

“The importance of diabatic processes for the dynamics of synoptic-scale extratropical weather systems—a review”

by
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Recommendation: Minor revisions

General Comments:

The authors state that their interpretation “reflects the fact that the balanced flow is determined by a quantity we call PV (and suitable boundary conditions). The omega equation then helps to obtain information about vertical motion.” This is ok. My point was that all non-rotating components as well as all rotating components that do not project onto a theta surface are neglected when only using PV. Given that the authors also veer into mesoscale arguments with significant circulations perpendicular to theta surfaces, the caveats and limitations of only using a PV framework could have been elaborated on.

Regarding the authors’ response: “When we mention the usefulness of the PV concept, then we don’t regard PV in isolation. Rather, e.g., in a QG framework, we mean that PV determines the geostrophic flow, which in turn determines the ageostrophic flow. For the context of this review article, this conceptual framework still holds, with the additional (complicated) element that diabatic processes can create or destroy PV, and in this way modify the flow.”

It is not clear what the authors mean by that the “conceptual framework still holds”. In general, PV thinking is based on postulating the invertibility principle, i.e., as the authors state, that one makes balance assumptions to revert PV into a purely non-divergent balanced and hydrostatic flow. The original PV, however, was calculated using the full flow field; so depending on the actual state of the atmosphere, the flow field obtained by PV inversion can have significant deviations from the actual flow field. When moving more and more to meso and smaller scales, one should hence be allowed to wonder how justifiable a purely balanced flow assumption is. And regarding diabatic heating; it can neither destroy nor create PV, except if occurring at the boundary. It merely rearranges PV. When “creating” or “destroying” PV in the interior by diabatic heating, these creations and destructions cancel each other; so it can be seen as misleading to refer to as creation and destruction.

Regarding the authors’ response to the flaws in the discussed surface pressure tendency. The “extensions” introduced by the authors who originally introduced the diagnostic did certainly not remedy the physical flaw in the diagnostic. A hydrostatic surface pressure cannot be changed directly by diabatic heating, as implied by their diagnostic (see Bannon 1996 and Spengler et al. 2011). It is therefore unfortunate that the authors decided to maintain their reference to this flawed diagnostic.

References:

Bannon, P. (1996): Hydrostatic Adjustment: Lamb’s Problem. *J. Atmos. Sci.*, 52, 1743-1752, [https://doi.org/10.1175/1520-0469\(1995\)052<1743:HALP>2.0.CO;2](https://doi.org/10.1175/1520-0469(1995)052<1743:HALP>2.0.CO;2)

Spengler, T., J. Egger, and S. T. Garner (2011). How Does Rain Affect Surface Pressure in a One-Dimensional Framework? *J. Atmos. Sci.*, 68, 347-360, <https://doi.org/10.1175/2010JAS3582.1>