

Interactive comment on “The genesis of Hurricane Nate and its interaction with a nearby environment of very dry air” by Blake Rutherford et al.

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This is the author's responses to the review by Dave Ahijevych for “The genesis of Hurricane Nate and its interaction with a nearby environment of very dry air”. We appreciate the reviewer's comments and have revised the manuscript so that all of these comments have been addressed. The reviewer's comments are given below in italic while the author's responses follow in regular font.

General Comments: This paper extends the marsupial paradigm of tropical cyclogenesis to a non-African Easterly Wave. Without a wave-centric reference frame, air parcels around the storm are divided into two camps: those inside the pouch and outside. It is shown that some mixing occurs across the pouch boundary due to lobes breaking off, but dry air is shielded from the inner vortex by a shearing sheath that can be traced

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back to the manifolds that separate pouch and non-pouch air. I almost cut my review short because I had never heard of the word 'manifold' outside of a car engine setting, but after reading through the paper, which is fairly well written, I now have a decent idea of what it means. Now that I've read the paper, the abstract and introduction make much more sense. Later in the paper there is a weaker section with some mistakes in the figure and text, but overall this is ready for publication. My technical corrections are the main component of this review. Some of the paper is still way beyond my area of expertise, and I have no idea whether it is right or wrong, such as the section on 'Manifold computations' (pages 7-8).

While the use of Lagrangian manifolds and lobe transport is likely not familiar to many readers, these concepts are important for understanding transport on stratified isosurfaces in a time-dependent flow. The revised version provides a more thorough introduction so that a reader without expertise in Lagrangian manifolds can follow more easily. Many other improvements have also been made including making the results section much more readable and better demonstrating the role of Tropical Storm Lee in providing vorticity to the pre-Nate region.

Specific comments:

After rereading the abstract it isn't clear why source the 'tilting' mechanism is given such prominence. It is barely mentioned again in the paper.

We have removed mention of the tilting mechanism from the abstract.

The adjective 'layer-wise' used in the abstract and other places is confusing. Could you replace 'layer-wise advection' with 'advection on a constant pressure level'?

We have replaced 'layer-wise' with 'advection on a constant pressure level' and removed the term 'layer-wise' from the manuscript.

Page 3, line 5. It isn't clear what 'non-advective fluxes' are. This becomes apparent later on, but it is first mentioned here without any explanation.

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We have explained what non-advective fluxes are at this point in the manuscript.

Page 9, line 15. It is not obvious that the pouch region that originated from Lee still contains high potential vorticity air. From the figure, PV is muddled and similar to the PV in the portion with Gulf origins.

A new figure has been added that shows the PV from Lee from an earlier time, and the attracting line that differentiates the regions R_1 and R_2 . The air contained in R_1 clearly shows the source high PV air from Lee that enters the pre-Nate region.

Technical corrections:

Page 3, footnote 2. Change 'if' to 'of'.

We have made the correction.

Page 7, Figure 1 caption. Change 'L2' to 'L4'.

We have corrected the labels in the figure and text.

Page 7, line 9. What is an 'LCS'?

LCS is an acronym for Lagrangian Coherent Structure, which we have added to the paper.

Page 7, line 10. What is 'FTLE'?

FTLE is an acronym for Finite-time Lyapunov exponent, which we have added to the paper.

Page 8, line 29. U2 is never labeled in the figure. That would be nice.

U2 is now labeled in the figure.

Page 9, line 2, 3rd-to-last word. Change 'northeast' to 'southwest'.

We have made the correction.

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Page 9, line 6, last term should be S1(I4,H1), not S2(I4,H1).

We have made the correction.

Page 9, footnote 7. What is 'VS'?

VS is an acronym for vorticity substance, which we have added to the paper.

Page 10, line 19. Can the lobe labels of L3 and L4 in Figure 2 (a) be reversed so as to match the order of the labels in Fig. 1? In other words, change L3 to L4 and change L4 to L3?

We have reversed the lobe labels on Figure 1 to match those in the remainder of the paper.

Page 10, line 25. Explicitly reference Fig. 2 after mentioning the gradient of theta-e. I was incorrectly looking for it (theta-e) in Fig. 3.

A reference to Figure 2 has been added where θ_e is mentioned.

Page 10, line 26. 'north' should not be capitalized.

We have made the correction.

Page 12, Figure 3 caption. Is the satellite panel described accurately? The text says it is 0.6 μm , but isn't that visible? Wouldn't that be white for clouds? Not sure what the units are of the color table and it isn't clear how it could be 0.6 μm imagery.

The GOES imagery shown is 3.9 μm shortwave radiation, and cold clouds are indicated by lower values. We have converted the data to temperature (K) in the revised paper. The units and description have been corrected in the text and the caption.

Page 13, Line 21. Manifolds are overlaid on water vapor not vorticity in Figure 5.

We have made this correction to indicate that the manifolds are overlaid on water vapor.

Page 14, first paragraph. Fig doesn't seem to go with text. Text talks about 700 mb

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vorticity and area. Figure has circulation and mean vorticity. Figure would also benefit from un-squished text. Y-axis ranges of panel (a) should be same as panel (b).

The Figure reference in the text has been changed to Figure 10. Panels (a) and (b) have been combined onto a single plot so that a comparison between the two simulations can be more easily made.

Page 14, line 18. Panel labels don't start with (a) in text reference or actual Figure 8.

We have corrected the figure labels.

Page 14, last paragraph. This paragraph is confusing. In line 21, when you say 'as the vorticity moves inward', do you mean the vorticity maximum (in the radial profile) is moving inward? And in line 27 what is meant by 'the stability of the unstable manifold'?

We have changed the text to indicate that vorticity increases toward center due to the convergent flow. We were referring to the stability of the flow along the unstable manifold, which switches from stretching to shearing during entrainment. This point has been clarified in the revised manuscript.

Fig 10, and Page 15, line 28. I think this time range is Sep 6 to 8, but can't read the time labels on some panels.

We have corrected the time range in the text and in the figure caption, and have moved the time labels or changed colors in many of the figures so that they are more readable.

Page 16, line 6. The term 'limit cycle' is first used. I was not familiar with it, but I understand it now after reading further.

The term limit cycle is now clearly defined at this point in the paper.

Page 16, lines 8-10. Something with wrong with references to Fig. 9 (c)-(h), which don't exist.

The reference should be to Figure 10 (c)-(h) and this error has been corrected.

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Page 20, Fig. 8. Need units in figure or caption.

We have added units in the caption.

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