

Replies to the Reviewers of manuscript acp-2014-1004 **Stratosphere–troposphere exchange (STE) in the vicinity of North Atlantic cyclones**

by P. Reutter, B. Škerlak, M. Sprenger, and H. Wernli

We would like to thank both referees again for their final comments on our manuscript. Remarks by the referees are marked in **red**, our replies are in black, and changes to the manuscript are written in **green**.

Referee #1

This is the second version of this manuscript that I have reviewed. The authors have made excellent revisions to the manuscript in response to my prior criticisms and I recommend publication after a handful of minor revisions.

Page 5, line 115: Please replace “are very variable” with “vary considerably”

We replaced it accordingly.

Page 8, line 181: “reguion” should be “region”

We corrected this.

Page 11, line 258: “trought” should be “trough”

We corrected this.

Page 12, line 271: remove stranded paren.

We corrected this.

Page 15, lines 367-370:

I don't think you have to redefine the evolutionary stages here. Recommend simply stating “(i) intensification phase, (ii) mature phase, and (iii) decaying phase.”

We replaced it accordingly.

Page 17, line 416: Please remove “Interestingly”

We removed the word “Interestingly”.

Page 21, line 533: Please remove “very”

We removed the word “very”.

Referee #2

The authors have done a good job of taking the comments from the previous version of this paper and using them to make notable improvements to the methodology of this research. I think the new technique to define a 'cyclone area' by its 3D structure is a notable improvement and I think it works for the updated analysis. However, there are a few technical corrections to make before publication.

L53-59: This reads as an incomplete thought, please add more context.

We reformulated the text as follows:

Different studies highlighted different processes to be relevant for STE, which indicates large case-to-case variability and a general lack of understanding about the relevance of processes leading to STE. These processes include turbulence by shear instability (Shapiro, 1980; Traub and Lelieveld, 2003) the breaking of gravity waves (Whiteway et al., 2003; Lane and Sharman, 2006), cloud diabatic processes in stratiform and convective clouds (Wirth, 1995; Poulida et al., 1996), and radiative cooling due to strong vertical humidity gradients near the tropopause (Zierl and Wirth, 1997).

L88: What is meant by "Some of them" ?

The last sentence has been changed to “In some of these studies the results were then extrapolated to the global scale.”

L115-121: Confusing sentence. Can these ideas be expanded, consider break up these thoughts.

The wording has been changed as follows:

This is in qualitative agreement with the study by Brioude et al. (2006) who looked at STE in the extratropical transition of tropical storm Arthur and pointed to the possible role of deep convection for mixing stratospheric air in folded regions irreversibly into the troposphere. Also Cooper et al. (2002) considered several warm season North Atlantic cyclones and emphasized the dry intrusion airstream, which often goes along with a tropopause, as a preferred region for STT.

L172: This is a bit confusing, the two dimensional shape of what is modified?

Hopefully this formulation is clearer for the reviewer and other readers:

As in this former study, cyclones are defined and tracked based upon the identification of local minima of SLP. However, in contrast to the former study, where the two-dimensional shape of the cyclone was identified by the outermost closed SLP contour, here in addition contours of negative geopotential height anomalies at 700, 500 and 300 hPa are considered to define the cyclone shape.

L208: "reguion" should be "region"

We corrected this.

L291: "trought" should be "trough"

We corrected this.

L418: There is much implied by the statement "upper-level forcing of the cyclone" that is not necessarily shown in the figures. Perhaps a better choice of words would be "upper-level structure."

We replaced it accordingly.

L561: What 'phases' are you referring to?

We changed the sentence to: "The relative variability between the lifecycle phases is very similar for STT and TST."

Fig. 9 & 10: The axes labels are hard to read. These could be bigger.

We increased the size of the labels.