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Discussions

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Interactive comment

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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In my opinion, this paper does not achieve its goal in illustrating how Nate interacts with its environment. Many results seem to be highly dependent on the way there are obtained and some statements are incorrect. It needs a major revision.

First, all the paper is based on the role of the air mass that comes from storm Lee. However, no figure is given to show the evolution and decay of this cyclone. In addition, there is no precise definition of the air constituting Lee, and it is then difficult to see which air mass will be involved in Nate development.

Second, the invariant manifolds may be highly sensitive on the way there are computed. From the different figures presented in the manuscript, small-scale motions may be very intense so as the exact position of the manifolds may change very much.

Now, my more precise comments.

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1) Line 31, page 2.The definition of invariant manifolds based on a moving reference frame is wrong. Following your definition, any Galilean transform (e.g. rigid-body rotation) will change the position of saddle points and of the manifolds. The second definition given page 4 which relies on the Okubo-Weiss criterion is wrong as well, for the same reasons (see Lapeyre et al. Physics of Fluids 1999, Lapeyre et al. Chaos, 2001, Koh and Legras Chaos 2002, Haller JFM 2005). In the same manner, the authors cannot say page 14 that Okubo-Weiss is Galilean invariant! A correct definition of manifolds is given in the method section page 7.

2) It is quite difficult to follow the paper as one needs to understand the different air masses origin and and there is no synoptic view of Lee (add a figure, please!) and a definition of its air mass. Also, can the author show Nate in its embedded environment (i.e. in a much larger spatial region)? An example of my difficulty in reading the paper is given page 3, lines 13-14 when the authors state that "One or more vorticity filaments...". It would be very useful to see them! Same thing, about the S-shape (line 17). Can the authors illustrate the remnant air from Lee!

3) The discussion about the role of the Lee air mass in the genesis of Nate relies on the description of manifolds on isobar p=700hPa. However, Figs. 4, 5, 10 show that interpretations are highly sensitive to different parameters (altitude, divergence of the flow, SST...). Moreover, vertical motions are not included in the computation of the manifolds. It would be important to include these motions to see how the manifolds are dependent on this parameter as well. From what I see from the different figures, it is not clear to me that the positions in space of the manifolds are well defined. The very filamentary lobes may only exist because of advection by very small scales or errors in the velocity field. Manifold analysis is a powerful tool when the large-scale velocity fields is responsible of chaotic advection. Here, a lot of inertio-gravity waves seem to be emitted during convection and I wonder if they are quite energetic in terms of horizontal flow. If it is the case, that challenges a lot the interpretations of the paper.

4) Page 9, second paragraph. What is the true definition of air coming from Lee?

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PV>some constant value ? air coming from latitude > 30 ? relative humidity < 50% ?

5) Panels in Figure 3 are unreadable. The color scale for PV does not highlight low and high values; also it is not possible to discriminate positive and negative values in OW criterion.

6) How are precisely defined R_1 and R_2? This is important to follow the interpretation.

7) The authors give average values of relative vorticity. However there are two subtleties. First, there is some uncertainty in the exact area of the lobes. This should be quantified. Second, there are a lot of gravity waves and I guess there are local spots with high values of vorticity. This can strongly affect the average value, so that the average would be meaningless.

8) Page 13. you should compare manifolds computed from trajectories along eta=0.6 and along p=600hPa surfaces to assess uncertainties in the position of the manifolds in the WRF simulation.

9) Figure 3 and 4 do not correspond to the same domain and the longitude axis is labelled differently. Please modify accordingly.

10) Page 13, line 18. "the flow on isobaric surfaces". I thought that it was on eta=0.6???

11) I don't see the point to paragraph about SST sensitivity. It does not seem to me that this paragraph is important for the discussion.

12) I do not agree with the discussion on the the vortex radial structure. First, how do you define an "average" radial profile? The vortex is not axisymetric at all. How is defined its center? From Figure 3, OW and PV are quite noisy due to convection, so radial average may be meaningless. I thus do not understand what is plotted in Fig.8.

Second, your definition of u∼ and v∼ is awkward. From the definition of T, we have T(u∼,v∼) =(u,v) with T=[u,n]/|u| Then T(u∼,v∼)= (u∼ u -v v∼ , u∼ v + u v∼) Hence

$u\sim=|u|$ and $v\sim=0$!

So I don't see why the use of $u\sim$ would be interesting.

13) What are the uncertainties on the curves in Fig 7.

14) Page 14,Line 21, the phrasing "vorticity moves inward" is misleading as it is not a 2D nondivergent transport. Also, it seems that the pouch boundary is defined through the OW criterion, which is quite different from the invariant manifold. Please clarify.

15) Panels of Fig. 10 should be at the same times as the Fig.2 Also, red/magenta colors are reversed with Fig.2

16) Conclusions. The fact that air cannot penetrate the vortex core while it can enter the pouch was discussed by Lapeyre Chaos 2002 and Babiano et al. Physics of Fluids 1994.

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