

Interactive comment on “The Nonequilibrium Thermodynamics of Atmospheric Blocking” by Andrew Jensen

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This is an interesting, if somewhat speculative attempt to analyse significant, persistent atmospheric flow regimes in terms of the thermodynamics associated with such regimes. As a stimulating discussion of important weather conditions it may represent a welcome contribution to the scientific literature. In its present incarnation however it is not mature and needs further substantial revision in order to achieve acceptable standards of scientific publications. Major shortcomings that should be addressed before publication can be considered are:

1. Clarification of the intended (speculative) connection between entropy production and self-sustaining flow (in this case, blocking) regimes. There seems to be some confusion between internal entropy generation and external entropy forcing. It is the

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latter that is associated with the maintenance of "order", viz dissipative structures that allow a matching amount of entropy to be generated internally and thereby maintain themselves. In other words, blocking highs in this context should be regarded as *ordered*, not disordered, flow regimes, which are maintained by a large external entropy sink (in this case, sensible/latent heating from the sea surface at high temperature near the surface, and cooling by radiation at low temperature in the free troposphere) and a matching high rate of entropy production internal to the system. Note that it is by no means obvious that the relevant (ordered) dissipative structures reside inside the high rather than at its margins, so a spatially resolved analysis of the entropy terms would be highly desirable.

2. Anticyclones are also characterised by a large rate of entropy export (inflow of cold air, outflow of warm air) which should be taken into account or at least discussed

3. More in general, the results obtained from entropy considerations in an open system should be verified against the use of the appropriate Gibbs potential for such a system, to avoid misreading effects from external mass exchanges; blocking highs may persist long enough for a significant portion of their mass to be acquired from or exchanged with the outside

4. The quality of the reanalysis data employed must be discussed and validated to show that it is sufficient for the study at hand and for its conclusions to be robust; in particular, it must be borne in mind that third-law (entropy) consideration may lose meaning if the data under consideration are inconsistent with energy conservation, a problem that reanalyses often have; for this reason it might be more appropriate to employ data from simulations with energy-conserving models.

5. Anomalies relevant to the two events discussed should be calculated and shown from climatology valid for periods of the annual cycle matching those of the events.

6. While the sketch of Li and Chylek's (2012) derivation by for the entropy production terms seems unnecessary, much more detail is required on their numerical im-

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plementation with reanalysis data in order for the results presented to be amenable to reproduction by other scientists and for application to other cases.

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