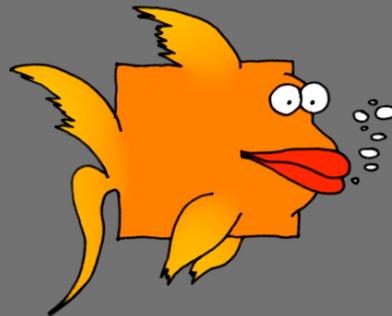


The Interaction of Radiance and ECOTECT

5th Annual Radiance Workshop
Leicester, 2006

www.squ1.com



www.ecotect.com

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Director : Square One *research* PTY LTD

INTRODUCTION

This presentation showcases four aspects of the interaction of ECOTECT and Radiance:

- **The New Radiance Export Wizard**
Version 5.50 of ECOTECT introduced a comprehensive wizard that guides new users through the process of exporting and rendering complex models in Radiance.
- **Focussed Visualisation of Radiance Data and Volumetric Analysis**
This wizard also allows the generation and extraction of both grid-point and surface values from Radiance and visualises them in the ECOTECT OpenGL page.
- **The Radiance Control Panel**
As part of ECOTECT, a free integrated development environment (IDE) for Radiance has been created, allowing access to code editing, syntax highlighting, interactive help, render/run control and code generation features.
- **The Radiance Image Viewer**
Also as part of ECOTECT, a free updated version of WinImage has been developed. This new version allows much greater control of command-line file loading (allowing the use of wildcard characters) as well as viewing/manipulating multiple PIC images.

Both **Radiance Control Panel** and the **Radiance Image Viewer** are completely free and are now available for download from: <http://squ1.com/products>.

The New Radiance Export Wizard

The following slides simply illustrate the steps in this wizard.

ECOTECT - D:\Square One\squ1-Operations\Presentation Material\Models\Lighting Design\RoomLighting.eco

File Edit View Draw Select Modify Model Display Calculate Tools Help

12:00 1st April Climate: [No Data File] Lat: -32.0° Lng: 116.0° (+8.0)

10.0 0.50° Apply to Copy Proportional Current Zone: Plant03

Analysis Grid

ECOTECT: Calculation Wizard...

radiance analysis | STEP 1 OF 7 Tool Hints **HELP!**

RADIANCE / DAYSIM IMAGES

RADIANCE is a freely-available lighting simulation tool that can produce physically accurate images of both daylight and artificially lit scenes.

DAYSIM is for daylight availability analysis and calculating energy savings from the use of automated lighting controls and occupancy sensors.

To use either tool, you will need to have already downloaded and installed it on your machine.

- [Visit Desktop Radiance Website...](#)
- [Visit DAYSIM Website...](#)

WHAT KIND OF IMAGE TO GENERATE ?

- Luminance Image (cd/m2)**
Image is based on the amount of light REFLECTED OFF each surface in the scene, exactly the same as a camera sees.
- Illuminance Image (Lux)**
Image shows the amount of light FALLING ON each surface. This is a purely analytical image showing Lux levels.
- Daylight Factors (%DF)**
Sets the horizontal sky illuminance to exactly 100 Lux, generating an illuminance image at noon in mid-winter. The result is the worst-case percentage of available daylight on each surface in the scene.
- Sky Components (%SC)**
Same as daylight factor, except that ALL materials are output as matte black to ensure only direct light from the sky is counted. For a vertical surface, this corresponds to the BRE Vertical Sky Component.

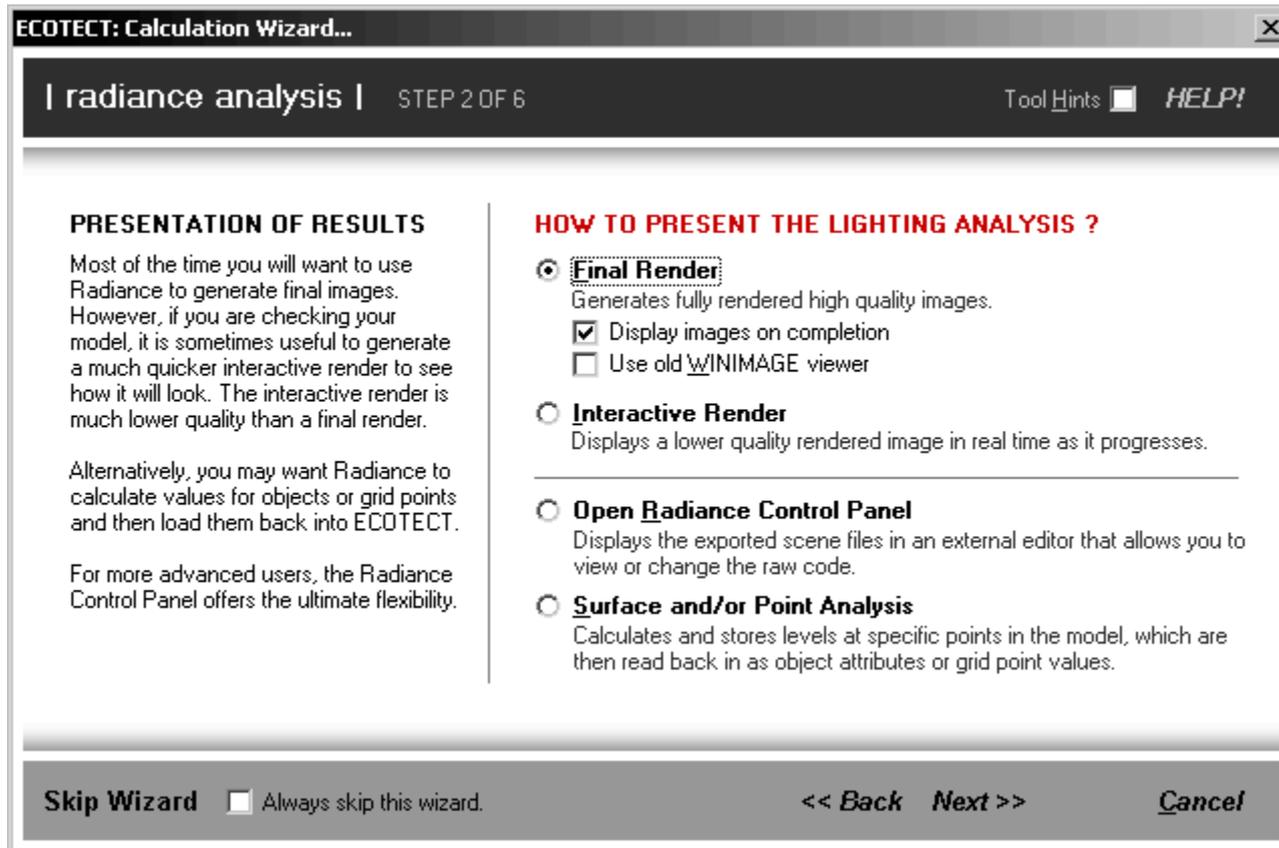
Skip Wizard Always skip this wizard. **Next >>** **Cancel**

Model 1. Camera_Normal

1/17965 Snaps: A CGI L MOP Idle

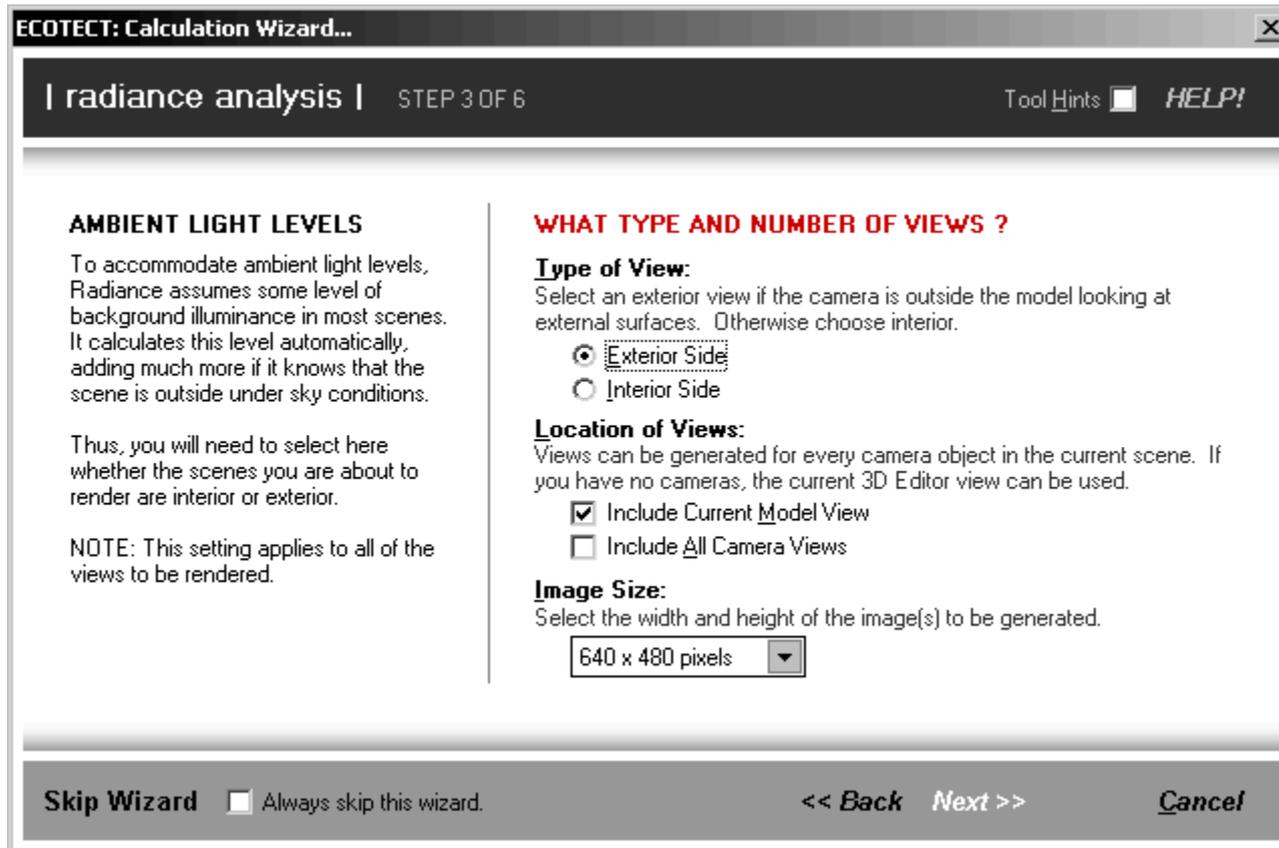
The New Radiance Export Wizard

After choosing the kind of image to generate, the user can then choose the means by which this image/data will be generated.



The New Radiance Export Wizard

The next step is to choose the type of view and final image size.



The New Radiance Export Wizard

Accuracy is an important issue as it also affects rendering time. This is all explained as the user chooses the most important aspects of their analysis.

The screenshot shows a dialog box titled "ECOTECT: Calculation Wizard...". The main header area contains "radiance analysis" and "STEP 4 OF 6". On the right of the header, there are "Tool Hints" and "HELP!".

CALCULATION ACCURACY
As with most calculations, the more accurate you want the Radiance analysis, the longer it will take. If you set the accuracy too low, you will end up with very splotchy images and questionable results. Too high and you will be waiting around for a week. Unfortunately there are no magic values, you will simply have to experiment.

NOTE: The values here are all inter-related. Setting any one of the parameters to low will have an overall effect on image quality.

HOW ACCURATE DO YOU WANT TO BE ?

Model Detail:
A very detailed model needs a high setting so that test points are spaced to accommodate even the smallest of objects.
 LOW MEDIUM HIGH

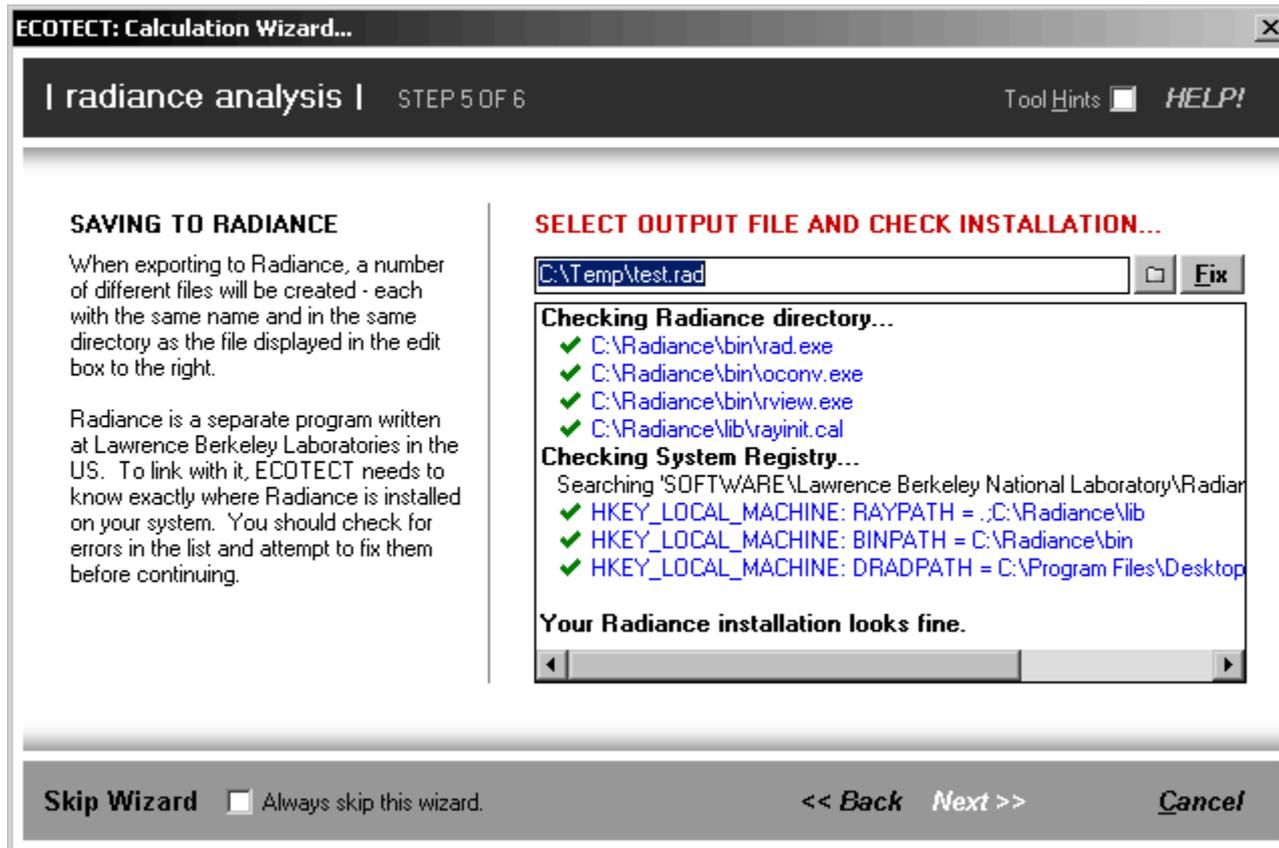
Lighting Variability:
How much the lighting distribution is likely to change over each surface. In an artificially lit space probably not much. In a daylight space, probably a lot.
 LOW MEDIUM HIGH

Image Quality:
Radiance increases the quality of an image by breaking each pixel up into sub-pixels, 2x2 for medium and 3x3 for high.
 LOW MEDIUM HIGH

At the bottom, there is a "Skip Wizard" checkbox with the text "Always skip this wizard." and navigation buttons: "<< Back", "Next >>", and "Cancel".

The New Radiance Export Wizard

One issue many users seem to have is installing and setting up Radiance in the first place – then telling ECOTECT where to find it. This page tests your installation and checks that all the required files and Registry entries are there.



The New Radiance Export Wizard

Finally, users are hit with the full summary of all their settings. There are a couple of more advanced settings in here that are not part of the wizard, however users quickly get used to this page and often skip the wizard process.

ECOTECT: Calculation Wizard... [X]

| radiance analysis | STEP 6 OF 6 (SUMMARY) Tool Hints [] **HELP!**

Output Options: Save Files Only [v]
Save Files Only
Run in RadianceCP
Interactive Render
Final Render
DAYSIM Header

Use DOS 8.3 filenames
 Save separate zone files
 Run in minimised window
 View images when done
 Pause on completion

Generate Point Data
 Current 2D analysis grid
 Current 3D analysis grid
 Objects tagged as shaded
 Currently selected objects

Include Material Definitions
 Check for Material.rad files
 Check for #Zone.rad files

Electric Light Objects
Generate Automatically [v]

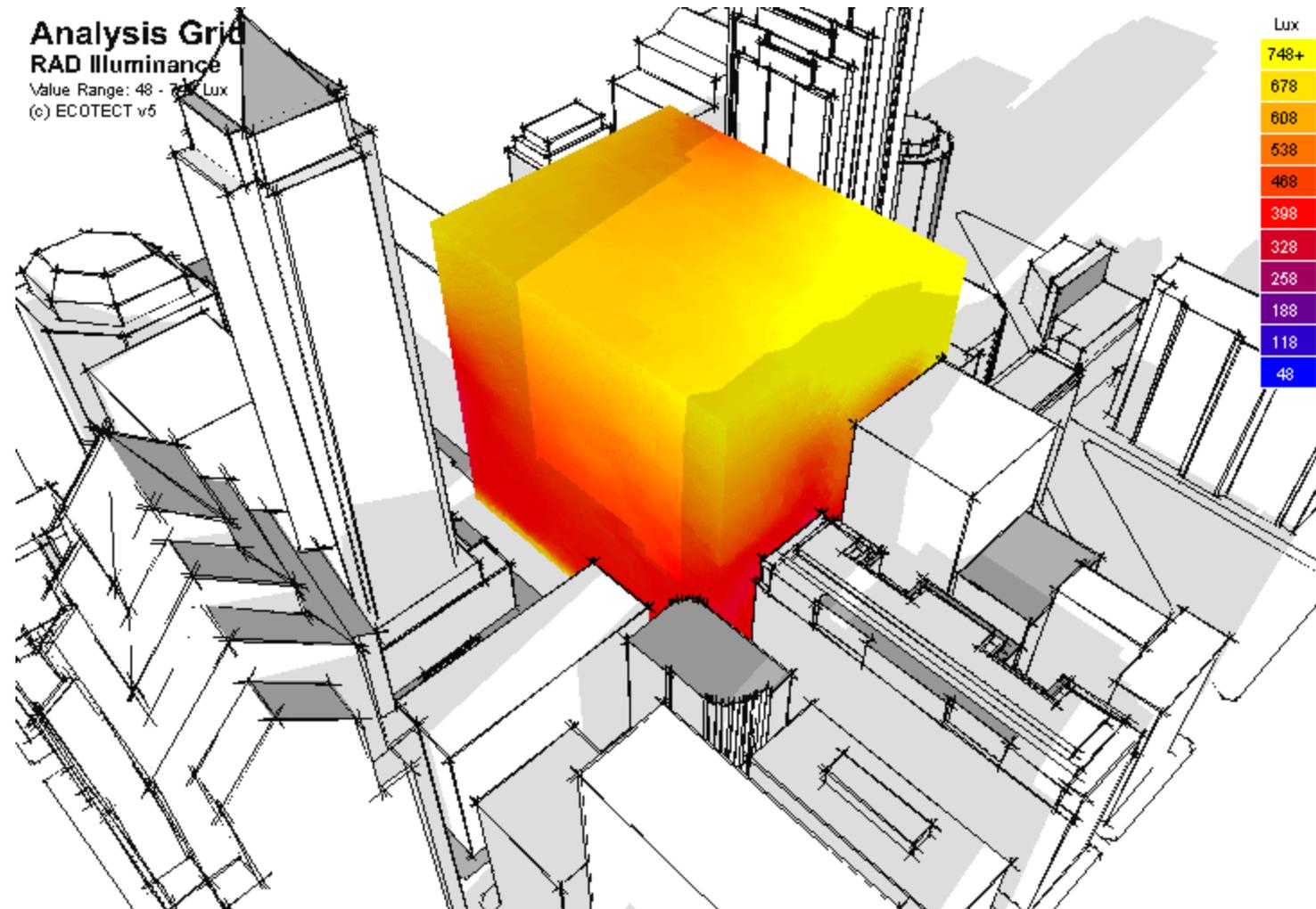
Sky Definition: Overcast sky [v] [icon] Use ECOTECT design sky Use ECOTECT sun angles

RIF File
Include camera views Type: Daylight Factor (%) [v]
Use current model view View type: Exterior Side [v]
Indirect reflections: 3 [v] Image Size: 640 x 480
Model Detail: MEDIUM [v]
Light Variability: MEDIUM [v]
Image Quality: MEDIUM [v]

Use Wizard Always skip this wizard. << Back OK Cancel

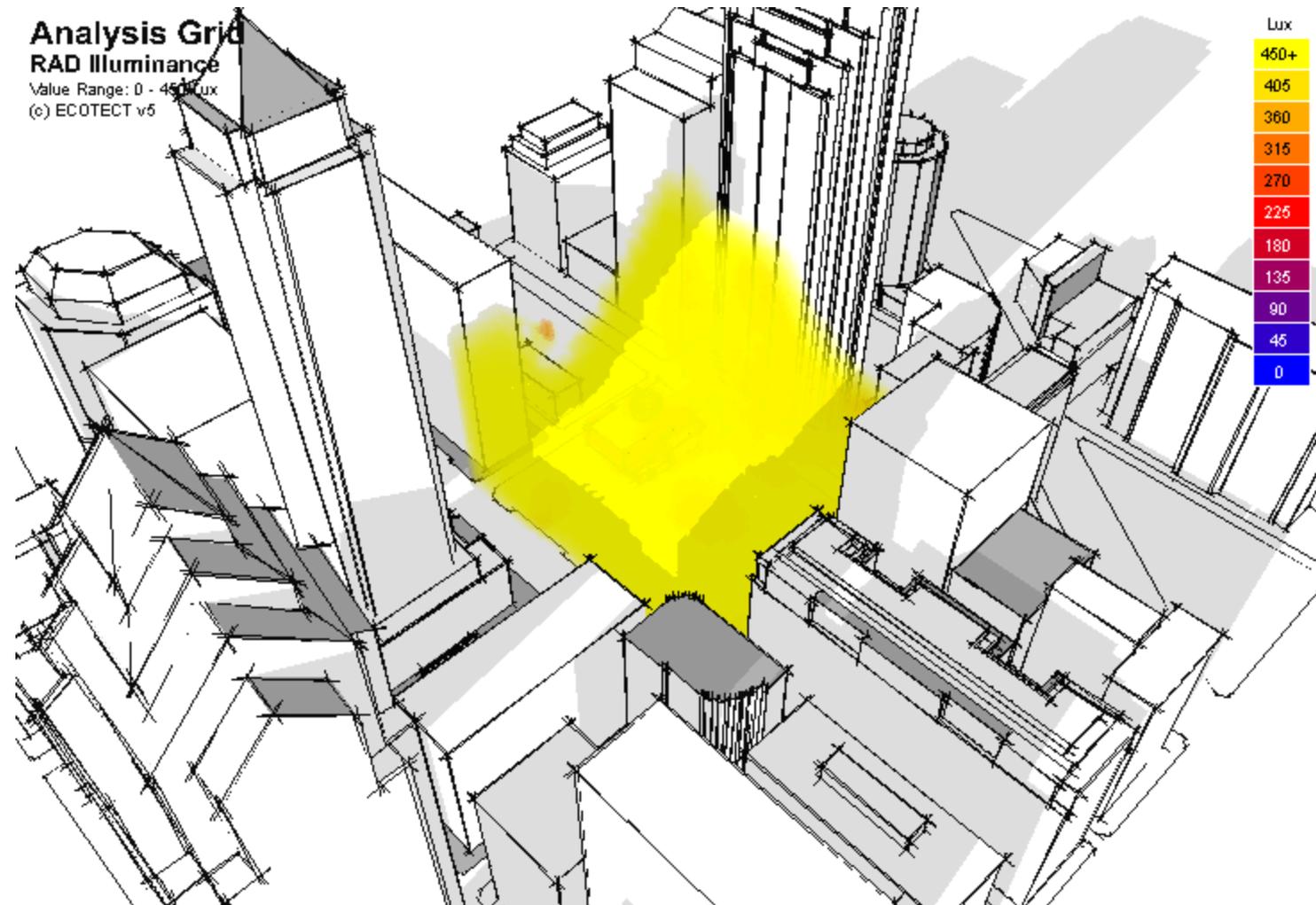
Visualising Radiance Data in ECOTECT

Data for a 3D analysis grid can be calculated in Radiance. This example looks at daylight factors and illuminance in the 'airspace' over a central city site.



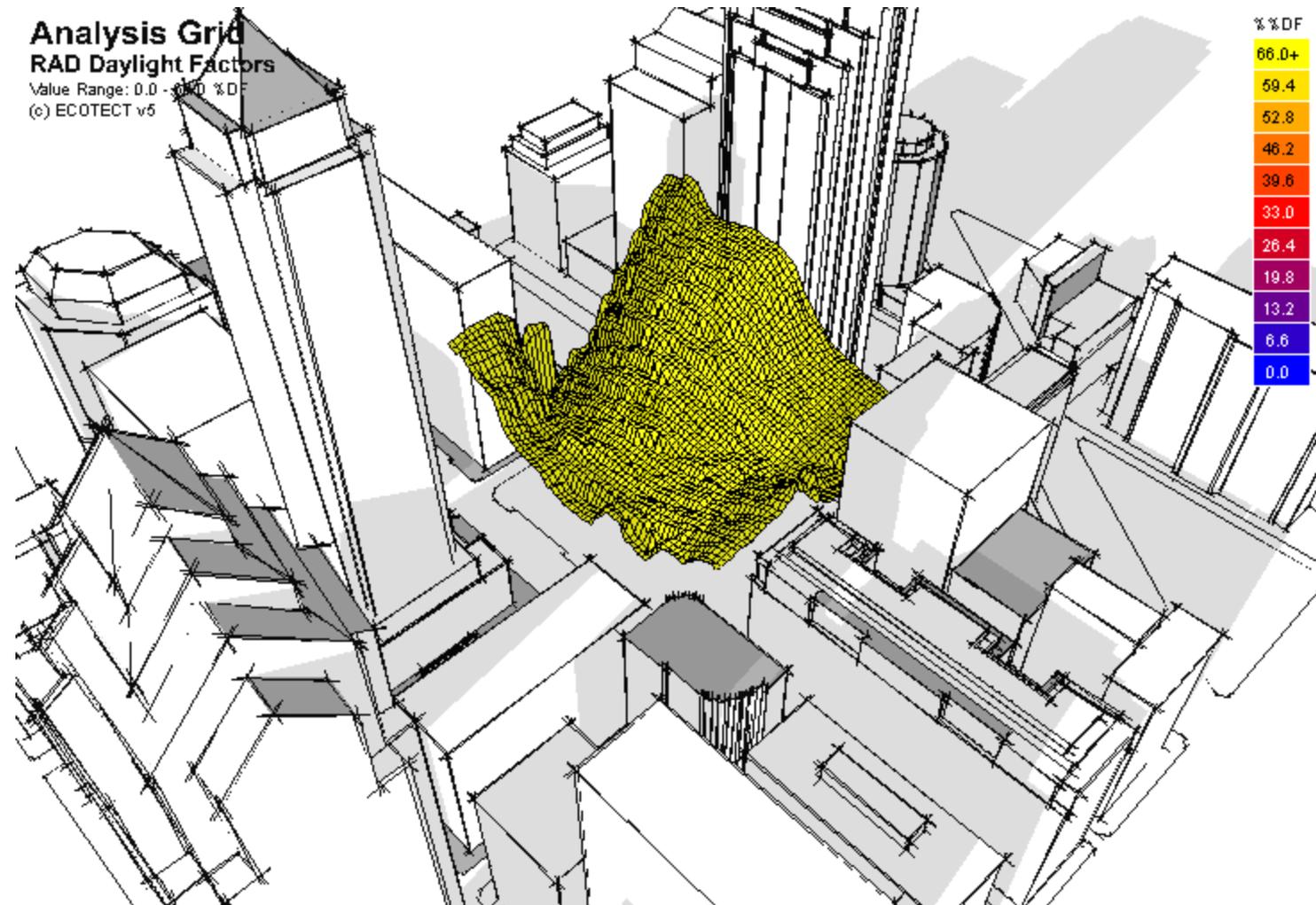
Visualising Radiance Data in ECOTECT

By setting upper and lower thresholds, 3D volumes can be displayed. In this case, the grid shows all spatial points below 450Lux at 12:00pm, 21st June.



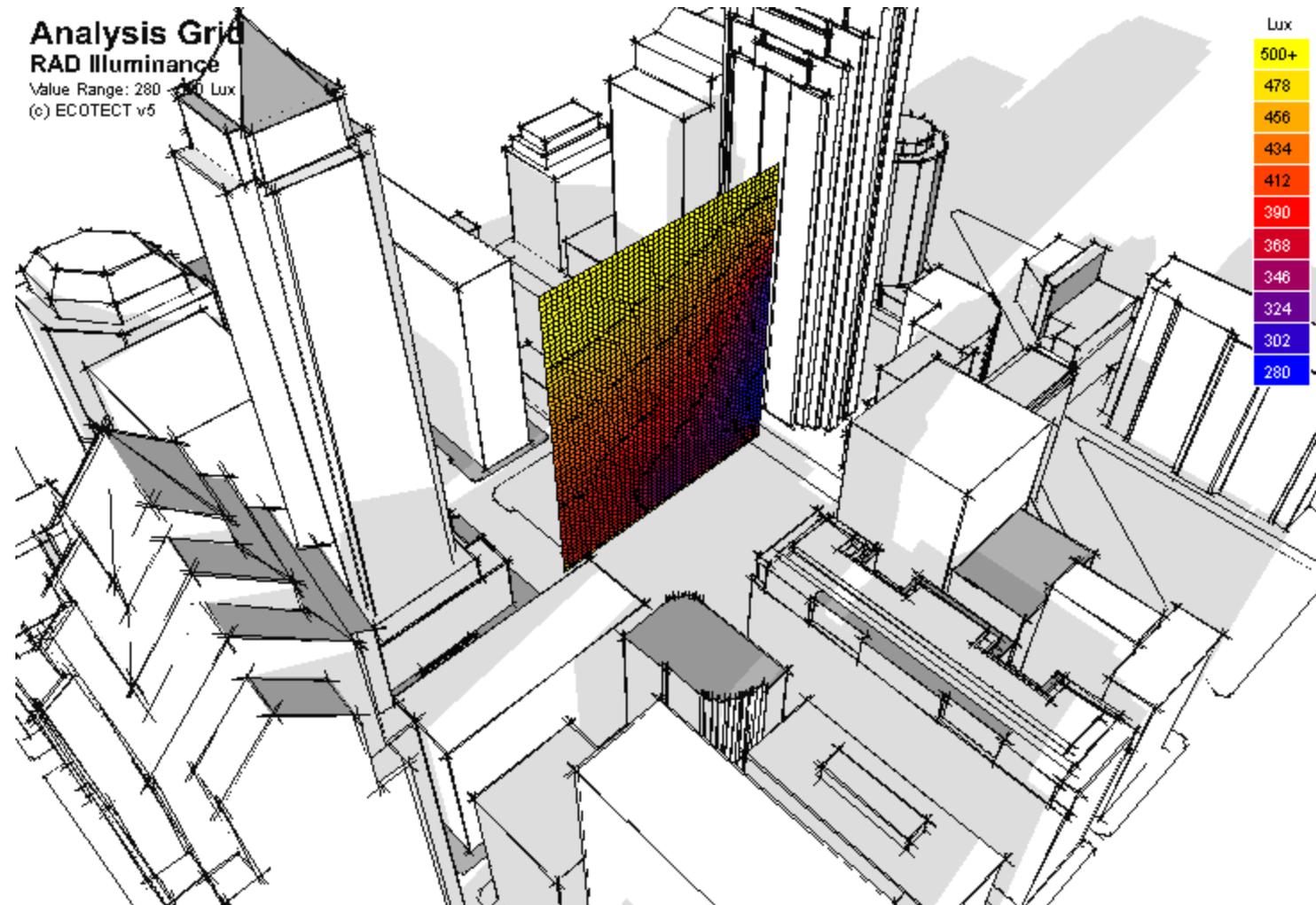
Visualising Radiance Data in ECOTECT

By generating iso-surfaces you can also visualise such thresholds. In this case the grid hides all points with an overcast sky daylight factor below 66%.



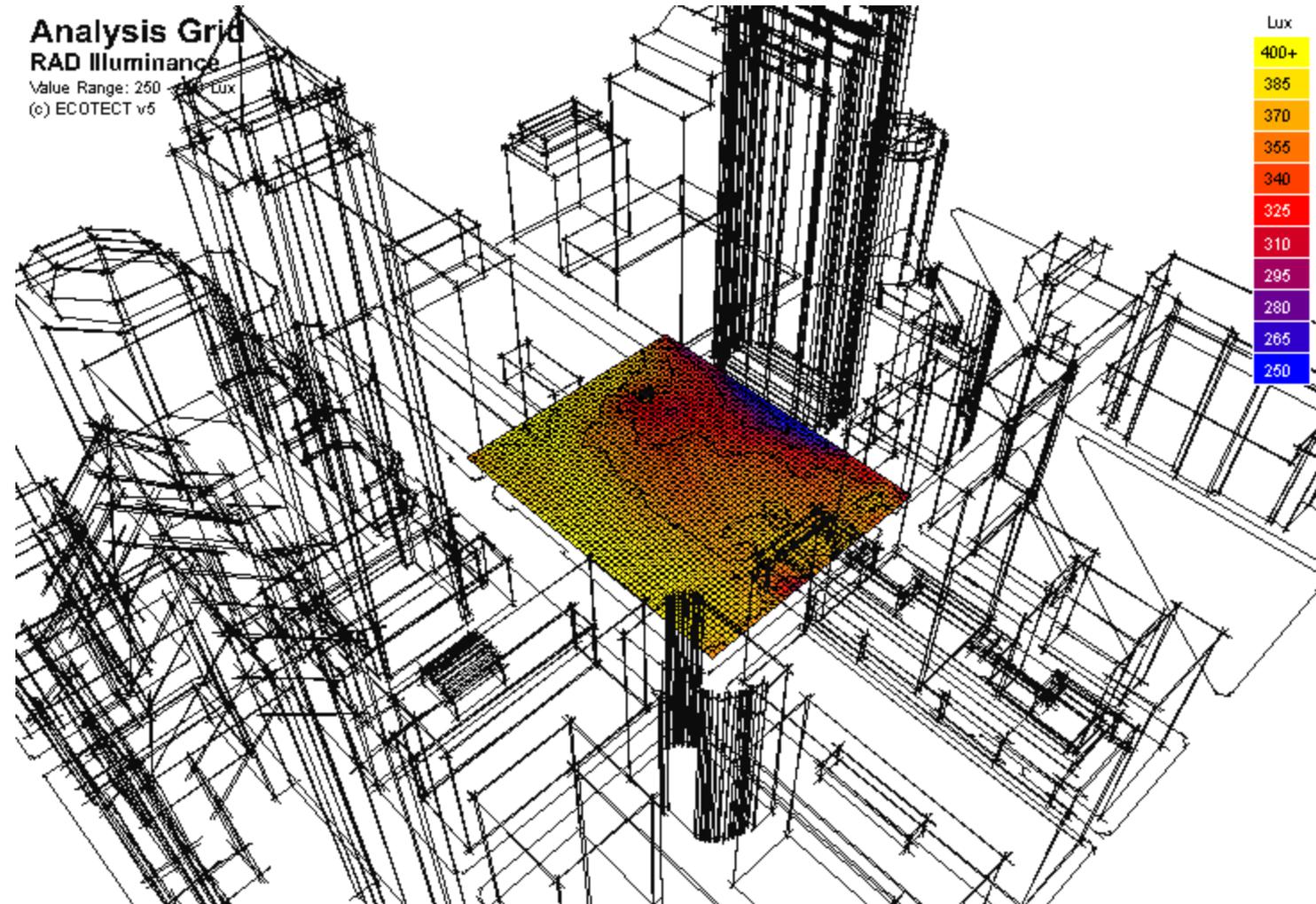
Visualising Radiance Data in ECOTECT

You can also interrogate this 3D volume using slices at any location in any axis to display contour plots.



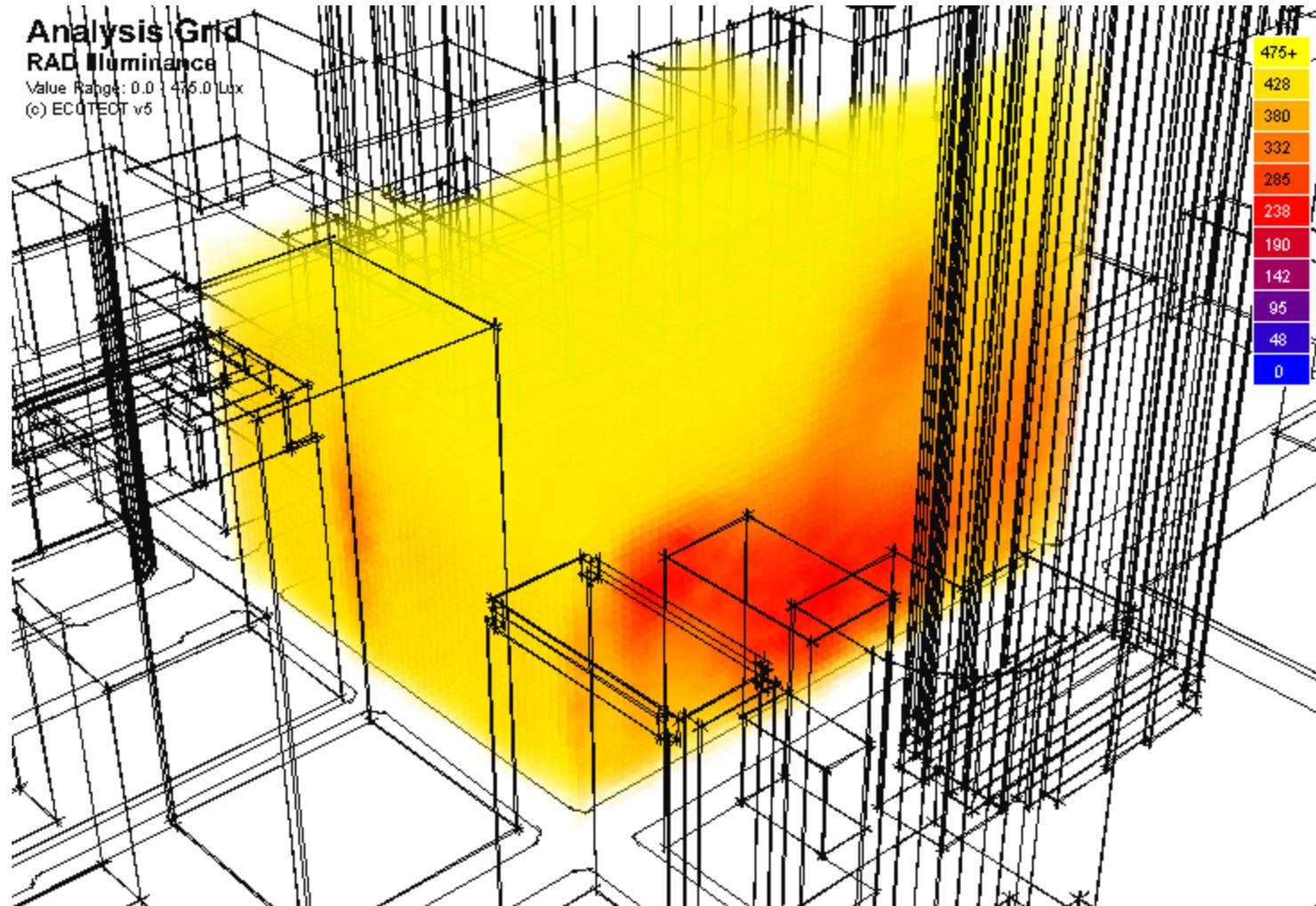
Visualising Radiance Data in ECOTECT

You can also interrogate this 3D volume using slices at any location in any axis to display contour plots.



Visualising Radiance Data in ECOTECT

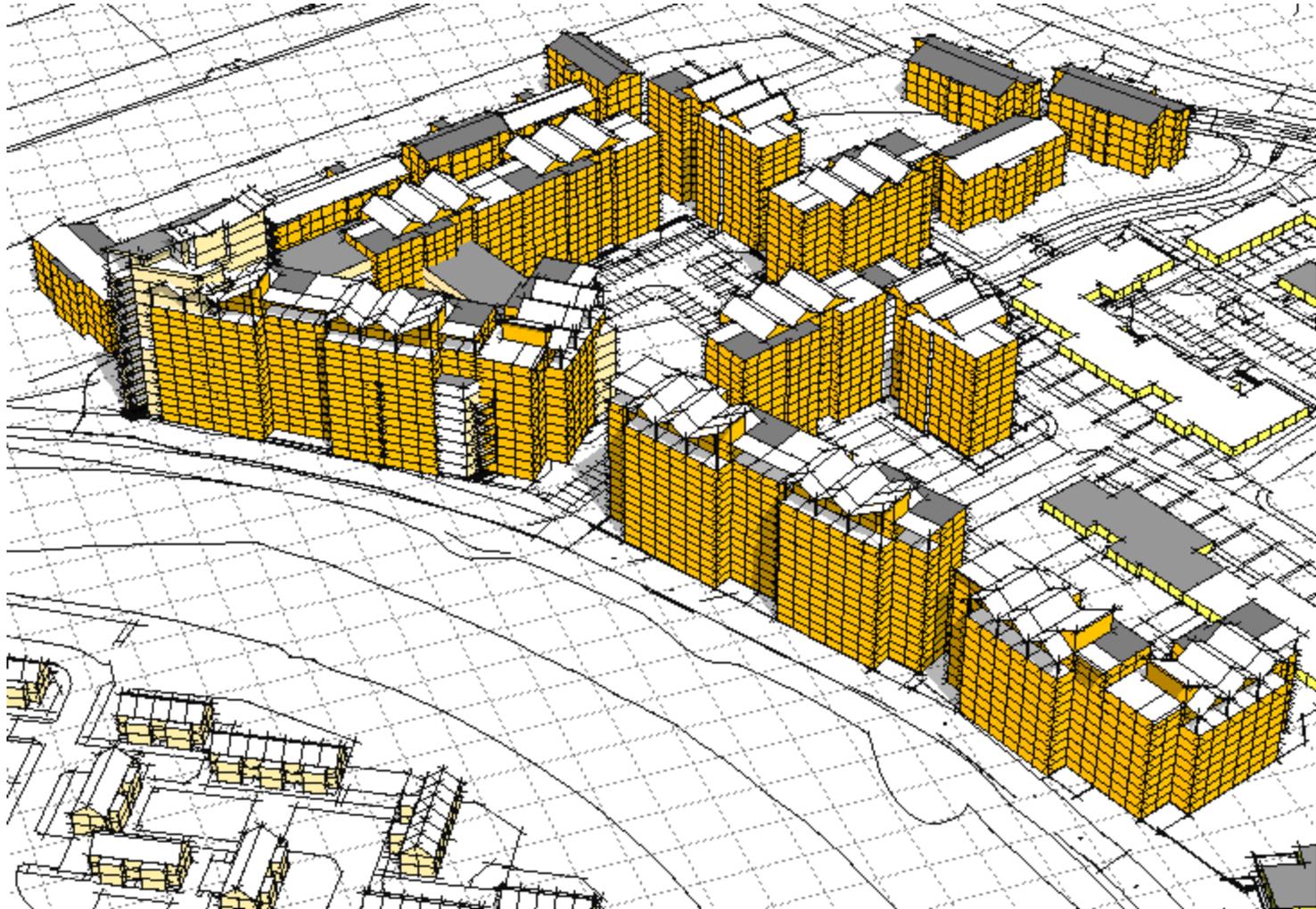
Using the right scale extents, you can dig deeper into the data to better visualise the spatial variation.



Model and Analysis by Spiros Stravoravdis of the Welsh School of Architecture

Visualising Radiance Data in ECOTECT

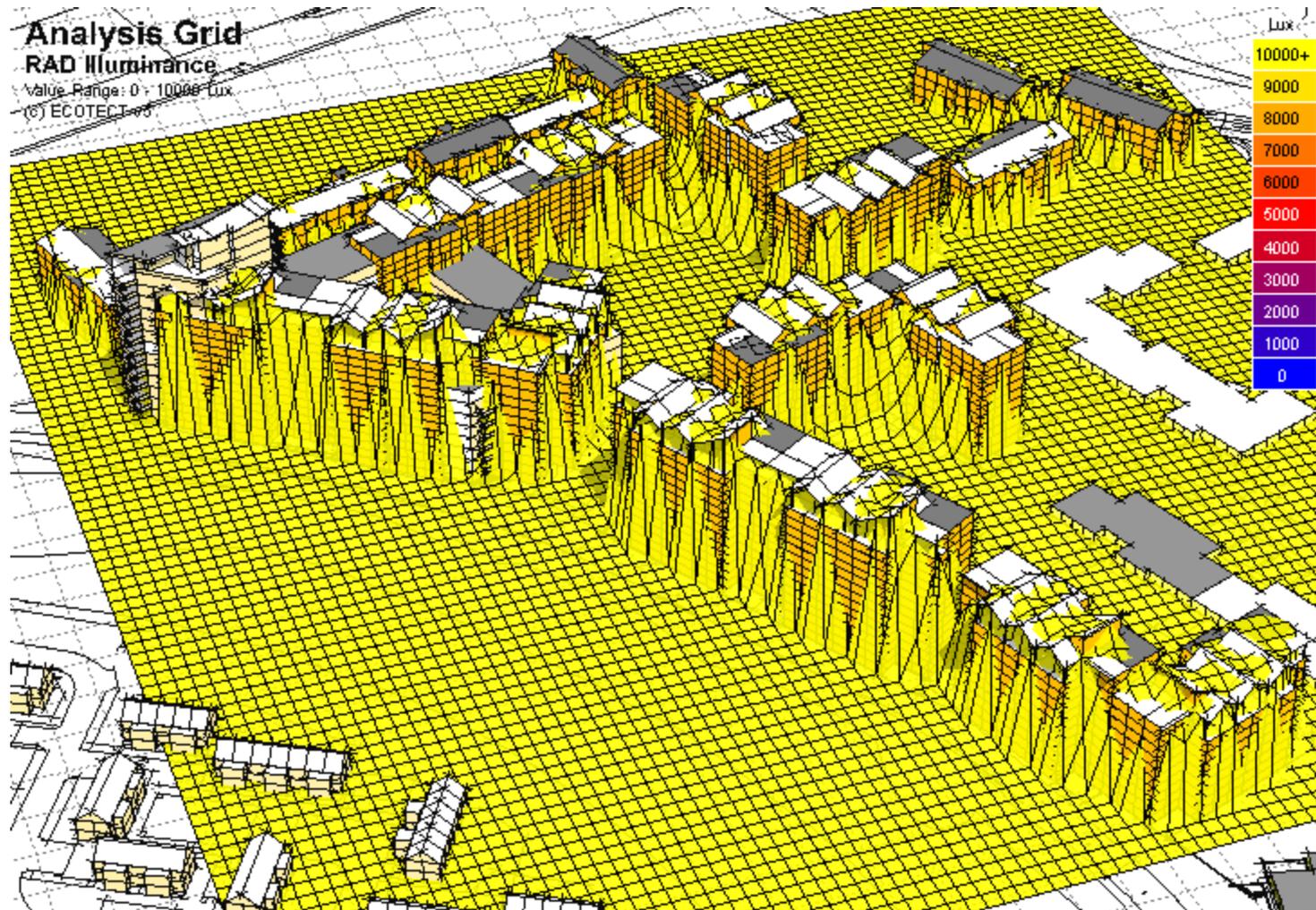
This same analysis can be done for different types of development.



Model and Analysis by Spiros Stravoravdis of the Welsh School of Architecture

Visualising Radiance Data in ECOTECT

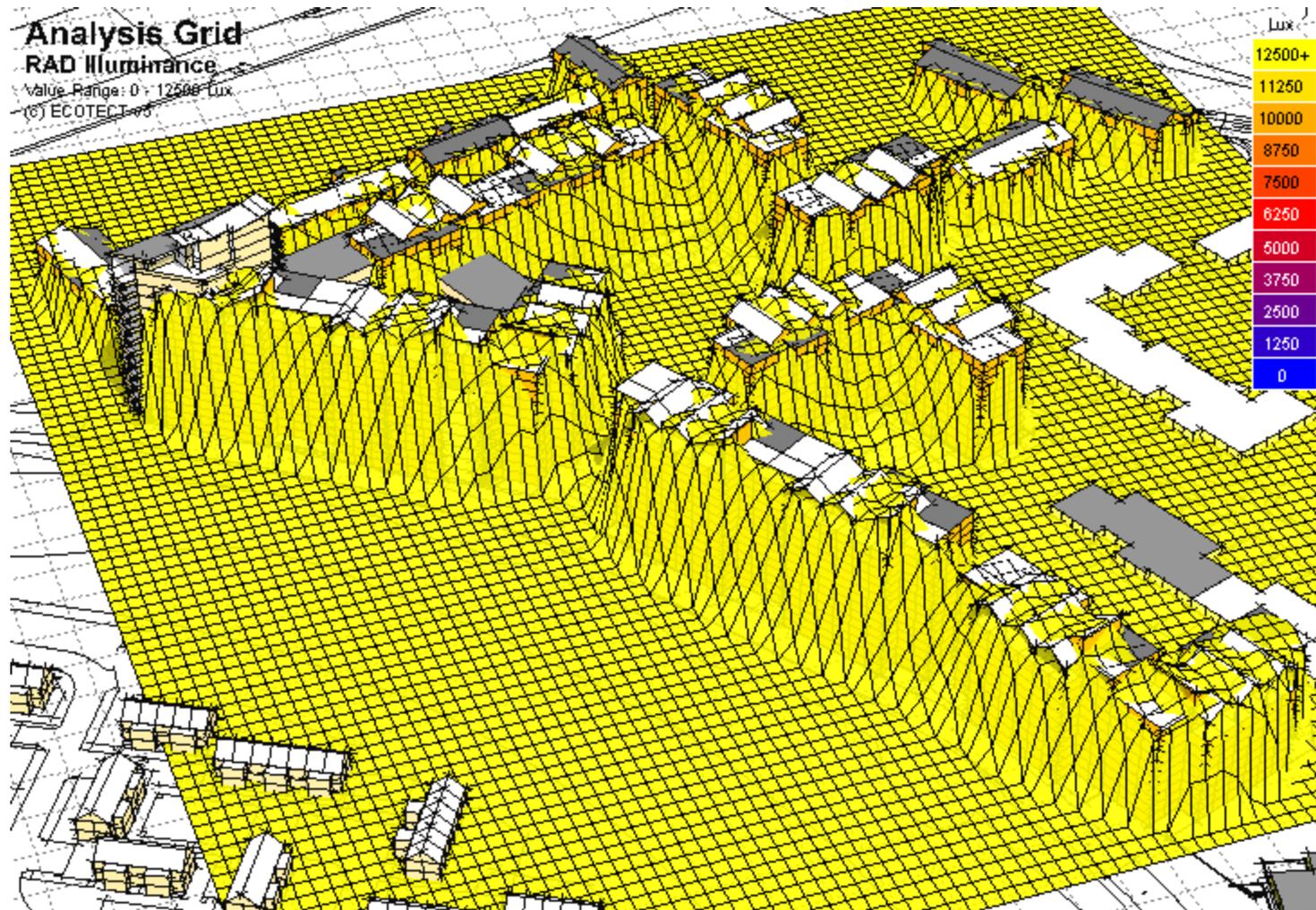
Which can then be used to show daylight illuminance thresholds at, for example, 10000Lux, 12500Lux and 15000Lux.



Model and Analysis by Spiros Stravoravdis of the Welsh School of Architecture

Visualising Radiance Data in ECOTECT

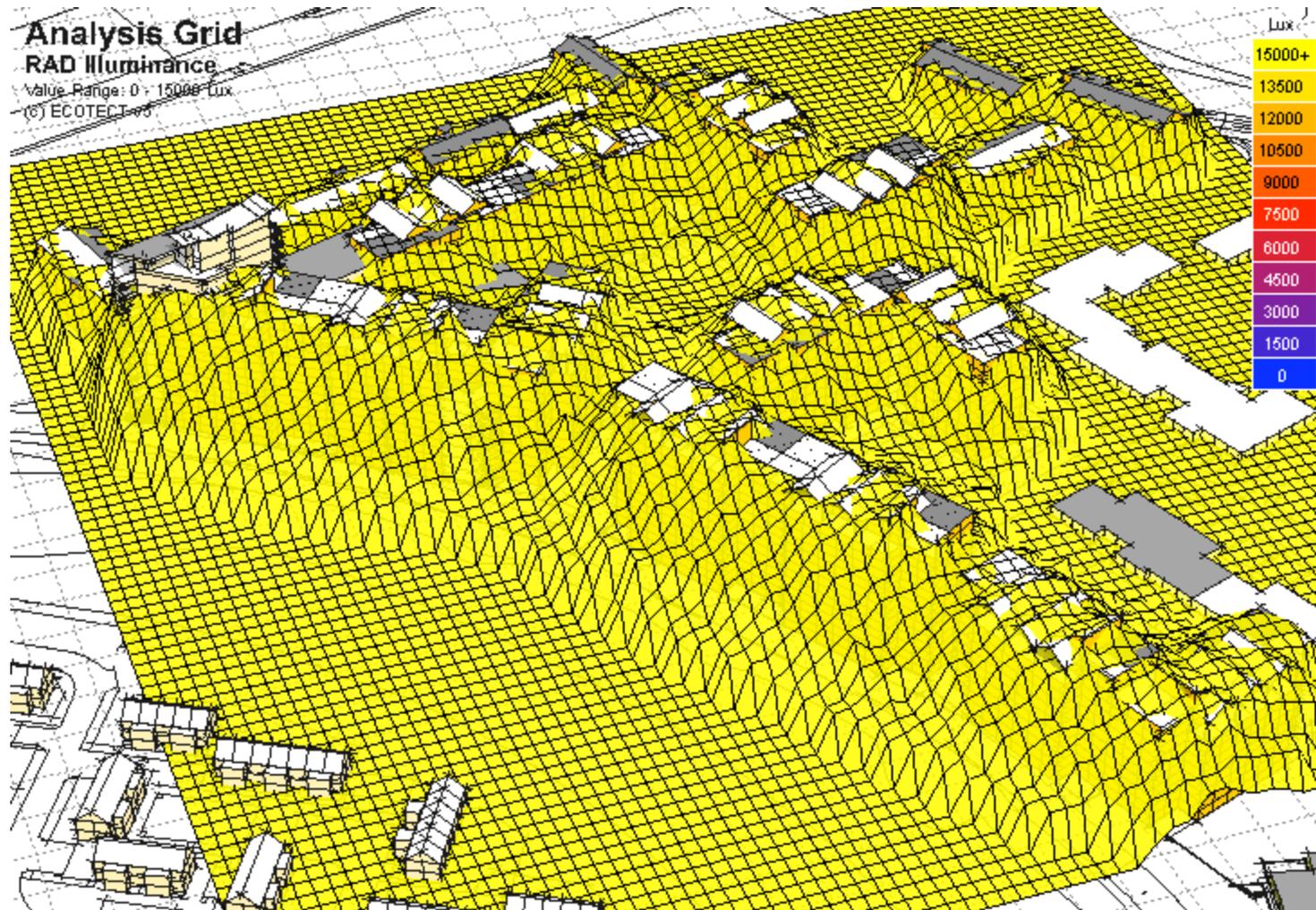
Which can then be used to show daylight illuminance thresholds at, for example, 10000Lux, 12500Lux and 15000Lux.



Model and Analysis by Spiros Stravoravdis of the Welsh School of Architecture

Visualising Radiance Data in ECOTECT

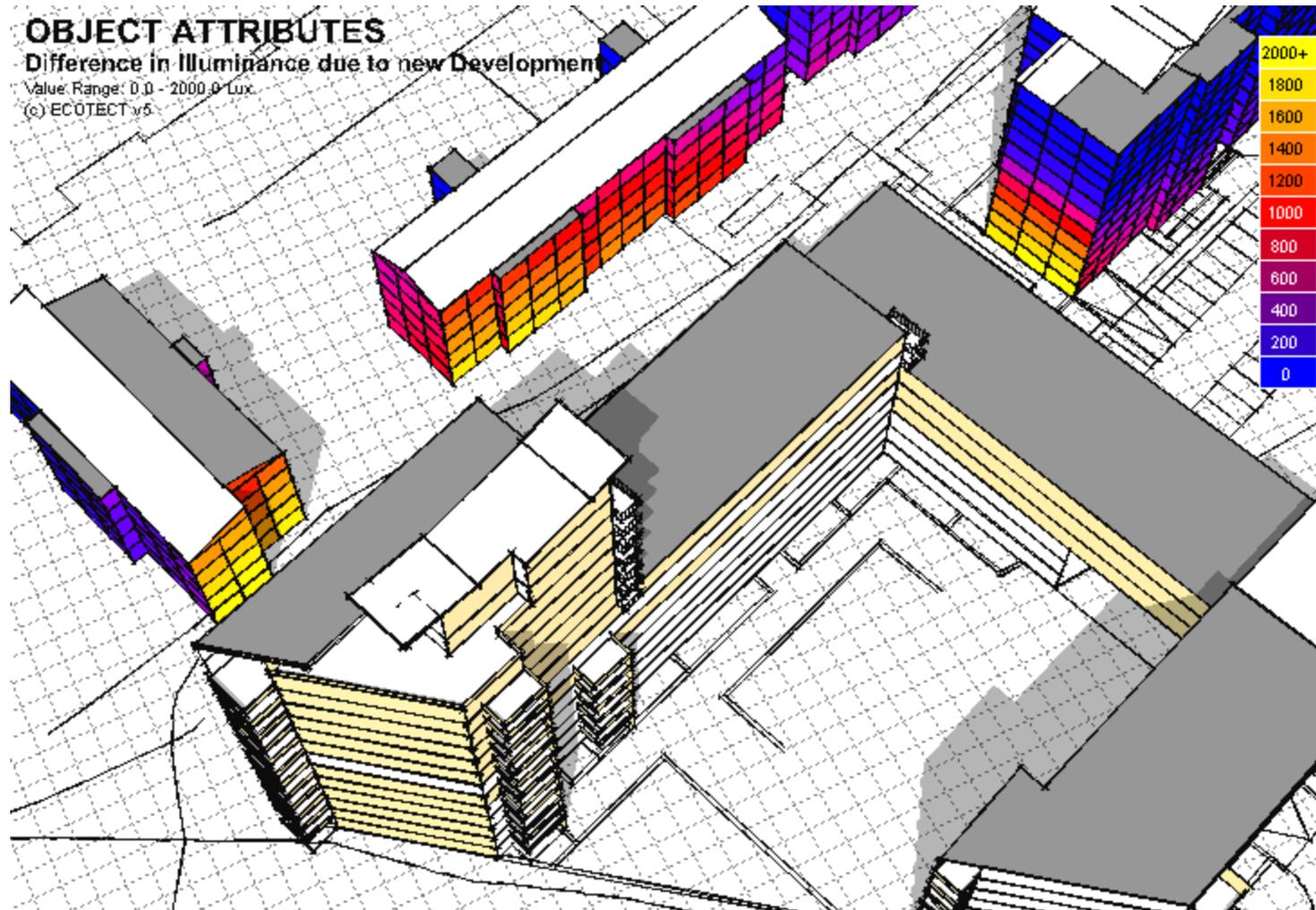
Which can then be used to show daylight illuminance thresholds at, for example, 10000Lux, 12500Lux and 15000Lux.



Model and Analysis by Spiros Stravoravdis of the Welsh School of Architecture

Visualising Radiance Data in ECOTECT

In addition to point data, you can also extract surface data using the centre and surface normal of individual patches. By processing multiple images from various configurations, it is possible to display a range of different values.



The Radiance Control Panel – Basic Layout

The screenshot displays the Radiance Control Panel (RCP) interface. On the left, the 'Render Settings' panel includes fields for Run Identifier (RCP), View Type (Interior), Display Type (Illuminance [lux]), Exposure Setting, Max. Relections (2), Image Size X (640), Image Size Y (480), Lighting Detail (Medium), Lighting Variability (Medium), Image Quality (Medium), and Post Process (True). Below this is the 'Project Information' tree, showing a hierarchy of Project File, Scene Files, Materials, and Views. The central pane is a code editor showing RIF and RAD syntax, with several lines highlighted in blue. On the right, the 'Radiance Language Help' window is open, showing a tree view of materials and a detailed description of the 'Spotlight' material, including its parameters and usage. Four orange arrows point from text labels to specific parts of the interface: 'Render Controls' points to the Image Size X and Y fields; 'Online Help' points to the Radiance Language Help window; 'Project Information' points to the Project Information tree; and 'RIF and RAD Syntax Highlighted Code Editor' points to the central code editor.

Render Controls

Online Help

Project Information

RIF and RAD Syntax Highlighted Code Editor

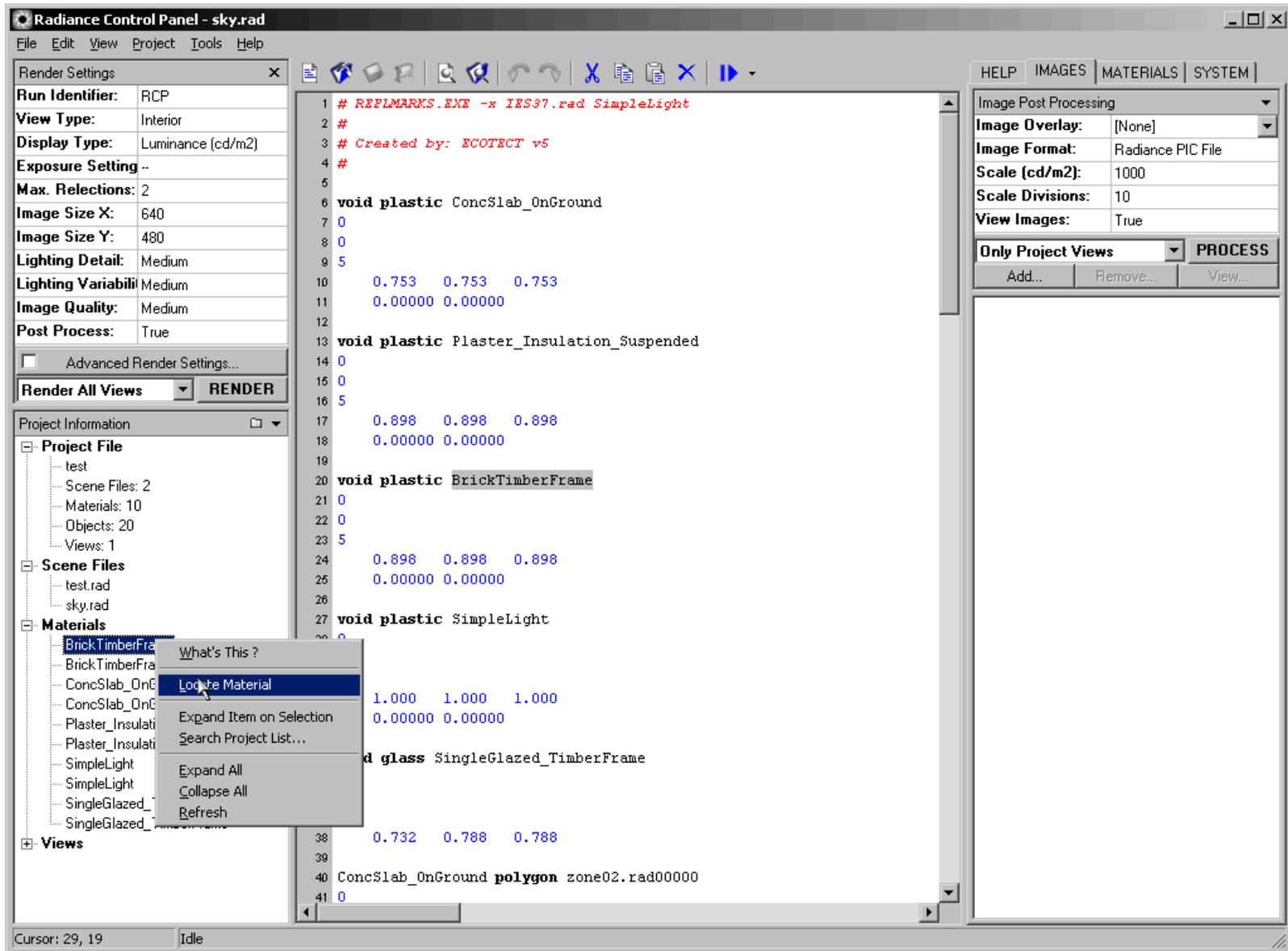
```
1 #
2 # Created by: ECOTECT v5
3 #
4 #
5 # Scene file.
6 scene= test.rad sky.rad
7
8 # Model extents.
9 ZONE = Interior -1.000 4.000 -1.000 3.000 0.000 3.000
10
11 # Associated files.
12 AMBFILE= test.amb
13 OCTREE= test.oct
14
15 # Misc. Parameters.
16 RESOLUTION= 640 480
17 DETAIL= MEDIUM
18 VARIABILITY= MEDIUM
19 QUALITY= MEDIUM
20 INDIRECT= 2
21 REPORT= 2
22
23 render=
24
25 # View definition(s).
26 view= c1 -vtv -vp -0.975 -5.512 3.394 -vd 2.498 6.502 -2.517 -vu 0 0 :
27
28
29
```

Spotlight

Spotlight is used for self-luminous surfaces having directed output. As well as radiance, the full cone angle (in degrees) and orientation (output direction) vector are given. The length of the orientation vector is the distance of the effective focus behind the source center (i.e. the focal length).

```
mod spotlight id
0
0
7 red green blue angle
xdir ydir zdir
```

The Radiance Control Panel – Finding Modifiers and Objects



The Radiance Control Panel – Generating Materials (Alpha)

The screenshot displays the Radiance Control Panel (RCP) interface for a project named 'sky.rad'. The interface is divided into several sections:

- Render Settings:** Includes fields for Run Identifier (RCP), View Type (Interior), Display Type (Luminance (cd/m2)), Exposure Setting (--), Max. Relections (2), Image Size X (640), Image Size Y (480), Lighting Detail (Medium), Lighting Variability (Medium), Image Quality (Medium), and Post Process (True). There is also an 'Advanced Render Settings...' checkbox and 'Render All Views' and 'RENDER' buttons.
- Project Information:** A tree view showing the project structure: Project File (test, Scene Files: 2, Materials: 10, Objects: 20, Views: 1), Scene Files (test.rad, sky.rad), Materials (BrickTimberFrame, ConcSlab_OnGround, Plaster_Insulation_Suspended, SimpleLight, SingleGlazed_TimberFrame), and Views.
- Material List:** A list of materials defined in the scene, including:
 - ConcSlab_OnGround (plastic)
 - BrickTimberFrame (plastic)
 - SimpleLight (plastic)
 - SingleGlazed_TimberFrame (glass)
 - ConcSlab_OnGround polygon zone02 (radiance map)
- RadianceCP: Materials... Dialog:** A dialog box showing a list of procedural textures and patterns. 'textfuncbrick' is selected.
- Radiance Materials Editor:** A panel on the right showing a preview of a red sphere and cube. It includes buttons for '<< INSERT', 'EXAMPLE IMAGE', '>>', 'Add...', 'Remove Item...', and up/down arrows. Below the preview is a table of properties for the selected material.

Property	Value
Picture File:	podlife.pic
Height/Width Ratio:	1
Scale:	2
Translation X:	0
Translation Y:	0
Translation Z:	0
Rotation X:	90
Rotation Y:	0
Rotation Z:	0

Cursor: 29, 19 Done

The Radiance Control Panel – Checking the Radiance Installation

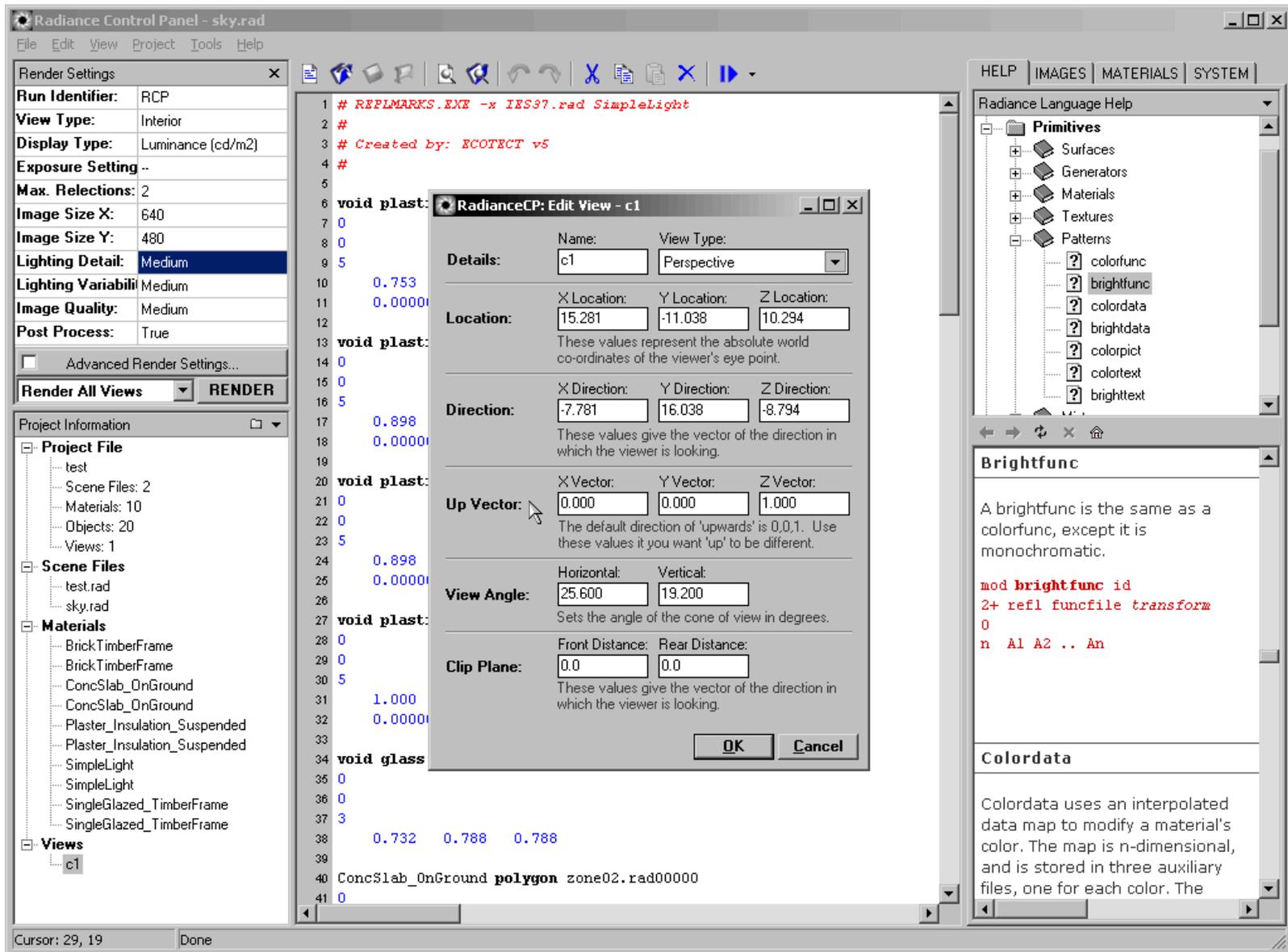
The screenshot displays the Radiance Control Panel interface for a file named 'sky.rad'. The window is divided into several sections:

- Render Settings:** A table with the following values:

Run Identifier:	RCP
View Type:	Interior
Display Type:	Luminance (cd/m2)
Exposure Setting:	--
Max. Relections:	2
Image Size X:	640
Image Size Y:	480
Lighting Detail:	Medium
Lighting Variabili:	Medium
Image Quality:	Medium
Post Process:	True
- Project Information:** A tree view showing the project structure:
 - Project File
 - test
 - Scene Files: 2
 - Materials: 10
 - Objects: 20
 - Views: 1
 - Scene Files
 - test.rad
 - sky.rad
 - Materials
 - BrickTimberFrame
 - BrickTimberFrame
 - ConcSlab_OnGround
 - ConcSlab_OnGround
 - Plaster_Insulation_Suspended
 - Plaster_Insulation_Suspended
 - SimpleLight
 - SimpleLight
 - SingleGlazed_TimberFrame
 - SingleGlazed_TimberFrame
 - Views
- Command Window:** A text area showing the scene description:

```
1 # RFPMARKS.EXE -x IES97.rad SimpleLight
2 #
3 # Created by: ECOTECH v5
4 #
5
6 void plastic ConcSlab_OnGround
7 0
8 0
9 5
10 0.753 0.753 0.753
11 0.00000 0.00000
12
13 void plastic Plaster_Insulation_Suspended
14 0
15 0
16 5
17 0.898 0.898 0.898
18 0.00000 0.00000
19
20 void plastic BrickTimberFrame
21 0
22 0
23 5
24 0.898 0.898 0.898
25 0.00000 0.00000
26
27 void plastic SimpleLight
28 0
29 0
30 5
31 1.000 1.000 1.000
32 0.00000 0.00000
33
34 void glass SingleGlazed_TimberFrame
35 0
36 0
37 3
38 0.732 0.788 0.788
39
40 ConcSlab_OnGround polygon zone02.rad00000
41 0
```
- System Check Panel:** A panel on the right with tabs for HELP, IMAGES, MATERIALS, and SYSTEM. It contains:
 - CHECK INSTALLATION:** A button with a 'FIX' button next to it.
 - ZOMBIE PROCESSES:** A button with a 'CLEAR' button next to it.
 - Checking RADIANCE directory...** A list of checks:
 - ✓ C:\RADIANCE
 - Looking for program files...
 - ✓ C:\RADIANCE\bin\rad.exe
 - ✓ C:\RADIANCE\bin\oconv.exe
 - ✓ C:\RADIANCE\bin\trace.exe
 - ✓ C:\RADIANCE\bin\rpict.exe
 - ✓ C:\RADIANCE\bin\rvview.exe
 - Looking for library files...
 - ✓ C:\RADIANCE\lib\skybright.cal
 - Checking System Registry...** A list of checks:
 - Looking for 'SOFTWARE\Lawrence Berkeley Na
 - ✓ HKEY_LOCAL_USER: RAYPATH = .\C:\RADIANCE
 - ✓ HKEY_LOCAL_USER: BINPATH = C:\RADIANCE
 - Looking for 'SOFTWARE\Lawrence Berkeley Na
 - ✓ HKEY_LOCAL_USER: DRADPATH = C:\RADIANCE
 - Your RADIANCE installation looks fine.**

The Radiance Control Panel – Editing Radiance Views



The Radiance Control Panel – Manual Access to Render Settings

The screenshot displays the Radiance Control Panel (RCP) interface for a file named 'sky.rad'. The main window is divided into several sections:

- Render Settings Panel (Left):** Contains fields for Run Identifier (RCP), View Type (Interior), Display Type (Luminance (cd/m2)), Exposure Setting (--), Max. Relections (2), Image Size X (640), Image Size Y (480), Lighting Detail (Medium), Lighting Variability (Medium), Image Quality (Medium), and Post Process (True). There is also an 'Advanced Render Settings...' checkbox and a 'RENDER' button.
- Project Information Panel (Bottom Left):** Shows a tree view of the project structure, including Project File, Scene Files, Materials, and Views.
- Main Render Command Window (Center):** Displays a list of render commands and their parameters, such as 'void plastic ConcSlab_OnGround' and 'void glass SingleGlazed_TimberFrame'. The current cursor is at line 19.
- RadianceCP: Render Settings Dialog (Center):** A modal dialog box with a table of parameters and values. The '-dc' parameter is currently set to 5.
- Radiance Language Help Panel (Right):** Provides documentation for various render parameters, including '-dc frac' and '-dr N'.

RadianceCP: Render Settings Dialog Table:

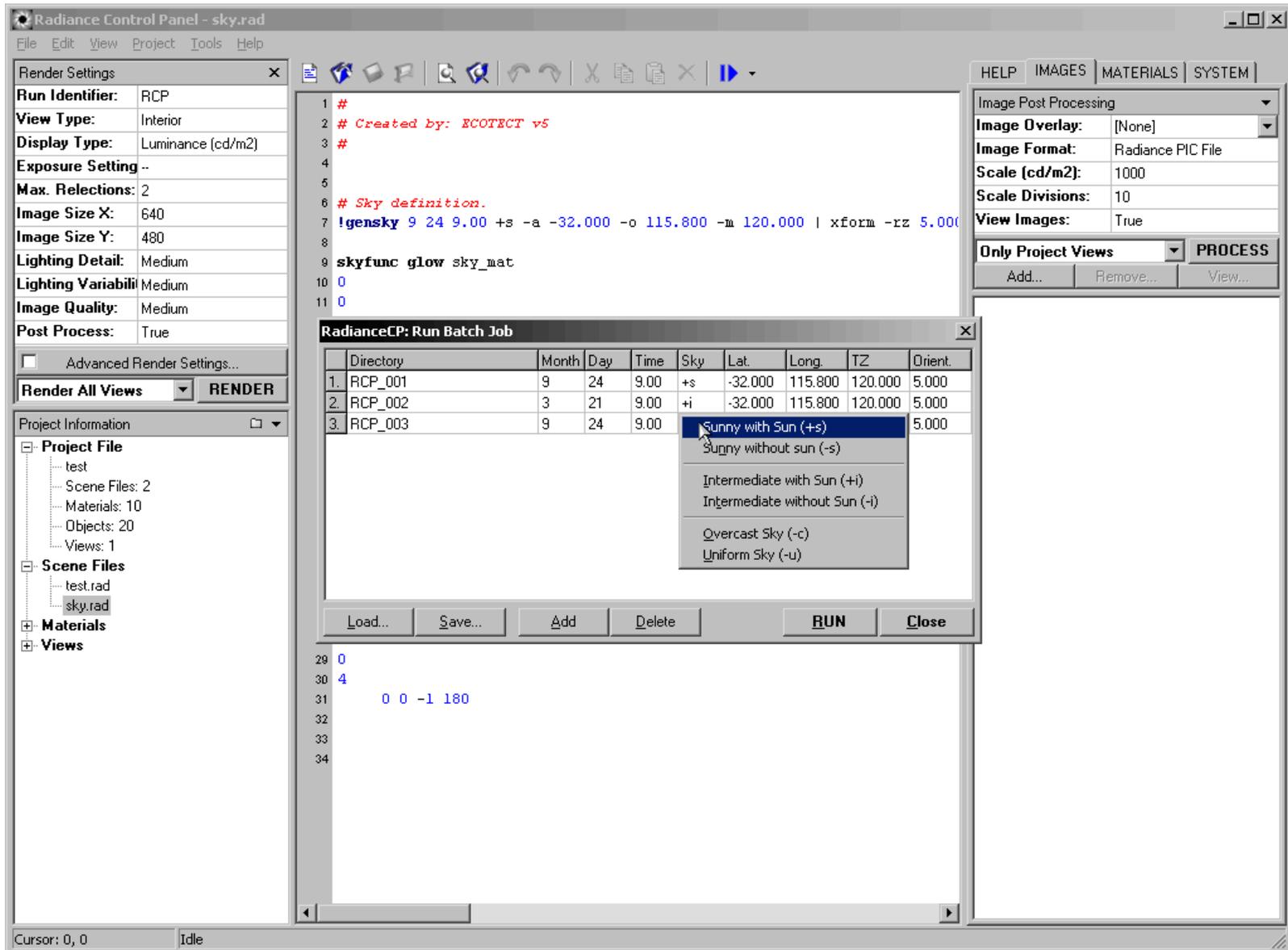
Parameter	Value
-dp	512
-ar	11
-ms	0.28
-ds	.3
-dt	.1
-dc	5
-dr	1
-sj	.7
-st	.1
-ab	2
-af	RCP.amb
-aa	.2
-ad	400
-as	64
-av	0.01 0.01 0.01
-lr	6
-lw	.002

Radiance Language Help Panel Content:

-dc frac
Set the direct certainty to *frac*. A value of one guarantees that the absolute accuracy of the direct calculation will be equal to or better than that given in the *-dt* specification. A value of zero only insures that all shadow lines resulting in a contrast change greater than the *-dt* specification will be calculated.

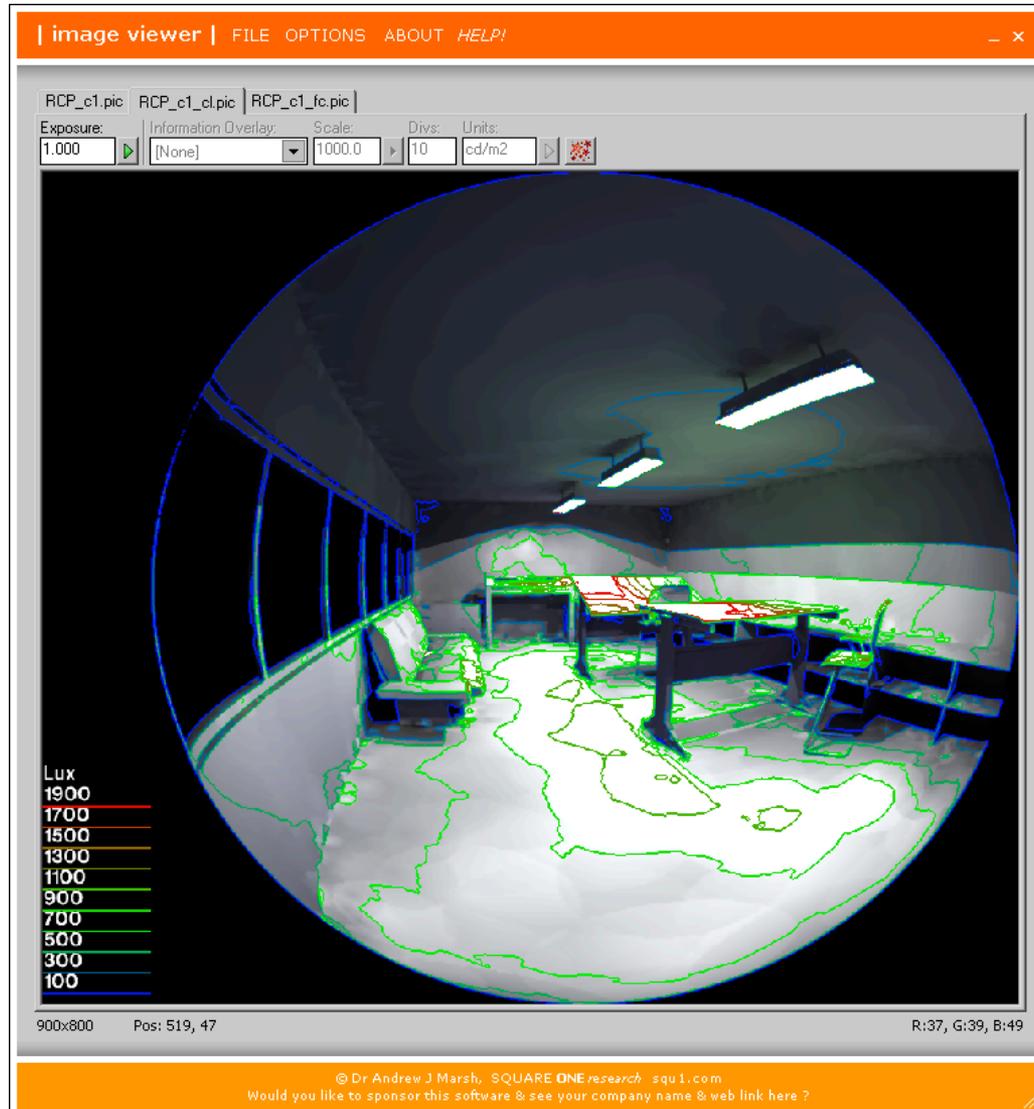
-dr N
Set the number of relays for secondary sources to *N*. A value of 0 means that secondary sources will be ignored. A value of 1 means that sources will be made into first generation secondary sources; a value of 2 means that first generation secondary sources will also be made into second generation

The Radiance Control Panel – Managing Batch Runs



The Radiance Image Viewer

This is a slightly more flexible version of the Windows *WinImage.exe* utility.



Summary

The aim of this presentation was to demonstrate how Radiance and ECOTECT can interact in ways that enhance a designer's understanding of results.

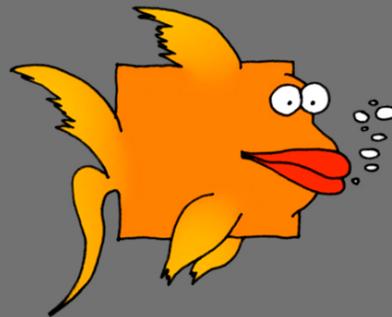
Like other tools such as OpenDX, ECOTECT serves as a visualisation platform for data generated by Radiance.

However, it can also be used to generate the model, export it, control the run and then import the results - thus making the use of Radiance much simpler and easier for the more casual user.

Combined with the free Radiance Control Panel and Radiance Image Viewer, the suite provides a complete Radiance Development Environment.

For more information and free downloads, visit the following sites...

www.squ1.com



www.ecotect.com