Questionnaire on model complexity

Dear modeller / model user,

Do you use any environmental computer model(s) in your work, such as hydrological models, landscape evolution models, meteorological models etc., either daily or just occasionally? Do you have an opinion about the complexity or simplicity of the model(s) you use? We are investigating this topic, and you can help by filling out a short questionnaire on model complexity. Your input will be used to analyse how the community (you!) think about complexity in models. We intend to publish our findings.

The questionnaire consists of just 12 multiple choice questions and should not take you more than 5 minutes to complete. Your time and effort are greatly appreciated!

NB: feel free to pass this on to colleagues who might be interested!

Many thanks,

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Background questions [1/5]

* Which of the following best describes your primary work sector?

- ◯ Academia
- ◯ Public sector - non-research
- ◯ Public sector - research institute
- ◯ Other (please specify)

- ◯ Private sector - consultancy
- ◯ Private sector - research institute
- ◯ Prefer not to answer

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* What is your career stage?

○ Undergraduate (BSc) student   ○ Assistant professor

○ Graduate (MSc / PhD) student   ○ Associate professor

○ Post-doctoral researcher   ○ Full professor

○ Junior researcher   ○ Emeritus / retired professor

○ Medior researcher   ○ Prefer not to answer

○ Senior researcher

○ Other (please specify)

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Background questions [2/5]

* What is your career stage?

○ Intern   ○ Director

○ Junior researcher / consultant   ○ CEO / company owner

○ Medior researcher / consultant   ○ Retired

○ Senior researcher / consultant   ○ Prefer not to answer

○ Manager

○ Other (please specify)

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Background questions [3/5]

* In which field do you work?

☐ Hydrology		☐ Meteorology	
☐ Water Quality		☐ Climate studies	
☐ Spatial planning		☐ Environmental Sciences	
☐ Ecology		☐ Earth System Sciences	
☐ Soil science		☐ Prefer not to answer	
☐ Geomorphology			
☐ Other (please specify)			

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Background questions [4/5]

* What is your age?

◯ <25	◯ 55- 64
◯ 25 - 34	◯ >64
◯ 35 - 44	◯ Prefer not to answer
◯ 45 - 54	

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Background questions [5/5]

* What is your gender?

◯ Male	◯ Prefer not to answer
◯ Female	

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Questions on model complexity [1/7]

* How often do you use* computer models in your work?

*use includes any of the activities that are normally part of the modelling process, such as data preparation / preprocessing, running a model, developing/adapting a model (also conceptually), and interpreting the outcomes.

○ I have used a model once

○ Rarely (less than once a year)

○ Occasionally (once to a few times per year)

○ Regularly (once a month on average)

○ Often (e.g. weekly)

○ Daily

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Questions on model complexity [2/7]

* How do you (mainly) use models?

Please select all that apply.

☐ Model developer - defining model theoretical underpinnings

☐ Programmer - adapting model code

☐ Applying existing models for forecasting and prediction

☐ Applying existing models for scenario (what if..) analysis

☐ Applying existing models for investigation of processes and their outcomes

☐ Applying existing models for policy and management support

☐ Other (please specify)

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Questions on model complexity [3/7]

* Please indicate the degree of your (dis)agreement with the following statements.

	strongly disagree	disagree	neutral	agree	strongly agree
Models represent / predict reality	○	○	○	○	○
Models are tools to investigate processes and their outcomes	○	○	○	○	○
Models are an implementation of a set of theories / used for hypothesis-testing	○	○	○	○	○
Models objectively represent our current state of knowledge	○	○	○	○	○
All models are wrong, but some are useful	○	○	○	○	○
Models support decision-making	○	○	○	○	○
Models are exploratory tools	○	○	○	○	○
Models are useful when data is absent	○	○	○	○	○

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Questions on model complexity [4/7]

* How would you characterise complexity in a model?

Please select all that apply.

☐ Number of input variables

☐ Number of processes explicitly included

☐ Number of interactions / feedbacks incorporated

☐ Options to choose from in terms of processes to turn on/off

☐ Number of output variables produced

☐ Non-linearity of processes incorporated

☐ Number of equations

☐ Length of the code

☐ The data at your disposal compared to the required input data

☐ Spatial and / or temporal resolution of input / output

☐ Computer calculation time

☐ Ease of use of the model (i.e., graphical user interface)

☐ Empirical versus physical nature of governing equations

☐ Representation of processes that act over multiple temporal and/or spatial scales

☐ Other (please specify)

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Questions on model complexity [5/7]

* In your opinion, does increasing model complexity lead to increased or decreased uncertainty in the model results?

- ◯ Increased
- ◯ Decreased
- ◯ Uncertainty and model complexity are unrelated
- ◯ Other (please specify)

- ◯ Depends on the duration, frequency, and quality of available observations / measurements
- ◯ Depends on the number of different variables and states that are observed / measured

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Questions on model complexity [6/7]

* Which of the following do you think most impact your decision to select/use a simpler or more complex model?
Please select max 3 options.

- ☐ The research question at hand
- ☐ The spatial and / or temporal scale at which the model is applied
- ☐ The availability of input data
- ☐ The researcher's experience
- ☐ Other (please specify)

- ☐ Reputation of the model
- ☐ Standard use of this model in my organisation
- ☐ Runtime
- ☐ The level of understanding of the system

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Questions on model complexity [7/7]

* Please indicate the degree of your (dis)agreement with the following statements.

	strongly disagree	disagree	neutral	agree	strongly agree
Discussion of model complexity should be high on the agenda	○	○	○	○	○
We should improve our models by making them more complex	○	○	○	○	○
New observation techniques allow us to justify increased model complexity	○	○	○	○	○
Increased computer power is a good reason to increase model complexity	○	○	○	○	○
Reduced complexity models can be as useful as complex models to increase our understanding of environmental processes	○	○	○	○	○
I have more confidence in the simulations of a complex model compared to a simple model	○	○	○	○	○
Explanation of rationale for model selection in research/advisory reports would increase understanding of relevance and usability of results	○	○	○	○	○

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Thank you for taking the time to fill out our questionnaire! You can add any additional comments you would like to make about model complexity in Earth and Environmental sciences. Please press the Done button below to submit your answers.