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Monitoring Land Use Changes along Dutch Rivers

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Background

The high water levels in the Dutch rivers of 1995 were a kind of warning for the Dutch government to better protect the river areas against floods. In the Delta Program Rivers, the government prepares the Netherlands for the consequences of climate change. The Rhine and Meuse must be able to discharge larger quantities of water. To keep the risk of flooding small, the river will be given more space and the dikes will be strengthened.

Objective

The main objective is to show the feasibility of European datasets to monitor the changes along the Dutch rivers. The amount and type of land cover/ land use (LCLU) changes are presented.

Introduction

The Copernicus programme makes available satellite imagery with high temporal and spatial resolution. Combining satellite imagery from different dates provide insight in the extent of the areas flooded by rivers during high discharges. Due to policies being implemented LCLU is changing along the Dutch rivers. Corine Land Cover (CLC) and Riparian Zones (RiZ) are two services being produced under the Copernicus Land programme that can be of help to monitor LCLU in time.

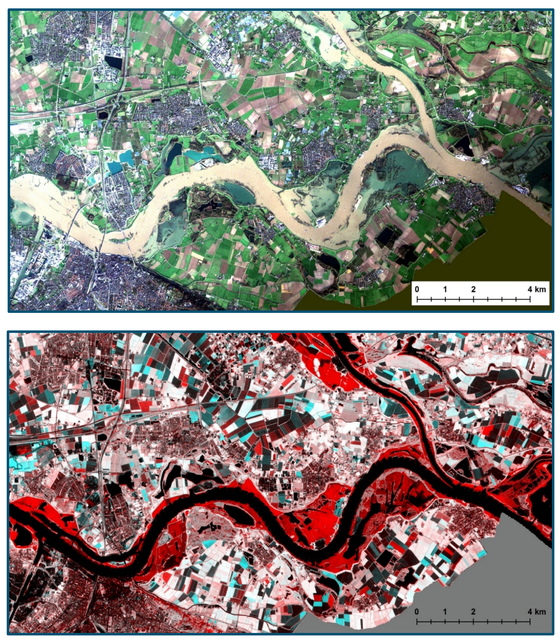

Figure 1. Sentinel image of January 8th 2018 with increased water discharge (top) and the same image combined with an earlier image with normal water levels. The red areas are flooded (below).

Data and methodology

CLC2018, CLC2012, CLCchanges 2012-2018 and the RiZ-2012 datasets together with Sentinel-2 images from 2017 and 2018 were used as datasources. The CLC datasets produced according to the "CLC2018 Technical guidelines" are preliminary and need still to have the final approval. The analysis is restricted to the extent of the RiZ dataset. LCLU classes of both CLC and RiZ are aggregated to a common nomenclature.

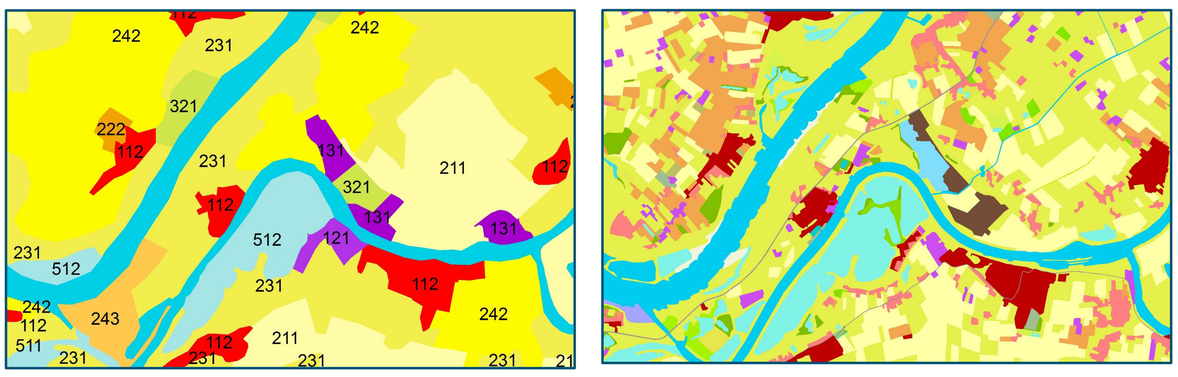

Figure 2. CLC2012 (left) and the spatial and thematic more detailed RiZ dataset (right). The number of objects in CLC2012 is by far outnumbered by the number of objects included in the RiZ datasets. CLC is characterized by a minimum mapping unit (MMU) of 25ha and 30 out of 44 CLC classes are present in The Netherlands. RiZ's MMU is 0.5ha and 68 LCLU classes are discerned in The Netherlands.

Results

- Cropland is having a higher share, while urban areas are occupying less land in CLC compared to RiZ.
- RiZ dataset has more than three times as much objects as CLC.
- Prominent LCLU changes between 2012 and 2018 covering nearly 40% of LCLU changes: construction sites into urban areas and pastures/arable land into watercourses, inland marshes, natural grasslands and construction sites.
- Typical changes in the riparian zone of the Netherlands are changes from pastures/arable land into construction sites which in their turn change into semi-natural land, wetlands or water body LCLU classes.

Tabel 1. Area of LCLU types aggregated to 10 main classes (number of objects, ha and %).

		RiZ count	CLC2012 count	CLC2018 count	RiZ ha	CLC2012 ha	CLC2018 ha	RiZ %	CLC2012 %	CLC2018 %
1	Urban	61714	1596	1609	178236	143851	146556	19.1%	15.7%	16.0%
2	Cropland	14119	796	800	258248	312128	307599	27.7%	34.0%	33.5%
3	Woodland and forest	9527	349	353	32047	15921	16427	3.4%	1.7%	1.8%
4	Grasslands	13303	429	457	362010	356682	355662	38.8%	38.9%	38.8%
5	Heathland and scrub	35	7	7	350	266	266	0.0%	0.0%	0.0%
6	Sparsely vegetated land	259	1	1	710	6	6	0.1%	0.0%	0.0%
7	Wetlands	812	109	117	8704	11053	12709	0.9%	1.2%	1.4%
8	Marine wetlands and waters	38	12	13	4829	292	340	0.5%	0.0%	0.0%
9	Rivers and lakes	5637	193	196	88144	77455	78088	9.4%	8.4%	8.5%
10	Sea and ocean	13	2	2	20	37	37	0.0%	0.0%	0.0%
		105457	3494	3555	933298	917692	917692	100%	100%	100%

Tabel 2. Prominent (left) and typical (right) LCLU changes (ha and %).

Change type	ha	%	Change type	ha	%
133-112	1092	8.9%	133-512	75	0.6%
211-321	1066	8.7%	133-511	49	0.4%
231-133	875	7.1%	133-411	272	2.2%
211-411	828	6.7%	133-324	179	1.5%
211-133	796	6.5%	133-321	147	1.2%

- Next to the expected extension of urban areas, land occupied by wetlands, rivers and lakes is also increasing with more than 2000ha between 2012 and 2017.

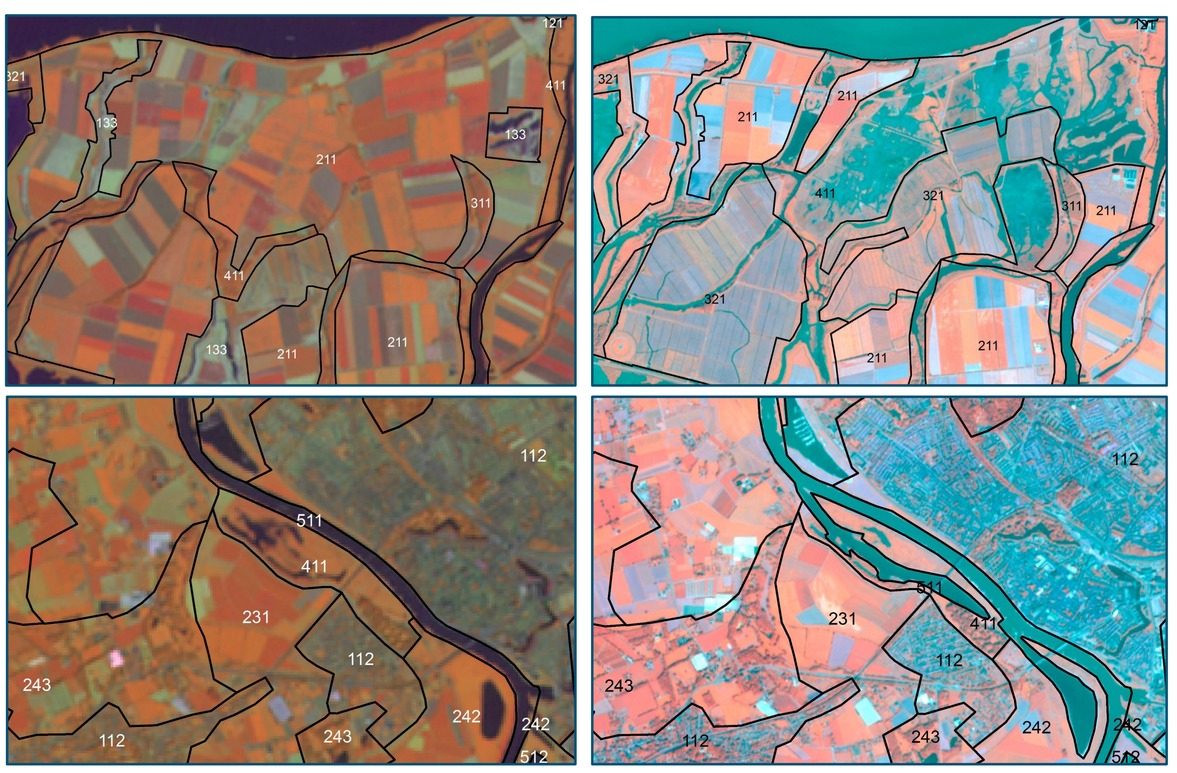

Figure 3. Two examples of LCLU for 2012 (left) and 2017 (right) along Dutch rivers (CLC nomenclature). The upper example shows the conversion of arable land (211) into inland marshes (411) and natural grasslands (321) (crossing Merwede and Meuse river). The lower example shows the conversion of complex cultivation (242) and inland marshes (411) turned into water courses (511) increasing the surface area of the river bed (IJssel river in Overijssel).

Conclusions

- Combining Sentinel-2 images of different dates provide insight in the area flooded during high level water discharge.
- Monitoring LCLU along Dutch rivers on basis of CLC shows the main trends resulting from the implementation of Dutch policies.
- Non-regular country specific CLC LCLU-changes are present.
- RiZ has the potential to provide more detailed LULC information.

Acknowledgements

This research was possible due to the work carried out under Specific contract No 3436/R0-Copernicus/EEA.56950 which is part of FSC No EEA/IDM/R0/16/009/Netherlands.

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