Climate change impacts on erosion in a water-shed using an integrative modeling approach

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Introduction

Xishuangbanna, SW China, a typical tropical rain forest region, has been dramatically changed by introduction of rubber plantations over the past 30 years. Rubber plantations have a less thick litter layer and higher water repellency contributing to higher runoff and water erosion. Weeding management has been proved to efficiently control the on-site soil loss in rubber plantation.

This study aimed at assessing how weeding management can reduce on-site and off-site soil loss under increasing precipitation and temperature with predicted climate change.

Figure 1: Hydrological station continuously measuring water level and turbidity at watershed outlet.

Conclusions

- Herbicide management at plot can affect total sediment export in watershed
- Increasing temperature showed higher impact on total sediment yield than increasing rainfall
- Reduced herbicide application in rubber plantation could efficently mitigate increased soil loss by climate change at plot scale but not at watershed scale

Objectives

A) Estimating the efficacy of plot level soil conservation on reducing total sediment yield at watershed level

B) Assessing how the increasing rainfall and temperature affect weeding efficacy on soil conservation

C) Exploring the efficacy of weeding management in mitigating total sediment yield under climate change

Results

Reducing weeding to once per year

- efficiently reduced total sediment export in watershed (Fig.2)
- highly reduced soil loss at plot level under varied climate scenarios (Fig.3)
- partly but not completely mitigated increased total sediment yield at watershed by climate change (Fig.4)

Increased temperature has stronger impact than rainfall

- as it more affects litter decomposition thus highly decreases surface cover (Fig.4, Fig.6)

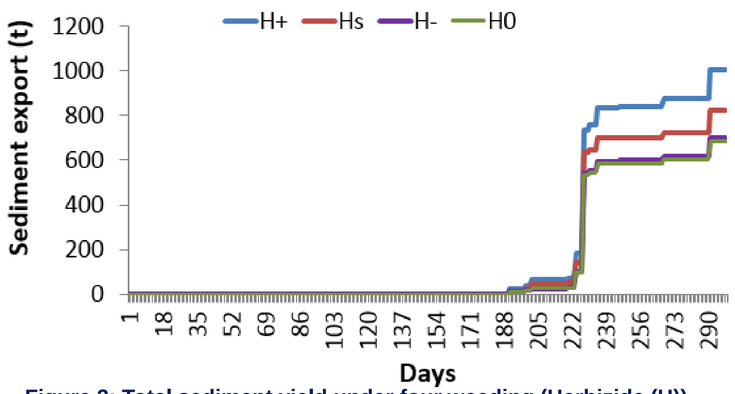


Figure 2: Total sediment yield under four weeding (Herbizide (H)) managements under baseline climate scenario

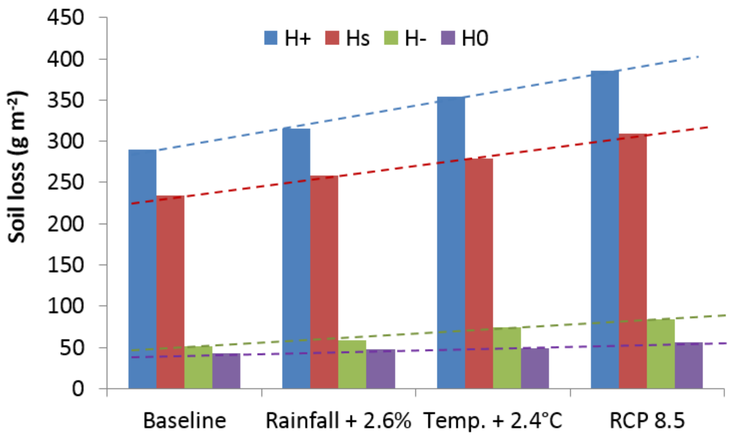


Figure 3: Plot soil loss in rubber under four weeding managements (Herbizide (H)) under different climate scenarios

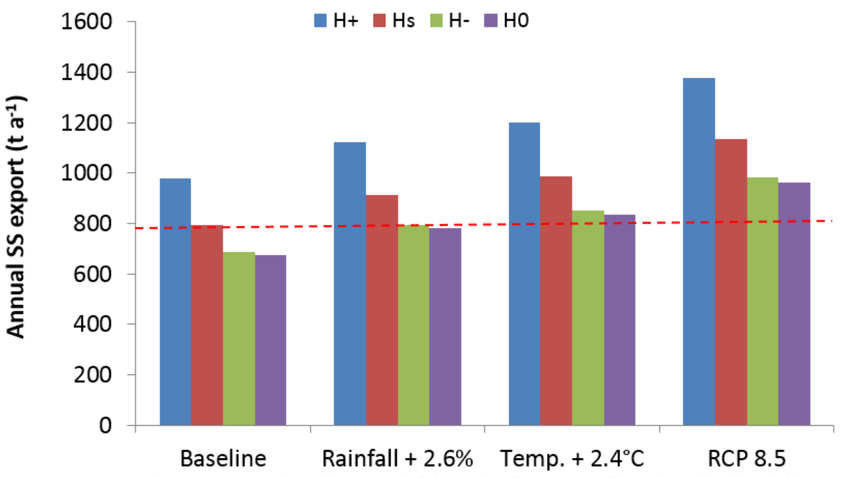


Figure 4: Total sediment yield under four weeding (Herbicide (H)) management and four climate scenarios

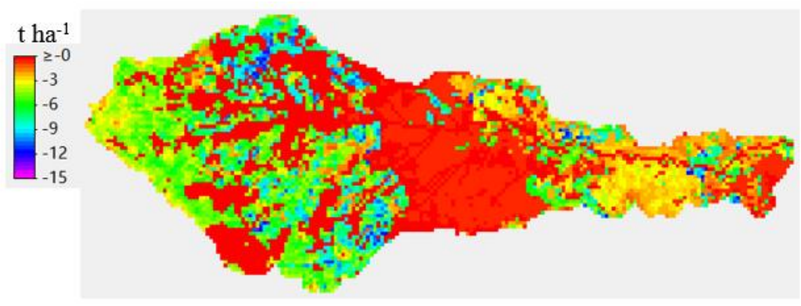


Figure 5: Net erosion simulated by model under twice-weeding (Hs) under baseline climate scenario

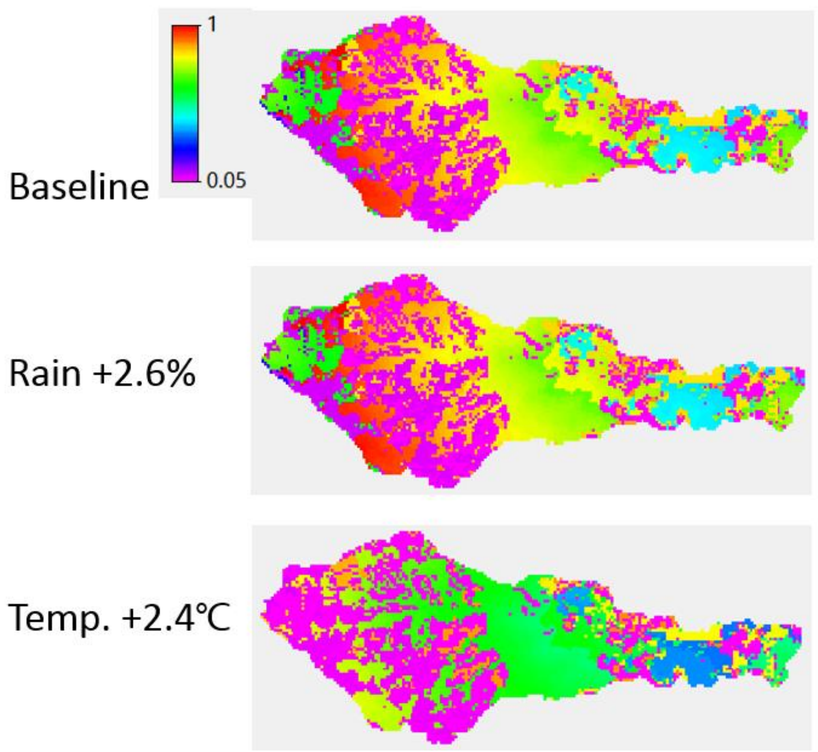
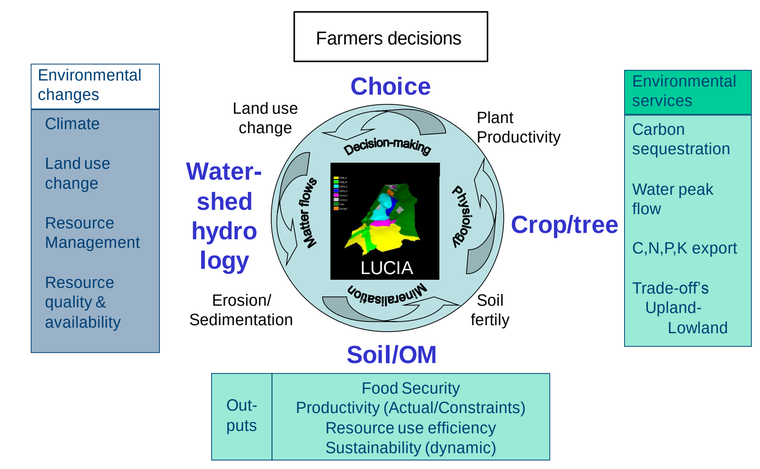


Figure 6: Surface cover distribution (0-1) affected by different climate sceanrios

Materials and Methods

LUCIA: Land Use Change Impact Assessment



https://lucia.uni-hohenheim.de

Figure 7: Concept of LUCIA model.

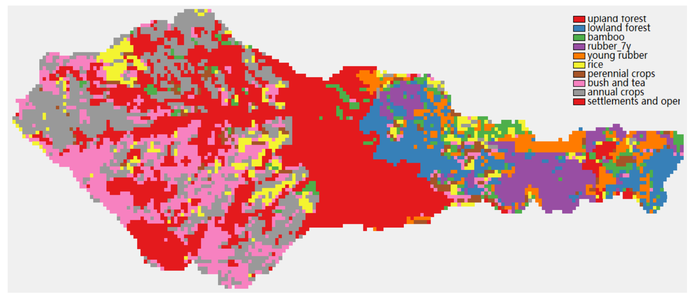


Figure 8: Land use type in simulated watershed

- A landscape spatial explicitly process-based model Land Use Change Impact Assessment (LUCIA) is applied to simulate the targeted watershed
- Four weeding managements (clear-weeding: **H+**, twice-weeding: **Hs**, once-weeding: **H-**, no-weeding: **H0**) were simulated respectively under four climate scenarios (baseline, rainfall increased by 2.6%, temperature increased by 2.4℃, rainfall increased by 2.4% and temperature by 2.4 ℃: RCP 8.5)
- Twice-weeding under baseline climate scenario is calibrated at both plot (rubber) lever and watershed level

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