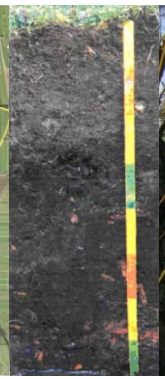
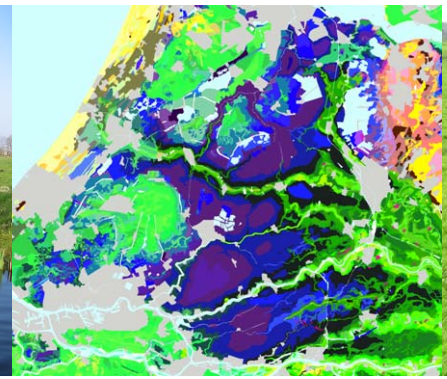
Influence of spatial resolution of land cover data on N_2O emission inventories

Dutch fen meadow system




Introduction

Land cover database are

- a simplification of the reality
- used for N_2O emission inventories

- Systematic errors in land cover data → little attention

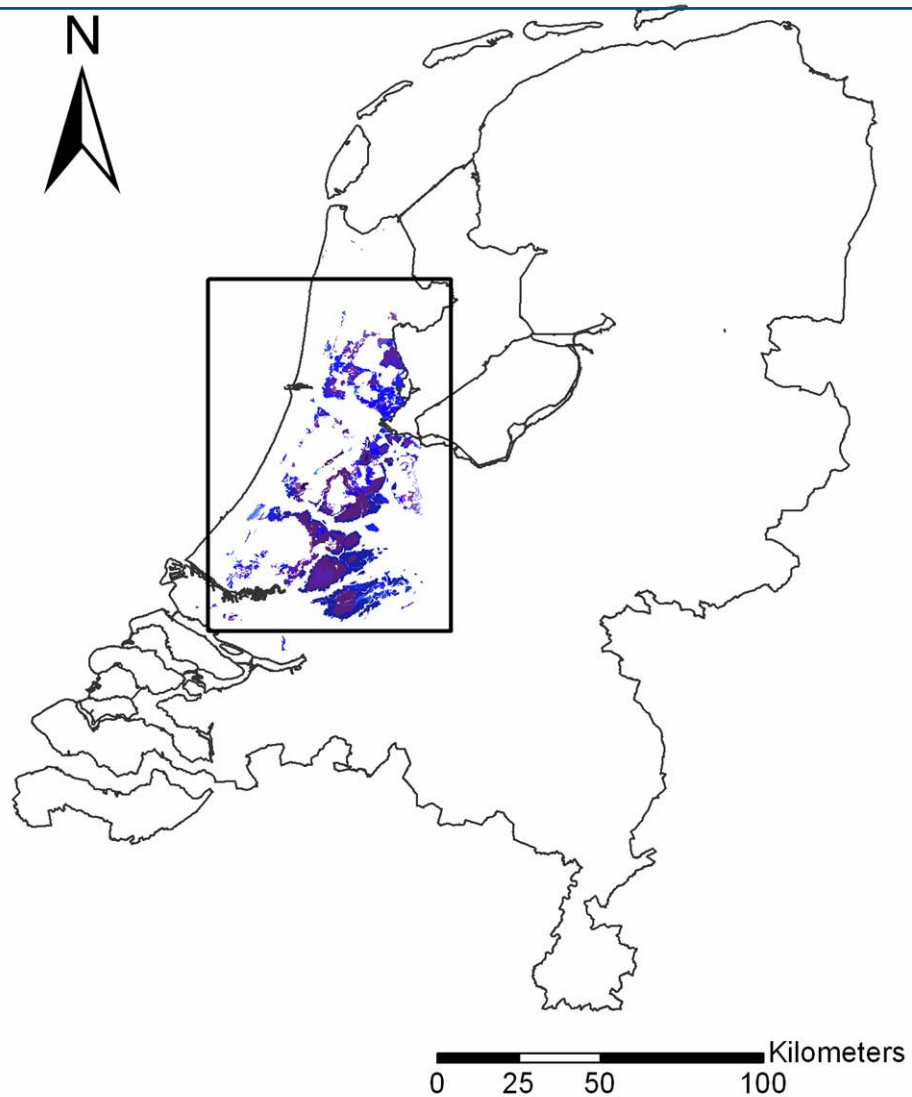
Goal

Objective: To analyze how land cover data introduce systematic errors (i.e. bias) into the results of regional N_2O emission inventories

Location

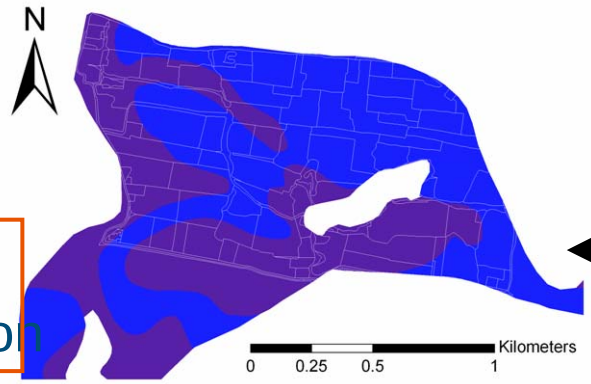
- Dutch Western fen meadow system: High & uncertain N_2O emissions

3 Research polders: Zegveld, Oukoop, and Menningweer



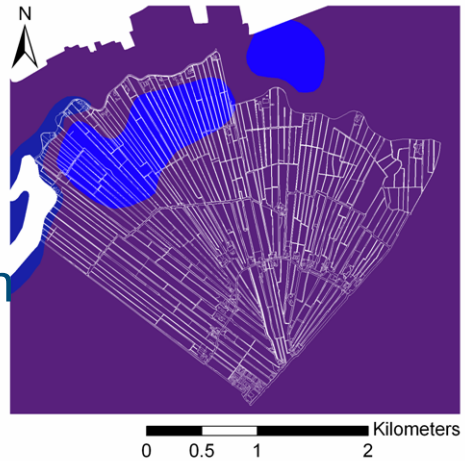
Polder Menning-weer

Irregular Reclamation



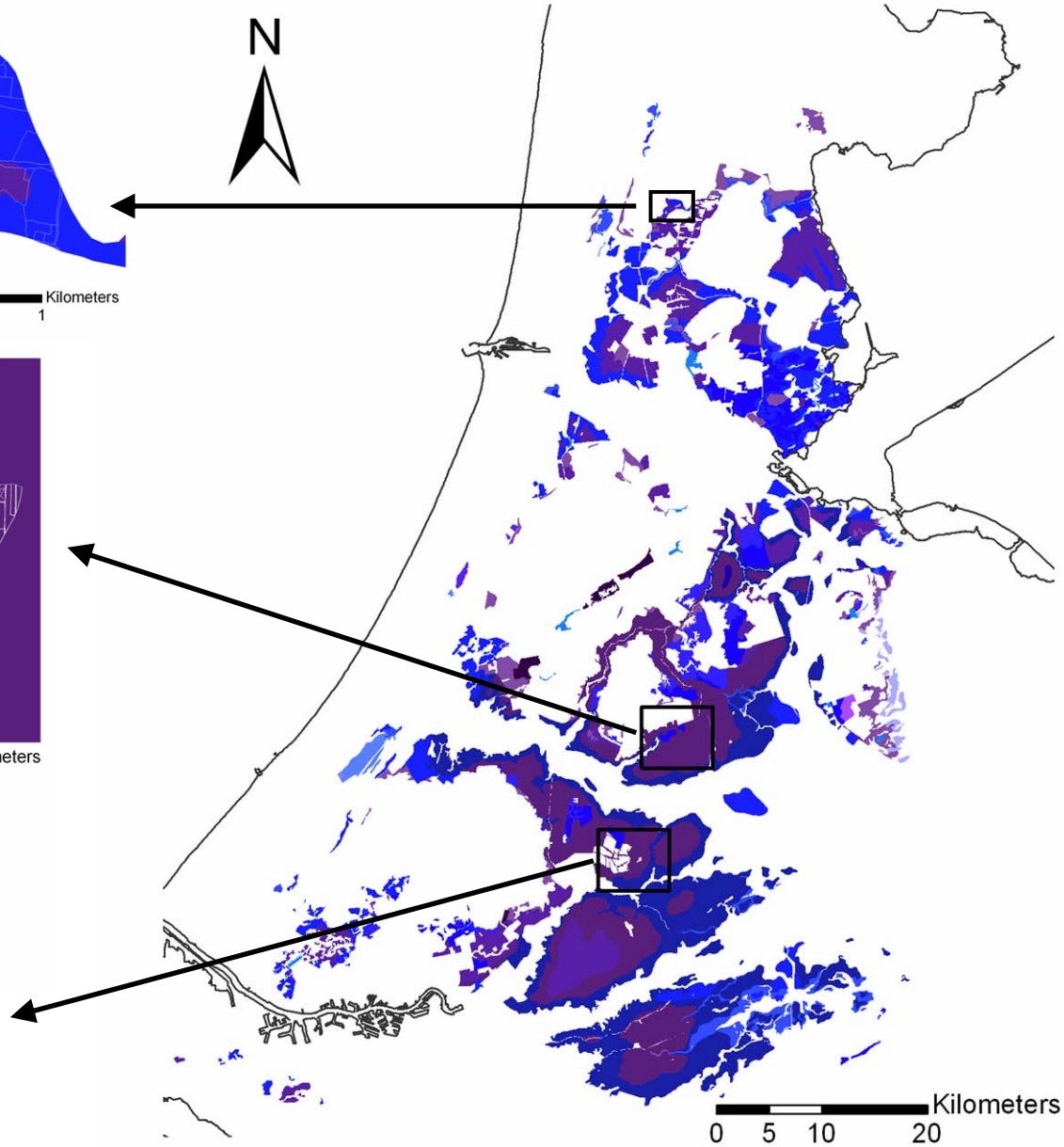
Polder Zegveld

Cope Reclamation



Polder Oukoop

Reclamation with wide Ditches



Land cover data

- Surface areas of main landscape elements
- 5 Land cover databases:
  - Field map
  - Top10Vector
  - LGN4
  - CBS Soil Use
  - CLC2000/CORINE

Field map: Vector data

Scale:

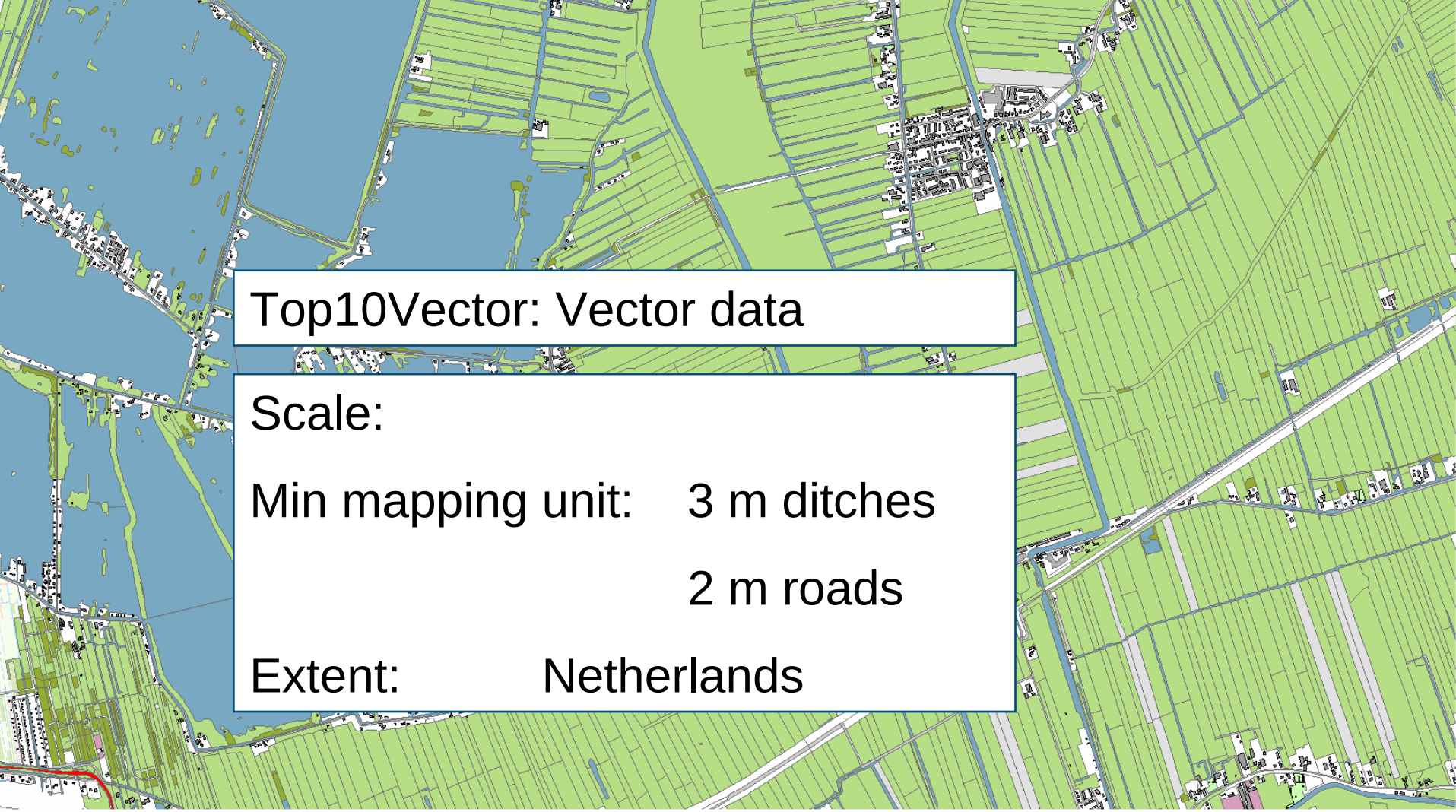
Min mapping unit: 0.2 m ditches

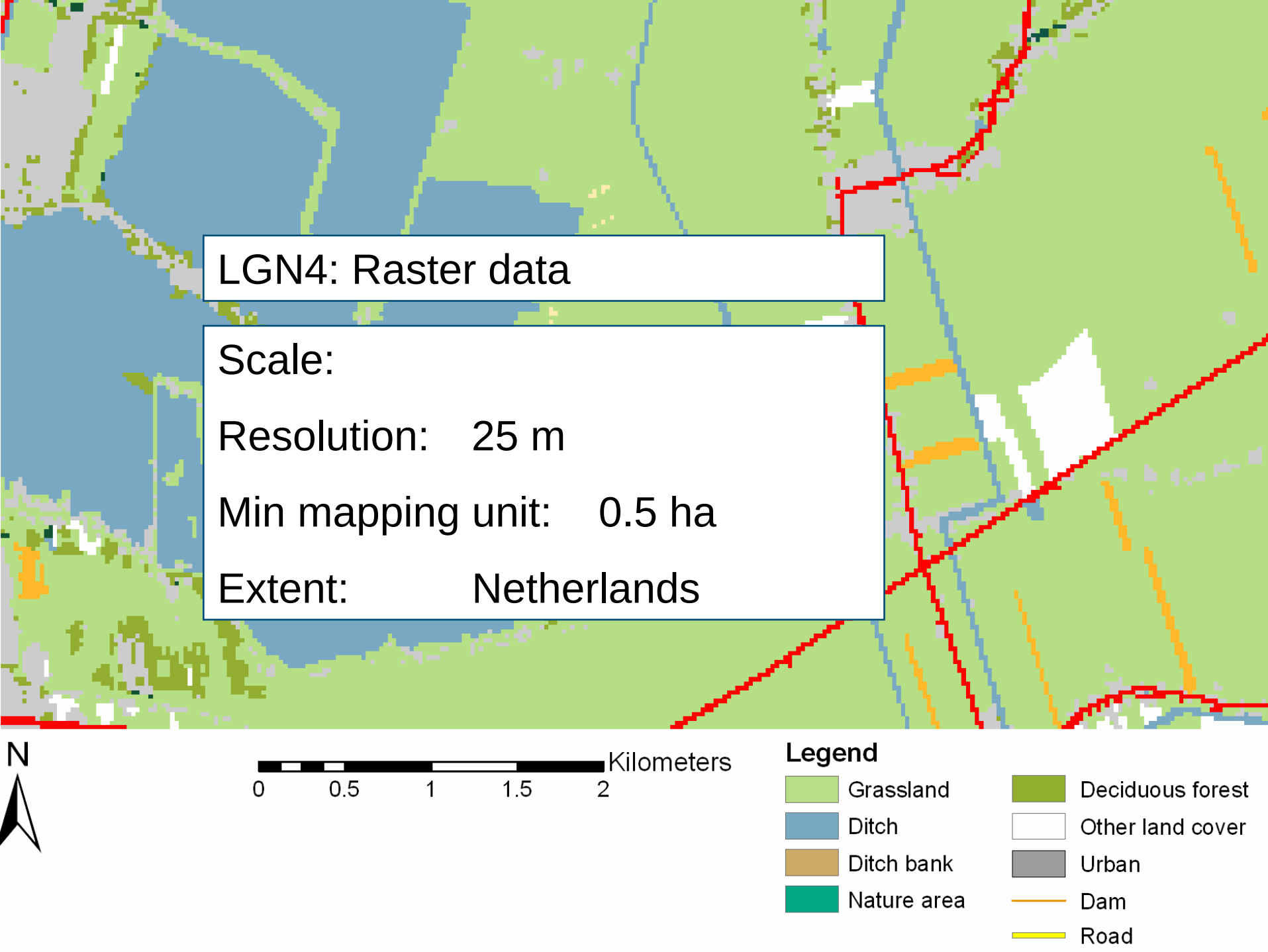
2 m roads

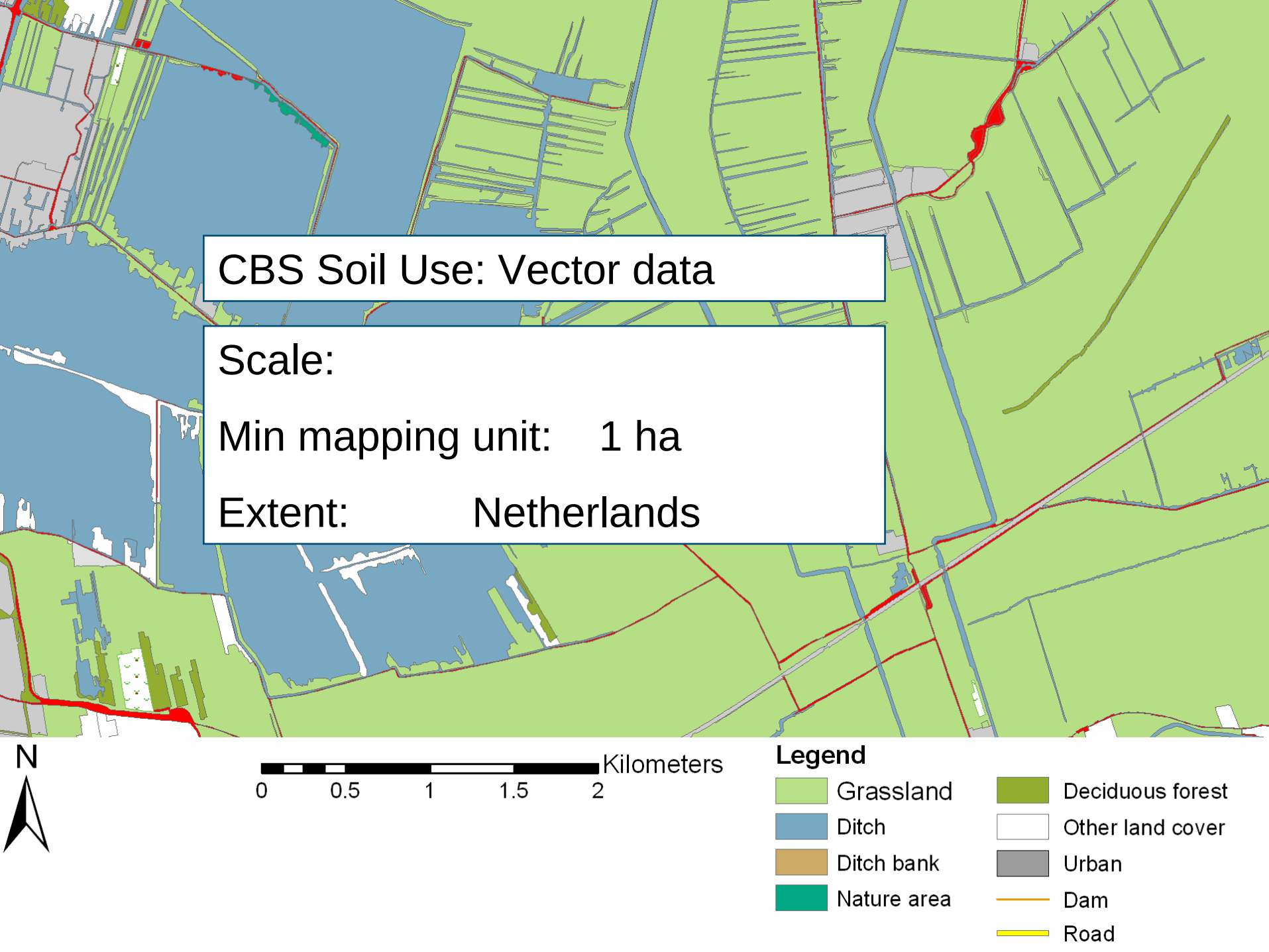
Extent: Research polders

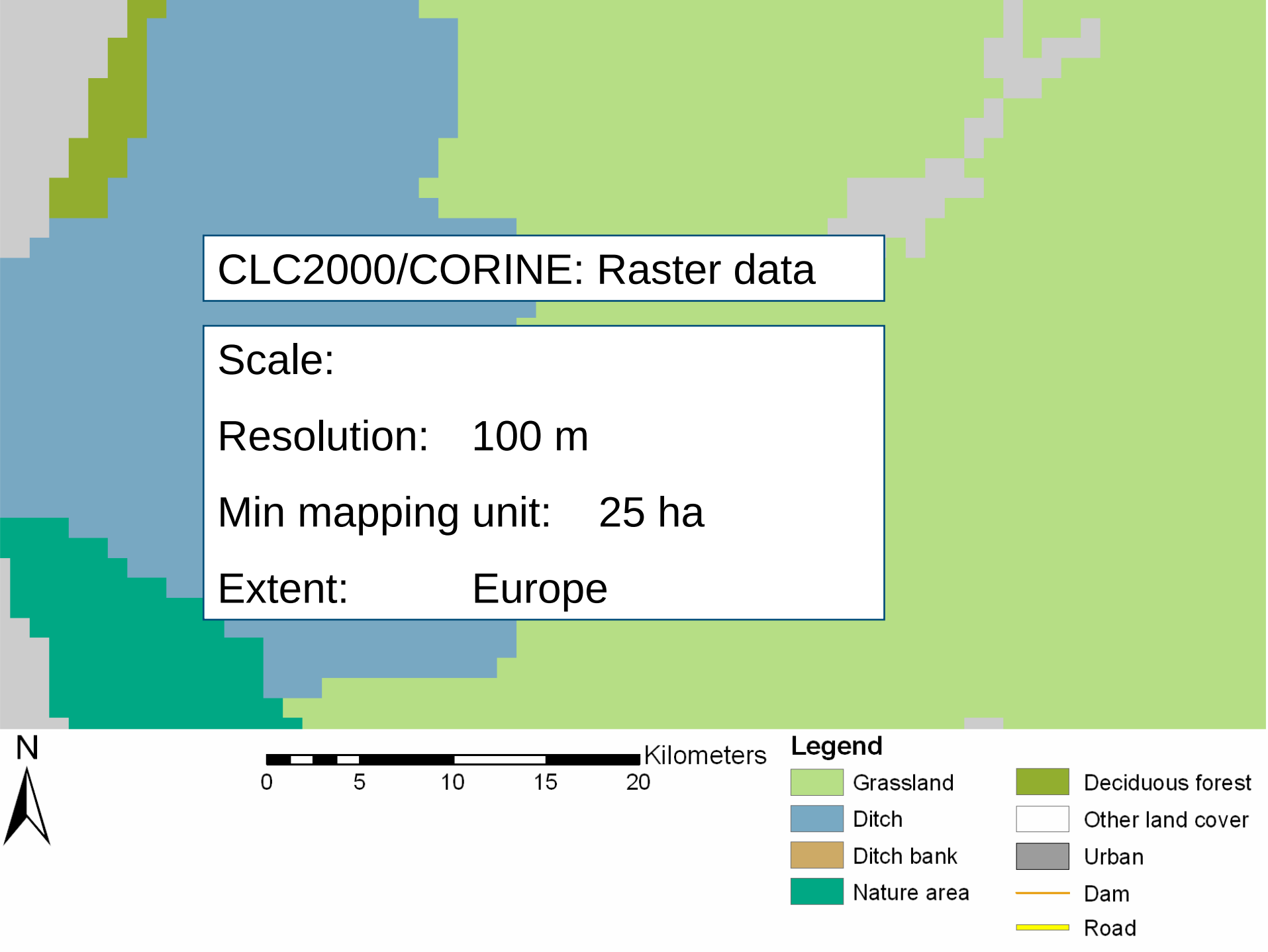
Legend

- Grassland
- Ditch
- Ditch bank
- Nature area
- Deciduous forest
- Other land cover
- Urban
- Dam
- Road


Top10Vector: Vector data
Scale:
Min mapping unit: 3 m ditches
2 m roads
Extent: Netherlands
Kilometers
0
0.5
1
1.5
2
N
Legend
Grassland
Ditch
Ditch bank
Nature area
Deciduous forest
Other land cover
Urban
Dam
Road

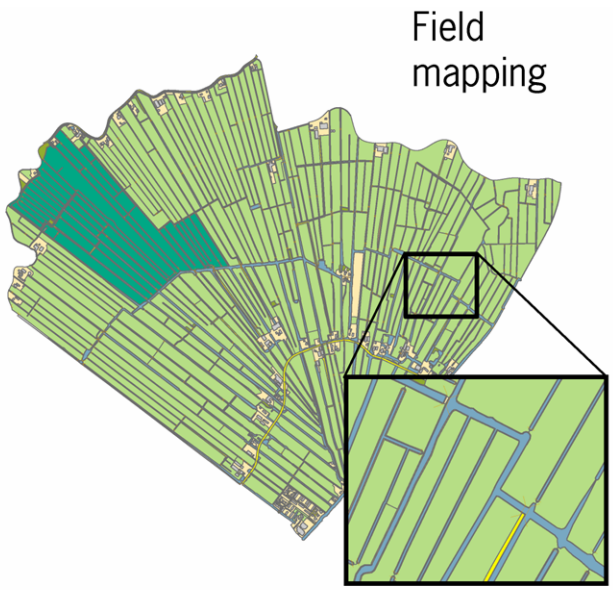

LGN4: Raster data
Scale:
Resolution: 25 m
Min mapping unit: 0.5 ha
Extent: Netherlands
N
0
0.5
1
1.5
2
Kilometers
Legend
Grassland
Ditch
Ditch bank
Nature area
Deciduous forest
Other land cover
Urban
Dam
Road

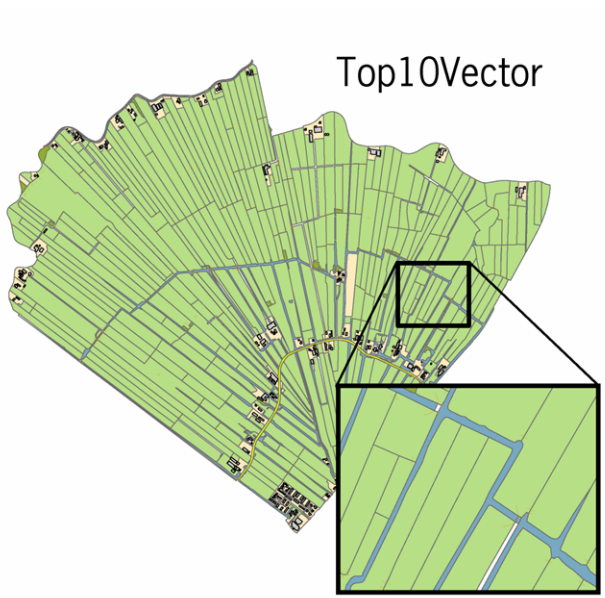

CBS Soil Use: Vector data
Scale:
Min mapping unit: 1 ha
Extent: Netherlands
N
0
0.5
1
1.5
2
Kilometers
Legend
Grassland
Ditch
Ditch bank
Nature area
Deciduous forest
Other land cover
Urban
Dam
Road

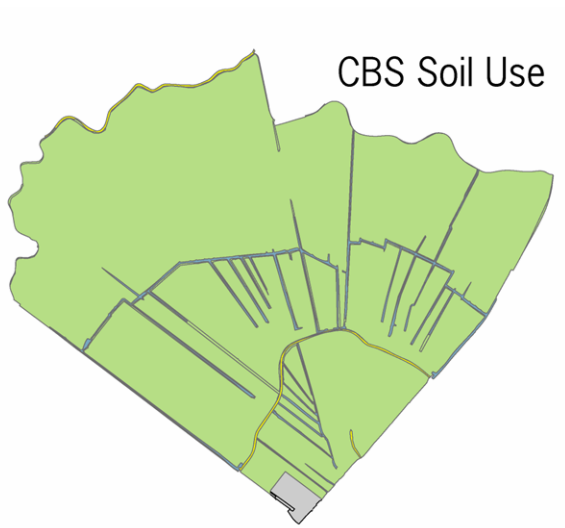

CLC2000/CORINE: Raster data
Scale:
Resolution: 100 m
Min mapping unit: 25 ha
Extent: Europe
N
0
5
10
15
20
Kilometers
Legend
Grassland
Ditch
Ditch bank
Nature area
Deciduous forest
Other land cover
Urban
Dam
Road

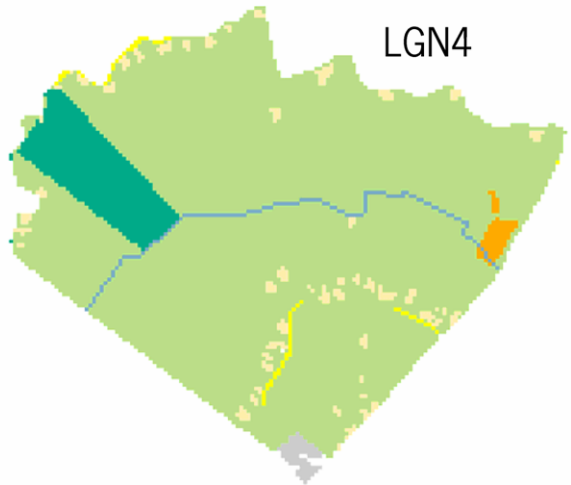
Four N_2O emission inventories

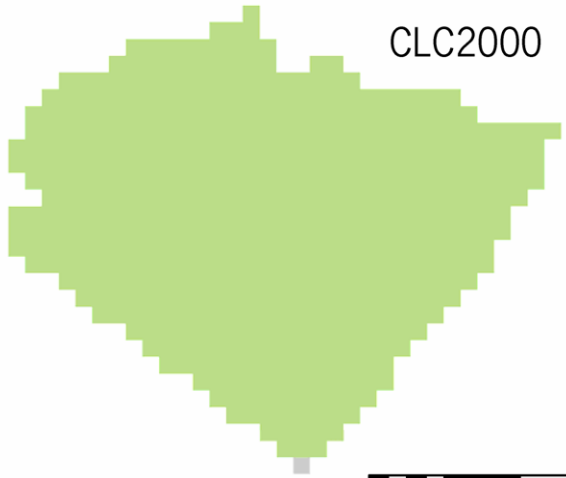
- Tier emission factor methods
  - Tier 1: Global
  - Tier 2a: Country-specific
  - Tier 2b: Polder-specific
- INITIATOR2
  - Simple process description → N processes
  - N_2O emission: function of denitrification and nitrification in the soil



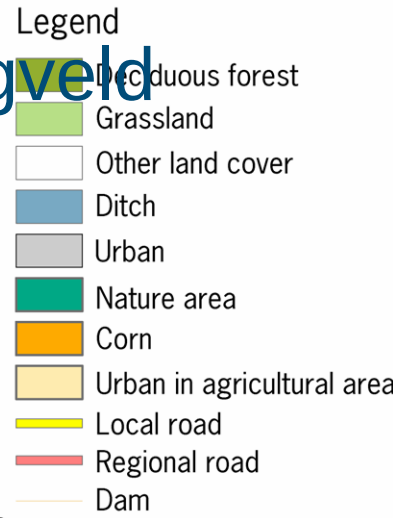


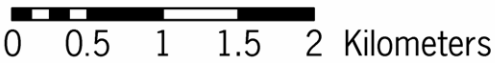






Polder Zegveld





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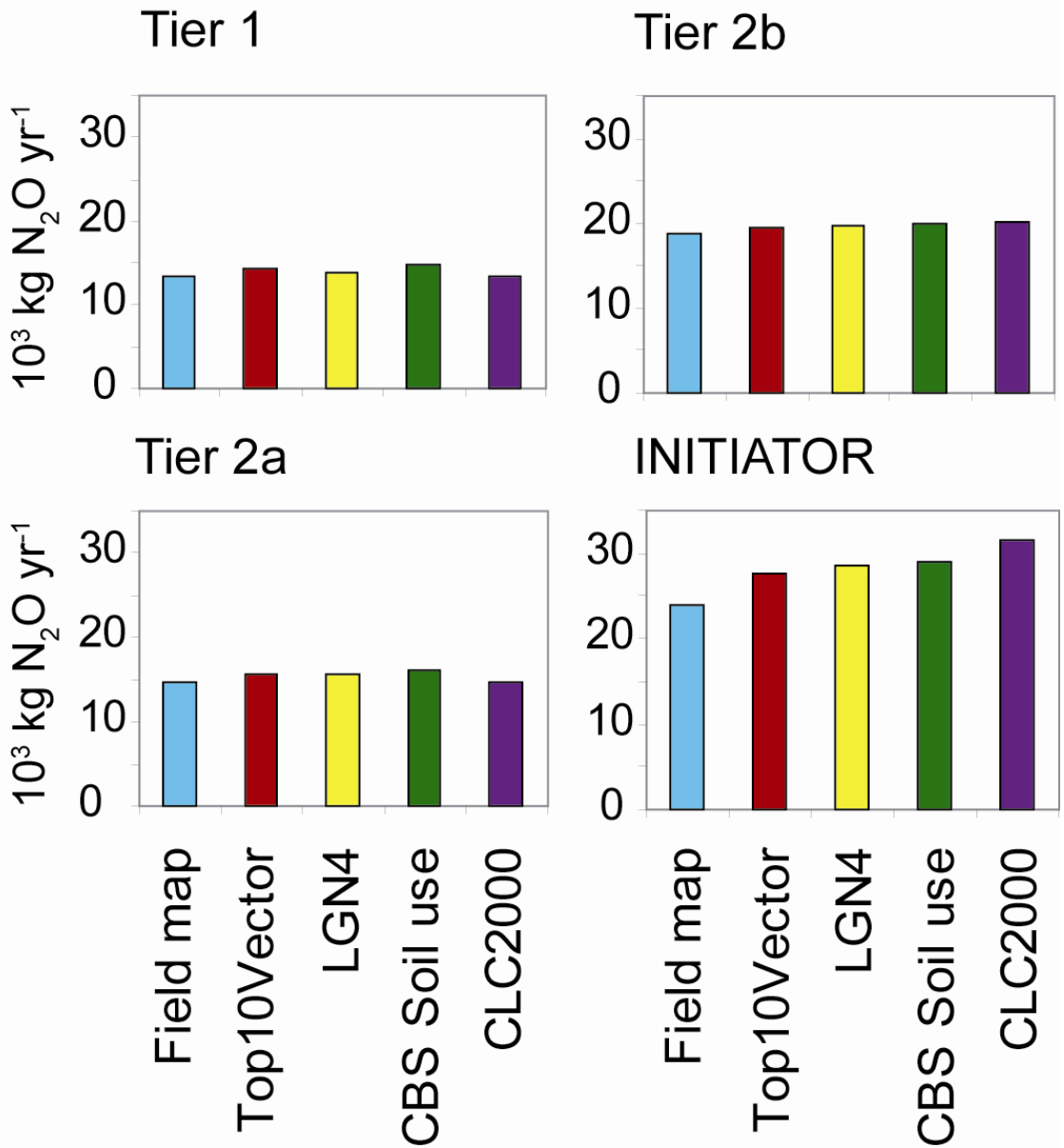
Introduction – Material & Methods – **Results** – Discussion & Conclusions

Areas main landscape elements (ha)

Database	Polder Zegveld		
	Grassland	Water	Ditch bank
Field map	513 (82%)	70 (10%)	33 (5%)
Top10Vector	586 (88%)	30 (4%)	--
CBS Soil Use	640 (92%)	19 (3%)	--
LGN4	627 (94%)	8 (1%)	--
CLC2000	669 (100%)	0 (0%)	--

N_2O emission from Polder Zegveld



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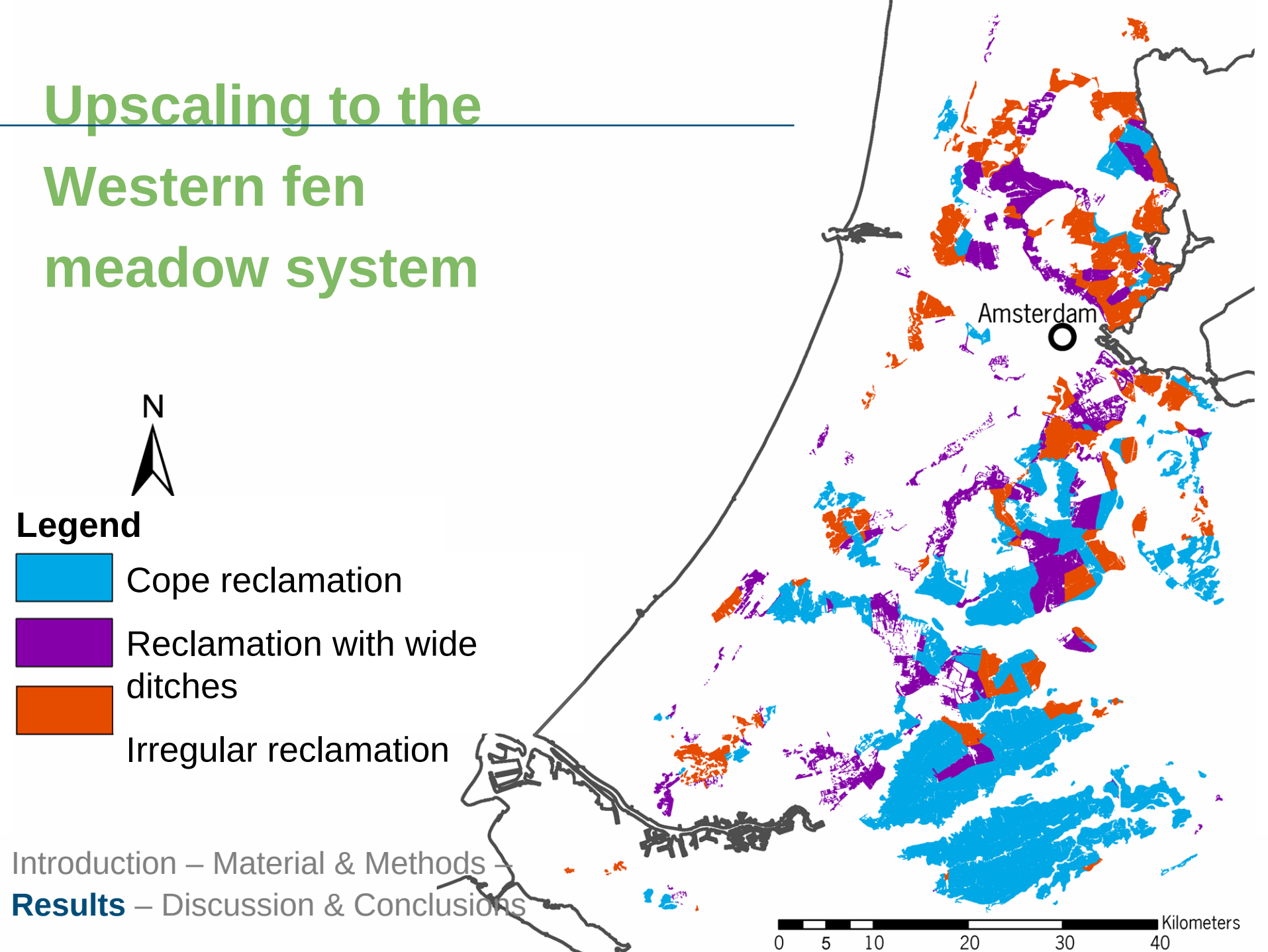
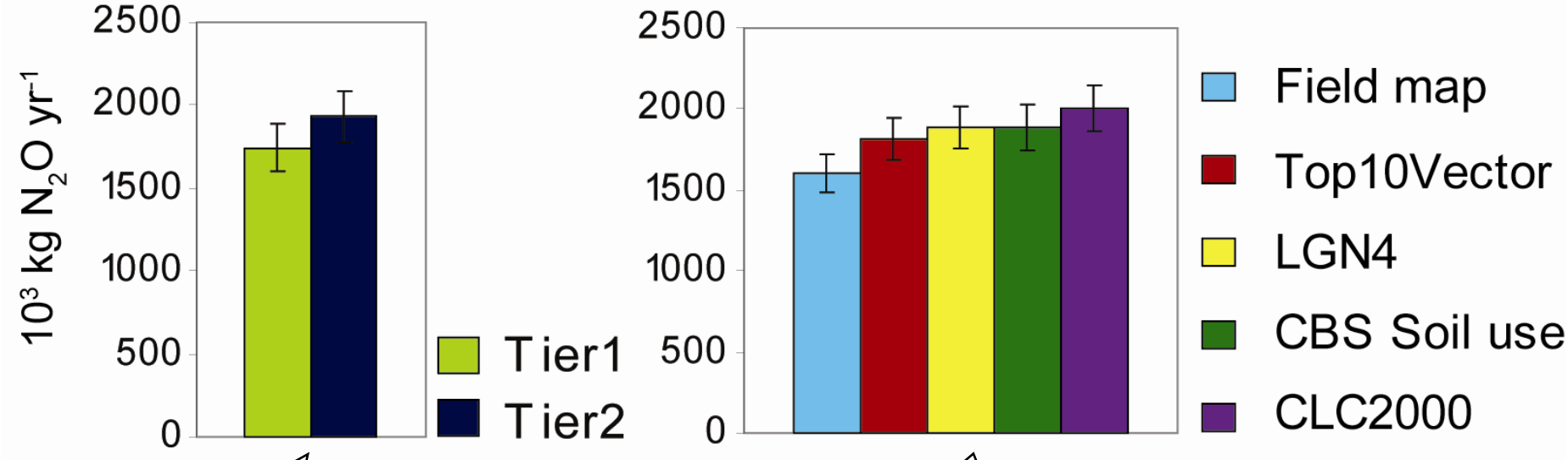
Upscaling to the Western fen meadow system



N_2O emission of Dutch Western fen meadow system



Error bars: variation in land cover data

Error bars: variation in inventory methods

Land cover data → N_2O inventories

- Overestimating of grassland (up to 31%)
- Causing overestimating N_2O emissions (up to 24%)
- Field scale
  - Differences inventory methods > differences land cover data
- Regional scale
  - Differences inventory methods < differences between land cover data

Main conclusion

Errors in land cover data are systematic and do not average out in space

Don’t forget the ditches!!

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Karin Molenaar

Nol et al (in press). Effect of land cover data on N_2O inventory in fen meadows. Journal of Environmental

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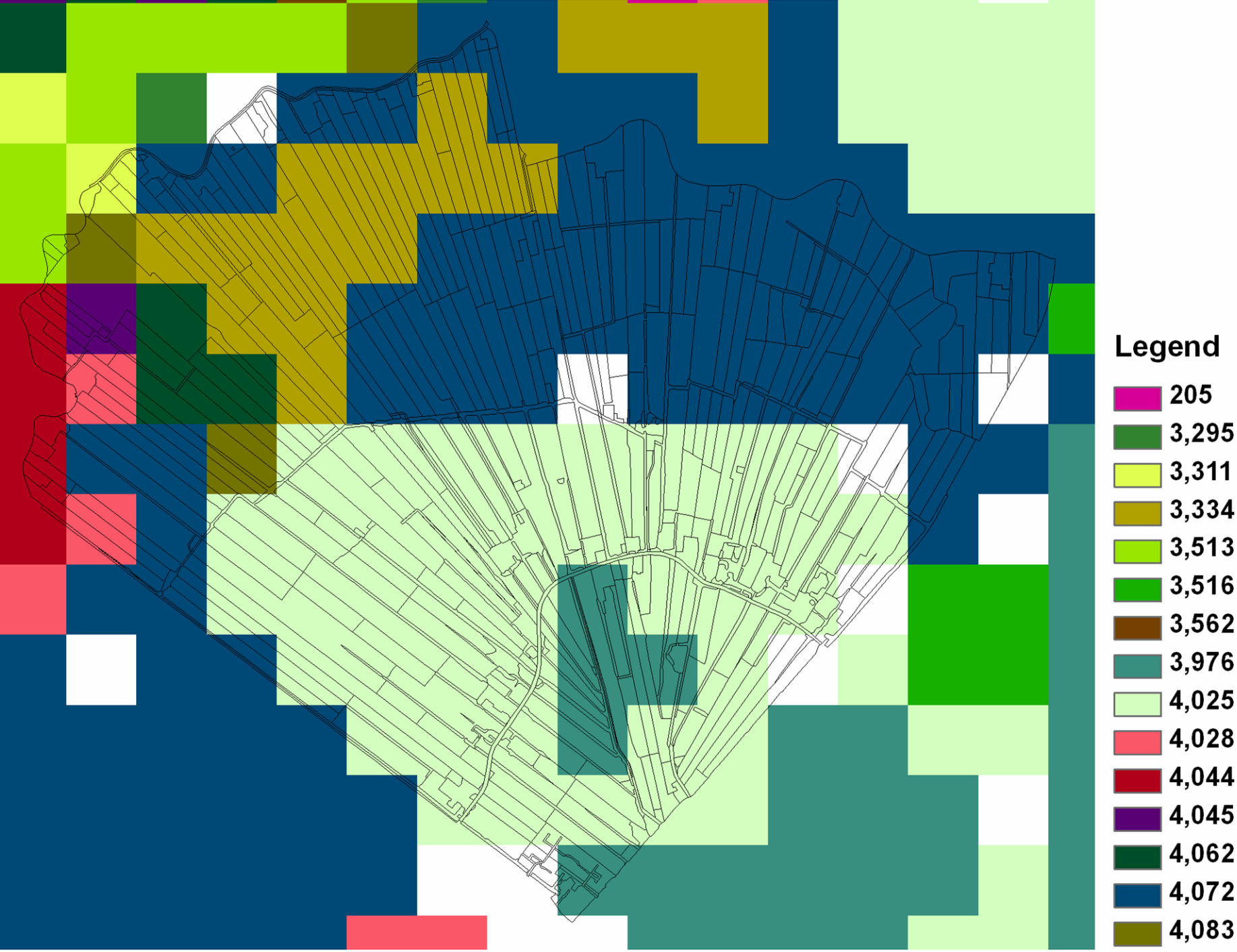
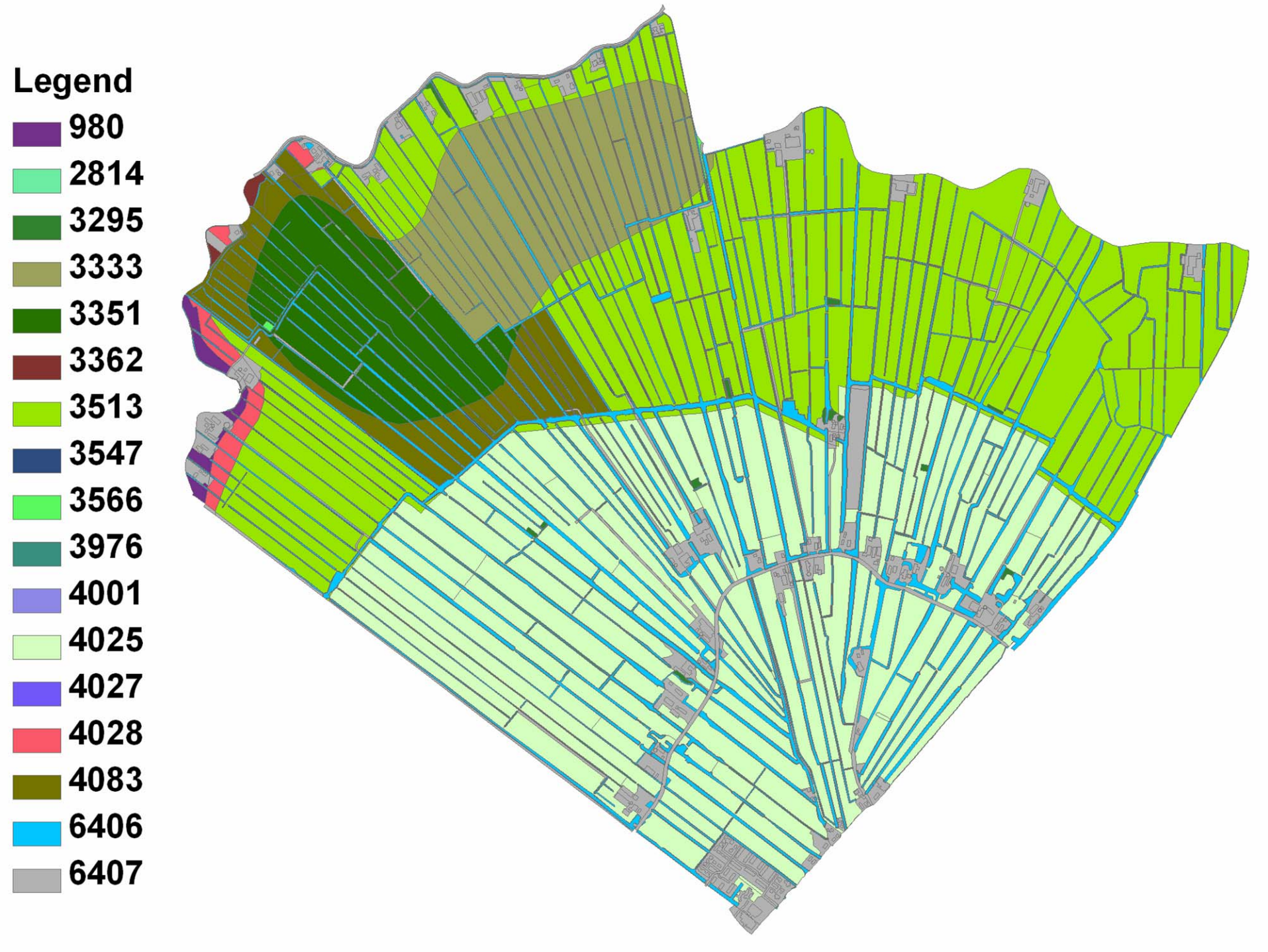
This research will soon be published in JEQ


Legend
205
3,295
3,311
3,334
3,513
3,516
3,562
3,976
4,025
4,028
4,044
4,045
4,062
4,072
4,083


Legend
980
2814
3295
3333
3351
3362
3513
3547
3566
3976
4001
4025
4027
4028
4083
6406
6407

Emission factors for N_2O emission from agriculture for different Tier levels

	Direct				Animals	Indirect	
Category	Fertilizer	Manure	Peat	Grazing	Manure	Atm.Dep	Leaching
EF	$EF_{1,SN}$	$EF_{1,ON}$	EF_2	$EF_{3Pasture}$	$EF_{3Man.Syst}$	EF_4	EF_5
	kg N_2O-N (kg N from applied fertilizer)$^{-1}$	kg N_2O-N (kg N from applied manure)$^{-1}$	kg N_2O-N ha^{-1} yr^{-1}	kg N_2O-N (kg N excreted in pasture)$^{-1}$	kg N_2O-N (kg N_2O-N in manure system)$^{-1}$	kg N_2O-N (kg NH_3-N+NO_X-N)$^{-1}$	kg N_2O-N (kg N leached)$^{-1}$
Tier 1	0.0125[a]	0.0125[a]	5.0[b]	0.020[a]	0.001 (Liq) 0.02 (Sol)	0.01[a]	0.025[a]
Tier 2a	0.017[c]	0.020[d]	4.7[e]	0.017[f]	0.001 (Liq) 0.02 (Sol)	0.01[g]	0.025[g]
Tier 2b	0.020[h]	0.020[d]	5.8[i]	0.017[f]	0.001 (Liq) 0.02 (Sol)	0.01[g]	0.025[g]
	$EF_{Denitrification\&Nitrification}$ kg N_2O-N (kg N input)$^{-1}$						
Tier 3 NL	0.031 ± 0.014[j]				0.001 (Liq) 0.02 (Sol)	0.031 ±0.014[j k]	0.033 ± 0.012[j k]
Tier 3 Research Polders	0.049 ± 0.006[j]				0.001 (Liq) 0.02 (Sol)	0.049 ± 0.006[j k]	0.046 ± 0.005[j k]

Surface area of grassland in research polders

Database	Polder Zegveld (in ha)				
	Total Grassland	Grassland (intensive)	Grassland (extensive)	Water	Ditch bank
Field map	513	434	70	70	33
Top10Vector	586	--	--	30	--
CBS Soil Use	640	--	--	19	--
LGN4	627	579	47	8	--
CLC2000	669	--	--	0	--

Database	Polder Oukoop (in ha)				
	Total Grassland	Grassland (intensive)	Grassland (extensive)	Water	Ditch bank
Field map	115	86	29	35	10
Top10Vector	142	--	--	19	--
CBS Soil Use	152	--	--	15	--
LGN4	155	155	0	8	--
CLC2000	167	--	--	1	--

Distribution of landscape elements in research polders used as reference for upscaling

Research Polder	Reclamation landscape	Landscape elements (%)		
		Grassland parcels	Ditches	Ditch banks
Polder Zegveld	'Cope' reclamation	87.6	10.5	4.9
Polder Oukoop	Reclamation with wide ditches	84.3	20.7	6.0
Polder Menningweer	Irregular reclamation	87.3	12.0	2.0

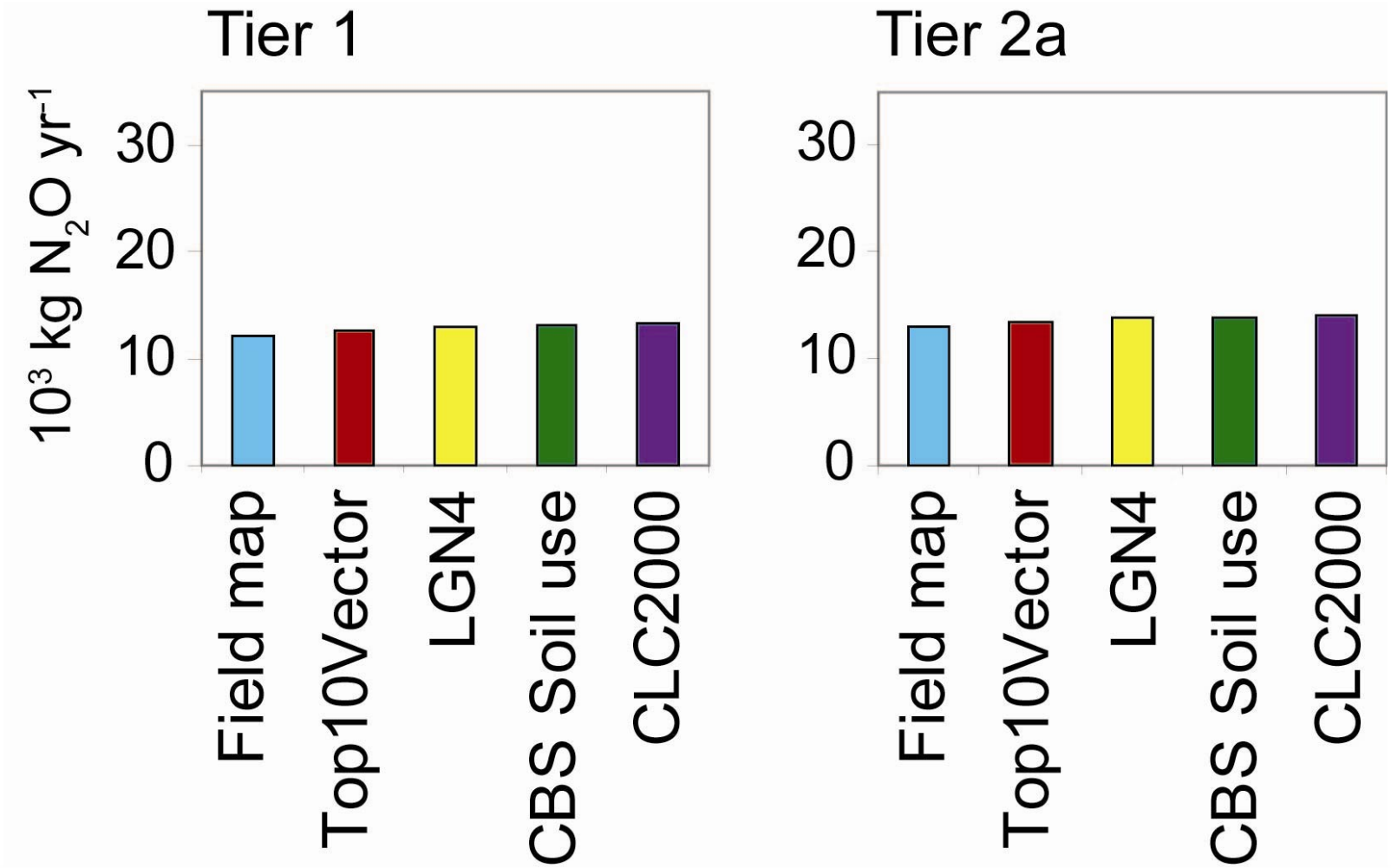
Surface area of grassland in western fen meadow landscape

Database	Surface area of grassland (ha)
Field map	74049
Top10Vector	86891
CBS Soil use	92692
LGN4	87461
CLC2000	96391

N_2O emission estimated for the Western fen meadows (10^3 kg N_2O yr^{-1})

	Cultivation of Histosols		Total Emission from Agriculture	
Database	Tier 1	Tier 2a	Tier 1	Tier 2a
Field map	582	547	1517	1685
Top10Vector	683	642	1725	1910
CBS Soil use	728	685	1747	1979
LGN4	687	646	1788	1987
CLC2000	757	712	1902	2106

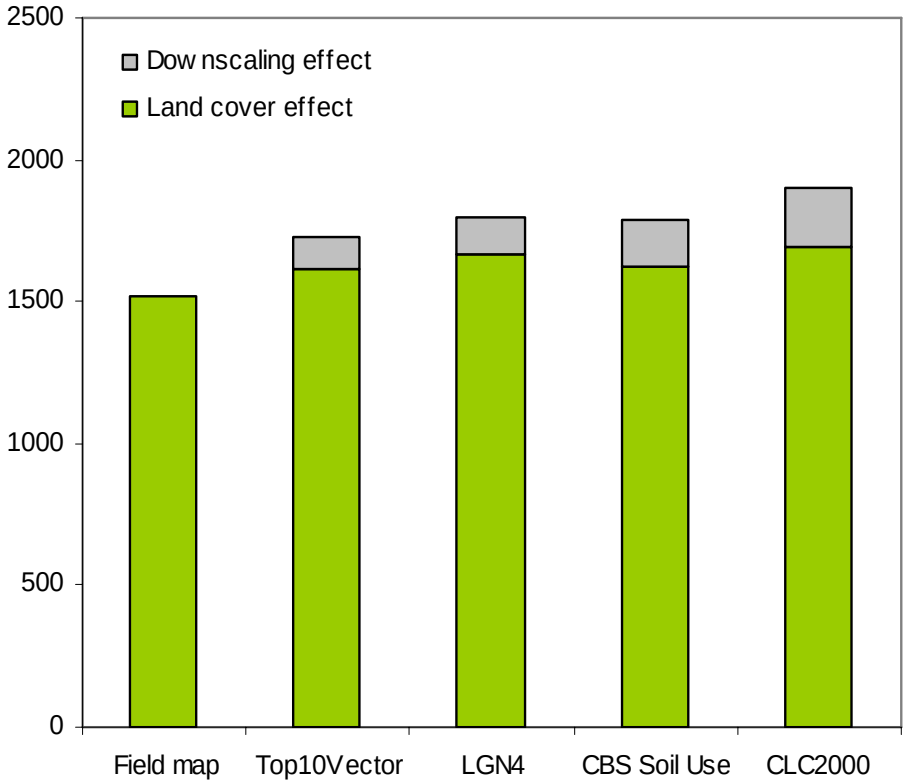
Effect of Land cover input for polder Zegveld



Downscaling and land cover effect

Western fen meadow system

Tier 1



Tier 2a