QUESTIONS & ANSWERS

DOMANDE & RISPOSTE

Dear Simone and Roberto,

after reading some of the papers of the RIAm Special Issue on WARM, I am writing to follow your invitation to interact with the Journal and with his Authors.

First of all, I would like to congratulate for the very interesting papers that you published, which may be useful for a larger audience (not only for people working on rice).

I also have some questions for Roberto, related to the paper on sensitivity analysis, which I found very stimulating:

1. *I was very surprised by the different importance of Topt (Optimum mean daily temperature for growth) in CropSyst and WARM, and I could not clearly understand the reasons, even if you have provided some comments in the paper. The effect of Topt in WARM is 10 times higher than in CropSyst, and, even if WARM is different compared to CropSyst (in terms of simulation of net photosynthesis), still I feel it difficult to accept the result (by the way, what are the measurement units of "mu"?). Probably one reason for the difference is that CropSyst has a linear response to temperature, while WARM has a non linear response. But is it enough?;*
2. *I was surprised about the lack of effect of LAIini (leaf area index at emergence) in WARM (its effects are exactly mu=0 and sigma=0!);*
3. *with CropSyst and WOFOST, SimLab was used through a pre- and post-processor outside the models. I was interested in doing something similar with a mineralisation model I am working on, and therefore I was curious to know if the version of Simlab to be used in this case is ver. 2 (the stand-alone version).*

Thank you very much for your attention,
All the best,
Luca

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Dear Luca,

thanks for your interest and for your questions.

1. WARM simulates biomass accumulation using a radiation use efficiency approach (RUE-approach), daily modulated by a factor accounting for thermal limitation. CropSyst computes each day two values of potential biomass, the first is practically the same of that implemented in WARM (RUE-approach), the second is based on a transpiration use efficiency approach accounting for vapour pressure deficit (TUE/VPD-approach). Each day, the minimum between these two biomass values is selected. In CropSyst only the RUE-approach accounts for thermal limitation and, in the conditions explored in the mentioned paper, the TUE/VPD-approach is used in most days (this is also confirmed by the values of mu for the CropSyst parameters radiation use efficiency and biomass transpiration coefficient). This can be explained by two considerations: (i) the potential transpiration - used by CropSyst for calculating biomass using the TUE/VPD-approach - cannot be higher than a certain limit, although plants grow under flooded conditions because of bio-physical constraints; (ii) the maximum (potential) radiation use efficiency for rice is higher than for other C3 species: this is suggested in a precious paper by Sinclair and Muchow [Sinclair, T.R., Muchow, R.C., 1999. Radiation use efficiency. Adv. Agron., 65, 215-265] and confirmed by measurements recently carried out in the same conditions by Boschetti et al. [the fifth paper of the special issue you are referring to]. Therefore, the main reason of the different importance of Topt in WARM and CropSyst is that the limiting effect of temperature (calculated on the basis of Topt) is used each day by WARM and only some days by CropSyst.
2. Also some parameters from the other two models in the comparative study assume exactly mu = 0 and sigma = 0. Evidently, (i) in the explored conditions (Opera (MI), 2004), (ii) using the Morris method, (iii) with the chosen parameterization of the Morris method itself (type of distributions and parameters of the distributions, seed for the generation), the WARM parameter LAIini assumes values 0 both for mu and for sigma. Note that the generated population of LAIini values using such parameterization of the Morris method includes different LAIini values (the fact that mu and sigma are equal to zero is not due to the use of the same value for LAIini in the different simulations).
3. WARM uses a c++ DLL for carrying out all the sensitivity analysis-related elaborations which SimLab executes (all the main methods are implemented). The DLL is wrapped to make it compatible with a Visual Basic 6 code (WARM is currently programmed using this language). This is because we consider important to have an integrated tool for sensitivity analysis directly in the WARM simulation environment. In the case of the mineralization models you are working on, I would suggest to adopt the same method I used for CropSyst and WOFOST. Practically, you can generate the combinations of parameters using SimLab 2 with its user's interface. You can use SimLab 2 also for analyzing the results of the simulations and, therefore, for calculating the sensitivity indices (obviously on the basis of the previous generation). In this way, you have only to program something able to read the file with the combinations of parameters generated by SimLab 2 (.sam) and coherently launch the simulations and write results (output of the simulations) in a format understandable by the final section of SimLab 2 (.txt). This is allowed by the fact that all the fluxes of information among the different sections of SimLab 2 are through text files. Note that, if you have not models with too many parameters, the methods based on variance decomposition and Monte Carlo simulations (e.g. Sobol', EFAST) are more powerful and robust than the Morris method, although they require much more simulations (e.g. if you have a model with 11 parameters, Morris requires a maximum of 120 simulations while Sobol requires more than 10000 runs). Pay also attention to the correlations among model parameters: not all the methods allow to manage it.

Best regards,
Roberto

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