Ryevitalise: Erosion Risk

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Project background: Satellite imagery and climate change projections improve our ability to map and forecast sediment sources and transport pathways at high resolution, which is vital for catchment management. Detailed assessment of temporal and spatial changes in erosion risk are key to forecasting pollutant dispersal, which affects water treatment costs and ecology. Erosion risk mapping has been carried out on the River Derwent catchment and clipped to the Ryevitalise catchment area. The aim of the work was to understand the spatial and temporal variation in erosion risk across the catchment, in order to inform where further monitoring should be undertaken and where land management such as natural flood management is required.

Methods used: Scenario modelling was carried out using SCIMAP[1] using high resolution data. SCIMAP requires the following data: topographic, rainfall and land use. Topographic data is provided by a digital elevation model (DEM), in this work a 5m resolution DEM from the Ordnance Survey was used. Rainfall data was downloaded from the Met Office[2], monthly rainfall data for 2016 and the long term average data was used. Climate change projections (UKCP09) were also used to project future changes in rainfall. Traditionally, land use maps provided by CEH[3] or CORINE[4] are used in erosion risk mapping and although derived from satellite imagery, they show the average land use throughout the year. In this work, seasonal land use maps have been produced using ESA sentinel 2 data (10 m resolution), this enables bare land to be mapped which is important in an agriculturally dominated catchment. The modelling also incorporates artificial drainage networks, which often dominate agricultural areas, traditional approaches to erosion risk mapping do not incorporate these elements which increase the potential pathways for sediment to move through the catchment system.

Results: The images show erosion risk from the land and the cumulative instream impact (rivers). The erosion risk has been modified to show where there is greater than 50% chance of diffuse pollution occurring from the land (yellow (low risk) to red (high risk) colour scheme. The instream channel risk ranges from green (low risk) to red (high risk) and represents the cumulative impact of upstream risk. The instream data shows that erosion risk from nearby land, may have an impact downstream and not in the immediate watercourse next to the diffuse pollution source.

Seasonal Erosion Risk: Appendix 1 show the scenarios modelled for each season. Traditionally, static land-use maps are used, however they often relatively underestimate erosion risk when compared to the higher resolution seasonal maps. This is especially apparent in months where there is a higher coverage of bare land. Bare land varies from 12% of the catchment area in February, to 9% in November and July, and 8% in April. Therefore, the seasonal land use maps are discussed in detail here. Importantly, by processing seasonal data, trends throughout the year can be understood. Figure 1 shows erosion risk incorporating seasonal land use maps and the long term average rainfall data. Generally, the areas of highest risk throughout the year are found below the peatland areas in the north of the catchment, with highest risk in the lower elevation areas dominated by agriculture.

[1] http://www.scimap.org.uk/
[2] Centre for Environmental Data Analysis (CEDA) - https://www.ceda.ac.uk/
[3] UK Centre for Ecology and Hydrology Land Cover map - https://www.ceh.ac.uk/services/land-cover-map-2015
[4] Coordination of Information on the Environment Land Cover, https://land.copernicus.eu/pan-european/corine-land-cover

However, there is a higher risk across the lower elevation areas in November, this is due to the higher rainfall amounts and presence of bare land. There is a similar erosion risk for February, April and July. **This highlights that interventions to reduce diffuse pollution are especially important in the lower part of the catchment in November.**

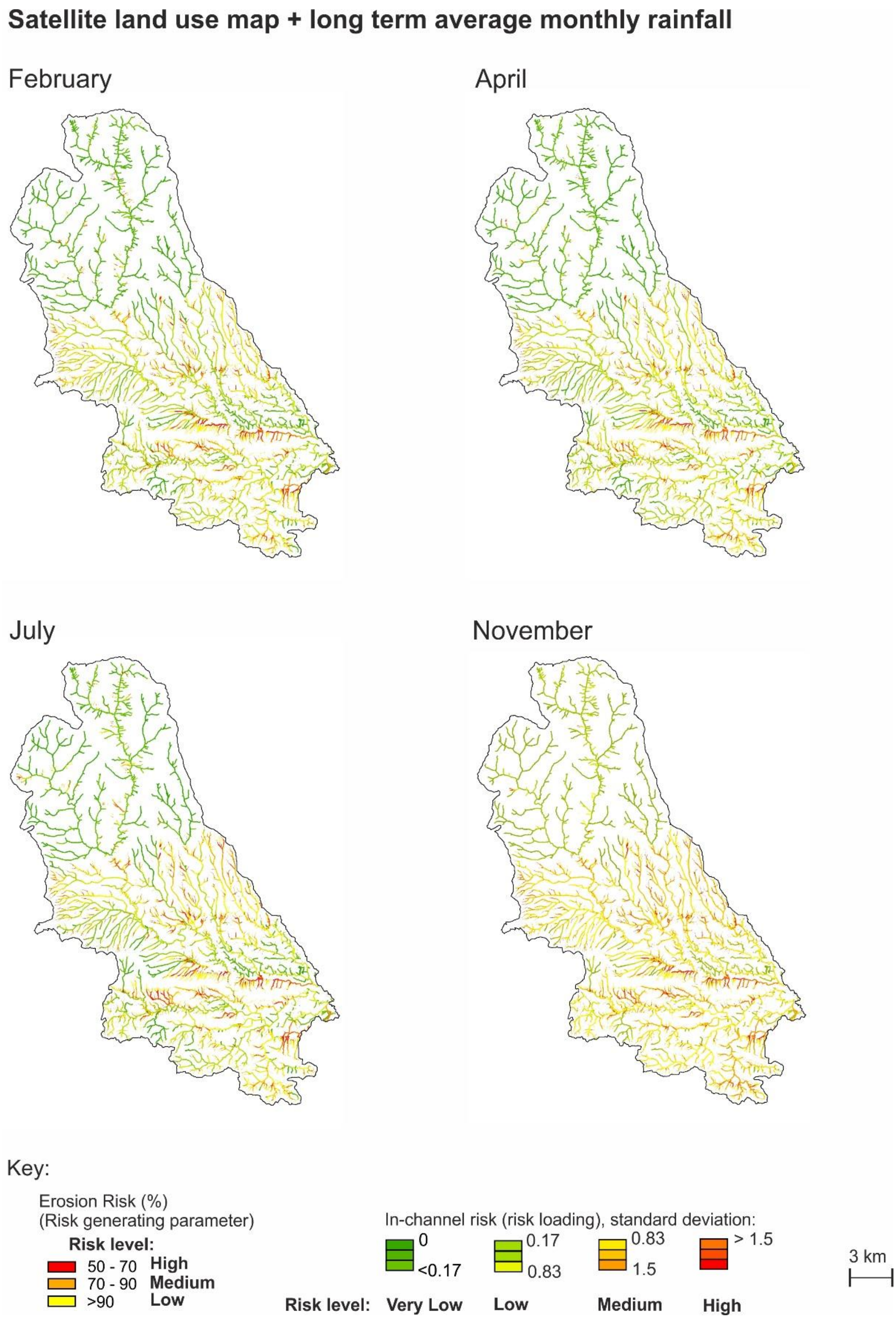


***Figure 1** – Seasonal variation in erosion risk in the Ryevitalise study area.*

Artificial drainage: Incorporating the field drains in the Ryevitalise study area increases the areas of medium risk in the lower elevation parts of the catchment, due to increases in the routes (pathways) the sediment can take to reach the main trunk channel.

Erosion risk under climate change scenarios: Figure 2 shows the variation in erosion risk in the Ryevitalise catchment under different climate change scenarios. Under all the scenarios mapped (related to low, medium and high emission scenarios), the hotspots of erosion risk stay the same. As SCIMAP models risk and not volumes of material removed, this does not mean that the amount of erosion will stay the same, as volumes are likely to increase due to increased amounts and intensity of rainfall. However, the source areas of the sediment is likely to stay the same. Therefore any management or interventions placed to reduce erosion risk are likely to have longevity.

Conclusions: Interventions should be focused in the lower areas of the Ryevitalise catchment area, in land surrounding the River Rye. Erosion risk varies seasonally, and interventions in the catchment are especially important in November, when erosion risk is highest.

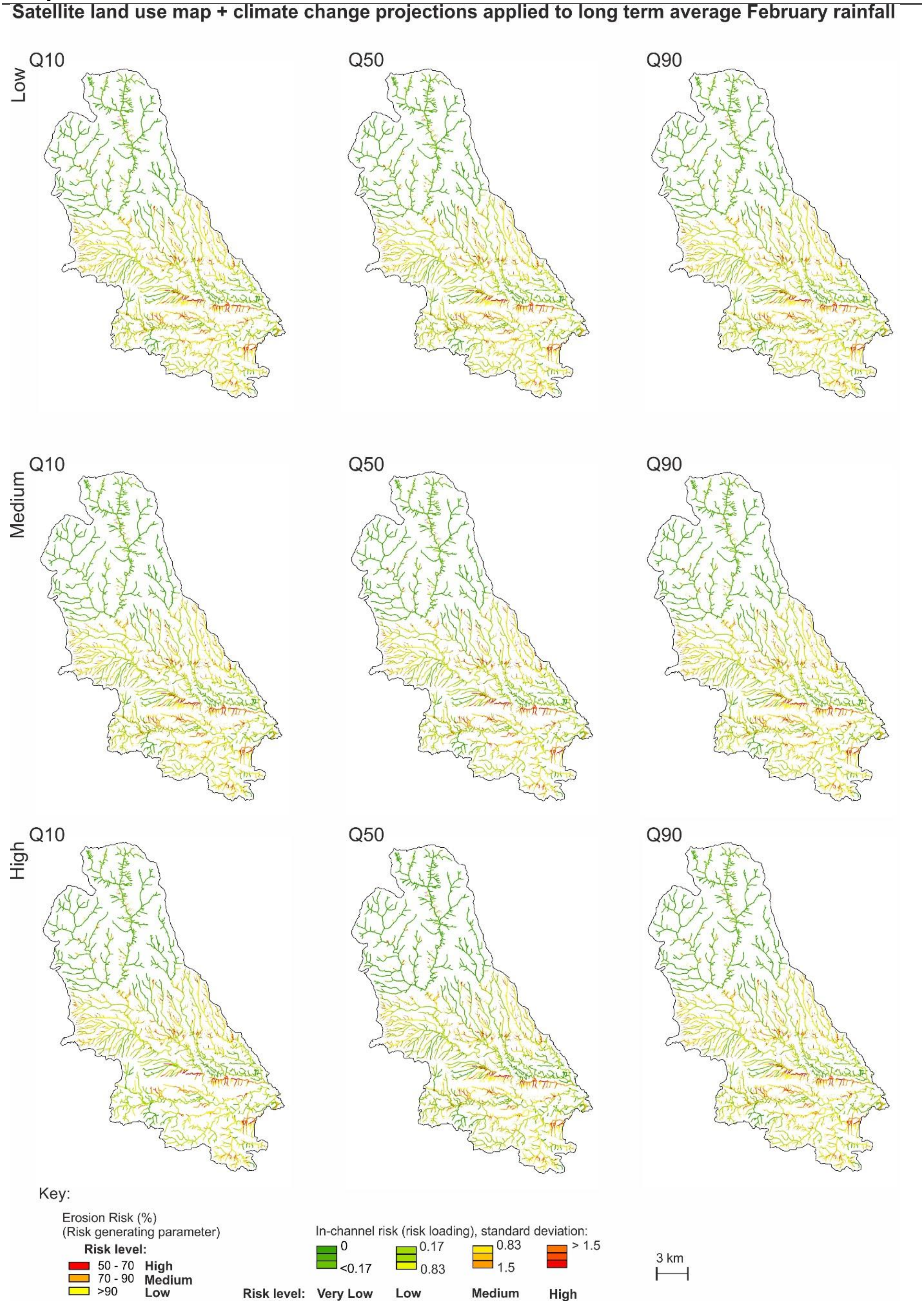
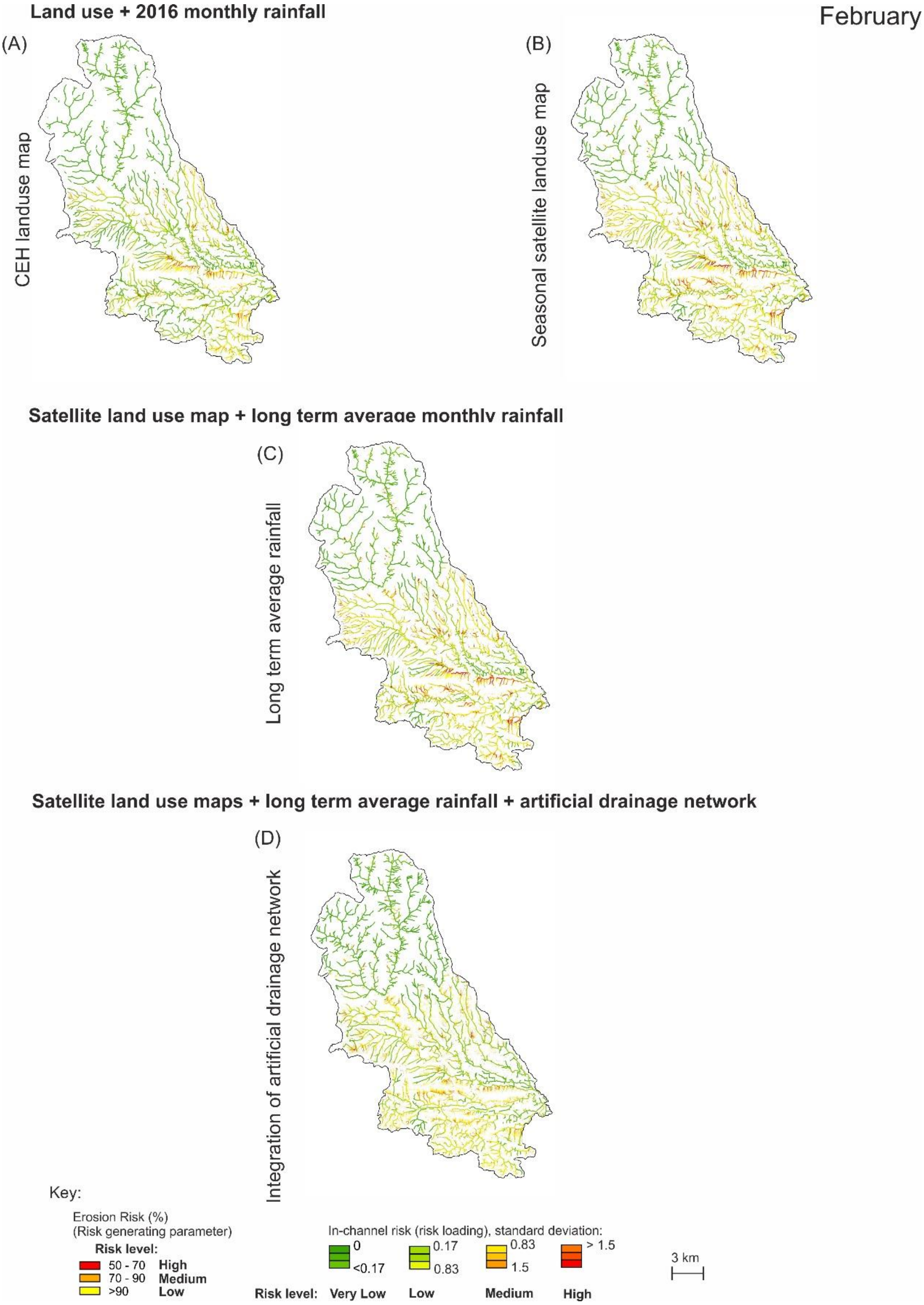


Figure 2 *– Erosion risk under different climate change scenarios.*

Appendix 1

The figures below show the different scenarios tested for the months of February, April, July and November.



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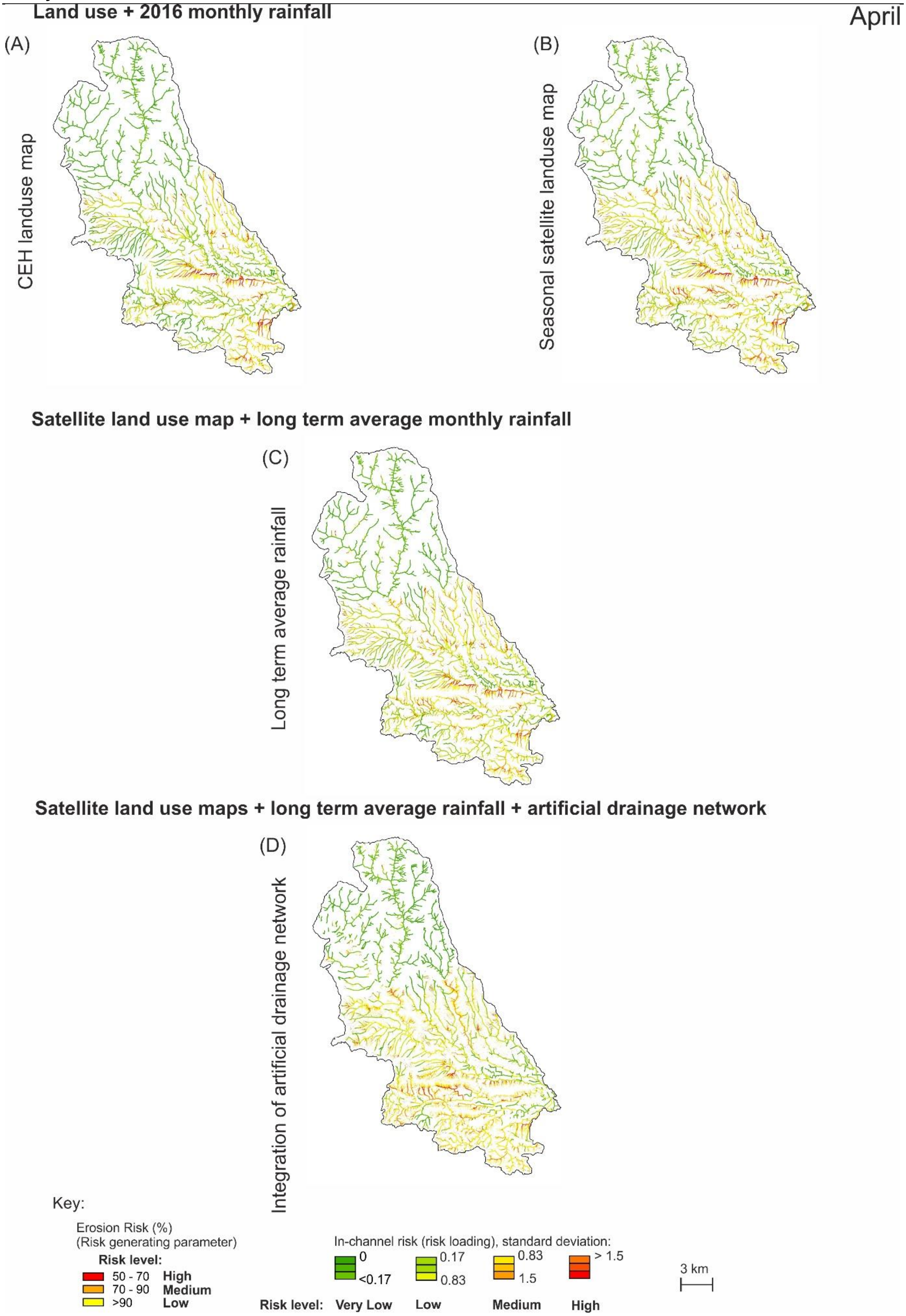
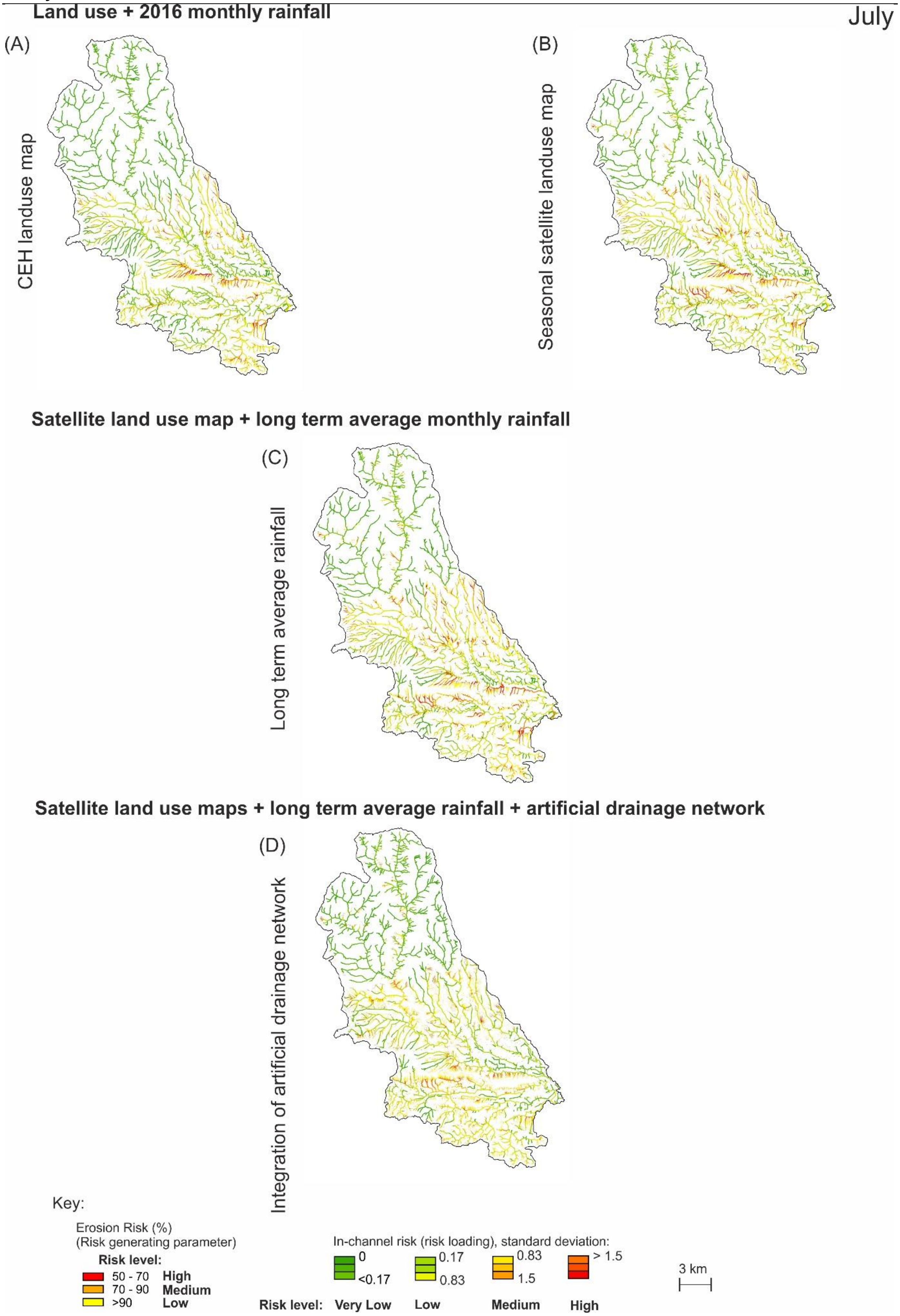
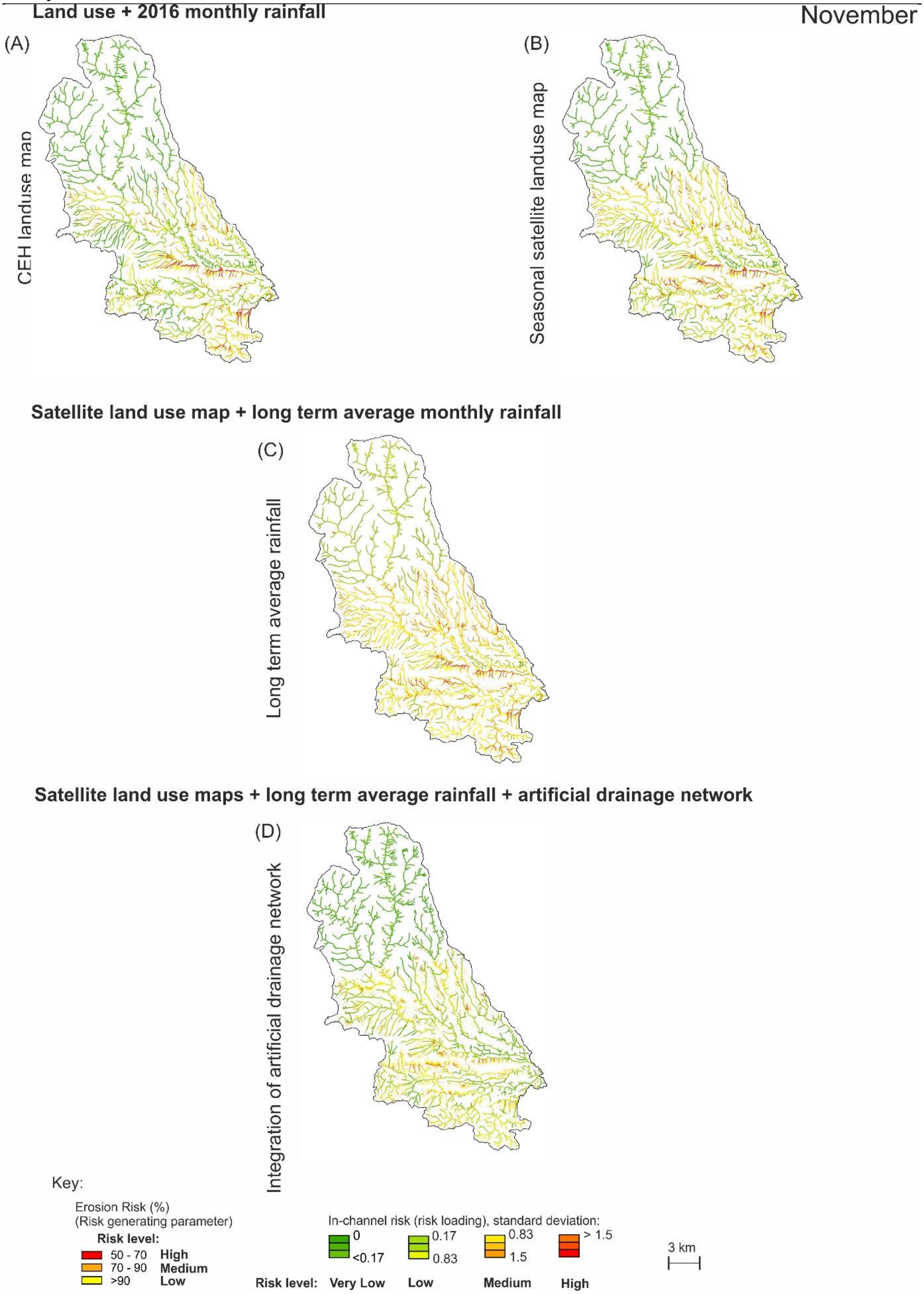



Land use + 2016 monthly rainfall
July
(A)
CEH landuse map
(B)
Seasonal satellite landuse map
Satellite land use map + long term average monthly rainfall
(C)
Long term average rainfall
Satellite land use maps + long term average rainfall + artificial drainage network
(D)
Integration of artificial drainage network
Key:
Erosion Risk (%)
(Risk generating parameter)
Risk level:
50 - 70 High
70 - 90 Medium
>90 Low
In-channel risk (risk loading), standard deviation:
0
<0.17
0.17
0.83
0.83
1.5
> 1.5
Risk level: Very Low Low Medium High
3 km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