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Atmospheric Measurement Techniques Discussions

Interactive comment on "An automatic contrail tracking algorithm" *by* M. Vazquez-Navarro et al.

Anonymous Referee #2

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The paper describes a new technique to automatically track the life cycle of contrail-cirrus using satellite data with high spatial and temporal resolution. The method, called the Automatic Contrail Tracking Algorithm (ACTA), uses 10.8 minus 12.0 micron brightness temperature difference imagery from the Meteosat SEVIRI sensor in Rapid Scan mode to track linear segments of contrail-cirrus over the northeastern Atlantic Ocean and Europe. Given the location of an initial contrail segment, ACTA uses a two-step procedure to track the contrail within each SEVERI image both forward and backward in time. The first step uses a series of tests to determine the change in position of a contrail between each 5-minute resolution satellite image, while the second step uses a set of binary masks to determine the shape of the detected contrail in the next SEVERI image. The manuscript presents an example of contrail-cirrus tracked for more than six hours over the Bay of Biscay.

General comments

The research presented in the manuscript is original and worthy of publication. The automated tracking of contrail-cirrus by satellite does not appear to have been described before in the literature, and the method shown here addresses an important but long-neglected problem in the research of the climatic effects of contrails. The main focus of the paper is the presentation of the newly-developed ACTA. The authors provide a generally well-written, detailed description of a complicated cloud analysis procedure. However, the remaining parts of the paper are underdeveloped and must be improved before publication. The introductory section barely even mentions the nature of the research described in the rest of the paper, and provides very little to the reader about the motivation for developing ACTA, its possible benefits, or any history regarding the estimation of contrail-cirrus (as opposed to linear contrail) coverage by previous researchers. The introductory section could also be improved by describing the organization of the paper to the reader. The name of the final section of the paper (Conclusions) is inappropriate because the section is more of a summary of the paper and a discussion of the strengths and weaknesses of ACTA. I would suggest renaming the section as (Summary and Discussion). The final ten lines of the paper (p. 1461, lines 20-29) appear out of place, and would be more appropriate in Section 3.

Although the description of ACTA in the manuscript is generally good, some subsections (particularly the very long and involved sub-section 2.1) could be improved by including some explanatory and transitional paragraphs. For example, the paragraph describing the Figure 4 flowchart (p. 1445, lines 9-21) is confusing because it introduces some words and concepts to the reader that are either vague (certain threshold) and/or were not yet fully explained (acceptance criterion). Perhaps it would be better to warn the reader at the beginning of the section that a more detailed description of both Step I and Step II follow later in the paper.

The important and surprising detail that wind field data is not necessary for the operation of ACTA is not revealed until the middle of the concluding section. This fact should be placed much earlier in the manuscript to inform the reader that ACTA relies only

on the satellite brightness temperature data to track contrails. The manuscript gives several references to the use of wind information in ACTA (e.g., the left hand side of Figure 4, Figure 5), but actually no wind data are used. This is confusing to the reader. Please remove all of these references to wind data from the manuscript.

It is difficult to verify the claim the authors present in Section 3 (top of p. 1459) that "the vicinity of other contrails parallel to the tracked one does not affect the tracking and that neither the crossing over a pre- existing contrail nor the presence of underlying cloudiness lead to a misidentification of the original contrail". The images in Figure A1 are simply too small for me to determine whether I agree or not. I note that at least some aged and dissipating contrails can lose their linear appearance, such that even ACTA cannot track every part of every contrail throughout its life cycle. However, this method is certainly an advance in the study of contrail-cirrus.

Specific comments

p. 1440, l. 26, p. 1441, l. 1: The paragraph abruptly ends here, but this is an excellent place to introduce the reader to the focus of the paper, the new ACTA method. The sudden transition to CDA is jarring to the reader.

p. 1441, l. 11-12: "a minimum length threshold (47 MODIS pixels)". This appears to be different from the threshold used in Mannstein et al.? Why is this threshold different?

p. 1441, l. 15: "The physical thresholds are scene-dependent..." Are these the same thresholds used in Mannstein et al.? They do not appear to be the same, because the Mannstein et al. thresholds were not scene-dependent (the binary checks related to the sum of the normalised images, the brightness temperature difference and the gradient of the 12 micron brightness temperature were constant in Mannstein et al.).

p. 1441, l. 22-23: "it is essential that those data cover heavily flown regions" Why is it ESSENTIAL? Why could contrails in light traffic regions not be tracked?

end of Section 1: To support the authors' case for the development of ACTA, previous

estimates of the ratio of contrail-cirrus coverage compared to linear contrail coverage would show that much of the aviation-produced cloud coverage is missed by current contrail tracking/detection methods.

p. 1445, l. 9-21: This paragraph is basically a more detailed rewording of p. 1444, l. 1-7, and is confusing as the thresholds and acceptance criteria are still not explained to the reader. Please omit this section, and instead, inform the reader that a detailed description of the entire step follows.

p. 1446 and Figure 7: It is not clear from the description presented here how the north/south range of array L is determined.

p. 1448, l. 24: It may be helpful to the readers' comprehension to have this information regarding the nature of the five tests mentioned earlier in the manuscript, perhaps at the top of p. 1444.

Section 2.1: For some of the tests, the width of the search area seems to be so narrow that if the size of the search array L is long enough, the guide points will always satisfy the acceptance (orientation) criterion, as long as enough guide points can be found. Is this true? For example, does Figure 6 pass the acceptance criteria tests even though it contains alien pixels? In other words, is the acceptance criteria test even necessary when the contrail is long enough? How often does this situation happen?

p. 1460, l. 6-7: "...each iteration requiring in average less than one minute..." Is each iteration for one contrail track, or for the entire SEVERI scene?

p. 1460, l. 21-23: It would be more accurate to say that ACTA can track the evolution of the brighter and more linear parts of the contrail.

Technical corrections

Figure 2: It is not clear from this figure that ACTA can be applied forward and backward in time. Perhaps in the blue box the authors can put "Look for Contrail C_i t + or - delta t"?

p. 1444, l. 21: "From a satellite point of view" I suggest rewording this to "In ACTA, a contrail is defined as a group of pixels...". The satellite has no opinion of itself about contrails. :-)

p. 1449, end of l. 4: Change "test" to "tests".

p. 1452, l. 12: "acceptance criterion (orientation)." Shouldn't this phrase be "acceptance criterion (alignment)."?

Figure 11: Please re-label the sub-pictures from a to f instead of 1 to 6.

p. 1458, l. 1: "shown on Fig. 11 (bottom, right)" Change to "shown on Fig. 11f".

p. 1458, l. 15: Change "rises" to "raises".

p. 1458, l. 27: Change "Figure 4" to Figure A1".

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 1439, 2010.