An example of soil erosion monitoring in Flanders

EUSO Stakeholder Forum

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Soil erosion monitoring: what's in a name?

IN FLANDERS:

- **No 'field measurements' of soil erosion**
- **Monitoring by modelling**

- **EVOLUTION in time?**
- **Important factors:**
  - → Rain erosivity (R)
  - → Soil erodibility (K)
  - → Topography (LS)
    - × Upstream area / landuse / connectivity
    - × Slope
  - → Crops and crop management (C)

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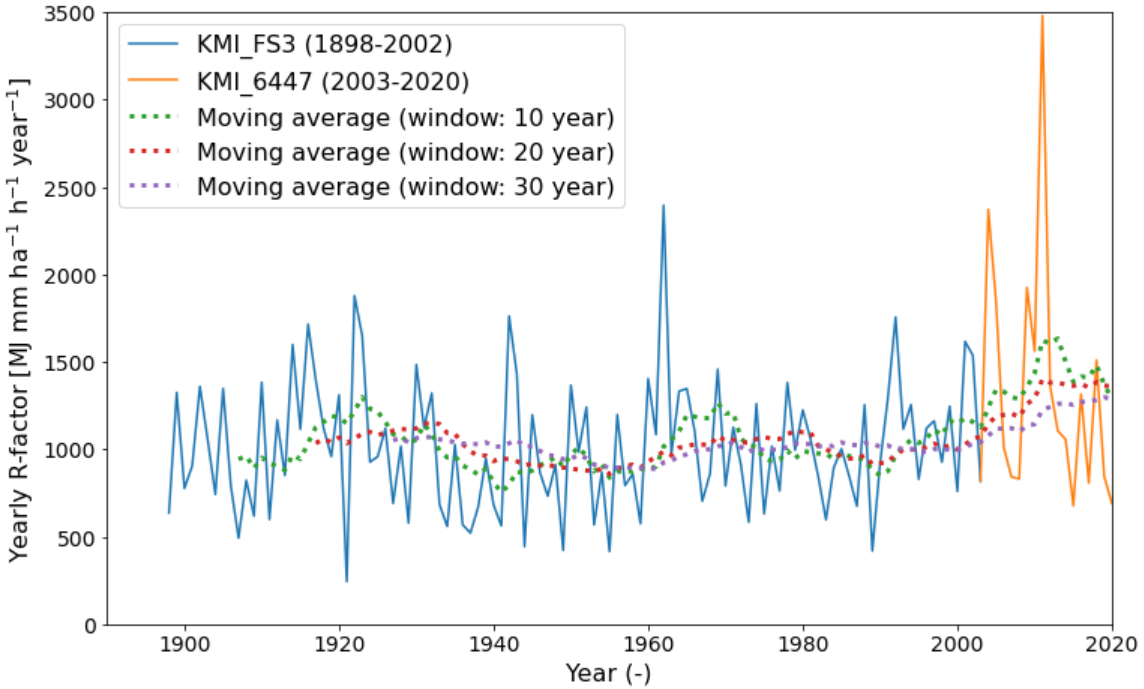
RUSLE-based modelling

Mean annual soil loss: $A = R.K.LS.C.P$

- **R : rain erosivity factor => 1250 MJ.mm.ha^{-1}.h^{-1}.year^{-1}**
  - → Royal Meteorological Institute (Ukkel, Brussels), 1898-2020
    - × 30 year mean average (climatic reference period)
  - → Confirmed by mean R of 50 meteorological stations, 2001-2020
  - → No year-dependent R-factor in our erosion monitoring!

Methodology:
Verstraeten et al. (2006)

Ref: Gobeyn et al. (2021)



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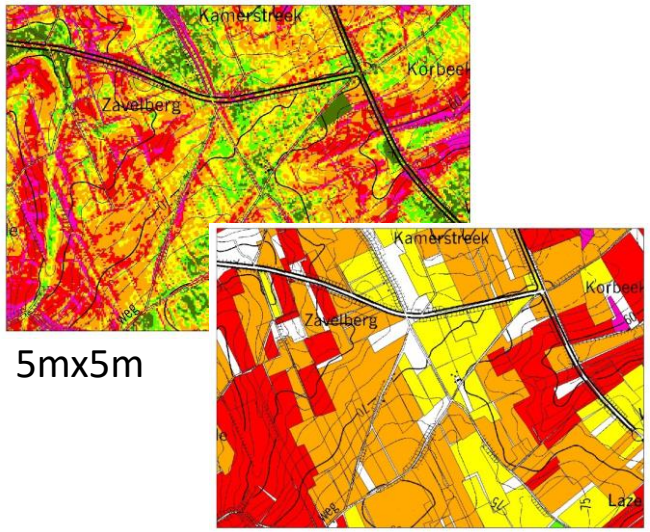
RUSLE-based modelling

Mean annual soil loss: $A = R.K.LS.C.P$

- **K : soil erodibility factor => soil texture (Belgian Soil Map)**
- **LS : topographical factor**
  - → 2-dimensional flux decomposition algorithm (Desmet & Govers, 1996)
  - → high resolution DTM based on LIDAR elevation data (16 points/m²)
    - × Converted to 5 m grid cells
  - → roads, parcel borders and land use are considered
- **C : crop management factor**
  - → depends on the application: potential erosion (general C-factor), erosion risk indicator (specific C-factor)
- **P : erosion control practice factor => 1**
  - → erosion control measures: C-factor

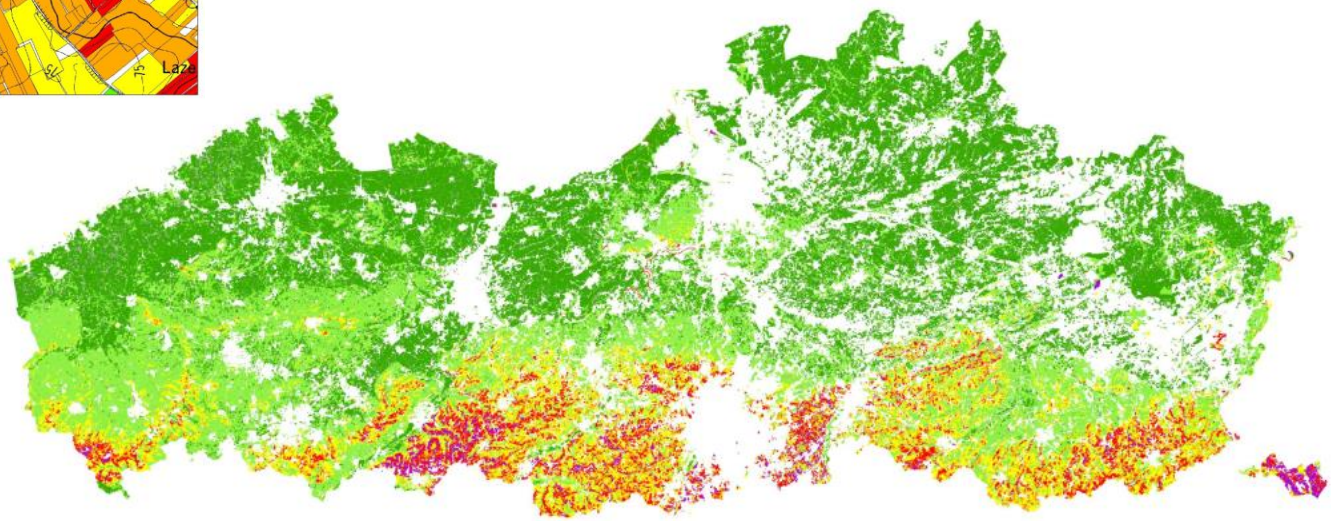
Potential soil erosion



5mx5m

Parcel level

- All agricultural parcels general C-factor
  → C = 0,37
- Parcel connectivity: 30%
- First version: 2001
- Used for soil erosion policy since 2006



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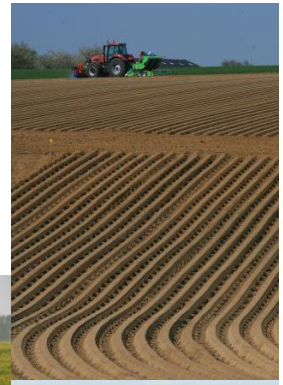
Soil erosion risk

- **Based on the potential soil erosion on parcel level**
- **Incorporation of crop and crop management information (CAP registration and conditionnality)**

- **Specific C-factor, based on**
  - → **Main crop (MC):** look-up table of C-factors
  - → **Cover crops (CC1, CC2):** before and/or after main crop
    - × max. reduction 10% (in function of C-factor cover crop)
  - → **Agri-environment-climate measures (AECM):**
    - × Grass buffer strips, grassed waterways
      - → C-factor 0,01
    - × Reduced tillage
      - → 40% or 85% reduction (in function of soil cover)
    - × Bird feed management
      - → 10% reduction



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Soil erosion risk

- **Specific C-factor, based on**
  - → **Obligatory measures GAEC (CAP):** conditions for income support
    - × Depending on potential erosion class and crop choice
    - × Farmers have the choice between different measures, but no general registration of chosen measures
    - × Measures are controlled in the field and monitored by questionnaires
      - → Farmers' choices and degree of adaptation
    - × Measures are linked to agricultural parcels through randomisation
      - → Taking into account potential erosion class and crop choice
    - × Reductions, e.g.
      - → Reduced tillage: 40% or 85% reduction (in function of soil cover)
      - → Micro-dams between ridges: 60% reduction
      - → Contour sowing: 10% reduction

- $C = C_{MC} * C_{CC1} * C_{CC2} * C_{AECM} * C_{CAP}$

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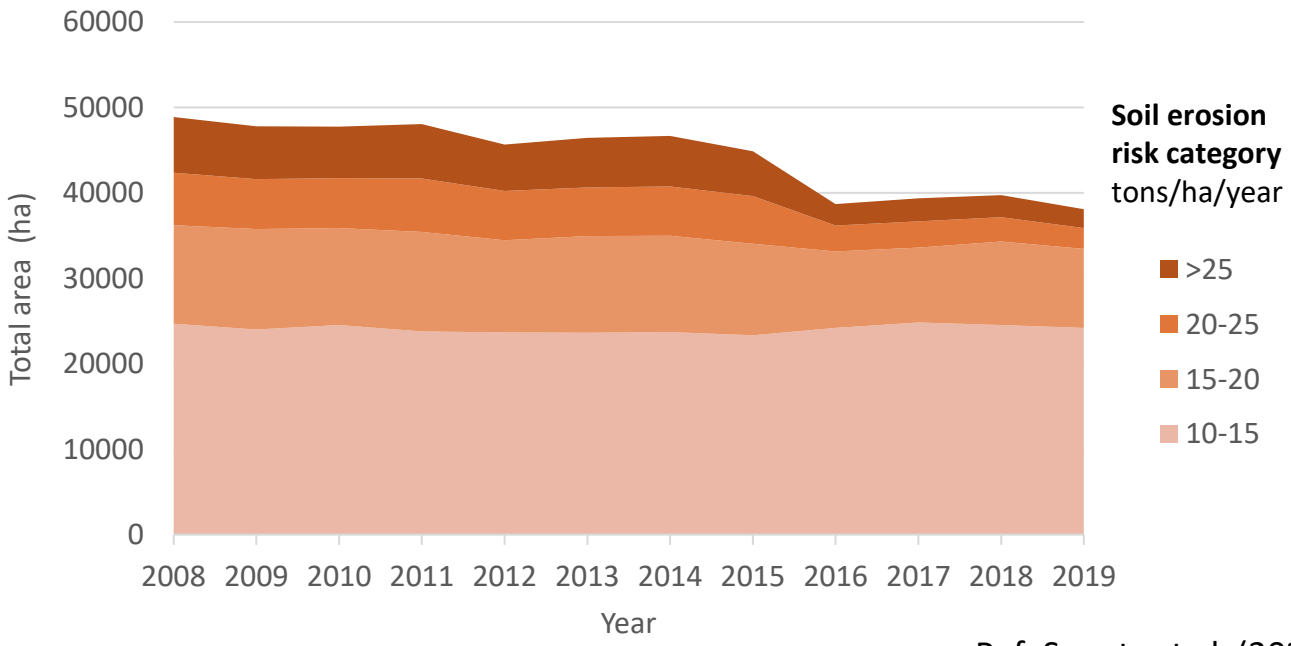
Soil erosion risk indicator

- **Evolution 2008-2019**
- **Official regional statistic since 2020**
  → https://www.statistiekvlaanderen.be/nl/erosierisico
- **Indicator = total area of agricultural parcels (ha) in the highest erosion risk categories**

Limit for visualisation:
+ 10 tons/ha/year

=> Rate of acceptable erosion?



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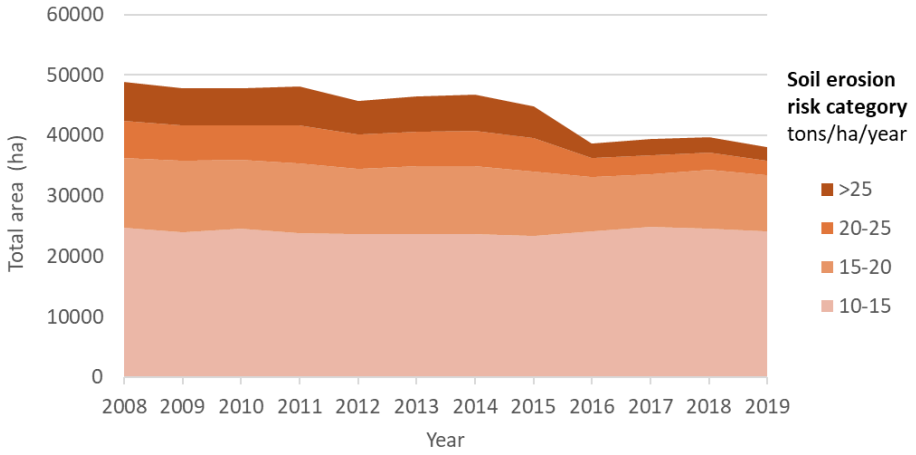
Ref: Swerts et al. (2020)

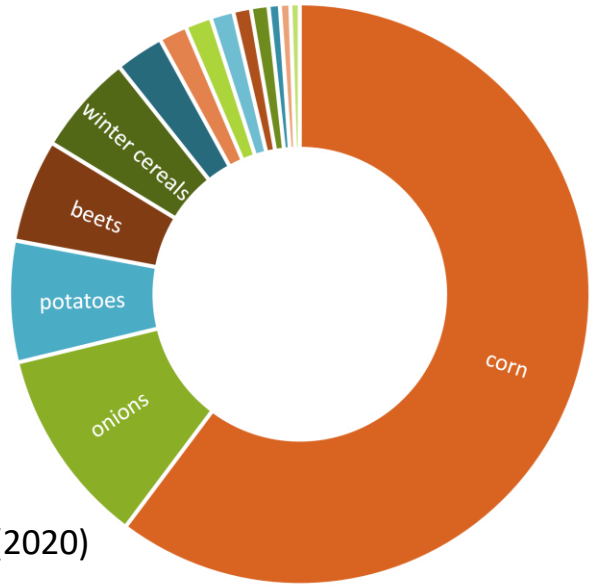
Soil erosion risk indicator



- **Situation 2019**
  145.000 ha potential erosion risk
  → 38.117 ha > 10 ton/ha/year
  → 4.677 ha > 20 ton/ha/year
- **Obvious influence of more stringent GAEC obligations since 2016**

- **Types of crops in highest soil erosion risk category**
  → 57% corn
  → 10% onions
  → 6% potatoes

Crops in the highest risk category (> 25 ton/ha/year)



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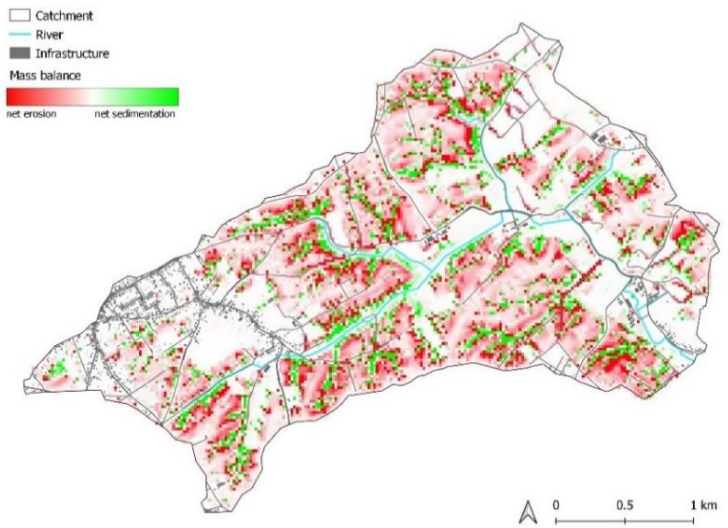
Ref: Swerts et al. (2020)

Sediment delivery indicator

- **In preparation (expected: spring 2022)**
- **Sediment delivery to watercourses, ditches and sewage system**
- **Modified version WaTEM/SEDEM (KULeuven) => CN-WS model**
  - → RUSLE equation combined with Transport Capacity (TC)
  - → Incorporation of buffering measures, ditches, sewage system,…
  - → Higher impact of upstream landuse/crop choices and connectivity elements
- **Opportunity for calculating net erosion risk**
  - → $Sediment_{IN}$ + gross erosion < TC
    - × net erosion = gross erosion
  - → $Sediment_{IN}$ + gross erosion > TC
    - × net erosion < gross erosion
    - × if $sediment_{IN}$ > TC: net sedimentation → net erosion = 0



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Conclusion

- **Soil erosion monitoring in Flanders = modelling approach**
- **RUSLE-based soil erosion risk indicator**
  - → Derived from the calculation of potential erosion on field parcel level
  - → Specific C-factor for crop and crop management choices
  - → Opportunities for improvement
    - × More detailed registration of erosion control practices
    - × Refined calculation of the C-factor
    - × Influence of organic carbon on soil erodibility
- **Sediment transport modelling => net soil erosion risk indicator**
  - → Higher focus of soil erosion and sedimentation at landscape level
- **No indicator for actual soil erosion**
  - → Actual rain erosivity cannot be used
    - × due to the high spatial variability of amounts and intensities of rainfall
  - → Advantage long term mean R-factor: indicators reflect the human impact

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