# Einsatz von KI und Visualisierung für große Datenmengen

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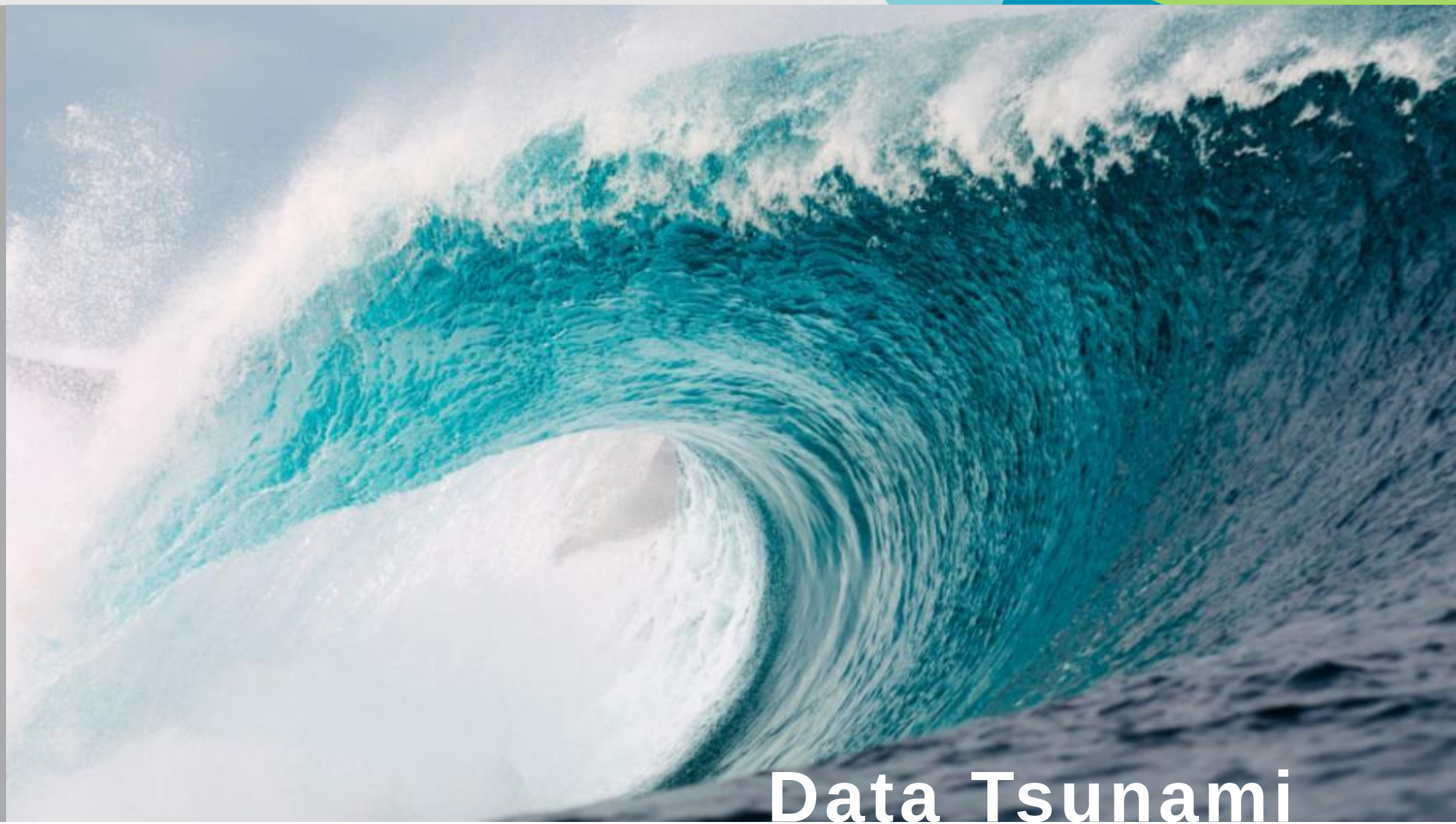




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# Deep Learning Principles



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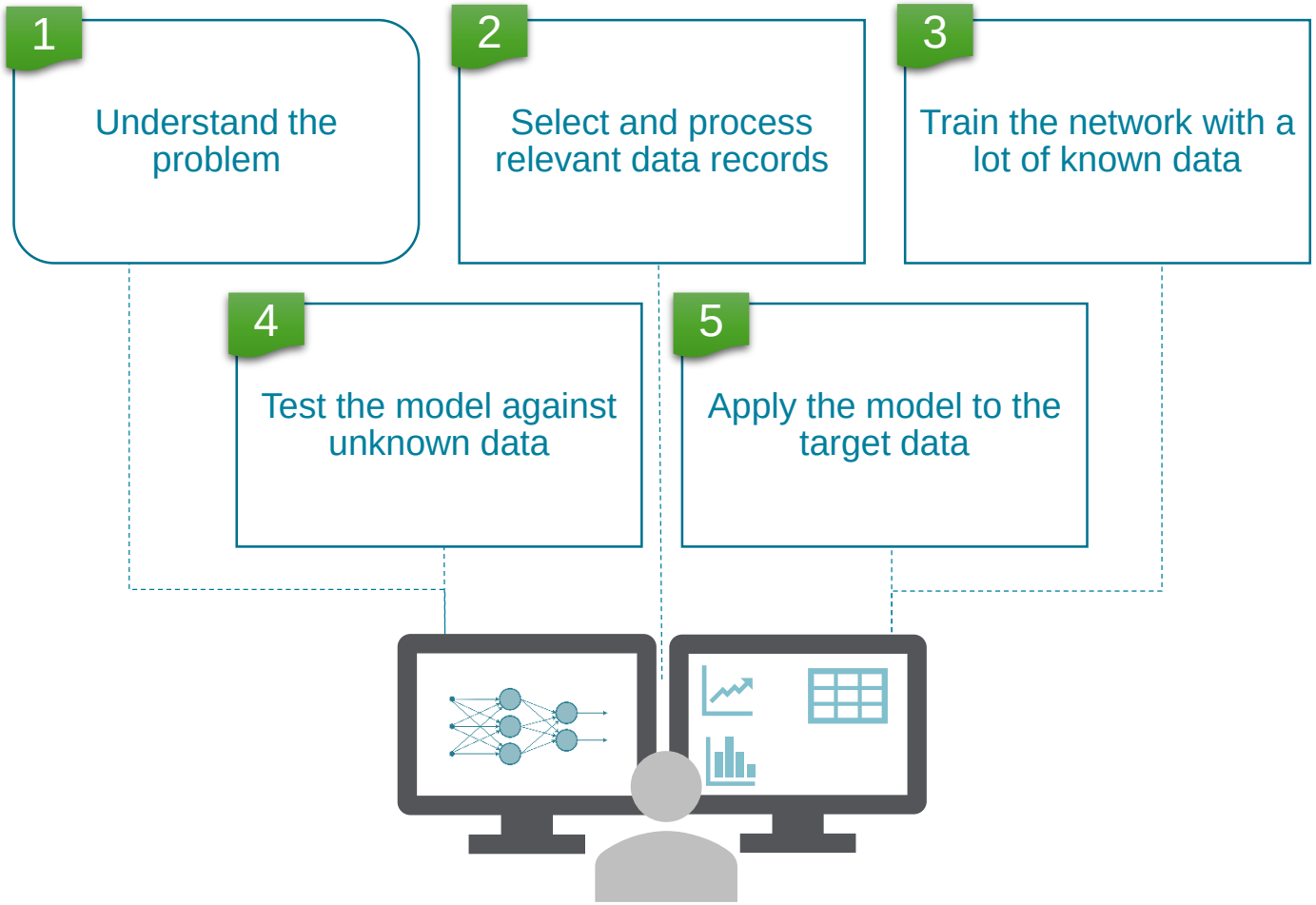
# How does it work?



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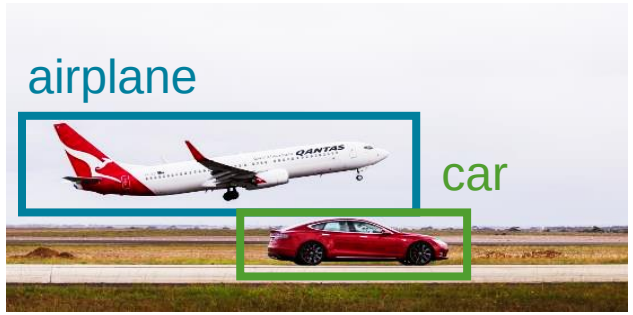
# The Challenge


## Classification

- Input: Image
- Output: Label of the class


## Localization

- Input: Image with known number of objects
- Output:
  - Label of the class
  - Bounding Box




## Object Detection

- Input: Image with unknown number of objects
- Output:
  - Label for each object
  - Bounding box for each object

**Increasing Complexity**



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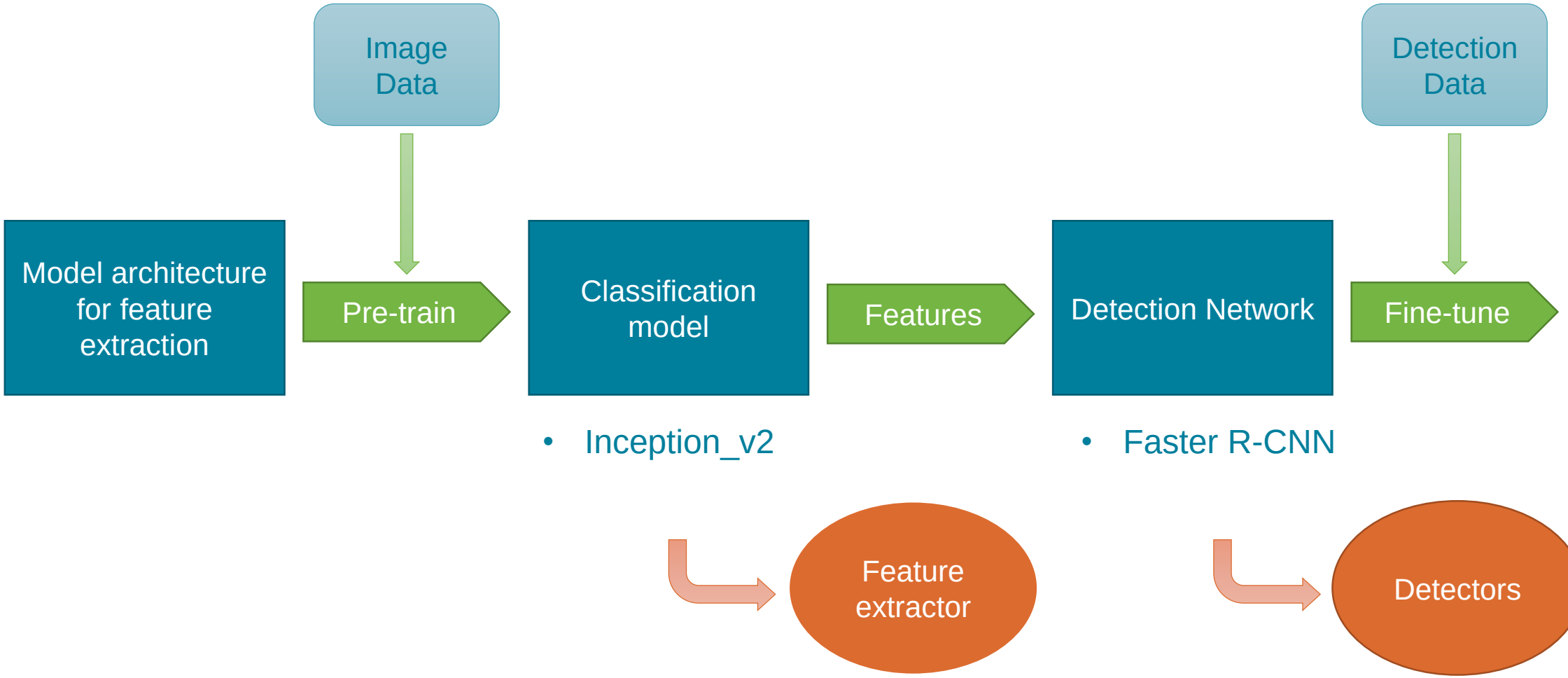
# Components of an object detection model



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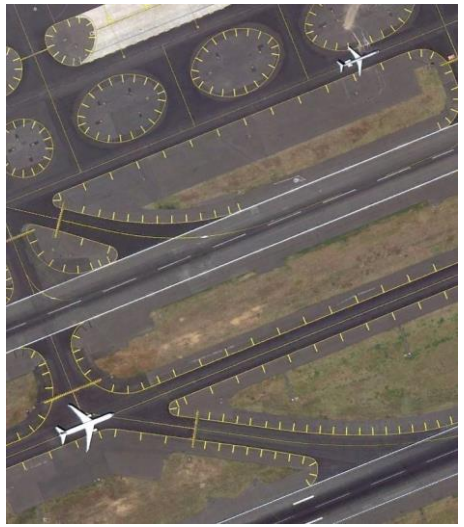
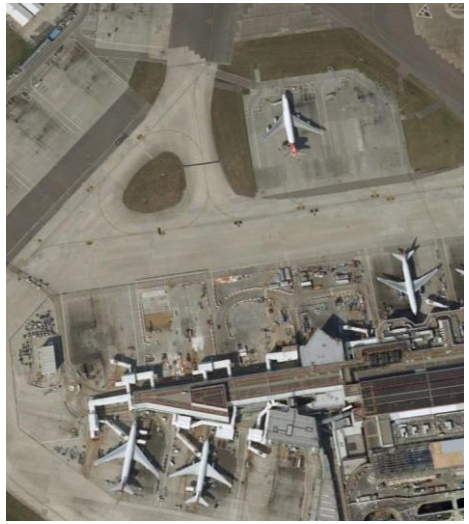

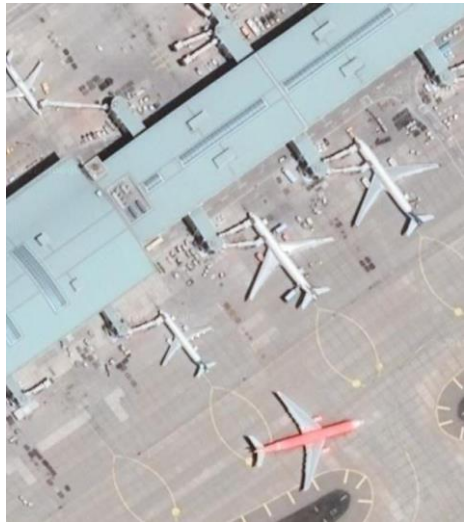

# Choice of data – airplane

- Sufficient amount of training and testing data
- At least 100 images to train a new object class
  - goal of training: feature generalization
  - Various different scenes → differing in backgrounds, arrangements, perspectives
- Consistency in scale, spatial resolution and size of the image



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# Applying Deep Learning Classification for Rail and Light-Rail


**Deep Learning to optimize processes**

- Classify the substrate of the track
- Classify the sleepers
- Based on available still images

- **Classification**
  - Input: Single Image
  - Output: Label of the class
  - Output: link to the linear reference model



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# Classification results – Determine substrate of the track







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# Classification results – Wooden or concrete sleepers?




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# Applying Deep Learning for Object Detection

- Is necessary in images and videos to deal with the huge amount of data
- Deep Learning can undertake the task of ‚simple' actions like counting objects in images or videos
- Those countings can be stored and compared over time
- And turned into monitoring systems with pre-defined KPIs in objects or object type combintations


**Use case: monitoring of an airport**

Raise alert if the amount of e.g. Boeing 777F changes by the number of 10 in comparison to the average number

- Assistance and support of analysts
- Continuous recording of objects of interest in an area of interest



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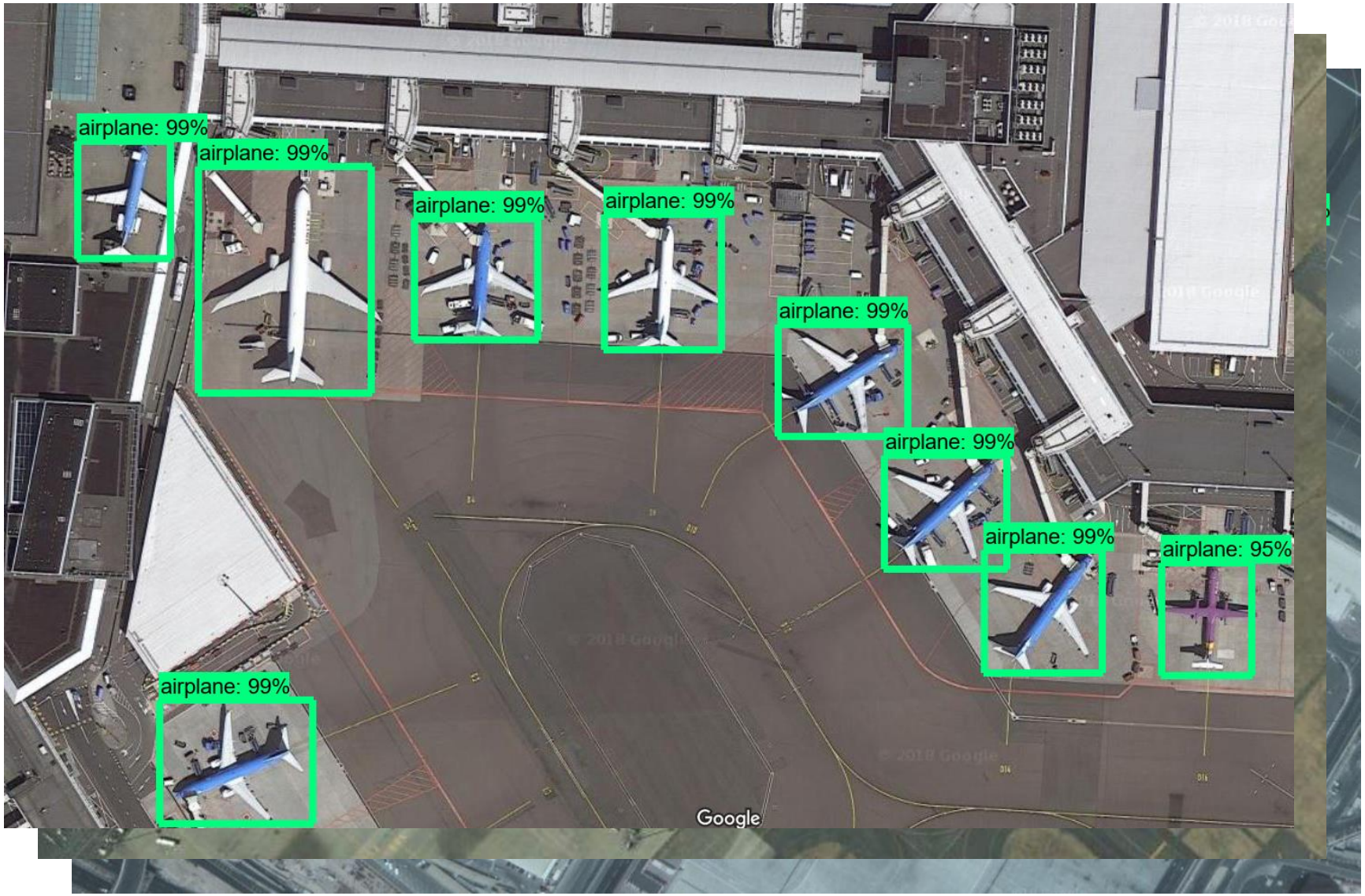
# Results

Object Class:
**Airplane**



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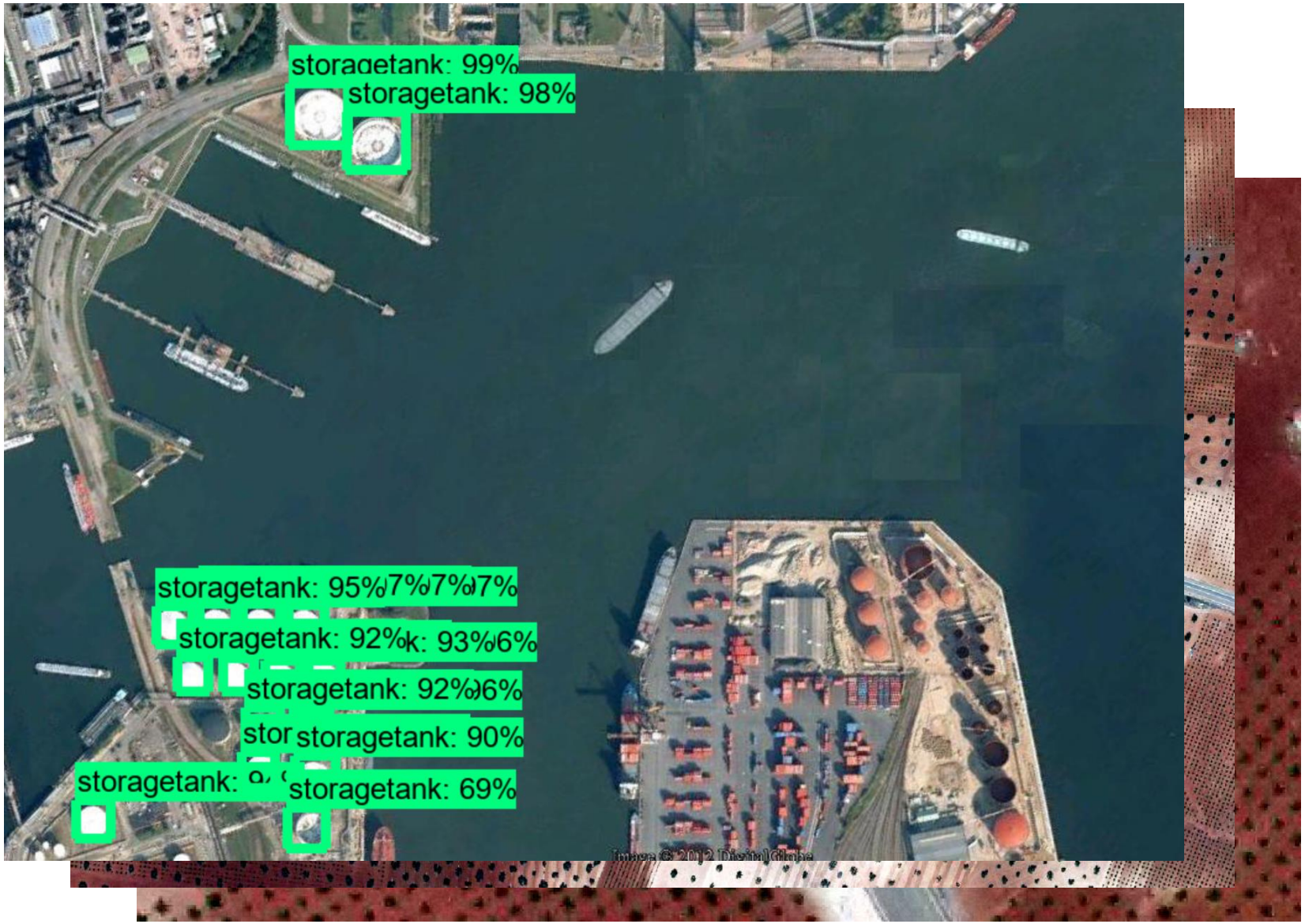
# Results

Object Class:
**Storage Tank**



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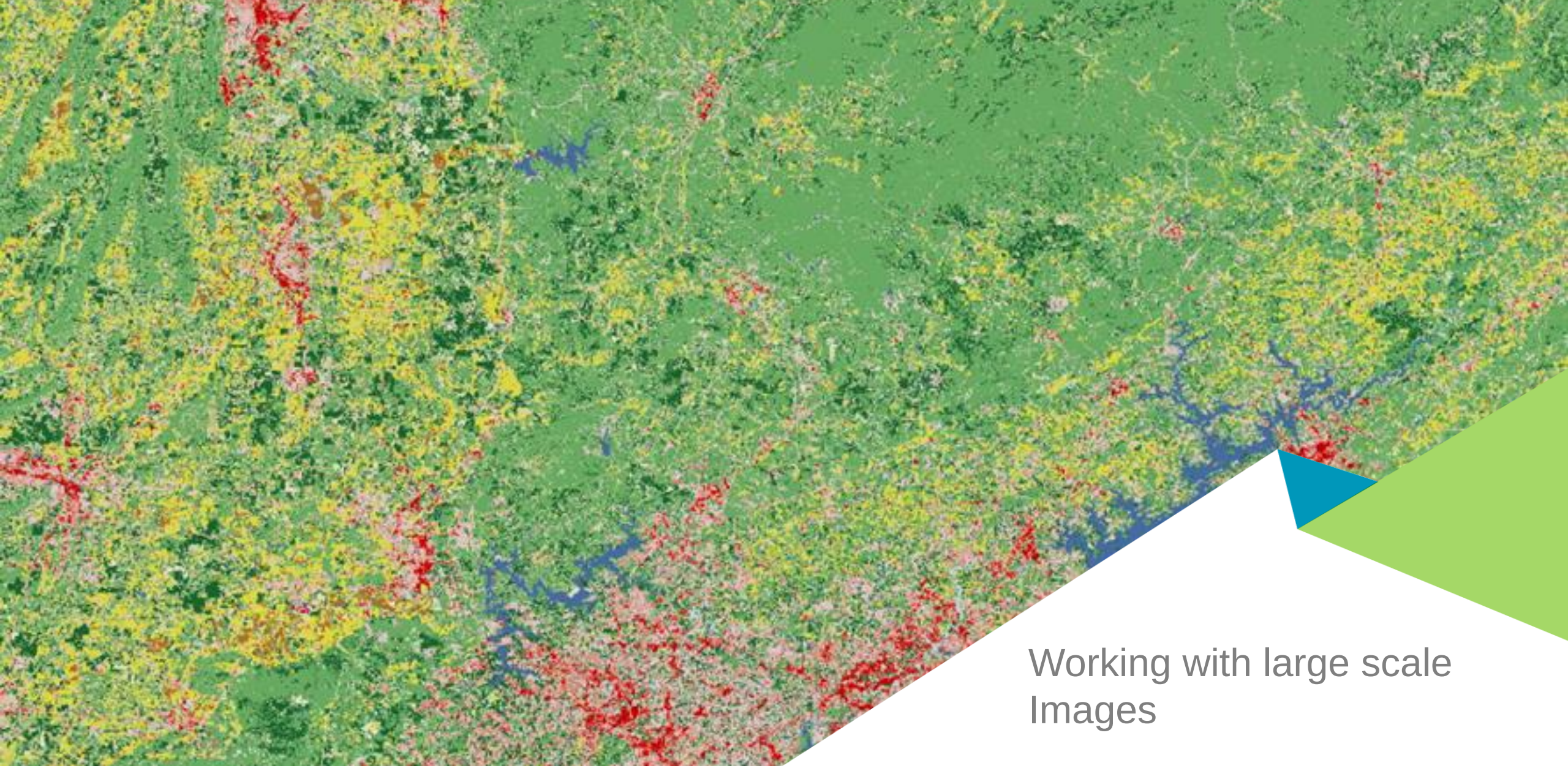

# Working with large scale Images



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# Spatial Modeler


One of the most flexible tools available on the market.
More than 400 functions for raster and vector data processing.



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# Spatial Models Combine

## Pre-Processing

- Pan-Sharpening
- Index calculation
- Dicing
- …

## Processing

- Bulk-load and process raster data and point clouds
- Execute DL operators
- Can be overlaid with other operators

## Post-Processing

- Filtering
- Mosaicking
- Simple output management



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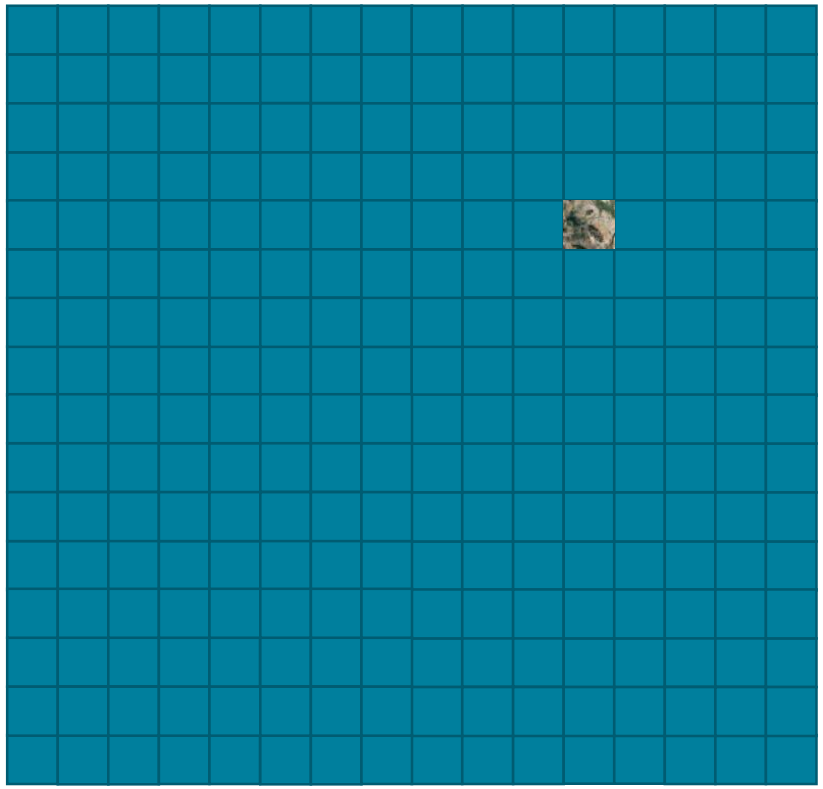
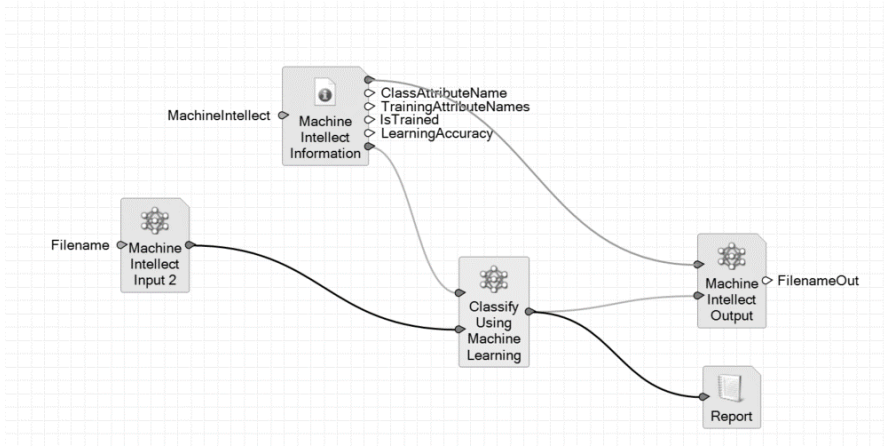
# Spatial Modeler supporting large spatial extent






OUTPUT

Dice the input → Process dices with DL model → Mosaic dices back together



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# Application in ERDAS Imagine





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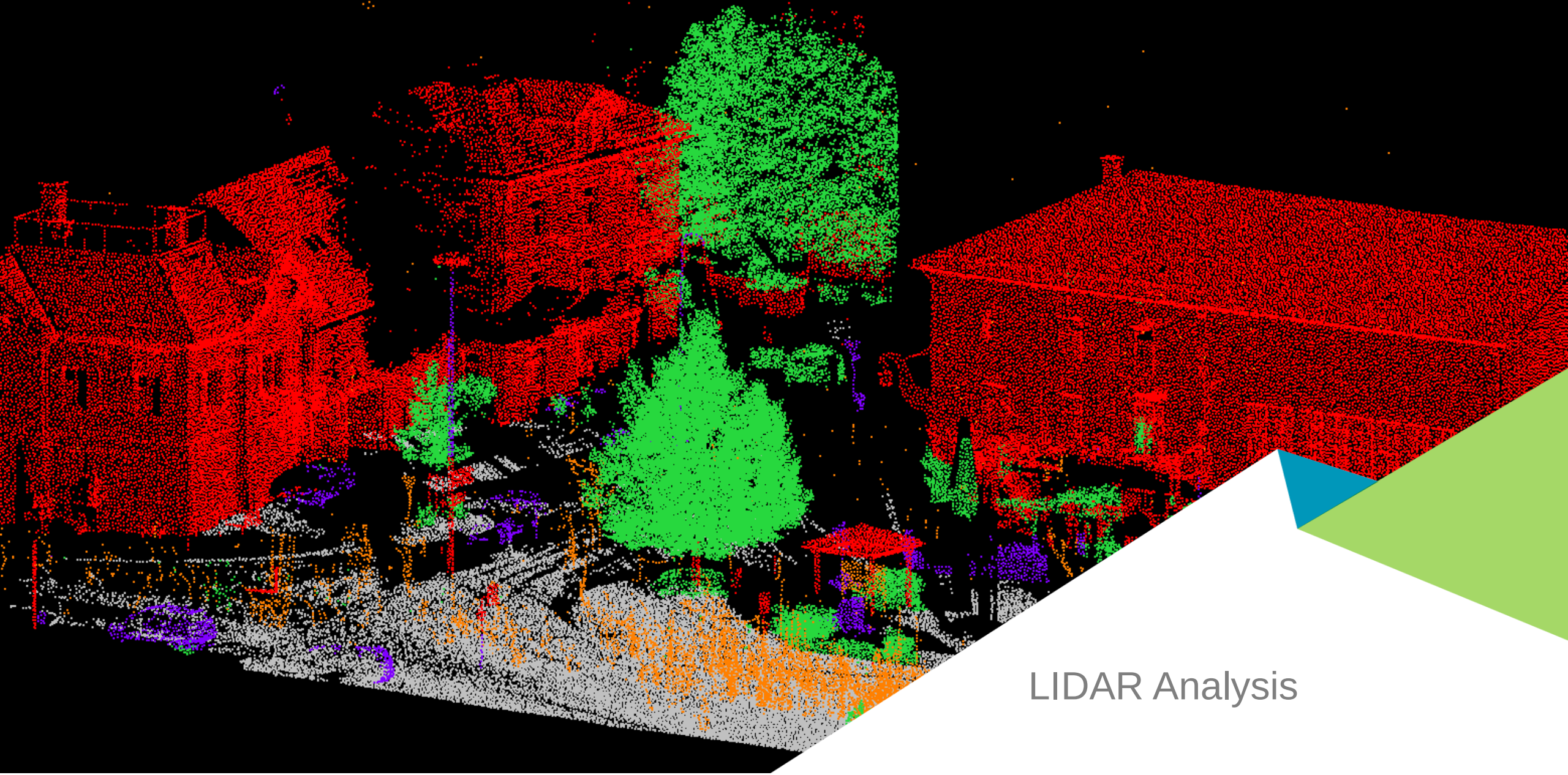

# LIDAR Analysis



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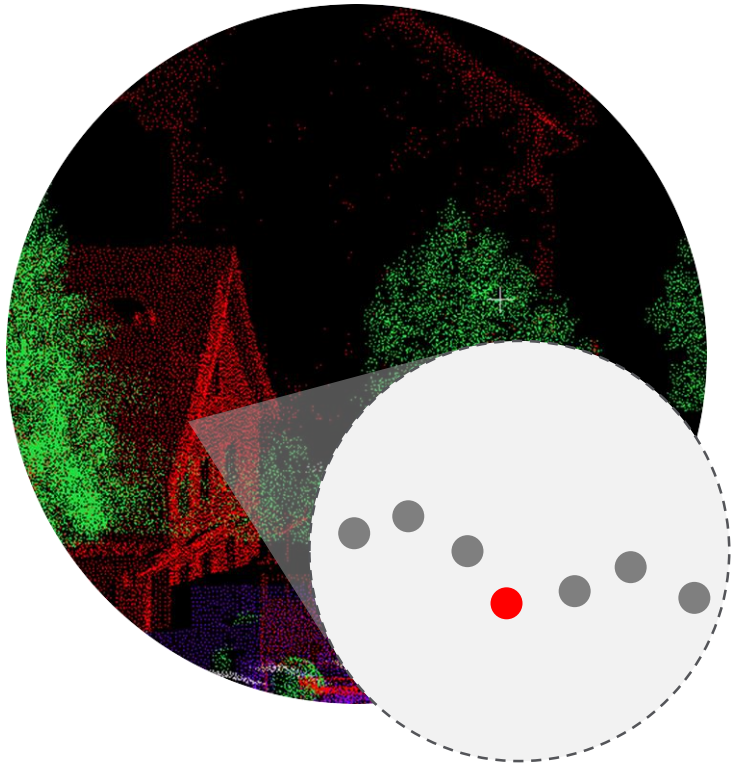
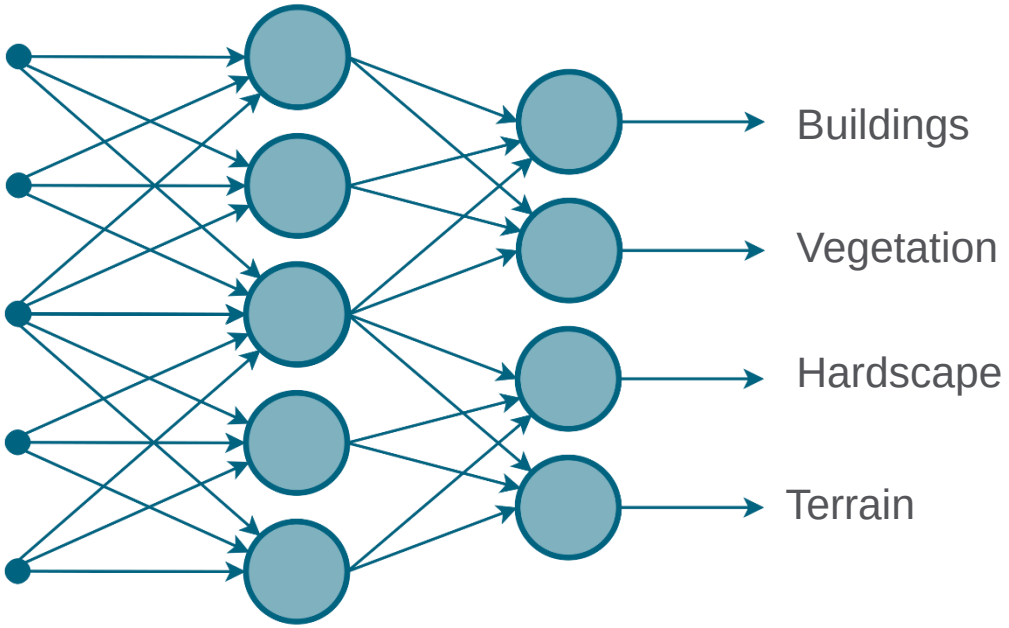
# Point Cloud Classification





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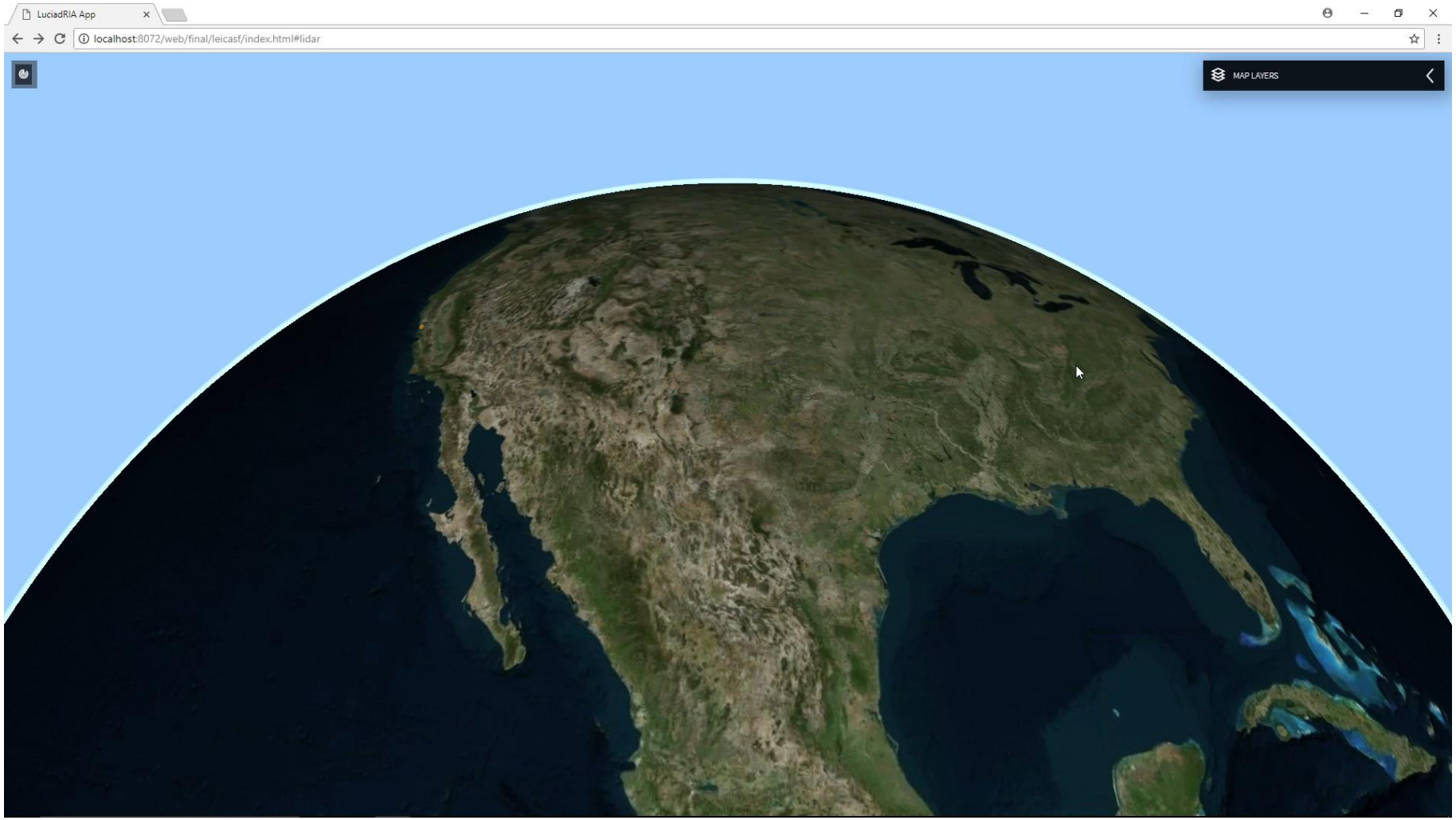
# Dynamic Digital Reality Mesh Point Cloud



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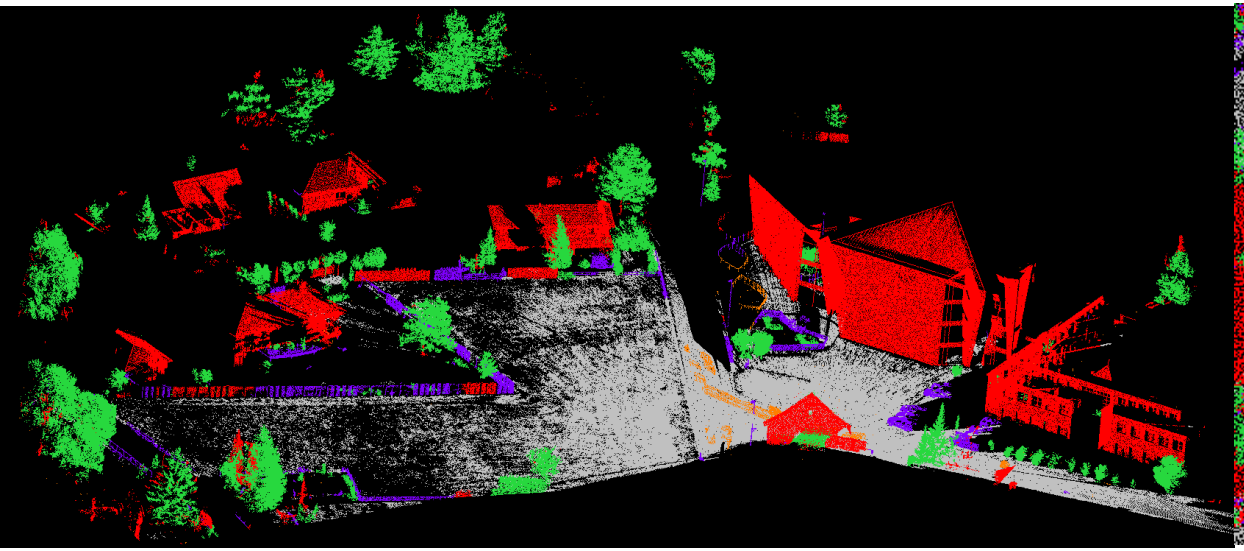
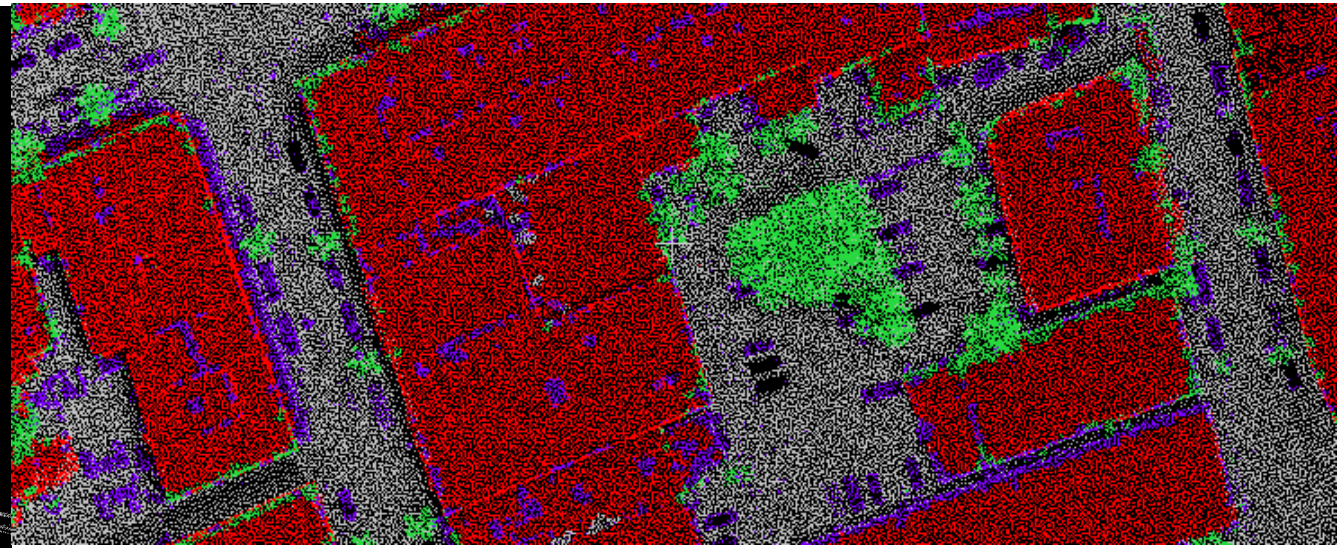
# Starting point: Point Cloud Classification





Automatic classification of point clouds for

- Terrestrial Laser Scanning
- Mobile Mapping
- Airborne Laser Scanning

I.e. assignment of each point to one of a set of predefined classes, e.g. building, vegetation, terrain, etc.



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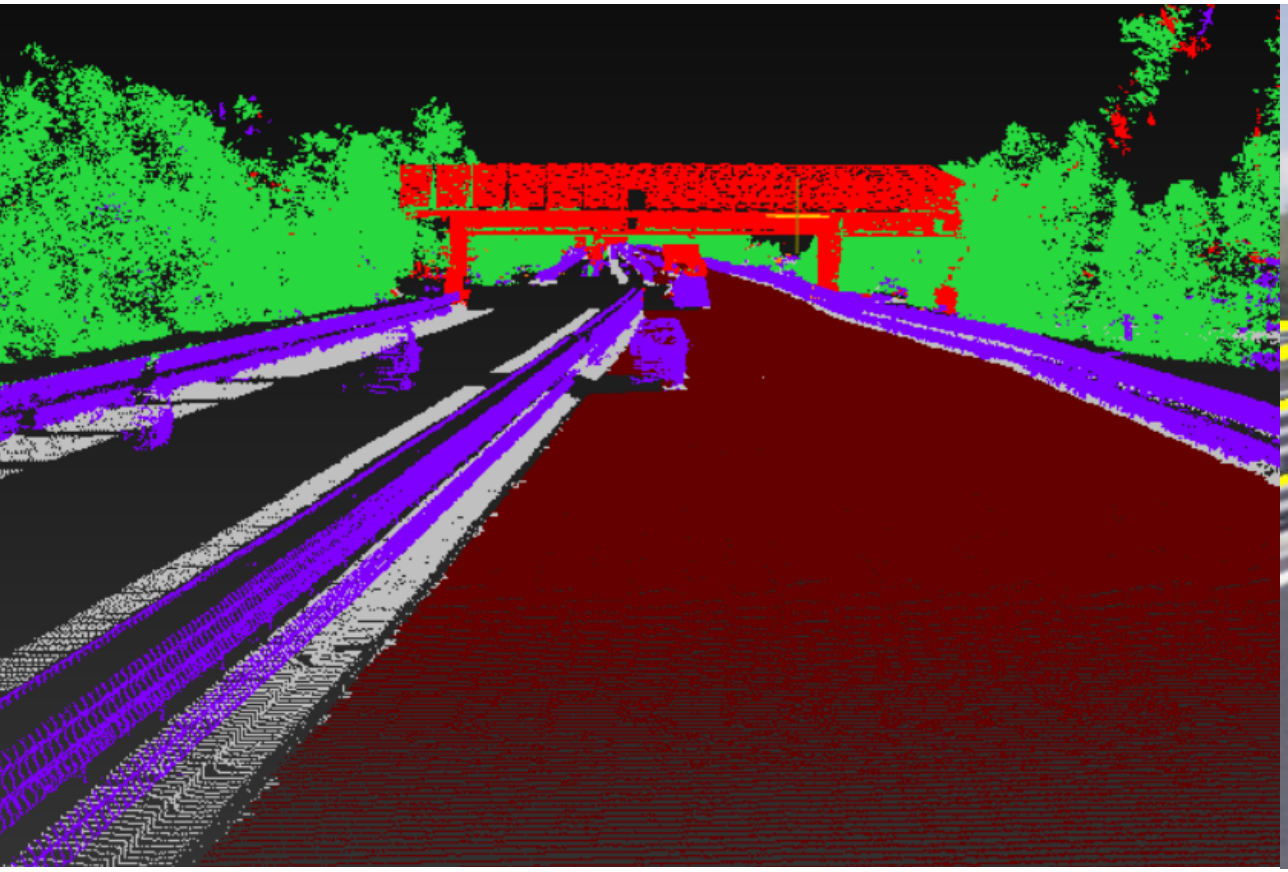
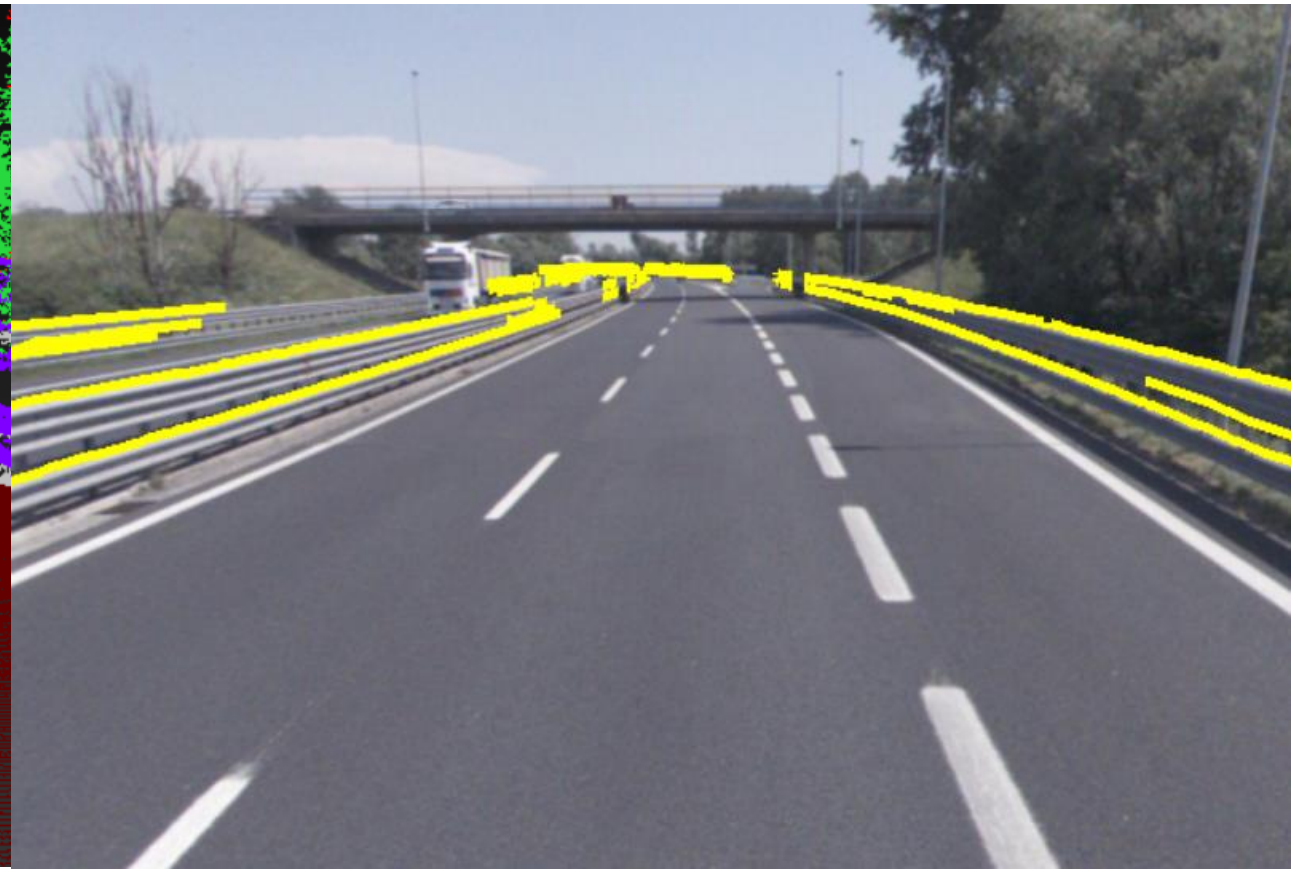
# Work conducted at Hexagon Geosystems







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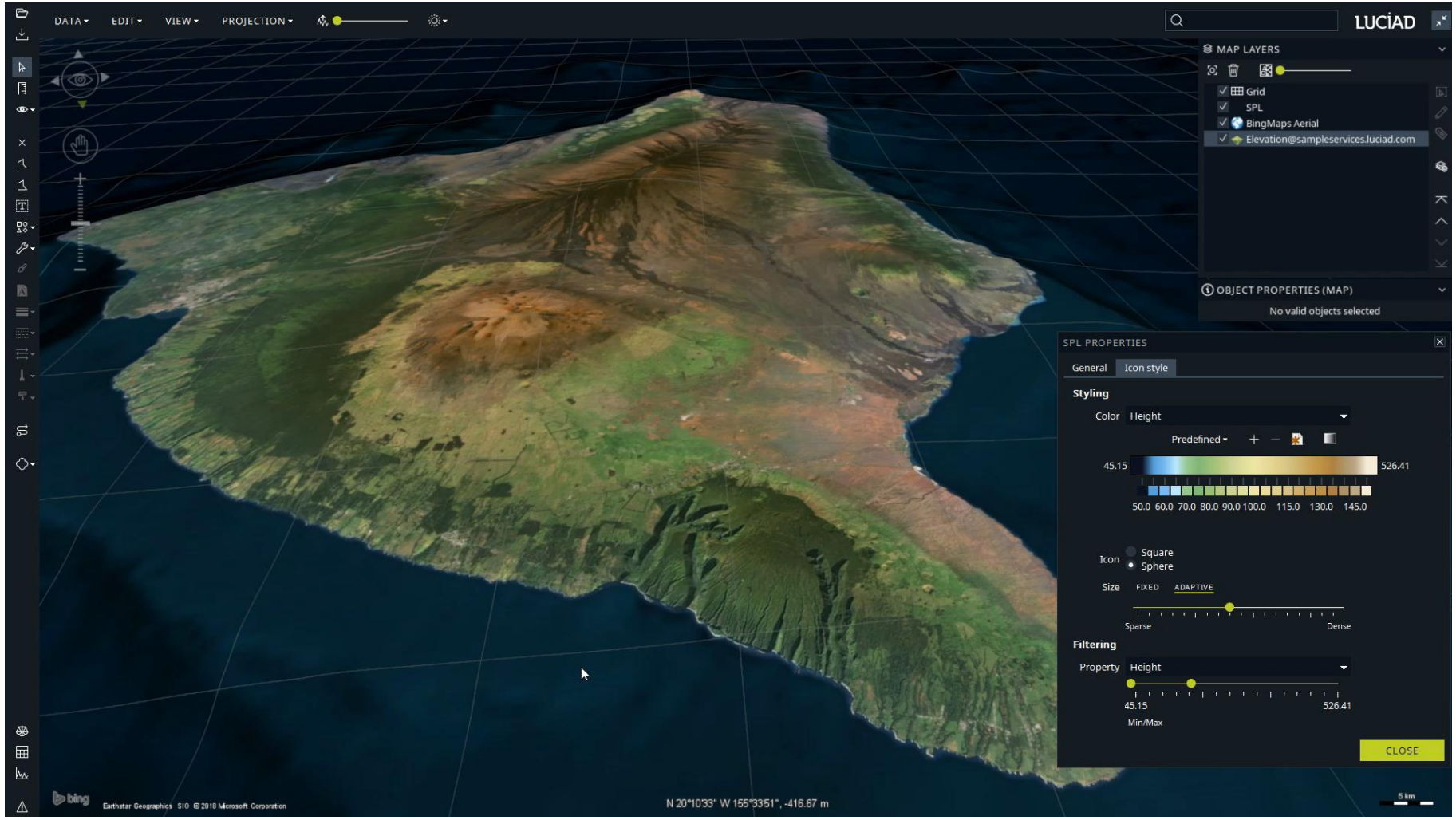
# Detecting and annotating in large datasets



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# Your key take a ways

- Deep Learning mechanisms can be applied in different domains
  - *For regular and large-scale images*
  - *On videos*
  - *For point clouds*
- You can classify areas and objects as well as identify & locate objects
  - *By observing and following certain rules, results could be significantly improved*
  - *Multi-phase approach is sometimes necessary to improve results*
- Interactive, dynamic visualization of large scene’s is possible
  - *Performance boost by GPL processing – even in the web – similar to the boost in DL*
  - *Fusing data sources and technologies (including DL) is the key for generating insights*

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