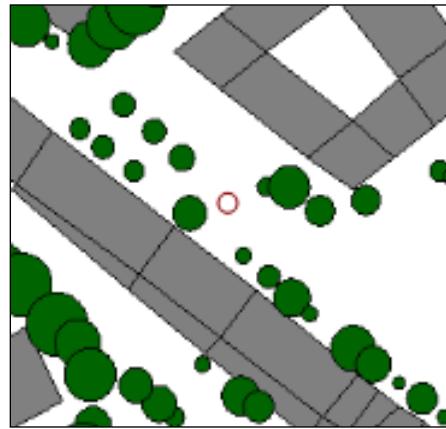


- ▶ SVF, Sunshine, Sunpaths,...
- ▶ SVF, 3D and layers
- ▶ Topo, RayMan obs, (Laser!)
- ▶ (wind, Tmrt, PET, UTCI, .....

- Grid, Vector data, Shape, GeoTiff
- Rapid visualisation
- Fast export to CMT
- Interfaces

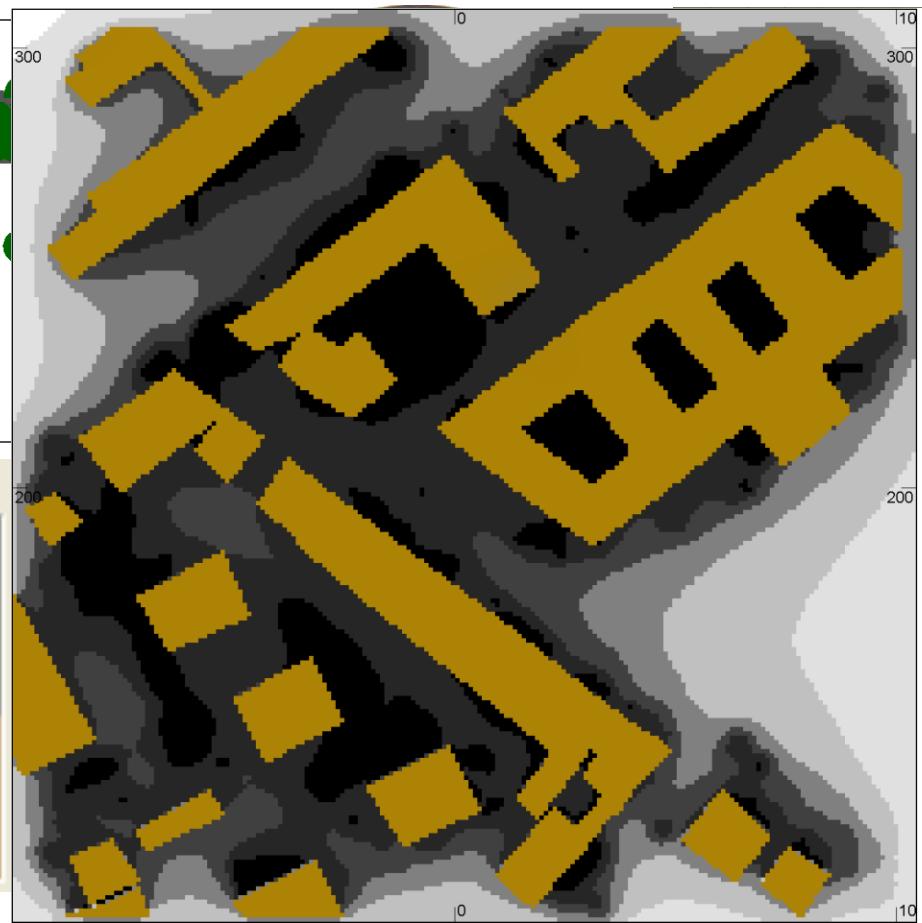
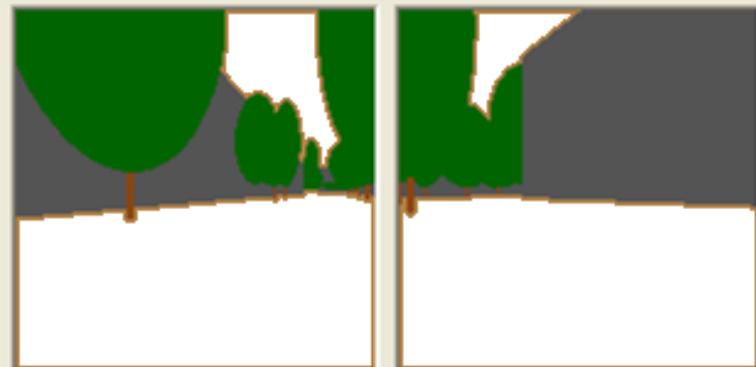
Combination of data formats

# SkyHelios – SVF, sunshine, wind, TI - based on raster and vector data

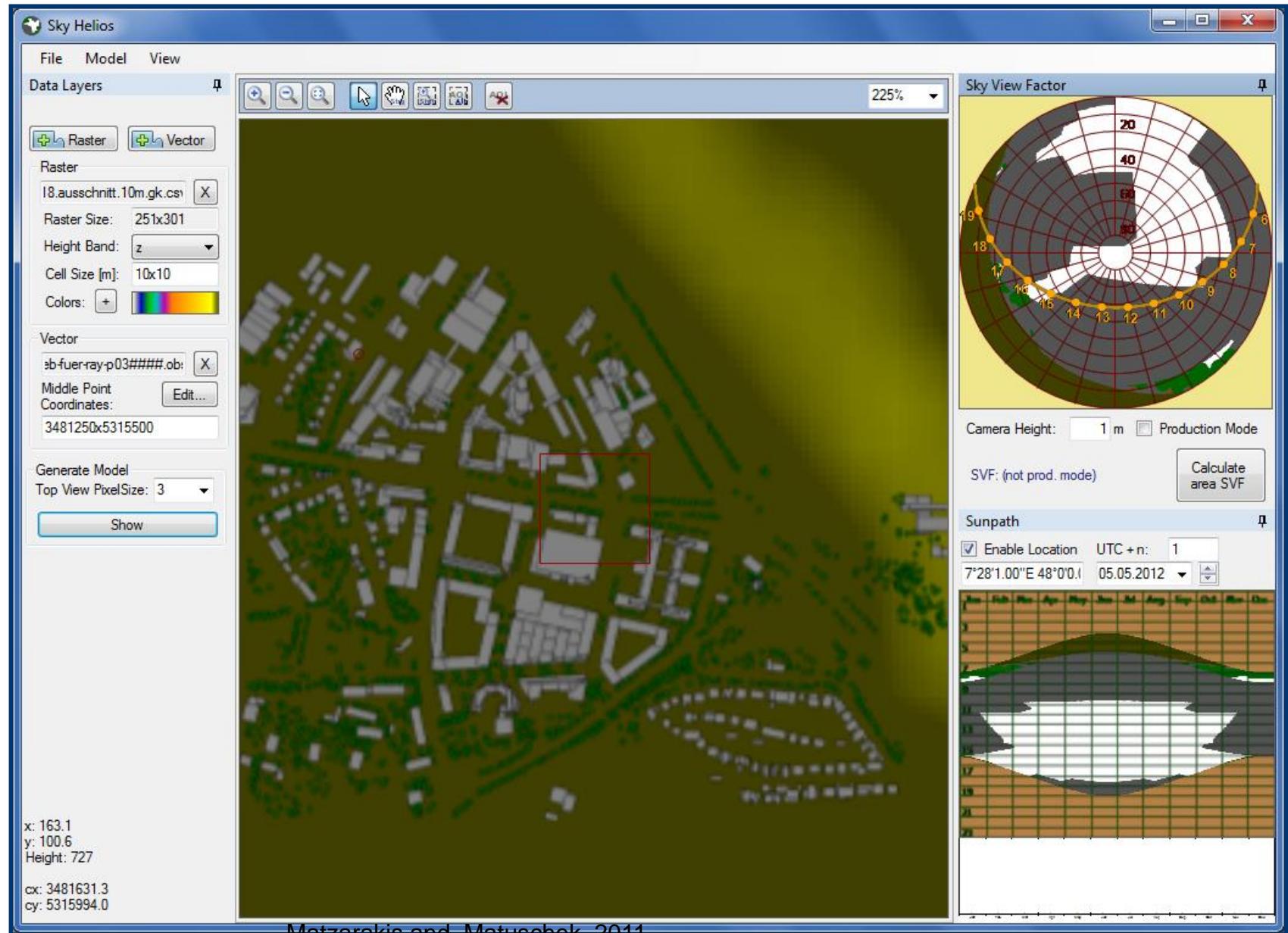


West

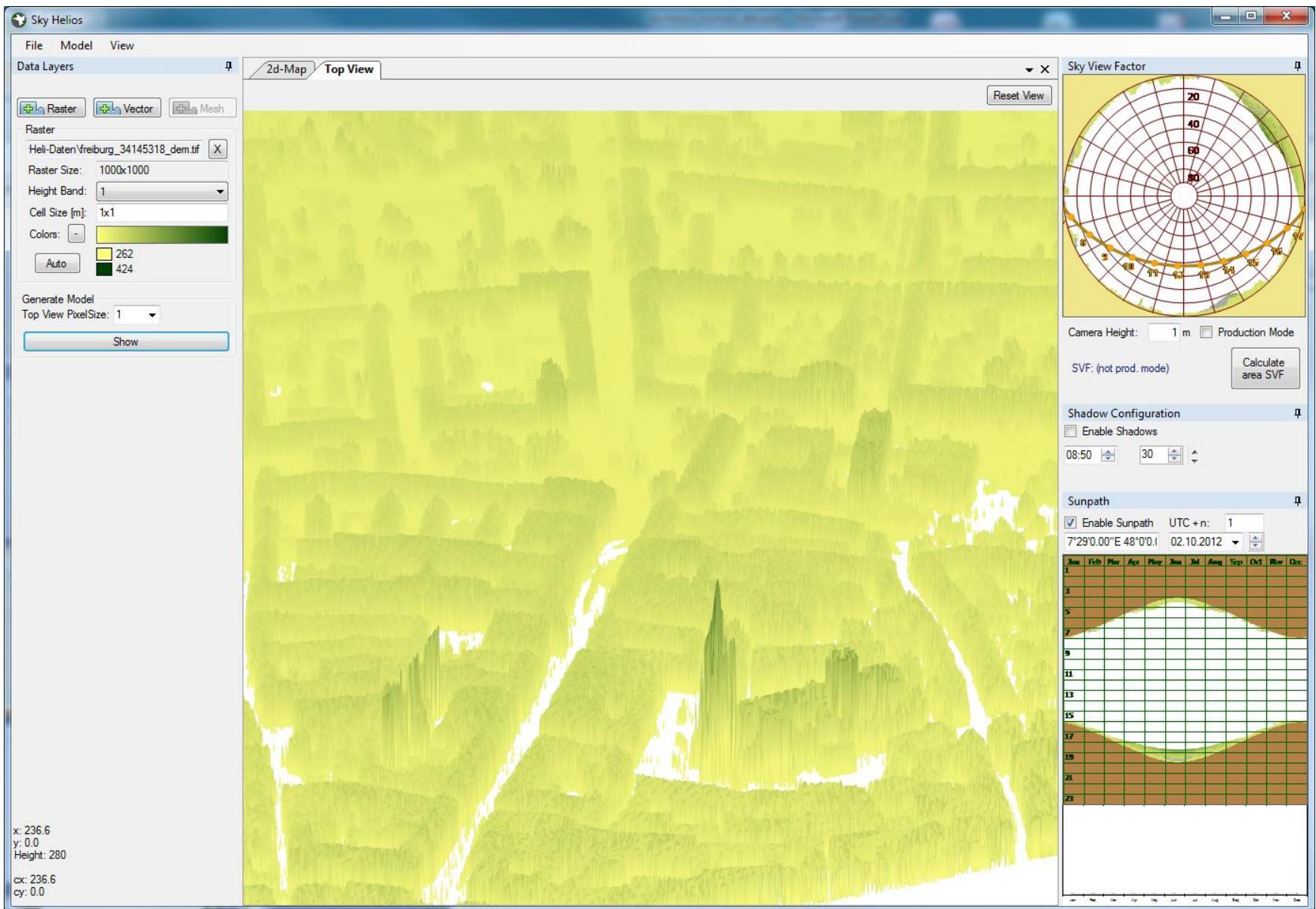
North



# Output (topo and obs)



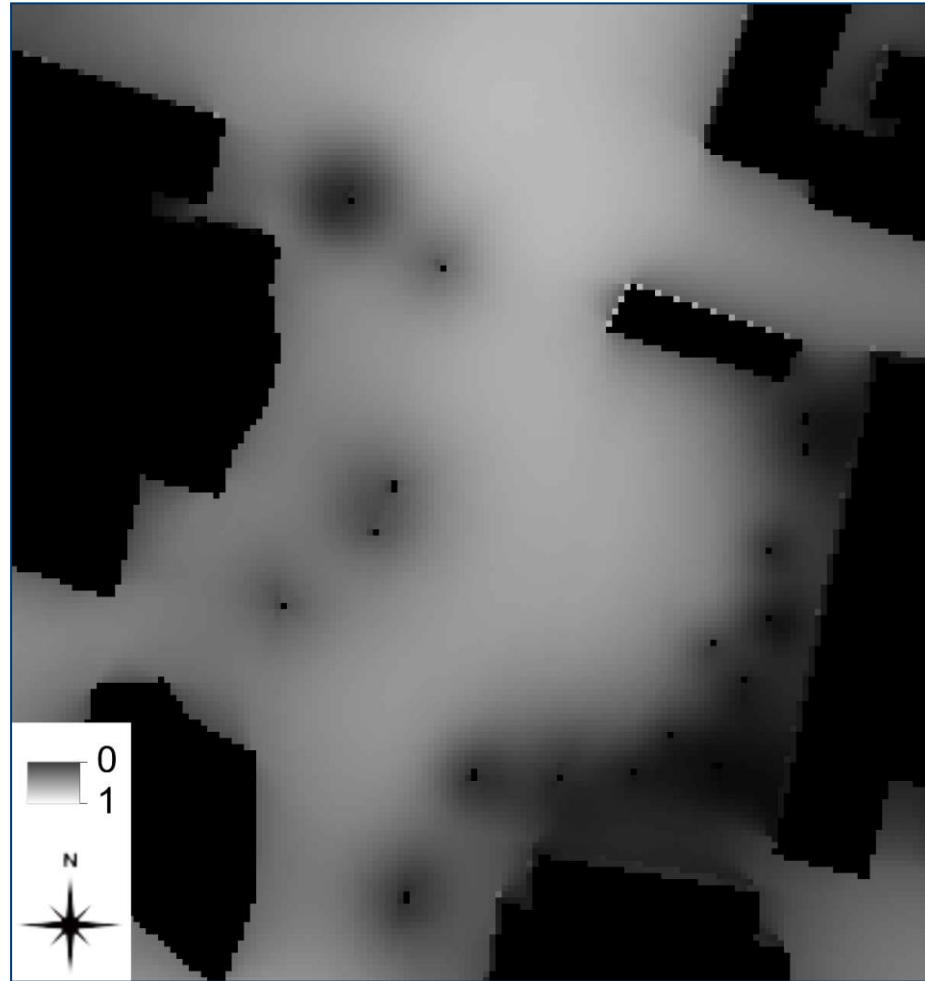
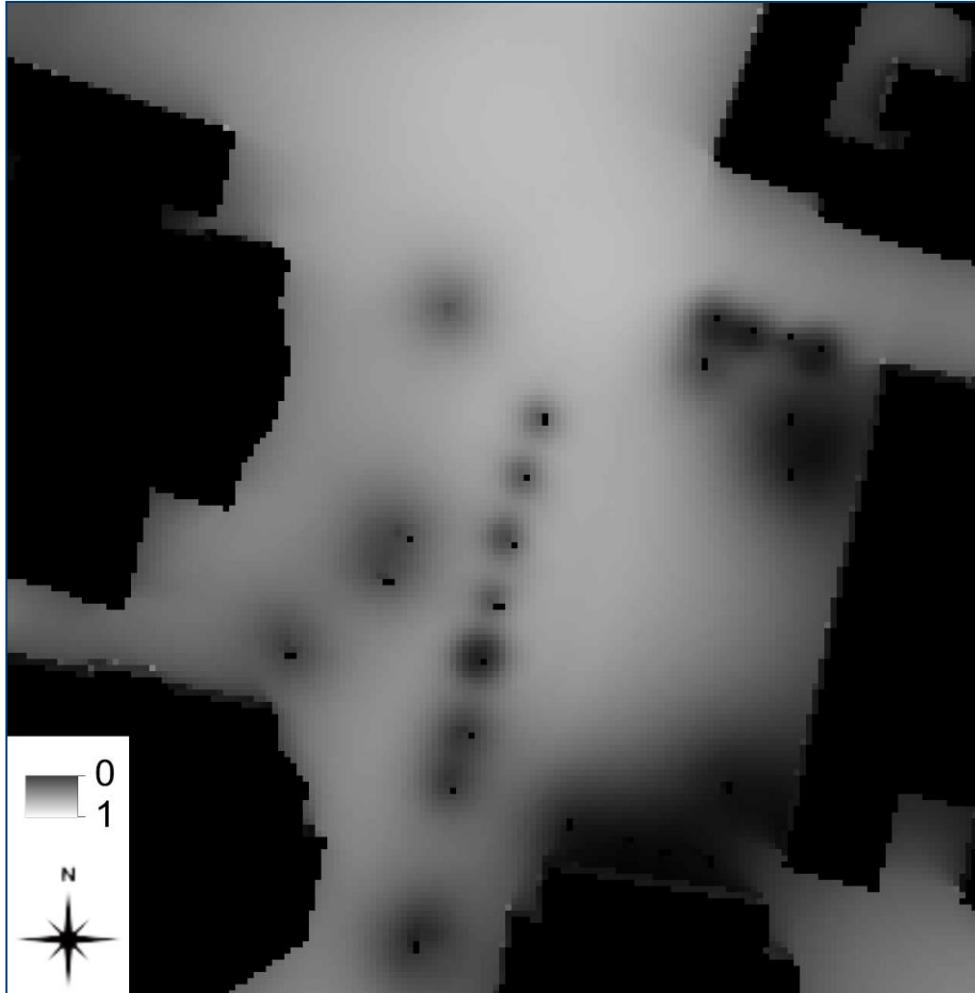
# Output (Shade/GeoTiff)



# Results – Place of Old Synagogue



## SkyHelios: Calculation of SVF



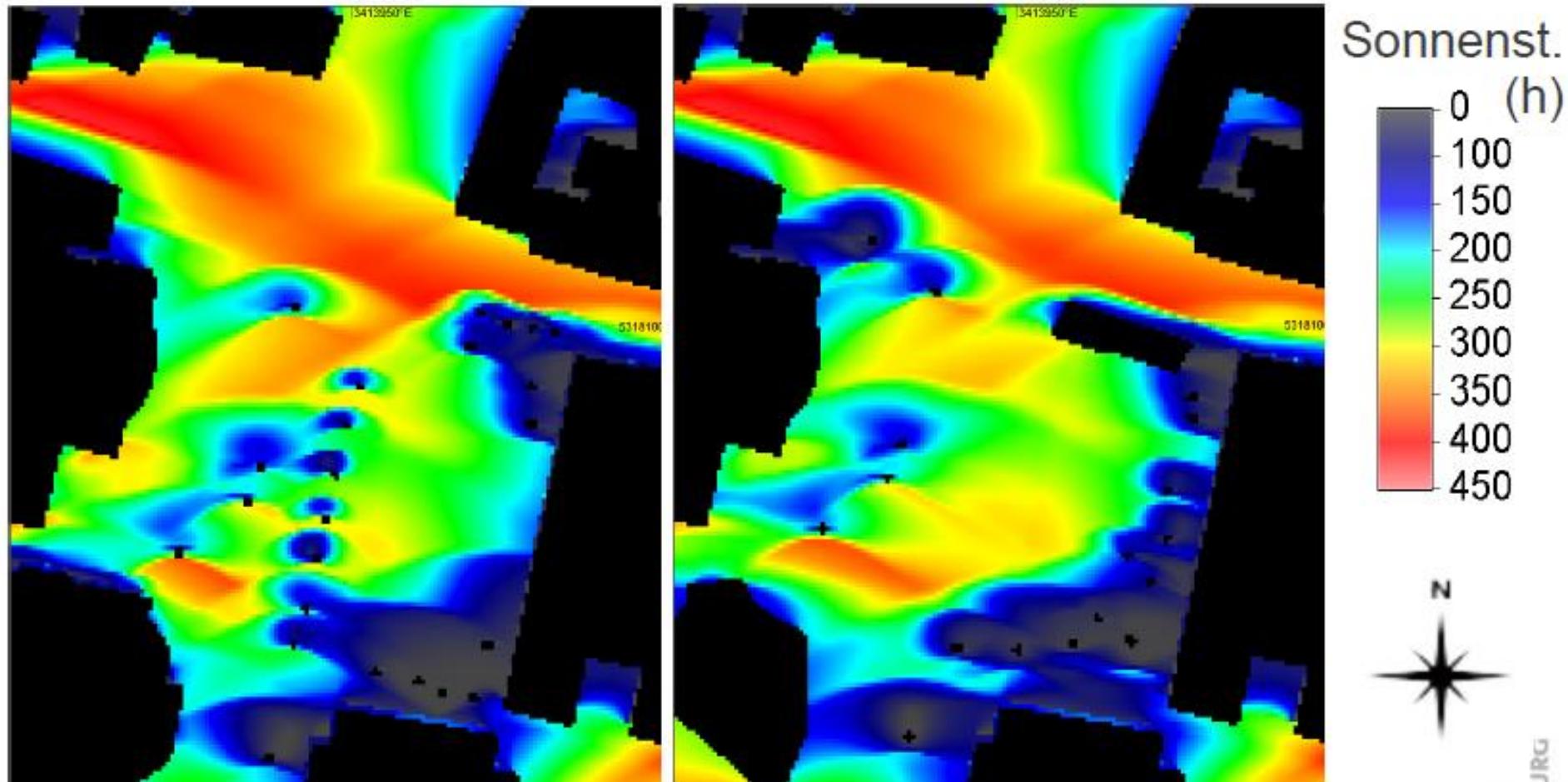
Area with high SVF will be only little larger, but moved westwards

Fröhlich and Matzarakis, 2011

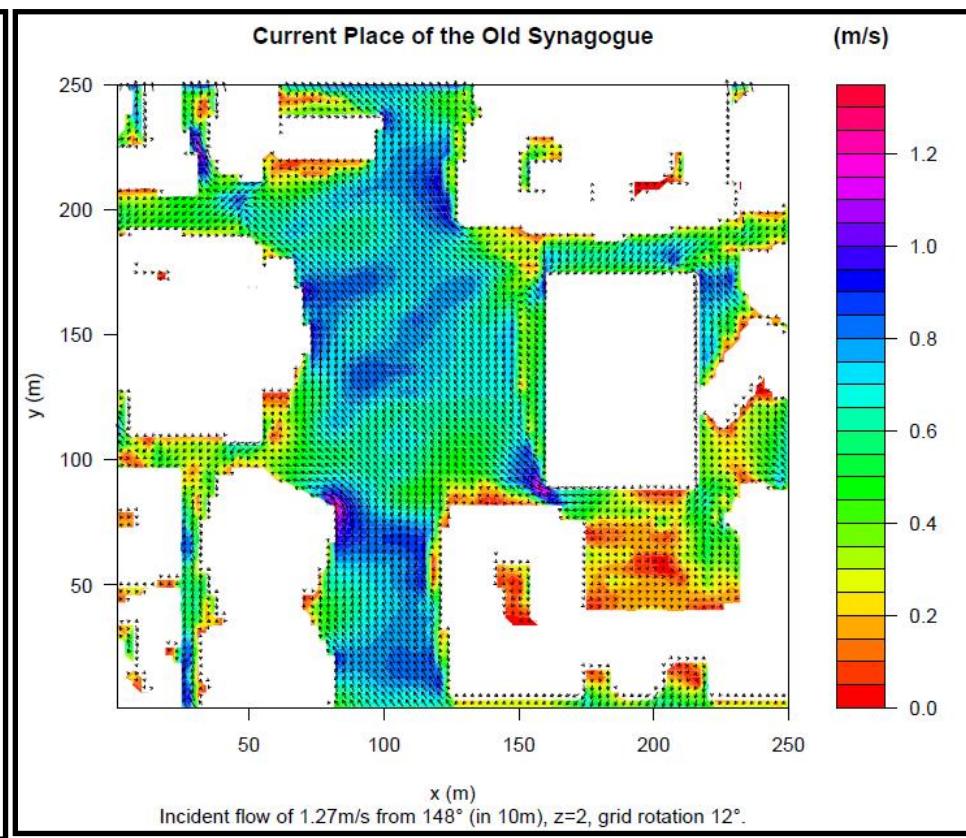
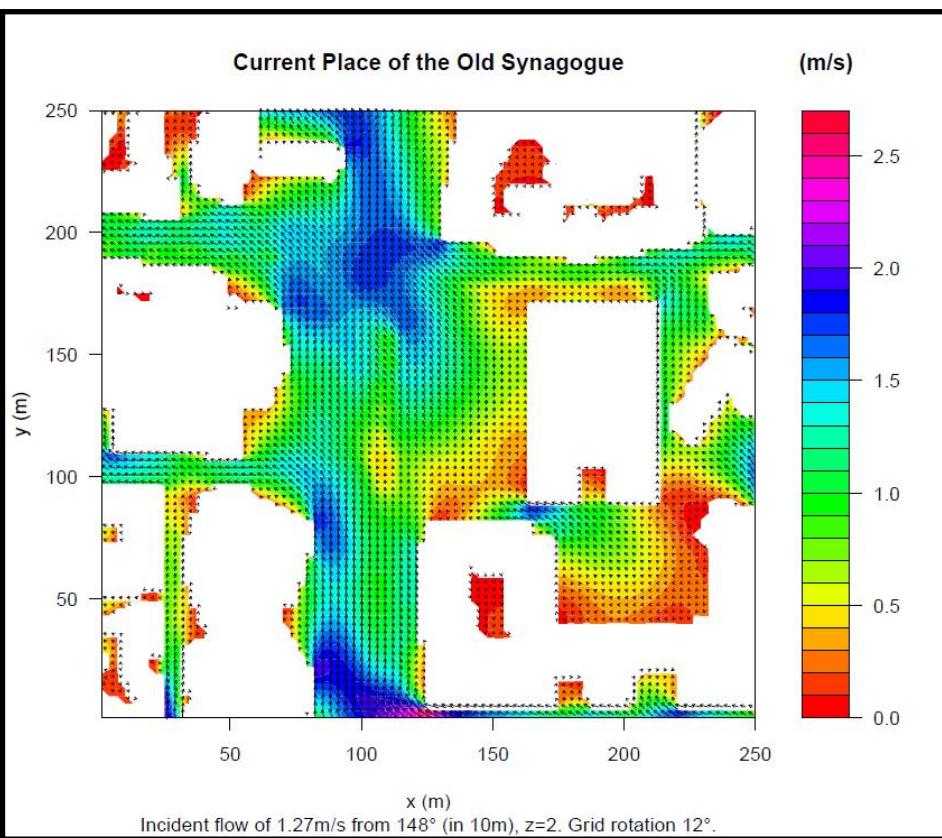
# Results – Place of Old Synagogue



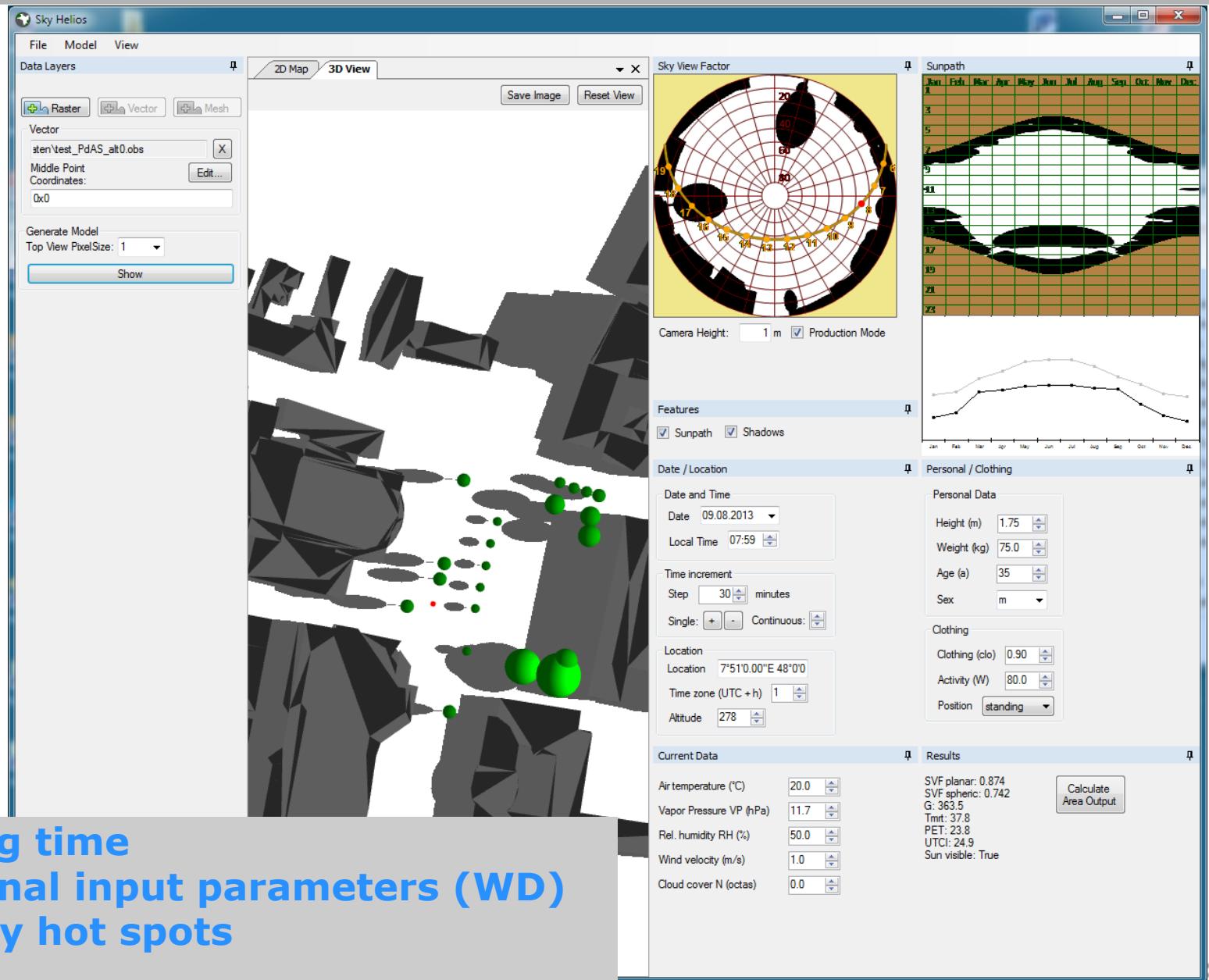
## Sunshine duration (July)



# Wind – ENVI-met and (SkyHelios)



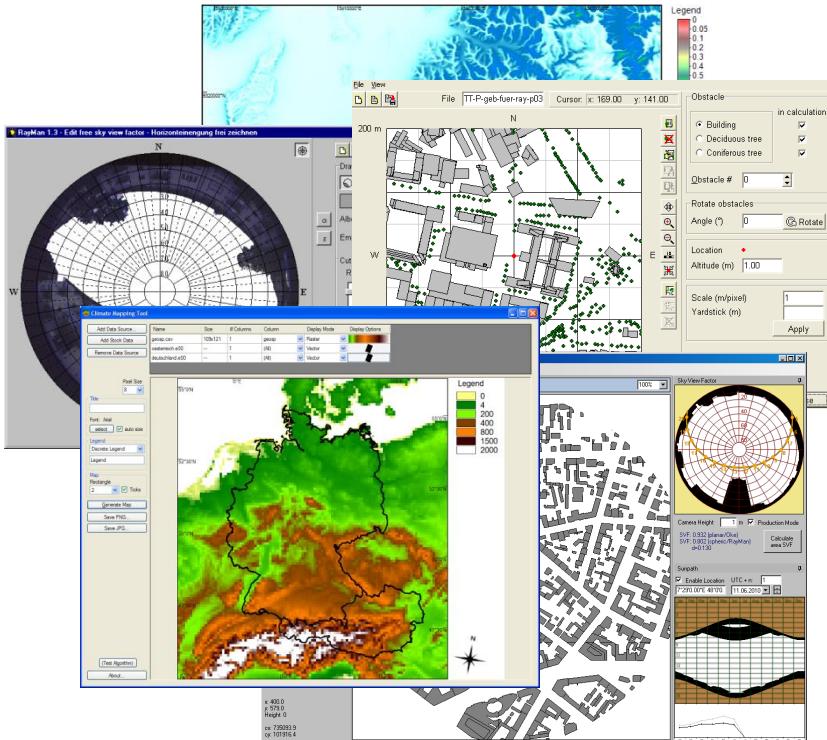
# New Generation: + Thermal indices



- **Running time**
- **Additional input parameters (WD)**
- **Not only hot spots**
- ...

# Interfaces

- RayMan      Obstacles can be imported in SkyHelios
  - From point to spatial
- SkyHelios      Production of SVF – Save and import in RayMan
- Conversion of shape files in obstacles files
- New: Google Earth



Ευχαριστώ  
πολύ

Ερωτήσεις ?



## With contributions

- **RayMan:** Frank Rutz, Yung-Chang Chen
- **SkyHelios:** Olaf Matuschek, Andreas Peer, Marcel Gangwisch, Christine Ketterer, Dominik Fröhlich