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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the origin of subvisible cirrus clouds in the tropical upper troposphere" *by* M. Reverdy et al.

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Specific concerns

1. The Reviewer points out that our study of links between SVC formation and convective activity is restricted to one region (Africa). This remark echoes the Reviewer #1's third major comment. Our choice to restrict this part of the analysis to SVC observed over Africa was motivated by the limited area covered by the brightness temperature maps derived from Meteosat satellite imagery, and the difficulty to merge temperatures measured from other geostationary satellites. Moreover, we restricted the analysis to SVC detected in the JJA season, while the rest of the article describes both DJF and JJA seasons, and to one year (2006), while the rest of the article studies the period between June 2006 and December 2008.

We agree with the Reviewer that these restrictions put in serious question the generality of the results presented in this section. Following this remark, we elected to use, instead of the Meteosat maps, the MERG NCEP/CPC brightness temperature dataset that combines measurements from several geostationary satellites (GOES-8/10, METEOSAT-7/5 and GMS). This merged dataset documents brightness temperatures on a global scale ($\pm 60^\circ$) with a $\sim$4km resolution hourly since February 2000, and thus includes the entire tropical belt under study. Using this dataset, we extended our study linking SVC formation and convection to the entire C1 SVC population. Due to these changes, we now consider ten times more SVC (744) and back-trajectories ($\sim$7000) than in our original paper. As a nice side effect, our analysis also benefited from the increased time and space resolutions of the MERG dataset. Moreover, we extended the analysis to cover both DJF and JJA seasons and include all such seasons between June 2006 and December 2008 instead of only 2006. Using global BT maps also let us follow back-trajectories further in time (since in our original analysis they often escaped single regions as defined in Table 1 after 5 days), and we now extend our search of intersection between back-trajectories and convective systems up to 15 days prior to SVC detection. Following these changes, we modified Section 5.3 of the present article to include a description of the new brightness temperature merged dataset, and of the new results obtained considering the tropical belt as a whole. Fig. 15-17 (previously 16-18) have been updated to take the new results into account.

2. The Reviewer notes that our choice to limit our analysis to SVC with coherent temperature histories might bias the results toward a specific subset of the SVC population that is not representative of SVC in general. We now document in the article the differences in average temperature, geometrical thickness and optical depth between C1 SVC and the general SVC population (Sect. 4.1.). Properties of C1 SVC appear very similar to the ones of the general population, even if they are indeed slightly smaller geometrically (by one CALIOP pixel).

3. The Reviewer suggests two recent references that contain information relevant to

the subject under study. In the first, Wang and Dessler (2012) investigate the fraction of TTL cirrus that can be directly linked to convection by confronting their water content (as seen from CALIOP) with colocated water vapor mixing ratio measured from MLS. In the revised paper, we now compare our results with those reported in that article (Sect. 5.3 and 6). In the second, Virts et al. (2010) conclude that most TTL cirrus are formed in-situ in regions of planetary-scale ascent associated with the propagation of Kelvin waves. We now discuss this result in our paper, by confronting it to our own conclusion about the importance of convection and by mentioning Kelvin waves as a process that can trigger the in-situ formation of SVC (Sect. 6).

4. The Reviewer notes that the distinction between "external processes" and convection made in the original paper is confusing. He wonders where other processes that can affect the formation of SVC, like temperature drops generated by Kelvin waves propagation, fit in this picture. We have now attempted to make our intentions clearer, by removing the reference to external processes and instead presenting our study as trying to identify if the formation of SVC is related to specific nucleation sites (sufate-based aerosols, biomass burning) or trace species (HNO3), or shares more conventional formation mechanisms with the general upper troposphere cirrus population.

Finally, the Reviewer mentions six technical corrections that have been taken into account in the revised paper.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 14875, 2012.

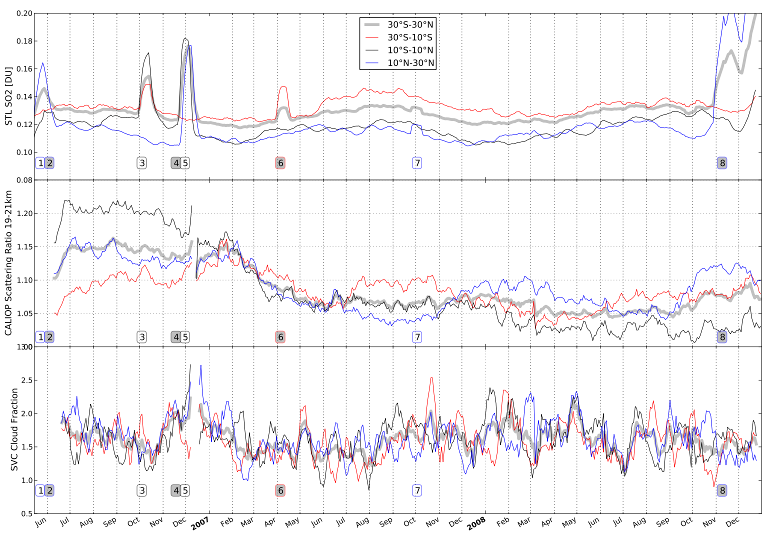

Fig. 1.

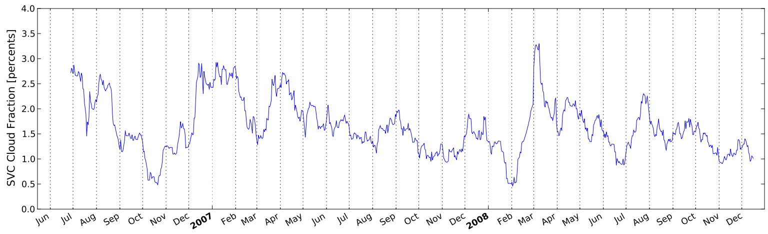
SVC Cloud Fraction [percents]
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jun Jul Aug Sep Oct Nov Dec 2007 Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 2008 Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Fig. 2.

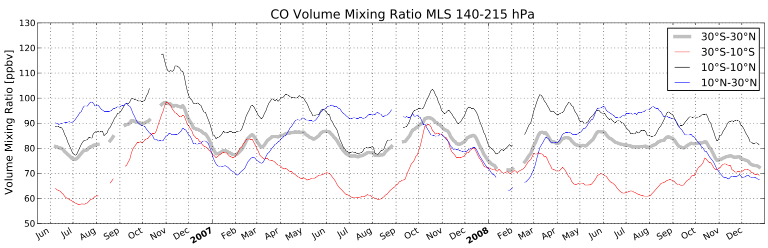
CO Volume Mixing Ratio MLS 140-215 hPa
Volume Mixing Ratio [ppbv]
130
120
110
100
90
80
70
60
50
30°S-30°N
30°S-10°S
10°S-10°N
10°N-30°N
Jun Jul Aug Sep Oct Nov Dec 2007 Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 2008 Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Fig. 3.

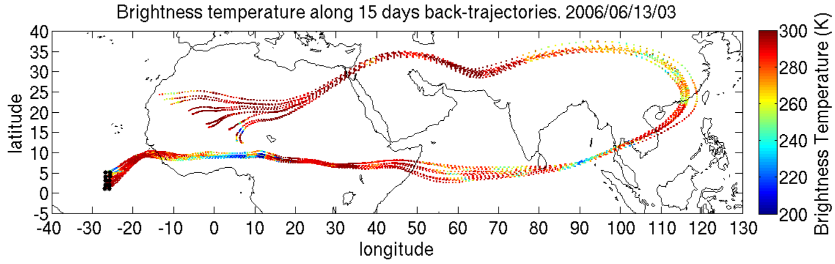
Brightness temperature along 15 days back-trajectories. 2006/06/13/03
latitude
longitude
Brightness Temperature (K)
40
35
30
25
20
15
10
5
0
-5
-40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120 130
300
280
260
240
220
200

Fig. 4.

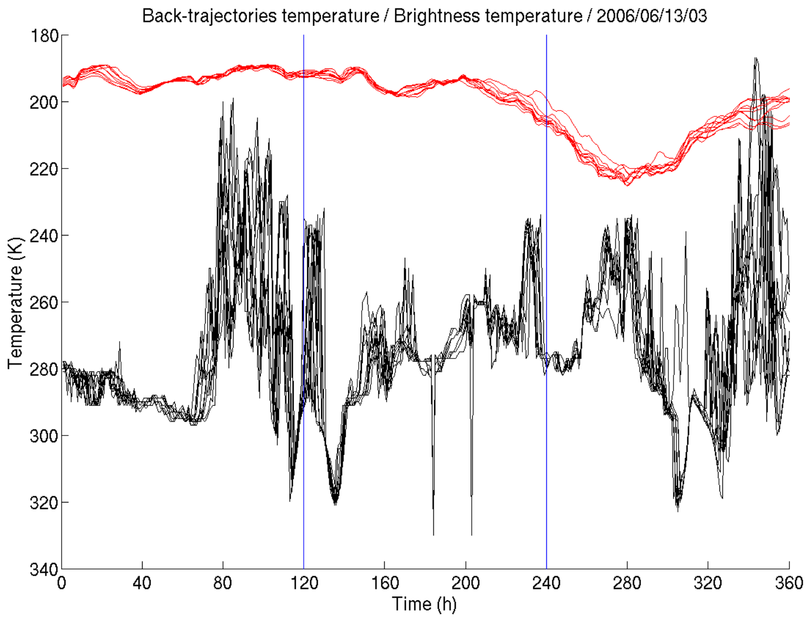
Back-trajectories temperature / Brightness temperature / 2006/06/13/03
Temperature (K)
Time (h)
180
200
220
240
260
280
300
320
340
0 40 80 120 160 200 240 280 320 360

Fig. 5.

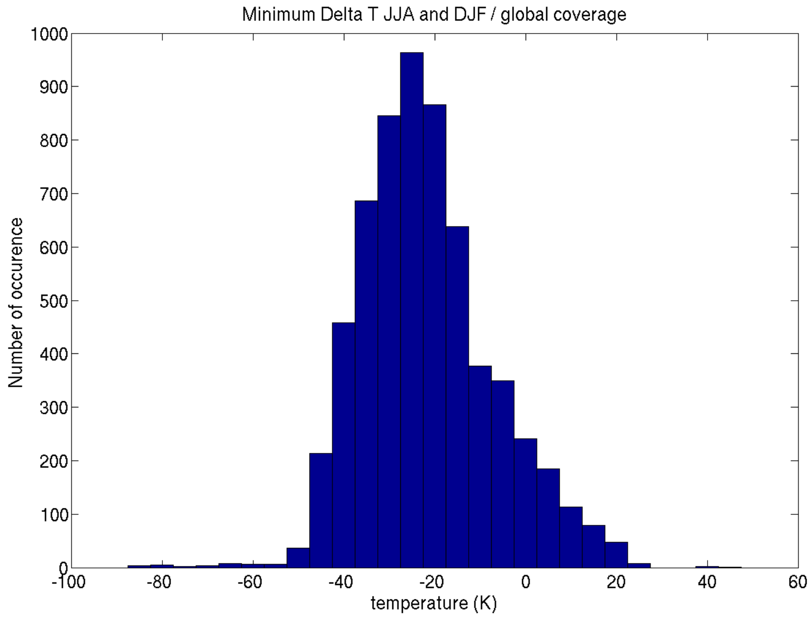
Minimum Delta T JJA and DJF / global coverage
1000
900
800
700
600
500
400
300
200
100
0
Number of occurence
-100
-80
-60
-40
-20
0
20
40
60
temperature (K)

Fig. 6.