Supplement 2

Exemplary EDIs from the quasi-climatological period

This supplement provides additional information about the quasi-climatological analysis of the extratropical intrusion (EDI) events and yields information for the interpretation of Supplement 3 and 4. Fig. S2.1 shows the cloudiness over the North Atlantic and Fig. S2.2 the mesoscale cloud organisation in the vicinity of Barbados on three EDI_{con} and three EDI_{div} days. Fig. S2.3 demonstrates the stronger upper-level forcing (upper-level cutoff with a strong surface cyclone beneath) on three EDI_{con} days compared to three EDI_{div} days where the upper-level forcing already vanished. The temporal evolution of the synoptic situation combined with the position of the air parcels with a minimal descent of 400 hPa $(48\,h)^{-1}$ arriving in Barbados in the layer 1000-650 hPa on a EDI day is shown for two events:

- **22 January 2020** (EDI_{con}; Fig. S2.4): The EUREC^{4}A EDI case study, which is discussed in detail in the paper, as an example for an event with EDI air parcels overtaking the front and arriving at Barbados on the front's warm side.
- **15 January 2014** (EDI_{div}; Fig. S2.5): An Example of an event with the EDI air parcels remaining behind the front arriving at Barbados together with the cold sector.

Finally, Fig. S2.6 shows the density distribution of the net cloud radiative effect (CRE) for the EDI days in comparison to the remaining days (nonEDI) of the quasi-climatological period.

The transport pathways of the two EUREC^{4}A case studies, i.e., 22 January 2020 and 14 February 2020, are animated in the following files:

- **Supplement 3**: Supplement3_trajectories_1000-650hPa_2020-01-22.mp4
- **Supplement 4**: Supplement4_trajectories_650-300hPa_2020-02-14.mp4

The movies show the synoptic situation over the North Atlantic and the position of backward trajectories from the BCO started in the layer 1000-650/650-300 hPa on 22 January/14 February 2020 (00-21 UTC, every 3 h). The trajectory positions are shown as points coloured according to the pressure. Color shading shows total column water, and contours show sea level pressure (grey; 5 hPa intervals), surface evaporation (blue; intervals of 0.5 mm h^{-1}), upward and downward winds at 500 hPa (purple and orange, respectively; ± 0.2, ± 0.4, ± 0.6 Pa s^{-1}), and 2 pvu at 320 K (red). The red cross marks the location of Barbados. A Gaussian filter was applied to evaporation and vertical winds for better readability.

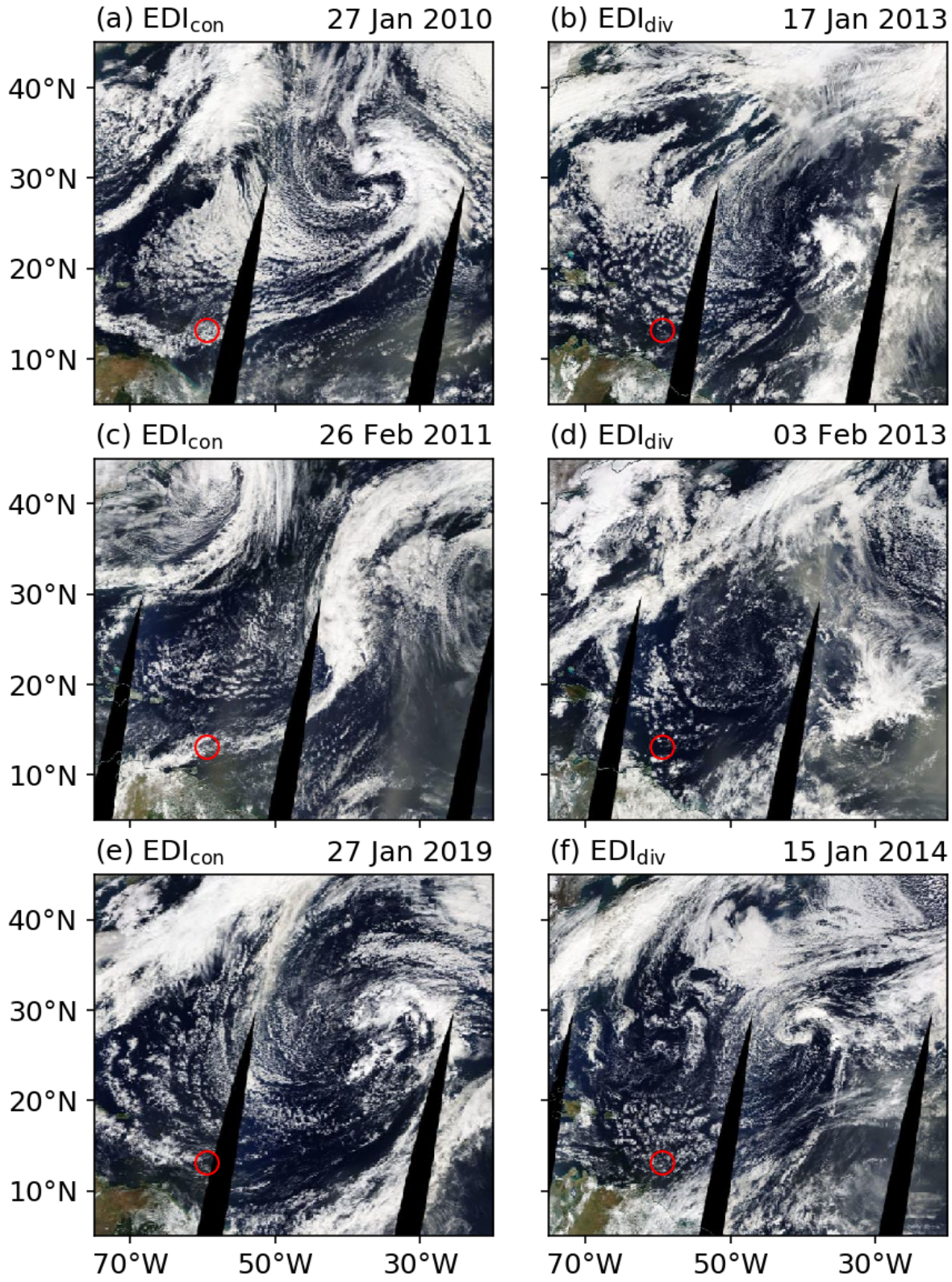

Figure S2.1: MODIS Terra satellite images at about 14:30 UTC on **(a,c,e)** EDI$_{con}$ and **(b,d,f)** EDI$_{div}$ days in the domain 5-45° N, 20-75° W, with the location of Barbados (red circle).

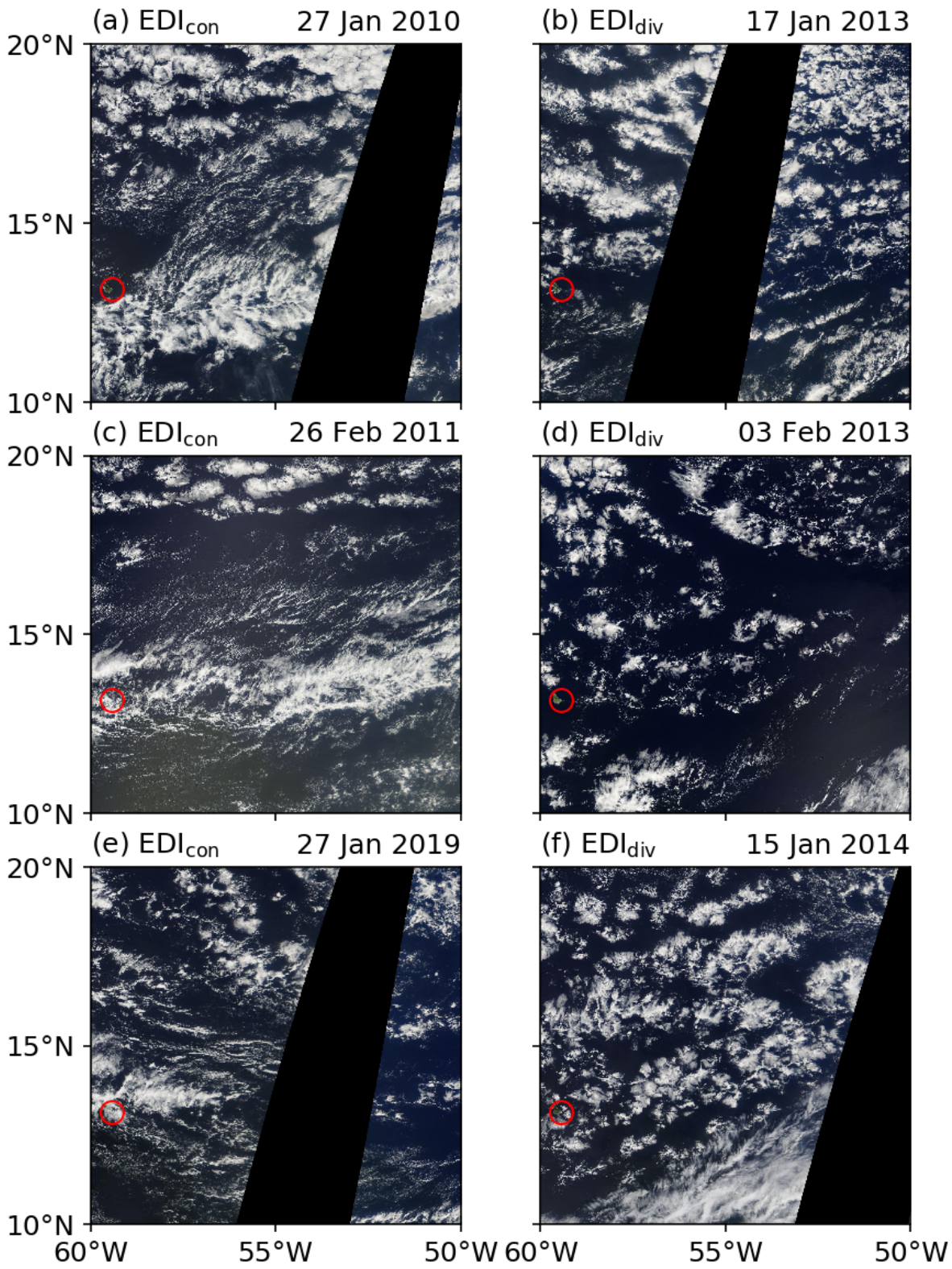

Figure S2.2: Identical to Fig. S2.1 but in the domain 10-20° N, 50-60° W.

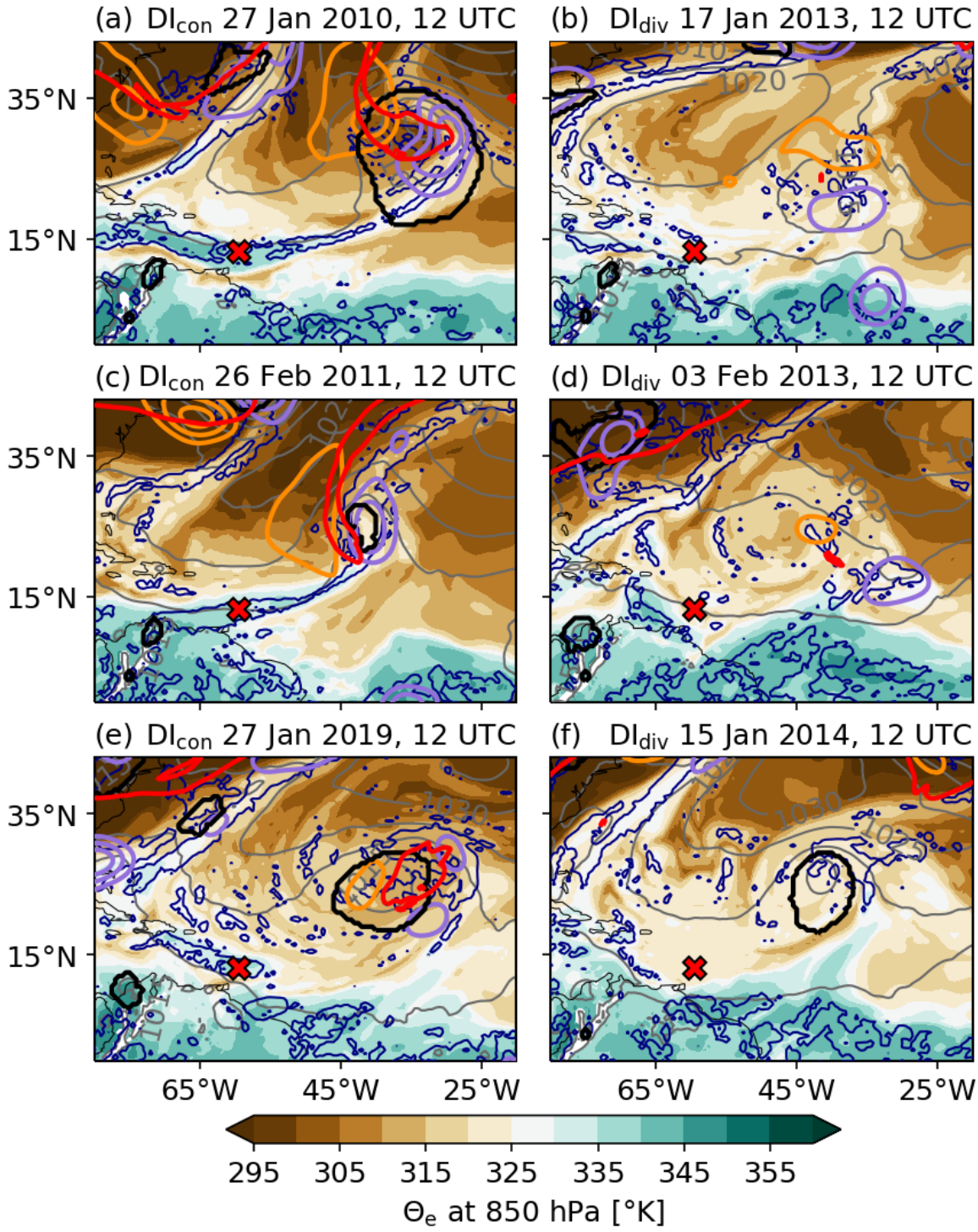

Figure S2.3: Synoptic situation over the North Atlantic on **(a,c,e)** EDI_{con} and **(b,d,f)** EDI_{div} days (identical dates as in Fig. S2.1 and S2.2). Shown are equivalent potential temperature at 850 hPa (shading), sea level pressure (gray; 5 hPa intervals), cyclone masks (black), precipitation (blue; 0.1 mm), upward and downward winds at 500 hPa (purple and orange, respectively; ± 0.2, ± 0.4, ± 0.6 Pa s^{-1}), and 2 pvu at 320 K (red). The red cross marks the location of Barbados. A Gaussian filter was applied to the vertical winds for better readability.

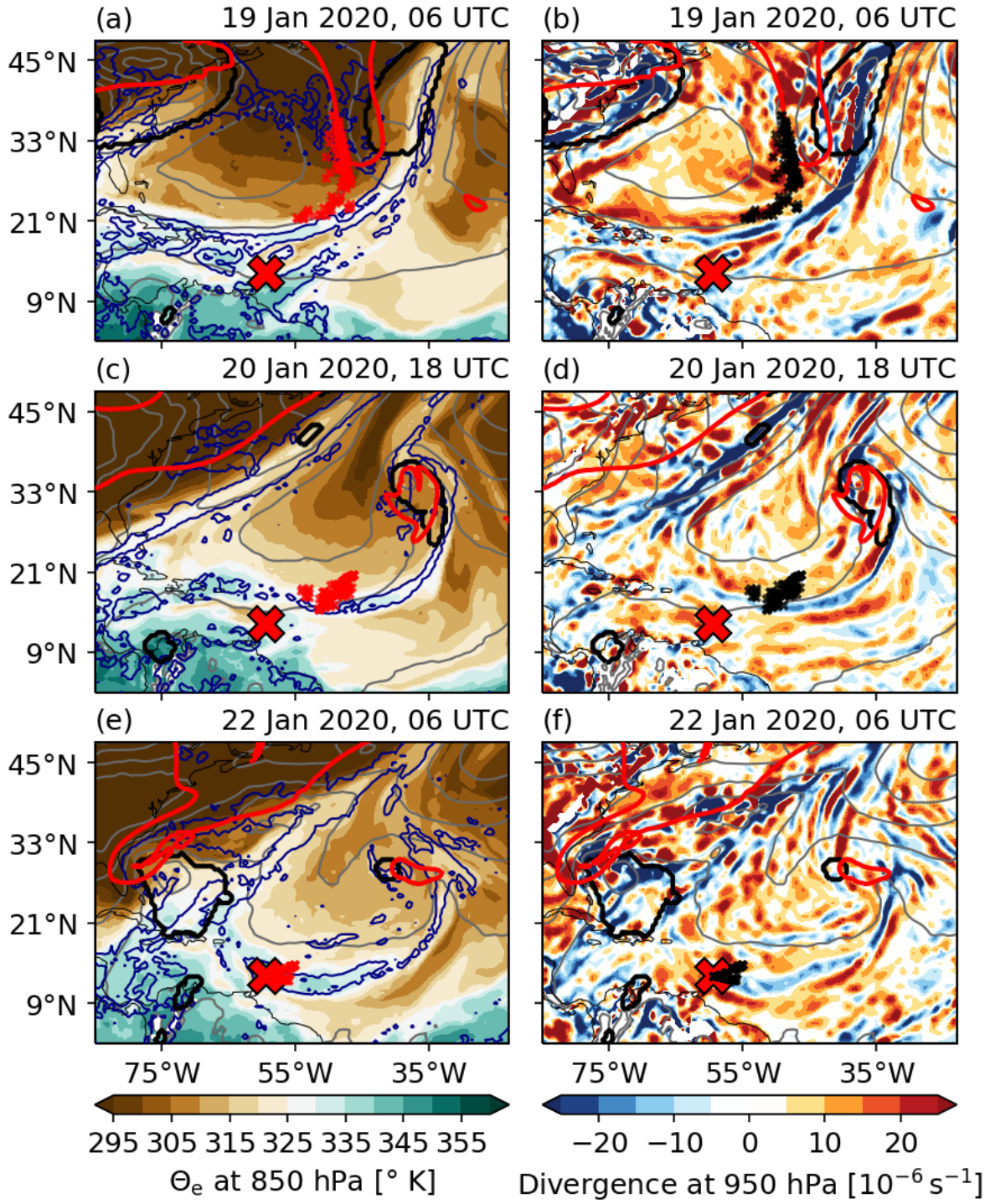

Figure S2.4: Synoptic situation over the North Atlantic on and the position (red/black thin crosses) of backward trajectories from the BCO started in the layer 1000-650 hPa on 22 January 2020 (00-21 UTC, every 3 h) which descend at least 400 hPa $(48)^{-1}$ on **(a,b)** 06 UTC 19 January, **(c,d)** 18 UTC 20 January, and **(e,f)** 06 UTC 22 January 2020. Shown are **(a,c,e)** equivalent potential temperature at 850 hPa (shading), precipitation (blue; 0.1 mm); **(b,d,f)** horizontal divergence at 950 hPa (shading); sea level pressure (gray; 5 hPa intervals), cyclone masks (black), 2 pvu at 320 K (red), and the location of the BCO (red thick cross).

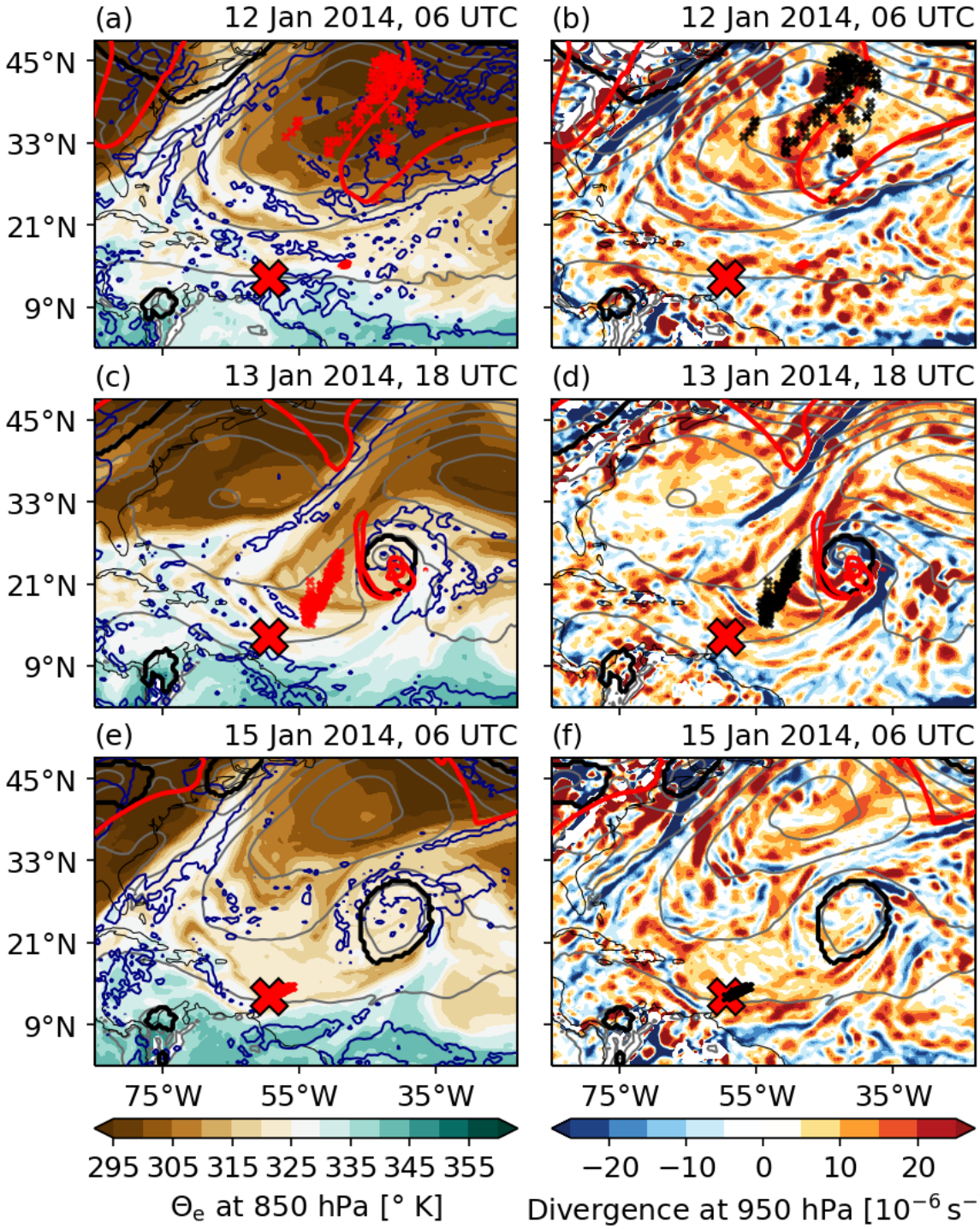

Figure S2.5: Similar to Fig. S2.4 but for the backward trajectories from the BCO started on 15 February 2014.

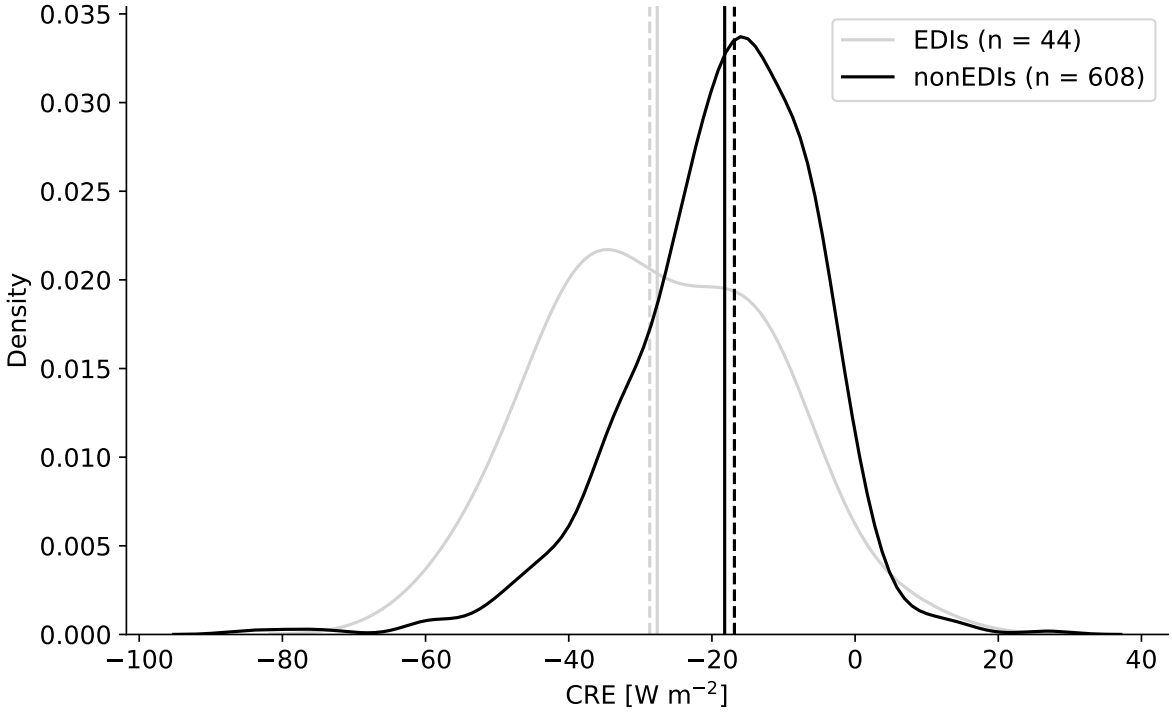

Figure S2.6: Density distribution of the CRE for the 44 EDI (lightgray) and the 608 nonEDI (black) days from the quasi-climatological period. The mean (continuous vertical line) and the median (dashed vertical line) are shown for the two data samples. The two data samples do not come from the same distribution according to the Kolmogorov-Smirnov test.