The use of a Fertiliser Allocation Model for the evaluation of the impact of farm practices and policy measures on fertiliser use, nitrate residues and nitrate leaching

Mia Tits[a], Mattias Van Opstal[b], Tom D'heygere[c], Annemie Elsen[a] , Jan Diels[b]

[a] Soil Service of Belgium, Heverlee, Belgium
[b] Department of Earth and Environmental Sciences, KU Leuven – University of Leuven, Leuven, Belgium
[c] Flanders Environment Agency, Aalst, Belgium

Fertiliser Allocation Model: Background

ArcNEMO: Nutrient emission model: quantification of nitrogen and phosphorus losses from agriculture to surface water

(D'Heygere et al., 2015)

→ ability to calculate a large range of (policy) measures concerning fertilisation

Spatially distributed model; resolution 50m x 50m

Processes in unsaturated zone of the soil profile: soil balance model for mineral N and P:

input	**output**
atmospheric deposition	crop uptake
mineralisation	denitrification
erosion	erosion
fertilisation	drainage
	leaching

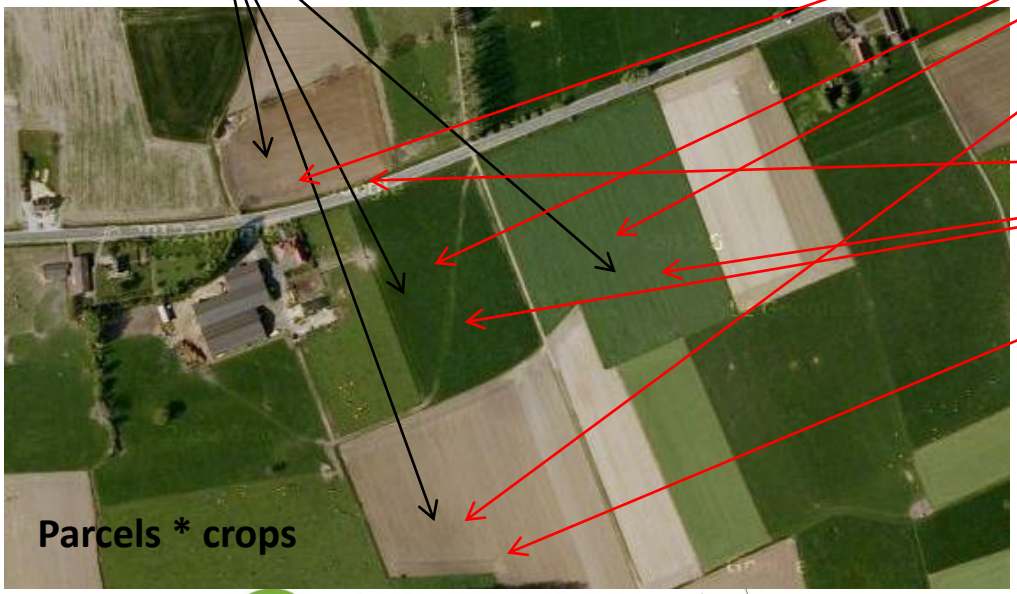
Input data available in Flanders concerning fertilisation, at parcel level?

Fertiliser Allocation Model: Background

Total use of N and P_2O_5 from animal manure

?

Total use of N and P_2O_5 from mineral fertilisers



Fertiliser Allocation Model: Objective

estimation of
the applied amount of N and P from animal and mineral fertilisers
on each agricultural parcel,
per fertiliser type:

- animal manure (animal origin, liquid or solid manure,…)
- mineral fertilisers

based on available information from the Flemish authorities (Flemish Land Agency)

by simulating the reasoning and practices adopted by Flemish farmers to fertilise their land.

Use of the Fertiliser Allocation Model (BAM) for scenario analysis

Scenario 0: reference scenario: actual fertilisation standards, actual cropping practices

Scenario 9: providing a winter cover crop on each parcel (mustard or grass)

→ fertilisation standards of parcels ↗

Scenario 11: application of fertilisation standards at farm level (not at parcel level)

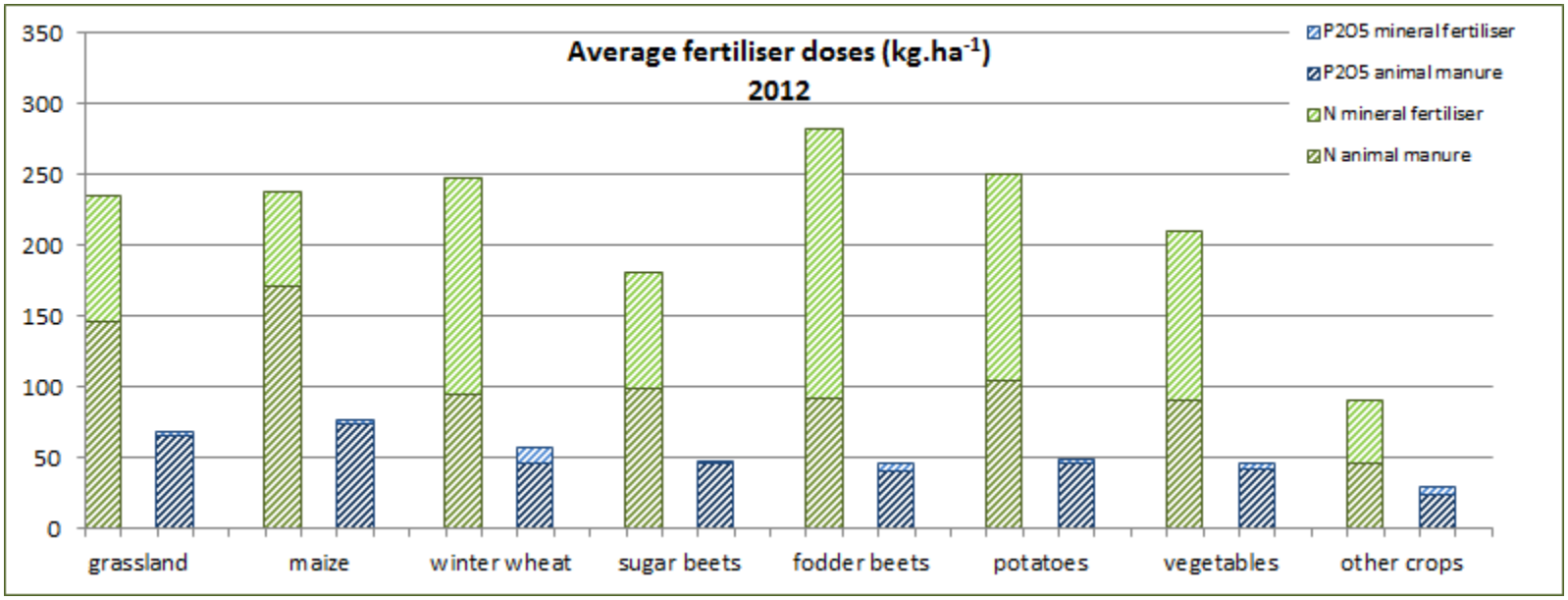
→ permission to fertilise more on some parcels if compensated by less on others; fertiliser allocation capacity at farm level must be respected.

→ drastic change of the allocation of available fertilisers to the parcels

fertiliser allocation capacity = $\sum_{parcels} (fertilisation\ standard * surface)$

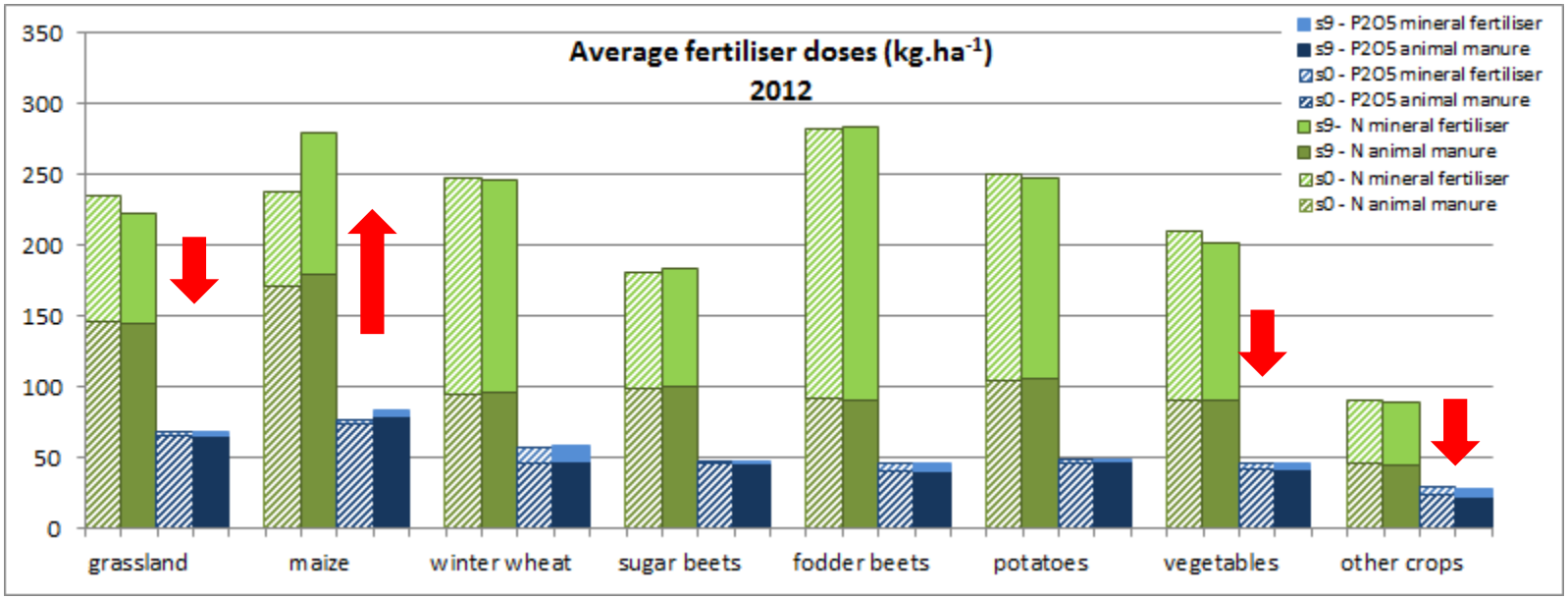
Reference scenario (s0):
actual situation (actual fertilisation standards and cropping practices)

Average calculated fertilisation doses per crop (Flanders):



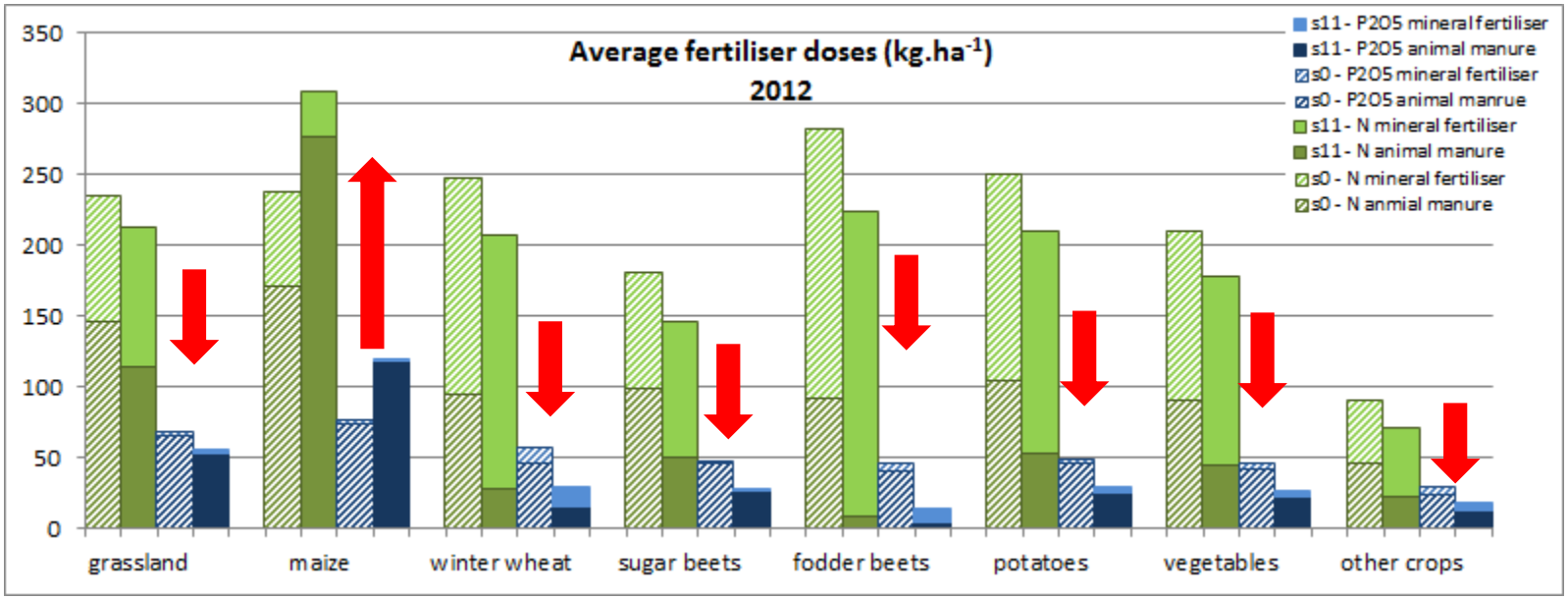
Scenario Winter cover crop (s9):
winter cover crop on each parcel (catch crops mustard or grass)

Average calculated fertilisation doses per crop (Flanders):

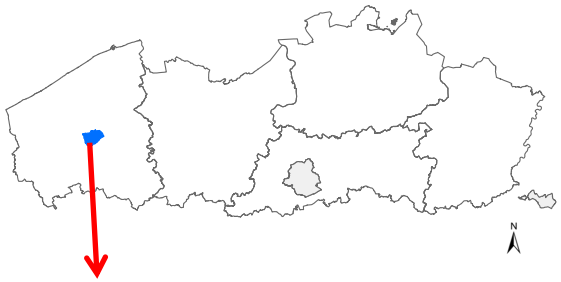


Scenario Farm level fertilisation (s11):
application of fertilisation standards on farm level (not on parcel level)

Average calculated fertilisation doses per crop (Flanders):

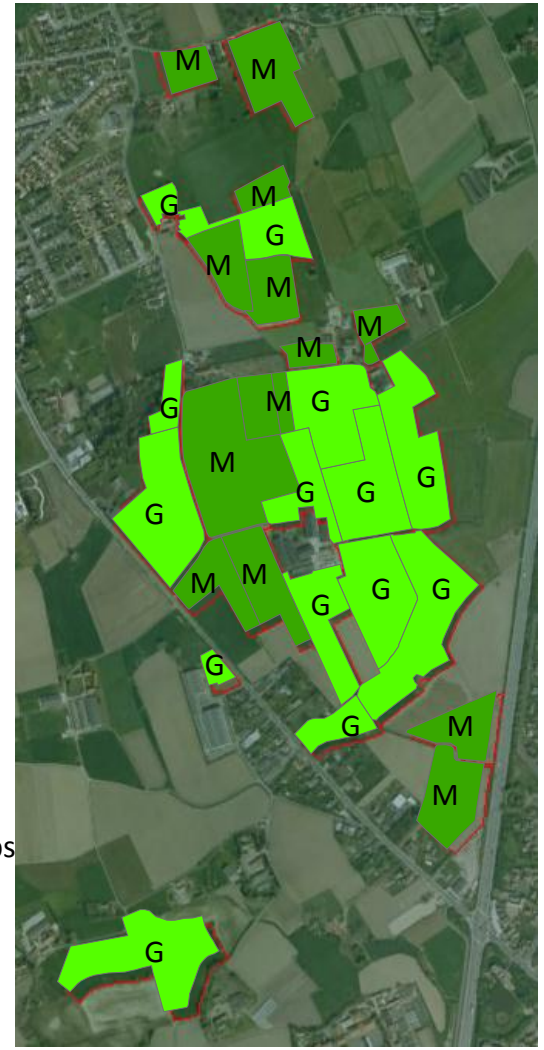


Example farm1: mixed farm with mainly maize and grassland

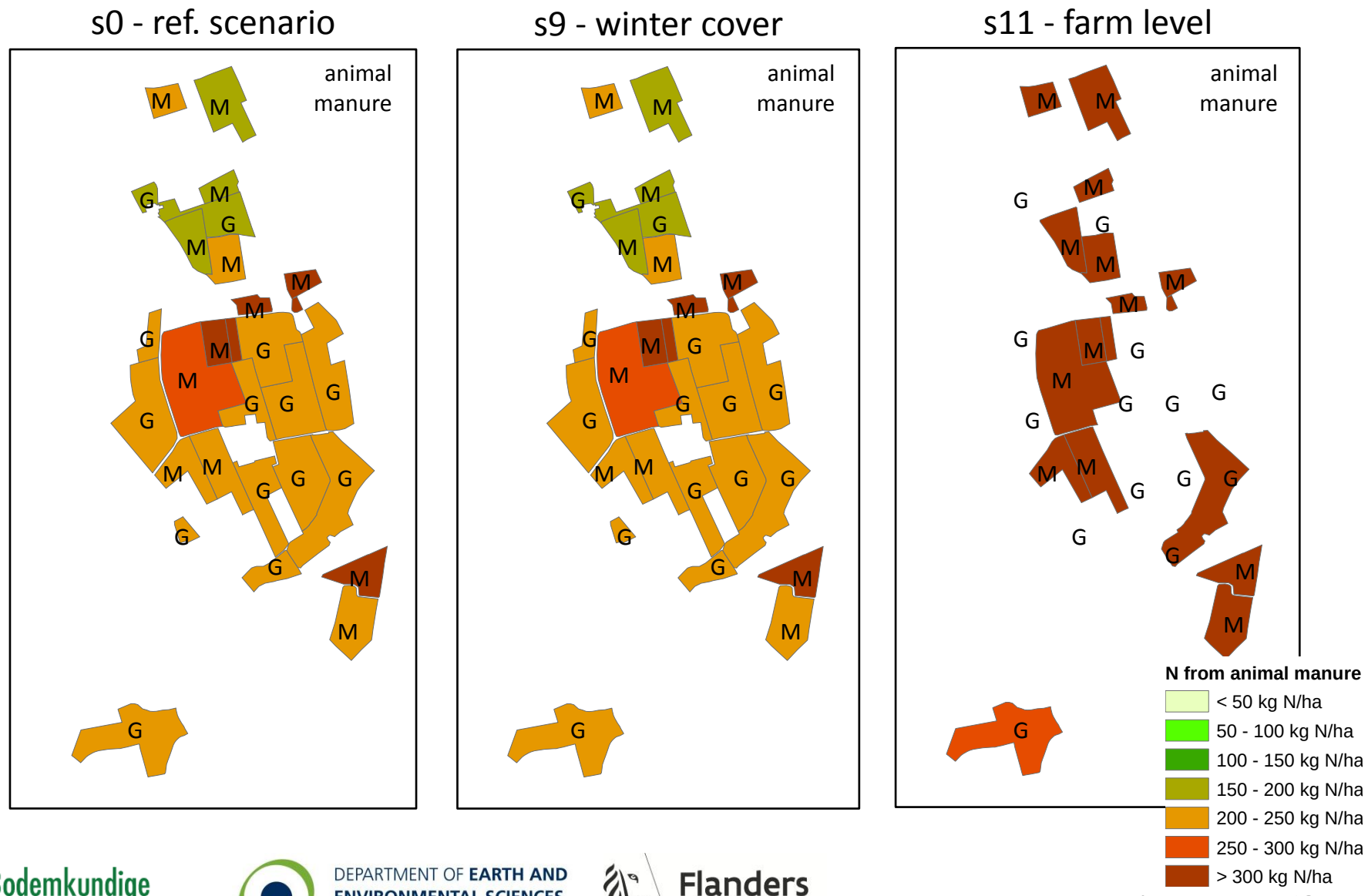


sandy loam region (West-Flanders)
grassland (34 ha)
maize (25 ha)
pigs (2661)
cattle (292)

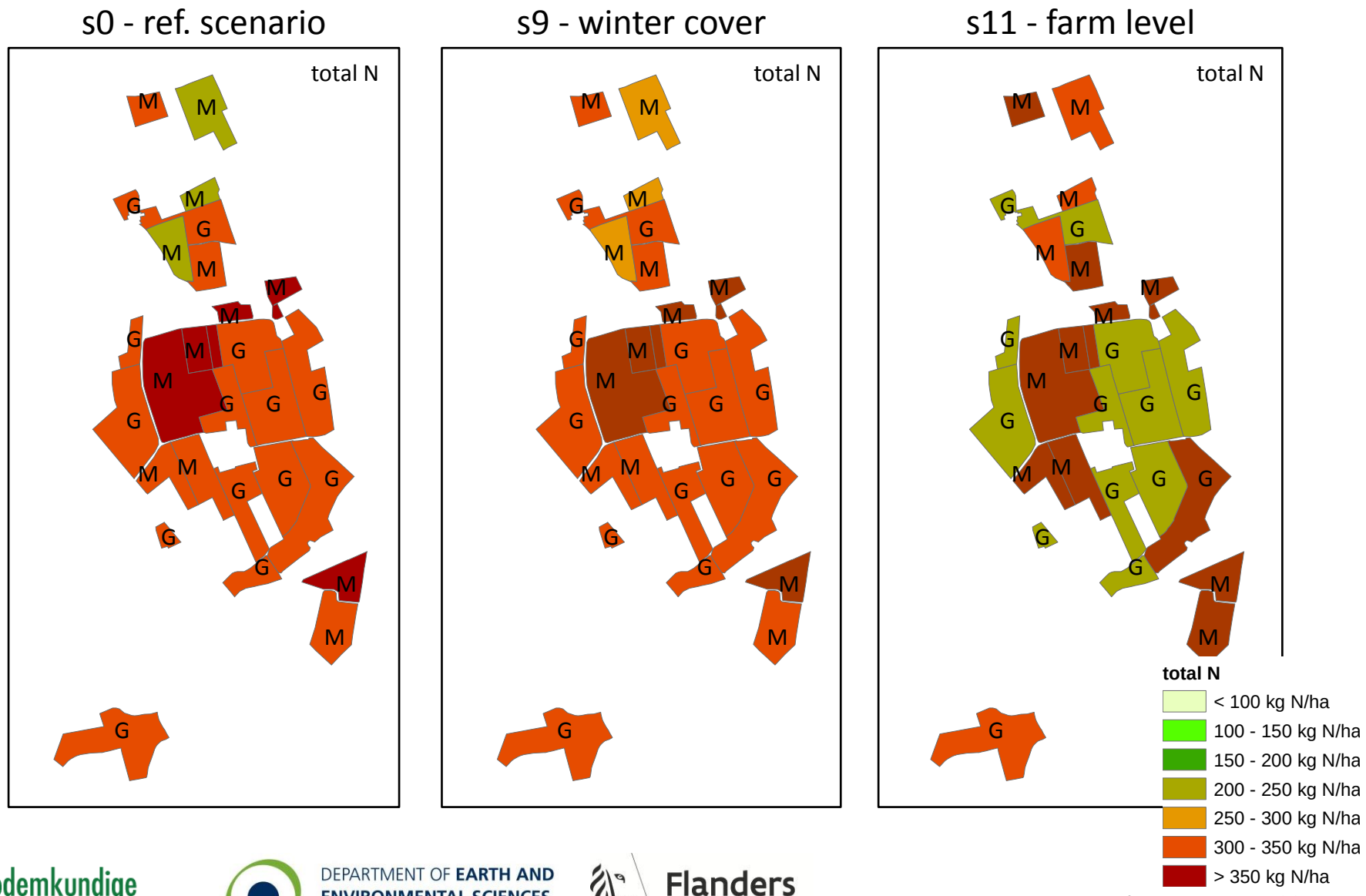
total N fertiliser use:
- 13 400 kg N from animal manure
- 6 800 kg N from mineral fertilisers



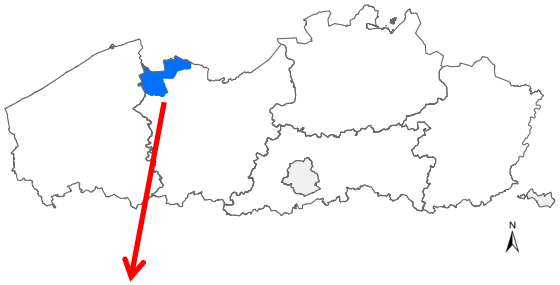
Farm1 (maize & grassland): calculated N fertilisation in different scenario's



Farm1 (maize & grassland): calculated N fertilisation in different scenario's



Example farm2: arable farm with different crops



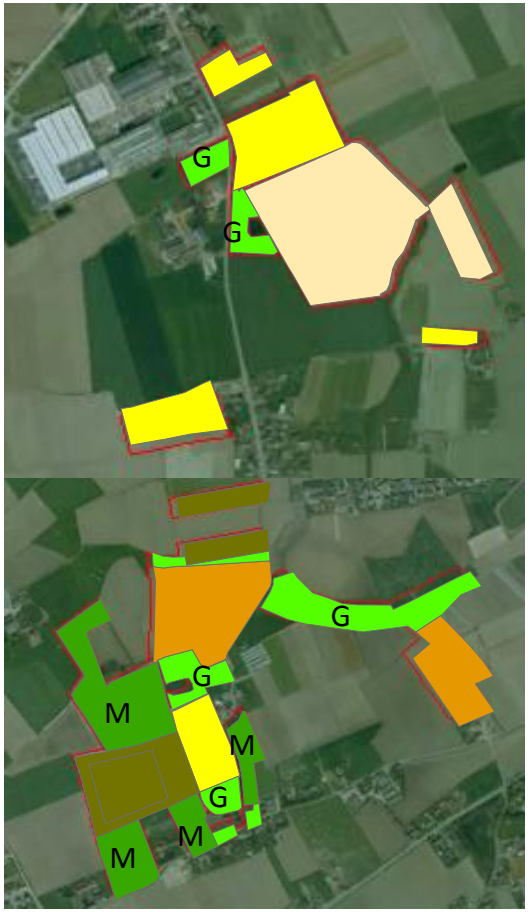
sandy loam region (East-Flanders)
grassland (2 ha)
maize (5 ha)
vegetables (5 ha)
chicory (3 ha)
potatoes (2 ha)
trees and ornamental crops (1 ha)
no animals
total N fertiliser use:

- 2 700 kg N from animal manure
- 900 kg N from mineral fertilisers

Farms

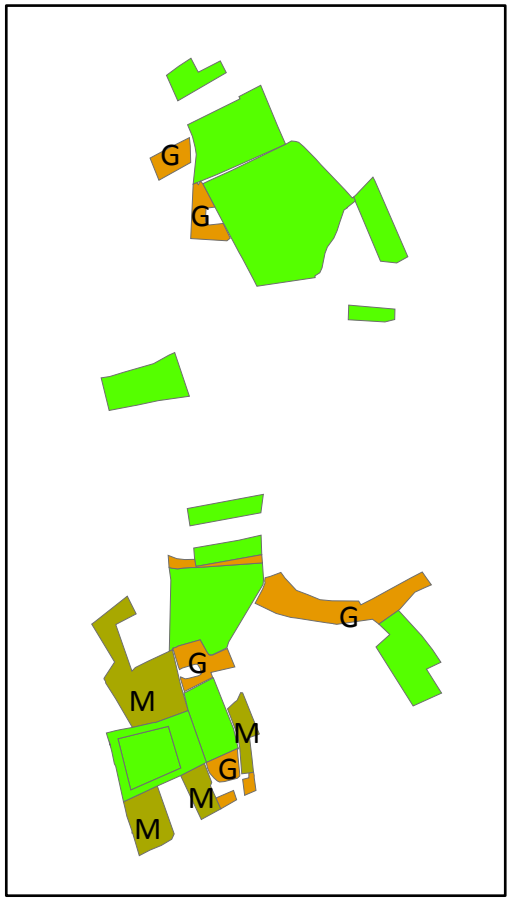
crops

- cereals
- chicory
- grassland
- maize
- ornamental crops
- potatoes
- sugar beet
- vegetables

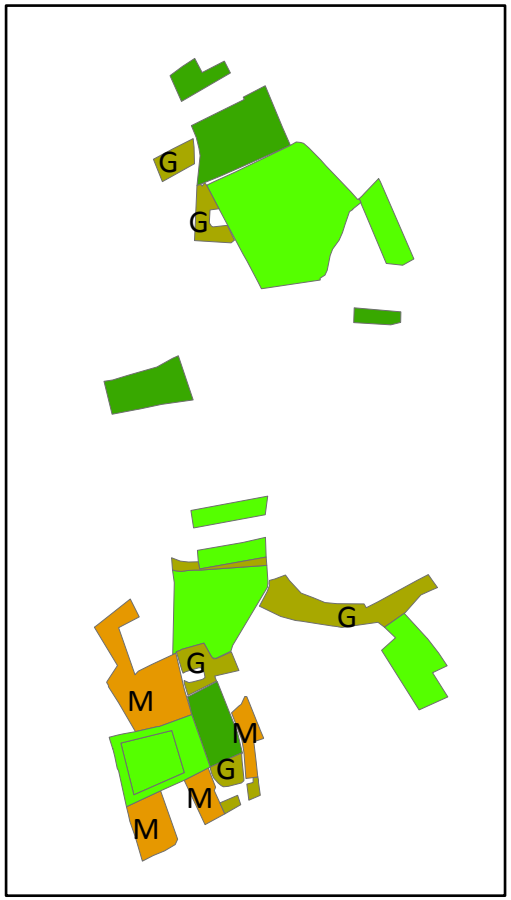


Farm2 (arable crops): calculated N fertilisation in different scenario's

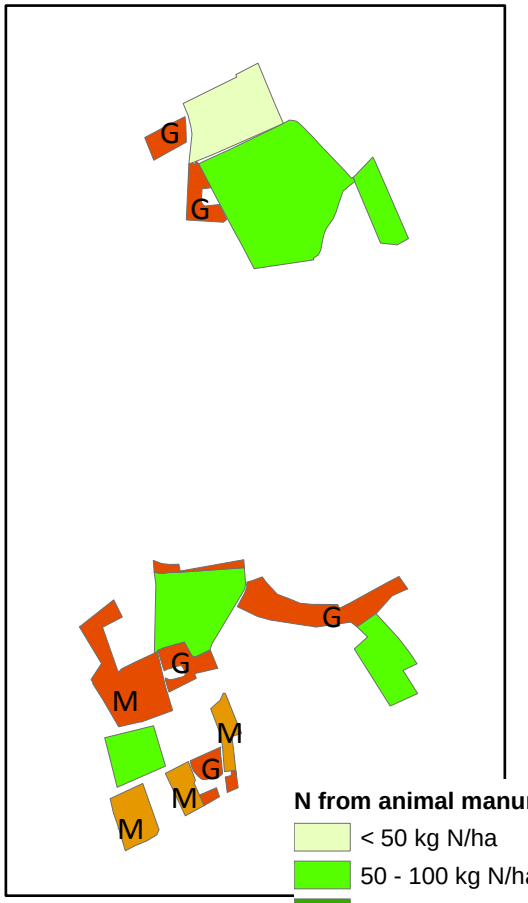
s0 - ref. scenario



s9 - winter cover

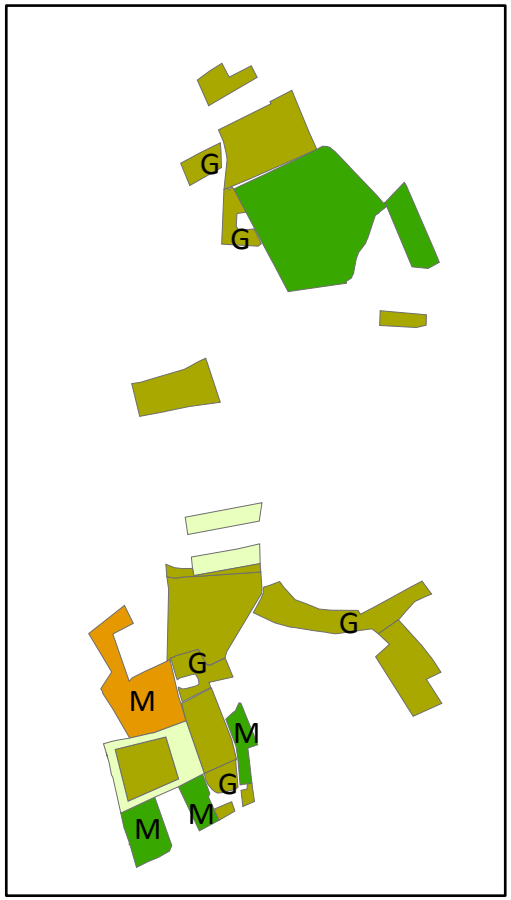


s11 - farm level

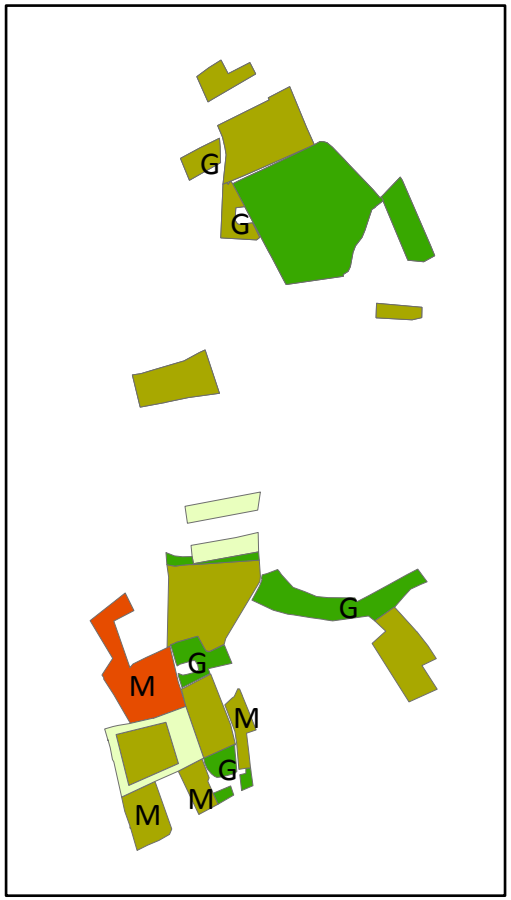


Farm2 (arable crops): calculated N fertilisation in different scenario's

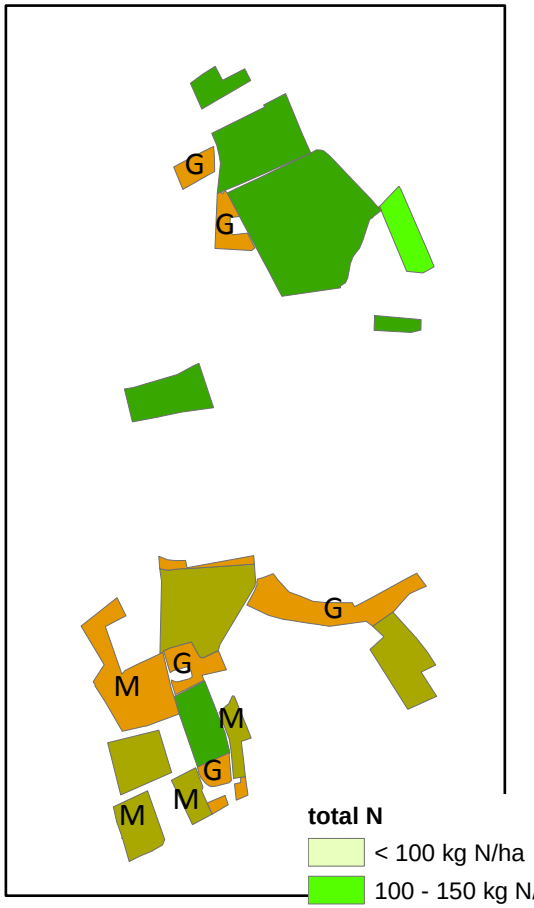
s0 - ref. scenario



s9 - winter cover



s11 - farm level



Conclusions

- The fertiliser allocation model is able to calculate realistic fertiliser doses per parcel at farm and region level.
- Doses are calculated per fertiliser type → modeling of plant uptake, mineralisation, leaching, etc. in ArcNEMO.
- The model simulates the reasoning and practices adopted by Flemish farmers to fertilise their land.
- Therefore it can be used to simulate scenarios in order to estimate the effect of policy measures on fertilisation at parcel level.

Acknowledgement

We'd like to thank the Flemish Land Agency and Flanders Environment Agency for the financial support of this project.

thank you for your attention