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Beyond Siamese KPConv: Early Encoding and Less Supervision

Iris de Gélis^{1,2}, Sébastien Lefèvre² & Thomas Corpetti³

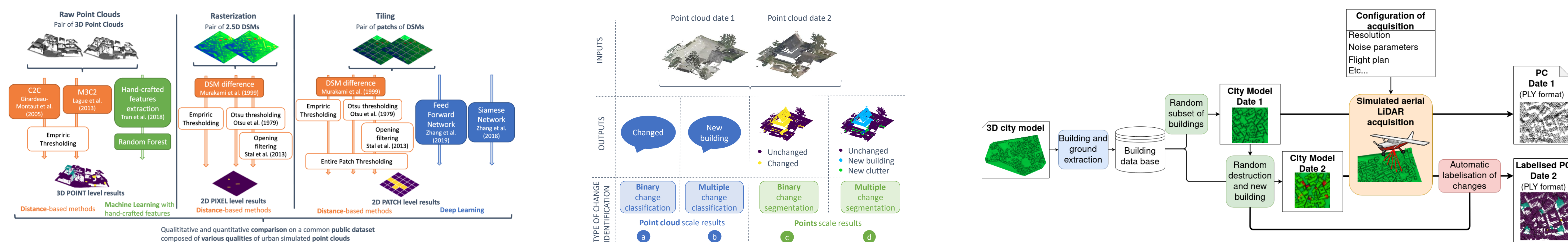
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When 3D change detection (and characterization) meets Deep Learning

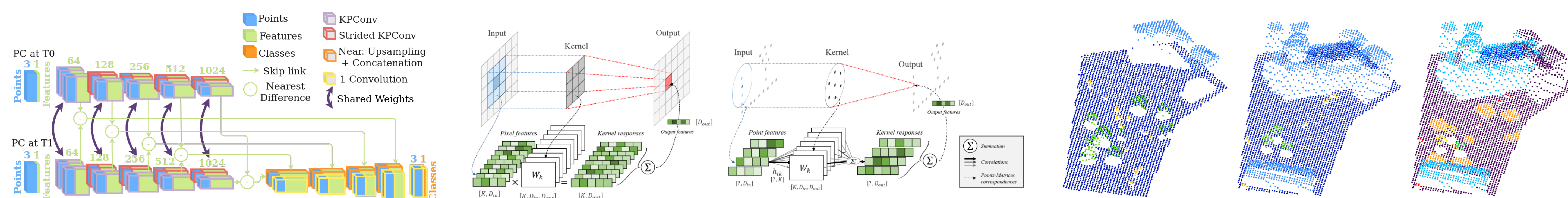
A doctoral journey from Iris de Gélis (2020–2023), to be ready for processing data acquired by the future CO3D satellite constellation [1].



DL+3D still at its infancy, especially for point change characterization, assessing SOTA needs a public dataset [2] and comparative study [3].

Siamese KPConv

The first deep architecture for multiple change detection at point scale over 3D point clouds [4, 5].



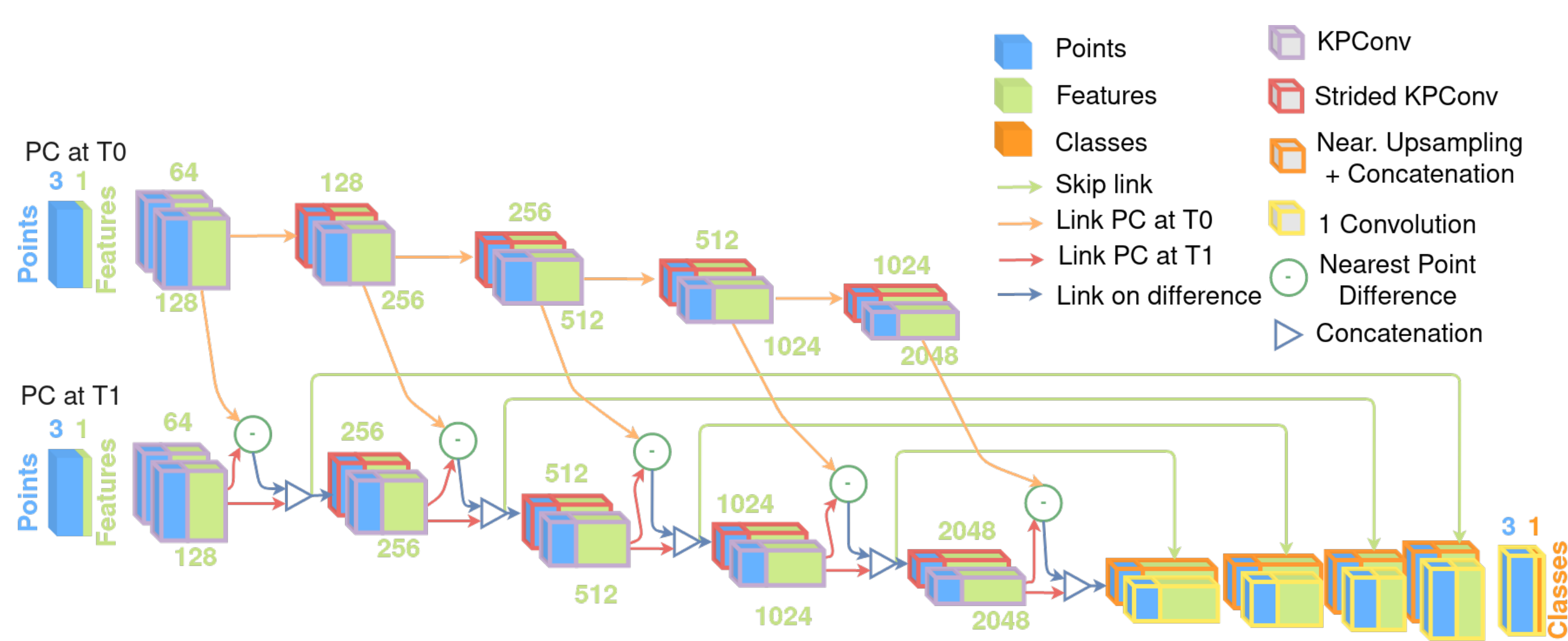
A Siamese architecture...

relying on the Kernel Point convolution...

and achieving state-of-the-art results ($mIoU_{ch} = 80.12$ vs. 52.37 for RF [6]).

Early encoding

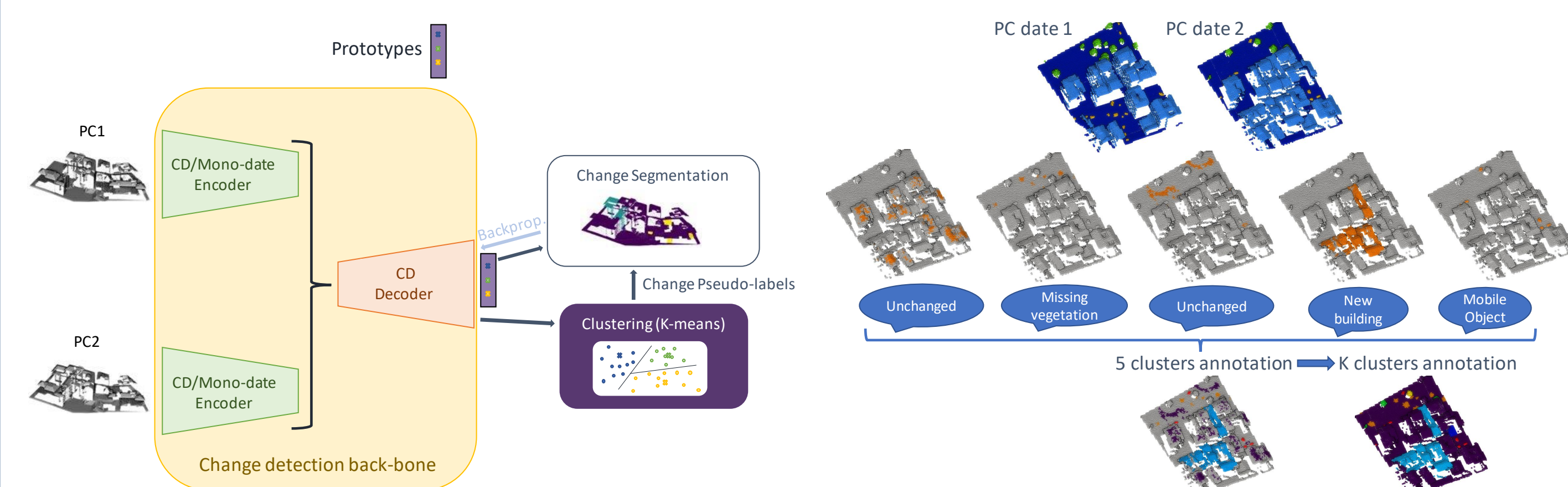
Change information is crucial!
Can be embedded explicitly or implicitly [7].



Method	mAcc (%)	mIoU _{ch} (%)
Siamese KPConv [19]	91.21 ± 0.68	80.12 ± 0.02
Siamese KPConv (+10 input features)	93.65 ± 0.16	84.82 ± 0.58
OneConvFusion	92.62 ± 1.10	81.74 ± 1.45
Triplet KPConv	92.94 ± 0.53	84.08 ± 1.20
Encoder Fusion SiamKPConv	94.23 ± 0.88	85.19 ± 0.24

Less supervision

Siamese KPConv and variants require large annotated datasets.
DC3DCD [8] is an appealing alternative based on unsupervised learning.



Revisiting DeepCluster to segment the PC in change clusters.

Enables user-guided mapping of predicted clusters to real classes.

Conclusions and Future Works

Contributions:

- A core set of deep models for 3D change categorization
- Various extensions of the recent Siamese KPConv model

Perspectives:

- Lack of curated real datasets (AHN is not perfect nor enough)
- Possible application in other fields where large PCs are available
- Towards new architectures (transformers) and other learning paradigms (semi-supervised)

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Tromsø, 9-11 January 2024