

# LightSketch & Scythe and Sew

tools for rapid architectural lighting analysis

Daniel Glaser<sup>1</sup>, Osbert Feng<sup>2</sup>, Jan Voung<sup>2</sup>, Ling Xiao<sup>2</sup>,  
John Canny<sup>2</sup>, Ellen Yi-Luen Do<sup>3</sup>

<sup>1</sup>Interdisciplinary Doctoral Program, University of California, Berkeley

<sup>2</sup>Computer Science Division, University of California, Berkeley

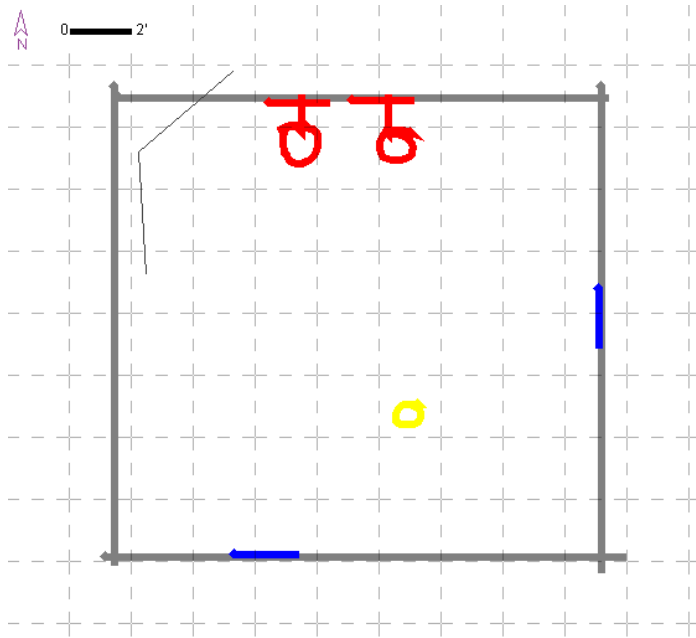
<sup>3</sup>Department of Architecture, University of Washington, Seattle

*2003 Radiance Workshop, Berkeley, CA, Sep 22-26*

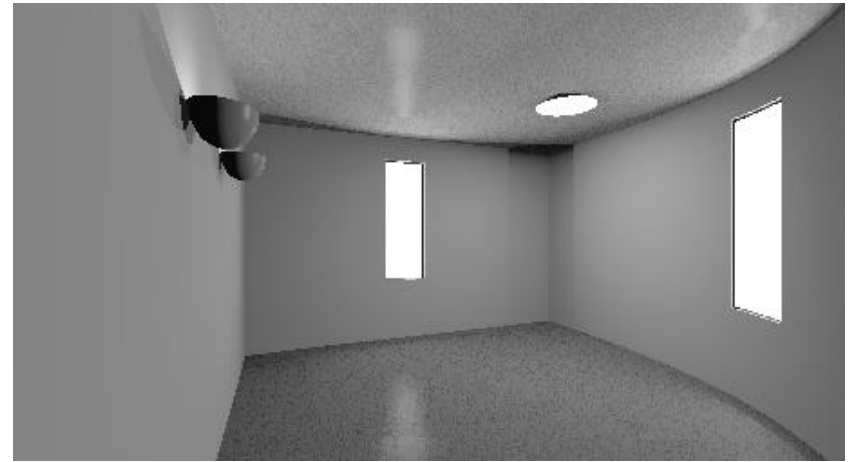
# Introduction

- There are few exploratory design tools for lighting simulation
- Physical models have limited utility for daylight and electric light simulation
- CAAD tools can be robust, but cumbersome
- We propose:
  - sketching as interface to robust simulation environment
  - Workbench to manipulate simulation results

# LightSketch



2D sketchpad



creates 3D Radiance models

# Symbols

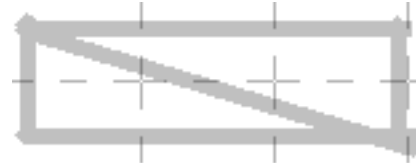
- walls/window



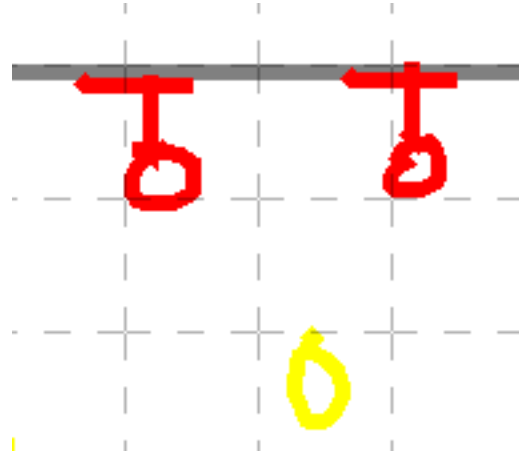
- skylights



- fluorescent



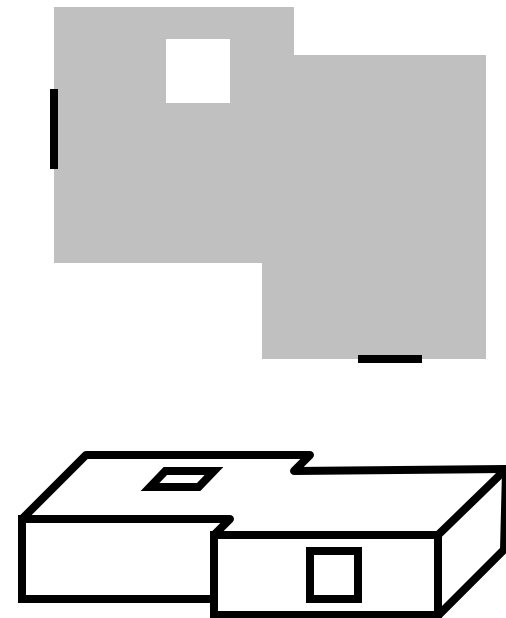
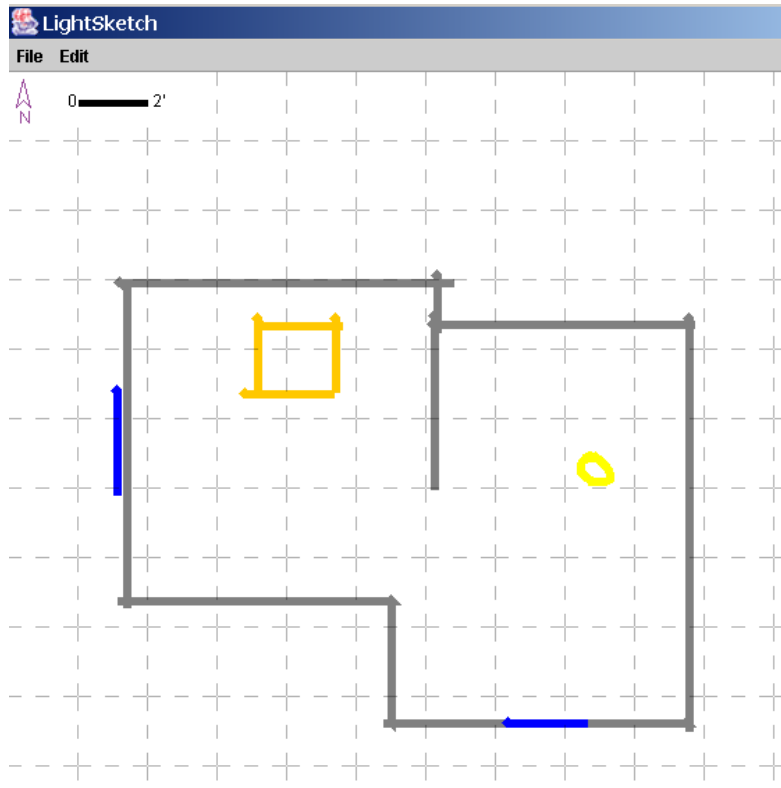
- sconce/down light



- desk, chair

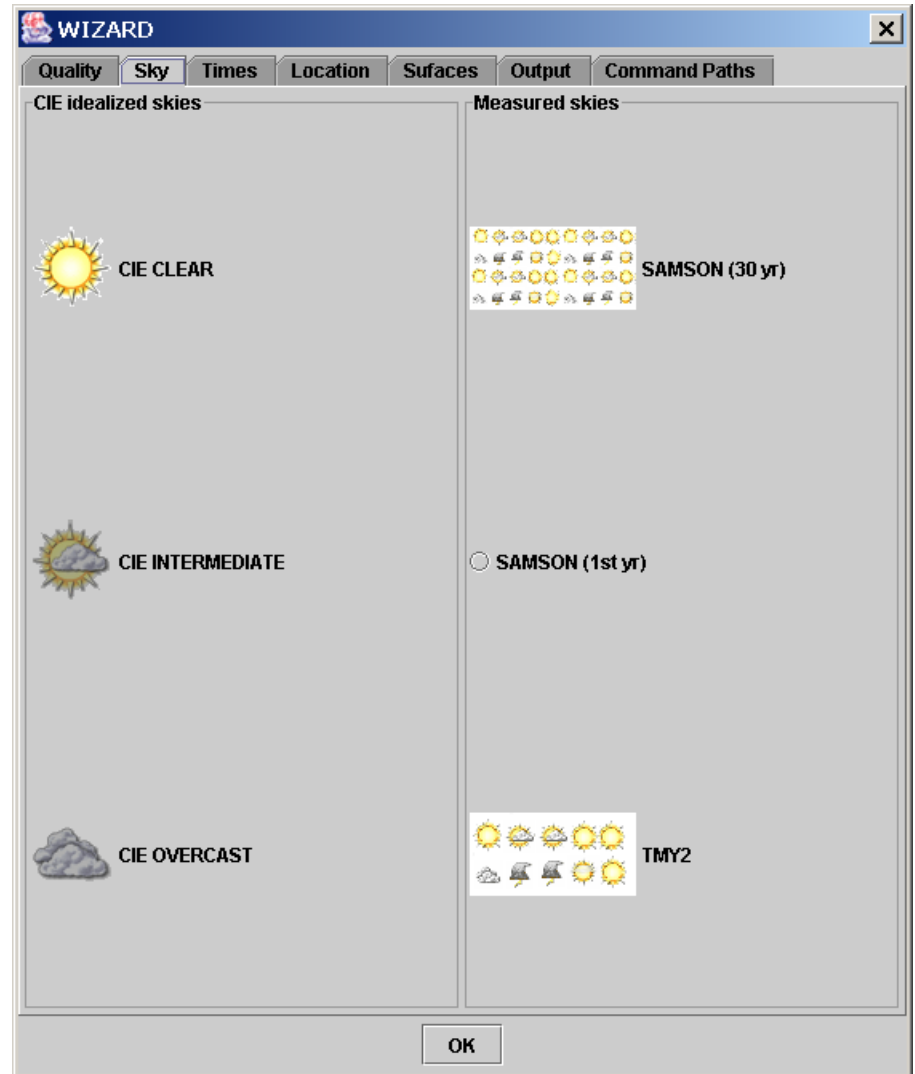
# Recognition

- Spaces are currently recognized by their convex hull and interior/exterior relations

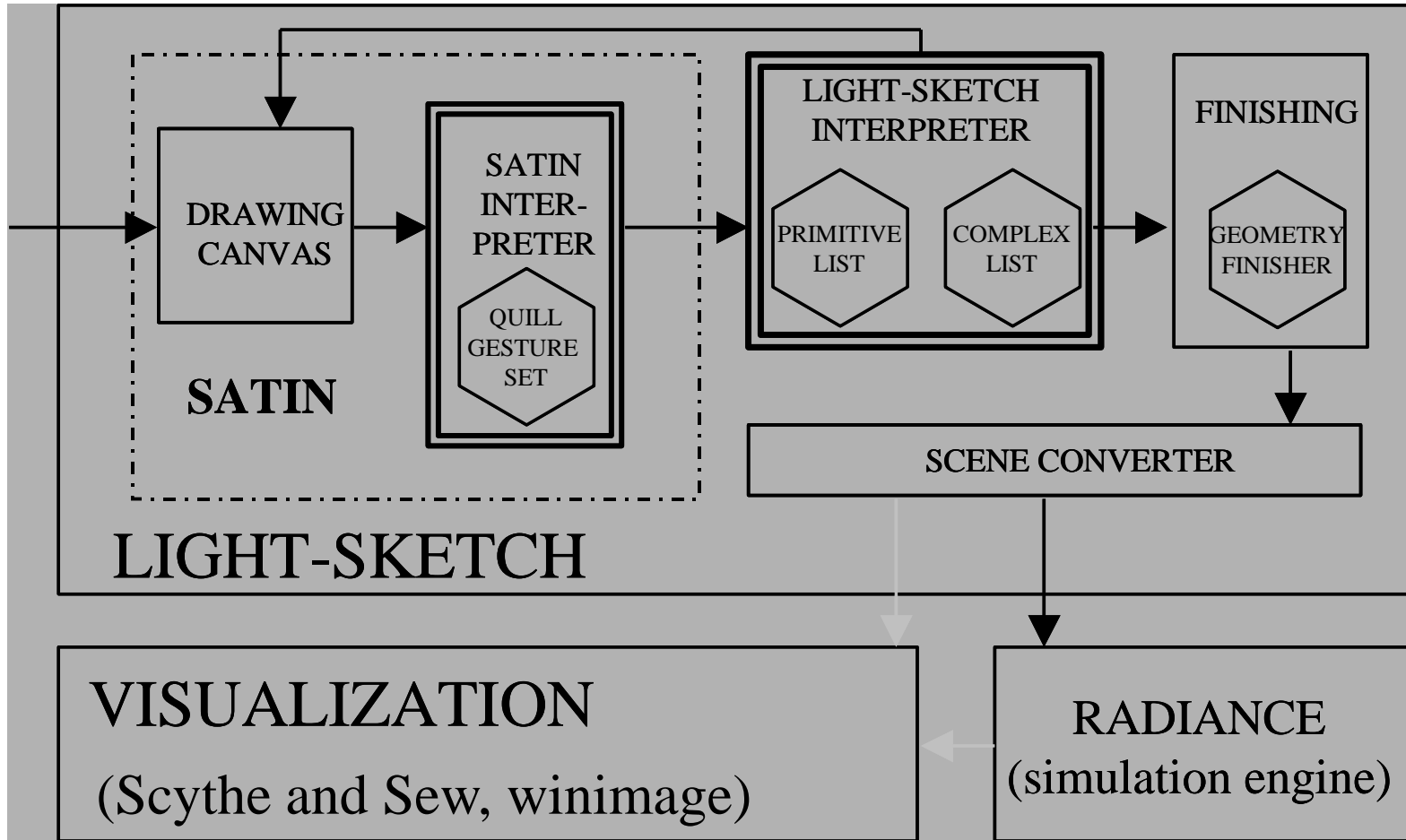


# Simulation Parameters

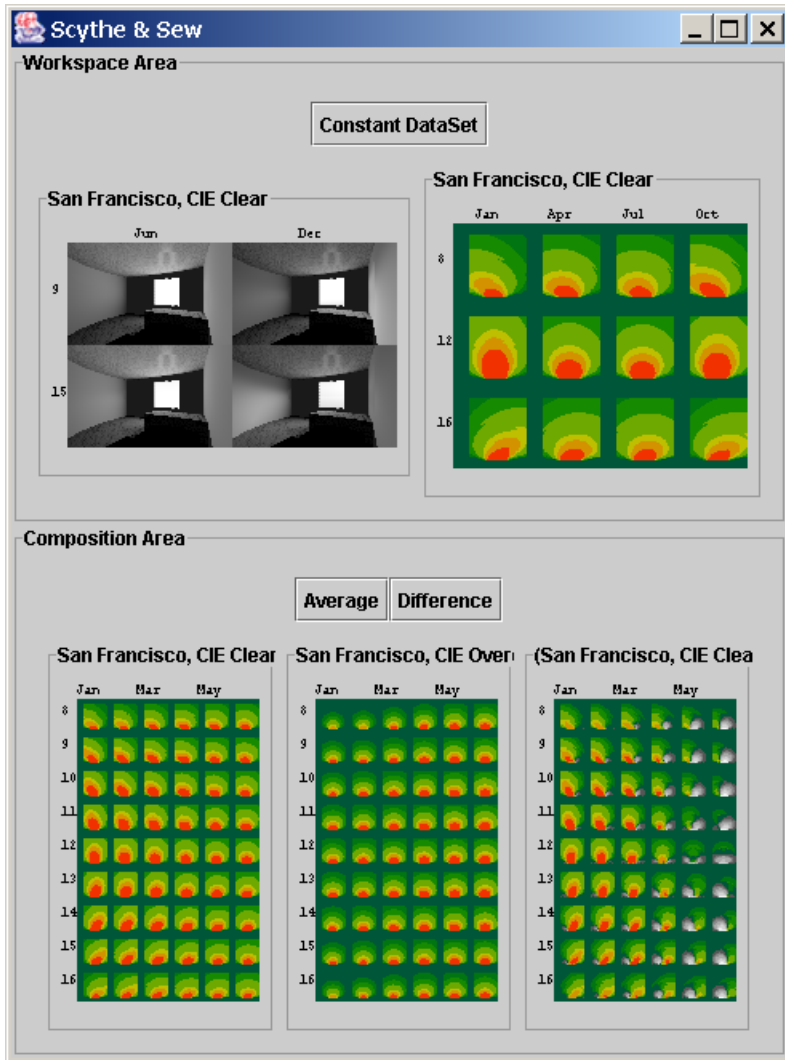
- Quality
  - low/med/high
- Sky
  - idealized, measured
- Times
- Location
- Surfaces/windows
  - Global for model
- Output
  - images
  - illuminance



# Architecture



# Scythe and Sew



## Workspace Area

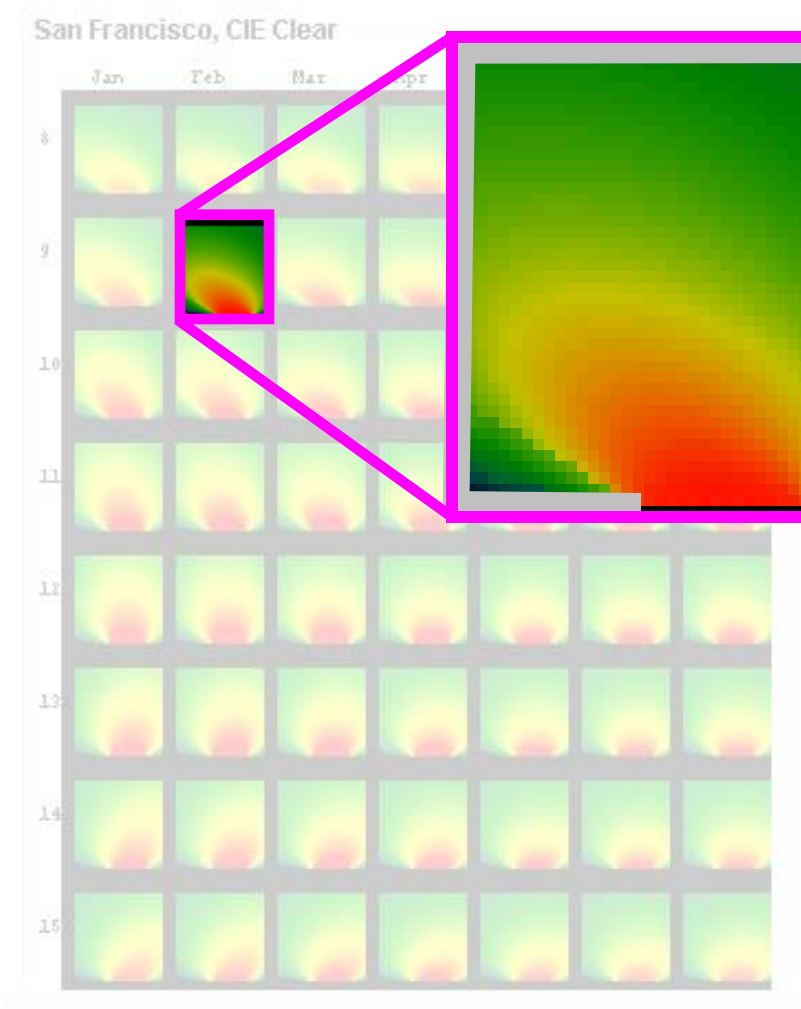
- manages a variety of patterns
  - constant
  - illuminance
  - luminance (grayscale)

## Composition Area:

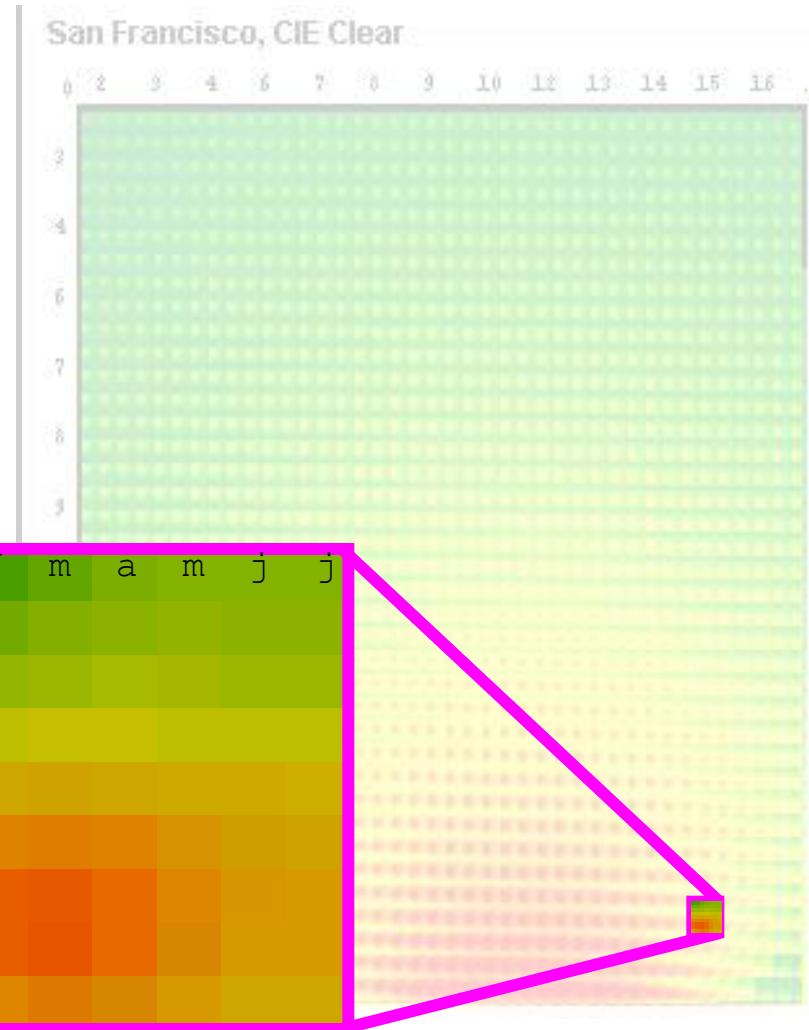
- algebraic resources
  - add
  - average
  - ratio



# Patterns as Unit of Analysis



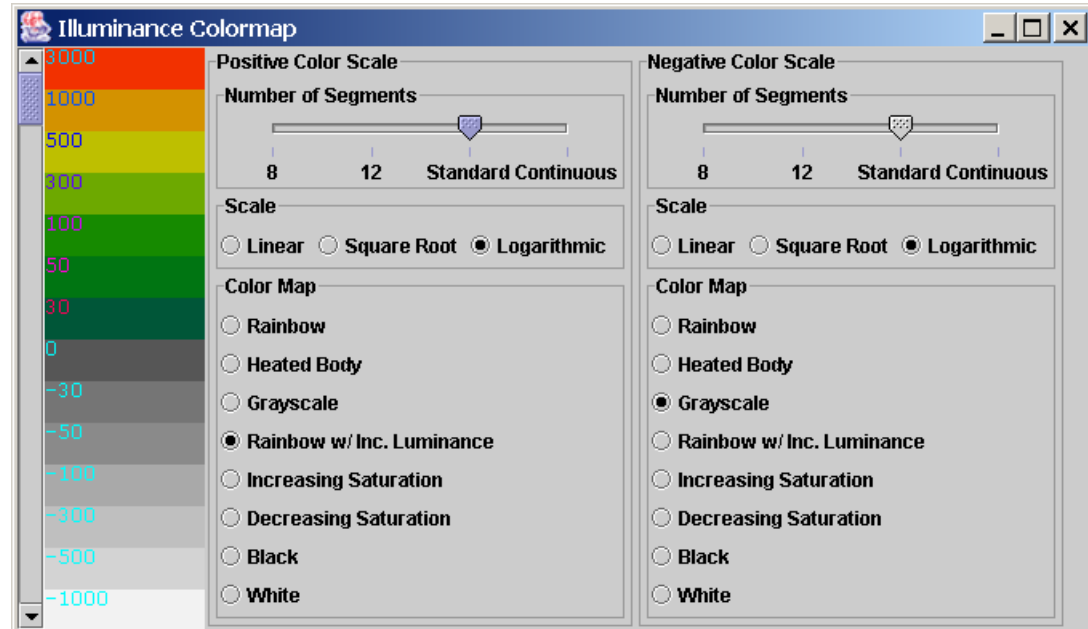
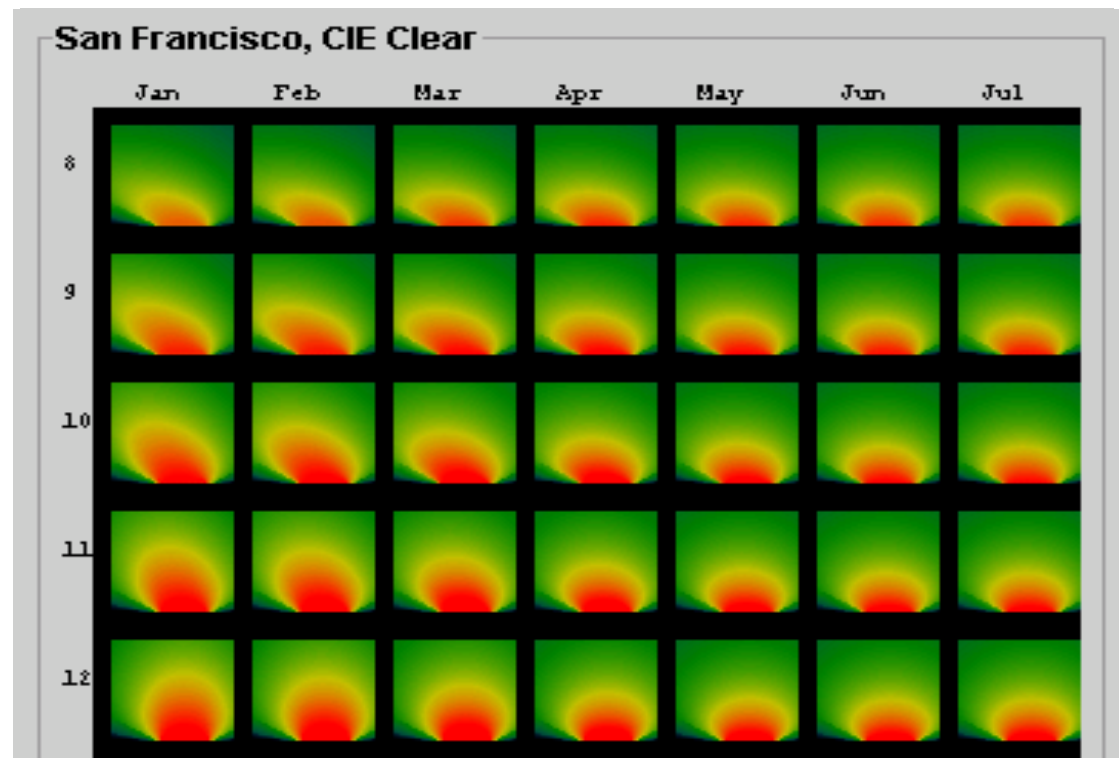
Time in Space



Space in Time

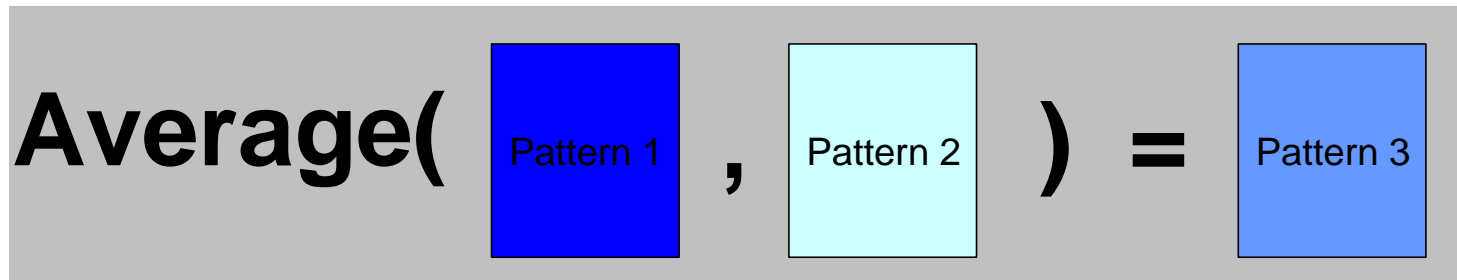
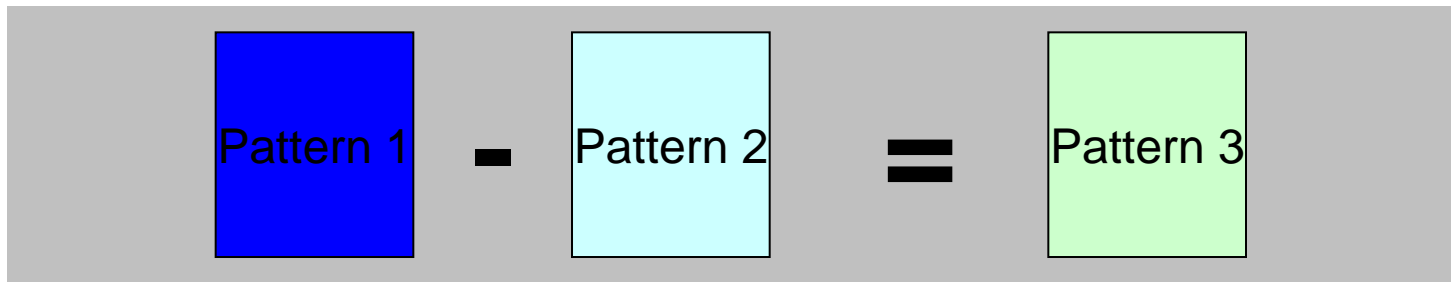
# Coloring Patterns

- Color expresses magnitude
- Different palettes for different uses
- Retain access to numerical data



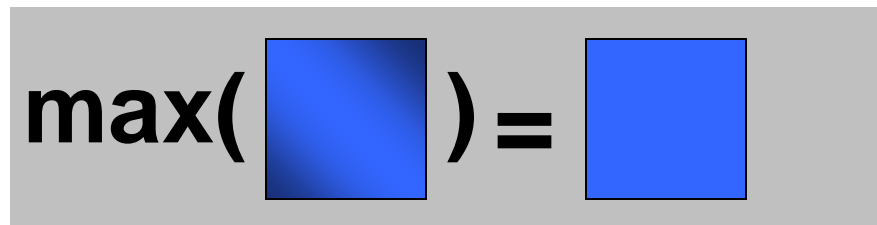
# Pattern Operators

- Patterns can be algebraically manipulated

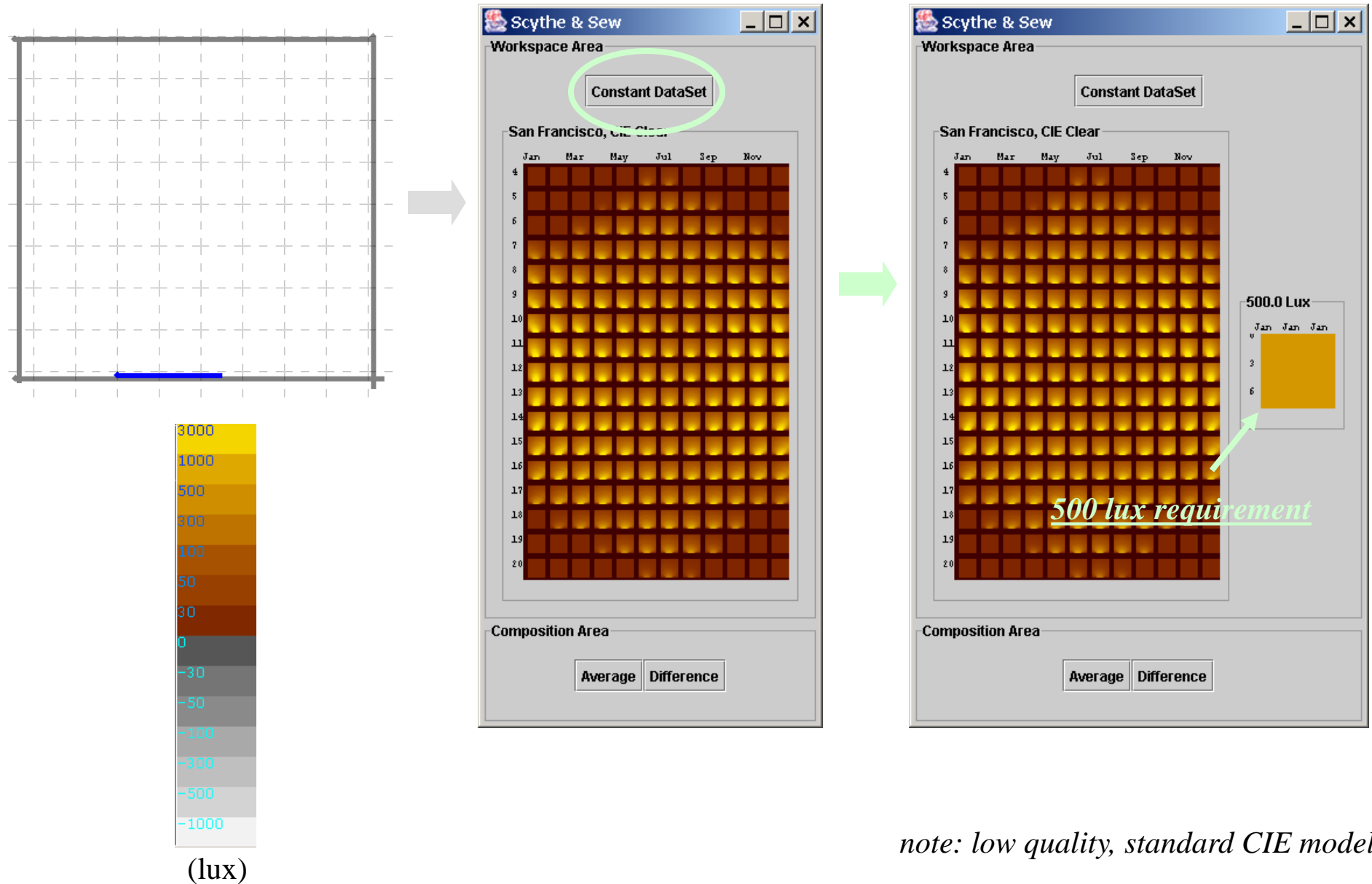


- Intra-Pattern operators

- max
- average
- min
- ratio

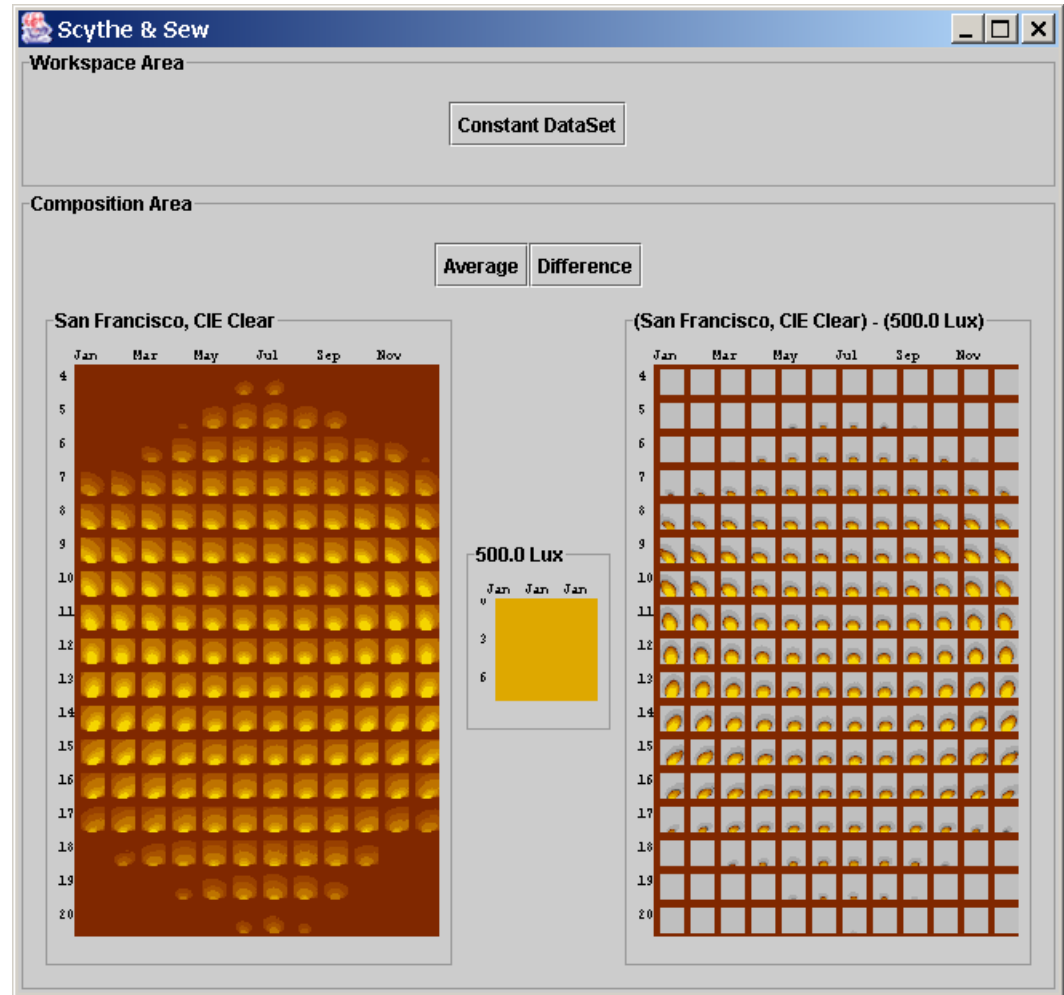
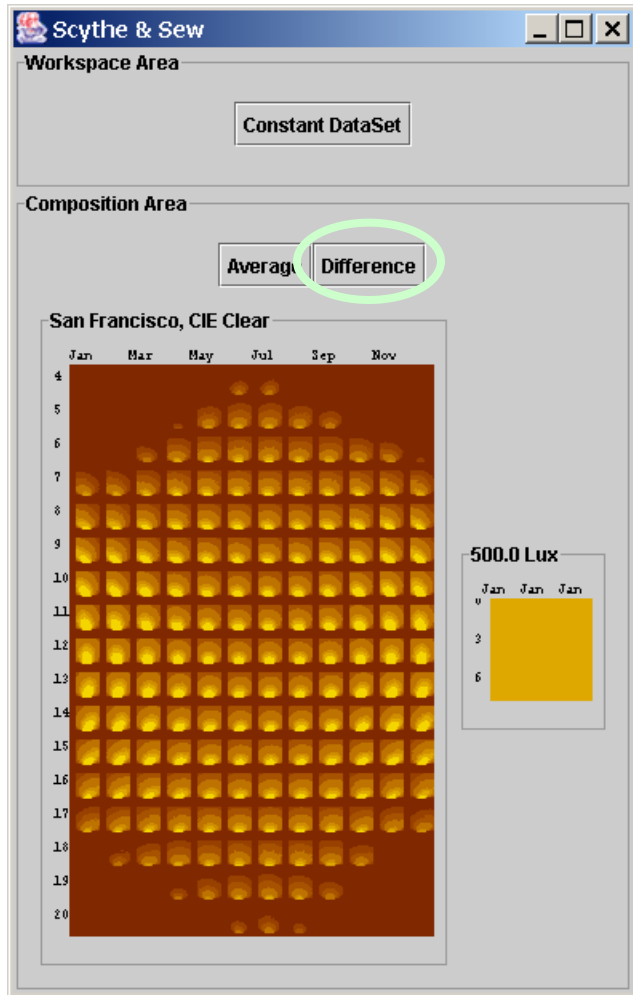


# Example 1: Illuminance Requirement



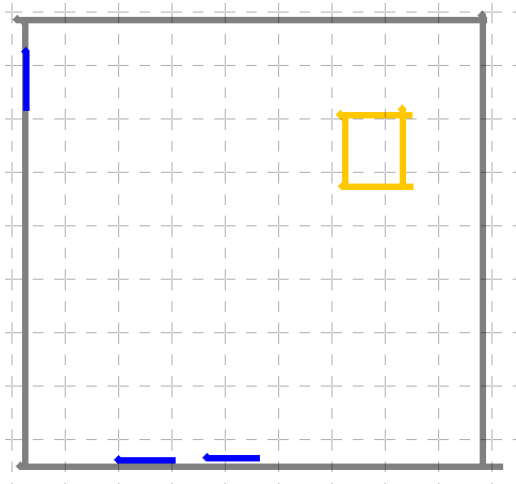
*note: low quality, standard CIE model*

# Example 1: ...

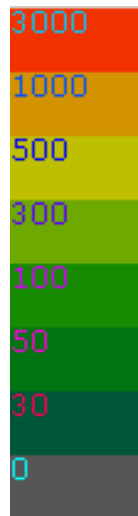


... met near window, but potential glare problems

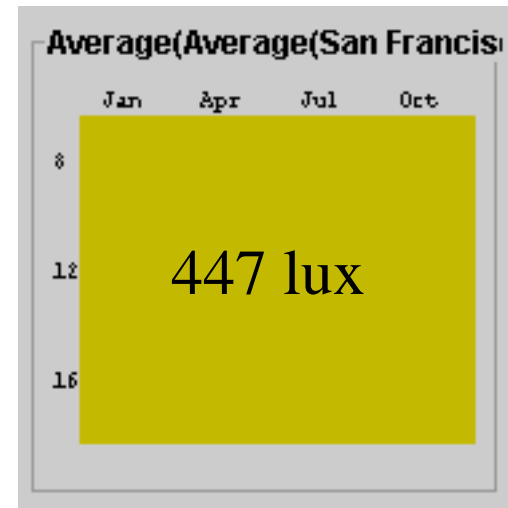
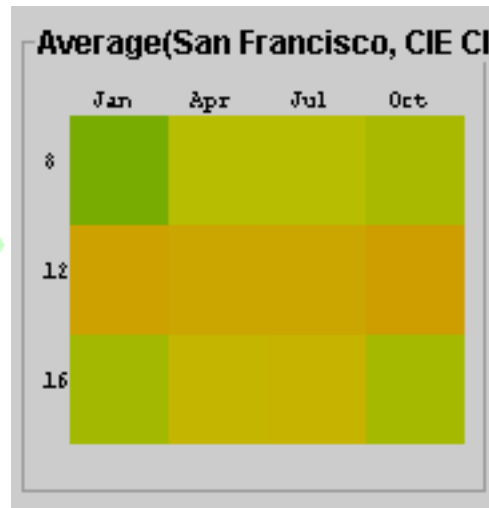
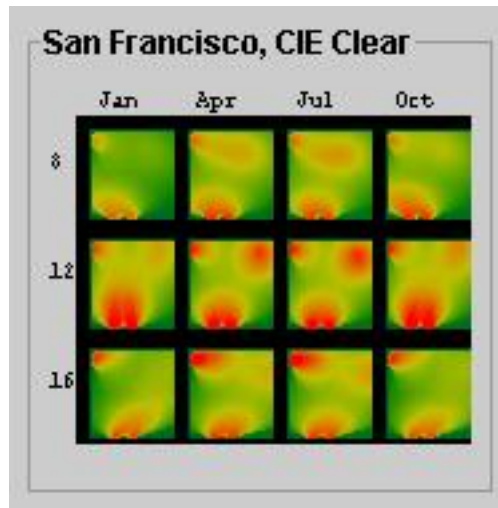
# Example 2: Intra-ops



Intra-Average (2x)

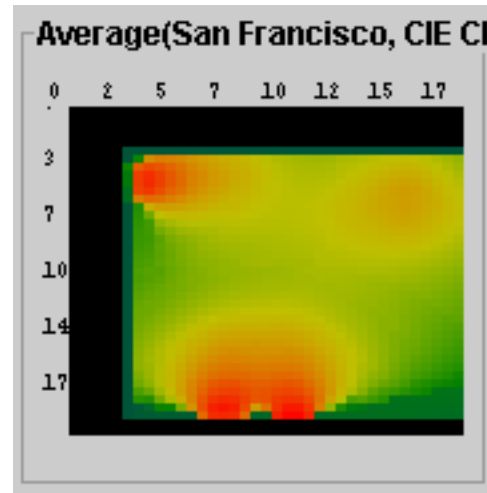
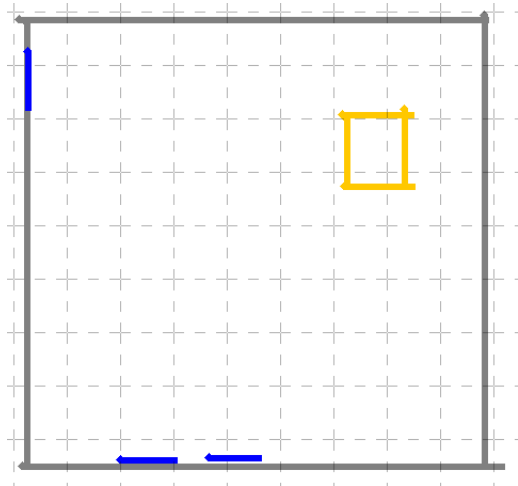


(lux)

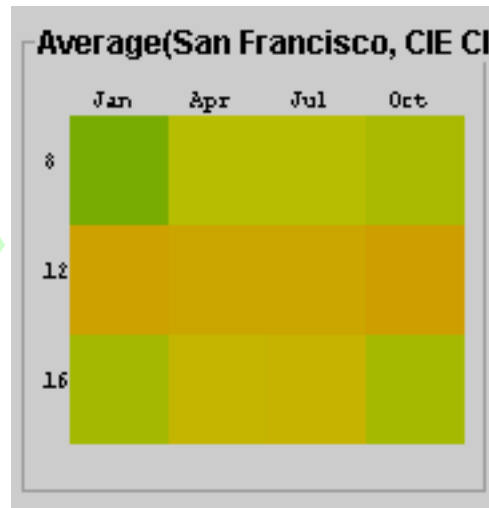
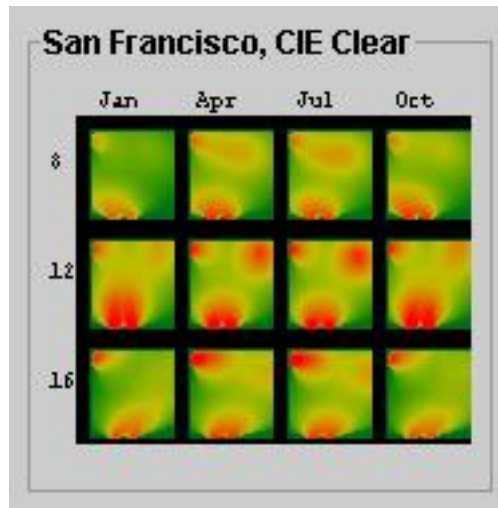
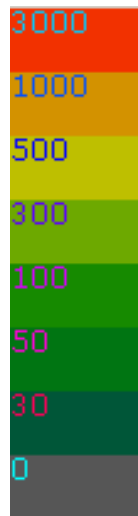


... can quickly summarize the data

# Example 3: Reverse Pattern



Time in Space  
(average)



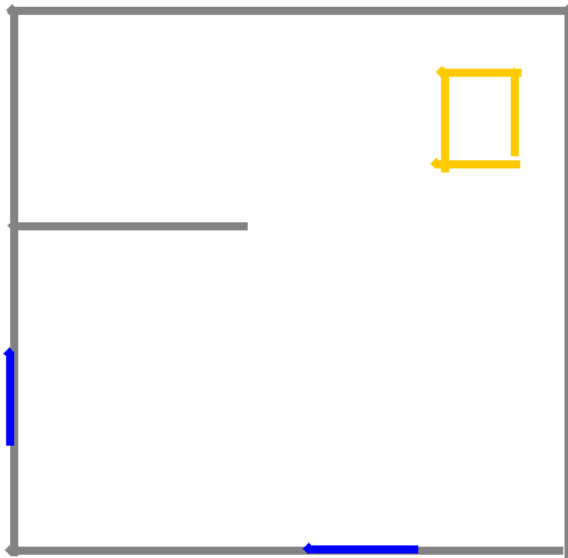
Space in Time

(lux)

... can provide insight into data

# Example 4: Comparing Sky Performance

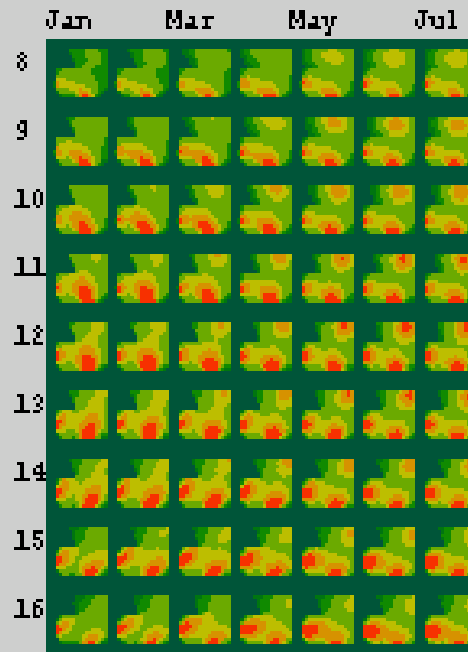
## LightSketch model



- square model
- W window
- S window
- NE skylight

pattern 1 

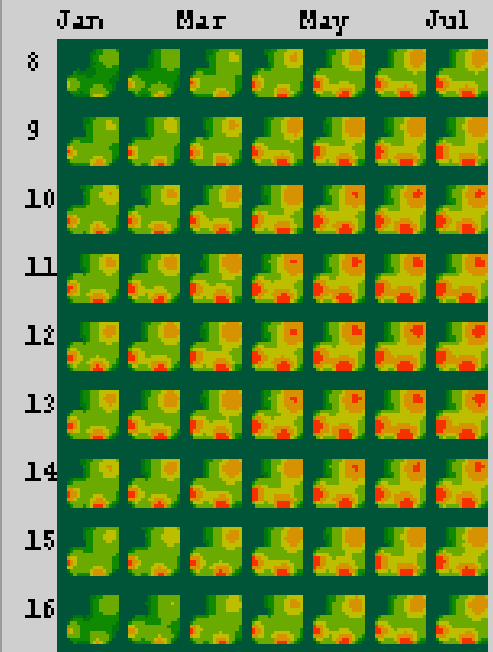
San Francisco, Clear



- more light in afternoon

pattern 2 

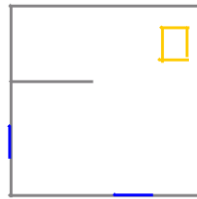
San Francisco, Overcast



- more light in summer

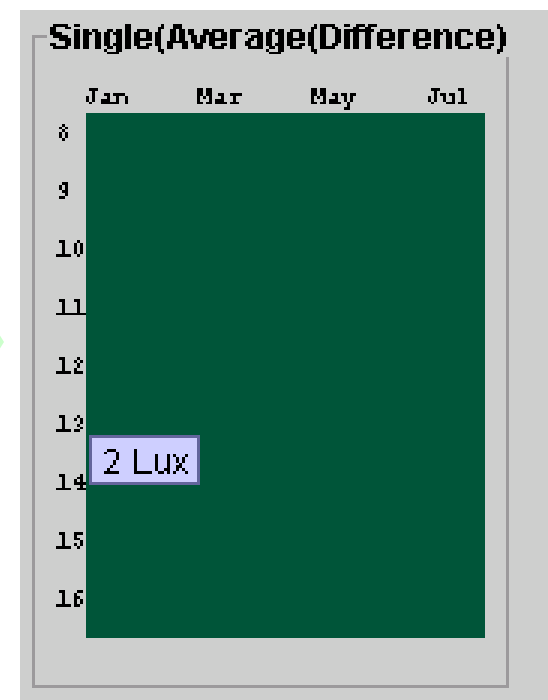
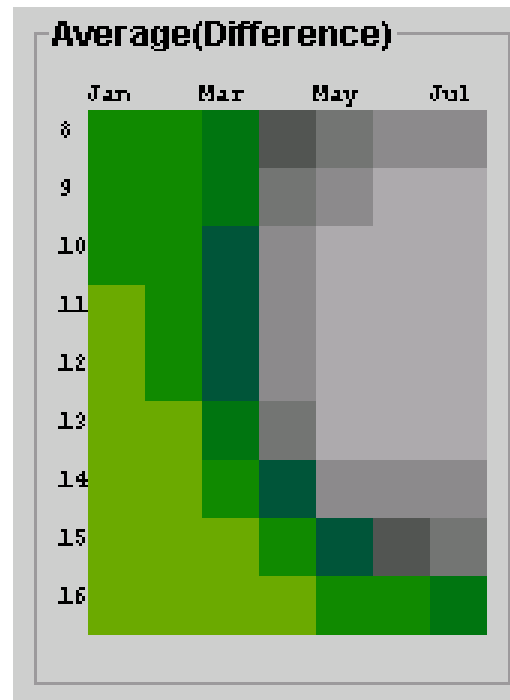
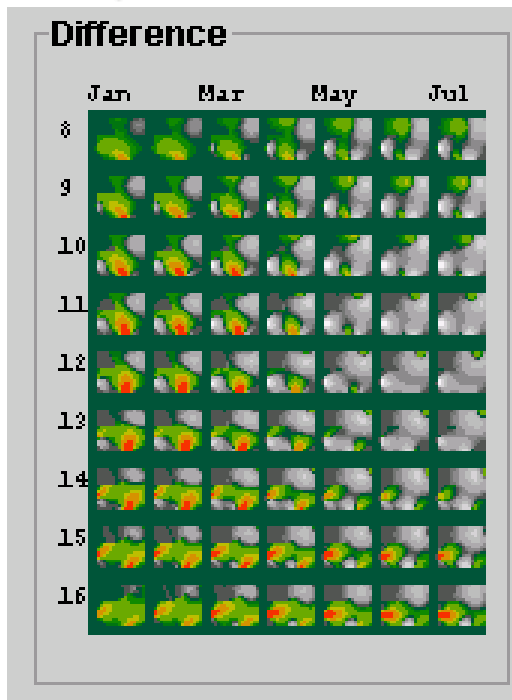


# Example 4: ...



$$\text{avg}(\text{Sun} - \text{Cloud}) =$$

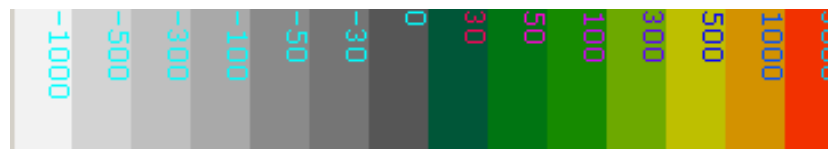
$$\text{avg}(\text{avg}(\text{Sun} - \text{Cloud})) =$$



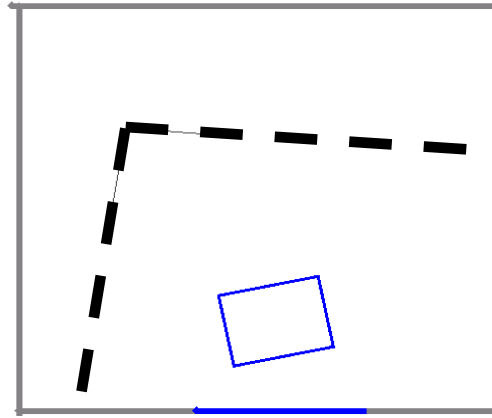
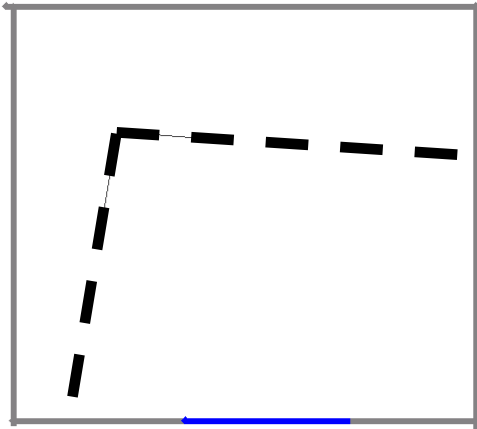
- **complex** distribution (positive values when clear > cloudy)

- **clear > cloudy** in winter/pm

- **similar** when fully aggregated!



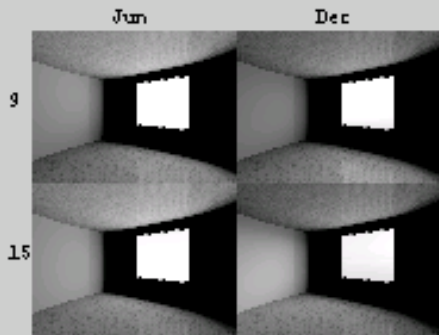
# Example 5: Luminance Data for Desk



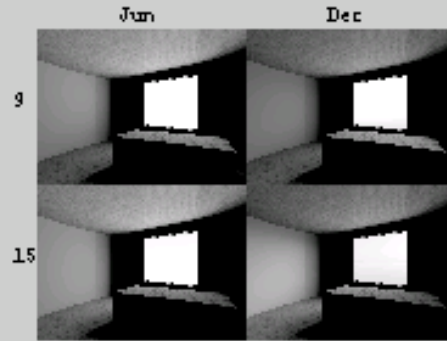
Adding a desk:  
reduces light everywhere in  
room except for work surface  
(from this viewpoint)



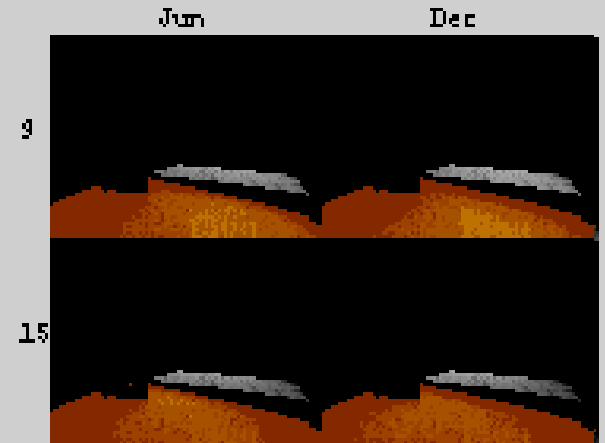
South Window



South Window w/ Desk



Consequences of Desk



# Conclusion

- LightSketch allows for quick sketching of simple lighting models (daylight and electric)
- LightSketch provides links to robust simulation environment
- Scythe and Sew provides a graphical workspace for managing complex data
- Keeps data in visual form for manipulation
- Operations allow for both inter and intra-pattern analysis

# Future Work

- Increase lighting vocabulary
- More complex geometry
- Improved sky models
- Additional operators
- Visualization refinements