Dear Editor,

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We would like to thank GMD for giving us the opportunity to revise our manuscript entitled **Sedapp v2021: a non-linear diffusion-based forward stratigraphic model for shallow marine environments**. We thank the referees for their careful read and constructive comments on the previous draft. We have carefully taken their comments into consideration in preparing our revision work.

Here below is our description on revision according to the referees' comments.

Referee #1:

Major points:

Comment 1: The introduction is a bit difficult to follow. The first paragraph introduces sequence stratigraphy and then ends with the citation of two papers, Burgess, 2012, and Burges and Prince 2015, that discuss how sequence stratigraphy is a paradigm that is no longer fit for purpose. What point are the authors trying to make here? The second paragraph lists different models. The third paragraph defines forward stratigraphic models, but then discusses solvers for Navier Stokes equations (Delft3D). It then discusses "fuzzy logic" and "deductive models" but not in any detail. I think the whole introduction shuld be re-thought-out. Is there to be a discussion of cellular automata models versus models that solve PDEs? Is there to be a discussion of sequence stratigraphy? Ultimately the point should be what does Sedapp advance, but this is missing.

R1: The related parts have been re-written as suggested.

Comment 2: What is new about Sedapp? There exist numerical models that solve for sediment transport where the central equation is diffusive. Admittedly the more applied codes are close source and propriety. Is the only advantage of Sedapp that it is opensource? Why did the authors write it in R? Why not use more parallel libraries, see for example eSCAPE developed by Tristain Salles.

R2: The functional form of the diffusion coefficient is an exponential of distance. This is different from many existing models whose coefficients are water-depth related. As shown in the discussion part, this modification has advantages in both the stability of the slope break trajectory and the controllability of the fluvial-deltaic shoreline shape . We write the code in R, not only because it is easier to make open-source, but also that there is an off-the-shelf FVM solver written in R. For the sake of our research compatibility, we chose to develop the code based on it. The referee's suggestion is a very good alternative, and we may try it in future studies.

Comment 3: The functional form of the diffusion coefficient is not justified in any way. Why is it an exponential of distance? Why should erosion be less efficient compared to deposition? In a transport ‑ limited model such as this, I see no argument for defining regions that will be eroded with the "Der" parameter, as erosion is simply a function of the curvature of the topography.

R3: The functional form of the diffusion coefficient was assumed as an exponential of the distance from the estuary. This is based on some existing model assumptions and several jet flow experiments. Generally, the diffusion coefficient is assumed to fall exponentially with the water depth (e.g. Syvitski and Hutton, 2001). This may be to reflect the relationship between short-term hydrodynamic energy and long-term geomorphological processes. The hydrodynamic energy decreases with the increase of the water depth. While the hydrodynamic energy also shows similar changing rule with the distance from the jet outlet as revealed by jet flow experiments. Based on this fact, we designed the current form of the diffusion coefficient. In practical application, the modified model indeed made plausible results, which have high similarity with those of the existing related models. Additionally, this model has higher flexibility against the existing ones when handling river inject problems. The essence behind this phenomenon is indeed a problem worthy of study in the future, which may bridge short-term hydraulic processes and long-term geomorphological processes. The erosion is not necessarily less efficient compared to deposition. The introduction of Der is mainly to facilitate some complex situations. For example, for a given location, some bed surface is "hardground", which is very difficult to be erode. While the overlying deposition process is relatively easy. In this case, the distinction seems necessary. For a long-term stratigraphic forming process, there may exist many sedimentary discontinuities, which may provide long enough time to generate some "hardgrounds". The Der is just used to offer one more choice.

Other points:

Comment 4: Line 55: Why are these two papers cited for what Is a simple diffusion equation. The equation could be called an Exner equation, and perhaps of a paper is to be cited, Chris Paola's review from the year 2000 would be more appropriate. In general the citations are a bit lazy. It would be worth being more selective about what statement requires a citation, and choosing the relevant citation. For example, pyBadlands (Salles et al., 2018) does not solve for erosion assuming that it transport-limited. It instead solves for the kinematic wave equation known as the stream power law. Sub marine deposition is a function of slope however. For it to be cited here is out of place.

R4: The citations have been modified as suggested.

Comment 5: Equation 1: Has compaction been intentionally left out?

R5: Eq. (1) here is an original equation, which is to explain the general form of such kind of models. The code implement actually includes the compaction process.

Comment 6: Line 61: The diffusion coefficient can be a function of space and the PDE can still be linear. If however the diffusion coefficient is a function of slope then it would no longer be linear. This statement on this line, "Models with constant Γ values are usually called linear models; otherwise, they are known as non-linear models" is not accurate.

R6: The original statement was indeed not accurate, it has been modified as suggested in the text. The corresponding parts of Eq. (4) have also been modified.

Comment 7: Line 65: What is the point of this list? Sedapp is a diffusive model, so it likewise cannot account for mass wasting or biological agents. The next sentences would appear to imply that a non-linear diffusion model can capture these processes, "on the contrary, non-linear models are relatively more flexible". Yet this is not the point, because diffusion models simply

cannot capture those processes. Therefore I am confused as to the point the authors are trying to get to.
R7: The original expressions are indeed not very appropriate, and they have been modified as suggested in the text.

Comment 8: Line 73 (and in the abstract): The models presented are 2D and 1D. They are not 3D.
R8: These places have been modified as suggested.

Comment 9: Line 81: Linux is likewise free. I don't see an advantage in pushing people to buy a Windows or OS license.
R9: Linux is indeed a better choice in regards of accessibility. While when we developed Sedapp, the majority of our team were using Windows. For the sake of convenient, we made it on Windows. However, R is a cross-platform language. The core codes could also be run on Linux. In the next stage, we will replace the windows-only parts with some full platform ones in order to make it truly cross-platform.

Comment 10: Line 83: "In this paper, we propose a new non-linear model, which is expected to overcome the shortcomings of the existing models". What are the shortcomings of the existing models? They were not explained in the introduction. In fact the "existing models" were not described. What are the existing models?
R10: The existing models here indicates the ones with diffusion coefficients that are only water-depth related. For example, the coefficient was assumed to fall exponentially with the water depth (e.g. Syvitski and Hutton, 2001). The main shortcomings of these coefficients are at the instability of the slope break trajectory and the poor controllability of the fluvial-deltaic shape along the shore. This part has been modified and detailedly explained in the new introduction.

Comment 11: Line 94: How does a user chose a value for "Der"? Why assume that the diffusion coefficient varies between erosion and deposition? It is the same process that is transporting the sediment therefore I see no argument for why it should change. In the work of Laure Guerit, https://doi.org/10.1130/G46356.1 the transtion from detachment-limited to transport-erosion is discussed in relation to alluvial fan deposition. This reference might provide a starting point for exploring some arguments for the parameter "Der". Unfortunately, as this function is presented here I find no justification for it.
R11: We have carefully read the work of Laure Guerit et al. (2019) as suggested, which does provide a lot of inspiration. While it includes more about the material flux in the whole catchment-fan regions. It is a bit beyond the scope of the current study. The main scope of Sedapp is focused on the area available for sediment accumulation in the downstream and subsequent shallow marine regions (the 3rd of the three factors for sediment record in Armitage et al., 2011). The introduction of Der is generally to facilitate the result-fitting in the above areas for some complex situations. For example, some initial surface is "hardground", which is very difficult to erode. While the overlying deposition process is relatively easy. The value of Der is usually empirically defined and modified based on the stratigraphic record.

Comment 12: Equation 4: Why is the diffusion coefficient an exponential function of distance? For sub-aerial sediment transport it would most likely be a function of water flux (see Smith and Bretherton, https://doi.org/10.1029/WR008i006p01506). Water flux does increase down-slope, but why as an exponential function?
R12: The functional form of the diffusion coefficient was assumed as an exponential of the distance from the estuary. However, as mentioned in Line 105, this assumption works only in the marine portion. Instead, as shown in Eq. (4), the water depth in sub-aerial portion is actually 0, where the coefficient generally reduces to a user-defined parameter. The paper (Smith and Bretherton, 1972) provides very useful inspirations for the improvement of the code for the sub-aerial portion. We may take the mass flux of the entire source-sink system into consideration in future versions of the code.

Comment 13: Line 104: I have been assuming "D" is the distance down slope, but this might not be the case. "D" is the distance from where?
R13: D is the distance from the river mouth. It works only in the marine portion.

Comment 14: Code implication: is the code explicit or implicit in time? Have any off-the-shelf solvers been used within the implementation in R? What controls code stability, is there a CFL equivalent?
R14: The code is implicit in time. There is an off-the-shelf FVM solver used in it. The time step and mesh size used in the simulation satisfy the CFL condition, which guarantees the code stability.

Comment 15: Line 133: "it will be contrary to the geological knowledge that deposition and erosion processes are two distinct processes with different rates". Who says this? They are both due to the transport of grains of sediment by moving water. The same water.
R15: The erosion rate is not necessarily different from the deposition rate. What we wanted to say is about some special situations. For example, for a given location, some initial surface is "hardground", which is very difficult to be eroded. While the overlying deposition process is relatively easy. For a long-term stratigraphic forming process, there may exist many sedimentary discontinuities, which may provide long enough time to generate some "hardgrounds". In this case, the distinction seems reasonable. There are indeed some ambiguities in this original expression, and we have modified this sentence in the text.

Comment 16: Case studies: Please confirm that the results are not sensitive to the model resolution. Or if they are explain why.
R16: The results are not sensitive to the model resolution.

Comment 17: Line 235: Why does the channel migrate?
R17: The shape of the river is a kind of predefined information. It is mainly used to reflect the influence of a curved channel on the depositional results.

Comment 18: Line 291: "This is seriously contrary to the common sense". I think common sense is over rated. Please cite some studies that would suggest that the results of Sedapp are more

appropriate.
R18: This sentence has been modified as suggested in the text.

Comment 19: Code availability: the code comes as a "rar" file. It would be better if the code was hosted on a repository, such as github, gitlab etc, and had a readthedocs with information on how to install and test it.
R19: The modified new version has been uploaded to both Github and Zenodo. An installation instruction has also been added in the documentation as suggested.

Comment 20: I found that on my French work laptop running linux I had to remove some non-standard characters within the comments of the code so that Example.r would execute. If this code was on an open repository bugs like this could be reported and fixed with the help of the community.
R20: These comments of code have been modified as suggested in the new version of the code.

Comment 21: I needed some linux libraries to install the library smoothr and to run the code (udunits2- devel on CentOS), which would mean switching to my personal laptop as I don't have sudo privalages on my work workstation. Therefore I switched to a Windows VM to test it. This extra dependence could be signalled in the documentation. I found that I needed to install "smoothr", "Rcpp", and "Matrix" libraries for the code to run. 3Rcpp" however was not listed in the dependencies.
R21: These extra dependencies has been signalled as suggested in the new version of the documentation.

Comment 22: The code however then fails upon trying to create a directory: 38: In dir.create(wdnow) : cannot create dir 'C: Users armitagj Documents MATLAB gaobei20', reason 'No such file or directory' This comes from: Sedapp to be called.R:247: t1p=i*2;wdnow = paste('～/MATLAB/gaobei',t1p,sep = '');dir.create(wdnow). With these bugs fixed the code ran on my VM, however given the small processing power the code was very very slow. The authors could consider creating a Docker container with the code. The point of entry could be a jupyter-notebook that is ready to run Example.r. This would then achieve one of the aims, for a cross-platform model. It would also iron out the small issues I found above.
R22: These bugs above have been corrected in the code. A Jupiter-notebook is indeed a better tool for the cross-platform realization. However, there is an off-the-shelf FVM solver needs to be loaded before the initialization. Therefore, it is not more convenient in this way. While we are trying to slim the solver in order to make it available in the potential Jupiter-notebook version.

Referee #2

Comment 1: The authors said “Although many advances have been made in the field of forward stratigraphic modelling (FSM), there are still some shortcomings to the existing models.” in the abstract. While I did not find the detailed description in the introduction part. Please modify or rewrite the related part in the manuscript.
R1: This part has been re-written as suggested in the new version of the manuscript.

Comment 2: As the authors said in the text that many existing models are not open to the public. The open-source feature of Sedapp is apparently a good aspect for its availability. There are actually many alternative programming languages that can satisfy this feature. For example, some other open source models were written in Fortran, C or python. Why did the authors write Sedapp in R?
R2: We write the code in R firstly because it is easier to use and easier to make open-source. Also, there is an off-the-shelf FVM solver written in R. For the sake of our research compatibility, we chose to develop the code based on it.

Comment 3: Fig. 7: This figure is interesting whose subplots show different stages of a river-dominated delta. I also noticed that the river is of a curvy shape. Why was the channel shifting like this? Is there any forces made it so? By the way, the initial segment is not very smooth, Is there any special requirement for that? Or the authors could modify it and make it look better.
R3: The shape of the river is a predefined information. It is mainly to facilitate to show the influence of a curved channel on the depositional results. The initial segment of these channels have been modified.

Comment 4: The Der settings in the model is very interesting, which could distinguish the depositional and erosional two processes. But what geological knowledge support this setting? Also, which variable name in the code corresponds to it?
R4: The introduction of Der is generally to facilitate the result-fitting in downstream and subsequent shallow marine areas for some complex situations. For example, some initial surface is “hardground”, which is very difficult to be eroded. While the overlying deposition process is relatively easy. The value of Der is usually empirically defined and modified based on the stratigraphic record. In the code, this parameter is called “dep.ero.ratio” in the main program.

Comment 5: In the code, I noticed a parameter called isostasy. With the default setting, I could get the same figure as in the text. However, when I switched the value, the results became very different. The left part dropped far below the expected place, while the right part also changed a lot. I think the authors should make a brief introduction in the documents about these parameters.
R5: Isostasy is the state of gravitational equilibrium between Earth's crust (or lithosphere) and mantle such that the crust "floats" at an elevation that depends on its thickness and density. Some brief introduction about this has been added in the new code documentation as suggested.

Comment 6: Porosity of the strata successions is a very import parameter concerned by resource geologists. The porosity changes at every moment as long as the overlying strata was changed, so does the previously deposited strata. That means whenever a new layer is generated, porosity of both new and old layers would be updated. I wonder how is this process implemented in the code.
R6: We use porosity functions to implement the compaction process. The current functions are shown in “phi.r” file of the code. Every previously formed layer is also updated when a new layer is formed with a nested loop. Details can be seen in the “Compaction Process” module of the

“Sedapp to be called.R” file.

Comment 7: When I ran the “example.r”, I also noticed that, the “fluvial slope” is updated at each step. Like: "Fluvial slope is ...", "Slope angle is ...◦". What is it? Why is it needed to be monitored here?
R7: These angles are monitored because the fluvial slope is a very important parameter for the depositonal processes. Also, this is a parameter that is very easy to be measured in modern sedimentary counter-parts. This could provide us with a good opportunity to test the rationality of the simulation.

Comment 8: For the comments of the code, I think the authors should improve them. There are many subroutine files to the main program. However, the comment styles within these files vary from each other. The authors should put them into a uniform manner.
R8: These files have been modified as suggested.