Institute for advanced architecture of Catalonia | BARCELONA

MASTER IN CITY & TECHNOLOGY
DIGITAL TOOLS AND BIG DATA
2019/2020

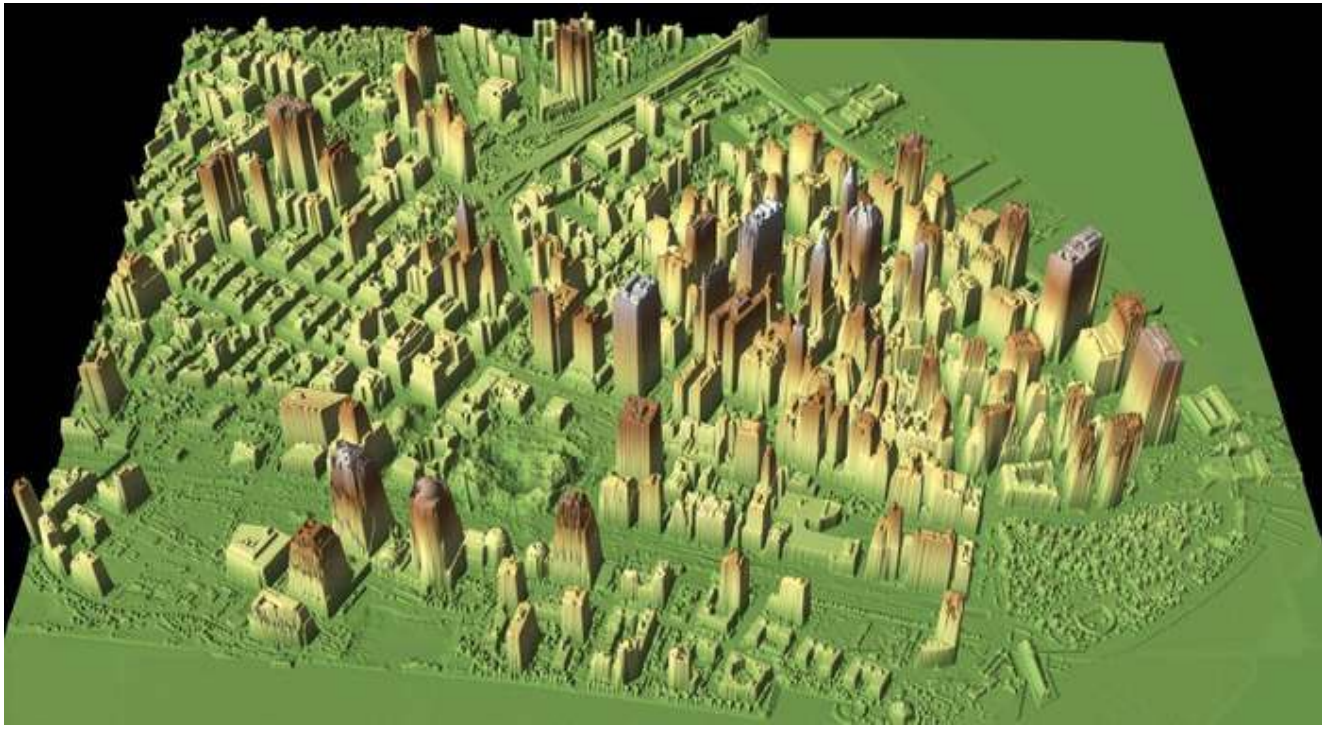
FACULTY DIEGO PAJARITO

Lidar

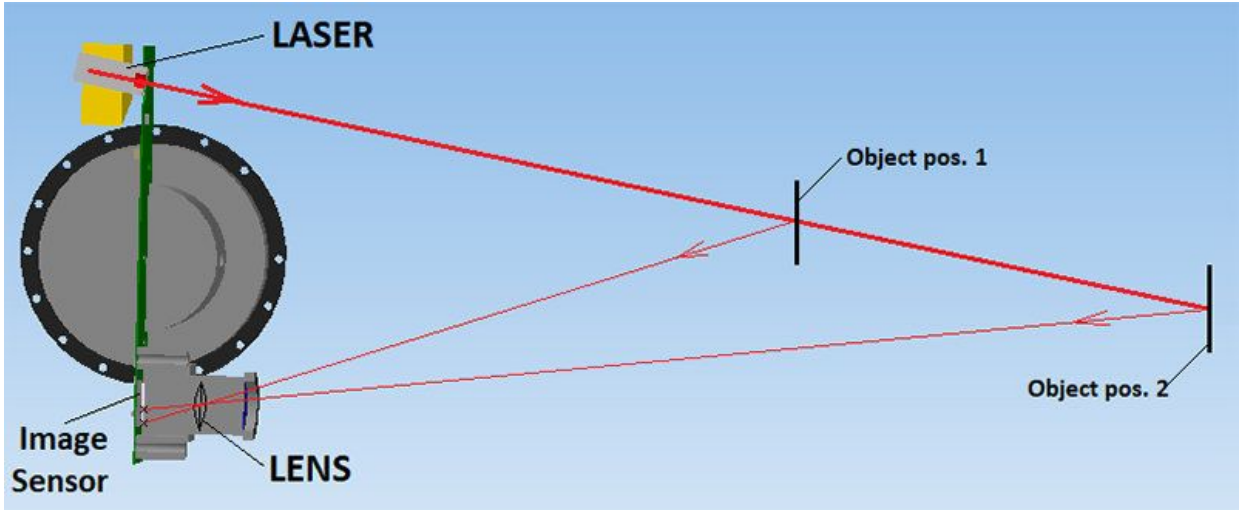
A remote sensing tool with spatio-temporal and 3D features

It determines the **distance** to an object by transmitting a **laser beam** at the object and **measuring** the **time** the light takes to **return** to the transmitter.

Light-Detection-Ranging



Source: https://www.britannica.com/technology/lidar



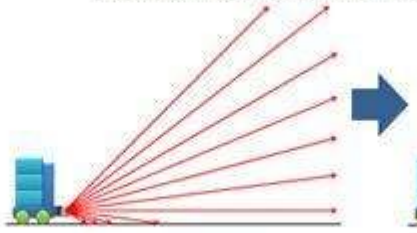
Use case 1)

Moving on flat surface with less moving objects in the area

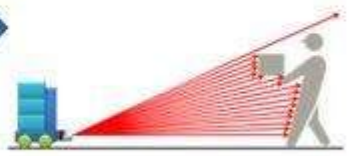
Quick scan in narrow range.

Use case 2)

Moving in the area with many moving objects



Quick scan in wide range.



After detecting the obstacle, change the scanning range and resolution to detect details.

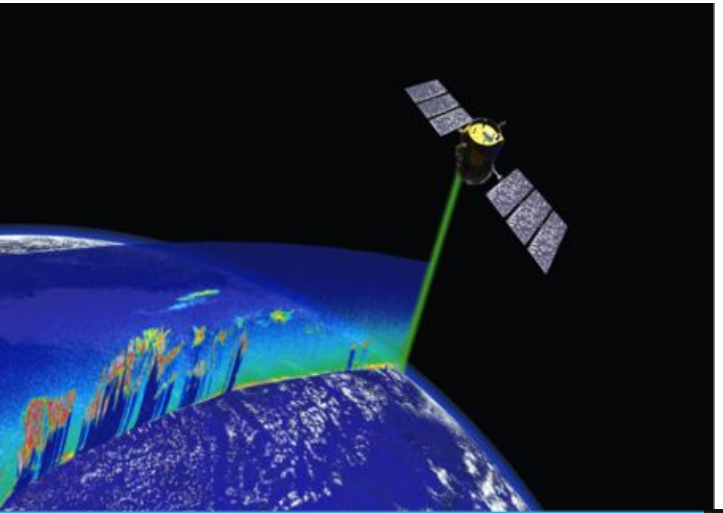
Sensor: https://www.generationrobots.com/blog/en/what-is-lidar-technology/
Use Cases: https://phys.org/news/2017-09-d-lidar-sensor-enabling-distances.html

Topographic	*Near-infrared laser to map the land*
Bathymetric	*Water-penetrating green light to also measure seafloor and riverbed elevations*
Others	*From about 10 micrometers (infrared) to approximately 250 nm (UV).*

Source: https://oceanservice.noaa.gov/facts/lidar.html
Lidar: https://en.wikipedia.org/wiki/Lidar

Public header block	*Format, number of points, extent of the point cloud and other generic data.*
Variable length records (VLR)	*N records:* *spatial reference system, metadata, waveform packet information, user application data. Up to 65,535 bytes.*
Point data records	*N points: (Point cloud)* *Coordinates, classification (e.g. terrain or building), flight and scan data, etc.*
Extended variable length records (EVLR)	*Similar to VLRs. Located after the point data records and up to 8-byte size descriptors.*

Source: https://en.wikipedia.org/wiki/LAS_file_format



Satellite

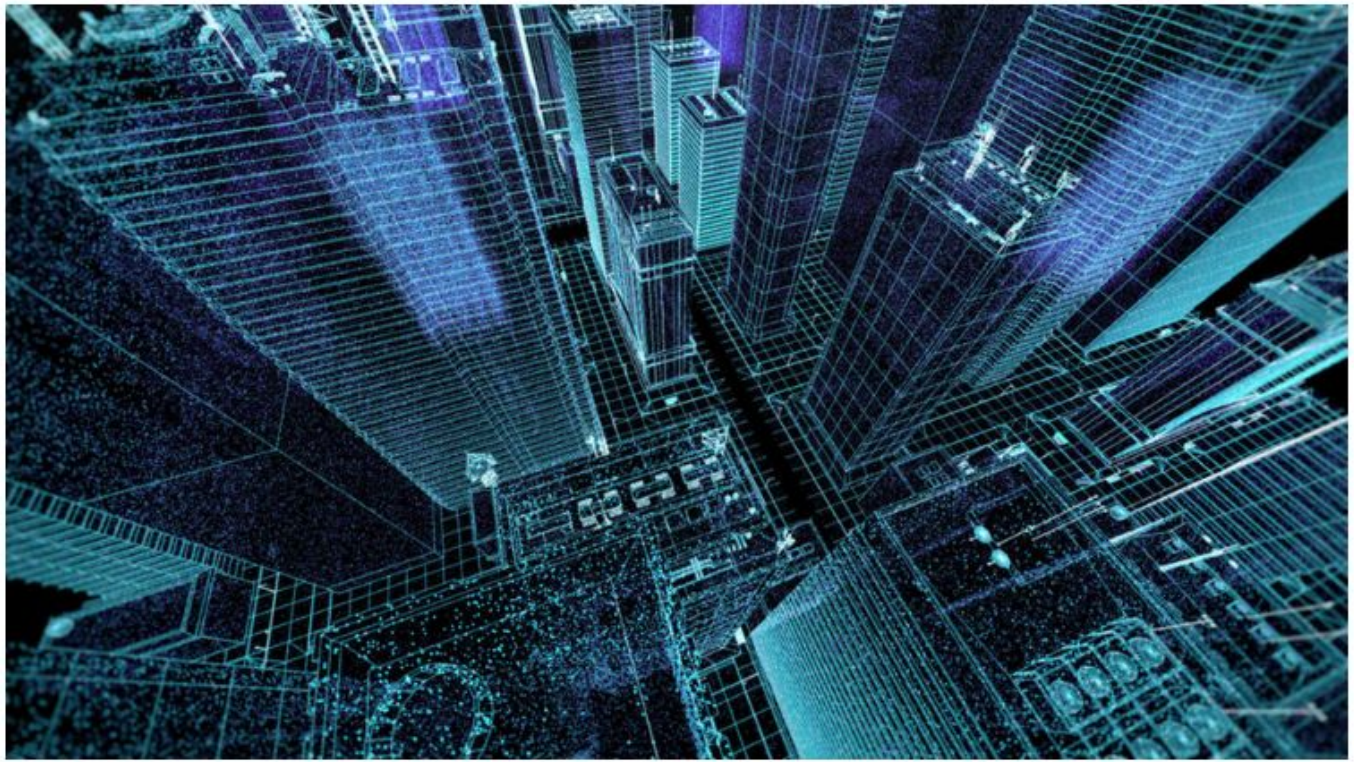
Airborne

UAV ground based Portable (e.g., iPad Pro)

Lidar Data Is Becoming an Increasingly Valuable Tool for Cities

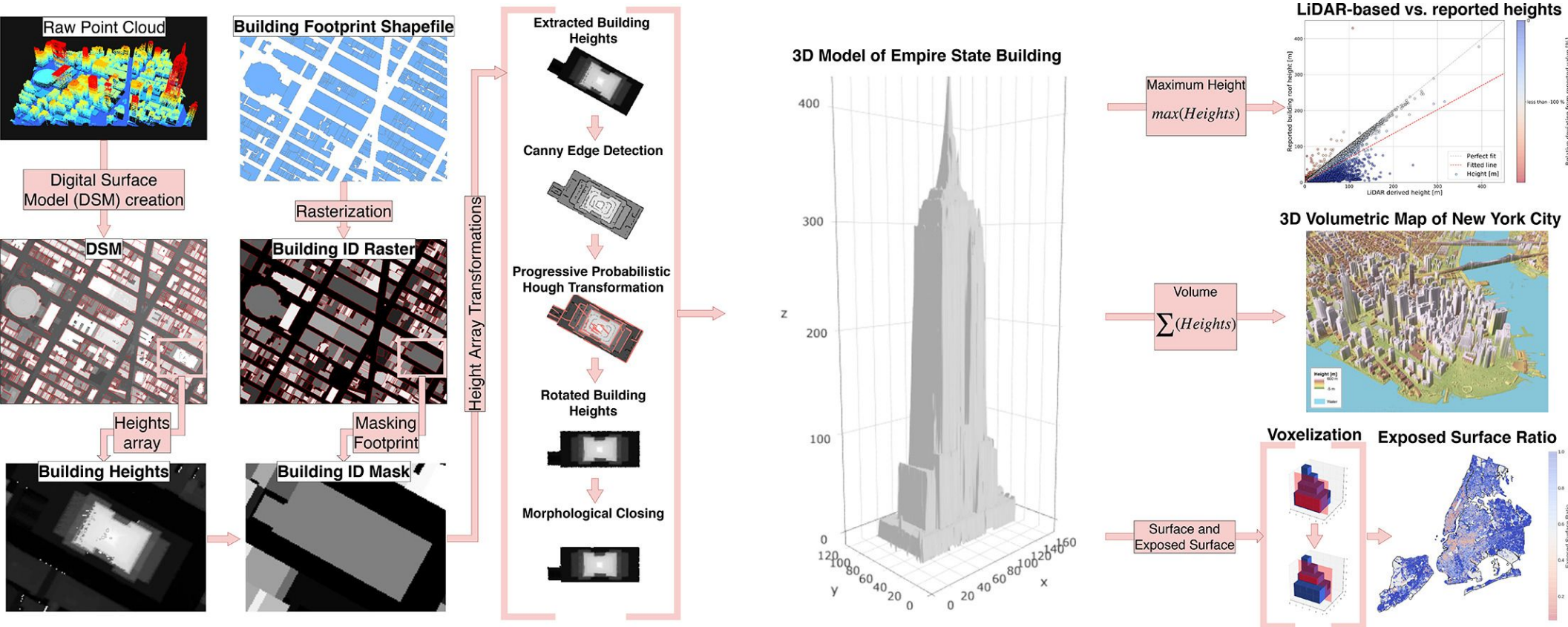
As more and more agencies discover uses for lidar technology, the argument for open data strengthens.

BY DANIEL FISHER, DATA-SMART CITY SOLUTIONS / AUGUST 24, 2018



SHUTTERSTOCK/PAVEL CHUKHOV

Source: https://www.govtech.com/fs/news/Lidar-Data-Is-Becoming-an-Increasingly-Valuable-Tool-for-Cities.html



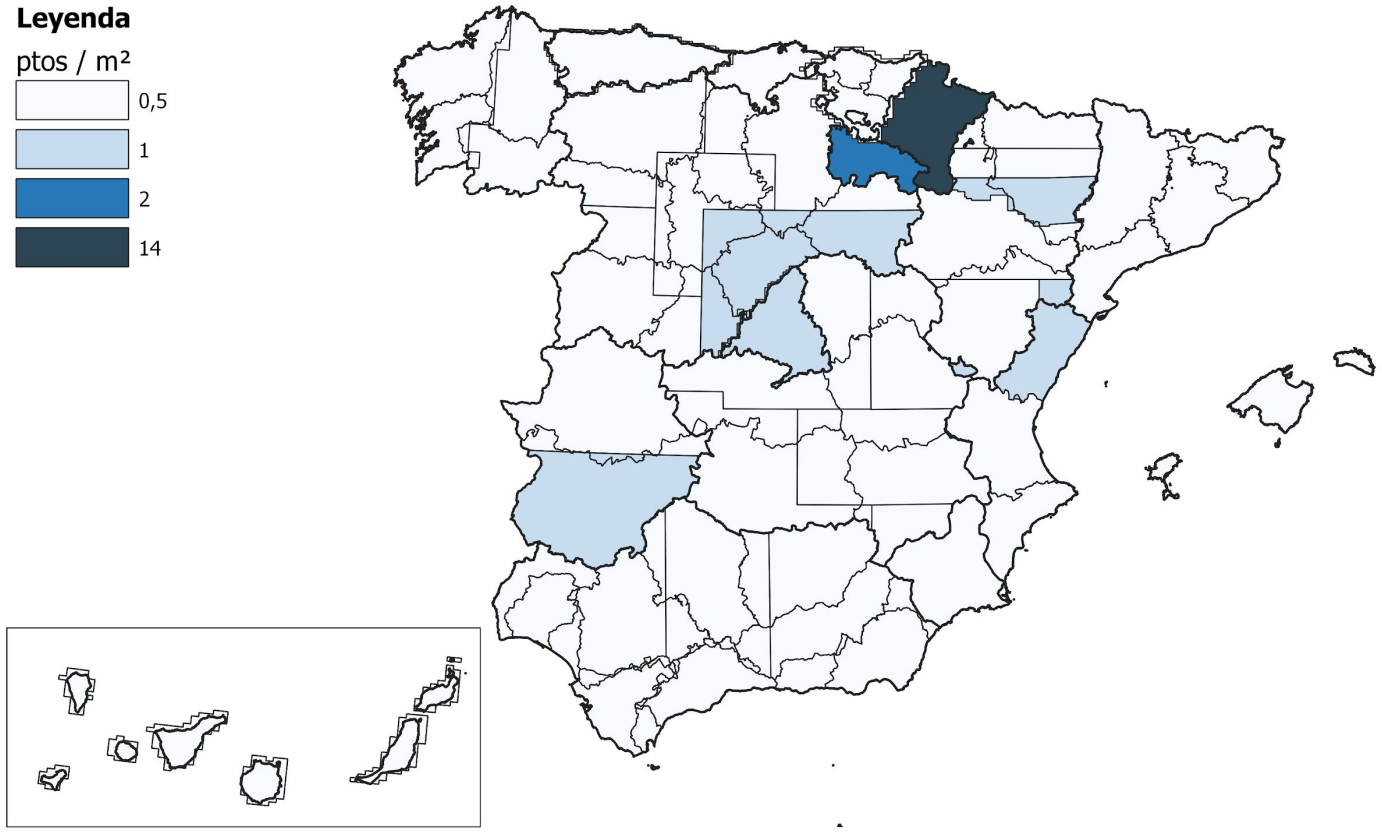
Source: https://www.sciencedirect.com/science/article/pii/S0198971518300176

By Green Valley Media

Lidar data

Some data sets available

MÁXIMA ACTUALIDAD PUBLICADA

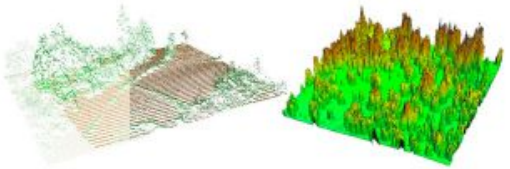


Source: http://centrodedescargas.cnig.es/CentroDescargas/buscadorCatalogo.do?

Source: http://centrodedescargas.cnig.es/CentroDescargas/buscadorCatalogo.do?

Características principales:

- Densidad mínima: 0,5 puntos/m^2.
- Cubre toda Catalunya en diferentes fechas:
  - 1ª cobertura: entre 2008 y 2011.
  - 2ª cobertura: entre 2016 y 2017.
- Cada punto LIDAR lleva asociado la fecha y hora de captura (tiempo GPS absoluto)



Descarga la 2a cobertura

Accede a la aplicación para descargar un único fichero ZIP con todos los bloques existentes en el área que selecciones

Descarga la 1a cobertura

Accede a la aplicación para descargar un único fichero ZIP con todos los bloques existentes en el área que selecciones

Especificaciones

Los datos se distribuyen por bloques de 2 x 2 km, en formato LAS 1.2 comprimido. Se puede descomprimir mediante herramientas como LASzip.

LAS specification version 1.2 [114,7 kB]

Los nombres de los bloques son las coordenadas en km de la esquina sudoeste de cada bloque, eliminando los 4 millones de la coordenada Y (ejemplo: el bloque 324562 es el bloque con la coordenada sudoeste 324000, 4562000 m).

La nube de puntos ha sido capturada con sensor LIDAR, calibrada y ajustada con áreas de control topográfico, obteniendo una exactitud altimétrica con un error medio cuadrático de unos 6 cm en áreas planas con poca vegetación. Posteriormente la nube ha sido clasificada automáticamente y, en la 1ª cobertura, además, se han editado manualmente el terreno, los puntos altos y bajos, y las torres y líneas eléctricas.

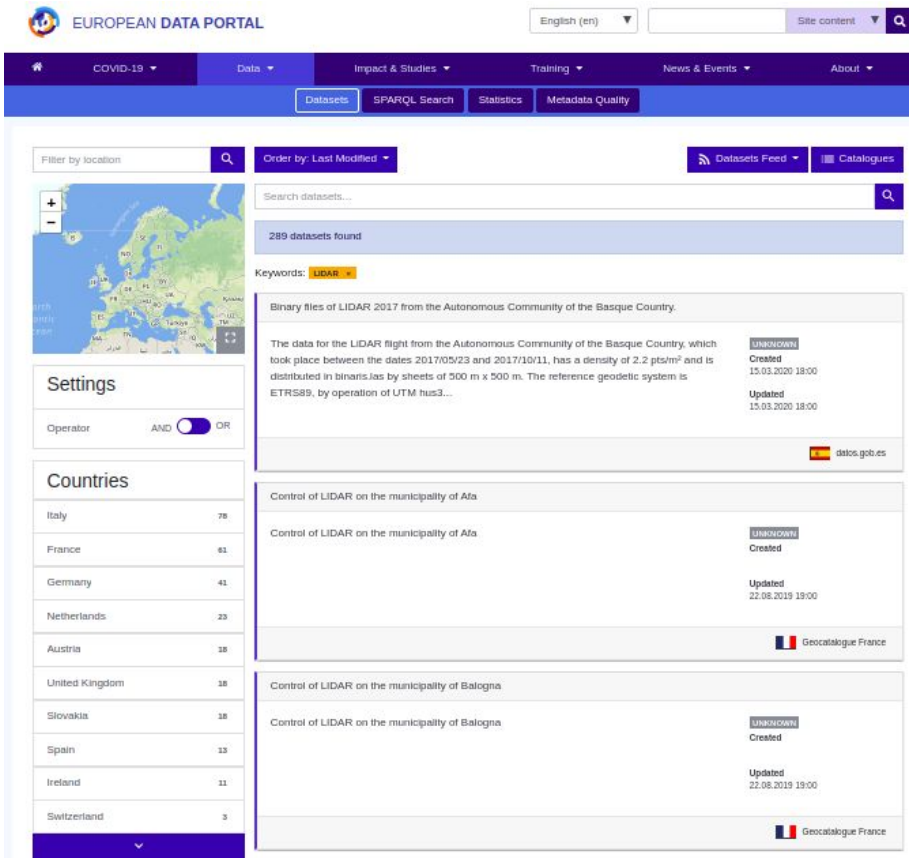
Catalan lidar open data

Source: https://www.icgc.cat/es/Descargas/Elevaciones/Datos-lidar

TUDelft 3D geoinformation about research education download etc

Cities/regions around the world with open datasets

dataset	country	year	building LoD	other classes	textures	acquisition	formats	notes
Adelaide	Australia	2015	LoD1/LoD2	Terrain	true		.3DS with JPEG textures, Blender, FBX	
American cities	USA	2019	LoD1		false		CityJSON, CityGML	125 million buildings, separated by state
Austin	USA	2013	LoD2		false		KMZ	
Berlin	Germany	2013	LoD2		true		CityGML, 2D Shape, 3D Shape - PolygonZ, 3D Shape - Multipatch, KMZ, DXF, DWG, 3DS, ESRI FGDB	Released in 2015
Bordeaux	France	2012	LoD2		true		3DS	Version without textures available here
Boston	USA	2017	LoD1+LoD2	Terrain	false		OBJ, DWG, MAX, Shapefile	
Brussels	Belgium	2014	LoD2		false		CityGML, DWG, DGN, GML, Shapefile, SketchUp	
Cambridge	UK		LoD1		false		DXF, Shapefile, COLLADA	
Dresden	Germany	2009	LoD1/LoD2/LoD3		partially		CityGML	
Dutch cities	Netherlands	2016	LoD1	Terrain and many other	false		CityGML, OBJ, IMGeo	A few Dutch cities generated with 3dfier
Espoo	Finland	2019	LoD1-3		true		CityGML	Many classes from CityGML: water body, terrain, landuse, etc.
Fredericton	Canada	2016	LoD2		true		KMZ	



TU delf compilation: https://3d.bk.tudelft.nl/opendata/opencities/
European Data Portal: https://www.europeandataportal.eu/data/datasets?locale=en&tags=lidar&keywords=lidar

Hands-on

Visualising Lidar Data

Stand Alone visualisation Software

Get the software http://www.danielgm.net/cc/release/

1. Get Lidar data for barcelona at the GDrive folder (CNIG)
2. Load the .LAZ file for Barcelona
3. Explore 3D views
4. Explore visualisation options

GIS extension

1. Install the QGIS extension
2. Configure GDAL settings (only Windows)
3. Load .LAZ file for barcelona
4. Explore 3D views
5. Explore visualisation options

Documentation: https://rapidlasso.com/lastools/

Grasshopper extension

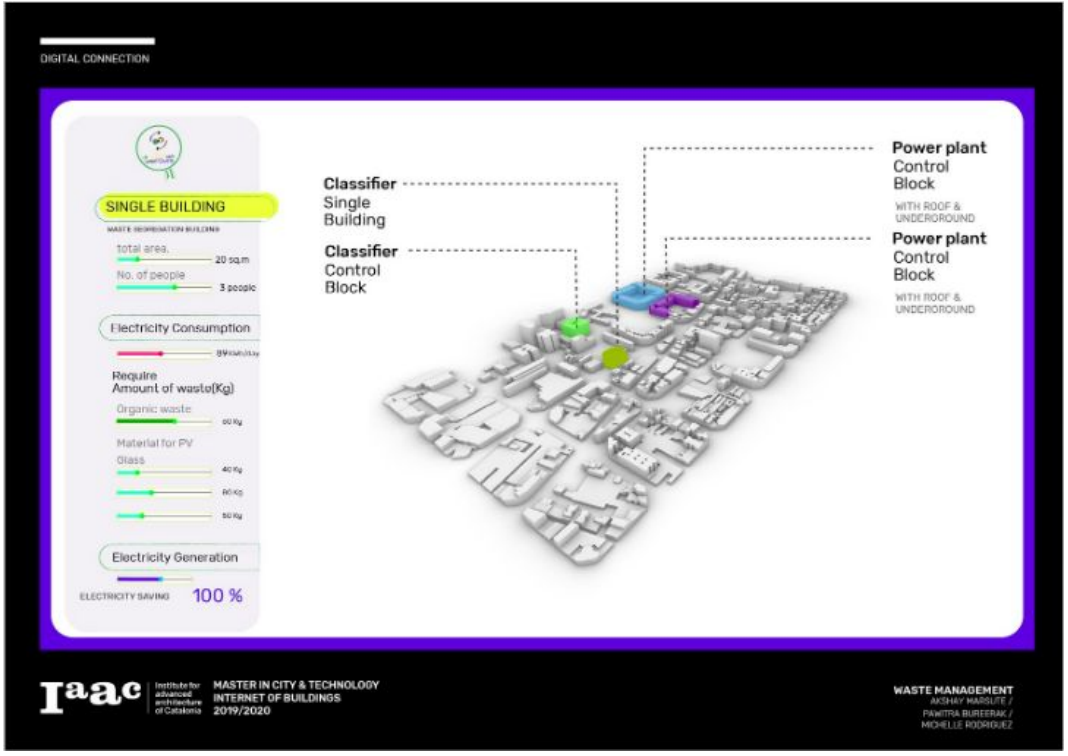
1. Explore software tools for lidar data in Grasshopper
2. Get the extension
3. Load .LAZ file for barcelona and the north of Spain
4. Explore 3D views
5. Explore visualisation options
6. Explore processing tools

Documentation: https://www.grasshopper3d.com/forum/topics/mesh-buildings-from-lidar-point-cloud

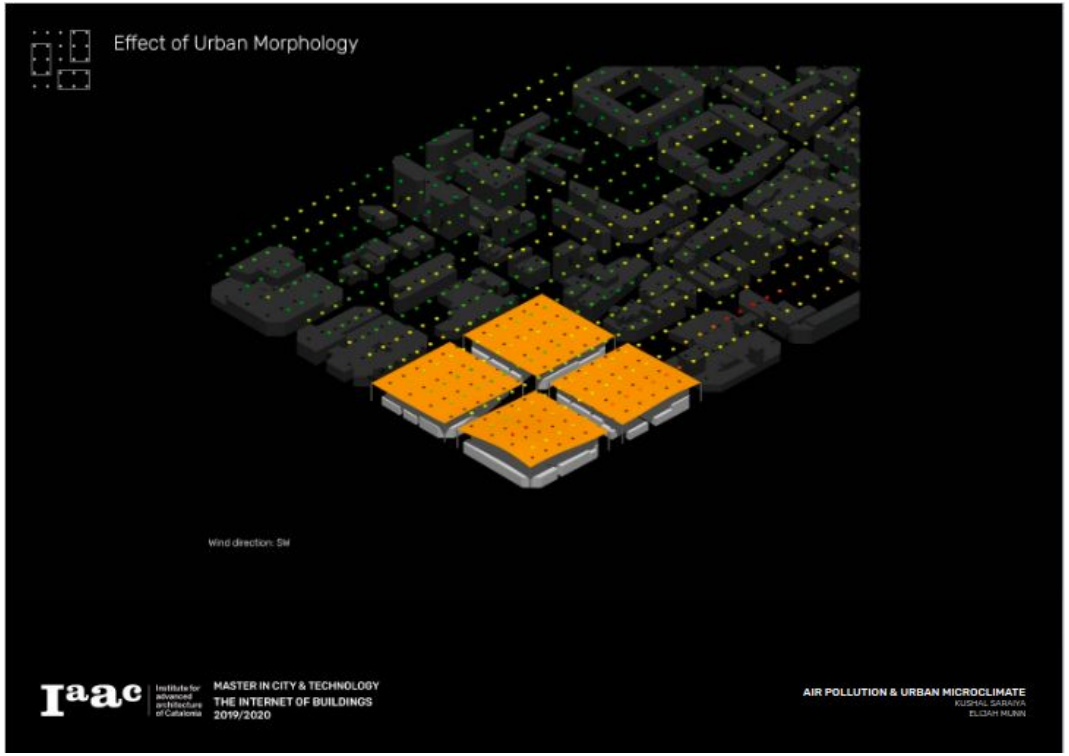
Simulation data 4 analysis

Bringing simulation data into analysis scenarios

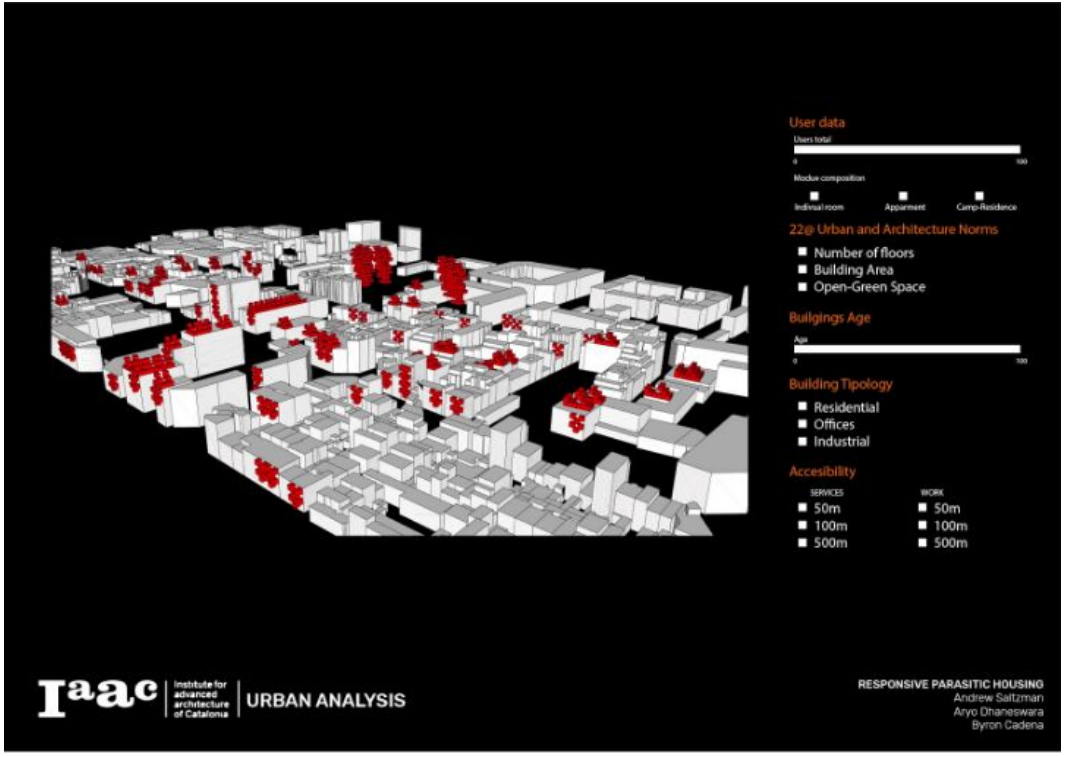
How to add the selected / proposed areas to the existing city-level dataset?



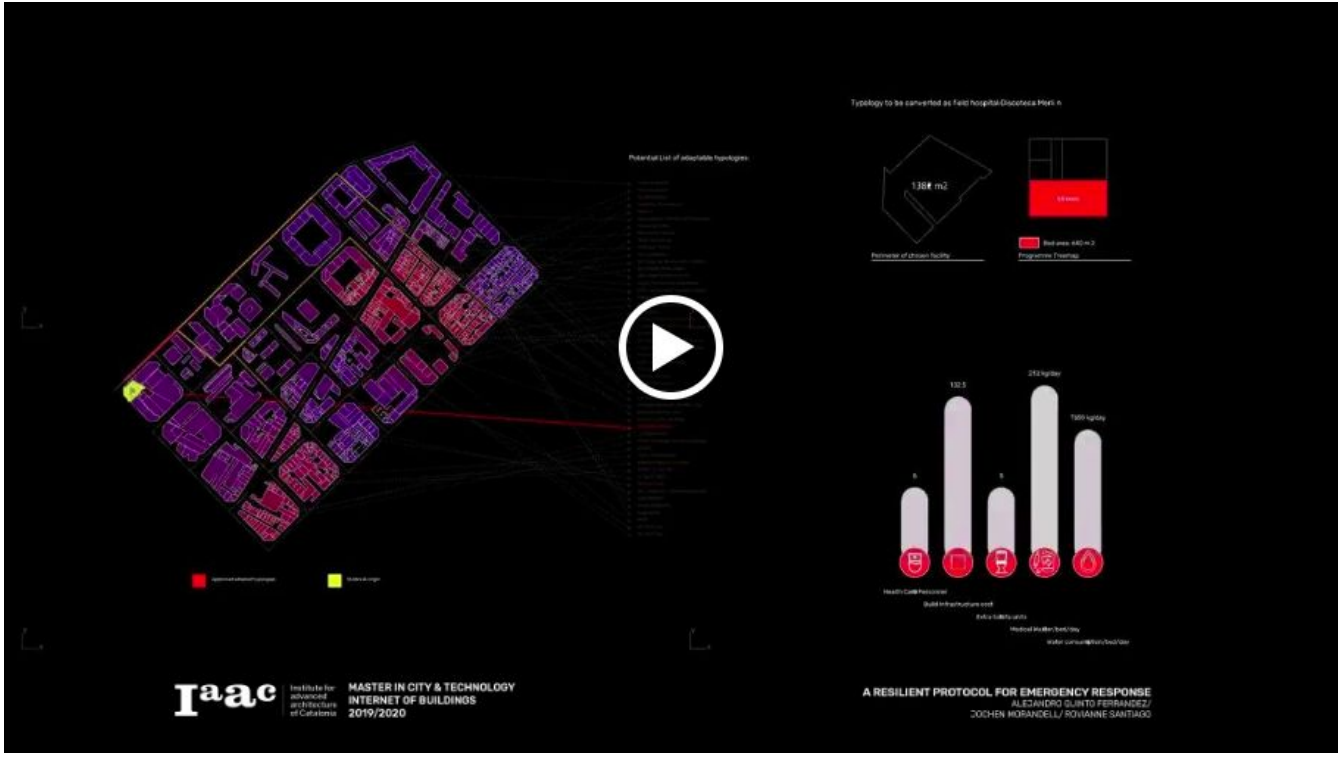
Wow the new typologies would change the existing city-level dataset?



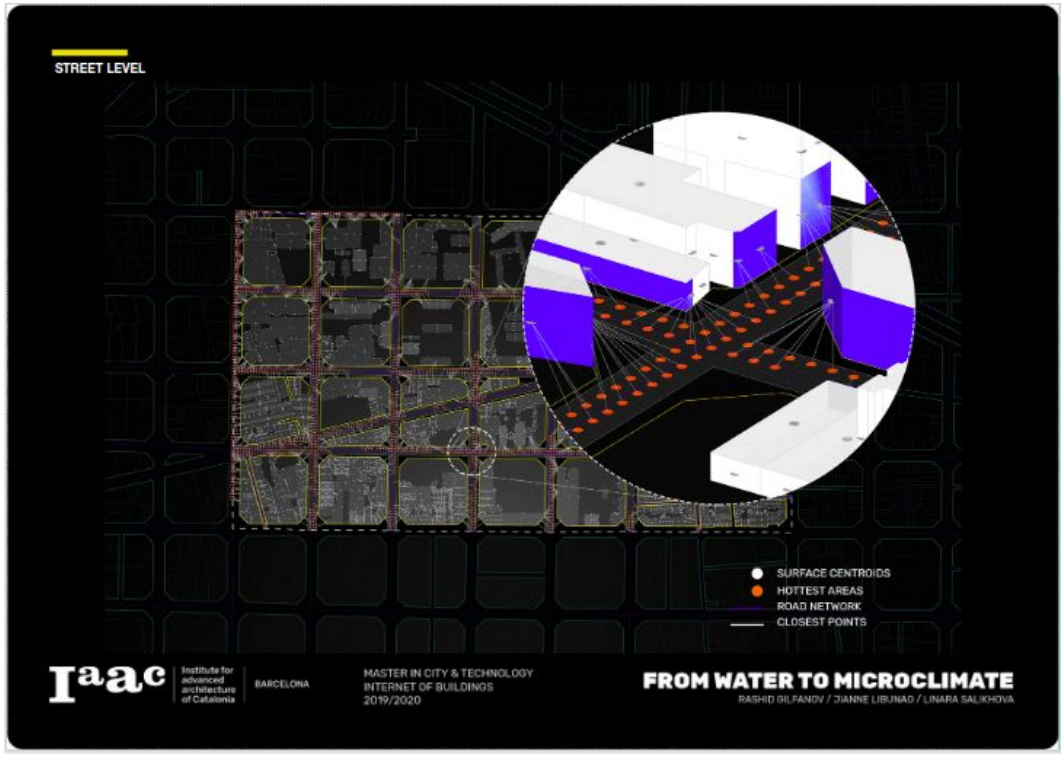
Where to put the new values coming from the proposal?



How to add the selected / proposed areas to the existing city-level dataset?



How the new dataset might be incorporated into the city-level data sources?



Hands-on

Integration of simulation and data analysis

Let’s see what we are thinking

http://etc.ch/nQxA

https://www.directpoll.com/

** This survey is designed only for the live session*

Bringing simulation data into a data analysis framework

1. Select an outcome from your studio project
2. Explore the options to read / import such income into one of the data analysis tools used during the course
3. Evaluate the analysis that might be performed over your simulation dataset
4. Discuss the benefits of integrating simulation and data analysis

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