Comment on wcd-2021-31
Michael Riemer (Editor)

Editor comment on "A vorticity-and-stability diagram as a means to study potential vorticity nonconservation" by Gabriel Vollenweider et al., Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2021-31-EC1, 2021

Dear authors, thank you for considering ACP for your publication. Your manuscript presented a thought-provoking decomposition of changes of potential vorticity in vorticity and stability changes and conservative and non-conservative changes. The manuscript has raised insightful contributions to the online discussion by two highly qualified referees.

Both referees raise fundamental concerns, and they agree on a very basic issue: The problem that you attempt to solve with your proposed diagram is underdetermined. This fact is lucidly demonstrated at the beginning of the review by referee #1. In other words, referee #1 provides a simple mathematical proof that the proposed diagram cannot contain the information that you claim to be depicted.

In your response, you provide a revised version of the diagram that seemingly overcomes this issue. The seeming solution is achieved by the tacit assumption that the conservative and non-conservative PV changes form an orthogonal basis. This assumption, however, is incorrect because any non-conservative change in stability or vorticity could have been partly achieved by conservative dynamics. For further illustration: Assume that both the conservative vorticity and stability change is zero and that only a frictional process operates, which leads to a nonconservative change of the vorticity component (for full clarity, in the notation of referee #1: \( dZ_D=0, dS_D=0, dS_P=0, dZ_P \neq 0 \)). The orthogonality assumption implied in your revision would obscure this simple process. Instead, the erroneous interpretation of the diagram under the orthogonality assumption would be that the evolution had included all four changes: \( dZ_D \neq 0, dS_D \neq 0, dS_P \neq 0, dZ_P \neq 0 \).

Thank you again for having brought an interesting discussion to WCD. Due to the fundamental flaw raised by the referees, however, I need to reject this manuscript.