'Earth Virtualization Engines (EVE)' – response to reviews

February 11, 2024

A synthetic response to the reviews was provided in the "author comments" uploaded on 6 January 2024. Here we supplement this with a brief response outlining the changes to the manuscript in response to the reviewer comments.

Review 1

The substantial points raised in this review were presented in a sequence of paragraphs, starting with paragraph 4. These are addressed in turn below.

1. "First, however, we must deal with AI ..." The FAQs have been substantially revised to address this point, as AI is central to EVE. EVE differs from what has been done in the past and what is being done elsewhere by its scale, and this, we have learned, is decisive. Specifically FAQ2 (they are now numbered) references the realization that generative AI benefits from the scale of the problem "which provide the vast amounts of globally gridded data needed to train the most advanced weather- and climate-related AI models ... [EVE] will demonstrate how interoperability of data and software co-proximate to the computational capacity needed for the requisite machine learning, can help users extract more information, with greater salience, from their own data, thus valorizing its collection and open provision". In FAQ4 we add "Third, whereas the aforementioned efforts mostly focus on twinning as a form of data provision, EVE additionally emphasizes AI integration to enable information provision." FAQ6 has been substantially revised to address the reviewers point. It now concludes: "AI On-Top goes well beyond emulation to enable interactivity across disparate sources of data, e.g., to create new types of models, and to give salience to the use of data. This is the game changer. One lesson of recent applications of generative AI is the disproportionate benefit of larger (AI) models, trained on larger and more diverse data. This requires very large computing capacity, both for the training and for creating the training data. It means that AI, in particular AI On-Top, isnt merely a part of EVE, it is one of the main reasons why EVE is necessary."

2. The first bullet of the summit statement itself has been modified to emphasize the importance of quality control. This is also emphasized through the addition of FAQ12 'How would EVE ensure data quality and accessibility'. Education and young researchers are included in the revision to the 'what next' (FAQ14) as well as to FAQ11 which addresses the trap of publish or perish and career development, and through the example of CERN in FAQ5

3. "But what will EVE provide to researchers at their desks?". We have addressed this by considerably expanding FAQ7, also outlining new uses of regional models. It was and is further discussed in FAQ13, on what would happen without EVE, where the advantages of standardizing bodies is raised. Already in the original we mentioned how EVE would give

researchers around the world greater access to computing capacity, and how EVE would create a demand for scientists, i.e., job opportunities (FAQ11). These changes also address the next paragraph ('EVE hopes to . . . ') of comments in Review 1.

More generally we agree with the Reviewer's comments about the need for specificity. While we have made some efforts in this regard in the revisions of the FAQs, particularly to better emphasize the interactivity. We acknowledge that these are rather superficial changes to the substantial point. In our defense we believe that the substance of this point is better developed outside of this statement. Toward this end we have relaunched the EVE website , and are in the process of developing much more specific and concrete proposals that align with existing activities and funding opportunities. This is however not something we are ready to address collectively and in this first statement, especially give the constraints of a document with nearly 150 names.

Review 2

The points raised in the review were itemized in a bullet list, which we address in turn.

1. On openness and capacity development. Yes, the point of EVE is to expand the public space in the digital sphere, which by definition is an aspiration of openness. The FAQs have been modified to say this more specifically. We now mention the aim of capacity development in FAQ1, and the reference to CERN's role in developing European postwar capacity in FAQ2, as well as the essential need for EVE to engage local stakeholders. A new FAQ (12) has been added to address data quality and global governance is identified as only one of the governance options. Specifically we say "This could be in the form of an international treaty, or through coordination of self-governed centers by existing inter-governmental organizations." This has been slightly revised to avoid anticipating specific institutions as playing a role in coordinating EVE.

2. The matter of trustworthiness is addressed in the aforementioned and new FAQ12. Hallucinations are specifically addressed by this revised FAQ. Also the importance of users being involved in the creation of the information is recognized as an important basis for developing trus and is raised through modifications to FAQ5.

3. We leave this issue of a sharper presentation of EVE's structure a bit open, as part of the forward looking revision to 'What's next' (FAQ14). Our expectation is that, if we are successful, the way in which regional centers of excellence will be built will differ regionally. The comments raised by the review are nonetheless prescient. We don't have answers to them all, but we also don't think that they need to be answered yet, by us, as long as the principle of interoperability and coordination is maintained.

4. We try to be more specific that EVE will also host data. Here however, as seen in the changes to FAQ2 which addresses this point, we are sensitive to the fact that many groups want to maintain control of their own data, and for the case where this data is light weight, it can be linked to the EVE centers with the help of standardization and protocols. EVE's bet is that by valorizing data, it will be more widely collected and shared.