Gaussian Processes Emulator for Water Erosion Prediction Project (WEPP) Model

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The world and environment surrounding us became vulnerable after human intervention. And it is our responsibility to take care of it. The Gulf of Mexico is being triggered with hypoxia for more than decades, and the reason for this is the nitrogen discharge as well as of the other minerals as a result of soil erosion.

I have always focused to use mathematical analysis and computational statistics to solve the most serious issues affecting the world today. With that in mind, I joined Prof. Niemi's group to use Gaussian processes to alleviate ecological problems. Prof. Niemi is the Head of Analytics at STRIPS group, whose main goal is to maintain the soil erosion across the country, specifically in the Midwest, and to prevent the nitrogen discharge into the Gulf of Mexico. The nitrogen discharge in the Gulf of Mexico causes hypoxia, an environmental phenomenon in which the concentration of oxygen is too low to support living aquatic organisms. Our research group focuses on the prairie strips farmland conservation practice. The conservation can be achieved by converting over 10% of crop fields to diverse and native perennials. This reduces the amount of soil leaving fields by 90% and the amount of nitrogen leaving the field through the surface runoff by up to 85%. These statistics are calculated by the Water Erosion Prediction Project (WEPP) model, a soil erosion prediction technology used by the United States Department of Agriculture (USDA). The WEPP is a continuous simulation computer program that predicts soil loss and sediment deposition by considering various functional, quantitative and categorical inputs (e.g., climate, hydrology, water balance, plant growth, residue decomposition, irrigation components, etc.).

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This research consists of two parts. First is to build an emulator (i.e., surrogate) for the WEPP model using Gaussian processes and to increase runtime rate required to get a spatio-temporal distribution of soil loss across one specific field. I build a surrogate on hierarchical Gaussian processes. Second is to conduct a sensitivity analysis (Dr. Morris) on the sediment runoff and its relationship to annual precipitation as well as the slope of the hill where it?s been measured.

In summary, relying on the results of the research we can conclude that ? here you should write the results of your analysis!

keywords: Gaussian process, emulator, computer model, sensitivity analysis.

1 Introduction

This part should include: Problem Gulf of Mexico. Mission of STRIPS and our part in it.

For the bibliographic references, see **???**.

2 Data

WEPP model in details and its usage in DEP.

WEPP:

2.1 Subsection 2.1

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Table 1: A simple example

First col	Second col	Third col	Fourth col
value 1	data	data	data
value 2	data	data	data
value 3	data	data	data

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Figure 1: A cover of EJASA

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3 Methods

Should be able to include the steps of assumptions and steps of the estimation process: sum up both here.

3.1 Assumptions

Include the material here

3.2 Estimation process

4 Results

5 Discussion

Acknowledgement

Thanks to Prof. Jarad Niemi!