Off-site impacts of soil erosion and runoff: why connectivity is more important than erosion rates

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Soil in Action: invited speaker

Off-site damage is caused by muddy runoff from agricultural fields

- Muddy flooding affects properties and roads
- And affects freshwater systems: streams and rivers causing ecological damage due to phosphorous and pesticides attached to fine soil particles
- Note introduction of sediment into formerly gravel-bedded rivers and its impact on fish breeding

- In Belgium, the costs of muddy flooding are 16-160 million euros/yr

Riemst, Belgium 2016

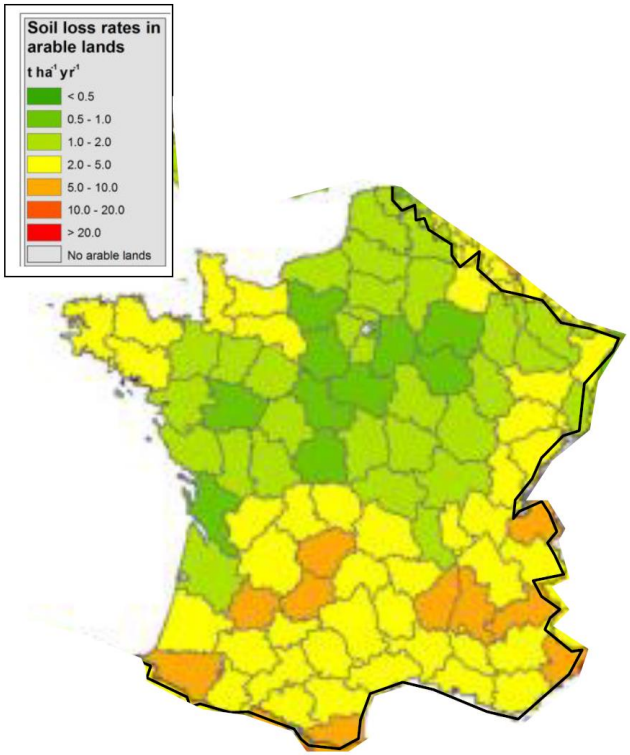
Riemst, Belgium 2016

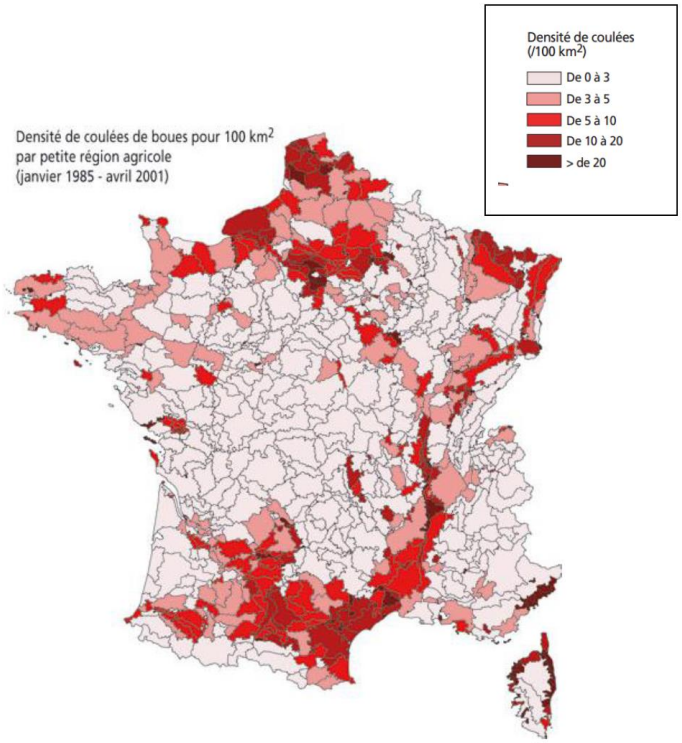
Muddy flooding, Flanders, May 2018 (data from the fire brigade)

Predicting the risk of off-site damage: erosion risk map (Flanders) with runoff flow lines superimposed

- An erosion-risk map, such as that used in Flanders, is of value in predicting the risk of erosion on a particular field.
- It is of very limited value in predicting the risk of off-site damage. For this we need to include the elements of connectivity – both topographic and anthropogenic.

Areas with low erosion rates may have high frequencies of muddy flooding e.g. northern France





Connectivity

- The degree of connectivity of the fields and the urban area or the river, is likely to be more important than the absolute rates of erosion on the field
- Predicted rates of erosion on fields are **NOT** good predictors of the risk of off-site damage
- Connectivity will be composed of topographic concentration lines (dry valleys) and anthropogenic elements

Anthropogenic elements of connectivity

- Tracks, roads, sunken lanes
- Ditches
- Drains under roads
- Field boundary failures: permeable or semi-permeable
- Field gateways
- *Underdrainage of fields
- *Tillage direction on fields

*not considered in this presentation

- Examples of connectivity

- But, in terms of mitigation, what we will want is **dis-connectivity**

Runoff from field into sunken lane

From the field to the river: Cambridgeshire, UK

Flow from arable fields through gateways (photo: Environment Agency, Somerset, UK); note influence of gateway and sunken lane in directing flows

Erosion on winter cereals, Rother valley, West Sussex, UK, February 2014

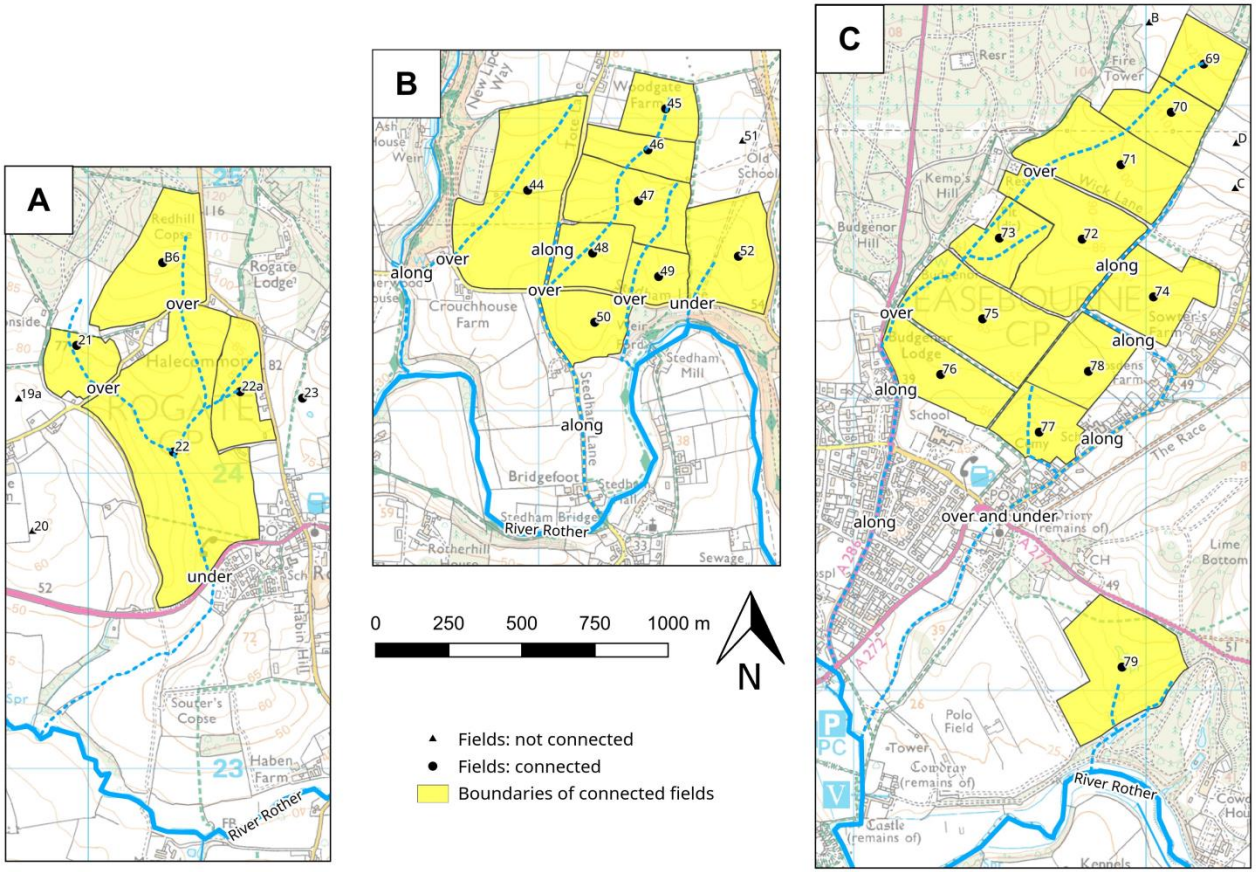
Is the field connected?

From the field to the river via a recently cleaned ditch (same field as previous slide)

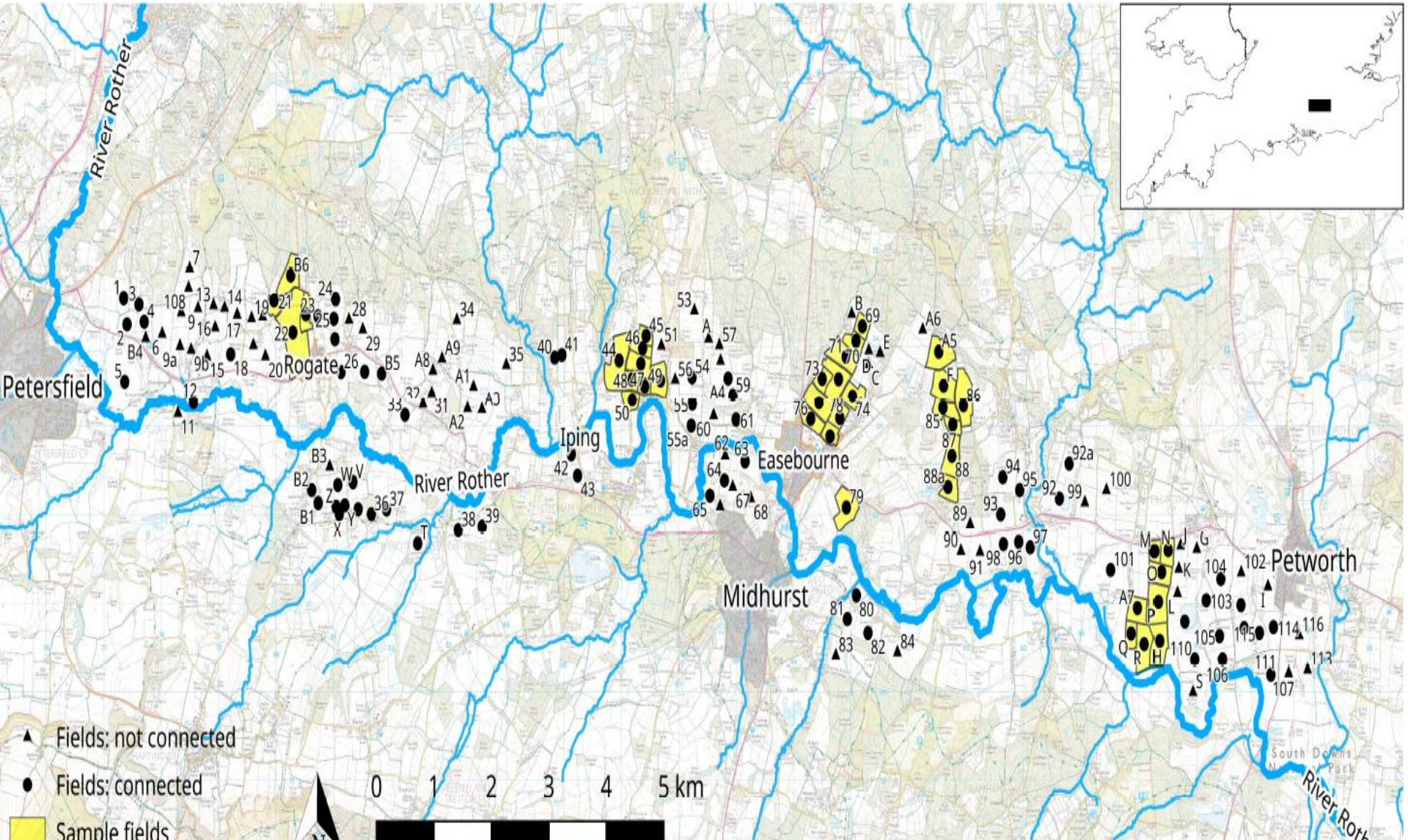
Connected flow from field to field via permeable hedge lines (January 2001, Google Earth image)

- Connectivity between fields is not necessarily recorded on maps or on remote sensed images e.g. presence or condition of ditches; culverts under roads; permeability of hedges
- It is certainly not addressed by available soil erosion models e.g. erosion-risk map of Flanders
- Actual or potential connectivity has to be addressed by field surveys; ideally by observations during runoff events. Remote sensed images may be helpful.

Connectivity between fields and the river: Rother valley, UK; note this is 'potential connectivity' – it can occur or it has occurred



Rother valley, UK: 165 fields with a known history of erosion since 1987. Of these, 101 are potentially connected to the river



Mitigation?

- If we put the emphasis on connectivity as a cause of off-site damage, we need mitigation measures to address this challenge e.g. buffer strips, grassed waterways, retention ponds

- It will not be good enough to simply rely on on-field measures such as conservation tillage

Runoff and sediment connectivity?

- A particular problem is the loss of fine sediment (<63 microns) from fields and from detention structures. These are often able to travel in suspension long distances and reach watercourses. They have a potential to pollute.

- Boardman and Foster (*Land Degradation and Development*, in press)

Retention bank to protect the house.
But how to drain it?

The answer! A ditch to connect to the river

Retention ponds in action, Flanders, June 2018

Straw bales – emergency measure – Flanders, June 2018

Alternative approaches? Runoff and sediment storage on roads?

Conclusions

- Connectivity between field and river or an urban area may be far more important than erosion rate
- Connectivity needs to be assessed by field observation aided by remote sensing - because many elements of connectivity are not apparent on maps or in models
- Mitigation measures: take care! Especially because of loss of fine sediments

Thank you!

References

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