Comment on gmd-2021-240

Anonymous Referee #1

Referee comment on "Integration-based extraction and visualization of jet stream cores" by Lukas Bösiger et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-240-RC1, 2021

Summary:

This paper proposes a new method to extract jet-stream core lines by using a predictor-corrector approach. Instead of defining the feature as a local extremum point at each grid point, they use an integration-based approach where from precomputed seed point of maximum wind speed the line is traced along the local wind flow and corrected towards the ridge lines to obtain the final core line features.

Their work is based on the local jet core extraction method by Kern et al., but in contrast to Kern's method, their approach does not suffer from cluttered, disconnected features. Instead, they demonstrate that their features remain connected over regions of high wind speed, and align with ridge lines. They are further able to identify merge and split events of the core line features that occur at certain time steps.

Contributions:

- Novel automated method to compute core lines using multiple time steps and a predictor-corrector approach, serves as an extension of Kern et al.'s method.
- Automated identification of split and merge events
- Interactive visualization of these features, along with associated atmospheric processes

In my opinion, this paper shows a scientific contribution to the community, its writing style is good and easy to understand, and it clearly demonstrates the benefit of the proposed method by means of real-case applications. In particular, the authors show, similar to Kern's work, that their approach helps meteorologists to better understand the

intercorrelation between jet stream core lines and surrounding / associated atmospheric features. I also want to highlight the short but good explanation of potential vorticity, warm-conveyor belts, tropopause, and the core line feature itself. There are only minor suggestions or questions from my side, but I can recommend accepting this paper with some minor corrections.

Critics:

- Figure 5 and Figure 6 should also contain the color tables, or it should be explained what the color means. The general captions of the figures are good, but some of the color tables are hard to read (Figure 8). I would recommend using larger text fonts or annotate the tables with latex.

- Typo in line 350: "jhe" --> "the"

- Table 1: What do Var1 and Var2 mean?

- In Figure 4, the authors compare the parallel vectors approach with their proposed method, however, earlier in the text, they emphasize that their work is based on the method from Kern et al. Are the results similar to the parallel vectors approach? Or can it be re-formularized using the parallel vectors operator? Maybe the authors could also show the effect of smoothing and how much the features actually diverge from the target result.

- Extremum lines in general do not have to be aligned with the flow. However, the authors actually want the features to follow the local streamlines if I understood it correctly. What is the intention here? Is it due to numerical instability and grid resolution that integrating the lines along the flow leads to more accurate results?

- Why did the authors choose to perform a regridding of the hybrid model level data? One could also extract the feature directly from model levels, however, gradients and interpolation must be done differently. Is it just because of simplicity or due to the focus on the tropopause and the upper pressure levels? For feature extraction near the surface, model levels might be more suitable than interpolated pressure levels.

- Figure 11: The core lines and the surface can hardly be seen. Would it be possible to use a more detailed view and a different viewing angle? Especially the top image of 11.a) does not clearly depict the features.

General questions:

- Is the predictor-corrector approach more stable for coarser grids than the other local methods? And what about more fine-scale grids?

- I would also suggest improving the conclusion and clearly demonstrate the benefit of the proposed method. What is the improvement over existing methods? Kern et al also demonstrated its benefit for operational forecasting. Is your approach and visualization tool able to help forecasters in operational service?