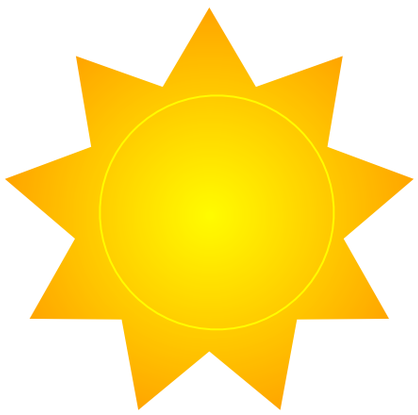


Mapping solar potential obstructions using LiDAR data

Krista Amolins

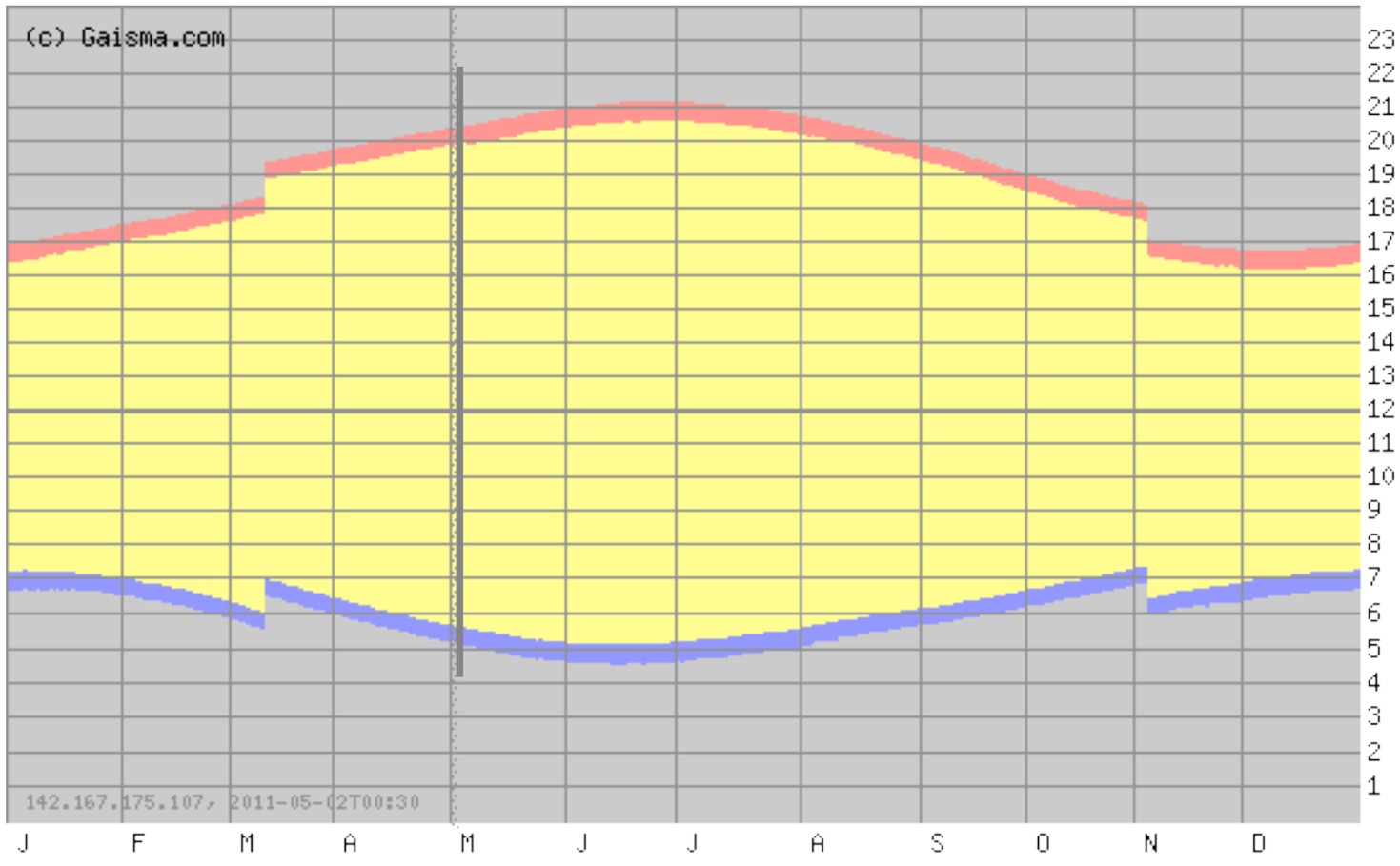
David Coleman, Yun Zhang, Peter Dare

University of New Brunswick, Fredericton, NB

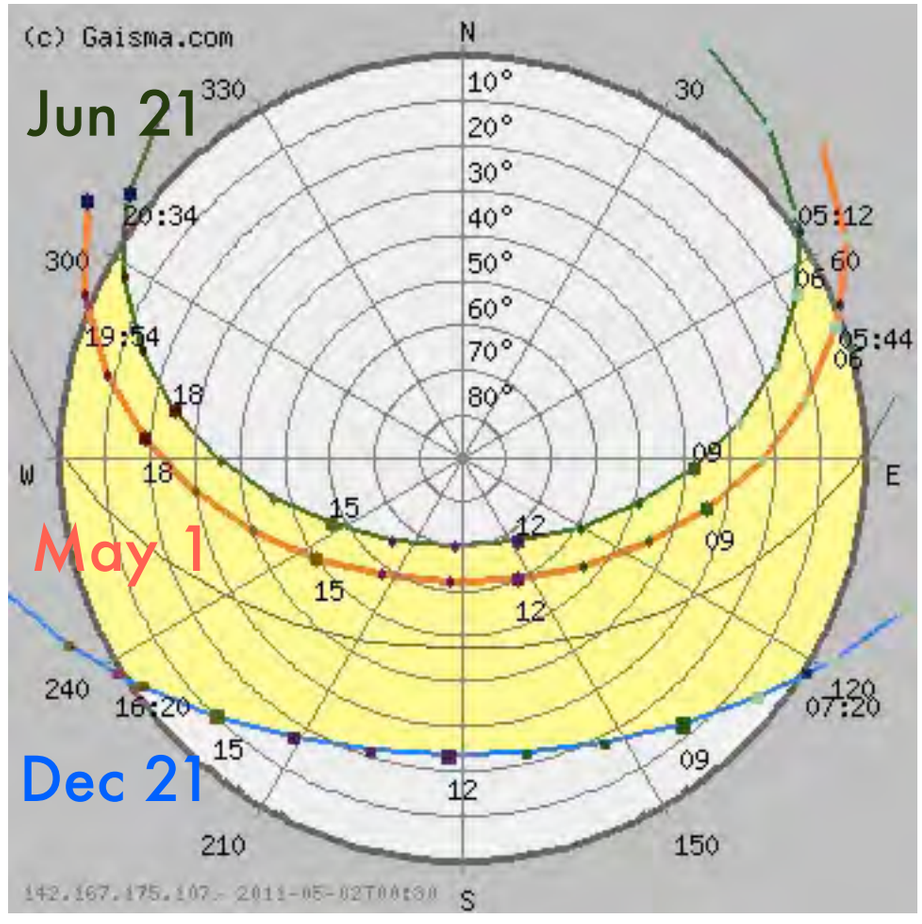
ASPRS 2011

UNB

Sunlight in Milwaukee



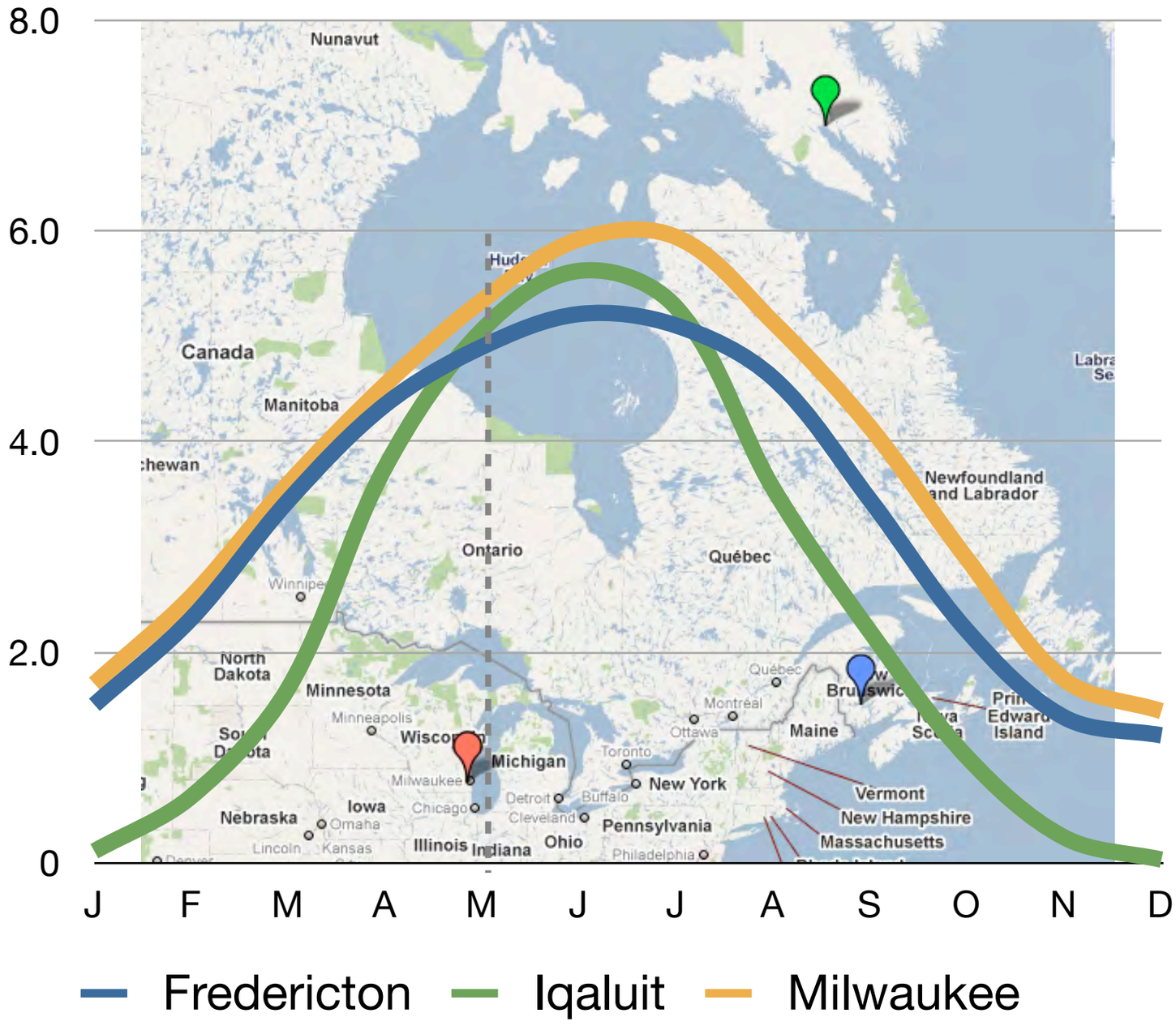
Sunrise, sunset, dawn and dusk times



Sun path

Image Source: http://www.gaisma.com

Insolation, in kWh/m^2/day



If could capture and **convert 100%** of the solar radiation hitting a 1 m^2 area on May 3:
- power 5 100 W light bulbs for 10 hours
- make 25 pots of coffee
- dry 1 load of laundry

BUT **high efficiency** solar panels convert **only 18%**

Source: NASA Langley Research Center Atmospheric Science Data Center, via http://www.gaisma.com

Limited Solar Potential

Fredericton, NB, Canada

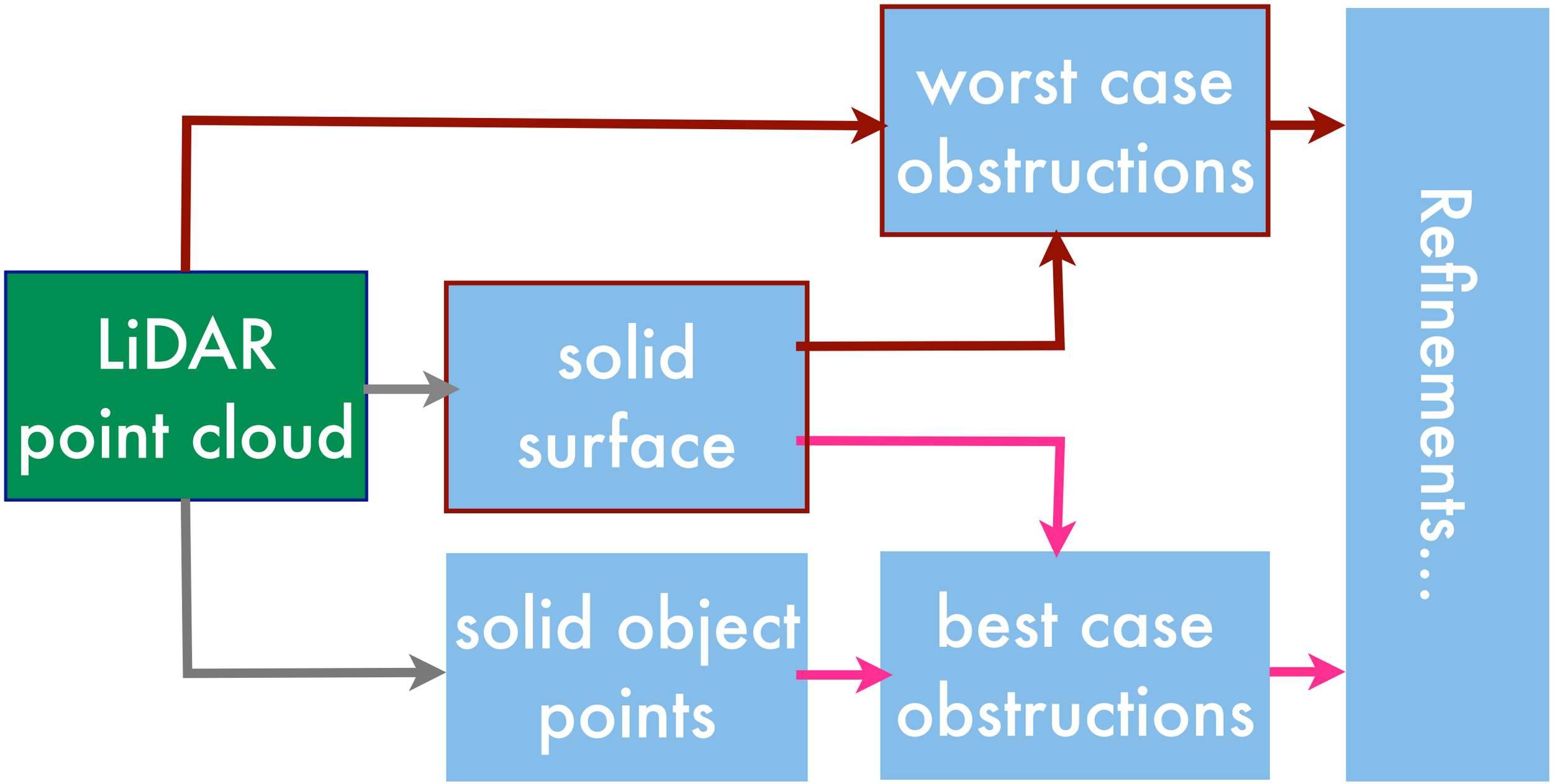
Worst Case

Sun angles
December 21
rise 124°
set 236°
max elev 20.7°

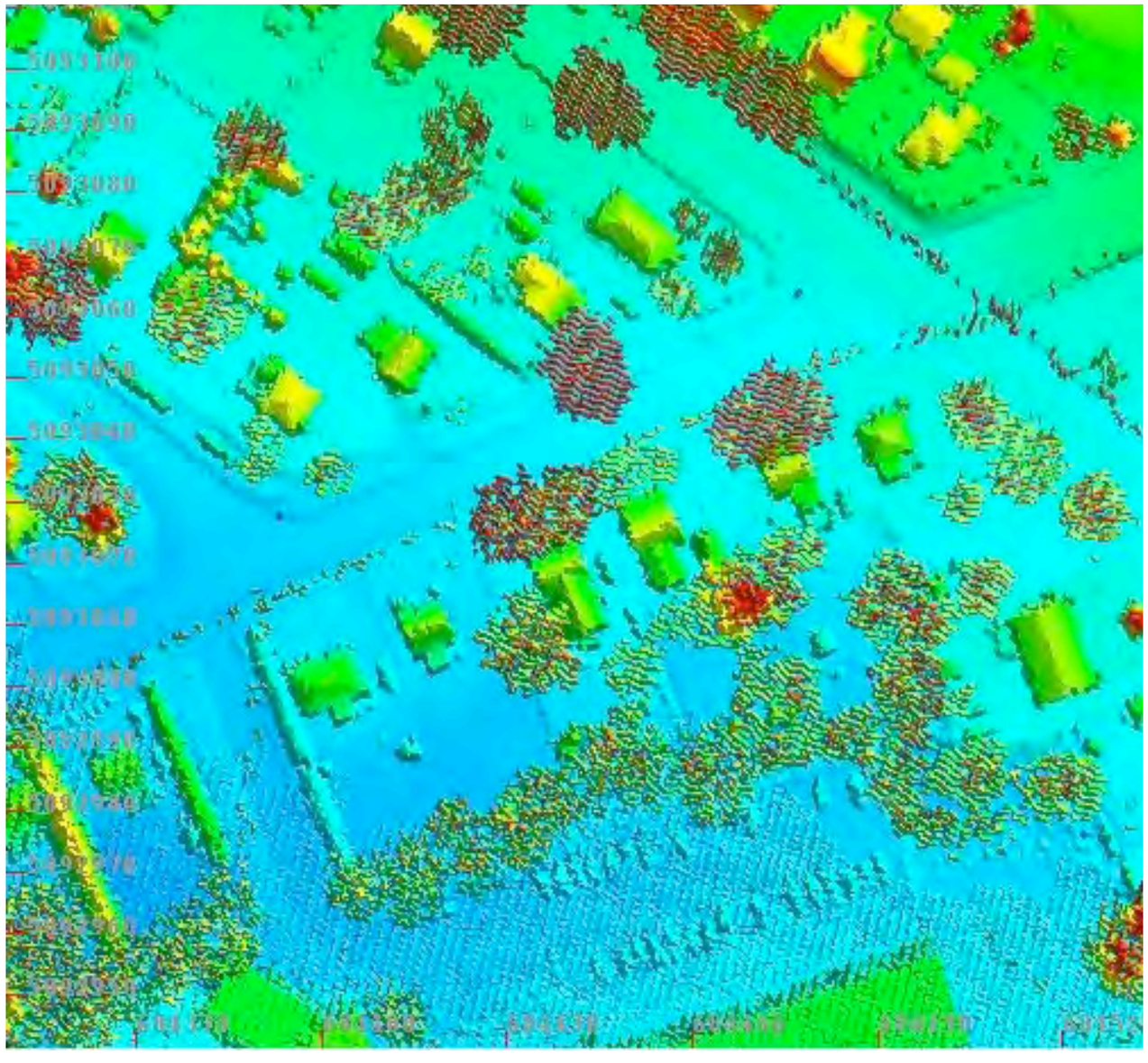
http://geonb.snb.ca/geonb/

Best Case:
Obstructions…

Workflow for Mapping Obstructions



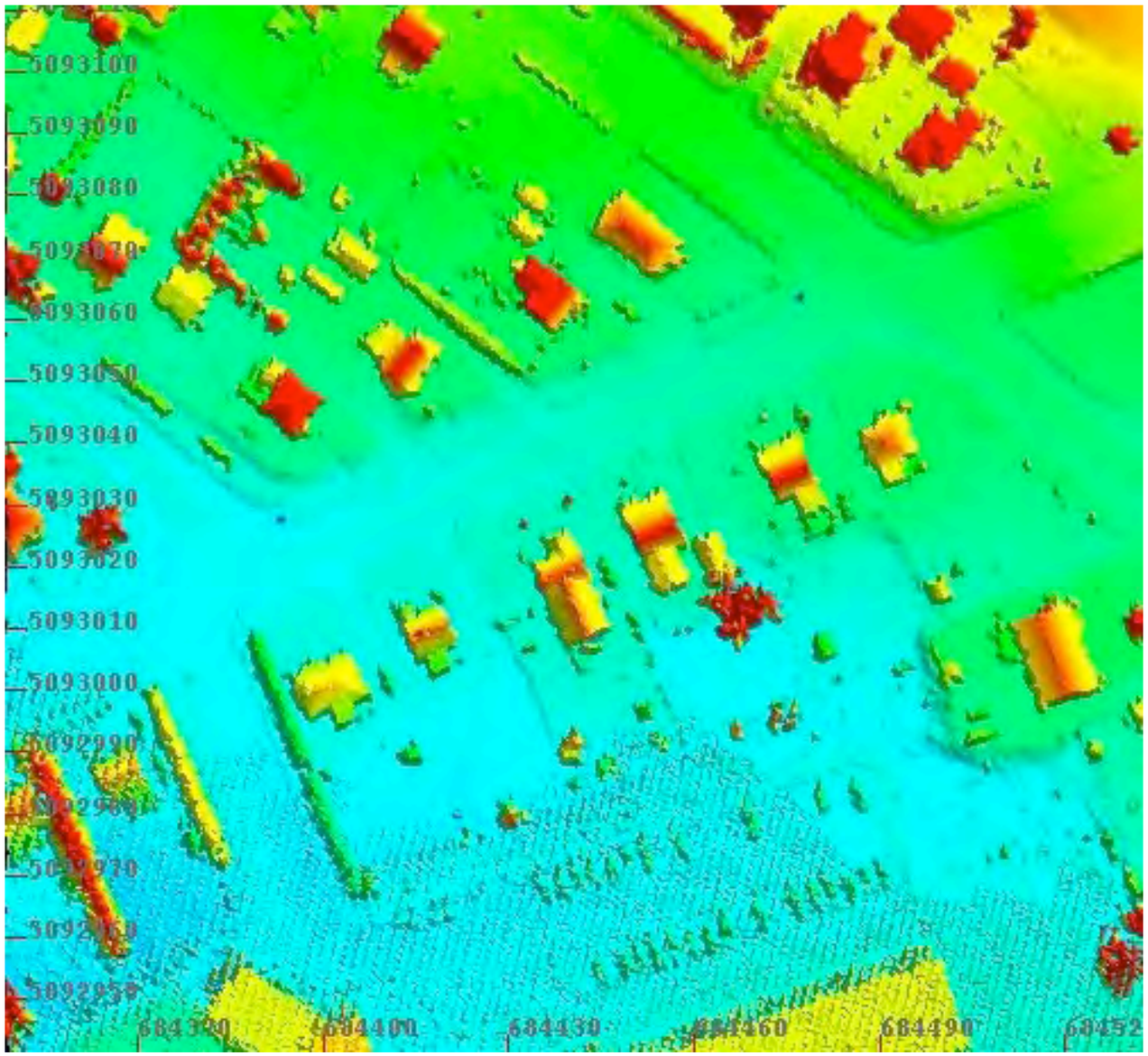
LiDAR Point Cloud



50 m

Data collected November 2007
→ leaf-off
Up to four returns per pulse;
most last returns from ground

Solid Surface



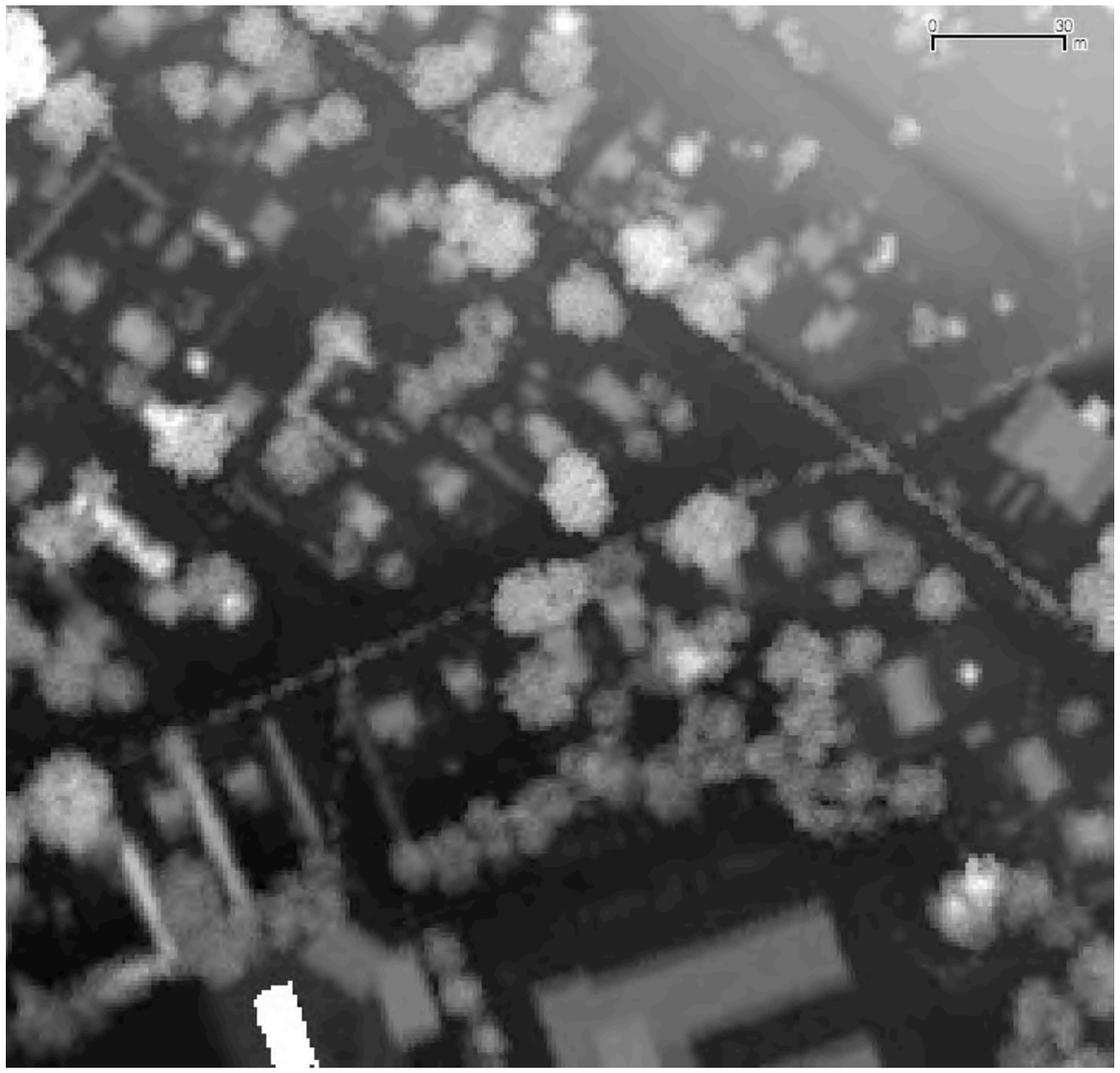
50 m

Grid resolution 1 m
Simple filtering: last returns.
Contains ground, buildings, evergreen trees and hedges, cars, some artefacts from deciduous trees.

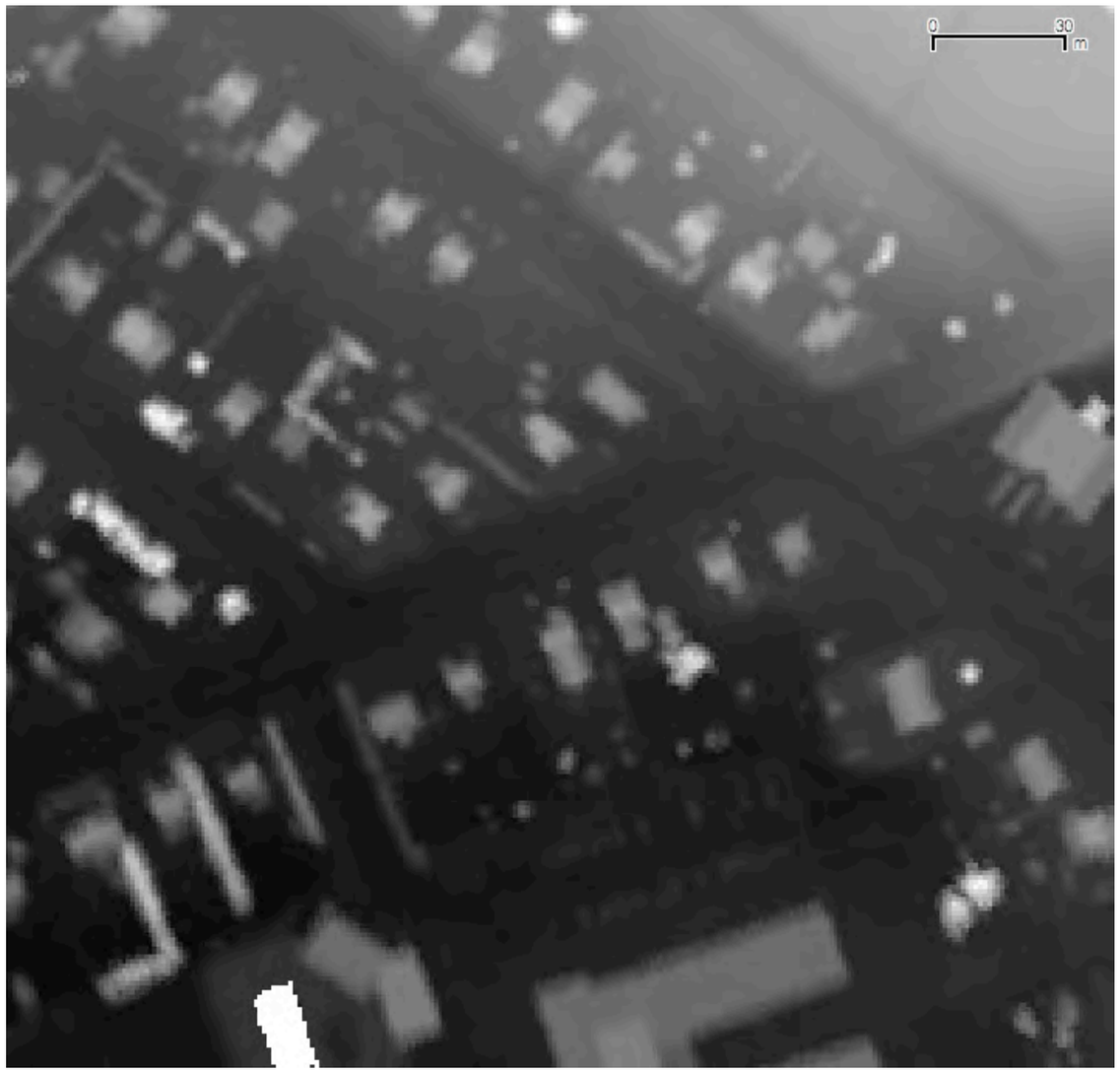
Worst Case Obstructions

- Worst case means: on the shortest day, when the sun does not reach a high elevation, will sunlight reach the surface?
- Compare LiDAR points to surface cells: are objects obstructing the sun at any time?

Worst Case Obstructions

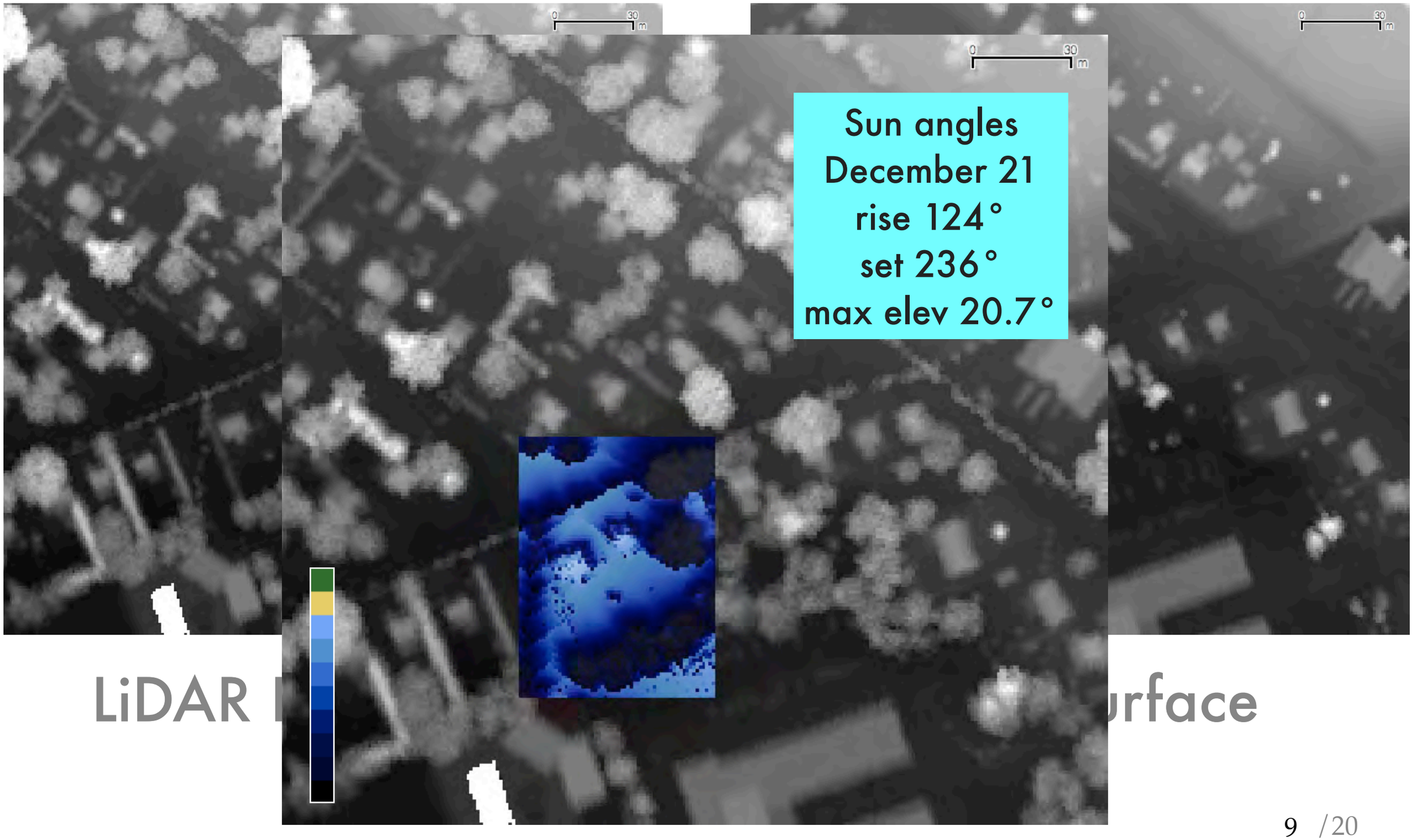


LiDAR Point Cloud



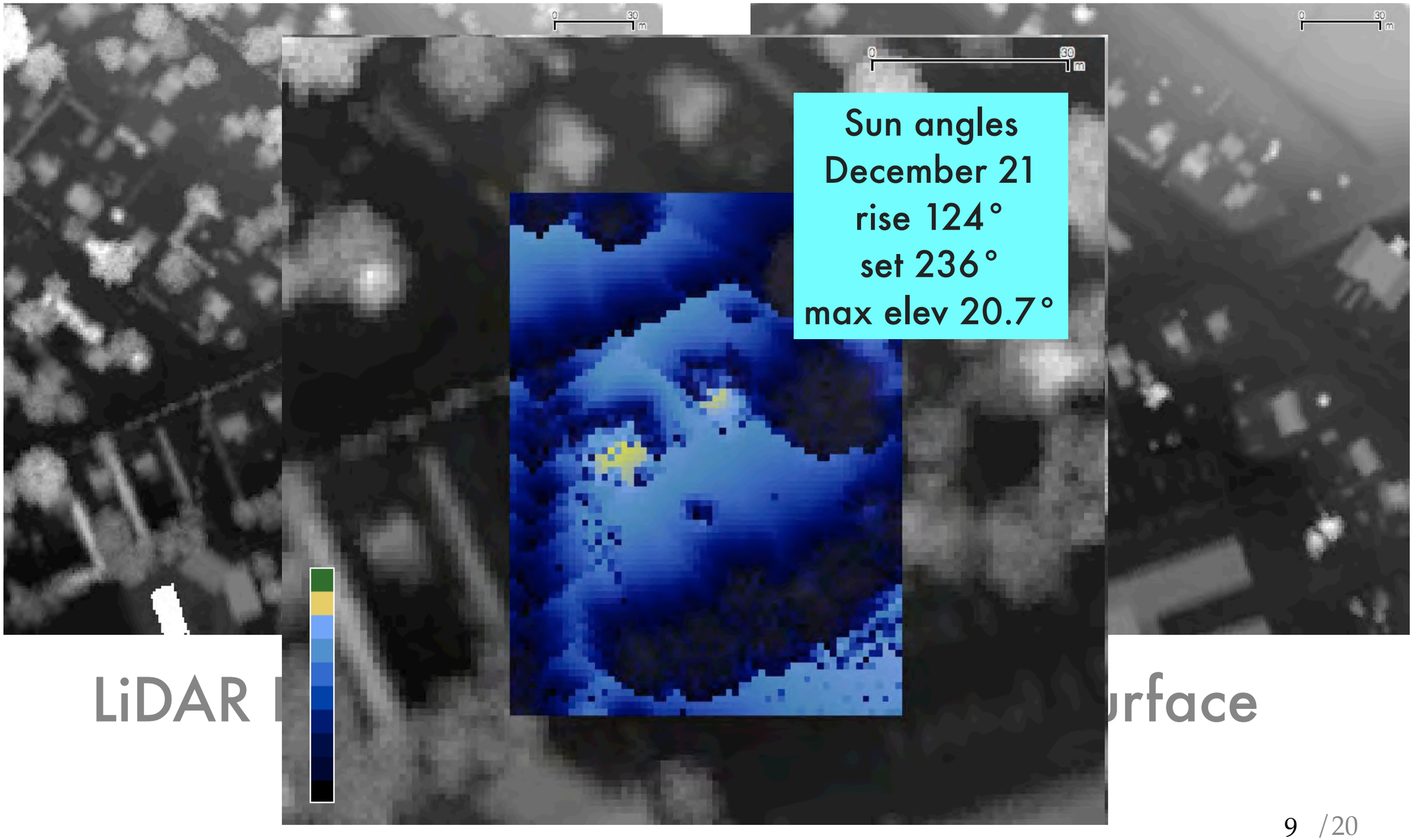
Solid Surface

Worst Case Obstructions



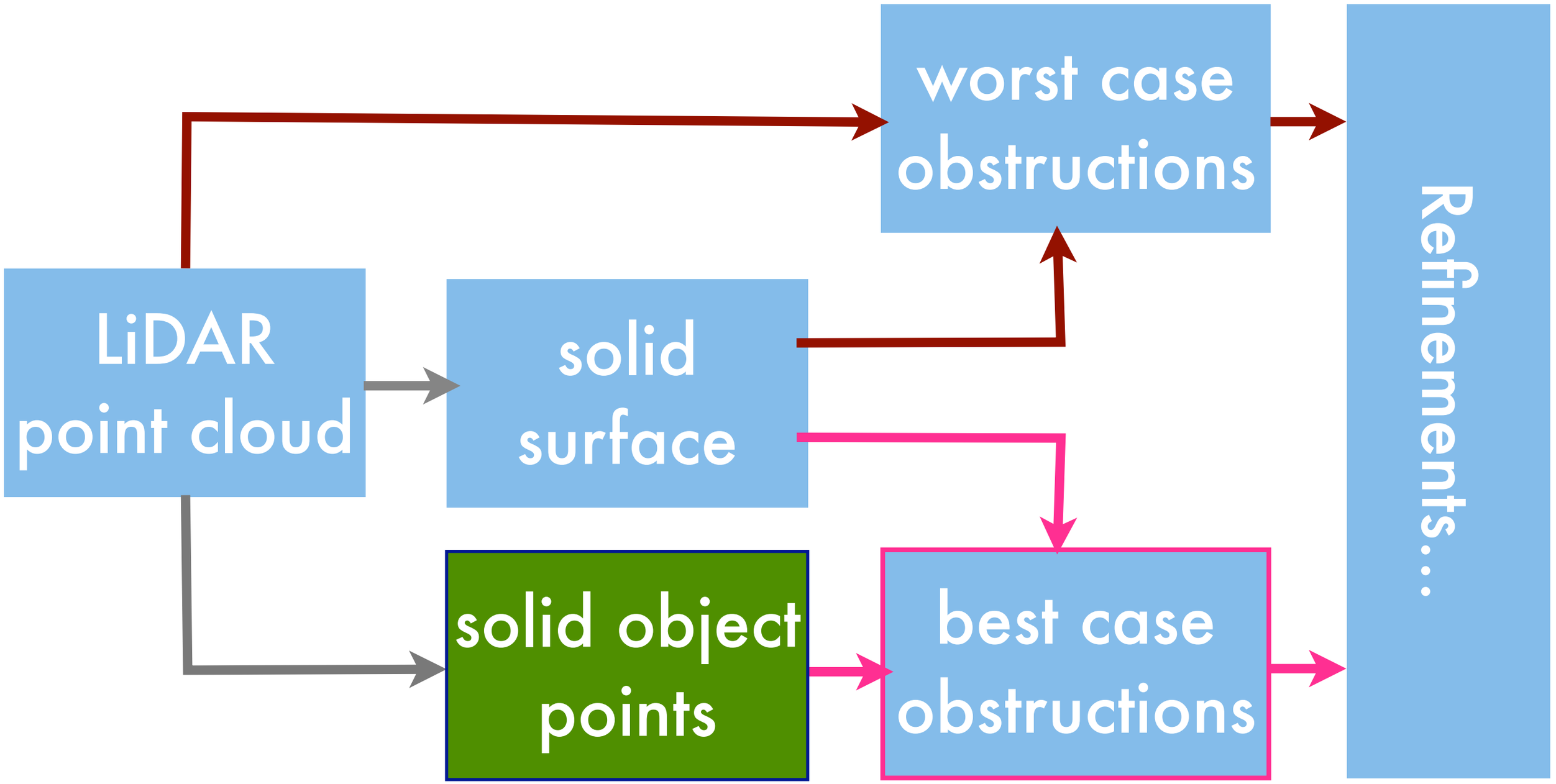
LiDAR [illegible] urface

Worst Case Obstructions



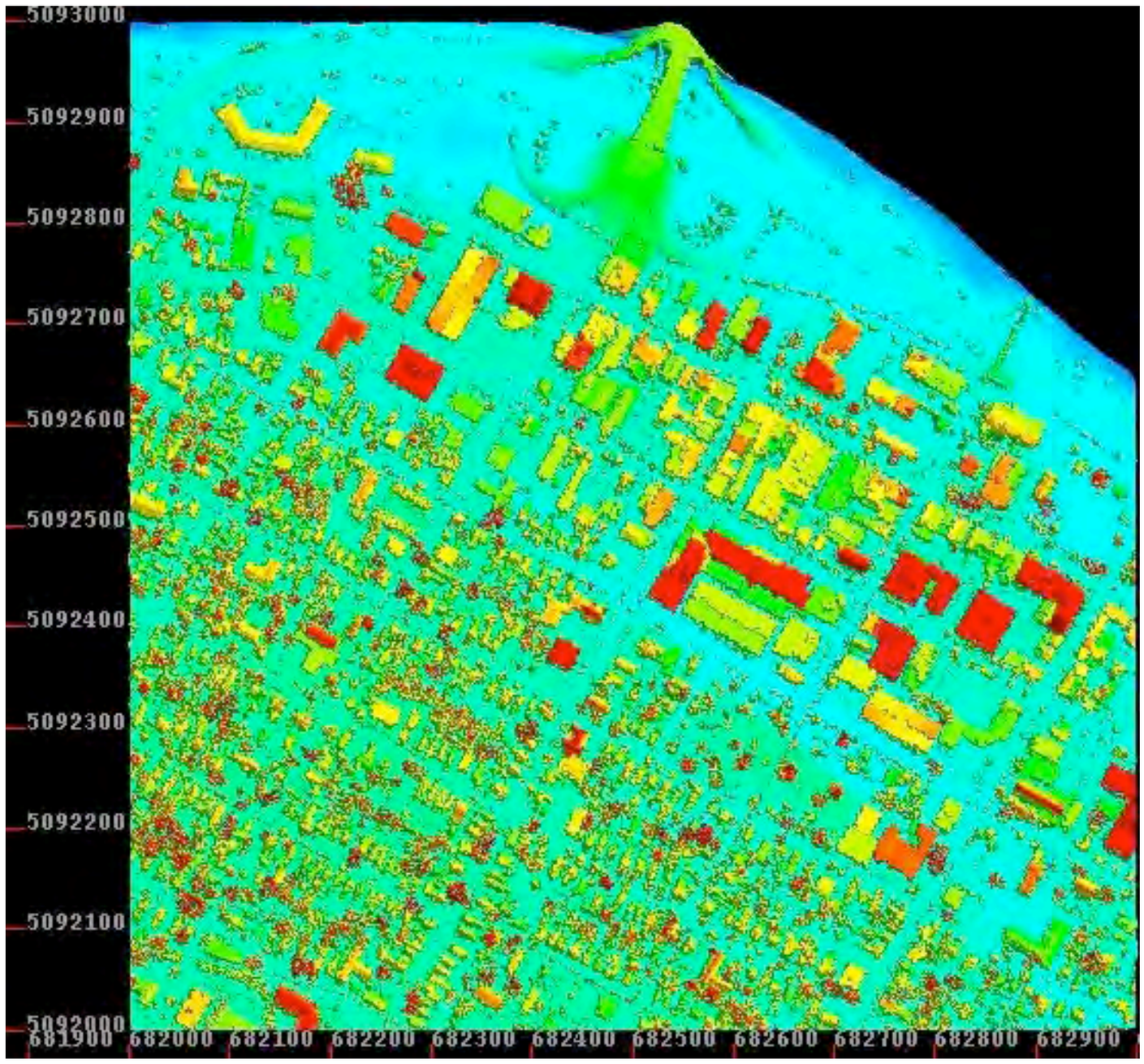
LiDAR [illegible] urface

Workflow for Mapping Obstructions



Solid Object Points

Data collected May 2006 → leaf-on
Points classified using intensity, local density, and local variation in height

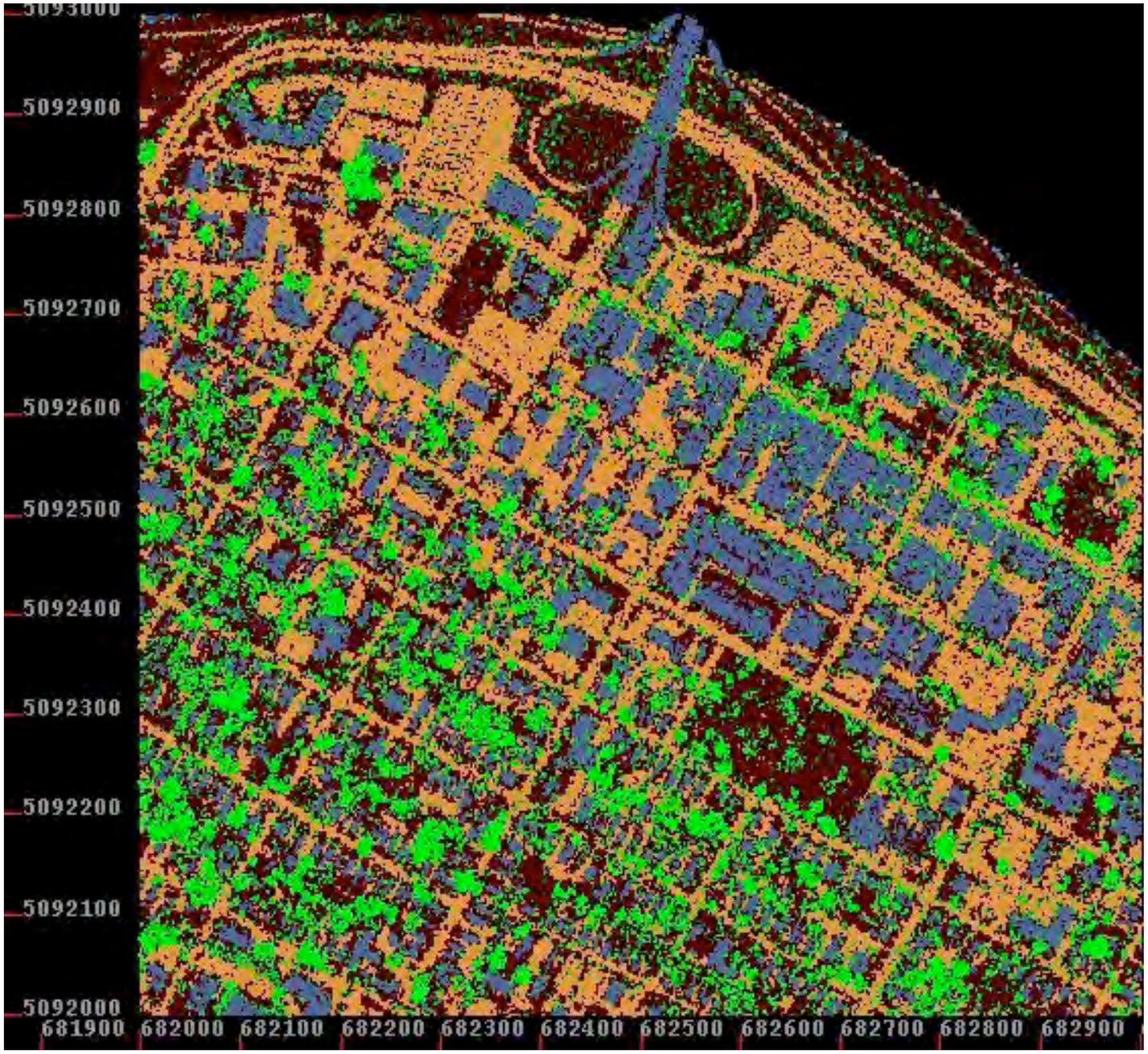


Solid Object Points

- Non-solid Objects

Data collected May 2006 → leaf-on

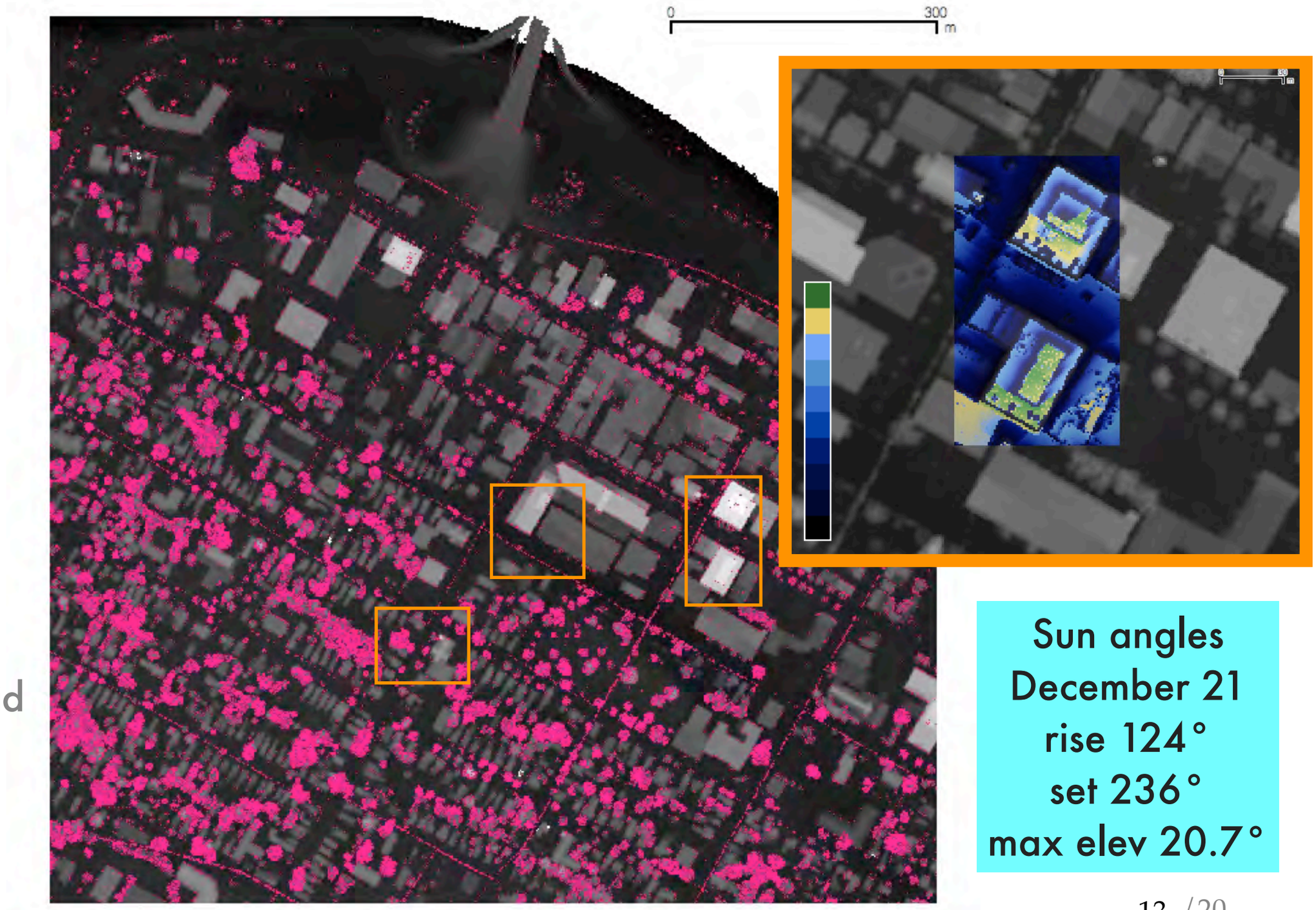
Points classified using intensity, local density, and local variation in height



Best Case Obstructions

- Best case means: (on the shortest day) are any of the obstructions not solid objects?
- Compare only solid object LiDAR points to surface cells: are objects obstructing the sun at any time?

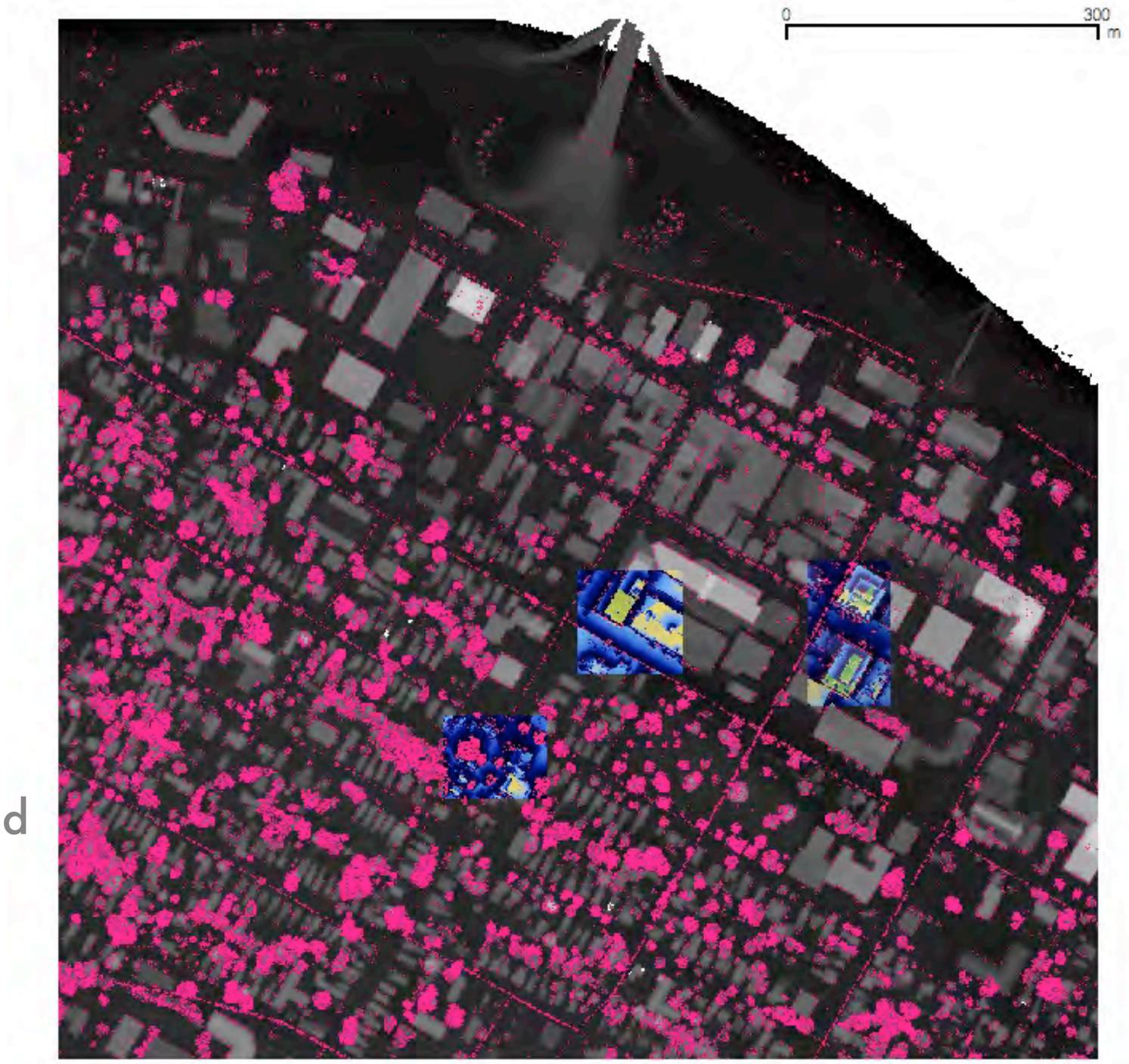
Best Case Obstructions



Greyscale: Solid surface
Pink: Non-solid Object Points

Sun angles
December 21
rise 124°
set 236°
max elev 20.7°

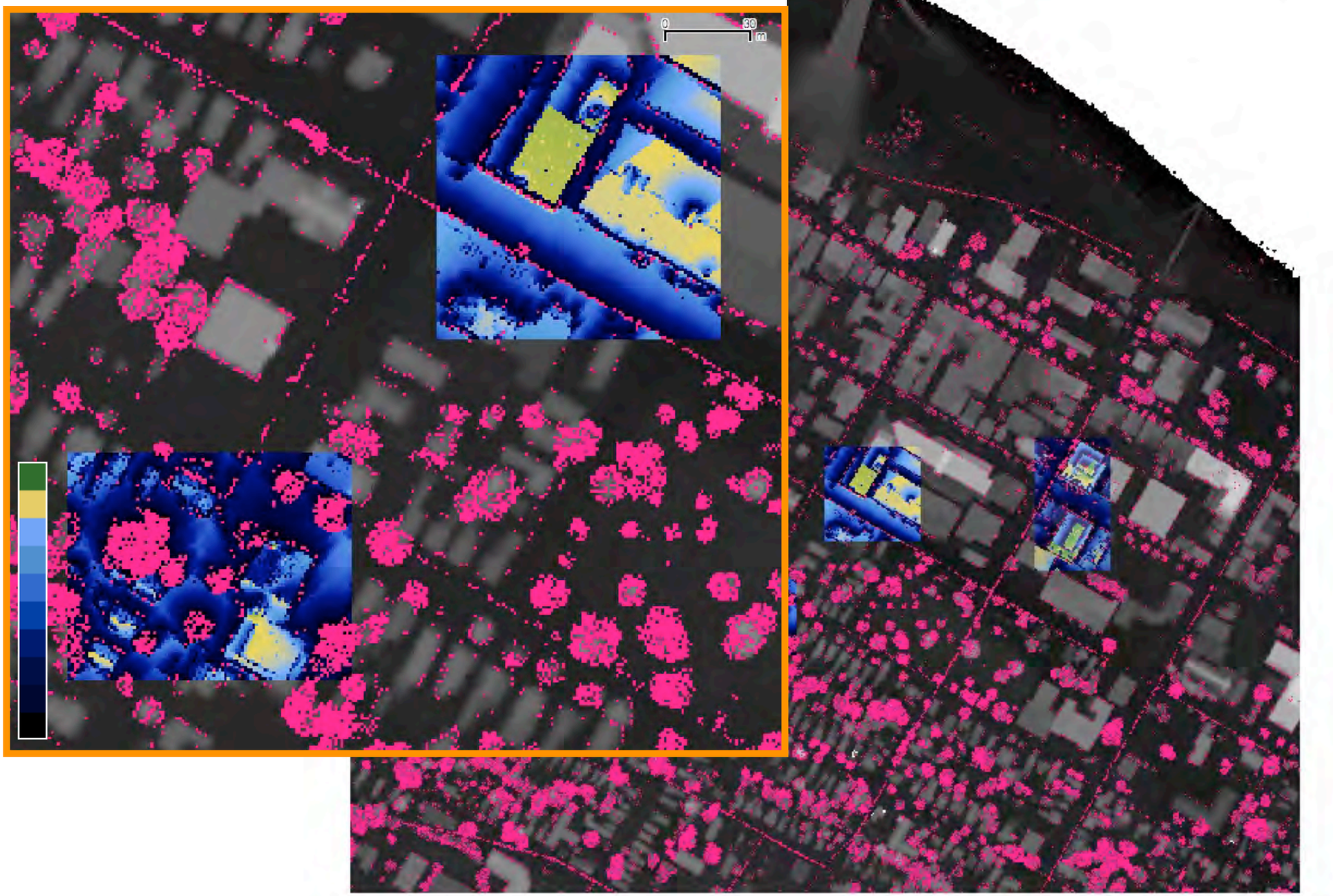
Best Case Obstructions



Greyscale: Solid surface
Pink: Non-solid Object Points

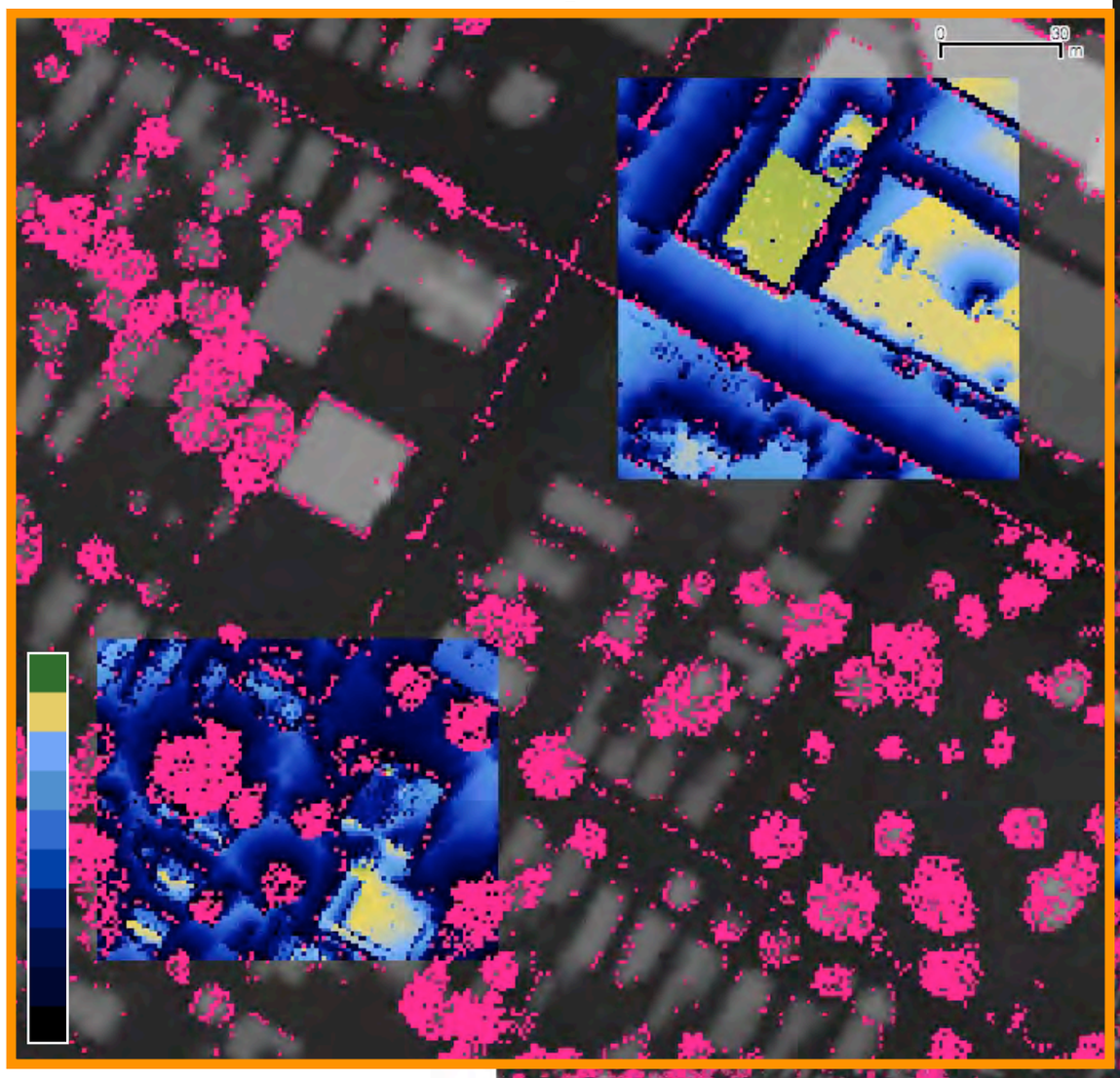
Best Case Obstructions

Non-solid Objects Included

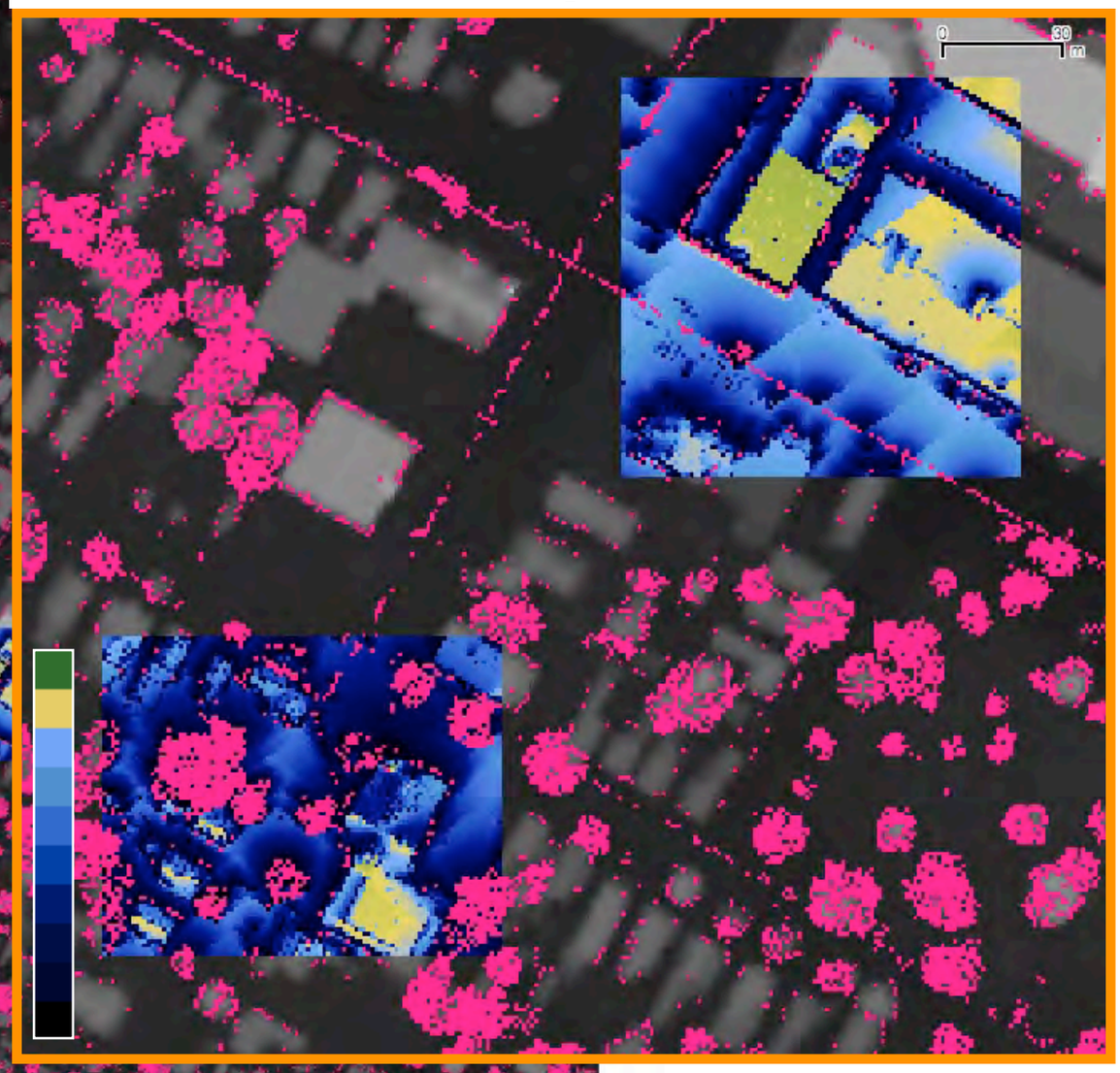


Best Case Obstructions

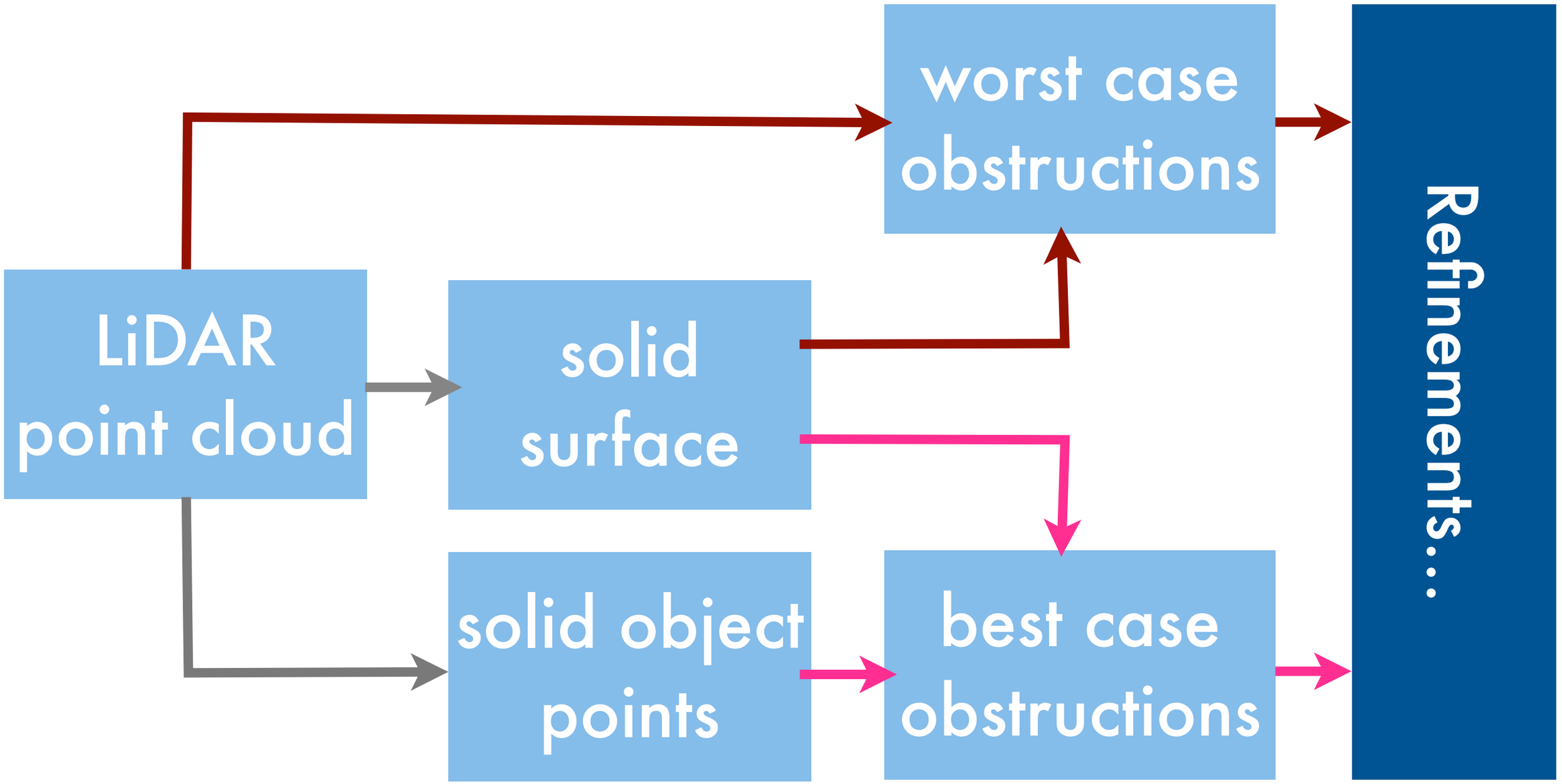
Non-solid Objects Included



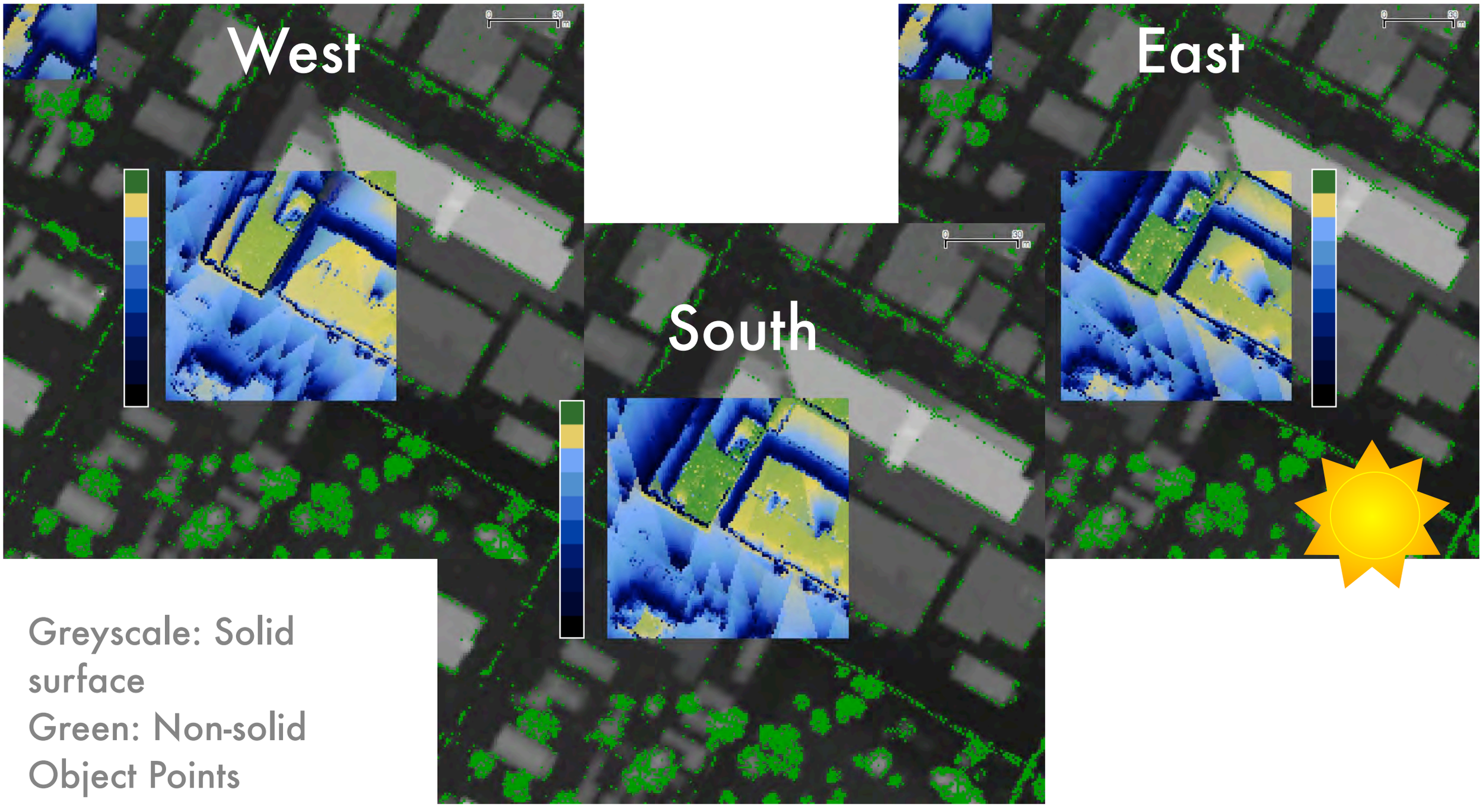
Non-solid Objects Excluded



Workflow for Mapping Obstructions

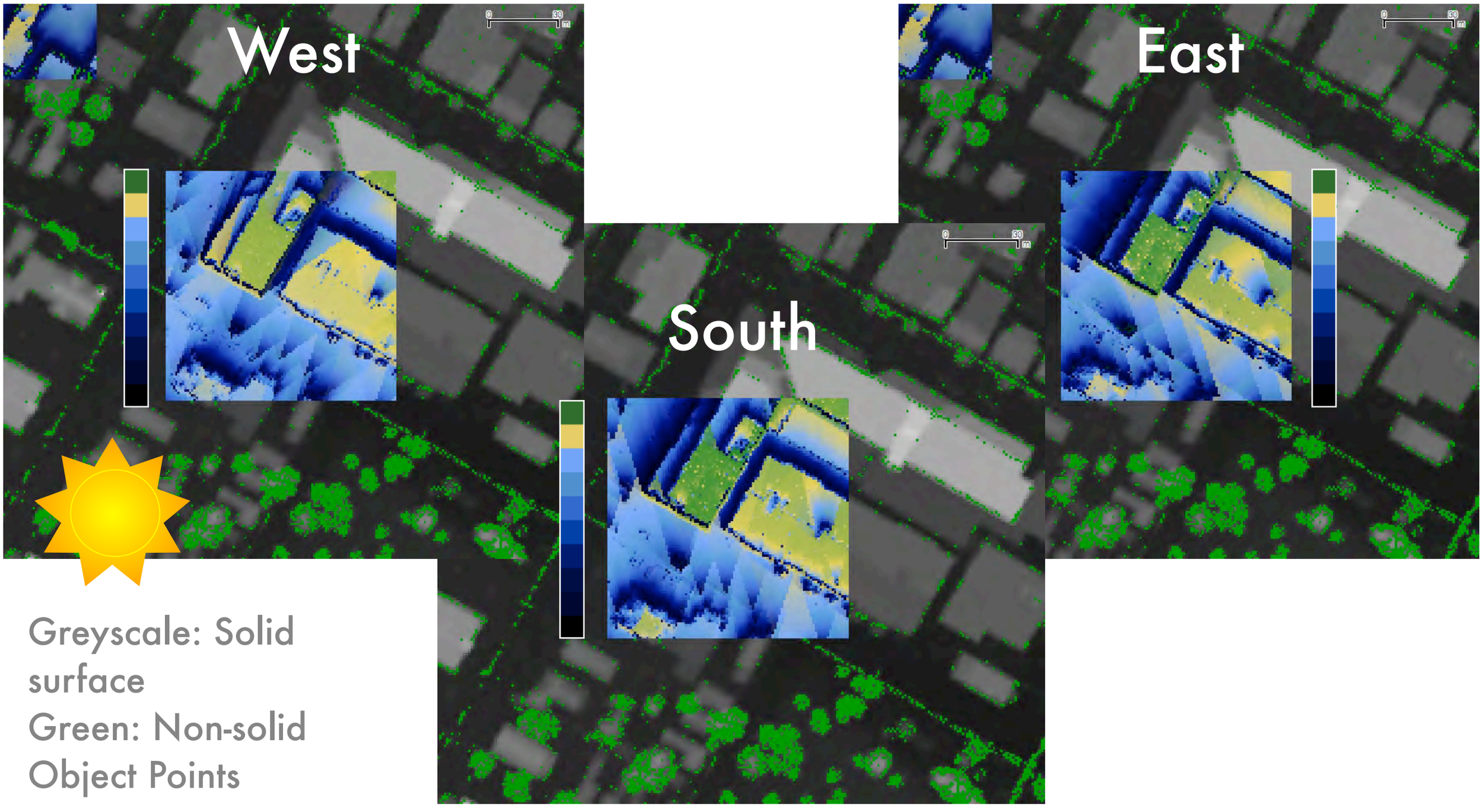


Refinements - Directional



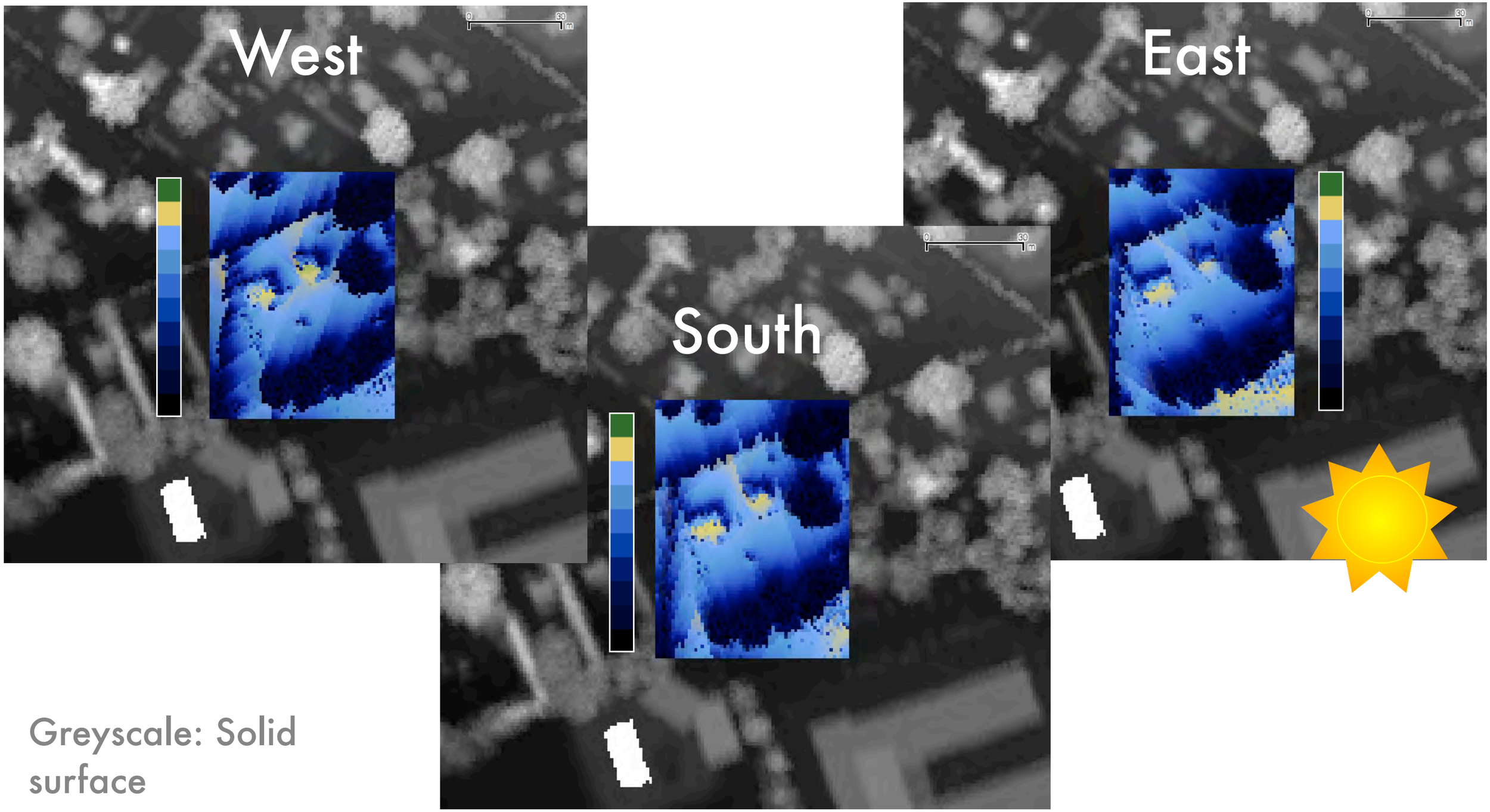
Greyscale: Solid surface
Green: Non-solid Object Points

Refinements - Directional



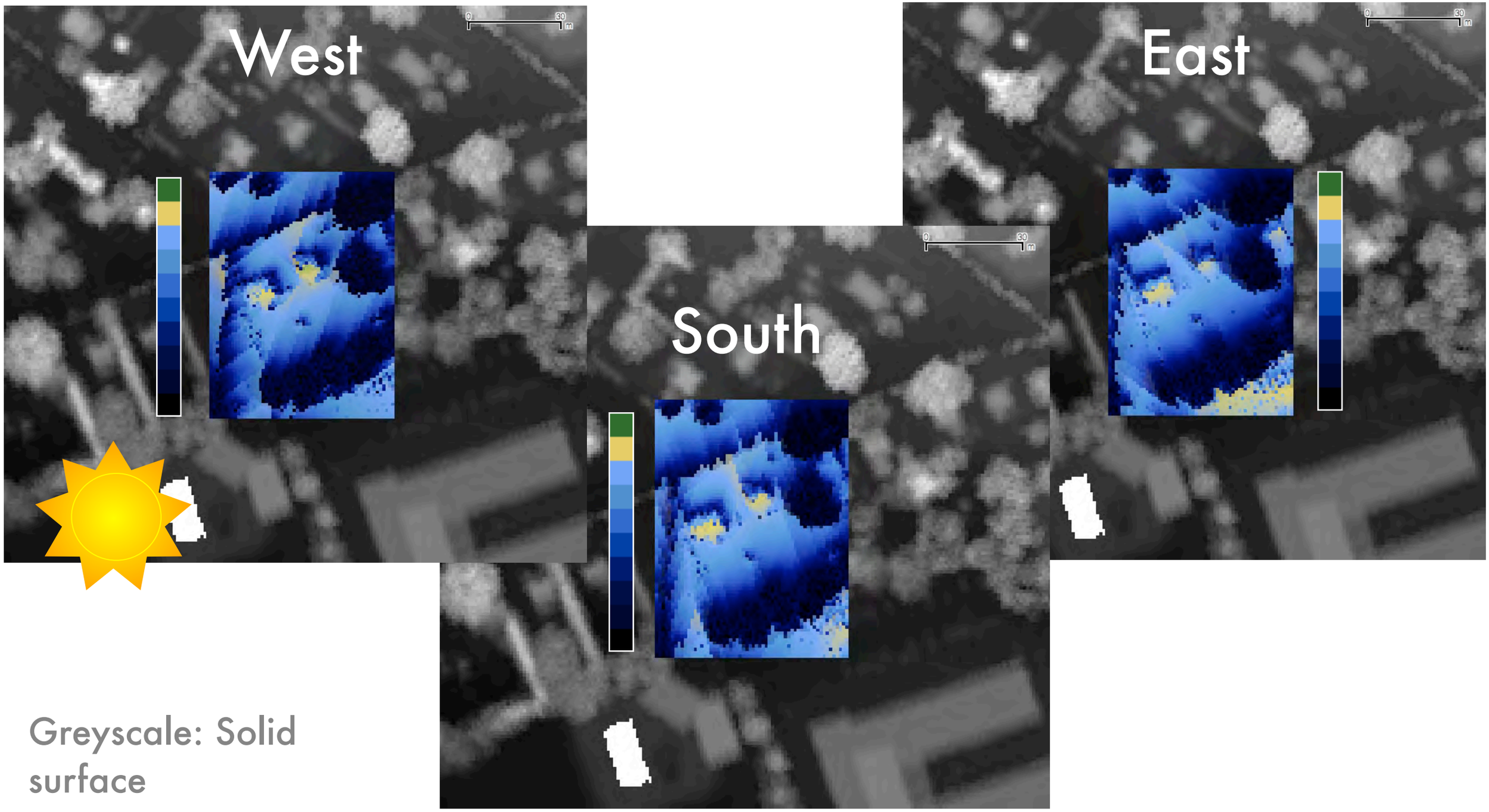
Greyscale: Solid surface
Green: Non-solid Object Points

Refinements - Directional



Greyscale: Solid surface

Refinements - Directional



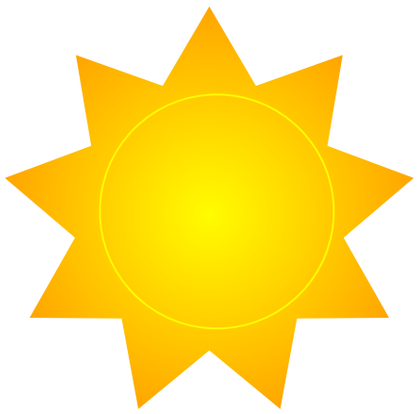
Greyscale: Solid surface

Recap

- Renewable energy sources, e.g., solar
- Low insolation in winter
- Filter LiDAR data: ground (solid surface) and obstructions (everything)
- Classify LiDAR data: solid objects (not trees, power lines...)
- Analyze obstruction direction, seasonal solar variations to refine results

Further Work

- Apply better filtering methods
- Smooth solid surfaces
- Quantitative assessment of results
- Improve classification
  - Separate trees from power lines
  - Locate building edges
- Apply to vertical surfaces



Thank You!