



HAL
open science

Beyond Siamese KPConv: Early Encoding and Less Supervision

Iris de Gélis, Sébastien Lefèvre, Thomas Corpetti

► **To cite this version:**

Iris de Gélis, Sébastien Lefèvre, Thomas Corpetti. Beyond Siamese KPConv: Early Encoding and Less Supervision. Northern Lights Deep Learning Conference (NLDL), 2024, Tromsø, Norway. <hal-04913386>

HAL Id: hal-04913386

<https://hal.science/hal-04913386v1>

Submitted on 27 Jan 2025

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

Beyond Siamese KPConv: Early Encoding and Less Supervision

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

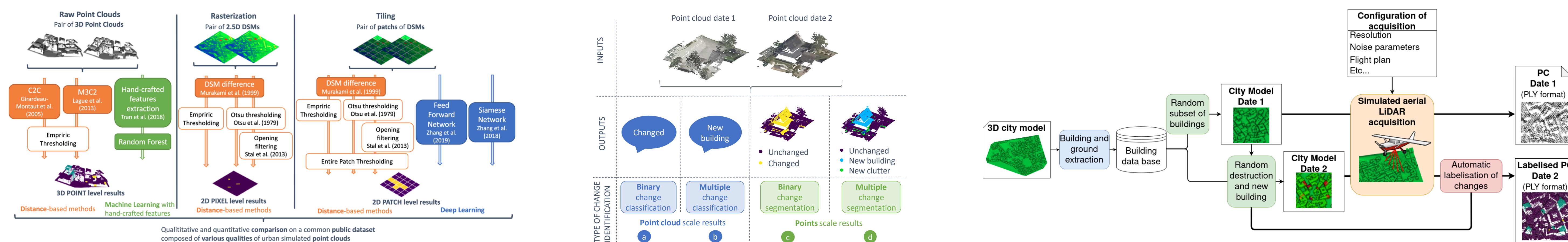
¹Magellium, F-31000, Toulouse, France ²IRISA UMR 6074, Université Bretagne Sud, F-56000 Vannes, France

³LETG UMR 6554, CNRS, F-35000 Rennes, France Email: iris.de-gelis@irisa.fr, sebastien.lefevre@irisa.fr



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

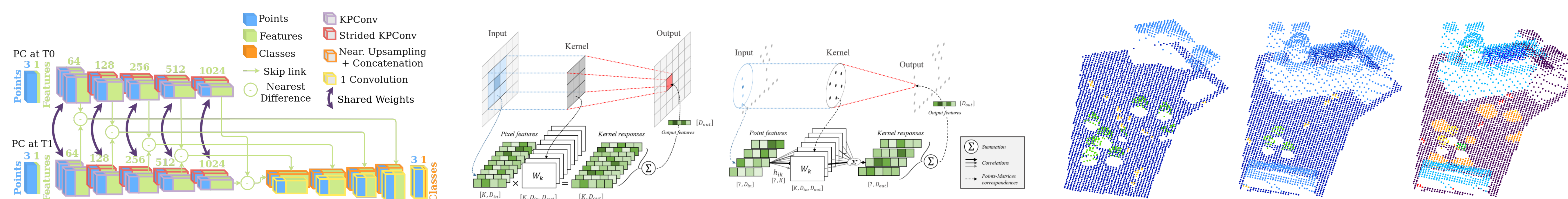
A doctoral journey from Iris de Gélis (2020–2023), to be ready for processing data acquired by the future CO3D satellite constellation [1].



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].



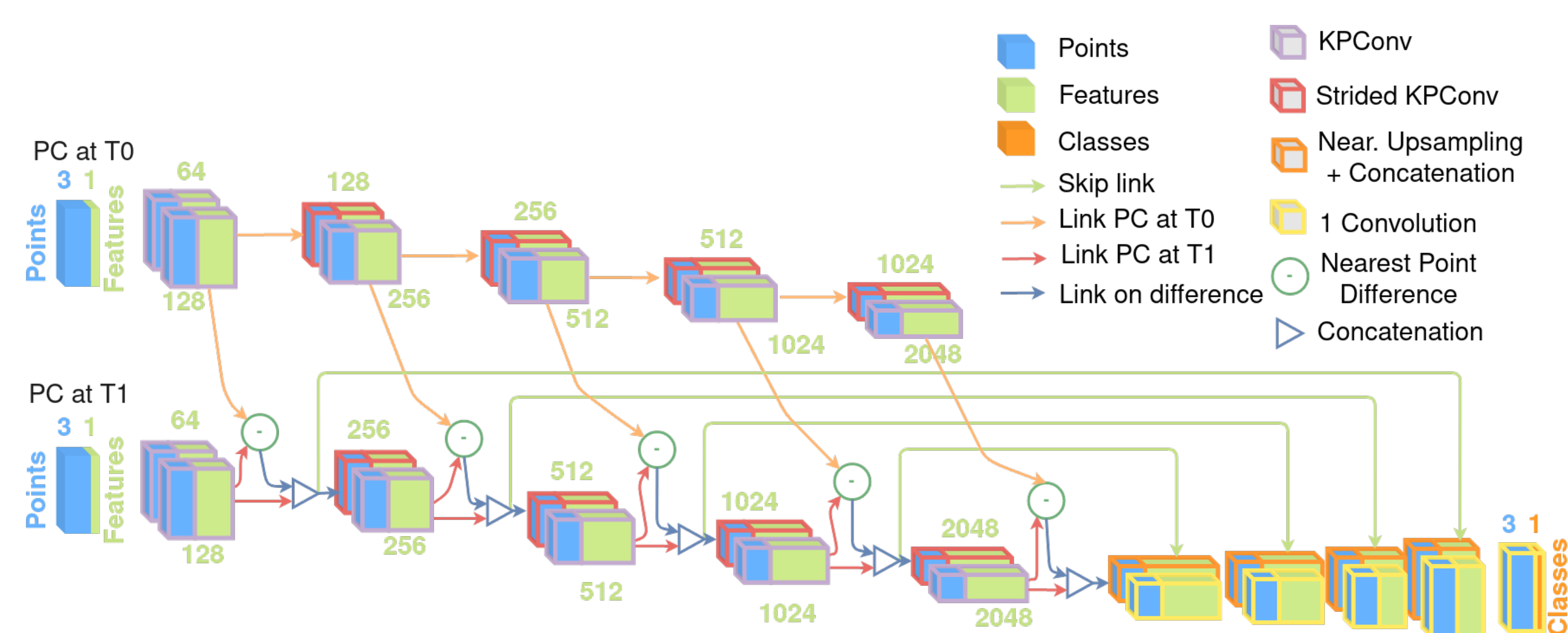
A Siamese architecture...

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

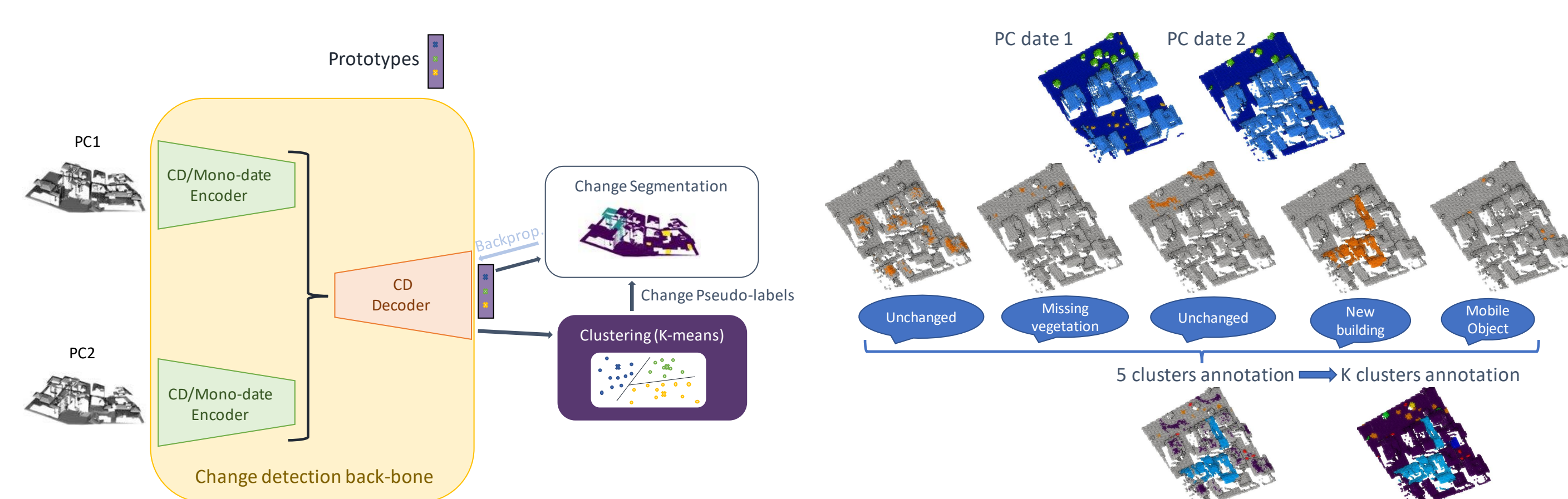
Change information is crucial!
Can be embedded explicitly or implicitly [7].



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)

References

- [1] L Lebègue, E Cazala-Hourcade, F Languille, S Artigues, and O Melet. CO3D, a worldwide one one-meter accuracy DEM for 2025. *ISPRS Archives*, 43:299–304, 2020.
- [2] I. de Gélis, S. Lefèvre, and T. Corpetti. Urb3DCD: Urban point clouds simulated dataset for 3D change detection, 2021.
- [3] I. de Gélis, S. Lefèvre, and T. Corpetti. Change detection in urban point clouds: An experimental comparison with simulated 3D datasets. *Remote Sensing*, 13(13):2629, 2021.
- [4] I. de Gélis, S. Lefèvre, and T. Corpetti. 3D urban change detection with point cloud siamese networks. *ISPRS Archives*, 43:879–886, 2021.
- [5] I. de Gélis, S. Lefèvre, and T. Corpetti. Siamese KPConv: 3D multiple change detection from raw point clouds using deep learning. *ISPRS Journal of Photogrammetry and Remote Sensing*, 197:274–291, 2023.
- [6] T.H. Tran, C. Ressel, and N. Pfeifer. Integrated change detection and classification in urban areas based on airborne laser scanning point clouds. *Sensors*, 18(2):448, 2018.
- [7] I. de Gélis, T. Corpetti, and S. Lefèvre. Change detection needs change information: improving deep 3D point cloud change detection. *IEEE Transactions on Geoscience and Remote Sensing*, 2024. (to appear).
- [8] I. de Gélis, S. Lefèvre, and T. Corpetti. DC3DCD: Unsupervised learning for multiclass 3d point cloud change detection. *ISPRS Journal of Photogrammetry and Remote Sensing*, 206:168–183, 2023.



Tromsø, 9-11 January 2024