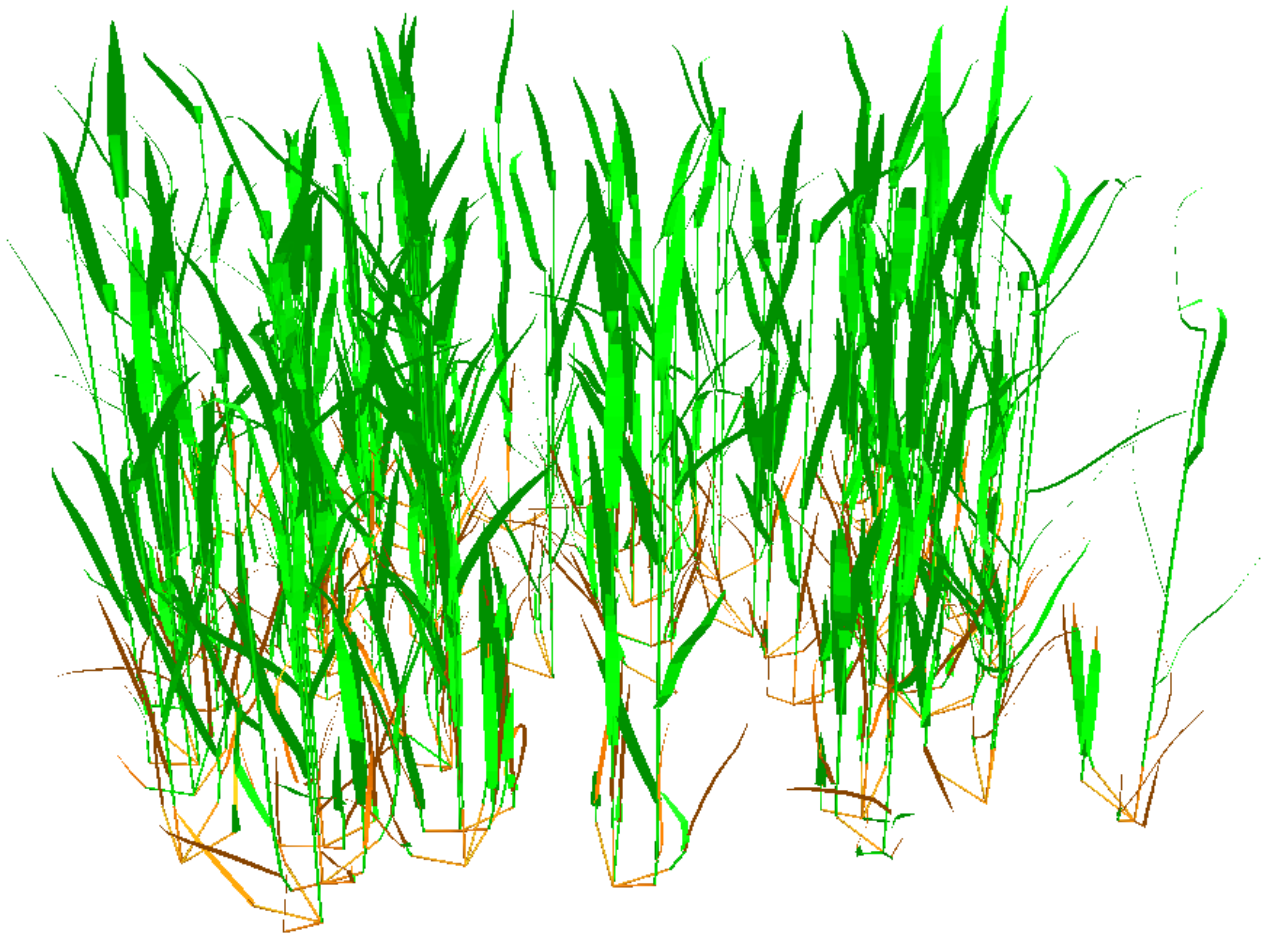
# Modelling light and light interception

https://www.cgtrader.com/blog/25-photorealistic-landscape-3d-renderings-if-only-those-places-existed

# What is a 3D Virtual Scene ?



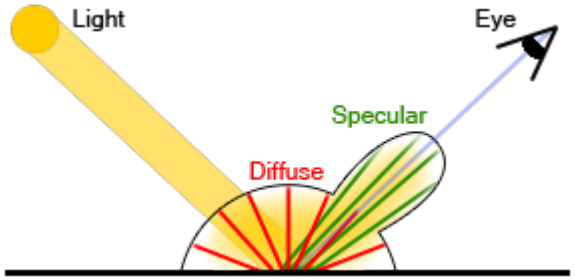
# It’s (very often) a mesh !

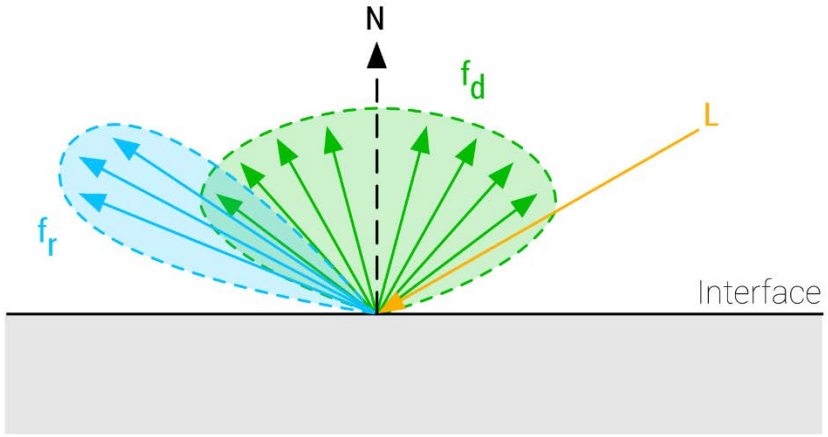
Vertices = { 3D points }
= [(x, y, z), ...]

Faces = {triangles}
= [(vtx, vtx, vtx), ...]

# What is a virtual light ?

# It’s a set of vectors !

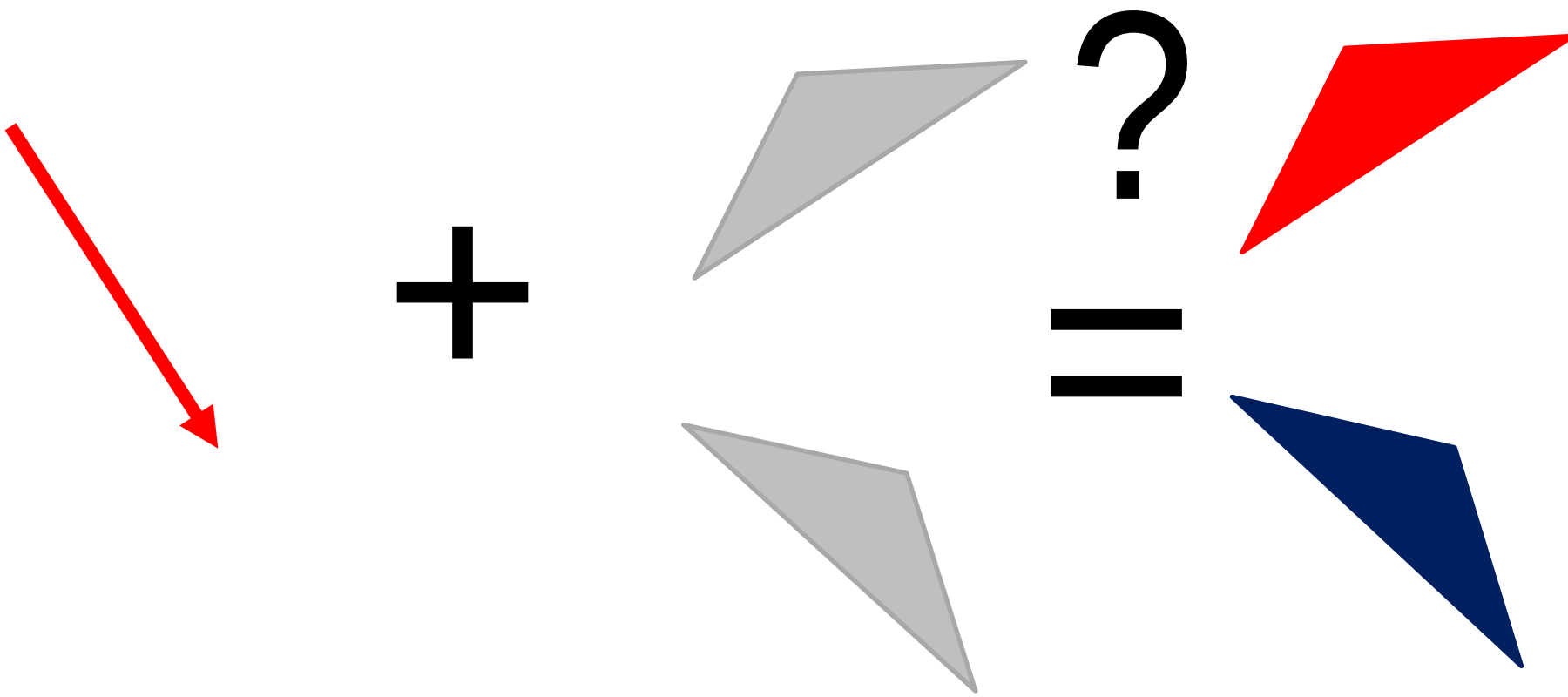



Vector = Propagating Direction + Energetic flux (W.m-2.s-1)

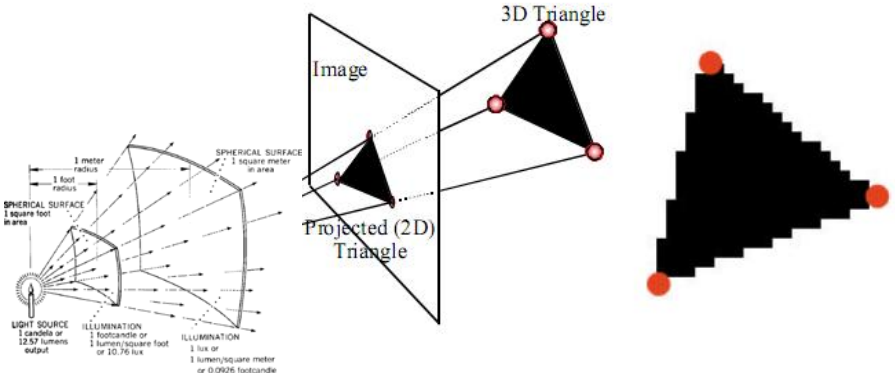
Light source = [PAR_light_direction_1, PAR_light_vector_direction_2,
FR_light_direction_1,...]

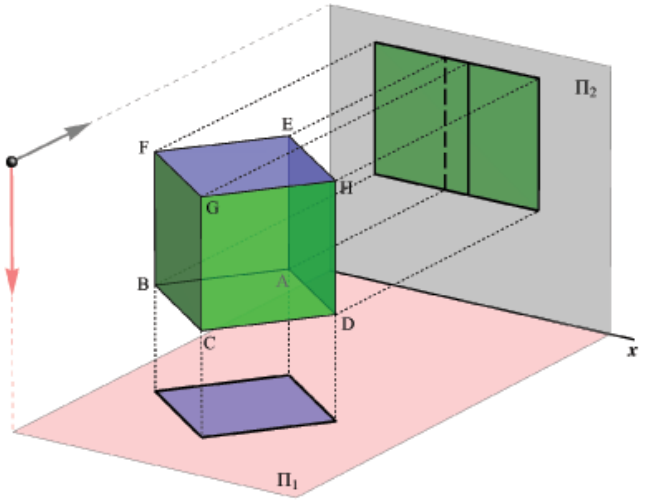
# The problem



# First order : projection

- Actual Surface : S
- Projected surface on a plane perpendicular to radiation direction: S’
- Irradiance =
  Light flux * S’ / S
- Distant sources (sun…) : orthogonal projection

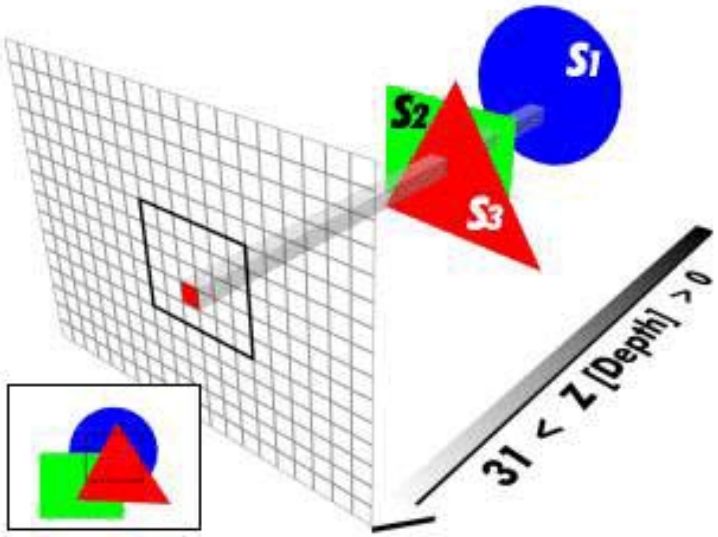


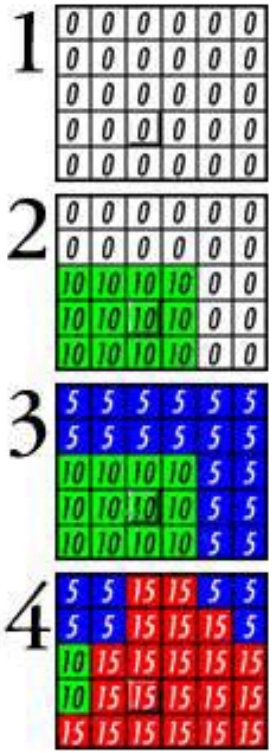



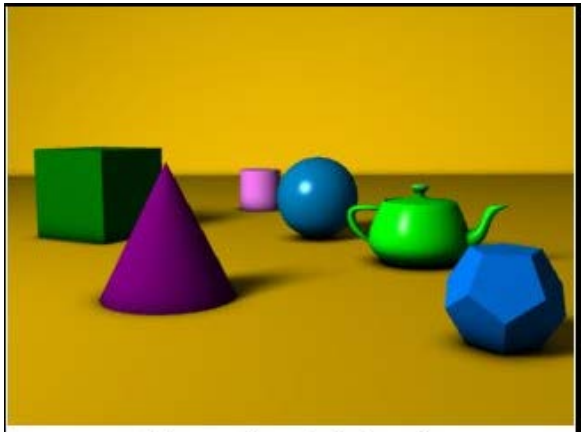
# First order : occlusions

Equivalent to the computation of synthetic image

Z-buffer



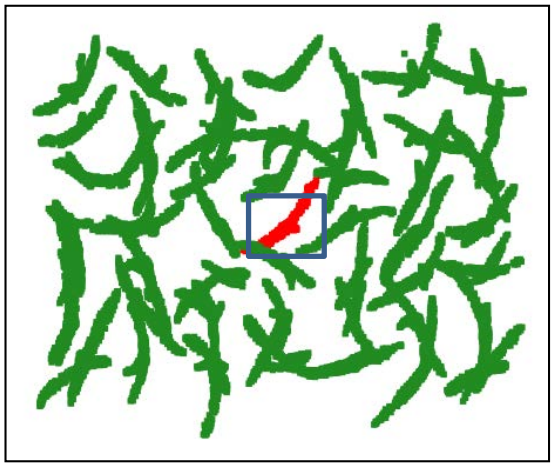



Une scène 3d simple

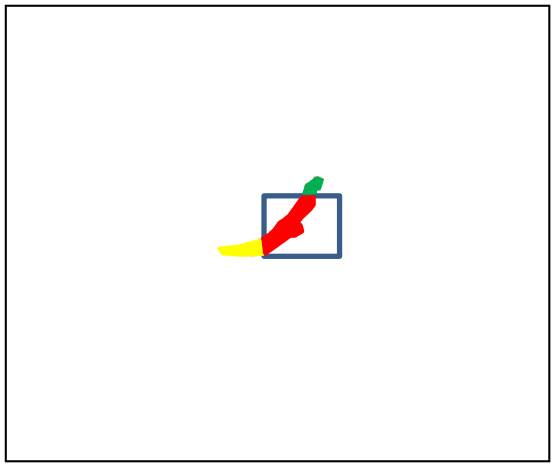
Le Tampon de profondeur

# Tip :Toric scenes

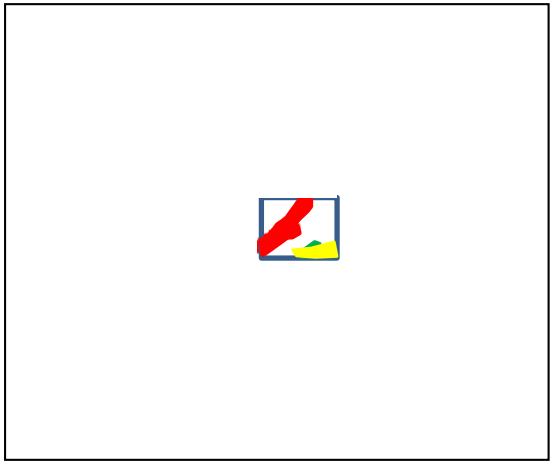
*True canopy*

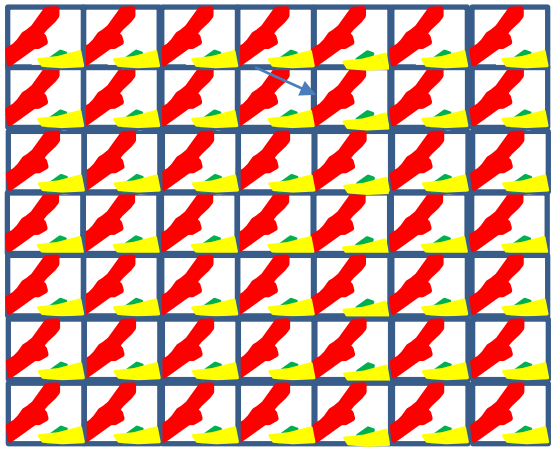


*Isolated*



*Periodised*





# The problem

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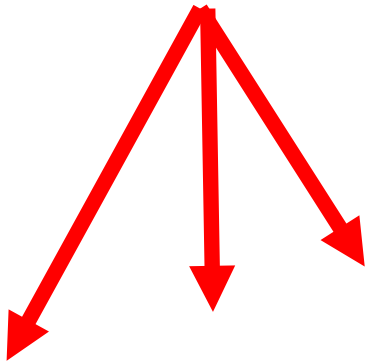
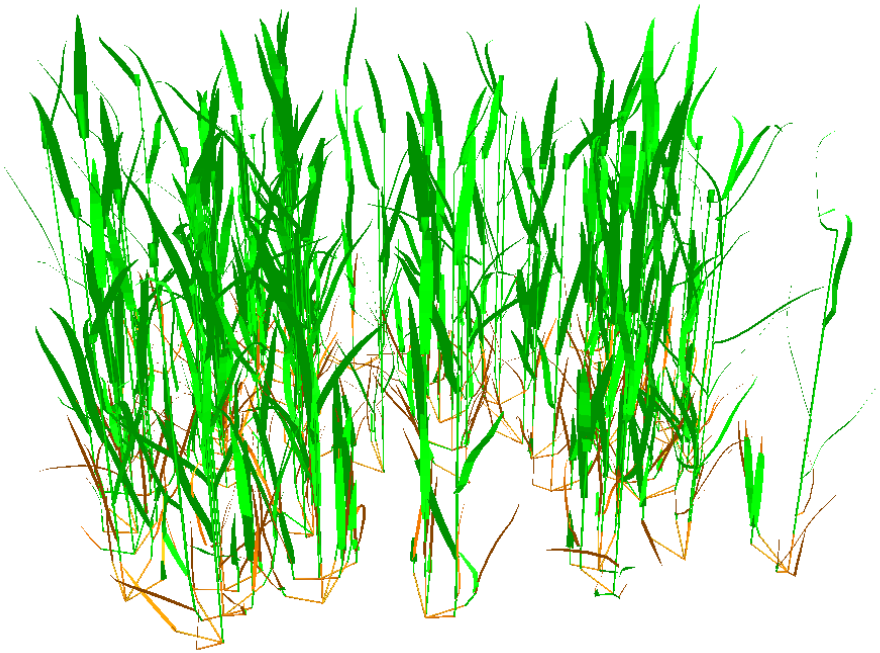
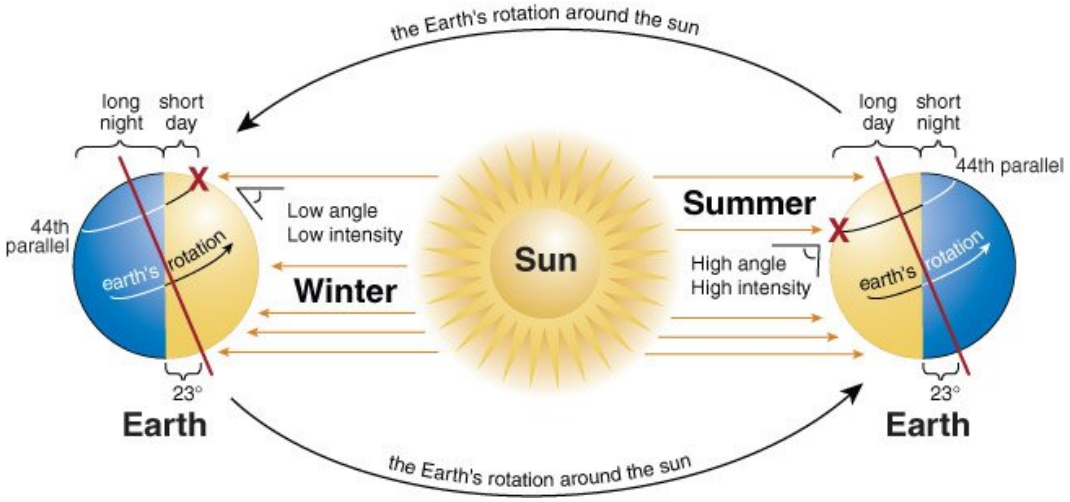
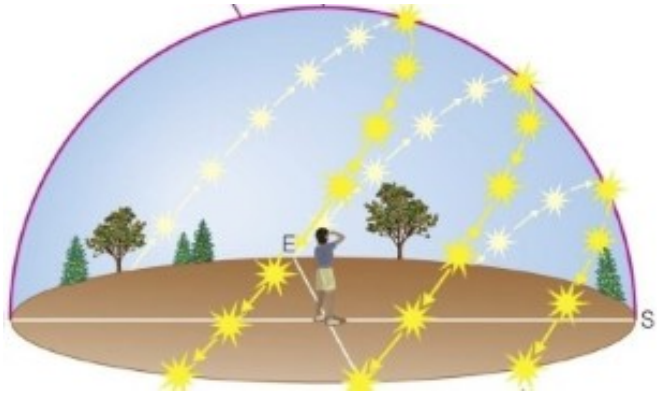


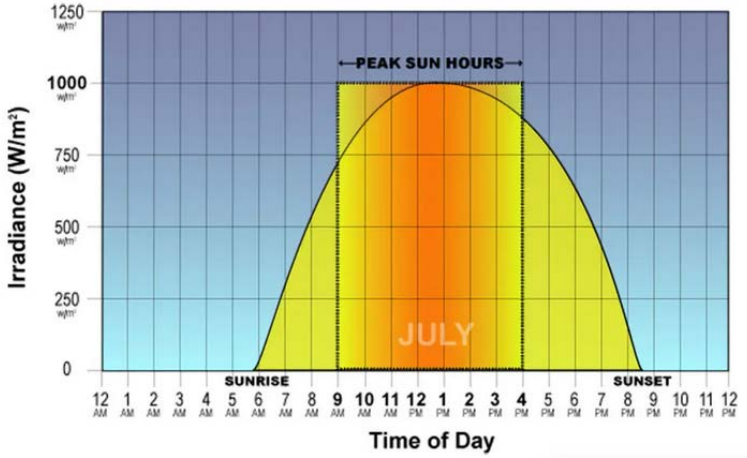
+



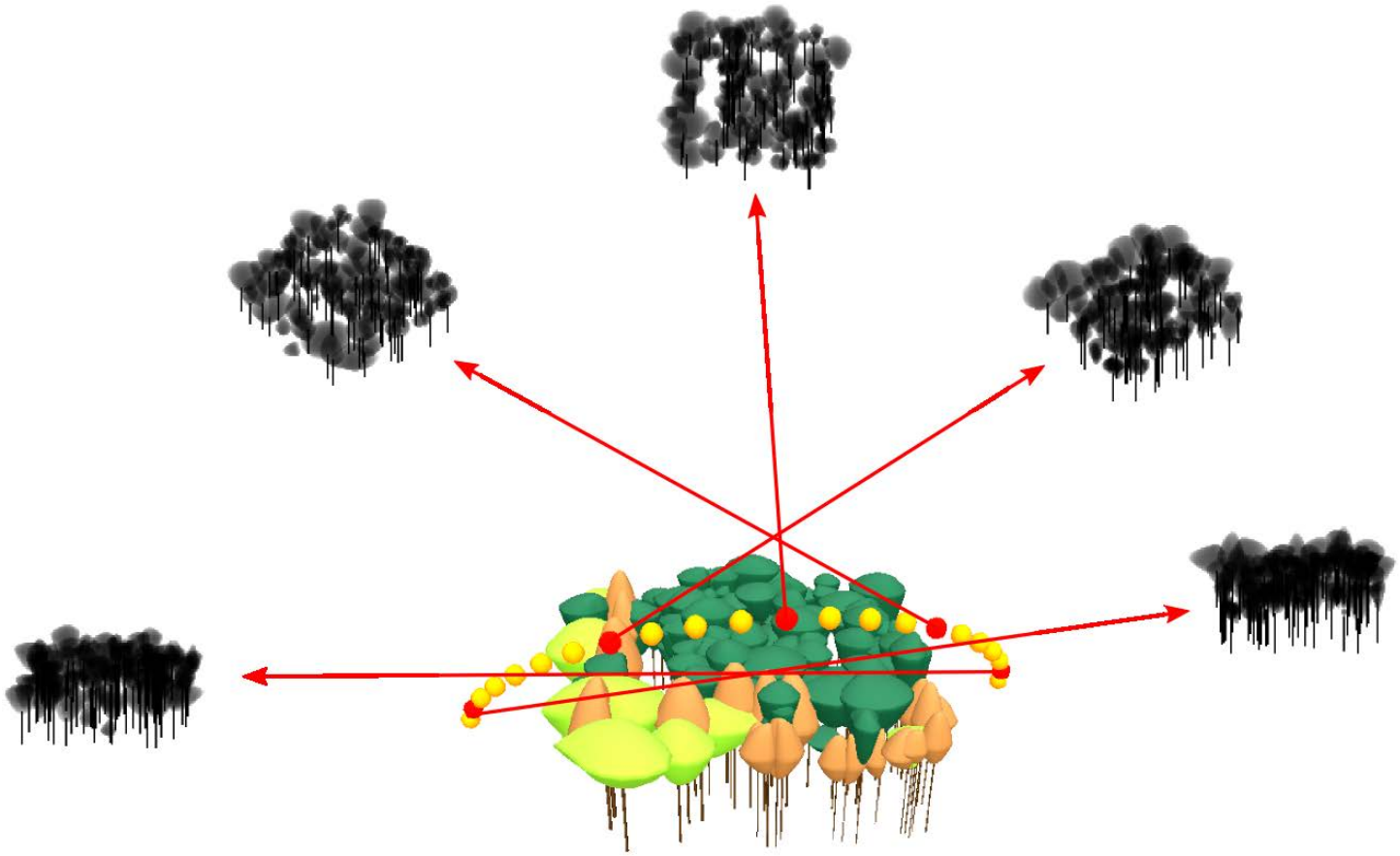
# Modeling sun



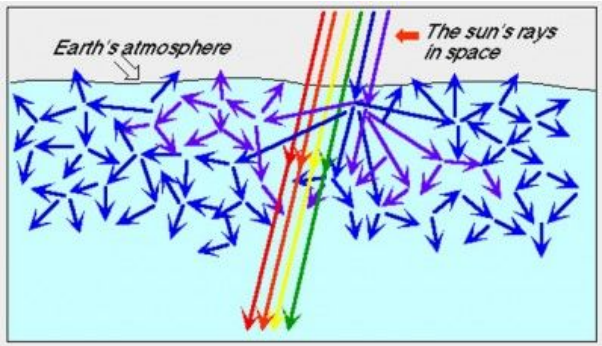



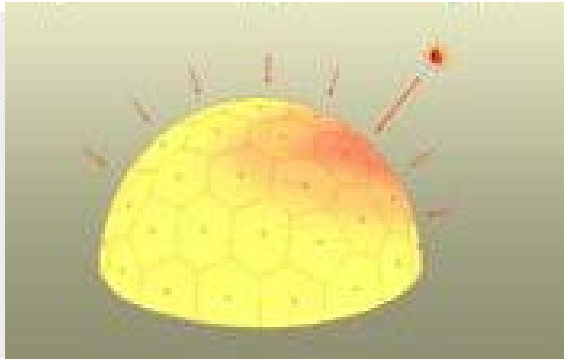



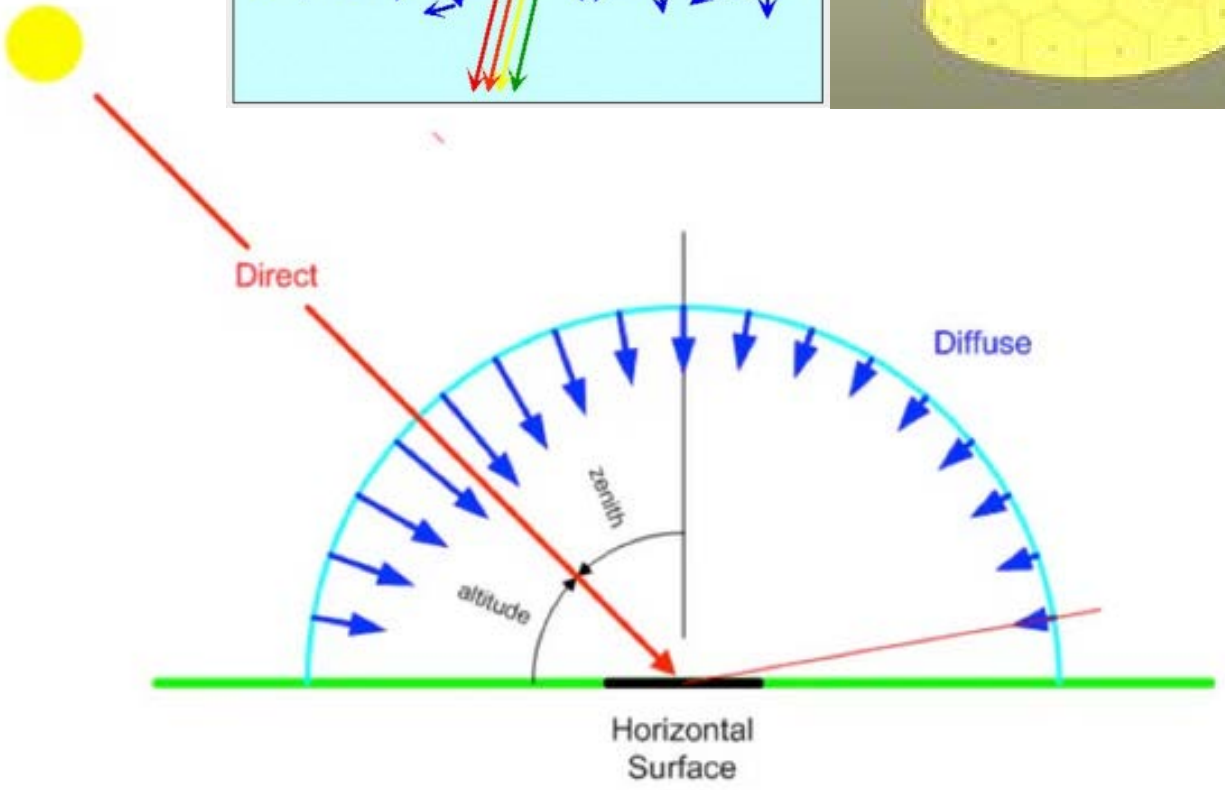
# Integration over a day



# Modelling sky



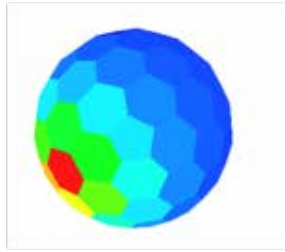



Direct and Diffuse Irradiation on the ground

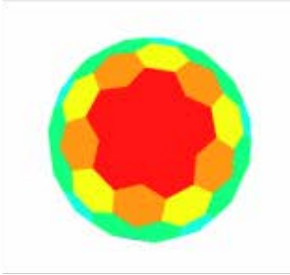
# Modelling sky irradiance

Diffuse light

Clear sky

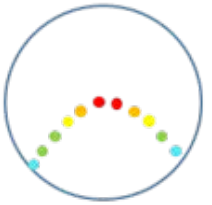


Overcast

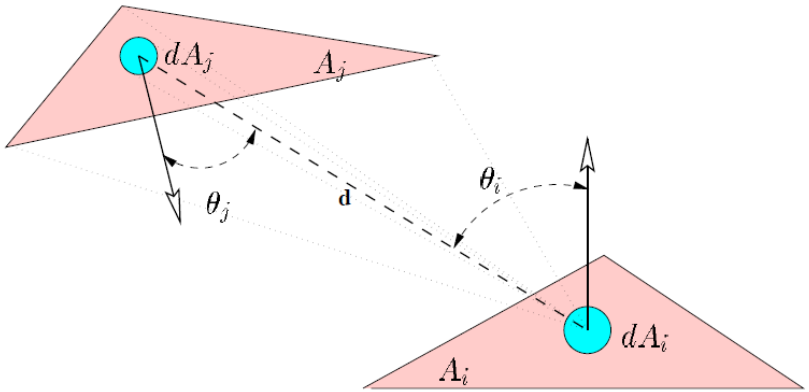


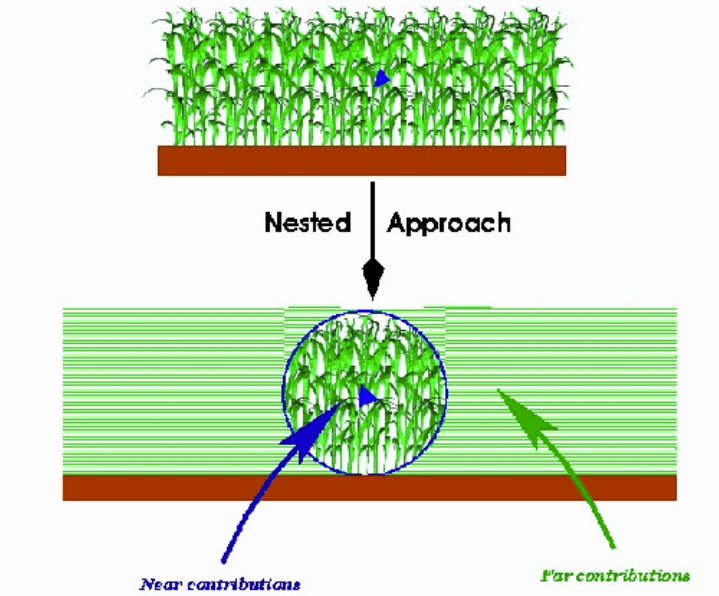
Direct light

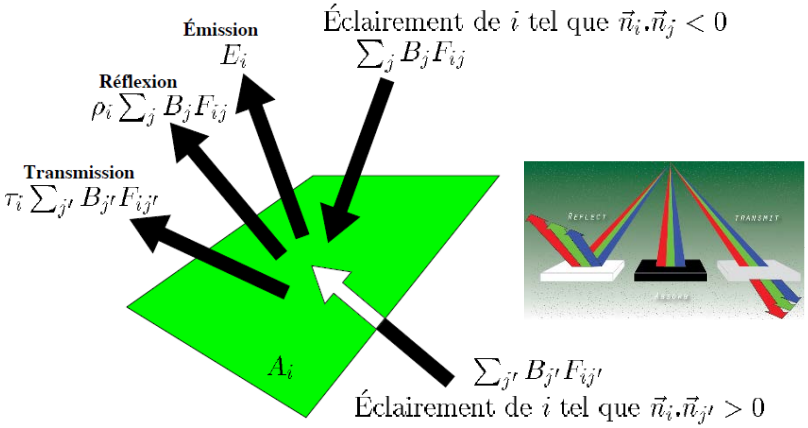
Sun



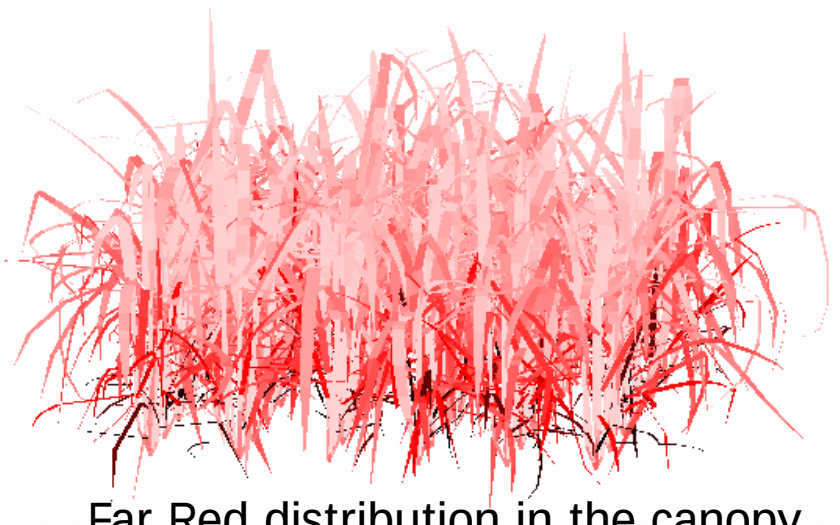
# Multi rediffusion : radiosity



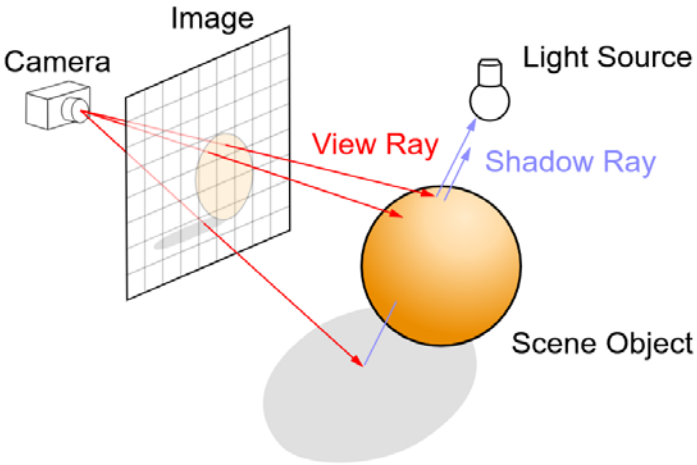



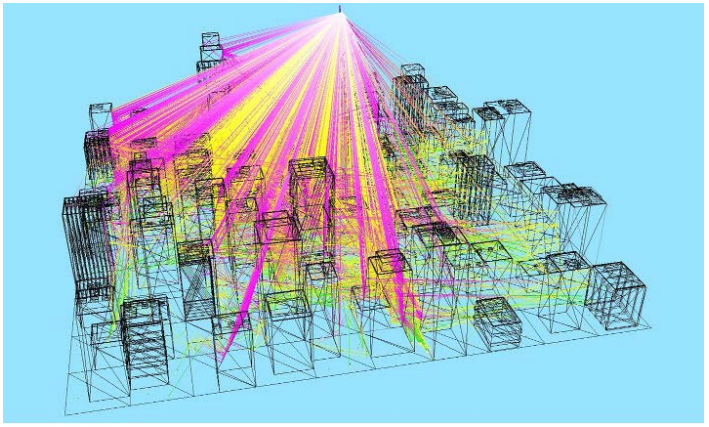


Far Red distribution in the canopy

# Multi rediffusion : ray tracing



Available on modern GPU but technical adaptation needed (target is not the image !)

# Can you guess what you need / what you absolutely need for modelling…

- Interception efficiency (percent of incoming light intercepted by plants) at solar noon
  - ✓ First order model
  - ✓ Sun / Sky model
- Photosynthesis
  - ✓ Absorptance
  - ✓ Reflectance
  - ✓ Transmitance
  - ✓ Emitance
- Signals (eg red/Far red)
- Microclimate (T°C)
  - ✓ Rediffusion model