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**INSTITUUT
NATUUR- EN BOSONDERZOEK**

Design and implementation of a monitoring scheme to assess habitat quality of European protected habitats in Flanders (Belgium)

ISEC 2018, St-Andrews

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Nature and Forest Research Institute (INBO)



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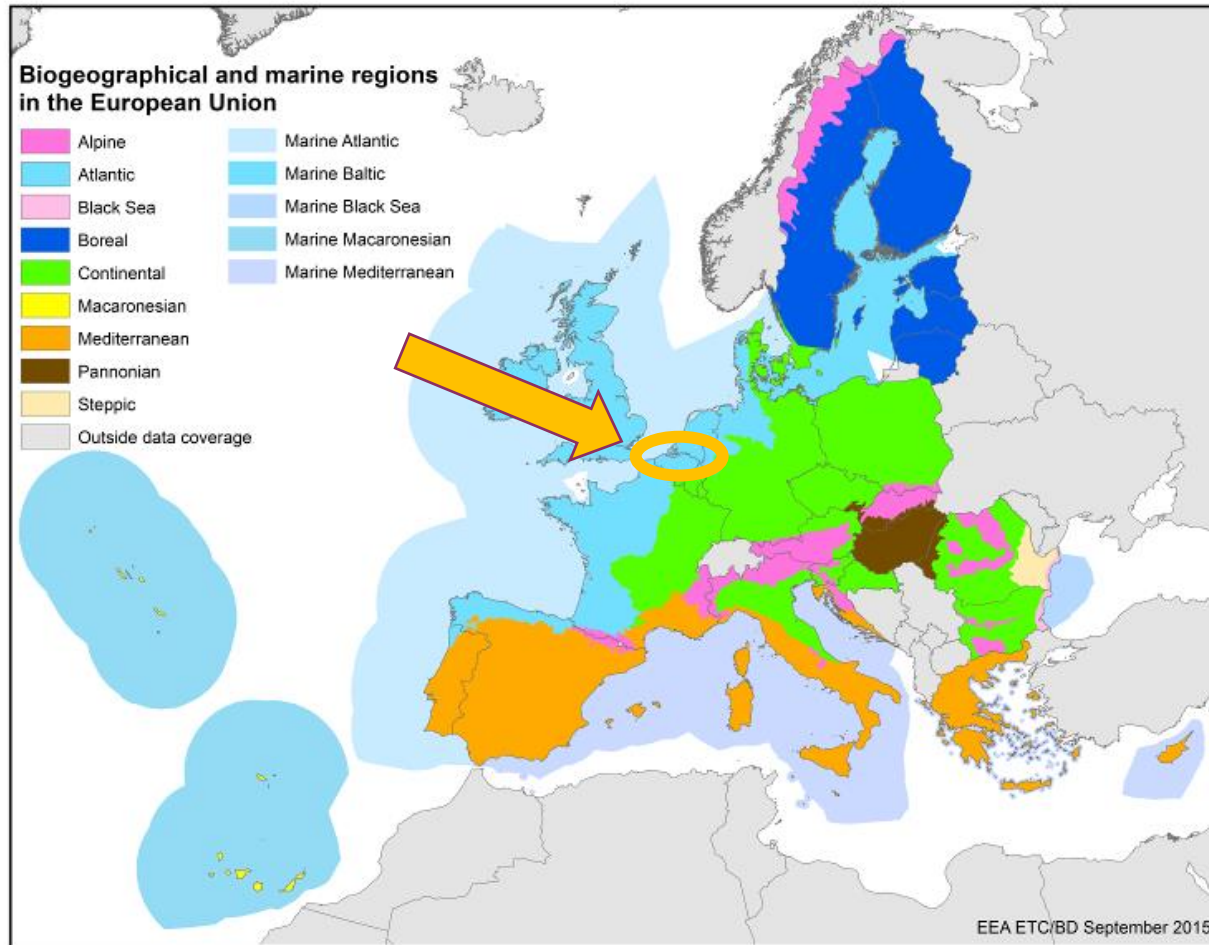
Introduction

Introduction

- ▶ European **Habitat Directive** and **Bird directive**
 - Maintain and restore protected habitats and species
 - Network of protected sites = Natura 2000 – network
 - List of protected habitats ≈ Natura 2000 – habitats



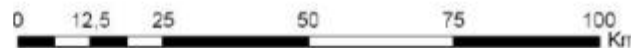
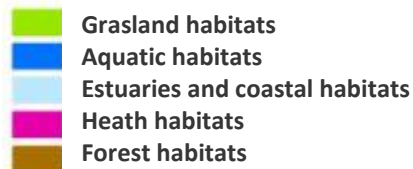
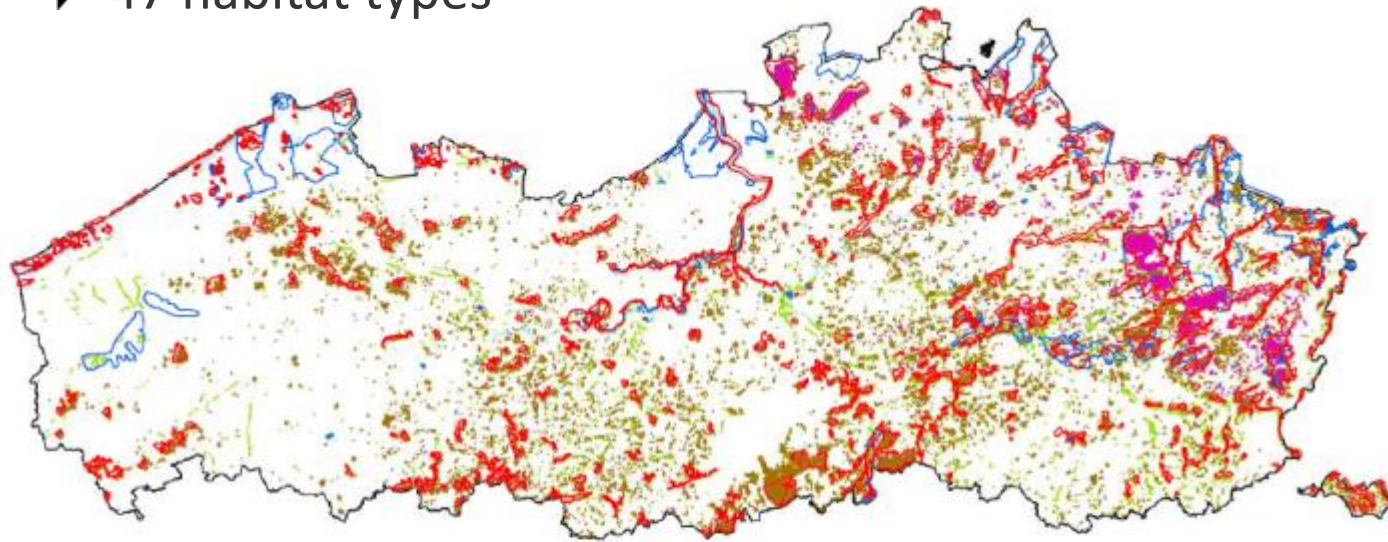
Introduction



Disclaimer: The maps serve for information purposes only, and may not and shall not be construed as an official map representing maritime borders in accordance with international law.

Introduction

- ▶ 4,8% of Flanders is covered by Natura 2000 habitat (66000 hectares)
- ▶ 47 habitat types



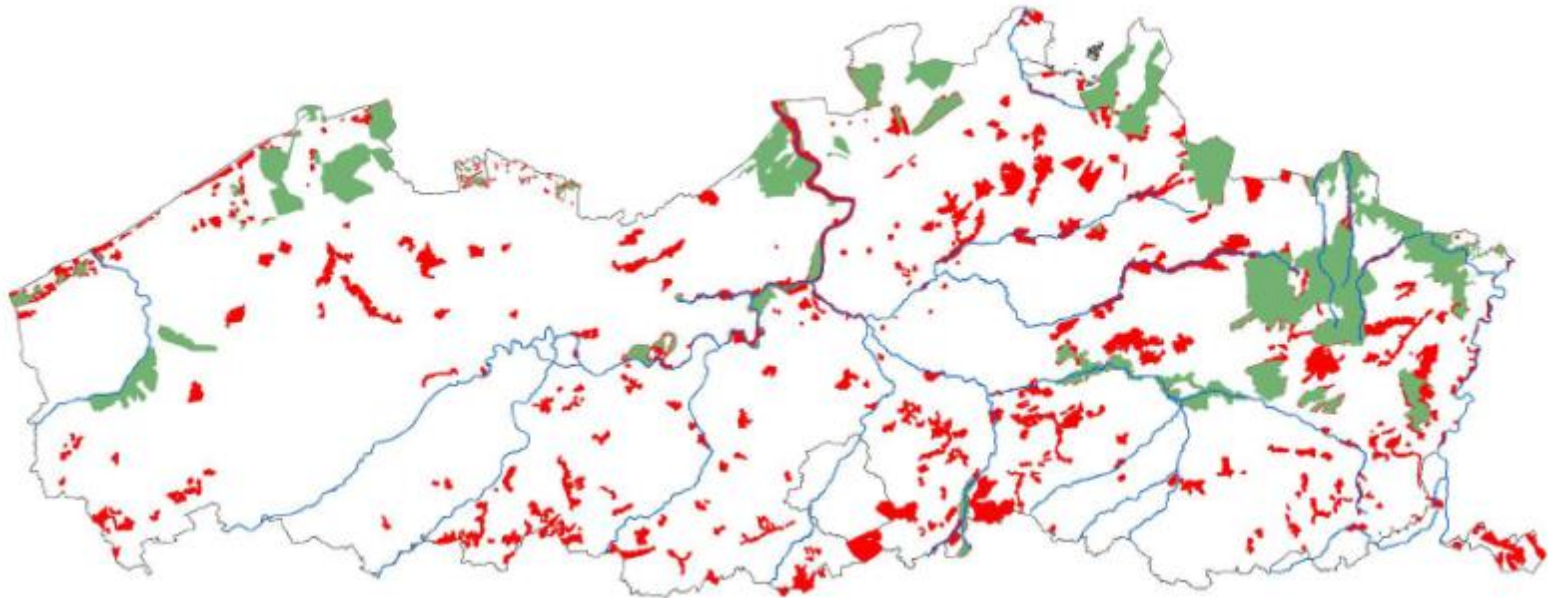
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Introduction

- ▶ 12,3% of Flanders is covered by Natura 2000 network (166.000 ha)
 - **SAC (Habitat directive):** 105.000 ha
 - **SPA (Bird directive):** 98.000 ha



Introduction

- ▶ EU member states have to **report** every 6 years on **conservation status** of Natura 2000 – Habitats
 - Range
 - Area
 - Habitat quality (Structure and functions)
 - Pressures and threats

- ▶ INBO is responsible for monitoring Natura 2000 habitats in Flanders (=~ Atlantic region of Belgium)
 - Habitat mapping → area and range
 - Monitoring scheme → habitat quality



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Monitoring scheme habitat quality

What do we need to measure?

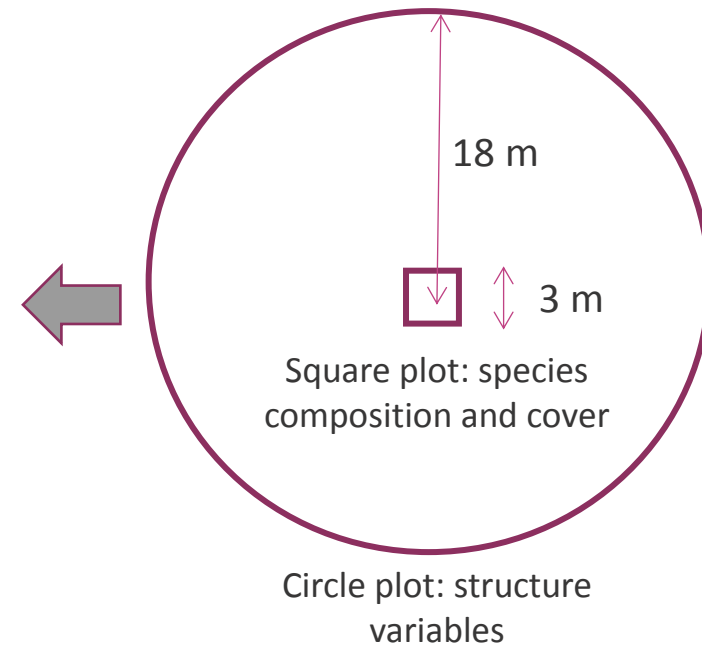
Information needs

% habitat with favourable condition > 25 % ?

Indicators for habitat quality



Measurement variables

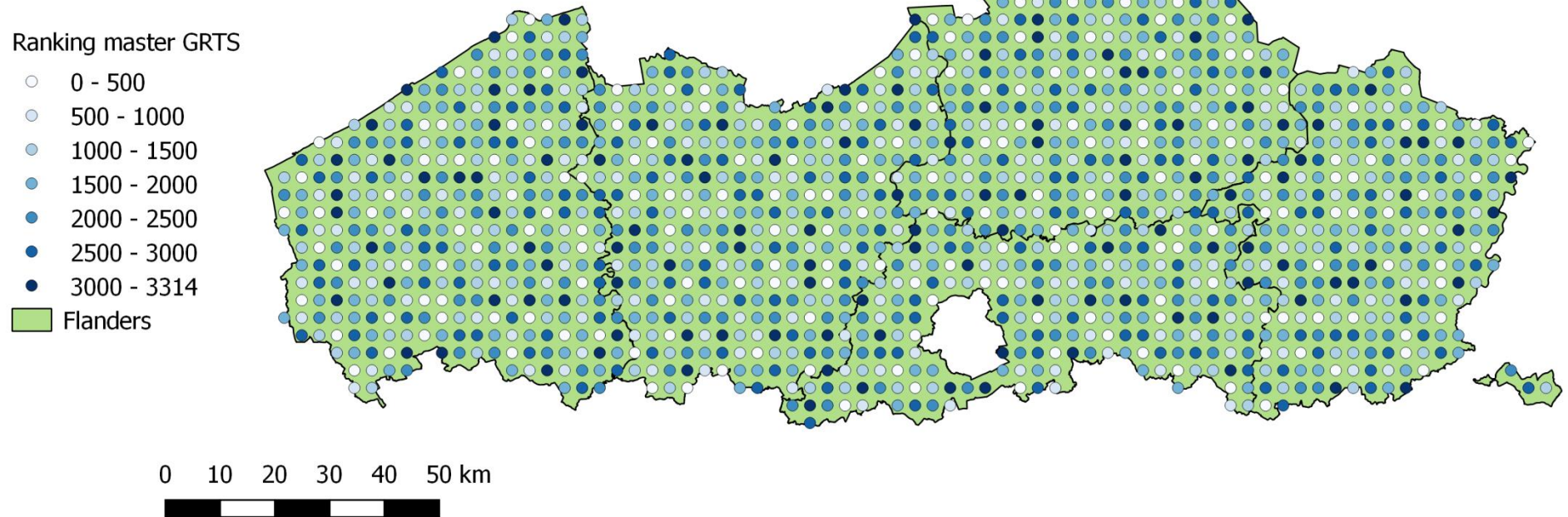


Sample design

- ▶ Sample frame: Habitat map of Flanders
 - + Covers all habitats/subtypes for the whole of Flanders
 - + Update is ongoing
 - Many polygons are partially covered by habitat (but exact location within polygon is not known)
- ▶ Sample method: Generalized Random Tessellation Stratified (GRTS)
 - [Stevens and Olsen \(2004\)](#)
 - Spatially balanced sample
- ▶ Practical implementation
 - GRTS-package (Onkelinx, 2015)
 - 'Master-sample'
 - 32m x 32m GRTS-sample covering Flanders
 - Each sample-point has a unique ranking
 - Separate sample for each habitat type
 - Not for rare habitats (< 10 hectares)

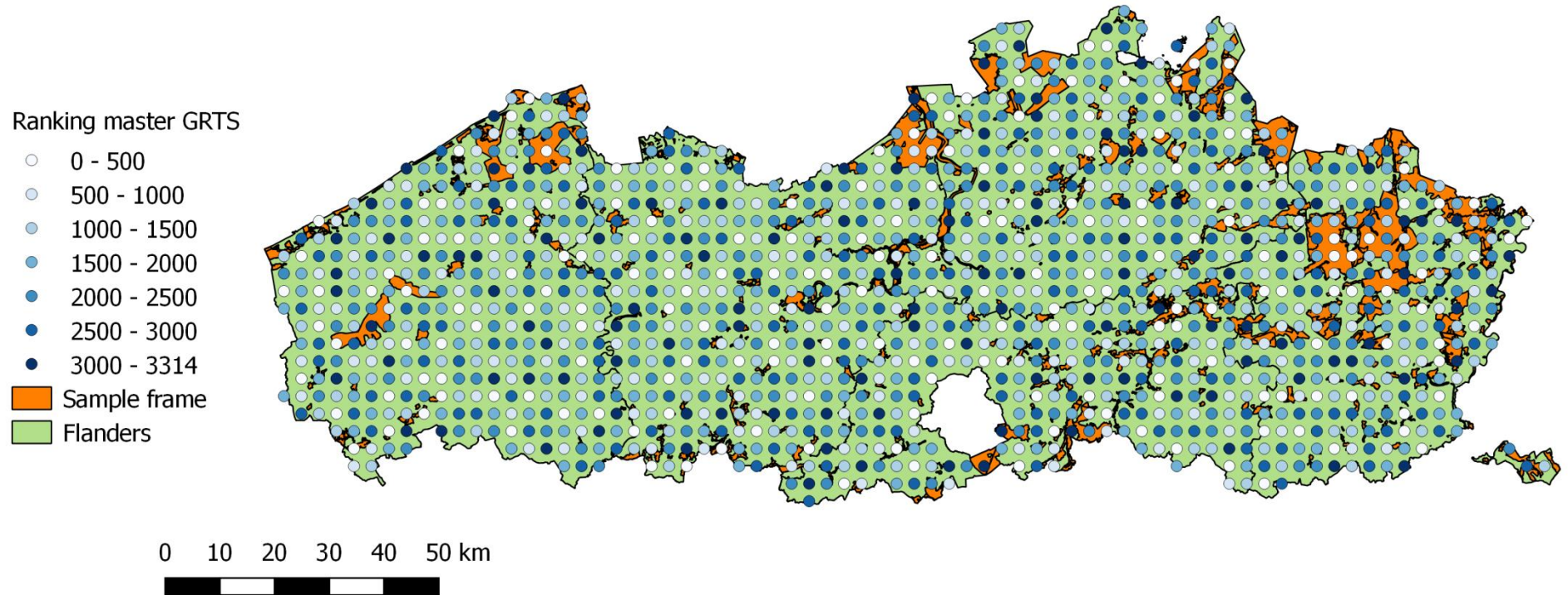
Sample design

Master GRTS-sample



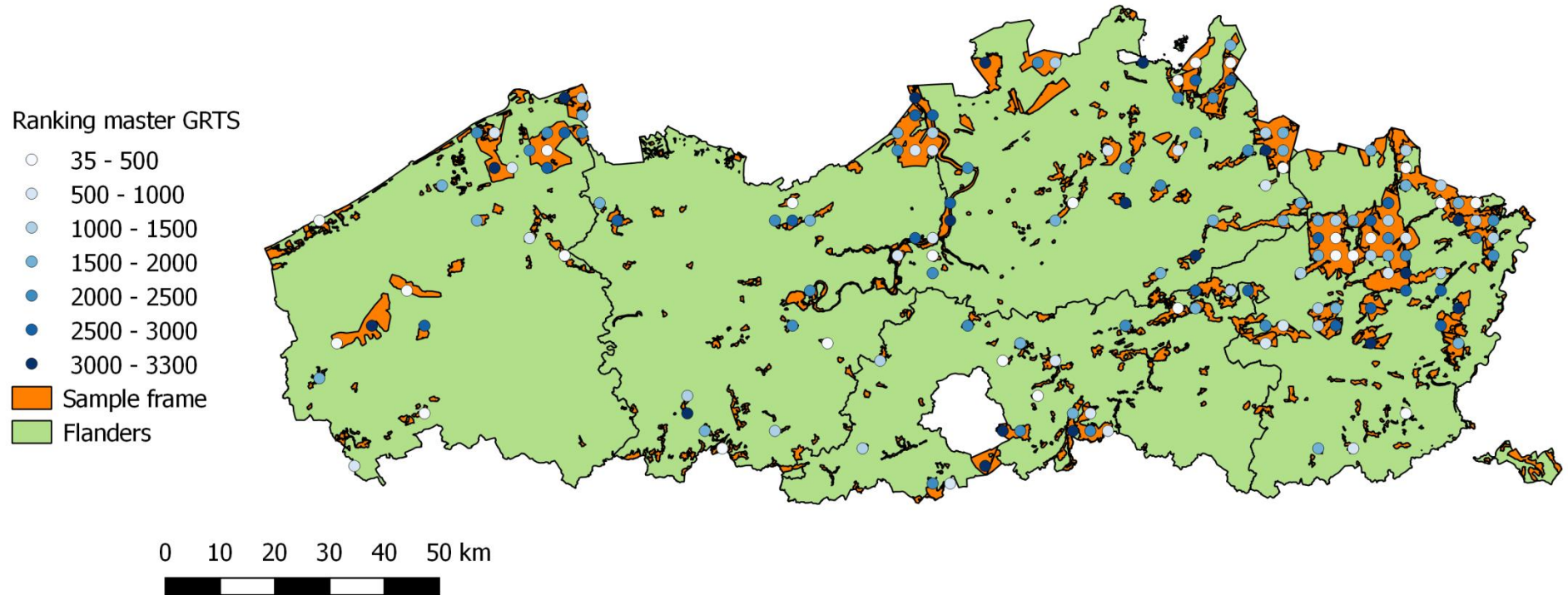
Sample design

Sample frame



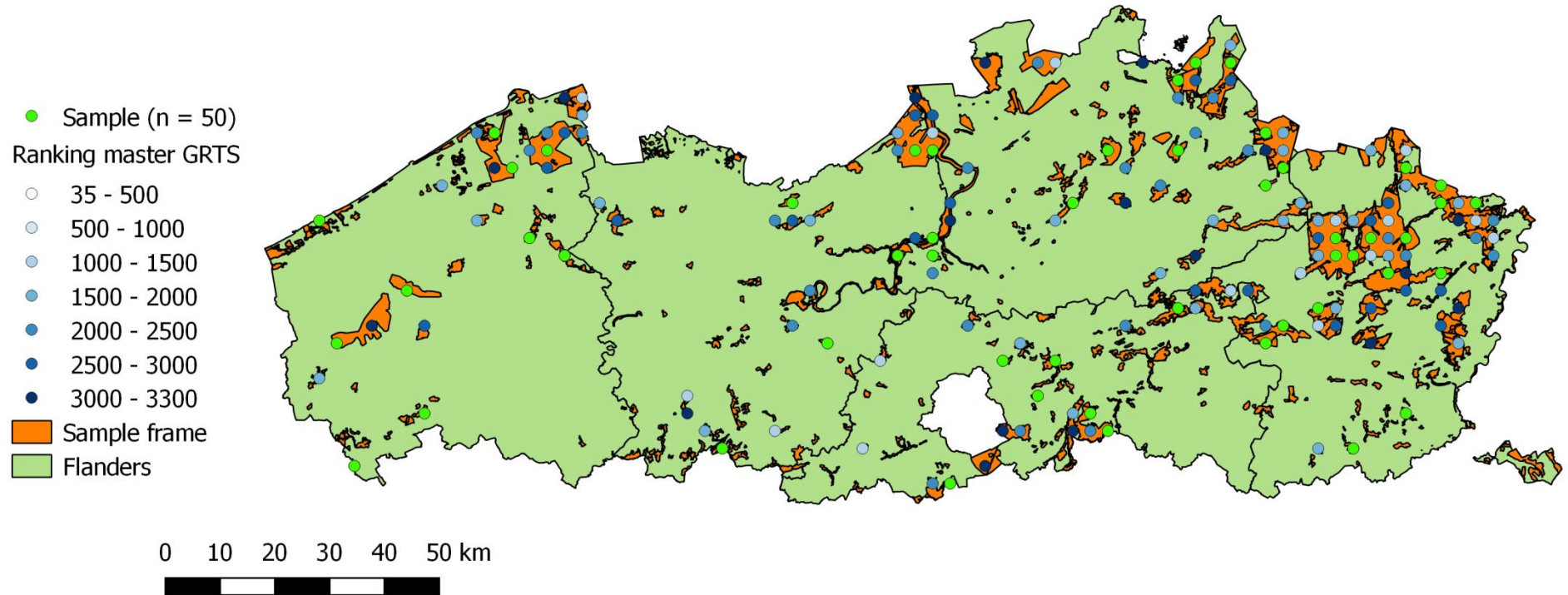
Sample design

Overlay sample frame and master GRTS-sample



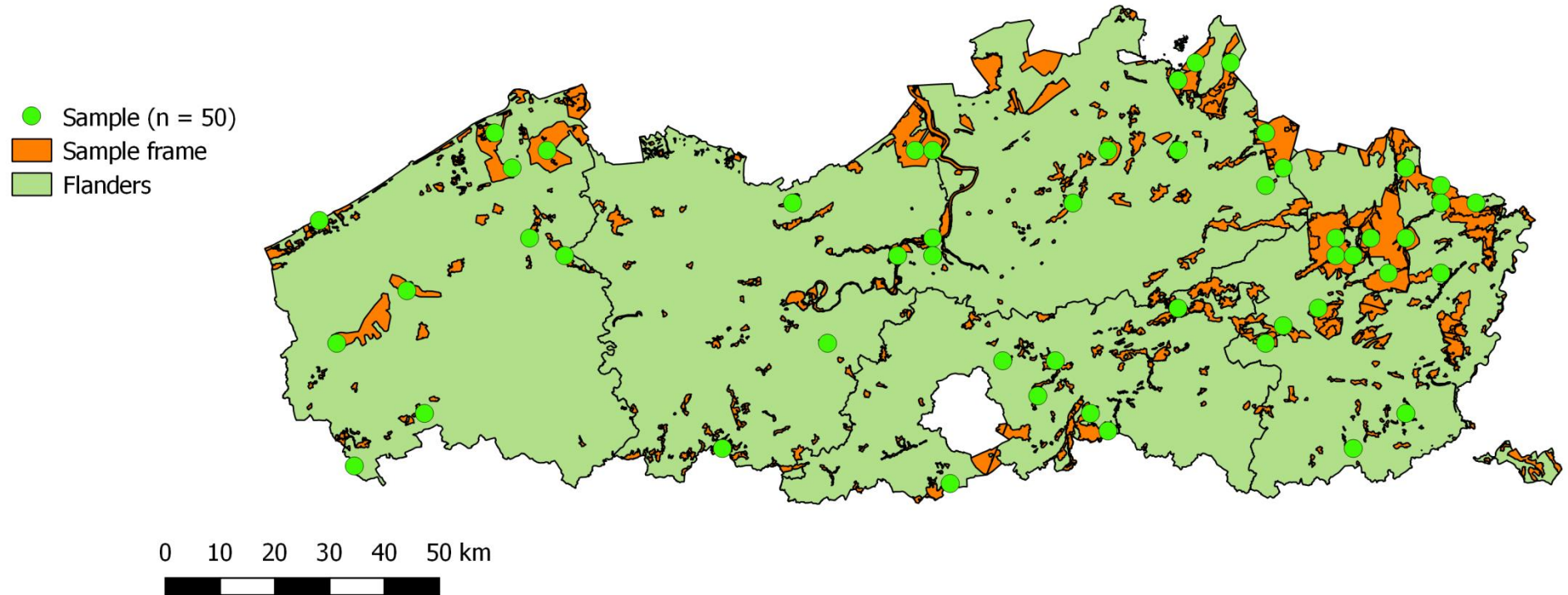
Sample design

Sample (n = 50): select 50 points with lowest ranking



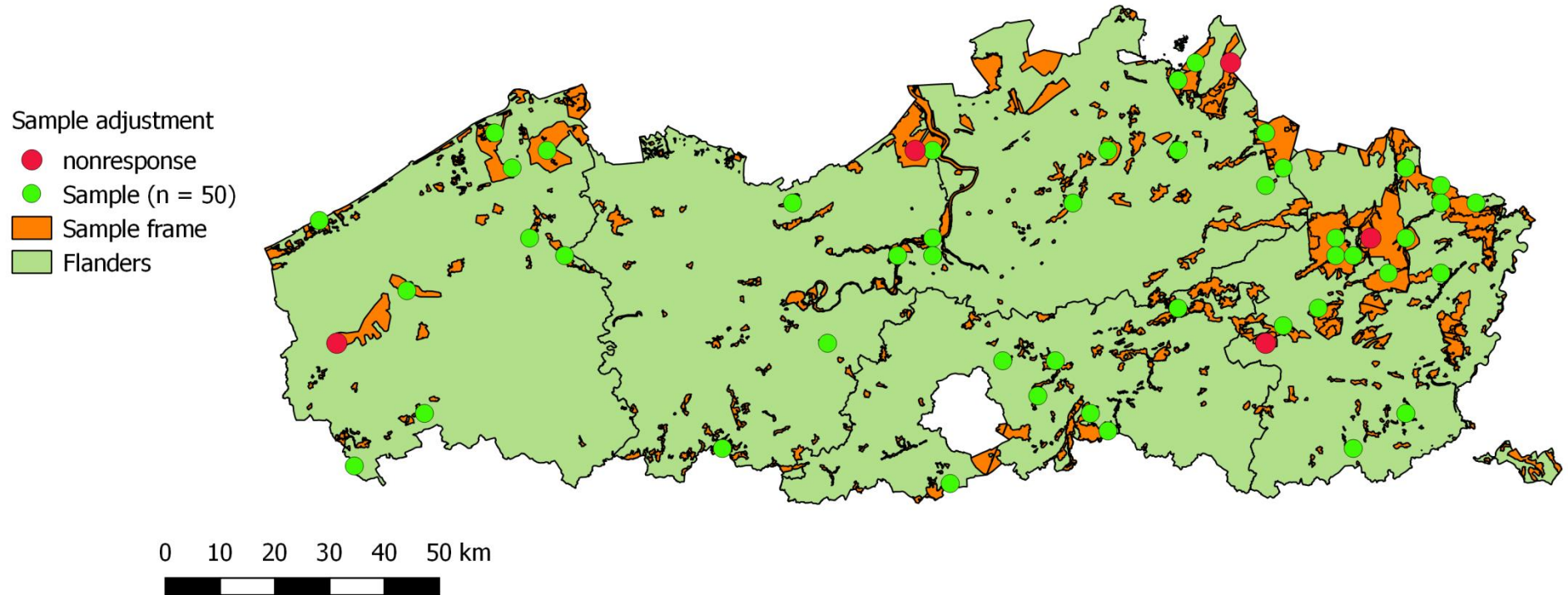
Sample design

Sample (n = 50): select 50 points with lowest ranking



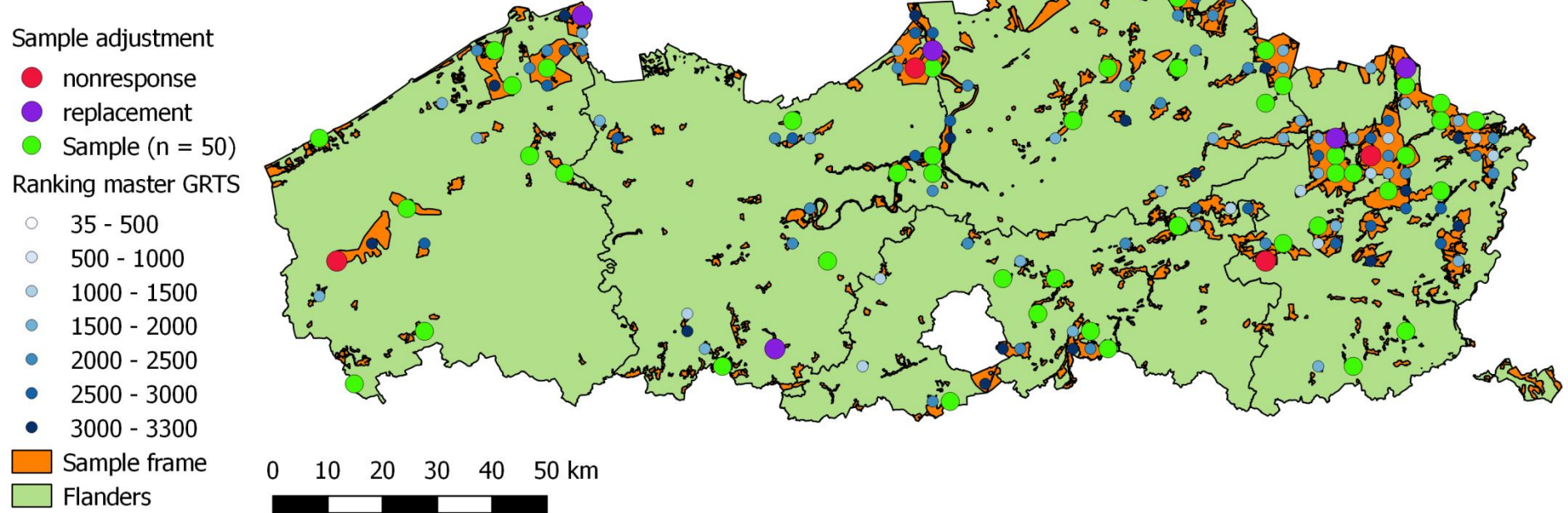
Sample design

Samples can easily be replaced in case of **non-respons**



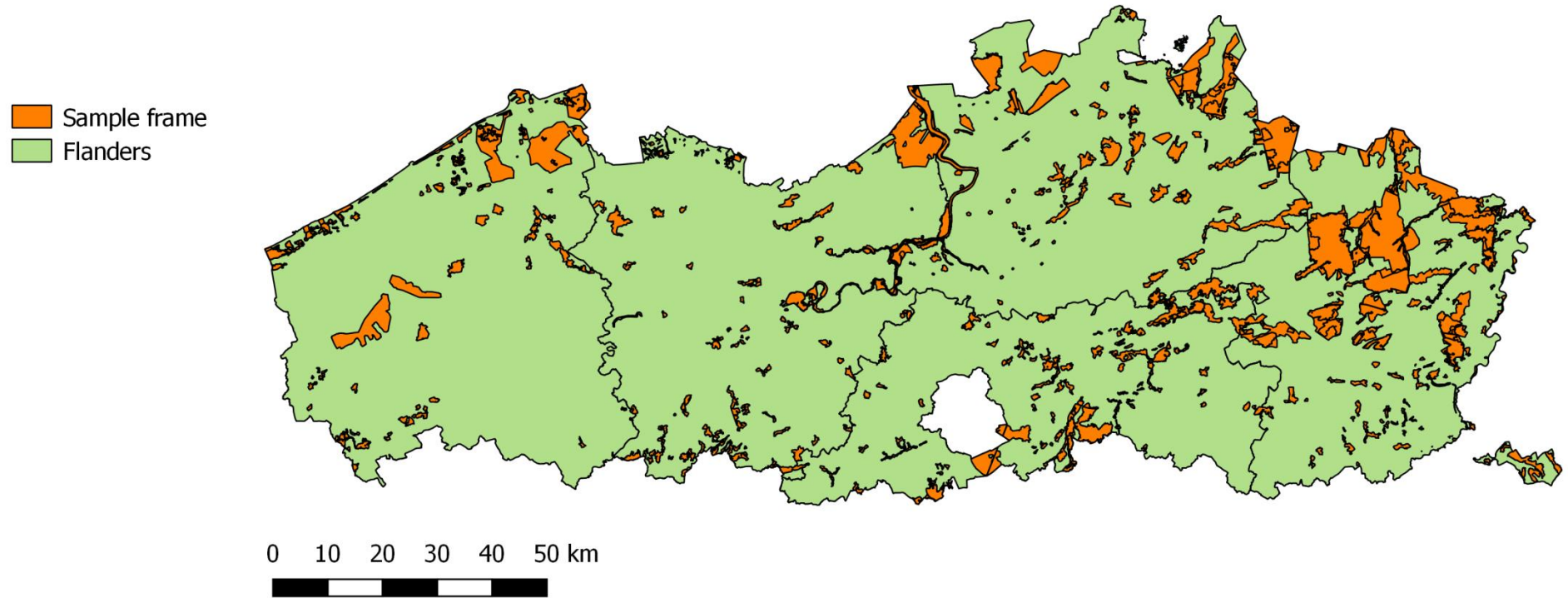
Sample design

Samples can easily be replaced in case of **non-respons**
based on ranking



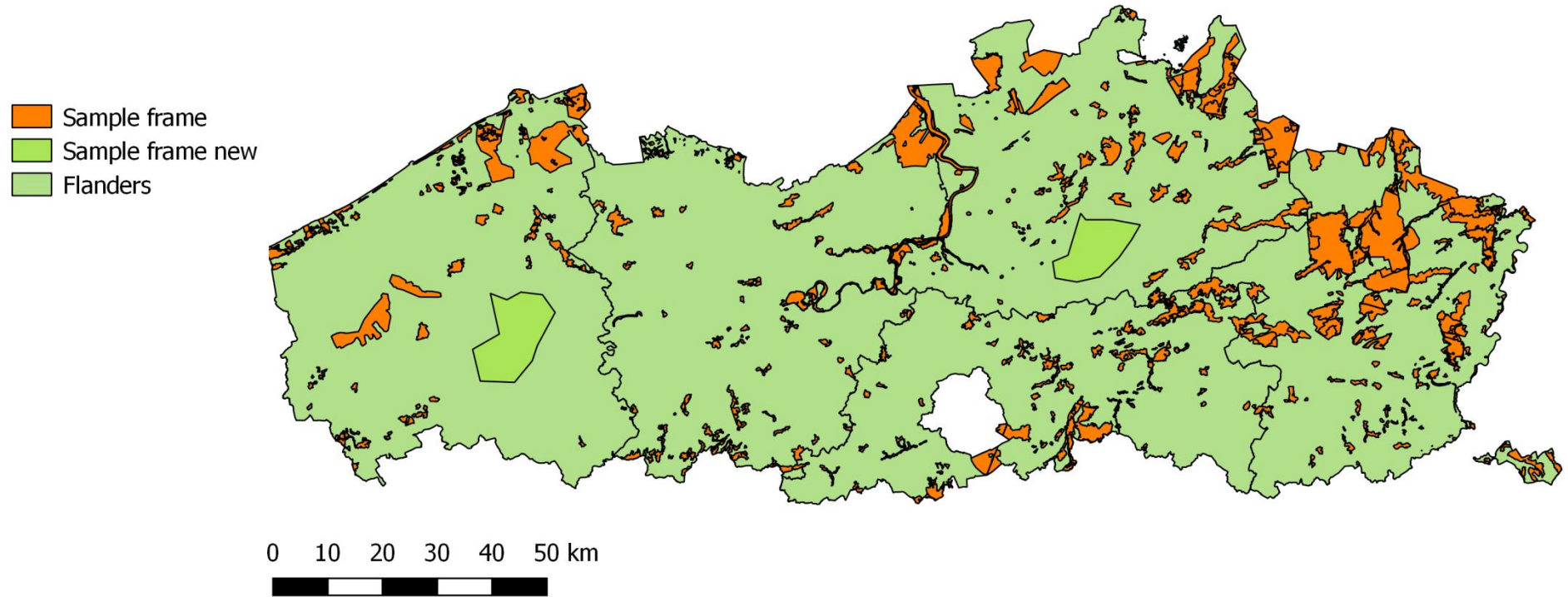
Sample design

Sample can easily be updated when sample frame changes



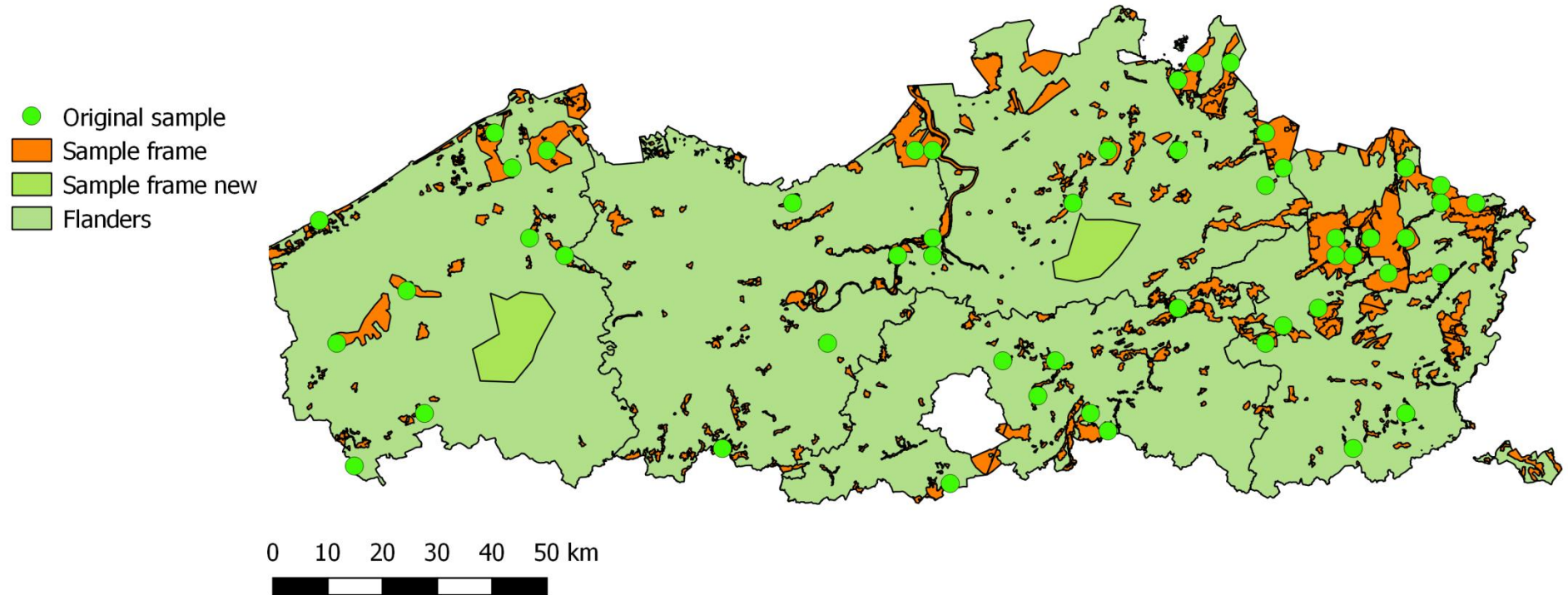
Sample design

Sample can easily be updated when sample frame changes



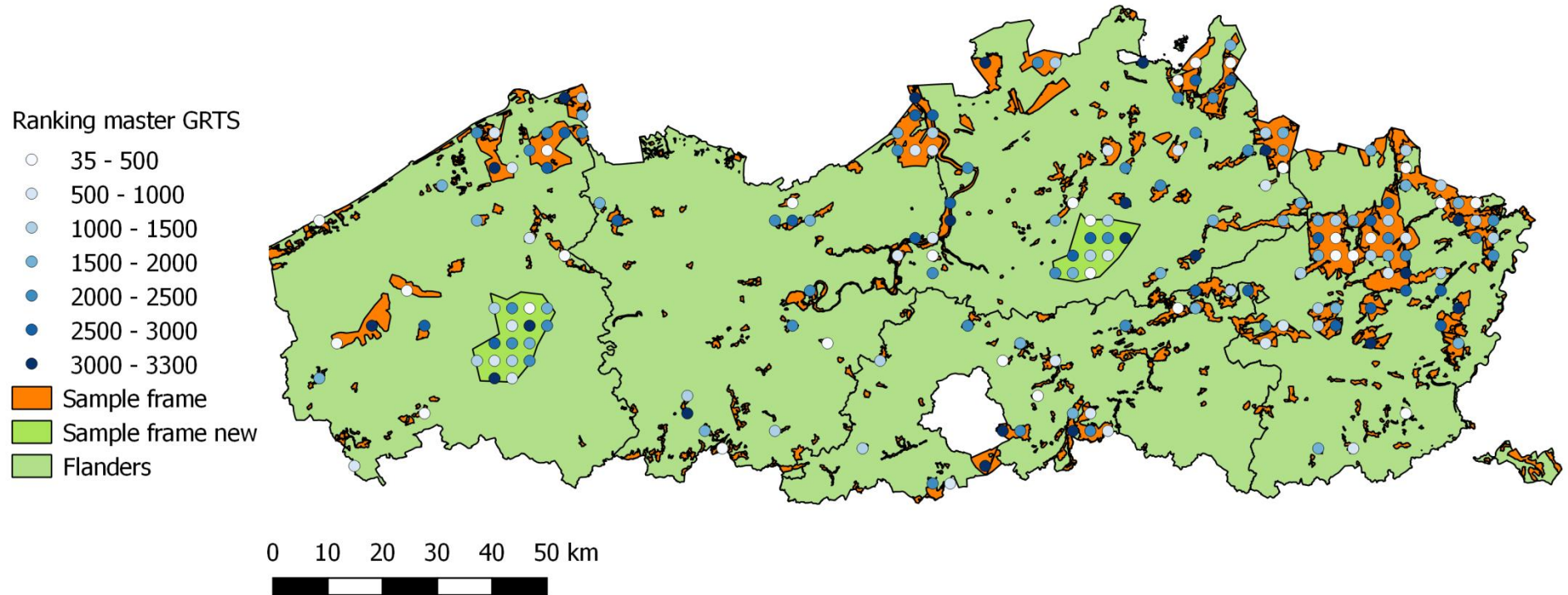
Sample design

Sample can easily be updated when sample frame changes



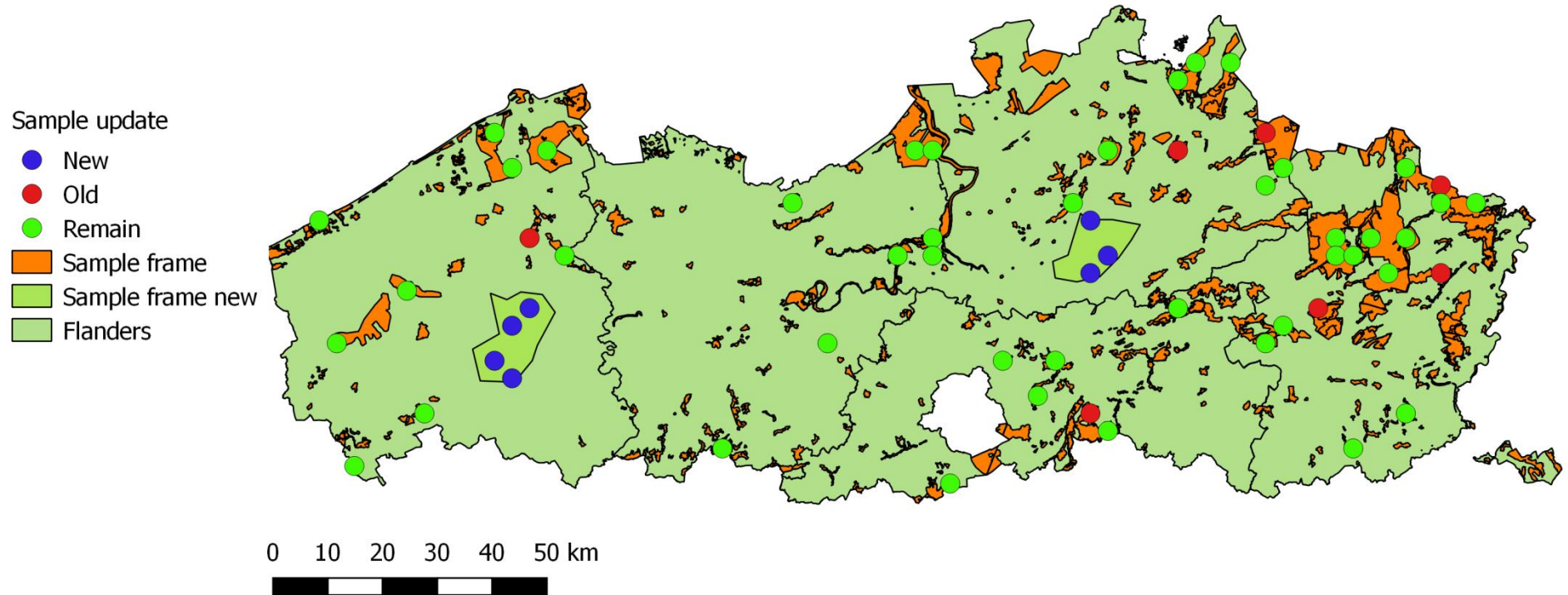
Sample design

Sample can easily be updated when sample frame changes



Sample design

Sample can easily be updated when sample frame changes



Sample size

- ▶ Sample size calculations give insight in relationship between sample size and precision of estimated parameters
- ▶ Choice of sample size is a policy decision
- ▶ Precision levels
 - Sample size = 170 → Minimal detectable difference (Δ) = 10%
 - Sample size = 80 → Δ = 15%
 - Rule of thumb: $\Delta / 2 \rightarrow n \times 4$
 - If we want $\Delta = 5 \%$ → $n = 170 \times 4 = 680$

Sample size

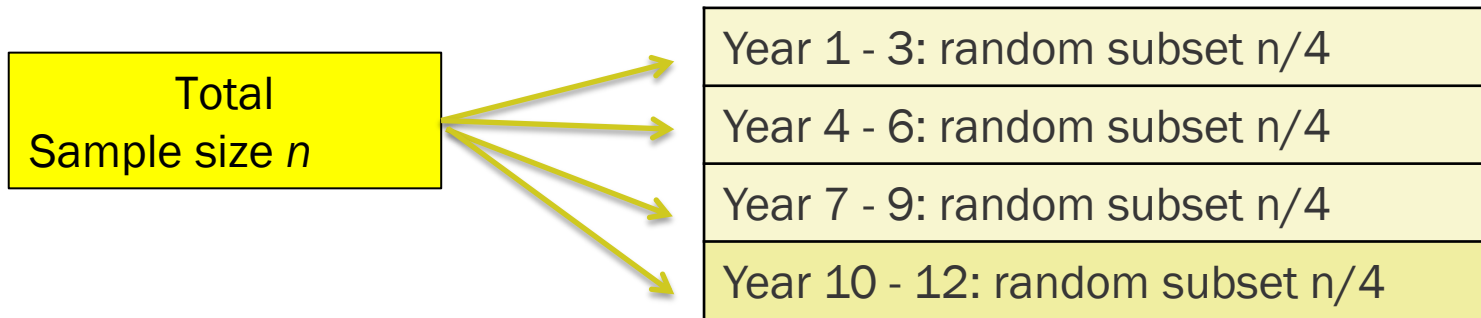
▶ Choice of sample size

- Habitattypes and subtypes (scale of Flanders) → $n = 80$
- Habitattypes within Natura 2000 Network → $\Delta = 170$ → oversample within Natura 2000 Network
- Finite population correction factor → decrease sample size for habitats with smaller areas

▶ In total

- Terrestrial habitats ≈ 4000 sampling units
- Standing water bodies = 300 sampling units
- Streams = 170 sampling units

Allocation of samples in time





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Implementation and experiences

Implementation

- ▶ Start in 2014
- ▶ First subset completed for most habitat types
- ▶ Analysis is ongoing for 2019 reporting

Experiences

- ▶ GRTS-method is a robust and flexible method
 - It can easily handle errors in sample frames
 - It can deal with dynamic sample frames
- ▶ Recommended for long-term monitoring