

Test EXAM Land Surface Process Modelling, GEO4-4406

The following exam questions give you an impression of the type of questions that will be asked in the LSPM exam. Each subquestion (1a, 2b, etc) will have approximately the same weight in calculating the final mark. A 2 h exam will contain approximately 9 subquestions.

Question

- a) What is the difference between a string and a list (in Python)? Also, illustrate your answer with two examples (one for string, one for list).
- b) Table 1 contains a Python 3 script. What is printed by the script? Also, explain what is exactly calculated by the script (the order of the calculations and 'flow' of the program).
- c) Pure Python (without using the PCRaster) could be (and is) used for building spatial and temporal simulation models like you did in the computer labs of our course. Give three concepts of PCRaster that make the programming of such models more effective and/or efficient. Shortly explain each concept.

```
a = 3
```

```
def compare(a):  
    b = 3  
    if a == b:  
        print('a equals b')
```

```
compare(12)  
print(a)
```

Table 1. Python program.

Question

This question refers to the paper that was sent to you by Derek Karssenbergh before the exam.

Major approaches to simulation modelling are:

- Agent-based modelling
- Stochastic modelling
- Modelling based on differential equations
- Modelling by including neighborhood interaction (cellular automata like, or extensions to cellular automata that use different spatial functions to calculate cell states)

- a) There is of course overlap between these four approaches and some models could be categorized as combining approaches. However, most models mainly rely on one of these approaches. For the paper that you read, 1) explain which approach is used, 2) give a key concept of this approach and 3) explain how this key concept is used in the model. If the model combines multiple approaches, select one of these and answer the question for this approach.

- b) Somebody would like to model the same system with a model rewritten from scratch, but using an approach that was not used in the original model (the model described in the paper). Would this be possible? If not, explain why not. If it would be possible, explain how it could be done. Restrict yourself to the four approaches given above.

Question

This question refers to the paper that was sent to you by Derek Karszenberg before the exam.

The determination (estimation) of the value of the model parameters is an important step in model building.

- a) Explain how the values of the model parameters were determined (estimated) in the paper that you read.
- b) Explain what observational data you would collect to improve the determination (estimation) of the values of the parameters in the model described in the paper that you read.
- c) Explain how (give the procedure) these observations can be used to better estimate the parameters in the model.

Question

In this question you can use the model in the paper that was sent to you by Derek Karszenberg before the exam to illustrate your answer. You can also pick another example of a model or system that is modelled.

Models are built for a particular purpose (in most cases). Preferably, the model structure (equations, input variables, state variables, and parameters used) needs to be chosen such that it fits the purpose of modelling. There are two main groups of purposes of modelling: 1) studies aiming for **optimal prediction**, that is, the best estimation of the state of the modelled system (in the past or in the future) and, 2) studies aiming for a **better understanding** of the system.

- a) Explain what modelling choices need to be made for each of the two goals (optimal prediction, better understanding). Illustrate your answer with an example, you can use the system that is modelled in the paper that I sent you or you can pick another example system.

Question

Figure 1.1. shows the results of a simulation with the SWAP model, which is a spatio-temporal hydrological model calculating the soil moisture content for each cell in the modelled area. The figure shows the soil moisture content calculated by the model (median and 95% confidence interval). This is done using Monte Carlo simulation. It also shows the measured soil moisture at the same location (REMEDIHUS).

- Explain how the 95% confidence interval is calculated from results of a Monte Carlo simulation.
- Make a sketch of the probability distribution of modelled soil moisture in august.

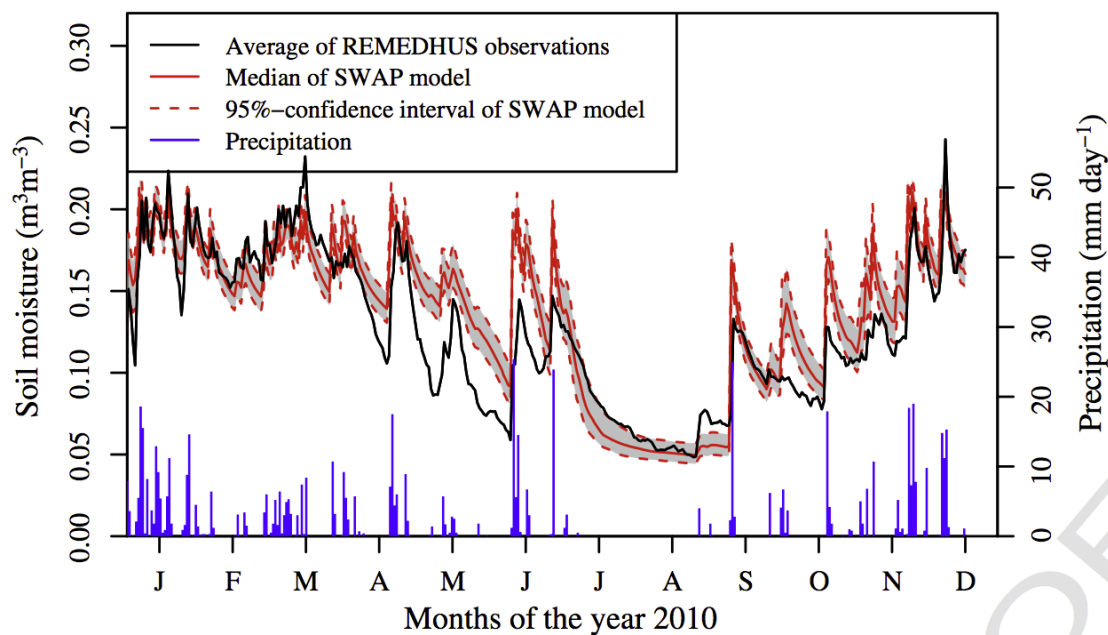


Figure 1.1. Soil moisture content simulated with the spatio-temporal SWAP model (light grey lines); soil moisture content measured at the same location (black line); precipitation (vertical bars).