Earth System
Dynamics

Discussions

EGU

Interactive comment on "Integration of terrestrial observational networks: opportunity for advancing Earth system dynamics modelling" *by* Roland Baatz et al.

Anonymous Referee #1

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The study by Baatz et al. assess the current status of the level of integration of models used by the LTER and CZO communities, and gives perspectives how the fusion of measurement and modelling communities could exploit the full strengths of observational networks to increase our understanding of Earth System Dynamics. In my opinion, this attempt is timely and deserves the presentation in a journal like Earth System Dynamics. There are many straightforward thoughts in this manuscript, and also the analysis of level of integration and the survey itself are useful instruments. However, I see three major points that need thorough revision.
1. The utilization of terms (integration, incorporation, linkage of data model-usage, coupling) is not precise, and especially terms like model integration should be defined

thoroughly and then remain reserved for the given used. One example is the abstract: "Advancing our understanding of Earth System Dynamics (ESD) depends on the development of models and other analytical tools that integrate physical, biological and chemical data. This ambition of increased understanding and model development of ESD based on integrated site observations was at the origin of the creation of the networks of Long Term Ecological Research (LTER), Critical Zone Observatories (CZO), and others". If I understand it correctly, in the second sentence, "integrated site observations" means a set of measured variables that comprises both driving variables and target (mapped) variables that are necessary to run and validate a process based model. As the preceding sentence already uses integrated, I suggest rephrasing the next one, otherwise the readers will stumble already here. In addition, objective 3) (Line 10) suggests network integration. This needs to be specified, and distinguished from model integration. In addition, the difference between model coupling and integration is not clear, and the terms are used interchangeably (see section3.2), though they are not: Is integration of a new variable more pertinent or could these processes be used at the same time, or would model coupling be more efficient? Furthermore, it remains unclear what exactly the authors mean with data-model linkage, and how was it quantified?
2. To this end, I suggest introducing a figure on how data assimilation, data integration and model coupling are related, where can they complement each other, and what are the differences?
3. The structure of the paper needs to be changed. A materials and methods section is required to give the reader an overview on the questions posed in the survey, and on the evaluation methods. The current Appendix structure (Appendix figures were missing) produces duplicate information which could be avoided when materials and methods section would follow the introduction.

In general, the different paragraphs even in a section or sub section need to be linked in a more straightforward way, and the writing styles need to be harmonized.

See some more detailed comments below.

Title
ok

Highlights
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Abstract
L6: "we look for" sounds colloquial, I suggest changing to "The survey results identified gaps . . ."
L10: please specify complementarity. Unclear if you mean complementarity of networks or observations that occur at given sites, but are missing at the other.
L13: functional topological network: Formulation unclear. Please specify.

Introduction
L20: this is an odd sentence, I don't think it's verbatim. What exactly do you refer to with "scientific and societal imperatives" which are paramount to improve our understanding? Please rephrase the sentence, and probably split it.
L30: exemplary is ambiguous here. I suggest to change to "are for instance networks . . ."
P3L2: ESD has been introduced before.
P3L3: please rephrase sentence, it starts with ". . .range form . . .", but there is not "to".
P3L2-10: This section is fundamental in this contribution. It contains data assimilation, an attempt to define integrated/coupled models and calls for "more" integrated models. The authors need to clearly define the borders what can be achieved with data assimilation, model integration and model coupling, work out what the differences are and to comment on if "more integrated" models are less or more efficient than coupled models. I also suggest having a figure here on how data assimilation, model integration and model coupling is connected or distinguished.

L11: how exactly are more integrated and coupled models different? For more integration, capabilities of a usually couples model need to be implemented in the parent (less) integrated model. There are also several ways of coupling, which should here described in detail.
L13: At this point the authors bring in another terminology: incorporation of measurements. I suppose, this is in no way different from data integration. Please be very clear at this point. Incorporation also contradicts the coupling approach promoted in the preceding sentence.
L17, and following two paragraphs come out of the blue. A connecting, introducing sentence is required at this point.
P4L6-9: The sentence seems too long for the part of the message I understand. I am not sure what your mean with organizing science questions. If I get it right, I suggest: "At the same time, the science questions, observed variables and associated measurement methods lead to . . ."
L10: I suggest deleting the "Here".
L12: still at this point model integration and linkage of data-model usage remain vague.
L17-28: Introduction could stop here. I find it very odd that you dive in section 2 directly into the Challenges without describing what was asked in the survey. I strongly advocate for a materials and methods section, as the neglect of the named section leads to duplicate information in the appendix.

Materials and Methods (in appendix, unfortunately)
Results
P5L1: How is data-model linkage defined? This needs to be explained in a preceding section (e.g., Materials methods or such like)
P5L3: Appendix and supplement: quite vague. All appendix, all supplements? The fundamental data should occur in the main text body.
L15: Does "used" mean that it is an input variable or a target variable. Please

consider having the categories input and target variables at this point. It may be useful information if calibration/validation data has been determined at the site directly.

L20: I don't see the relation of this paragraph to the section head "data-model linkage". Please consider having another section head, or link figure one with (for instance) scales of the input data. This would be the link to your section head. In Figure 1 I suggest leaving the 0-values white.

P6, section 2.2: I suggest reducing this section to one paragraph, i.e., only giving one example, but explain this properly. The corresponding figure is illegible, especially the river-like structure, the model structure? (seed rain model and some ellipses and arrows, without explanation), is it boxplots I am looking at, is the reference scenario "human impacted" only? Also after several readings it is not clear to me what the difference between data-model linkage and integrated modelling should be, especially if the Figure caption starts with "Integrated model ..." and section 3 is on integrated modelling. The reference to the figure is missing.

L24 "holistic integrated models". This class has not been defined before. Does this class comprise all the models used by the survey respondents?

L25/26: unclear what "replaced" means. Would modellers prefer using other products than the directly measured ones, and what would be the reason? The following sentence claims that there is a need for on-site measurements, but would they be used?

P7L9-10: All disciplines and compartments should be subject to the main text.

Subsection 3.1: I don't fully understand how the level of integration was calculated exactly, and how the variables (L12, 14) find their way into this metric. Please specify. The metric "level of integration" is also not discussed in this section, but there is only a reference to the figure.

L30-31: According to the subsection head this section is about integrated modelling. In the named lines, it says "requires coupling of models...". This switch of model integration to coupling is really confusing, and inadequate.

P8L1: RT-FluxPIHM: what is the purpose of this model?

C5

L10: I suggest stopping here (don't give the next example) and tell the reader what the preliminary results were. The figure suggests increased groundwater flow though now trees with a greater rooting depth are present. Please discuss this briefly, and what regional implications does it have?

P9L18: please add the appropriate reference to your analysis.

P10L18-20: Please rephrase sentence.

P11L18-20: True, but this paper would be a chance to describe how this could be set into action.

P12L29-30: Please finish this sentence. This section: what do the communities think of your two suggestions? Would a new network replace the old ones? Please also specify the term functional topological networks. What does it imply for the networks.

P13L19: here the term "more deeply-informed" comes into play as another model class. It is necessary for the authors to clarify how this translates to model coupling, integration in their opinion.

C6