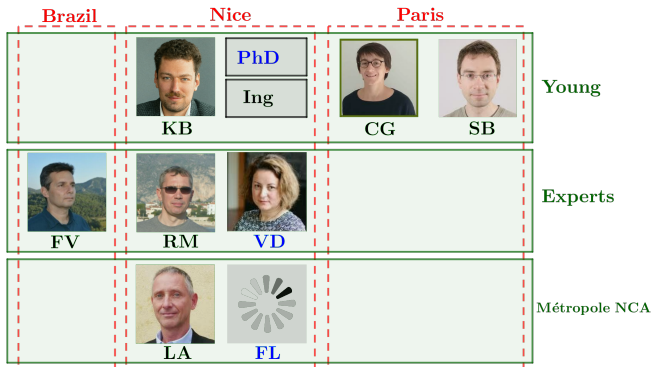


ANR JC project **Top-up**: High-resolution **topography upscaling** for urban flood modeling



CG: Cindy Guichard, Sorbone + Inria

SB: Sébastien Boyaval, LHSV, Ponts PartisTech

FV: Frédéric Valentin, LNCC, Brazil

LA: Ludovic Andres, PAST UCA, Métropole NCA

FL: Florent LARGERON, Métropole NCA

Motivation

Flow domain: scale $L = 1 - 10km$

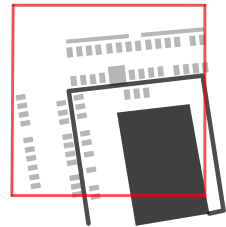
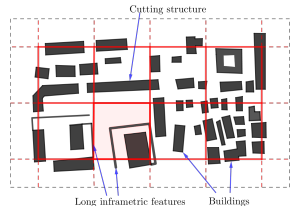


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Zone inondable par débordement de de cours d'eau

Small structures:

- Buildings, walls, cars
- $l = 0.1 - 100m$



Key difficulty: scale contrast $l \ll L$

Motivation

Flow domain: scale $L = 1 - 10km$

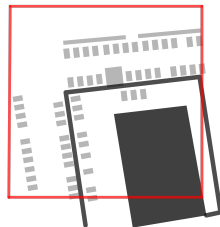
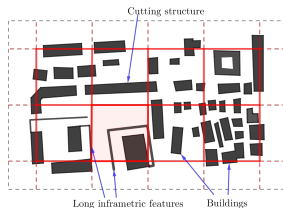


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Zone inondable + établissements sensibles

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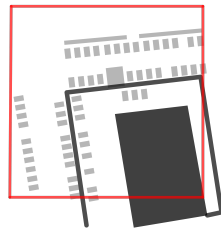
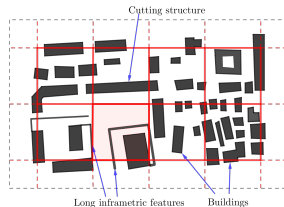


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Zone inondable + établissements sensibles

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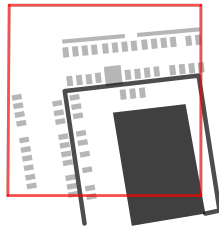
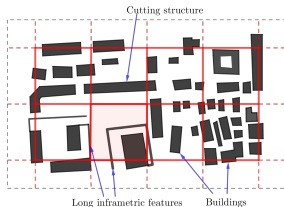


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Zone inondable + établissements sensibles

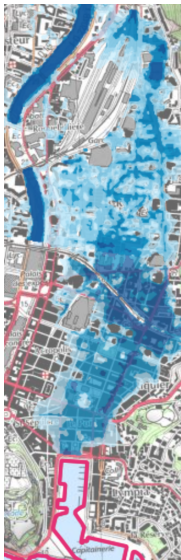
Small structures:

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- $l = 0.1 - 100m$

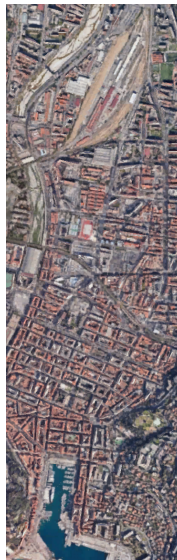


Key difficulty: scale contrast $l \ll L$

Motivation

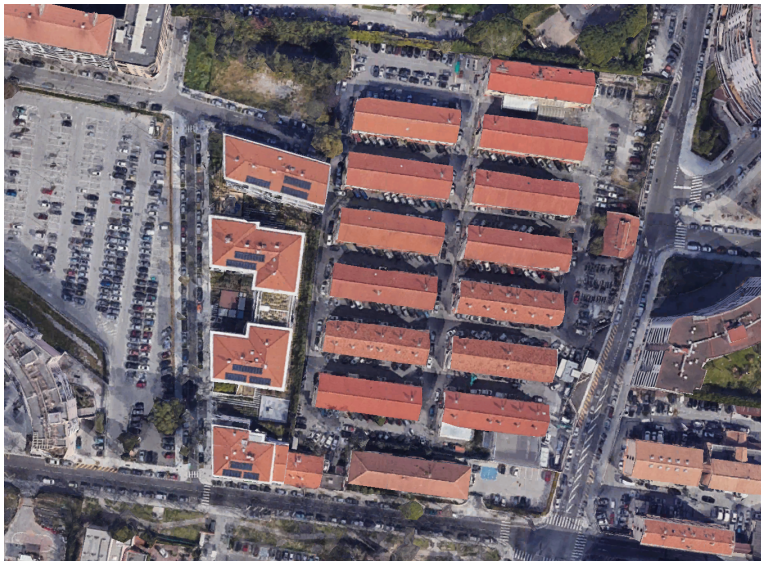


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Google Earth

Motivation



Google Earth

Motivation

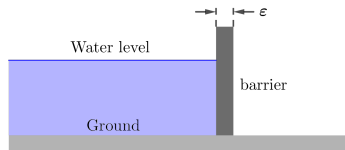


Google Earth

Motivation



Google Earth



No solution continuity w.r.t. parameters

In conclusion:

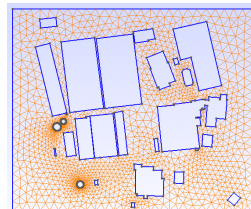
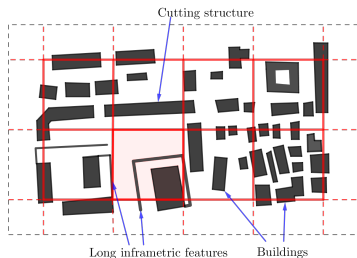
- Small scale structural features has to be **accounted for**.
- High resolution (infra-metric) topographical data **is available**.

Top-up's question:

- How to integrate **small scale** structures into the **large scale** simulations?

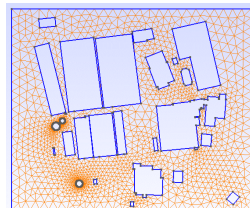
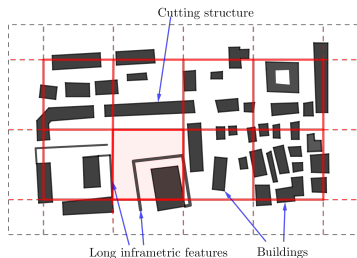
Challenge:

- Small cells over large domain = very large system.



Multi-scale numerical methods

- “upscale” relevant **local fine-scale** information to the coarse grid
- solve **global coarse** problem
- goal: parametrize the fine scale solution with few dof
- opportunities: parallelism, offline/online workload distribution



Domain Decomposition solve the global fine-scale problem, but **preconditioned** by

- **local fine-scale** contributions
- **global coarse** problem
- goal: weak scalability and coefficient robustness

$$\text{wall-clock time} \leq f \left(\frac{H}{h} \right)$$

- opportunities: parallelism