Author's response

R. El Montassir, O. Pannekoucke and C. Lapeyre

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Dear M. O'Brien,

We thank you for accepting our manuscript for publication in GMD. We are grateful for your constructive comments and suggestions, which have helped us improve the manuscript.

We have carefully read the comments and suggestions and have made the following changes to the manuscript.

1 Major changes:

- L. 284: Added more details about the EXIM product.
- L. 325: Added a reference to the EXIM documentation.
- Fig. 1: Updated the caption using the term "error modelling"

Track-changes: To facilitate the comparison between the two versions of the manuscript, a track-changes file lists all changes, where the old statements are coloured red and the new ones are coloured blue.

Response to editor's comments

We copied the editor's commentary below, we replied in teal to each point. We also provide the changes made in the manuscript for each comment.

1. *Reviewer 1 suggested avoiding use of the term "residual modeling" and I agree with their reasoning. Your revised manuscript avoids the use of this phrase in one place, but it remains in others (e.g., Figure 1). I suggest doing a global search-and-replace, using the phrase "error modeling" instead.*

   - Done.

2. *line 319 - "and EXIM is advecting the last observation while keeping the same level of details" ¡– I agree that's true, but HyPhAICC is also advecting the last observation, so this explanation seems incomplete. Is it because EXIM uses a more accurate (and less diffusive) advection scheme? Can you reference EXIM documentation that would support this argument? If not, the discussion here should be revised.*

   - Thank you for pointing this out. We have revised the section 2.5 to include more details about the EXIM product. We have also added a reference to the EXIM documentation. Indeed, EXIM uses the kinematic extrapolation method explained in the text below.

   L. 284 "In addition to U-Net, we consider in our comparison, a product ~~based on kinematic extrapolation techniques,~~ called EXIM (for Extrapolated Imagery), developed by EUMETSAT as part of their NWCSAF/GEO products [García-Pereda et al., 2019]. This product involves applying the Atmospheric Motion Vector field multiple times to a current image to produce forecasts. Each pixel's new location is calculated using the motion vector, and this process is repeated, assuming a constant displacement field. For continuous variables like brightness temperature, the method uses weighted contributions to forecast pixel values, ensuring that there are no gaps by interpolating values from adjacent pixels if necessary. For categorical variables such as cloud type, the pixel value is directly assigned to the new location, and conflicts are resolved by overwriting. If

a pixel is not touched by any trajectory, the value is determined by the majority class of its nearest neighbours [García-Pereda et al., 2019][1]. This approach is also called kinematic extrapolation."

L. 325 "This observation aligns with the fact that the Persistence uses the last observation as its predictions, and EXIM is advecting the last observation ~~while keeping the~~ using the kinematic extrapolation, which keeps the same level of details without diffusion effects [García-Pereda et al., 2019]."

Kind regards,
The authors.

References

[García-Pereda et al., 2019] García-Pereda, J., Fernandez-Serdan, J. M., Alonso, O., Sanz, A., Guerra, R., Ariza, C., Santos, I., and Fernández, L. (2019). NWCSAF High Resolution Winds (NWC/GEO-HRW) Stand-Alone Software for Calculation of Atmospheric Motion Vectors and Trajectories. *Remote Sensing*, 11(17):2032. Number: 17 Publisher: Multidisciplinary Digital Publishing Institute.

[1] https://www.nwcsaf.org/exim_description (last visit 4 July 2024)