Overall observations.

The manuscript offers an interesting philosophical review of numerical and conceptual models in the geosciences. However, it gives insufficient attention to how these models are used to interpret present processes, reconstruct past events, and predict future events. Although my expertise lies in hydraulic, hydrological, and geomorphic modelling rather than philosophy, I find that the discussion remains somewhat disconnected from the models currently used to understand real-world systems and inform decisions, such as flood zoning and geophysical exploration for mineral resources. Overall, I consider the manuscript publishable and worthy of consideration for publication.

Specific comments

Abstract

Line 1. “Humans are a representing species: we construct conceptual, numerical and material models that represent the world in certain respects.” I would also mention that we humans also create models not only of this planet, for example there is interesting models about astrobiology, extraterrestrial geomorphology etc. Even though this text is focused on Earth, it could be worth mentioning somewhere regarding these kinds of models that actually question the frontiers of numerical and conceptual modelling.

Introduction

I understand the philosophical point of view of the author regarding “ what is a model” which can vary from a lot perspectives, cultures, historical periods, materials and geographical areas. I think, one of the main aspects that is being obviated in the introduction is the mention of Cartography. Which is one of the most ancient and powerful ways of representing reality for decision making. Maps in general have played a key role in human history, power and continue to provide key information of society.

Line 50. I get a little lost seeing the pictographic representations of prehistoric animals and behaviors (please add a cite) are you referring to the caves in France, Spain etc ?. As mentioned before, I can’t find a strong connection with the lions and geoscience. I understand the point, but other readers might get confused since this an EGU publication. I think the introduction should conceptualize more geosciences models.

2 Kinds of models and some examples

Line 75 **“**A model is more than a theory made numerical: models can intermediate in many ways between theory and the world and also are a source of knowledge in their own right”

Line 80. In a certain way we could say that models in geosciences are intended to reconstruct past, predict future and monitor-understand current geomorphic processes (either endogenic or exogenic).

Lines 110 to 125. Here I would consider clarifying the difference between what is a hydrological, hydraulic and geomorphic model. For readers not familiar with modelling geomorphic processes I think this a key aspect to consider since you refer types of models. Also, other types of models could be considered such atmospheric models for example.

3 Model representation

Line 140. Why is 3D map not a model ? If it was created from LiDAR, photogrammetry etc. Please explain why these types of “ models” are not a “ model”. 3D modelling is had groundbreaking advances in the last two decades for understanding geomorphology for example and also engineering

Line 179. “There is nothing essentially physical about these models”

There has been a great amount of research regarding the validation of hydraulic-geomorphic numerical models with laboratory experiments (flume sediment transport for example). I don’t understand the idea that there is nothing physical, since the main of objective of modelling is to understands the physics (in these cases) of the reality of the Earth.

Figure 2. I see no relation with geosciences models. I understand that this paper has a strong philosophical overview, but as a numerical modeler myself I find some key elements missing such as data collection, pre processing, processing, post processing, validation, field verifications etc.

4 How we communicate about models

Line 255. We all agree that models do not represent with precision or exactitude reality. Either on going processes, past events or future scenarios of earth dynamics (or extraterrestrial). But most of us at least hydraulic-hydrological-geomorphic modelers agree that without numerical modelling it would be difficult to take informed decisions for human development and adaptation of critical problems (such as sea level rise, microplastics pollution, extinction of species etc...). A lot of the developed models (either open source or commercial) have had deep impacts on public policies and in general the world economy. For example, without geophysical models it would not be possible to locate critical fossil fuel sources that move the global economy. My point is that a great variety of models have been well communicated either in a public or private-corporate manner that allow human progress. The concept of "human progress" is highly debatable I agree, but models have been deeply linked with the concept of " communication" since mostly these are done from multidisciplinary approach. The geologist models the stratigraphy of a fossil fuel deposit, the engineer decides where to drill or excavate, just mentioning one of the cases where models move the capitalist global economy. Without the communication of the way models work and how they help us how reality is being interpreted it would be difficult to achieve the advances humanity has achieved.

4.2 Model representation in public affairs, public engagement and consulting

Overall in this section I think something key is missing. Addressing how some groups of society question models. Climate change projections are valid, true, possible, or a scam as come qualify it? Models have strong numerical backbones that try to represent reality and future scenarios. Nevertheless, even if they were developed by people that have spent their lives "perfecting" these kind of tools, they keep getting questioned and submitted to scrutiny by society and sometimes key decision makers such as politicians. In a paper of this type I think this would be important to address in a paragraph or two, since questioning models many times means questioning research, science and eventually leading how we are going to design public policies for future generations. I leave the comment for this section: Should we take into account climate change models into urban planning? (an example)