

# LidarScout

## Direct Out-of-Core Rendering of Massive Point Clouds



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- Data set: CA13 San Simeon
- 18 billion points
- LOD construction: 28m 44s



- Data set: Gisborne+Addendum
- 262 billion points
- LOD construction: 2 days



CA13



28m 44s → 2 seconds

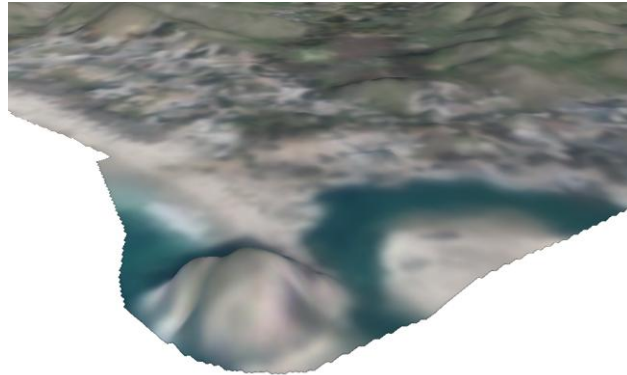
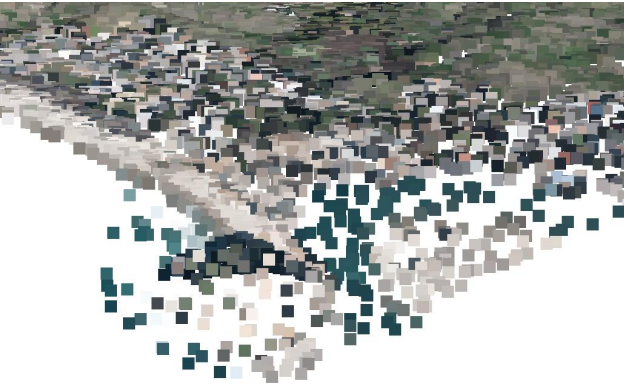
Gisborne+Addendum

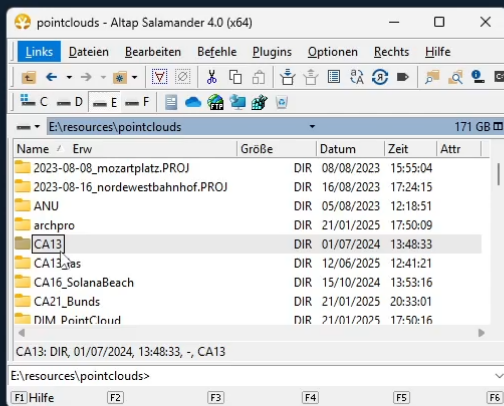


2 days → 35 seconds



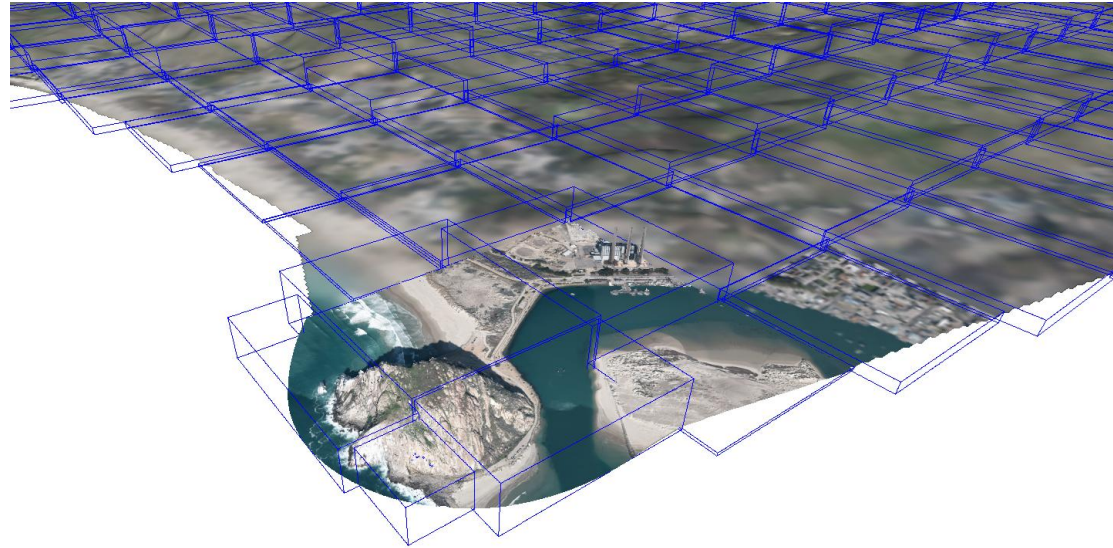
- Direct: No preprocessing; no additional disk space; no LOD
- Overview: Coarsely subsample data from disk
- Heightmap reconstruction
- Full Detail on close-up



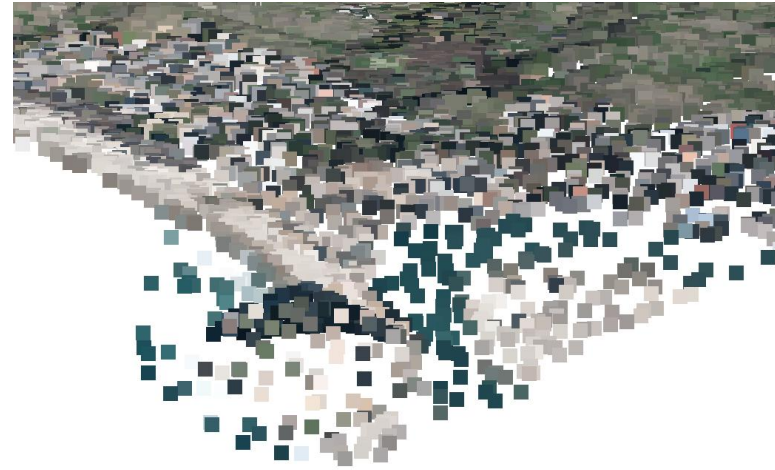




- Apply to industry-standard formats
  - **LAS**: For laser scans
  - **LAZ**: Compressed LAS; widely used
- Both contain AABBs
- AABBs used for finding full-res file on closeup



- LAZ is compressed - what about random access?
- Chunks of 50k points
- Adaptive arithmetic compression
  - First point in chunk is uncompressed!
- CA13      0.3 M accessible
- Gisborne   5.2 M accessible



- Disks optimized for sequential access
- SSDs: Theoretically  $>1\text{M}$  random reads/s  
(We got  $\sim 200\text{k}$ )
- For coarse overview:
  - CA13                    0.3 M random reads
  - Gisborne                5.2 M random reads

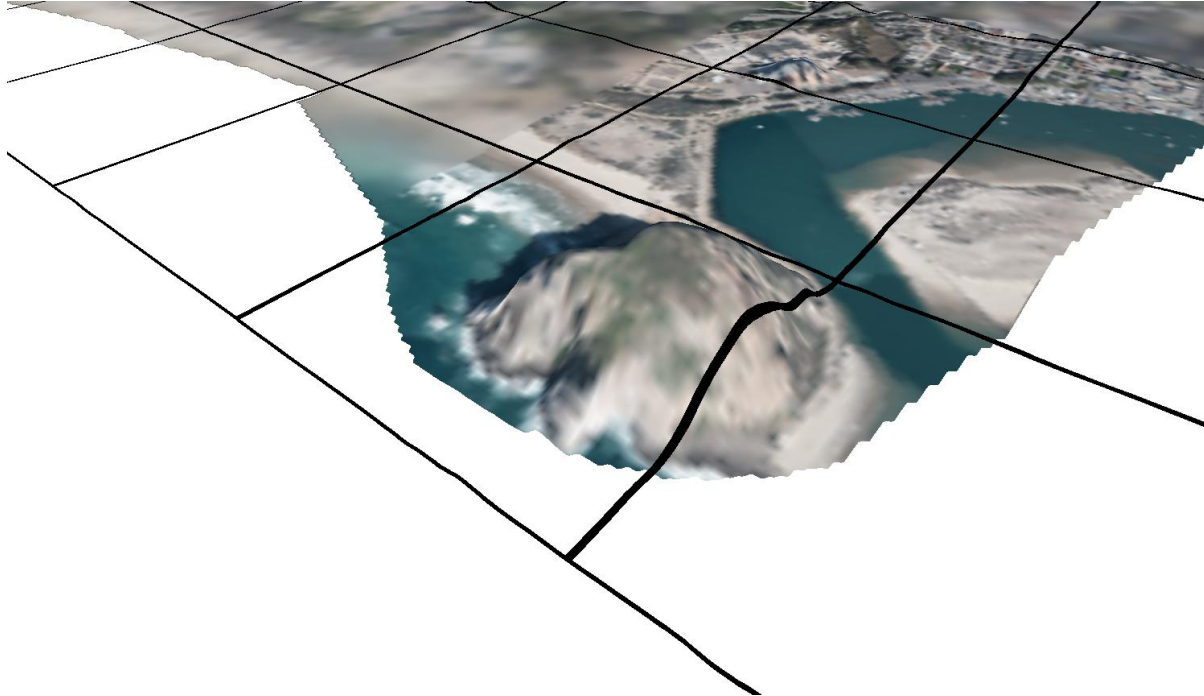


# Heightmap Reconstruction

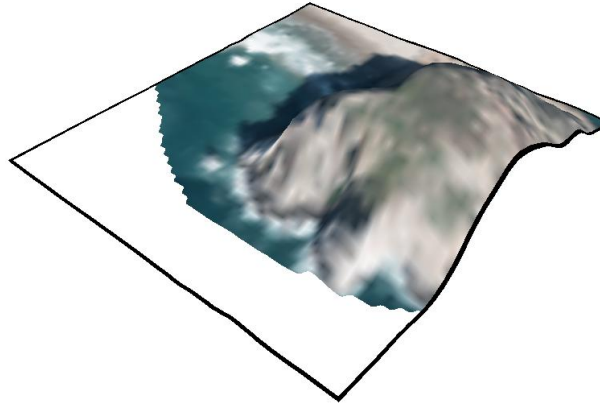
# Heightmaps for Overview



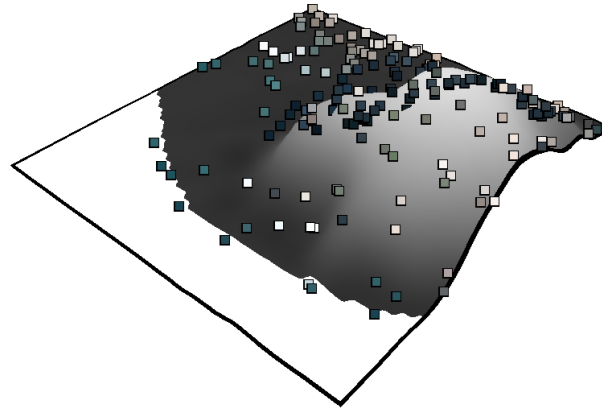
- Heightmap comprises grid of Patches
- Patch: 640 x 640 meter; 64 x 64 pixels



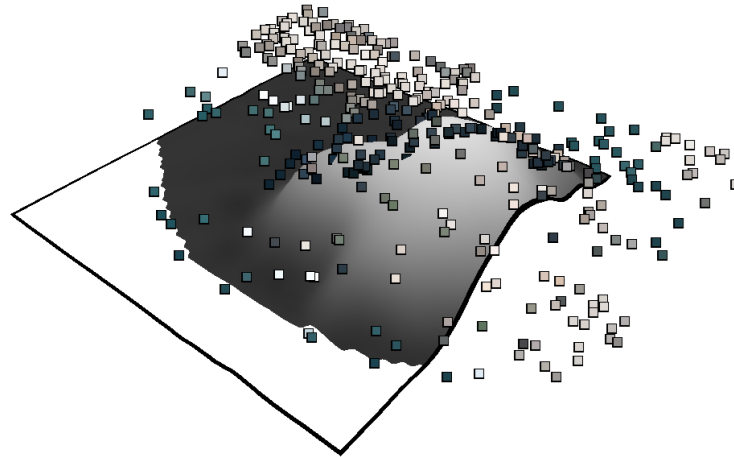
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- Heightmap comprises grid of Patches
- Patch: 640 x 640 meter; 64 x 64 pixels
- Construct from sparse sample in 960 x 960 meter area

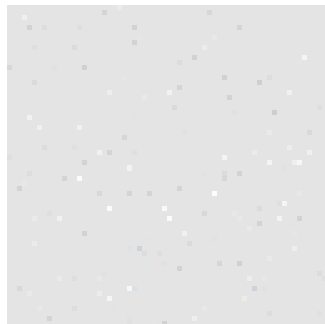


# Patch Heightmaps and Textures

Scan



Chunk Points



Triangulation



Interpolation



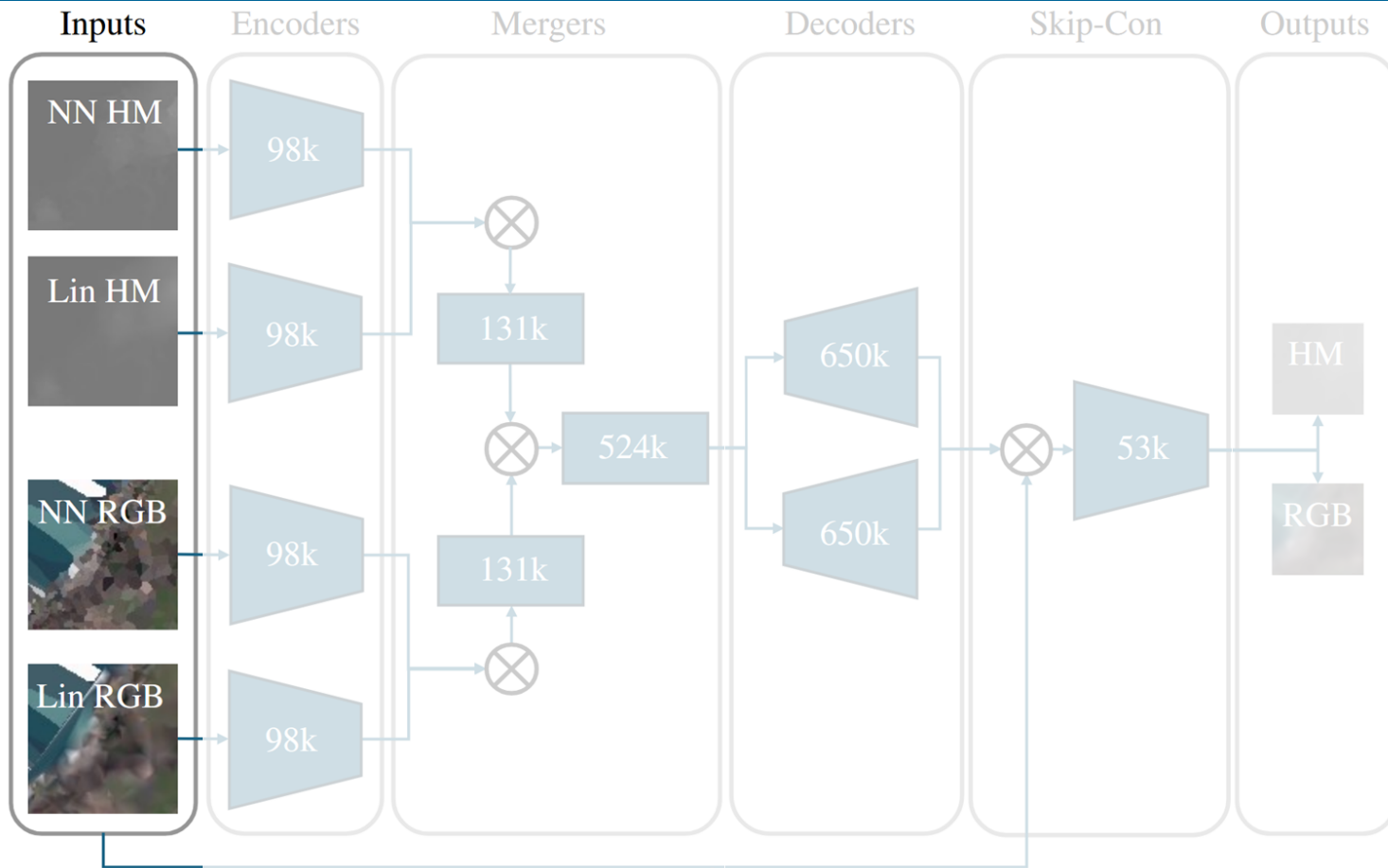
CNN



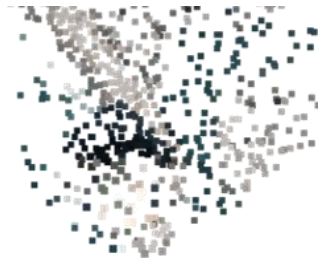
Estimation



# Network Architecture



## Chunk Points



### Linear



### HQSplatting [1]



### LidarScout (ours)



### Cubic



### U-Net (NPBG) [2]



### Scan

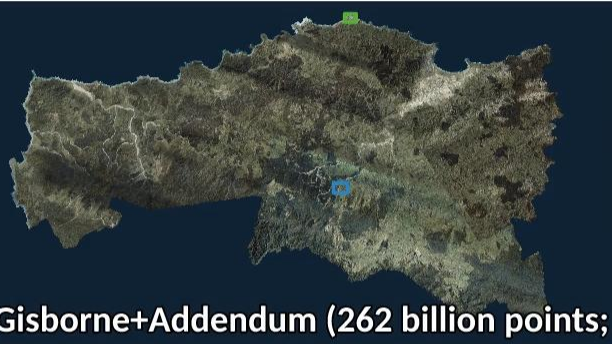


[1]: BOTSCH M., HORNING A., ZWICKER M., KOBBELT L.: High-quality surface splatting on today's gpus. In Proceedings Eurographics/IEEE VGTC Symposium Point-Based Graphics, 2005. (2005), IEEE, pp. 17–141.

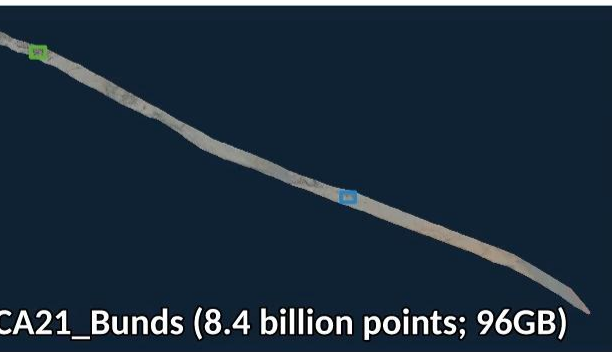
[2]: Aliev, Kara-Ali, et al. "Neural point-based graphics." *Computer Vision—ECCV 2020: 16th European Conference, Glasgow, UK, August 23–28, 2020, Proceedings, Part XXII 16*. Springer International Publishing, 2020.



# LidarScout: Direct Out-of-Core Rendering of Massive Point Clouds (Without Preprocessing or LOD)



Gisborne+Addendum (262 billion points; 2.4 TB)



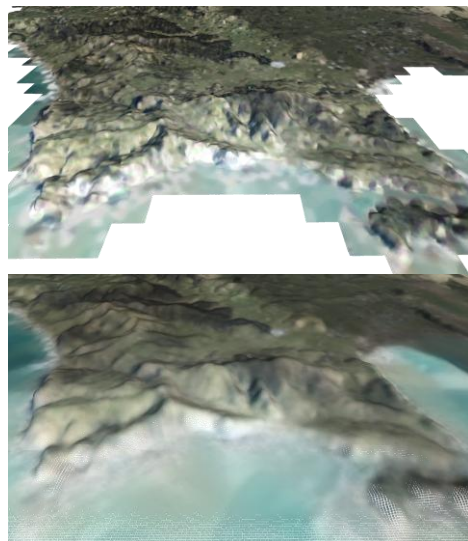
CA21\_Bunds (8.4 billion points; 96GB)



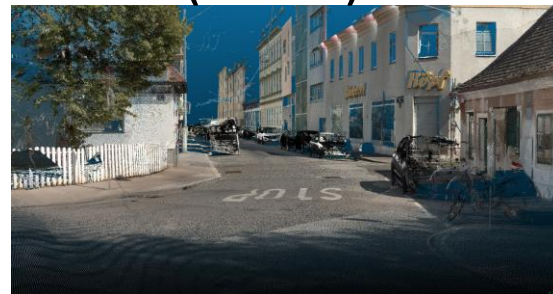
SSD



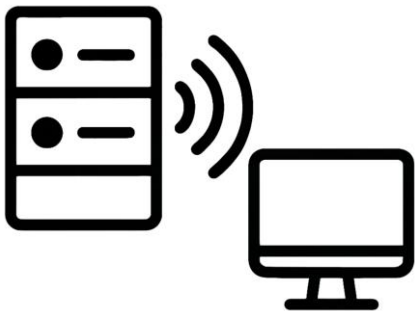
Point cloud density  
patch size 640m



2.5D (heightmap)  
-> 3D (mesh)



Stream from server



Generative models



# Thank you for your attention

<https://github.com/cg-tuwien/lidarscout>

