First of all, we would like to thank the three referees for their thoughtful and constructive comments.

Responses for referee 2

Major issues

1 and 2. In order to address the concern expressed by the referee in the first two comments, we computed, for each region, the time evolution of the medians of the distributions of cloud and environmental properties for all the trajectories going over warmer waters (Table 1 of our paper). Figures 1 to 4 compare the medians obtained for the set of trajectories going over warmer waters (blue) with the ones obtained for the set of trajectories analyzed in the paper (black), i.e. the 30 % of the total number of trajectories having the highest cloud fraction and going over warmer waters. Differences are observed, as expected, in terms of cloud fraction, and for some regions in terms of SST and LTS (especially during the first 3 days). However, no significant differences are observed in terms of divergence during the first 3 days when the transition takes place. This suggest that the results presented in the paper are not affected by our choice of the set of trajectories to be analyzed.

In the revised manuscript, we used a simple logical reasoning to point out that even if the divergence was to decrease sooner, for e.g. from the second day on, this would not produce a significant change in the depth, hence in the dynamics of the boundary layer and in the cloud evolution (at least for values of the order of the median divergence) (see the discussion included before the last paragraph of section 3.2). This idea is confirmed by ongoing work using Large-Eddy-Simulations to assess how a change in the divergence during the third day affects the cloud break-up.

3. As suggested by the referee, we used a radiative transfer code to estimate the change in downwelling radiation produced by an increase of the free-tropospheric humidity. We found that if the specific humidity would for e.g. increase with 2g/kg, or 4g/kg, from the boundary layer top (1km) up to 3 km, the cloud top cooling would be reduced by 15, and respectively, by 30 %. We revised the paragraph discussing the impact of free-tropospheric humidity on cloud evolution to include such an example and to better explain how competing effects due to a reduction of the cloud top entrainment and of the cloud drying could partially offset the impact of the cloud top cooling decrease.

4. We repeated the analysis for the central initial trajectory location. Figure 5 shows the time evolution of the medians of cloud fraction, SST, LTS, divergence and humidity at 700hPa for the set of trajectories analyzed in the this case for NEP (black, i.e. the 30 % of the total number of trajectories starting from this single point, which have the highest cloud fraction and go over warmer waters) and for its corresponding subsets of fast (dashed grey line) and slow (full grey line) transitions. For reminder, we plotted in figure 6 the same quantities for the analysis performed for all the nine starting locations (a repeat of figs 4, 5a,b,c,e from the revised manuscript).

The differences between the fast and the slow transitions observed when the analysis is performed for the central initial location (Fig. 5) are similar to the ones obtained for the nine initial locations (Fig. 6); though their magnitude is smaller. This reinforces the idea that the differences between the two subsets of trajectories are not only due to their initial location, but that their are related with the values of the SST/LTS during the first days or prior to the start of the trajectories. To address this comment, as well as the other comments of the referees concerning section 4, we entirely rewrote this section.

5. The analysis of the aerosol optical depth was removed from the core of the text, and only briefly mentioned in Appendix B.

Minor issues

1. They were added in the abstract of the revised version.

2. This was rephrased in the revised manuscript.

3. The trajectories are 3D, and they are initiated at 200m above sea level. However, for the most part, they remain within the boundary layer during the 6 days (see also our answer to the 2nd question of referee 3). Section 2.1 was revised to explain more clearly how the trajectories are computed.

4. The values of the divergence discussed in the paper represent the average divergence within the boundary layer (computed as the average of the ERA-INTERIM divergence profile from 1000hPa to 900hPa). This was mentioned in the revised manuscript, at the end of the section 2.2.1.

5. This is mentioned in the revised manuscript.

6. The criterion used to select the trajectories going over warmer waters is : $latitude_{fin} < latitude_{init}$ and $longitude_{fin} < longitude_{init}$ for the northern hemisphere, and respectively, $latitude_{fin} > latitude_{init}$ and $longitude_{fin} < longitude_{init}$ for the southern hemisphere. So, indeed the trajectories going southward/northward are also considered. We mentioned this in the revised manuscript. The fraction of trajectories excluded from their direction can be deduced from Table 1, and corresponds to 27% for NEA, 46.3 % for SEAa, 14.3 % for NEP and 17.75 % for SEP.

7. These values are the means of the cloud cover.

8. We thank the referee for pointing this out.

9-10. These typos were corrected in the revised manuscript.

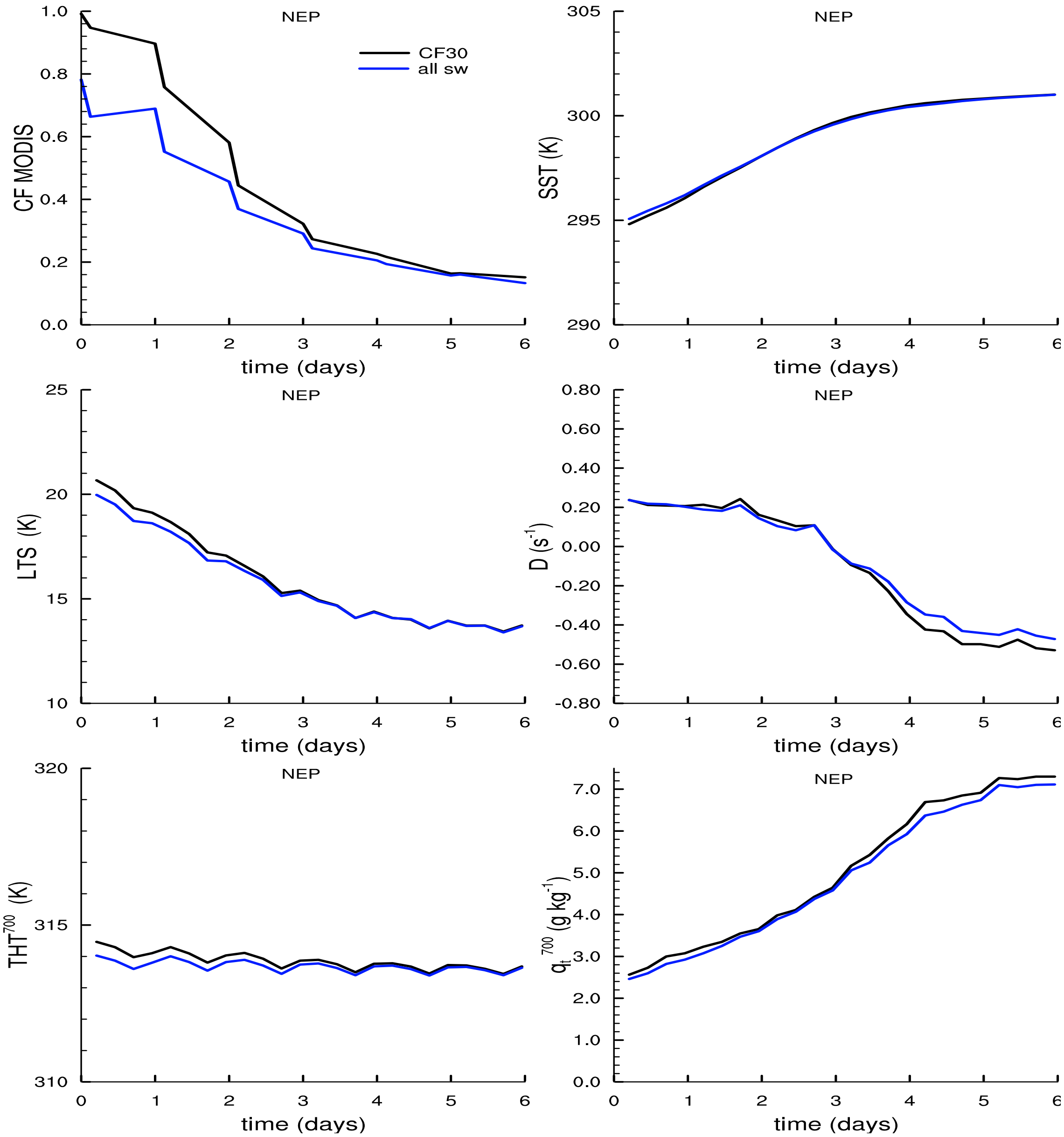

Figure 1: Time evolution of the medians of the distributions of cloud fraction, SST, LTS, divergence, potential temperature and specific humidity at 700hPa, for the trajectories going over warmer waters (blue) and for the 3000 trajectories having the highest initial cloud fraction and going over warmer waters (black) for NEP.

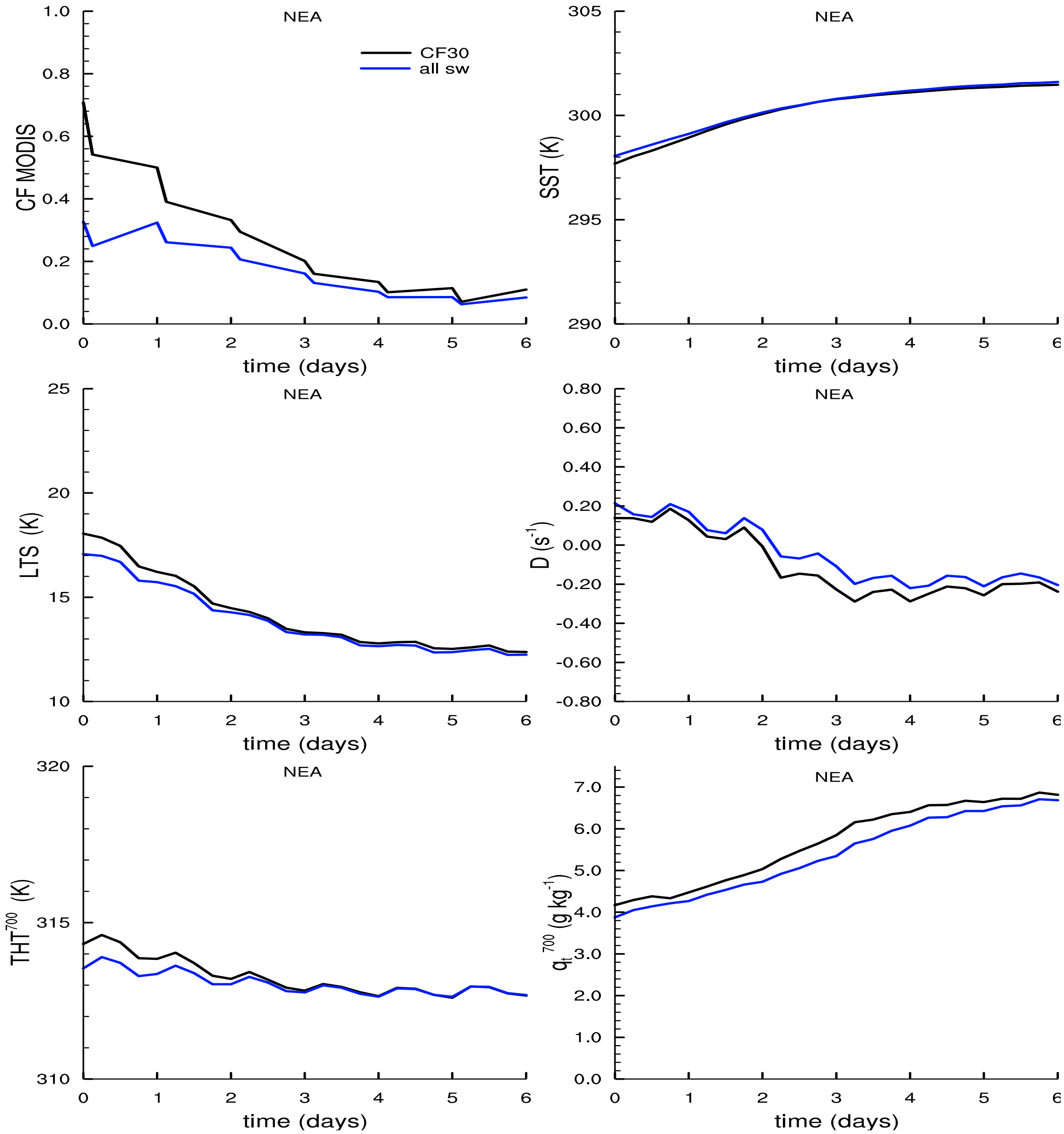

Figure 2: Same as Fig.1 but for NEA.

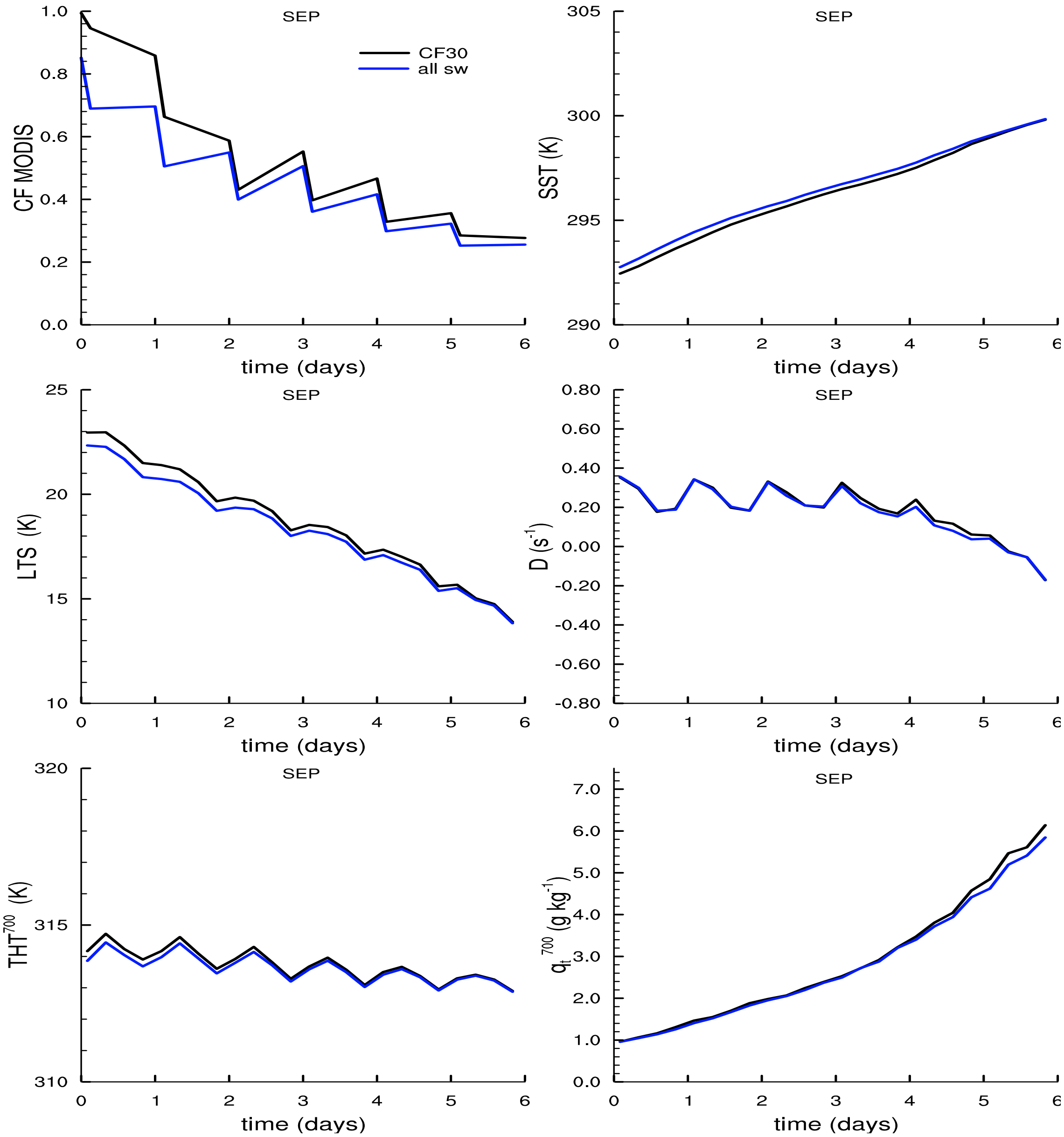

Figure 3: Same as Fig.1 but for SEP.

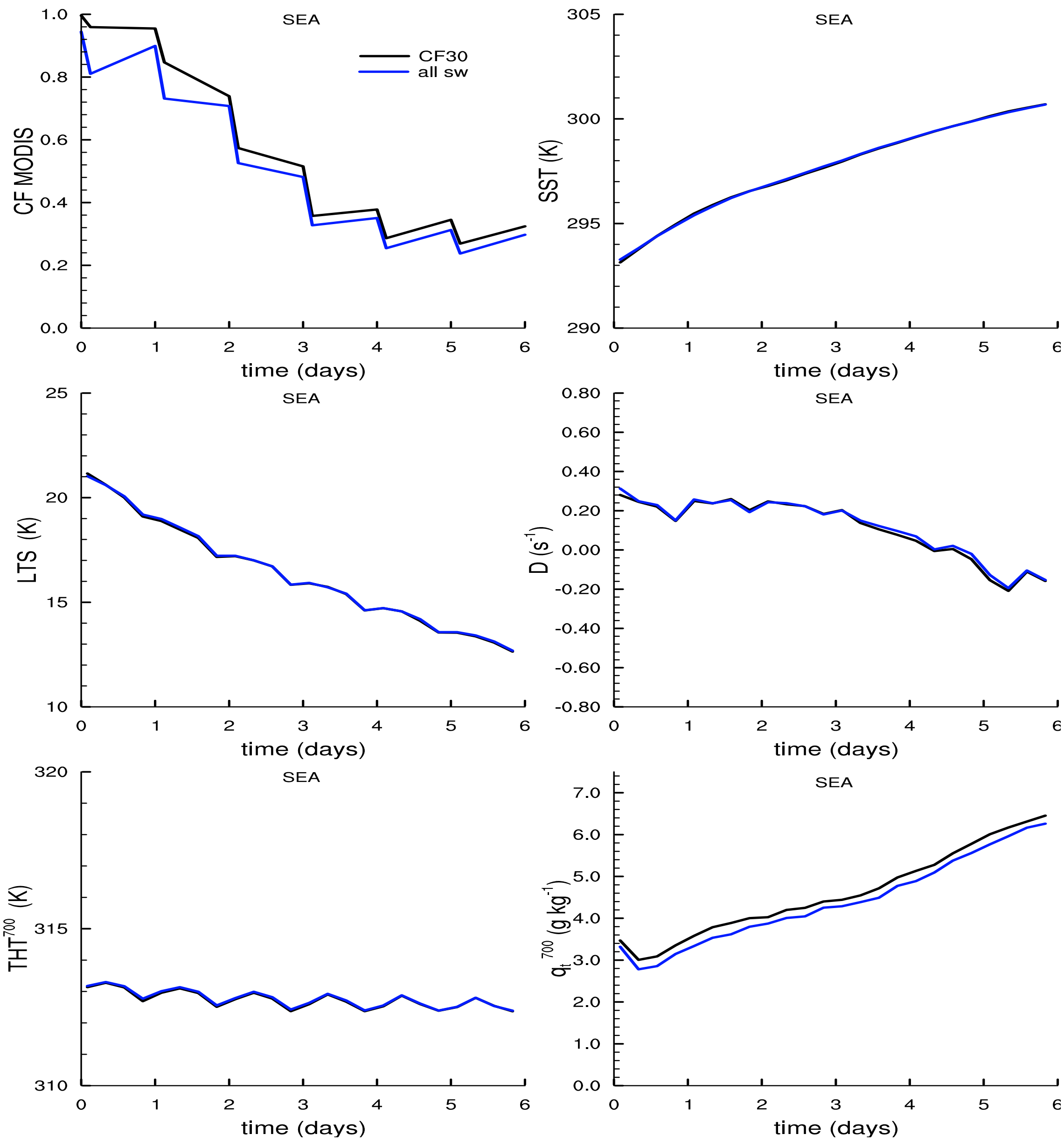

Figure 4: Same as Fig.1 but for SEA

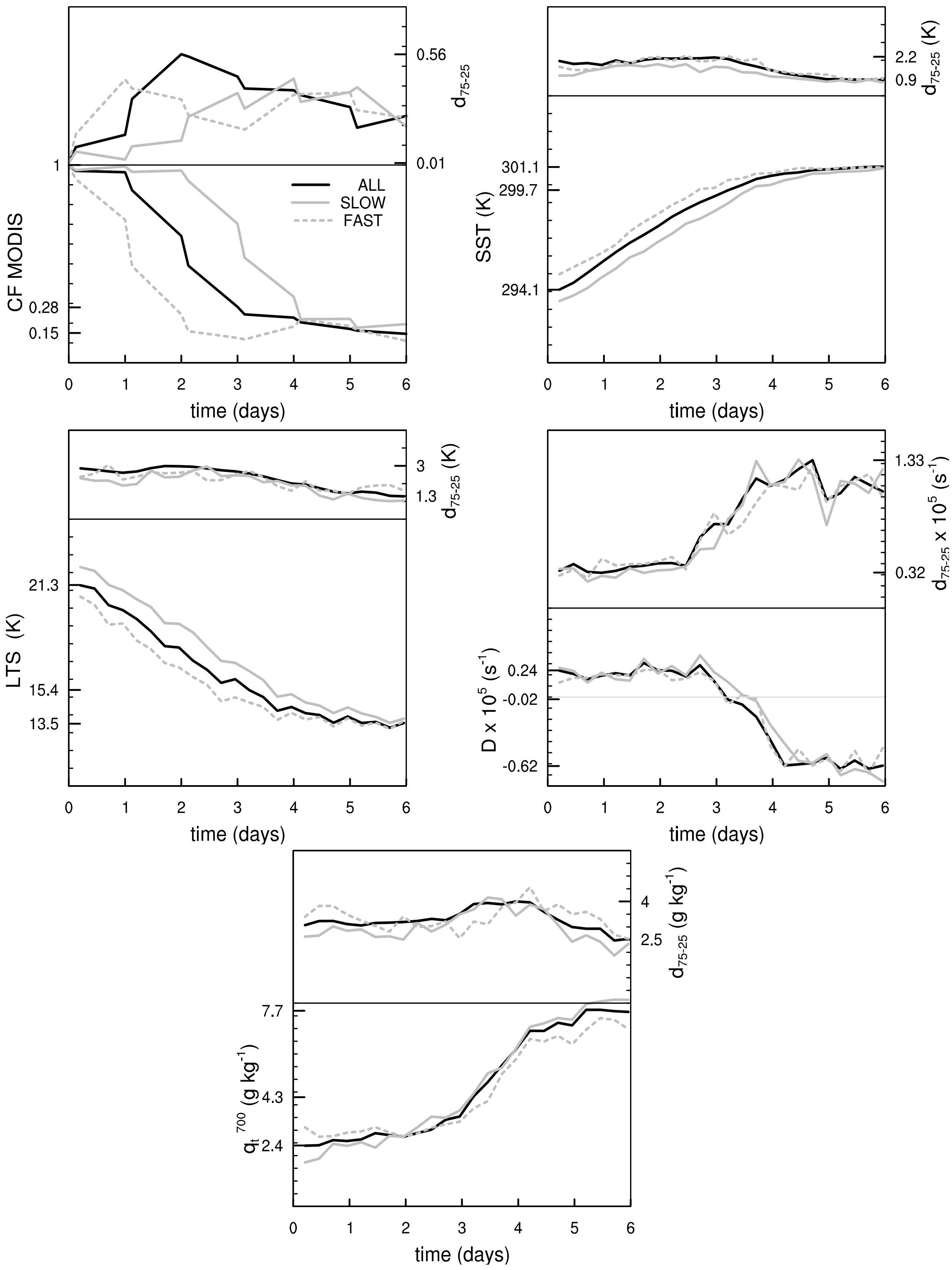

Figure 5: Same as fig. 4, 5a,b,c and e of the revised manuscript but for the trajectories coming from the central point of the stratocumulus region in NEP.

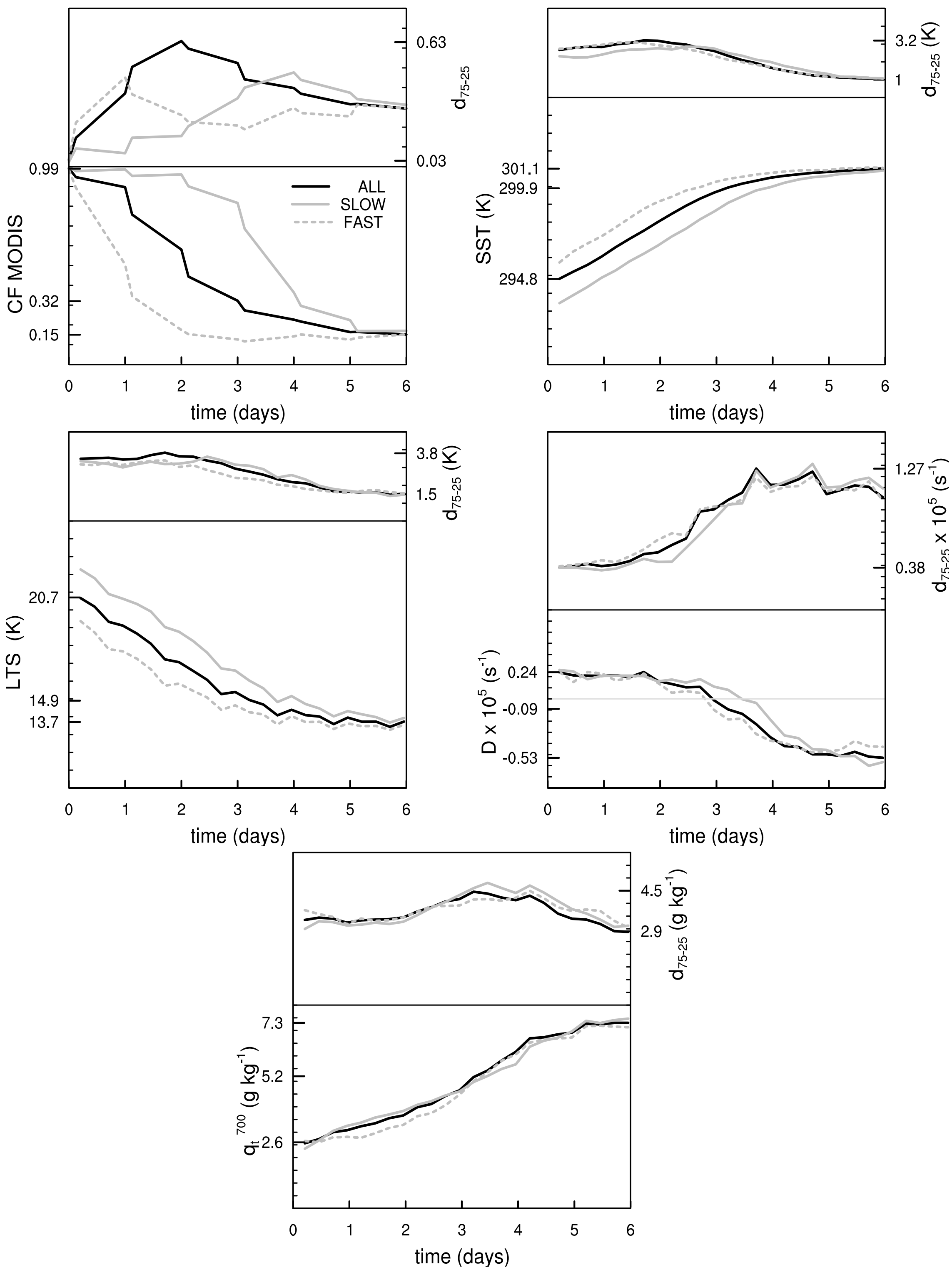

Figure 6: A repeat of figs. 4, 5a,b,c and e of the revised manuscript.