



# Influence of oscillating vegetation cover and precipitation on catchment erosion and sedimentation: Insights from a landscape evolution model

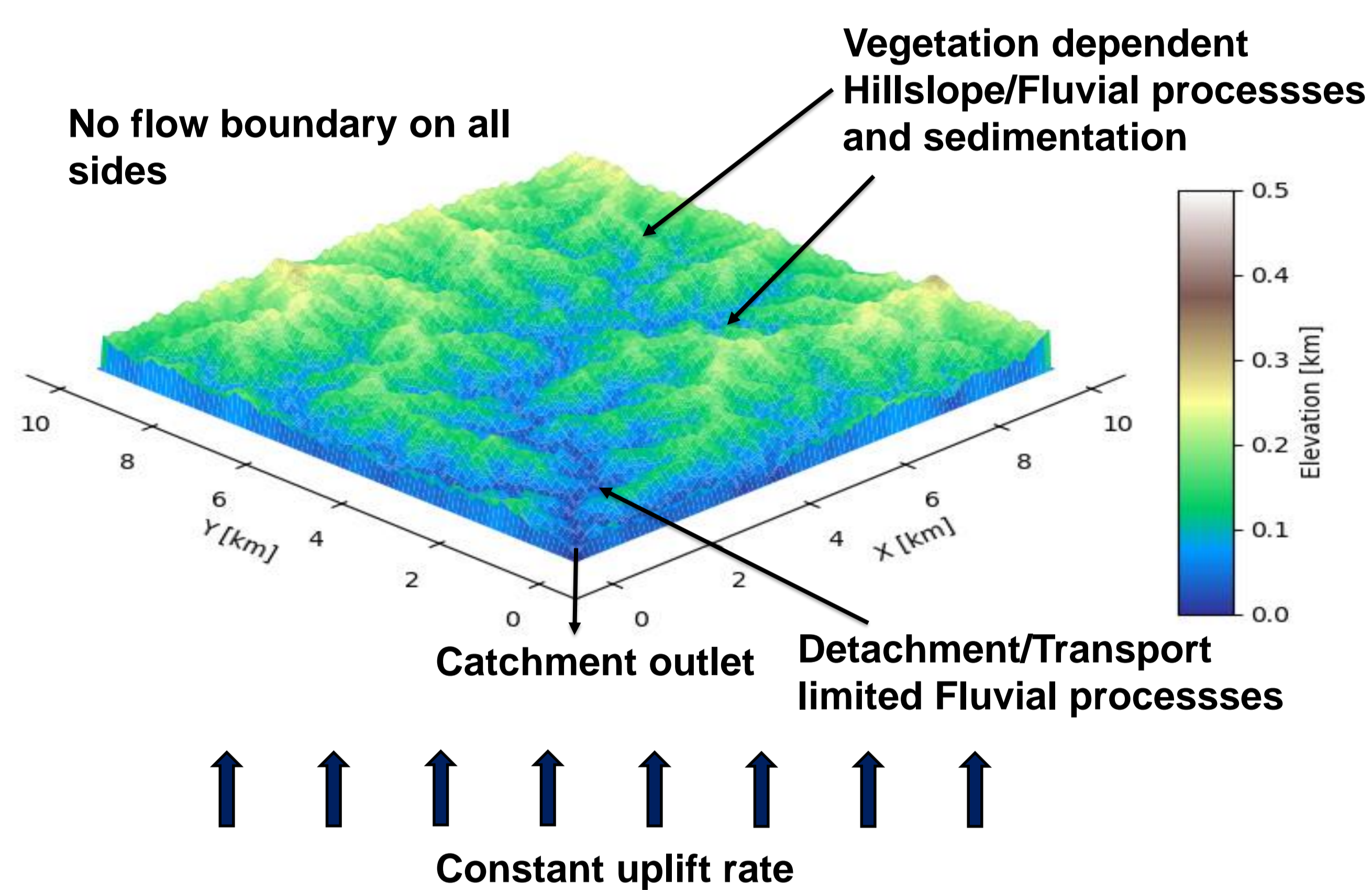
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## Introduction

- Periodicity in climate and vegetation cover influences catchment geomorphology.
- Rates of rock uplift (tectonics) also play a significant role in altering geomorphological processes.
- Climate and tectonics are variable over of millennial to million year time-scales.
- For million year scale landscape evolution studies, it is significant to evaluate the effect of variable tectonics and different periodicities of climate change on catchment erosion and sedimentation.

## Model Setup and Boundary conditions



## Materials and Methods

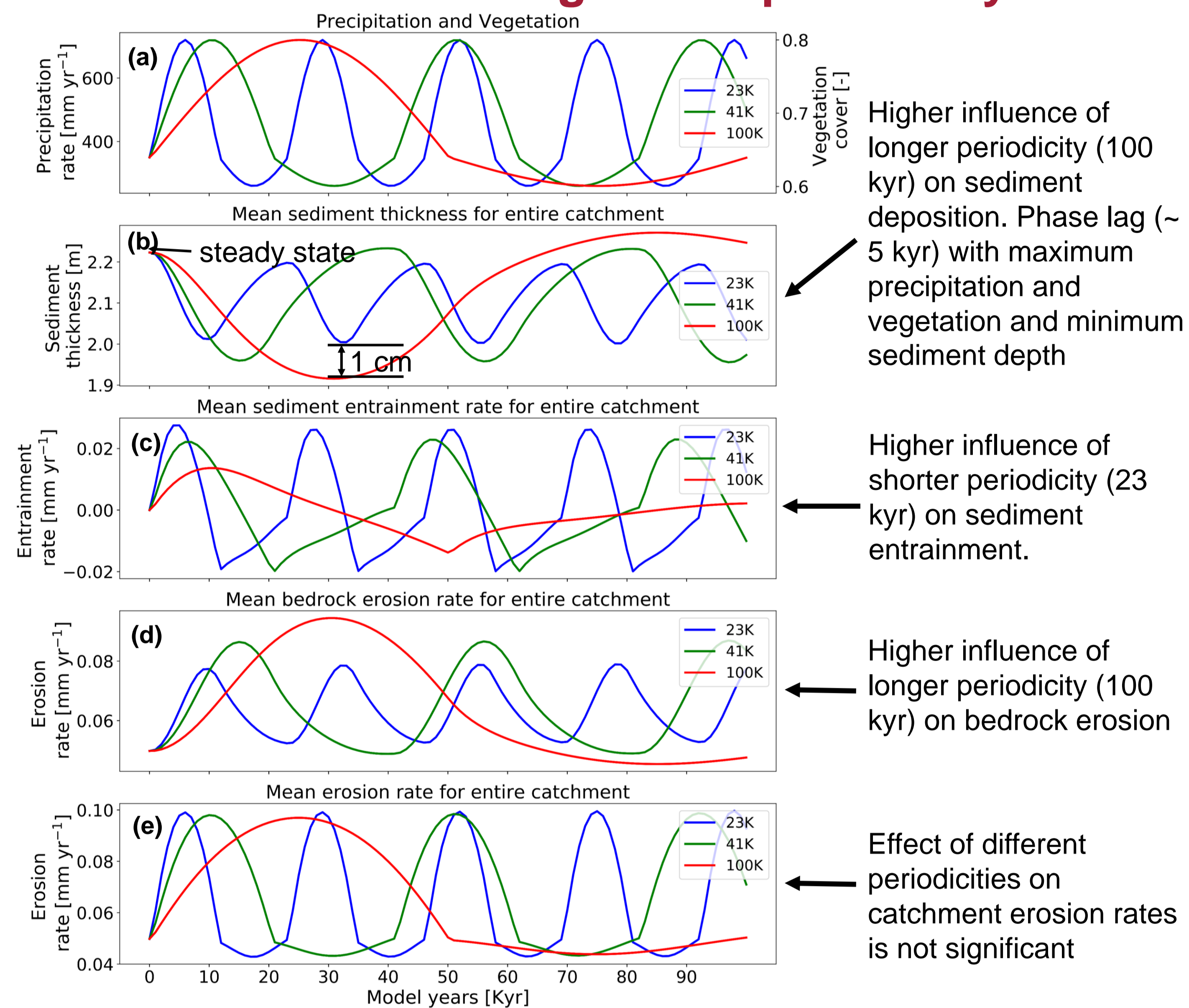
- Model inputs reflect desert (~26 °S) and Mediterranean (~33 °S) climates for sites in Chilean Coastal Cordillera.
- **Landscape evolution model:** Landlab (Python based toolkit)
- Vegetation dependent hillslope and fluvial processes, weathering and soil production were incorporated in Landlab LEM.
- Sensitivity of catchment erosion and sedimentation was analysed to periodic fluctuations in climate and vegetation for:
  - Different periodicities of climate/vegetation fluctuations (23 kyr, 41 kyr and, 100 kyr)
  - Different rates of rock uplift (0.05 mm a<sup>-1</sup>, 0.1 mm a<sup>-1</sup>, 0.2 mm a<sup>-1</sup>)

## Conclusions:

- Variable rates of rock uplift influences catchment topography, erosion and sedimentation linearly.
- The effect of variable periodicities of climate/vegetation fluctuations is significantly pronounced in longer periods (100 kyr) for sedimentation and bedrock erosion.
- The effect of variable climate/vegetation on catchment erosion and sedimentation vary significantly with variable rock uplift rates.
- However, periodicity of climate/vegetation change influences erosion (~0.01 mm yr<sup>-1</sup>) and sedimentation (~1 cm) to lesser extent.

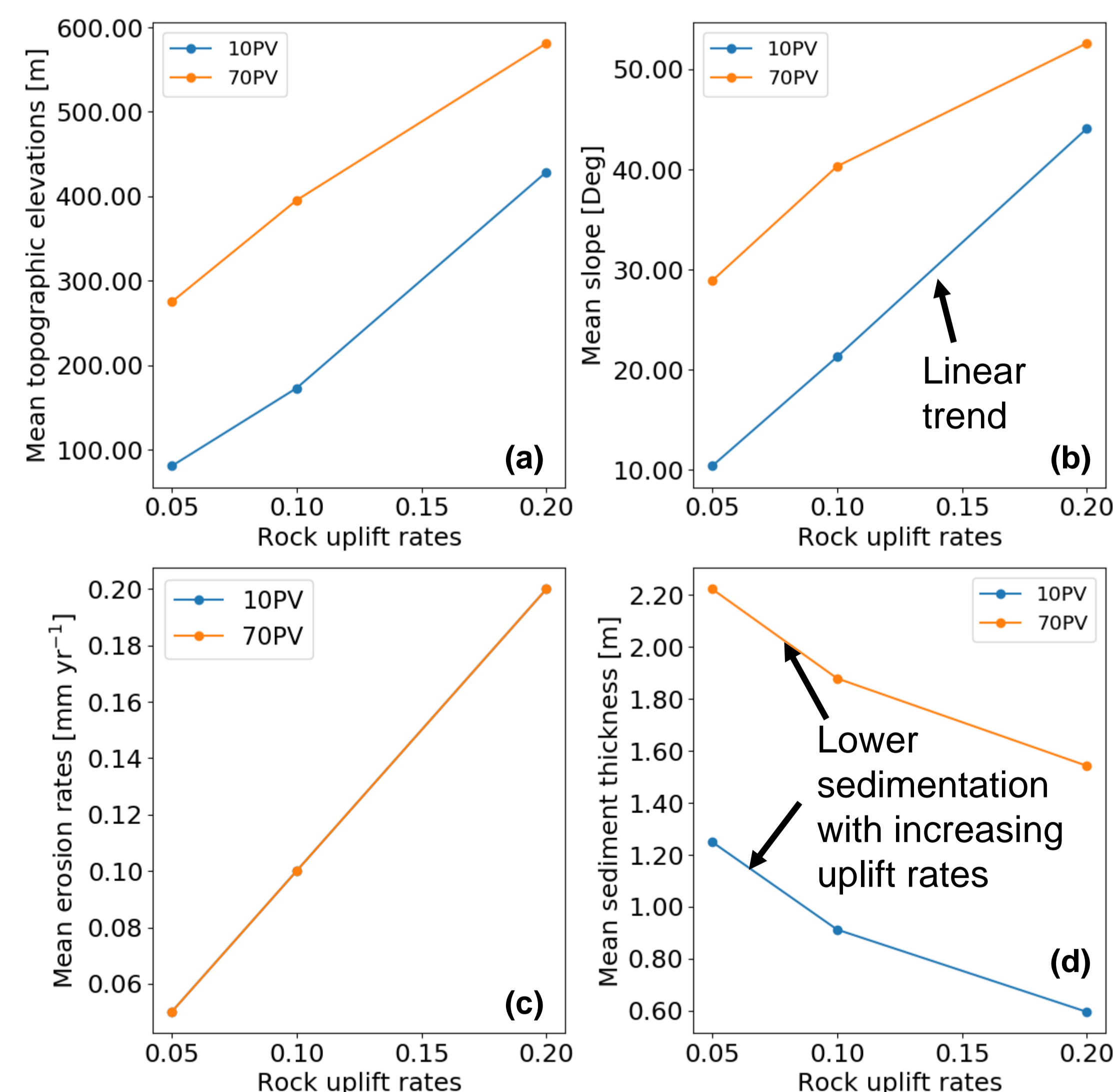
## Model Results:

### Influence of Climate/vegetation periodicity:



**Figure 1.** Effect of (a) variable periodicities of vegetation cover [-] and precipitation [mm yr<sup>-1</sup>] fluctuations on mean catchment (b) sediment thickness [m], (c) sediment entrainment rate [mm yr<sup>-1</sup>], (d) bedrock erosion rate [mm yr<sup>-1</sup>], and (e) net erosion rate [mm yr<sup>-1</sup>]. Rates of rock uplift kept constant at 0.05 mm a<sup>-1</sup>

### Influence of variable uplift rates:



**Figure 2.** Effect of variable rock uplift rates (0.05 mm a<sup>-1</sup>, 0.1 mm a<sup>-1</sup> and, 0.2 mm a<sup>-1</sup>) on mean catchment (a) topographic elevations [m], (b) slope [Deg], (c) erosion rates [mm yr<sup>-1</sup>] and, (d) sediment thickness [m]. Periodicity of climate/vegetation fluctuations kept constant at 23 kyr

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