Erosion mapping in Finland at scales 100 m and 2 m, RUSLE

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Introduction

The dim water containing eroded soil particles with phosphorus is considered the main reason for eutrophication caused by agriculture. The soil rich in phosphorus finally moves into the lakes and sea. The Test Area supposed to be prone to erosion according Baltic Sea RUSLE model (100m) was studied in details with large scale (2m) RUSLE erosion model in this presentation. The EEA 10 km x 10 km statistical grid was used as reference for calculations.

Materials and methods

Fig. 1 The Test Area in SW-Finland consist of four 10 km x 10 km EEA reference grid cells. The 100 m RUSLE model at background. Flow accumalation was calculated with D8-algorihtm. Green indicates low erosion and red high erosion.

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Fig. 2 The Test Area covers four 10 km x 10 km EEA reference grid cells. The 100 m RUSLE model at background. Flow accumulation was calculated with D8-algorithm. Green indicates low erosion and red high erosion.

Fig 2. The Test Area covers four 10 km x 10 km EEA reference grid cells. The 100 m RUSLE model at background. Flow accumulation was calculated with D8-algorithm. Green indicates low erosion and red high erosion.

Fig. 3 The erosion in t/h/y calculated from 2 m Lidar based RUSLE-model. The numbers are higher than average estimation in Finland (0.5 y/ha/y). Flow accumulation was calculated with MDD8 –algorithm. Green indicates low erosion and red high erosion.

Fig 3. The erosion in t/h/y calculated from 2m Lidar based RUSLE-model. The numbers are higher than average estimation in Finland (0.5 y/ha/y). Flow accumulation was calculated with MDD8 –algorithm. Green indicates low erosion and red high erosion.

Fig. 4a. and 4b. Four hundred 1km x 1km EEA grid cells classified by standard deviation with 100m and 2m RUSLE-model. The red cells indicate high risk areas > 1.5 std. Overlapping high risk areas cannot be found.

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Discussion

Erosion modelling is one way to assess critical source areas having high source potential and transport risk of phosphorus. In this study, erosion on the Test Area was described using RUSLE. RUSLE is the latter version of the famous USLE-model. Both are well documented empirical models for practical use in agriculture and civil engineering. Their qualitative accuracy is better than their quantitative accuracy. In Finland the 100m scale is rough when considering the small featured topography. However, the small scale model succeeded relatively well on coarse watershed level (hundreds to thousands km²). The watersheds with high measured amount of suspended solids correlated well with RUSLE results (fig 6. and 7.). The water quality in Finnish inland waters was also well predicted by small scale RUSLE; however, on areas smaller than 100 km² the accuracy of 100m model is questionable.

Several problems arise when applying erosion models at regional or larger scale. First, most models were developed on a plot or field scale. When these models are applied over large areas the model output has to be interpreted carefully. One cannot expect that a model that was designed to predict soil loss on a single agricultural field produces accurate erosion estimates when applied to the regional scale on a grid of say 50 m pixels or coarser. One should also be aware of which processes are actually being modeled. For example, the USLE Equation was developed to predict rill- and inter-rill erosion only. Secondly, at the regional scale it is usually impossible to determine the model’s input data like soil and vegetation parameters) directly in the field. Third problem with erosion modeling is the difficulty of validating the estimates produced. At the regional and larger scale, virtually no reliable data exist for comparing estimates with actual soil losses. In this study we used 2m Lidar based RUSLE model to predict actual soil loss in test area. The model has been calibrated on six Finnish experimental fields.

On Baltic Sea Region-level only small scale models have been available so far and their could have been used only to detect large Priority Areas. On the other hand, a farmer works on large scale on his field and new technologies like nationwide Lidar based RUSLE in Finland gives possibilities to pinpoint potential Hot Spots on field by farmer himself or any other interested citizen. In the future the whole BSR-region might be examined on large scale models suitable for farmers. There is a need for research how to utilize these accurate models on the country and on the Baltic Sea level.