Response to the comments of the reviewers

26.11.2022

Markus Köhli

Physikalisches Institut

Ruprecht-Karls-Universität Heidelberg

ANP-PAT

Martin Schön

Helmholtz Centre for Environmental Sciences, UFZ Leipzig

Dear Reviewer 2,

we are very grateful to the reviewer for the helpful comments and suggestions. In the following we address individually the comments to the manuscript 'URANOS v1.0 - the Ultra Rapid Adaptable Neutron-Only Simulation for Environmental Research' submitted to GMD. Reviewer's comments on the manuscript are bold, our answers italic and the latexdiff of the submitted paper indented in quotation.

Reviewer 2

Thank you for addressing the comments.
A few minor points which I encourage to address in a minor revision:

The manuscript is confusing for the reader with up to 9 sections and not having the overview of the whole manuscript in one paragraph up front. Please add at the end of the introduction one paragraph on the structure of the manuscript, addressing briefly the name/content of each section.

We have added the suggestion.

> The manuscript is divided into ten sections. After an overview about neutron Monte Carlo codes the physics concepts and the mathematical computation routines in URANOS are discussed in section 2. It is followed by a description of the design ideas of URANOS with the geometrical layer concept and its computational flow in section 4. The individual steps of the calculation are then presented in section 5 with the source configuration and in section 6 with the computation of neutron interactions. Finally section 7 discusses the scoring options. Section 2 to 7 therefore provide a description of the core of URANOS in terms of computation and design. In section 8 a variety of examples illustrates the capabilities of URANOS, the precision for typical use cases and provides links to previous research questions. Section 9 addresses the computational performance and section 10 presents the graphical user interface.

L216: Please add, "...MT numbers (Material Type)" ... and "...MF numbers (Material File)...". The reader does not understand the MT or MF, if not explained. It could otherwise be removed straight away, if not important.

We considered and discussed the reviewer's suggestion. We think that the sentence "The ENDF format uses the 'MT numbers' to identify neutron reaction types and 'MF numbers' to classify the data type of the respective file set" is sufficient for that purpose. We tried to find official sources for describing the spelling out of those identifiers, not successfully though. The data structures for which those identifiers stand for are clearly described in the cited ENDF manual. In case we would have decided ourselves to simply call them A and B would not have changed the necessity for using them as representations for navigating though a data base. We also believe that the reviewer's demand to remove commonly used identifiers in case it would be impossible to spell them out, is not very well founded. It would practically mean to remove most of the variable declarations in the paper as we have not defined them literally. We hope that the reviewer might take into consideration that other fields of science have different standards.

L331: Not all reader read the manuscript from beginning to end. The name "cosmic ray neutron sensor" implies the space as source and not a random artificial layer above few meters above the soil surface. Add here the difference between neutron source (cosmic origin) and neutron source (URANOS source layer), although it was stated before.

Unfortunately it is not clear to us what the reviewer means with this comment. We tried to identify possible solutions. With the term "cosmic ray neutron sensor" the reviewer might have meant "cosmic ray neutron source". Line 331 is the beginning of the section about source options. It starts with a general introduction about source placement configuration and then discusses energy distributions. Later, the cosmic neutron source is discussed in its own section. Near the cited line 331 there is no such term as "cosmic ray neutron" appearing. Consecutively we have added the following statement to the section 'general sources':

> The cosmic source used for studies of environmental neutrons is typically represented by a plane source.

And in the section of general sources we have added:

> Whereas the cosmic neutron source would typically be release from an extended layer, usually the geometry for other types of sources may be limited to a considerably small plane, scaling even down to a point source.

Although addressed by the authors in the response letter, the minor importance of protons and myons to CNRS and this study has not been added to the manuscript. Please add where appropriate:

"The high energy cascade contributes to the production of neutrons by three different particle species with three different fractions and attenuation lengths (around 140 cm2/g for neutrons, around 110 cm2/g for protons and around 500 cm2/g for myons). Future work will address these different attenuation lengths and model the high-energy cascade accordingly."

We have added the suggestion to the section about the evaluation of the cosmic ray neutron spectra.

> The high-energy cascade contributes to the production of neutrons by three different particle species with three different fractions and attenuation lengths (around 140 cm^2/g for neutrons, around 110 cm^2/g for protons and around 500 cm^2/g for myons). Future work will address these different attenuation lengths and model the high-energy cascade accordingly.

Thank you very much for the review of our manuscript.