Sequential Monte Carlo calibration of NUCOM-Bog on multiple peatlands (P2.291)

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Introduction

Peatlands store a vast amount of carbon in their soil. With climate change, the stability of these carbon pools is under threat. Peatlands are mainly located in the northern hemisphere and can occur in different forms (e.g. bogs and fens). Their differences in hydrology lead to different types of peatlands and to a different carbon balance of the ecosystem. In this study we calibrate the NUCOM-Bog model (Heijmans et al., 2008) on 4 different sites. These sites differ in hydrology, climatic conditions, water table depth, vegetation and chemical status. The NUCOM BOG model (Heijmans et al., 2008) simulates NUtrient cycling and COMpetition for 5 plant functional types (PFT): graminoids, shrubs, hummock, lawn and hollow mosses in peatlands/bogs with a monthly time step. Each PFT has its own characteristics and competes with the other PFT's for light and nitrogen. NUCOM Bog calculates the NEE, WTD, GPP and R_{eco} on a monthly time step.

Materials and Methods

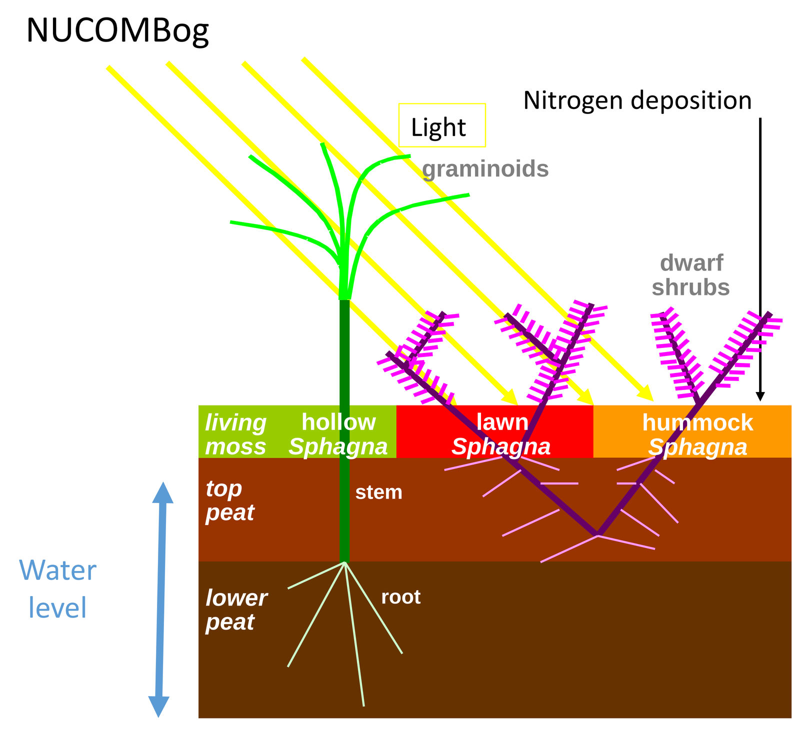
We will compare four different peatlands, with different climates:

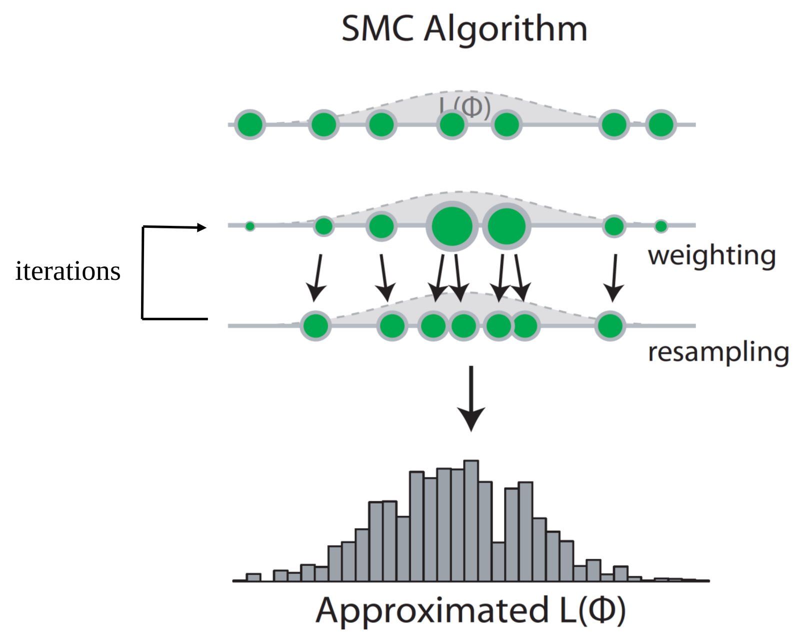
Site	Type of peatland	Location	Annual average temperature (°C)	Annual amount of precipitation (mm)	Amount of data available
Mer Bleue	Raised bog	Canada	6.3	943	14 years
Monte Bondone	Alpine fen	Italy	5.4	1290	5 years
Glencar	Atlantic bog	Ireland	10.5	2571	10 years
Rzecin	Floating carpet	Poland	8.5	526	8 years

The NUCOM Bog model has been wrapped in R and is available on CRAN for download (Pullens et al., 2016).

Sequential Monte Carlo

The NUCOM BOG model is calibrated against monthly NEE and WTD data of the four sites using the Sequential Monte Carlo technique (SMC). This technique samples seeds from a prior distribution and runs the model with it. Based on the likelihood the seeds are weighted, from the seeds with the highest weight a new set of seeds is made (resampling). After x iterations the seeds will result in a posterior distribution of the parameter.





Results (Mer Bleue)

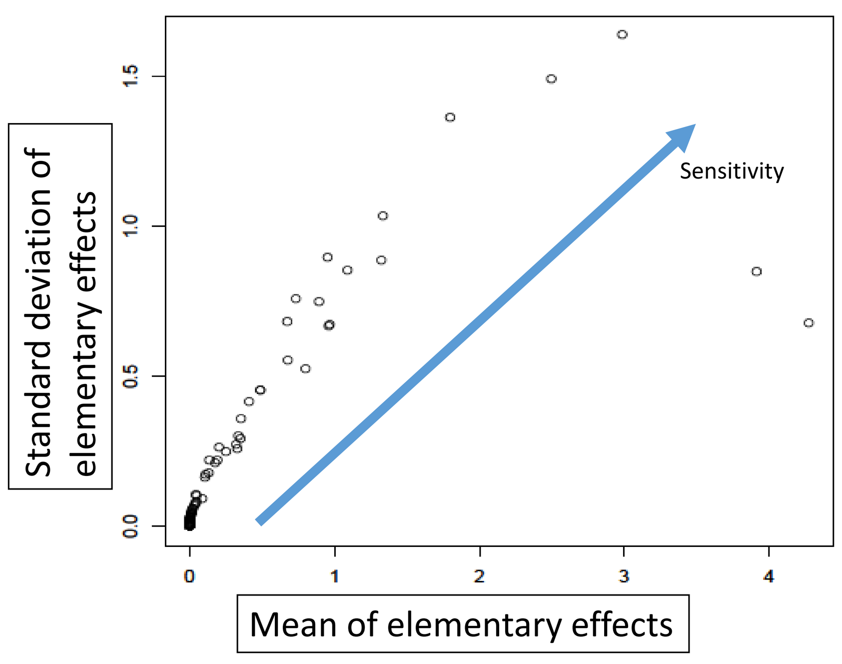
Sensitivity Analysis

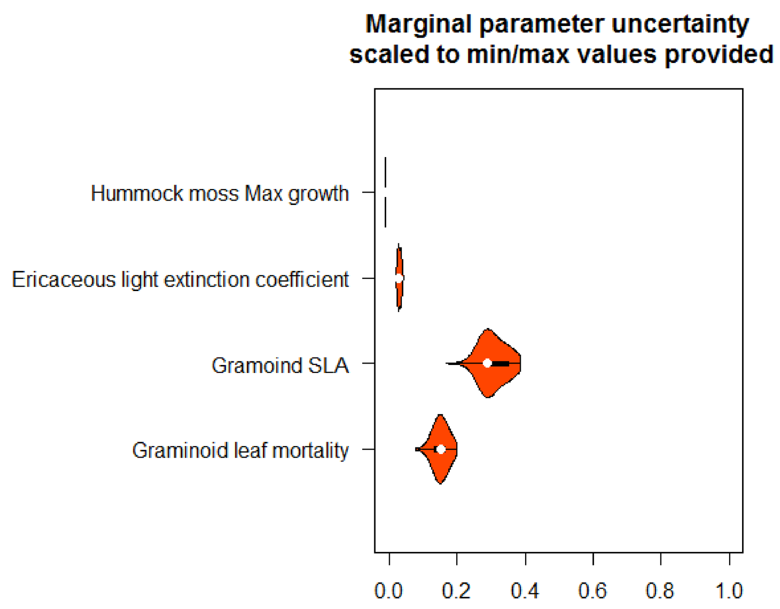
The sensitivity analysis was done with by means of the Morris function of the Sensitivity R-package, out of the 200 model parameters, 30 are considered sensitive. These parameters are used in the Sequential Monte Carlo.

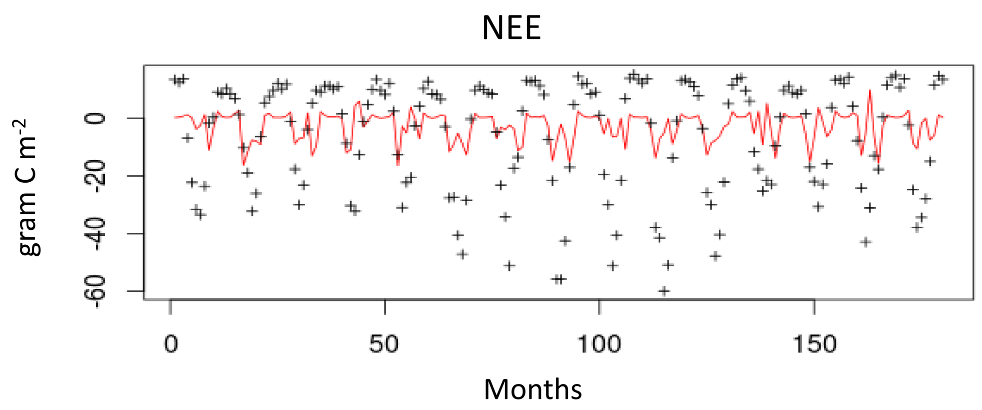
The sensitivity analysis indicates that the model is most sensitive to mortality and growth parameters.

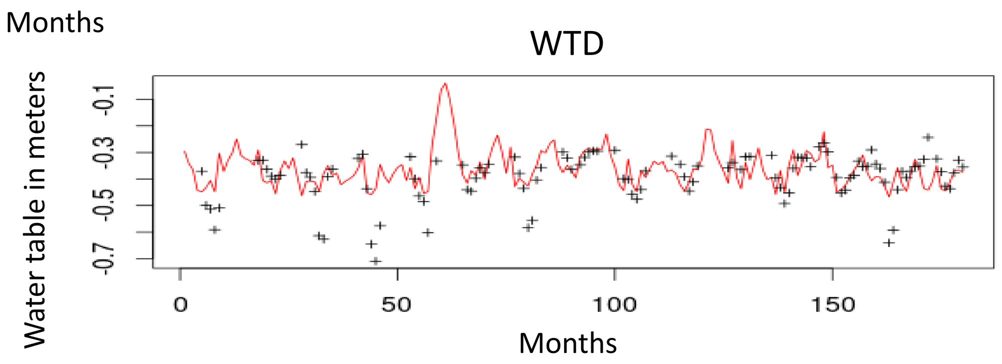
Sequential Monte Carlo

In total 30 parameters will be calibrated, with the number of seeds set 10^5 to and 10 iterations. The posterior distribution of some of the parameters is plotted here and we can see that for some parameters the SMC can find a very narrow posterior distribution. If we run the model with the parameter set with the lowest likelihood, we get the following results.









Conclusions

Based on the results we have obtained so far (for Mer Bleue), we can say that the model is sensitive to the growth and the mortality of the PFT's. Although diffulties arise when parameters are highly correlated to each other. These parameters have to be furhter analysed and also the structure of the model needs to be analysed. We conclude that calibration is a useful tool to highlight model discrepancies, and also that it can be a useful tool to be used for inferring functional differences across ecosystems.

References

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