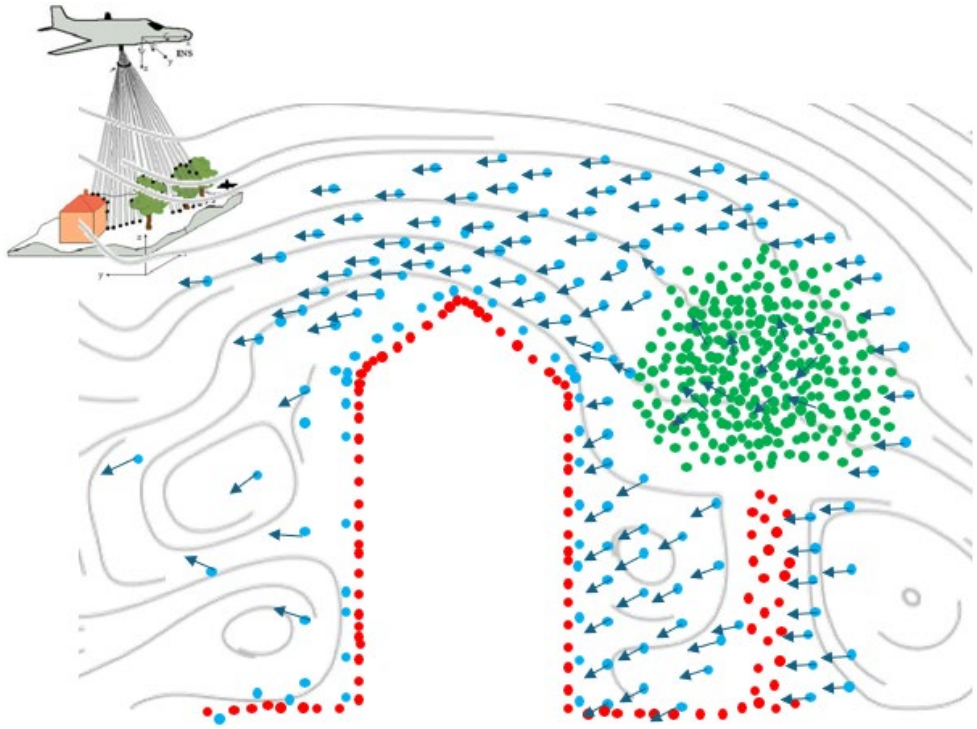
POINT-TWINS: Point clOud-based dynamIc coNTinuous-scale adapTive urban WINd Simulation



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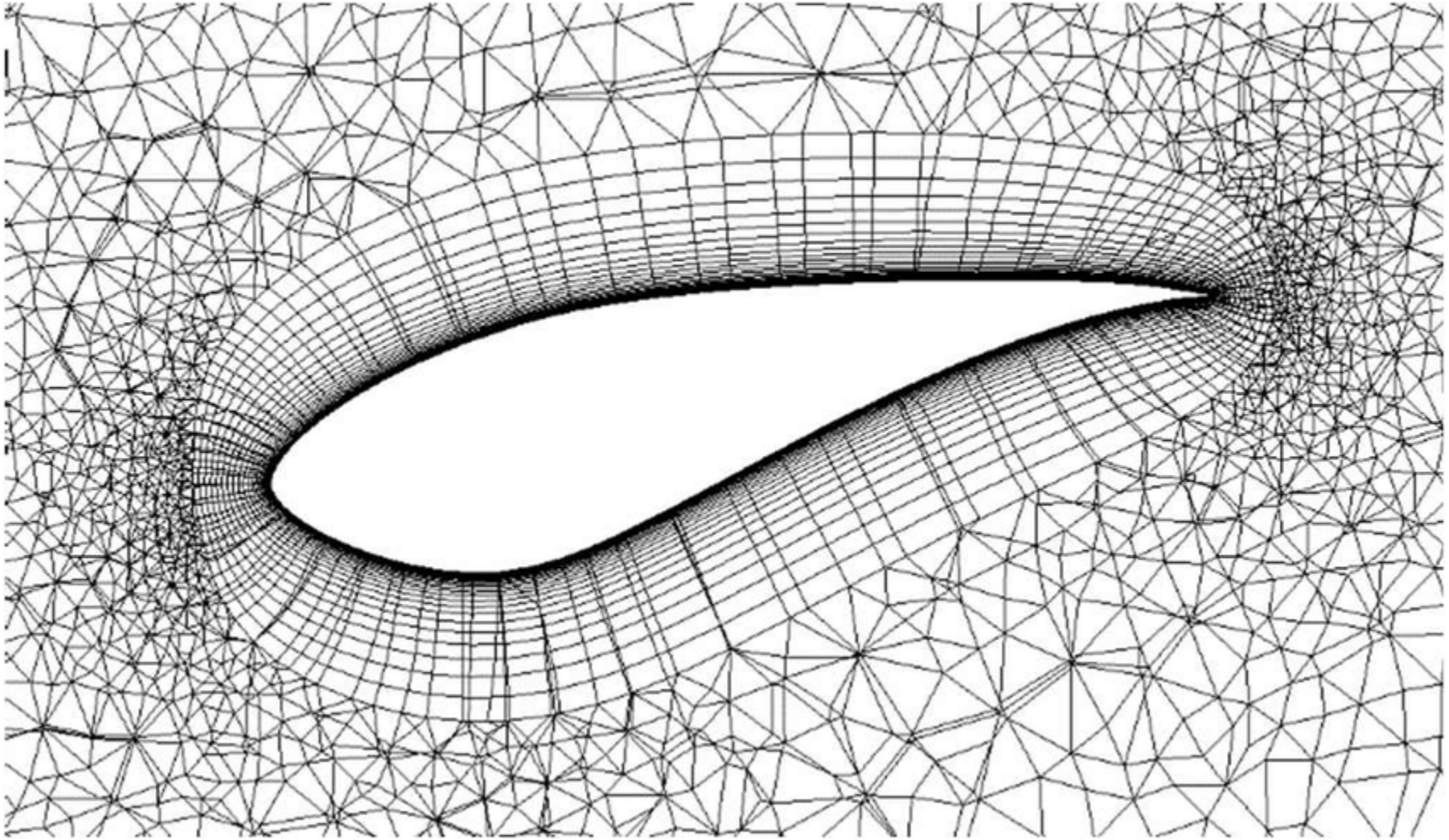
Mesh-based fluid dynamics simulation



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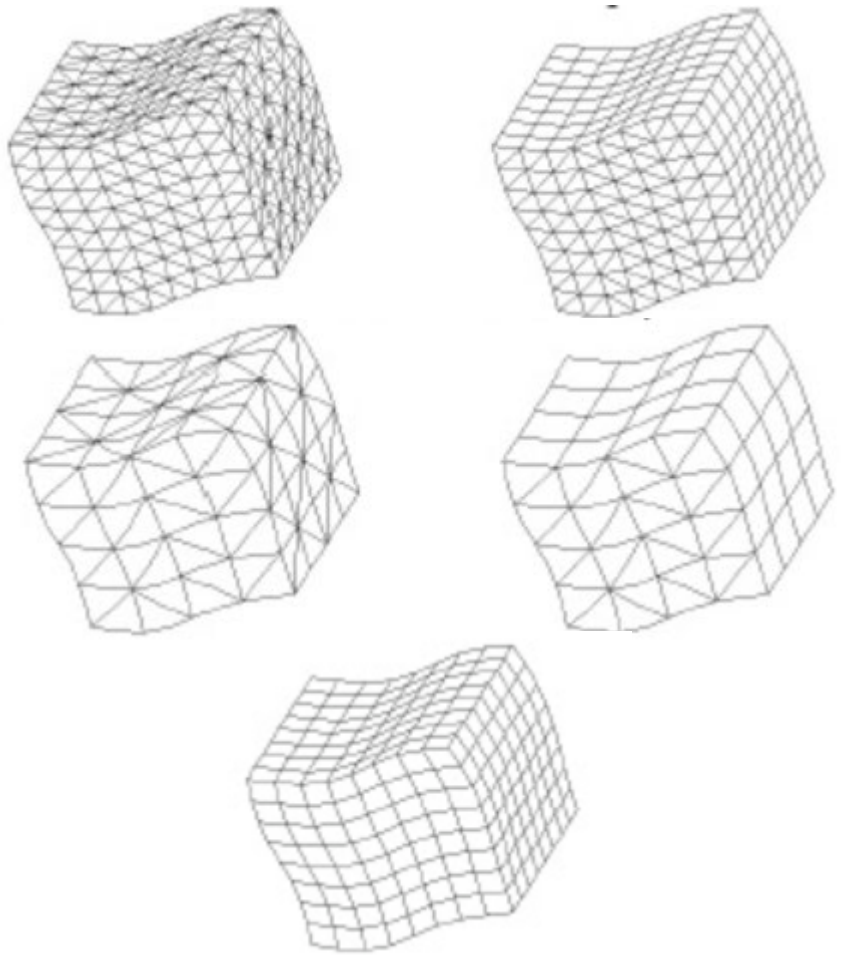
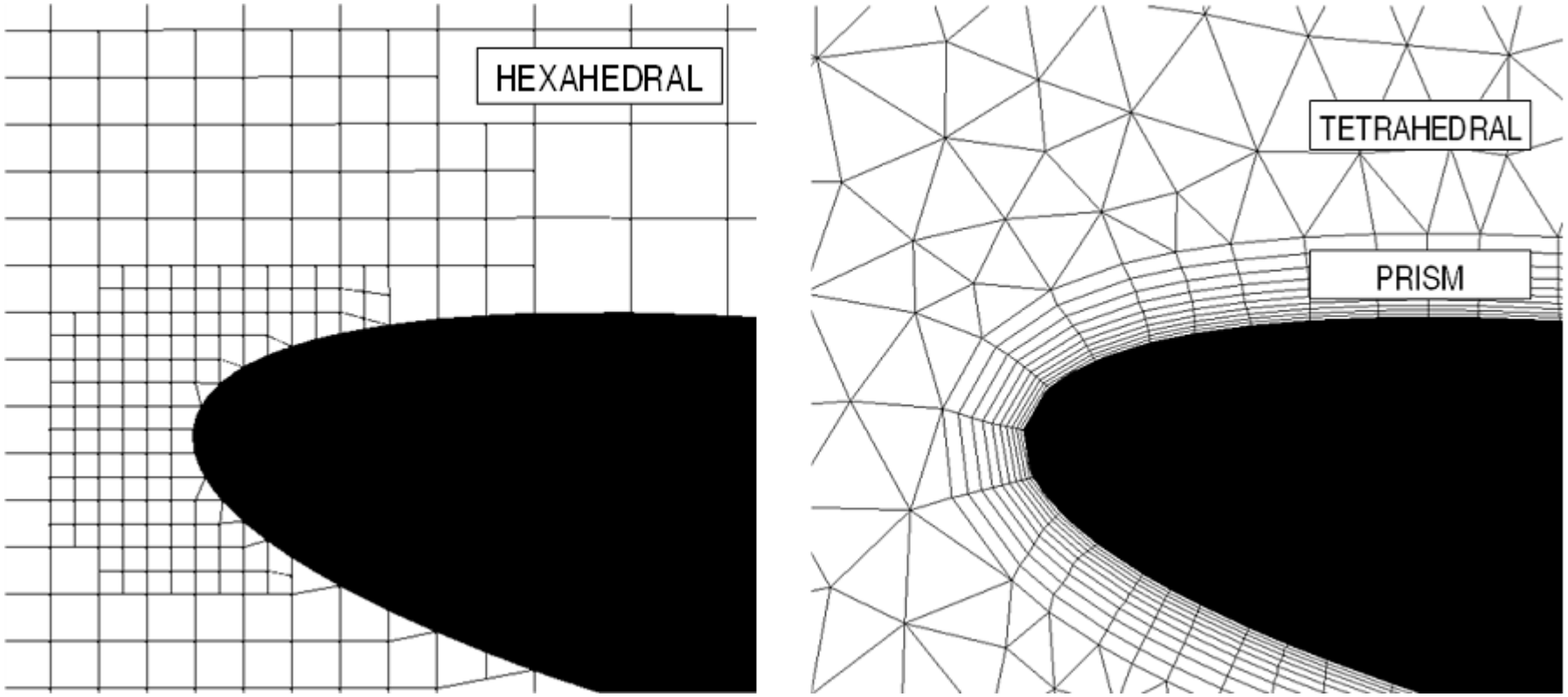
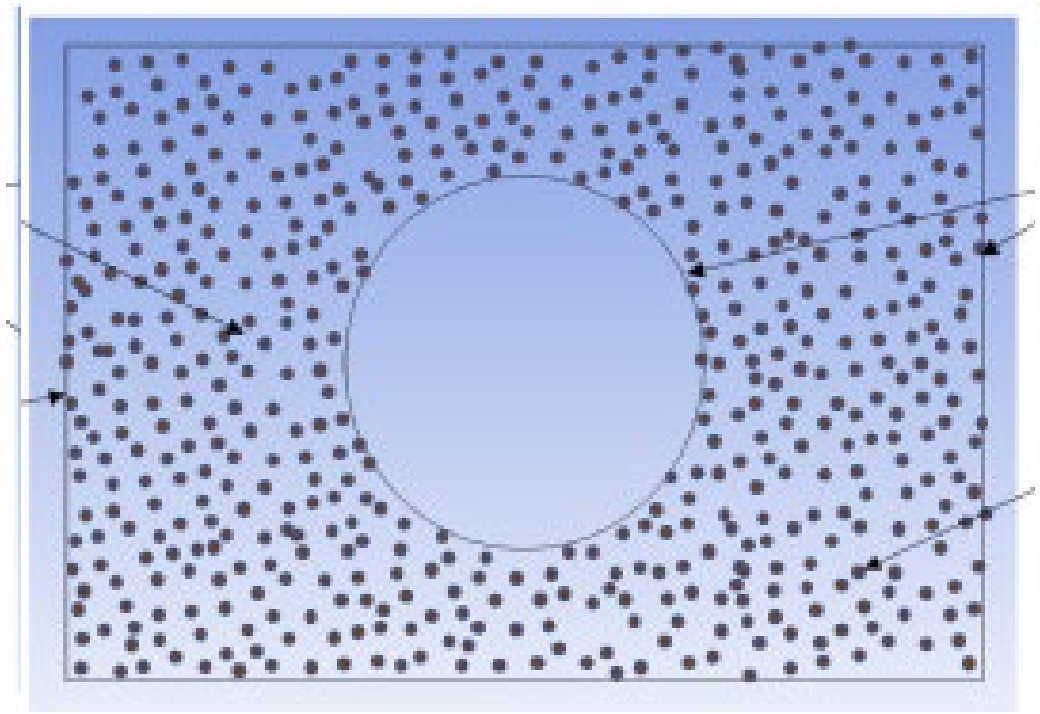
Difference in mesh generation



Difference in mesh generation

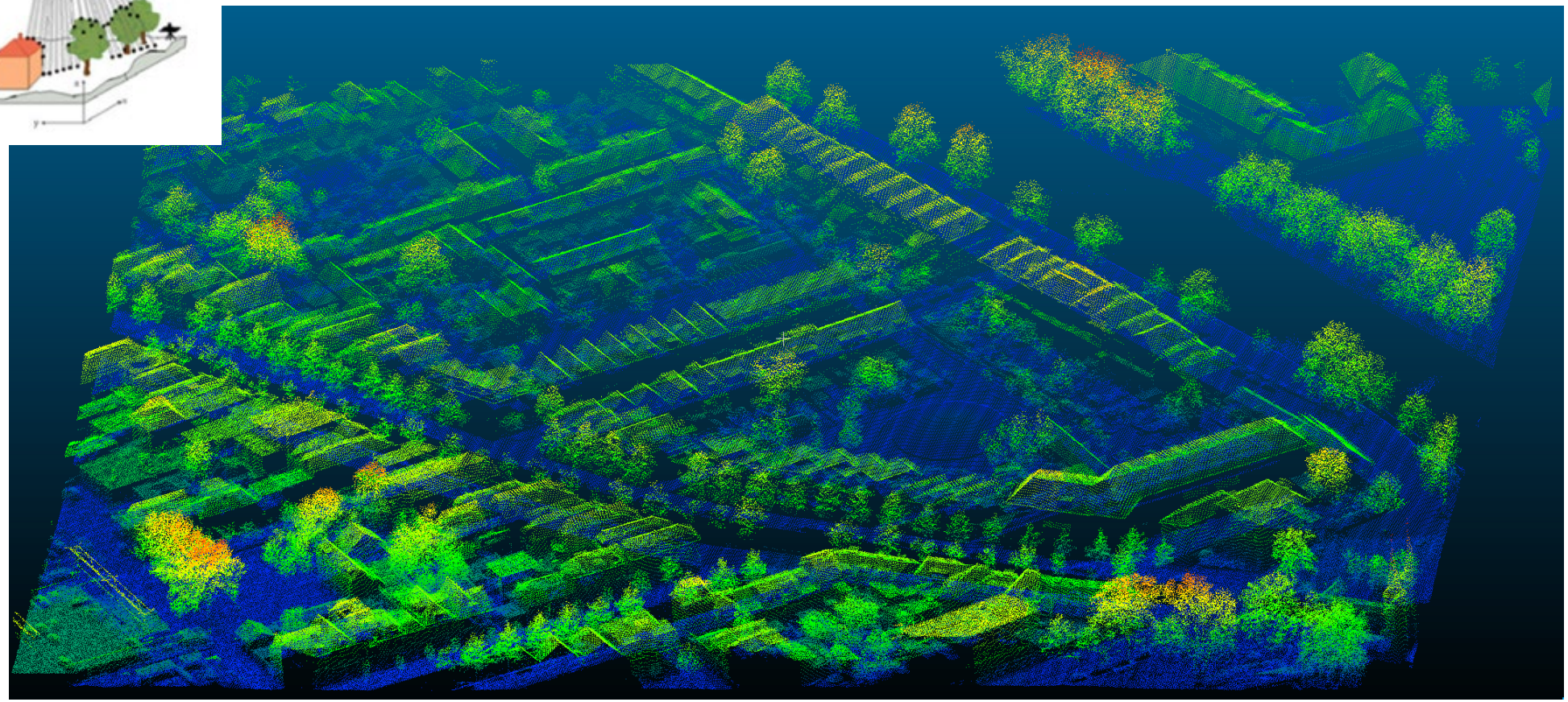


Meshfree instead of mesh-based

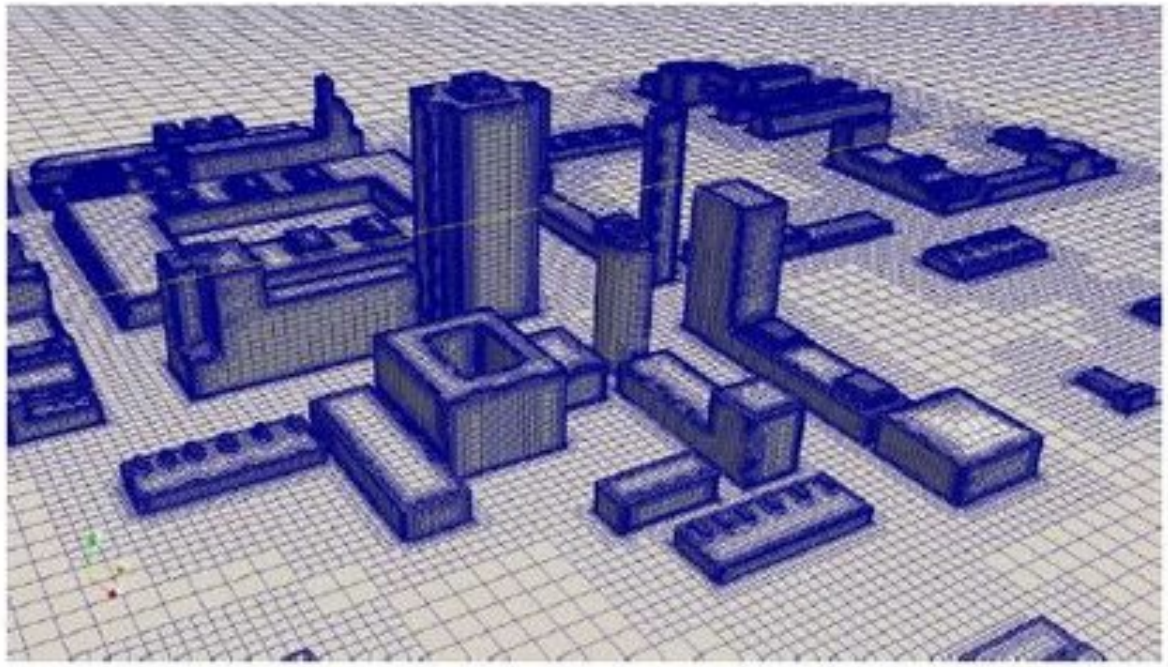


Source: Mazhar, Farrukh, et al. "On the meshfree particle methods for fluid-structure interaction problems." Engineering Analysis with Boundary Elements 124 (2021): 14-40.

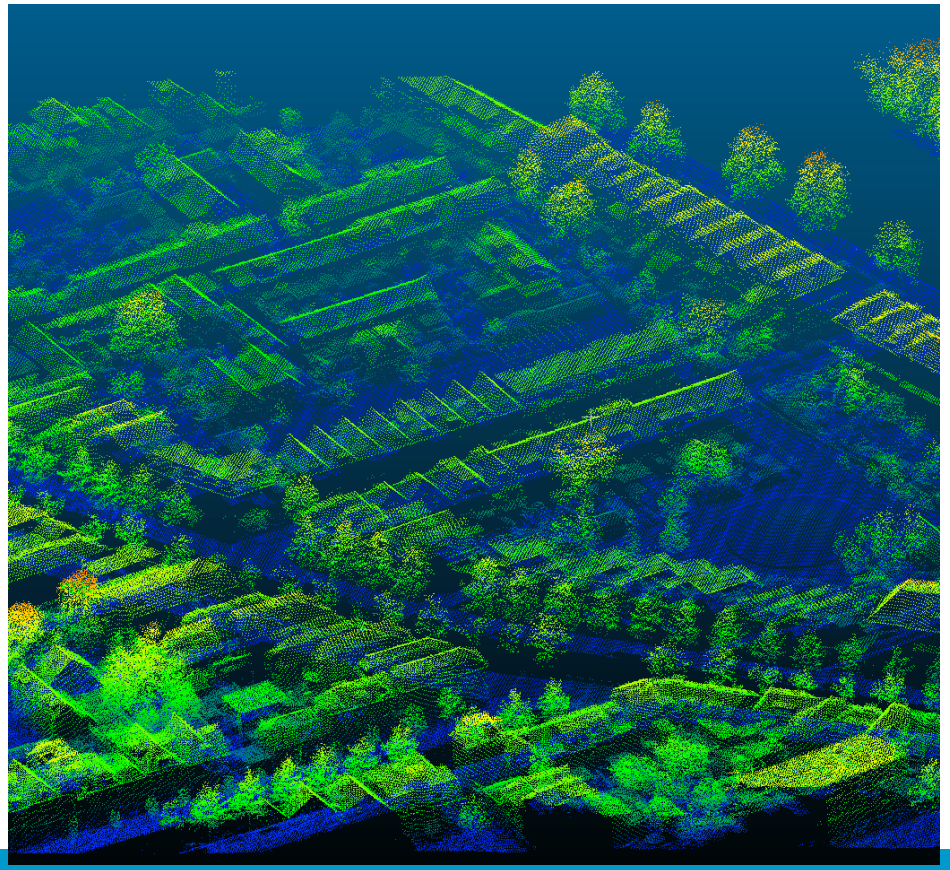
Airborne LiDAR Point Cloud



Wind simulation on original point cloud instead of fitted meshes

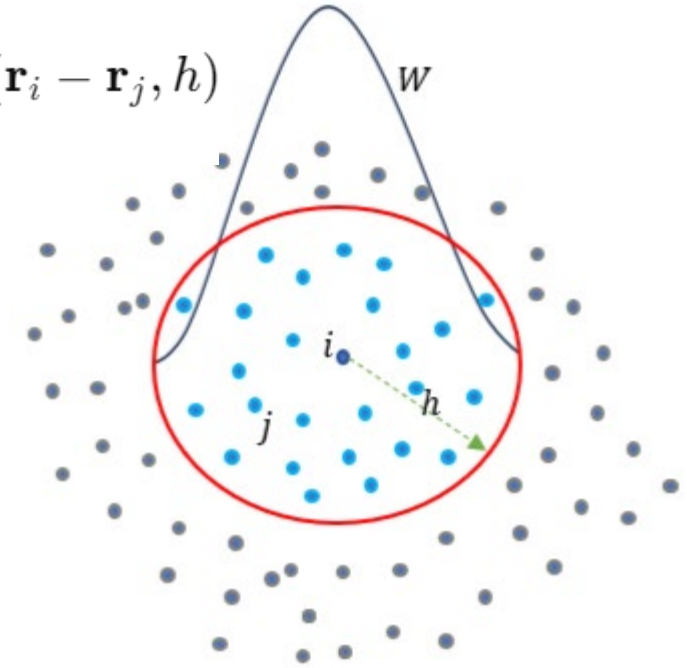


Source: Mohammed, S. A., & Abdullah, S. A. (2018). Aerodynamic simulation of windflow aroundurban regionsusing different turbulence modeling approaches. Journal of Garmian University, 5(2), 115-125.



Meshfree simulation

$$\rho_i = \sum_j m_j W(\mathbf{r}_i - \mathbf{r}_j, h)$$



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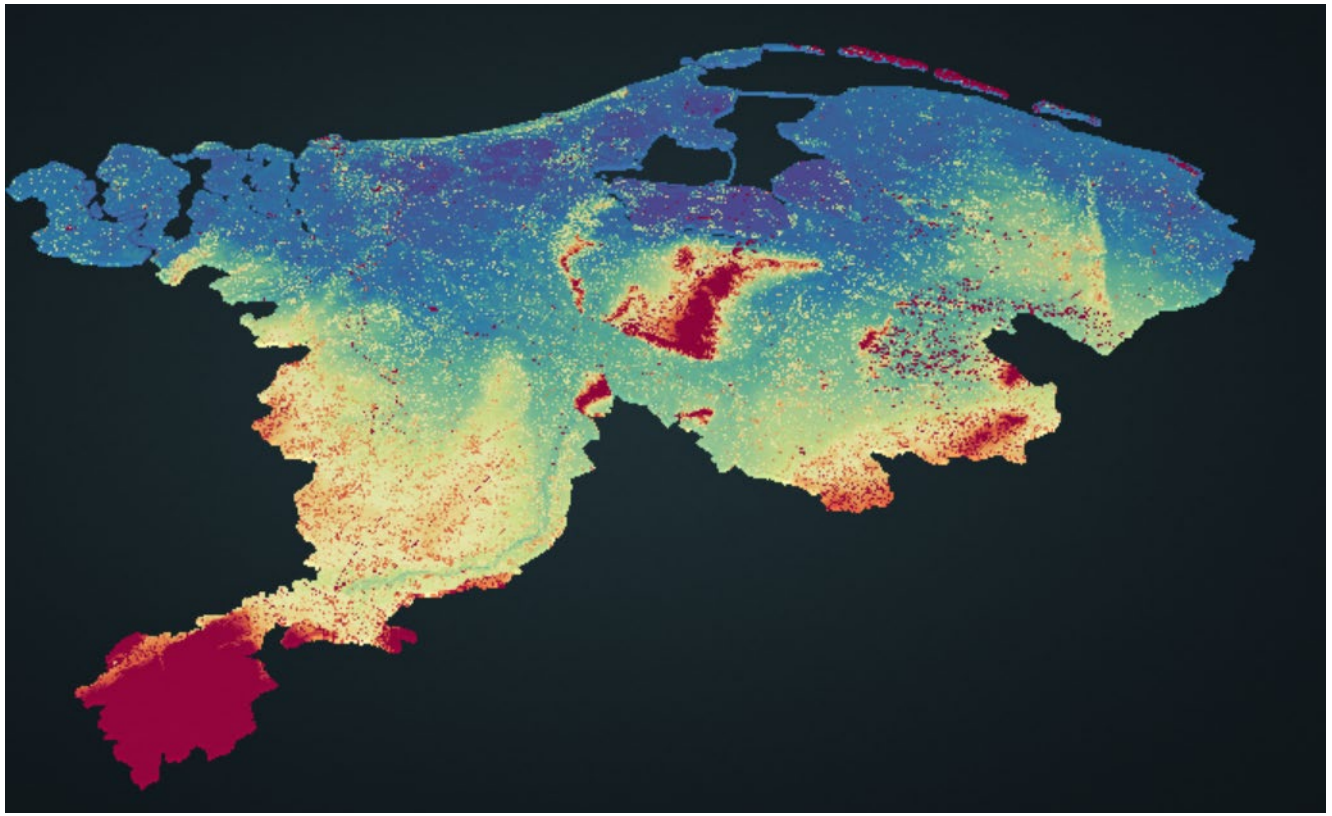
Problem: management of massive Point cloud data

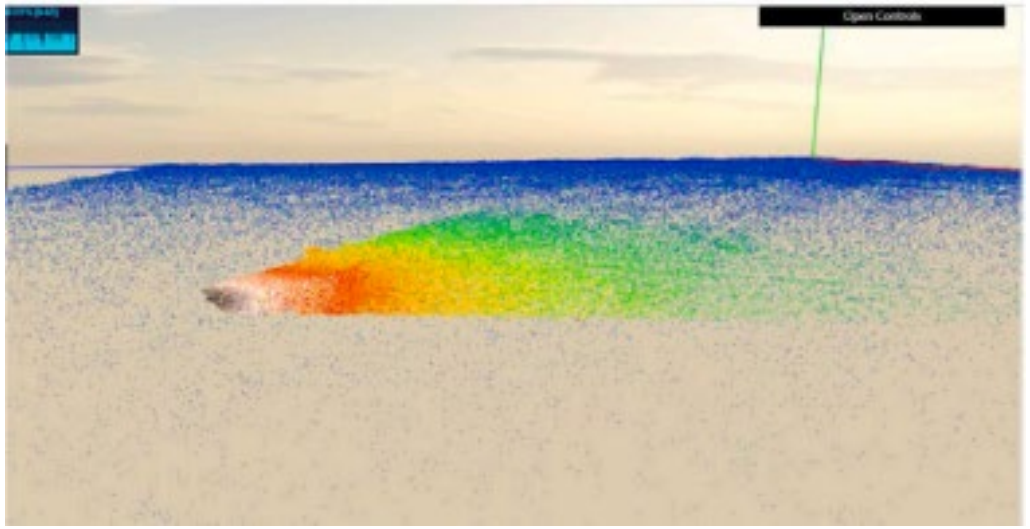
- Storage
- Query
- Processing

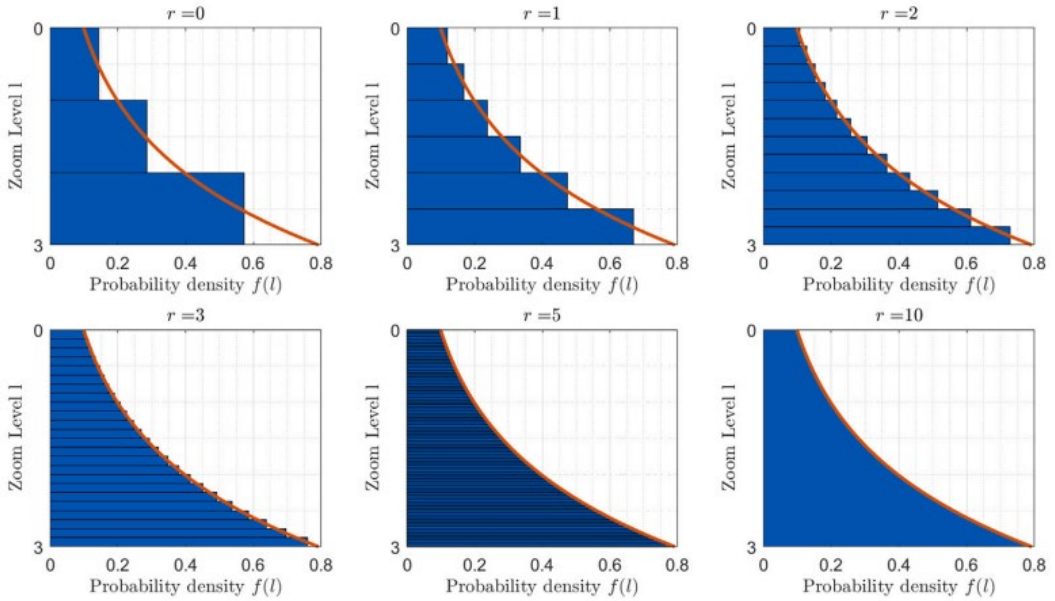


Source: http://ahn2.pointclouds.nl/

Continuous-Scale

- Continuous Level of Detail (cLoD)

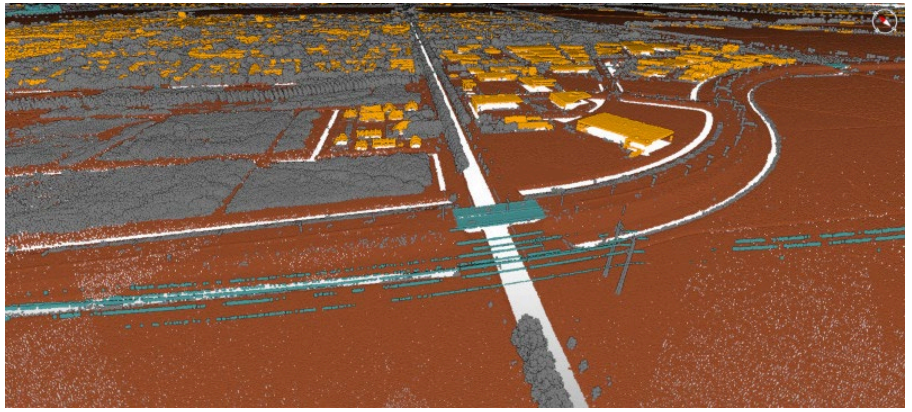




Source: van Oosterom, P., van Oosterom, S., Liu, H., Thompson, R., Meijers, M., & Verbree, E. (2022). Organizing and visualizing point clouds with continuous levels of detail. ISPRS Journal of Photogrammetry and Remote Sensing, 194, 119-131.

Continuous Level of Detail (cLoD) development for wind simulation

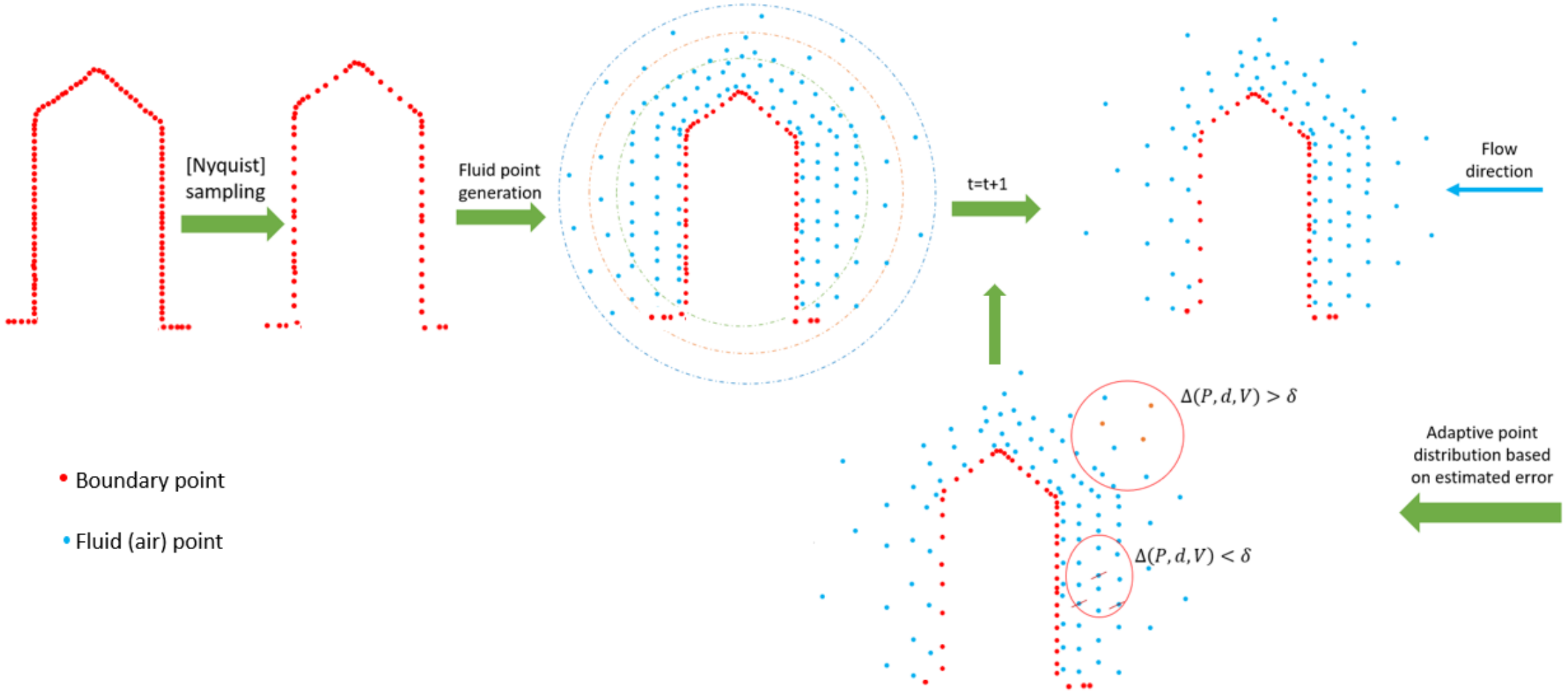
Point semantics



Source: https://ns_hwh.fundaments.nl/hwh-ahn/AHN_POTREE/index.html

Geometrical complexity

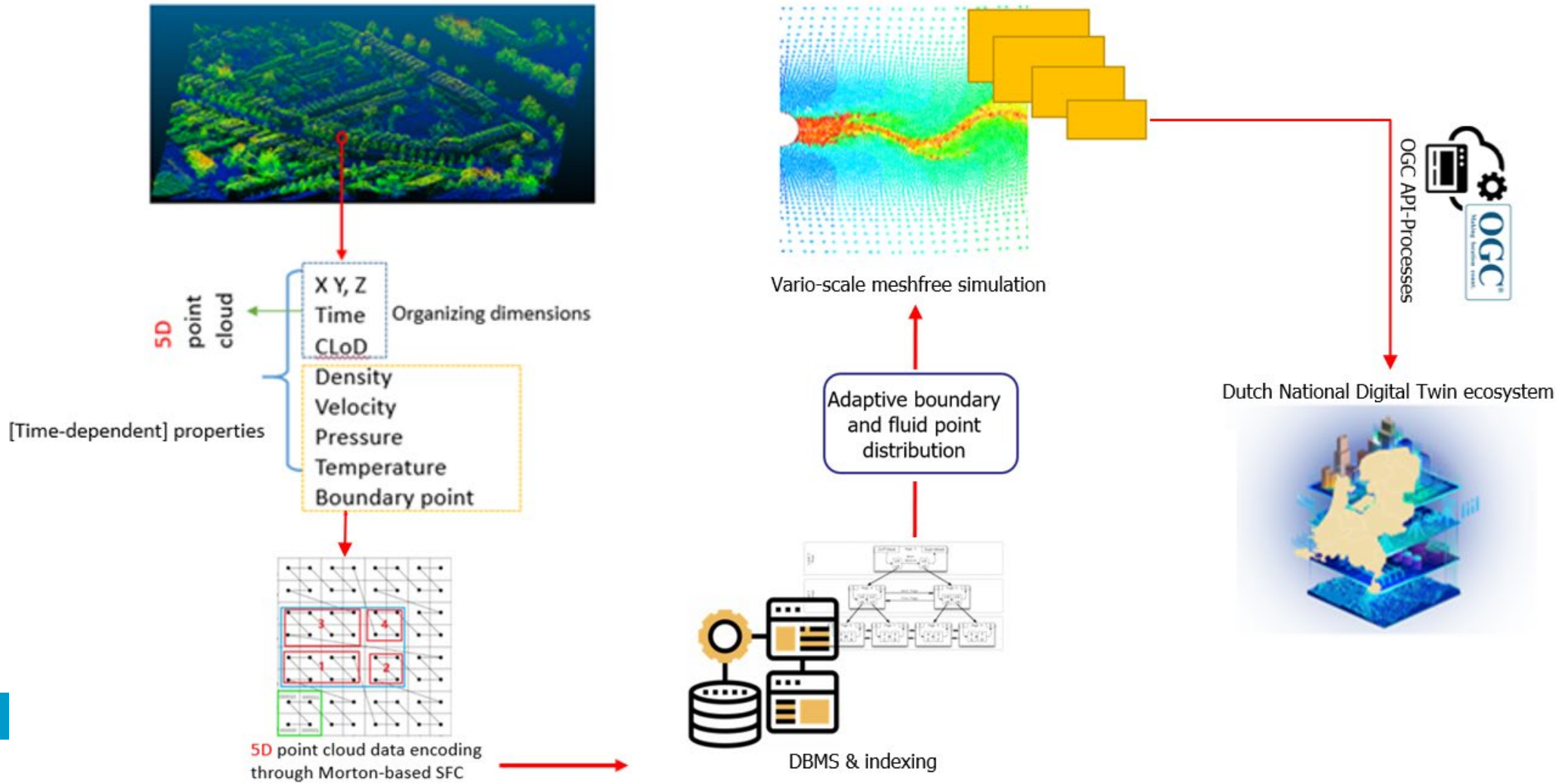
Time-scale-geometrical complexity adaptive point cloud distribution



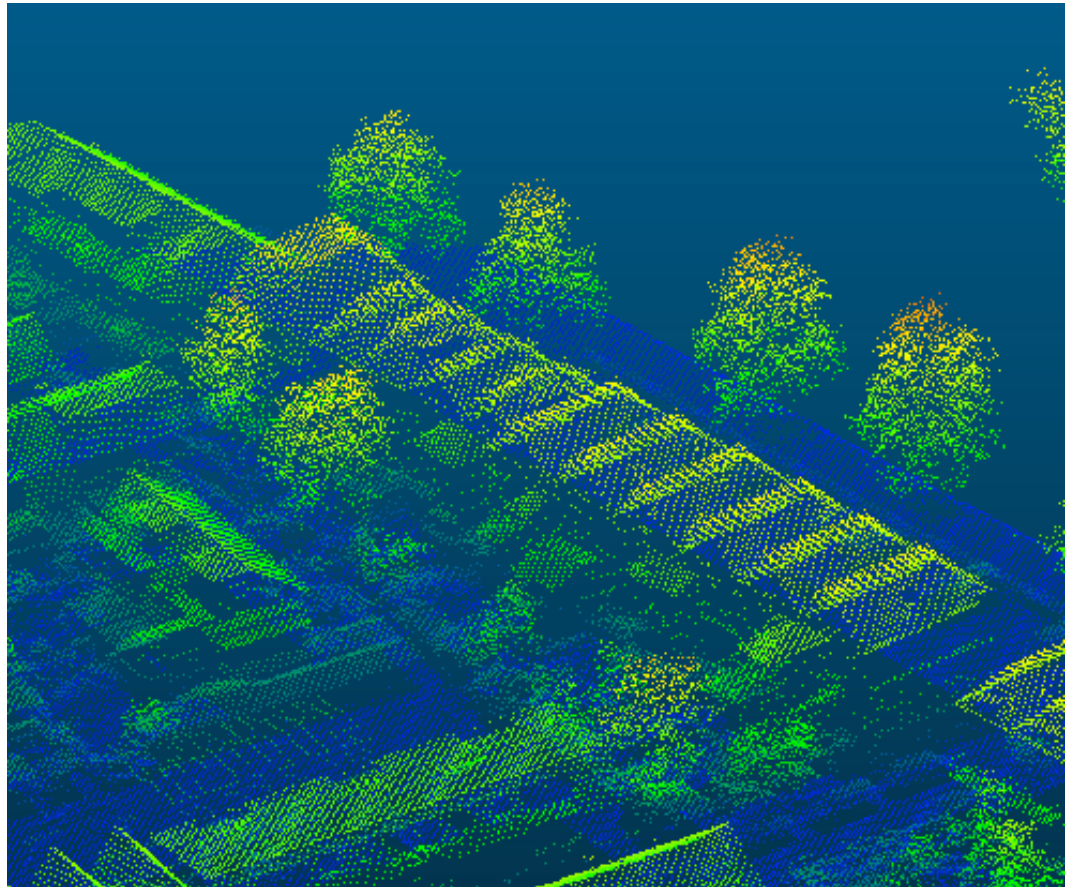
nD- Point Cloud

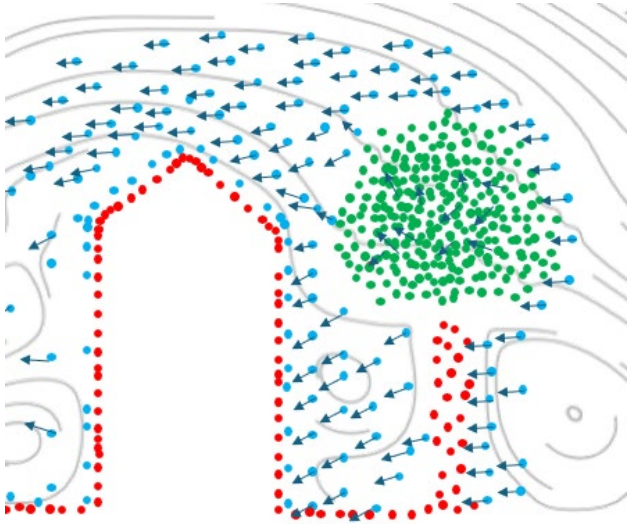
- Space
- Scale
- Time

Overall Scope



Tree foliage in meshfree wind simulation





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Thank you!

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