Deriving tillage-controlled runoff patterns (TCRP) for agricultural fields

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Key points

• Does the explicit inclusion of the tillage direction in agricultural fields lead to significant changes of modelled surface runoff flowpaths and associated soil erosion by water?

• Does the algorithm used for determining the actual tillage controlled runoff pattern yield results that stand ground truthing?

• Is the inclusion of additional parameters possible or necessary (e.g. design storm or some representation of runoff concentration?)
Motivation

• Tillage direction is known to influence patterns of surface runoff and subsequent soil erosion by water on cultivated fields

• On catchment scale, this process is usually ignored, for example when using a digital elevation model (DEM) with 1m resolution

• The applied procedure includes some sub-gridsize information (tillage direction and roughness) and is supposed to lead to more realistic surface runoff and erosion modelling results

• Procedure is based very closely on "TCRP" concept (Takken et al., 2001)
Motivation

- Erosion field mapping will often show the pattern of parallel surface runoff in tillage direction until concentration in some thalweg situation
- 1x1m DEM will not capture this pattern, but instead “blur“ the surface flow paths diagonally
Motivation

- In other configurations, runoff will break through the tillage direction and follow the topography alone.
- This is increasingly likely with high slope, high rainfall intensity and low roughness.
Methods

- Application of decision algorithm created by *(Takken et al., 2001)*
  
  \[
  \text{Logit} = -5.9 + 13.3 \times S + 0.1 \times A - 0.4 \times R
  \]

- Function of slope (S), angle between tillage direction and topographic aspect (A), oriented roughness (R)

- Based on Belgian field data

- Decides, which cell follows tillage direction (tilldir) and which follows topography (topo)

- Corrections are necessary to create valid flow directions
Methods

• Preparatory work: DEM derivatives: slope, aspect
• Tillage direction
• Oriented roughness
Methods

- After application of the algorithm: Which cells follow topo, which follow tilldir?
Methods

• Closeup of an individual field in the catchment

• Regular D8 surface runoff flowpaths (flow accumulation)
Results

• Calculated „TCRP“ runoff flowpaths

• In some places identical with topographic (usually steep slopes and thalweg situations)
Conclusions and outlook

• Main work in 2019: script and concept preparation

• Main work starting 05/2020
  
  − generation of field observations for validation and improvement of the algorithm for Austrian conditions

  − perform surface runoff and erosion modelling with the output of the TCRP method as input

  ➢ decide whether the implementation is worth the effort
References

