

Exemplary EDIs from the quasi-climatological period

This supplement provides additional information about the quasi-climatological analysis of the extratropical dry intrusion (EDI) events and yields information for the interpretation of Supplement 3 and 4.

Cloudiness related to EDIs: 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.

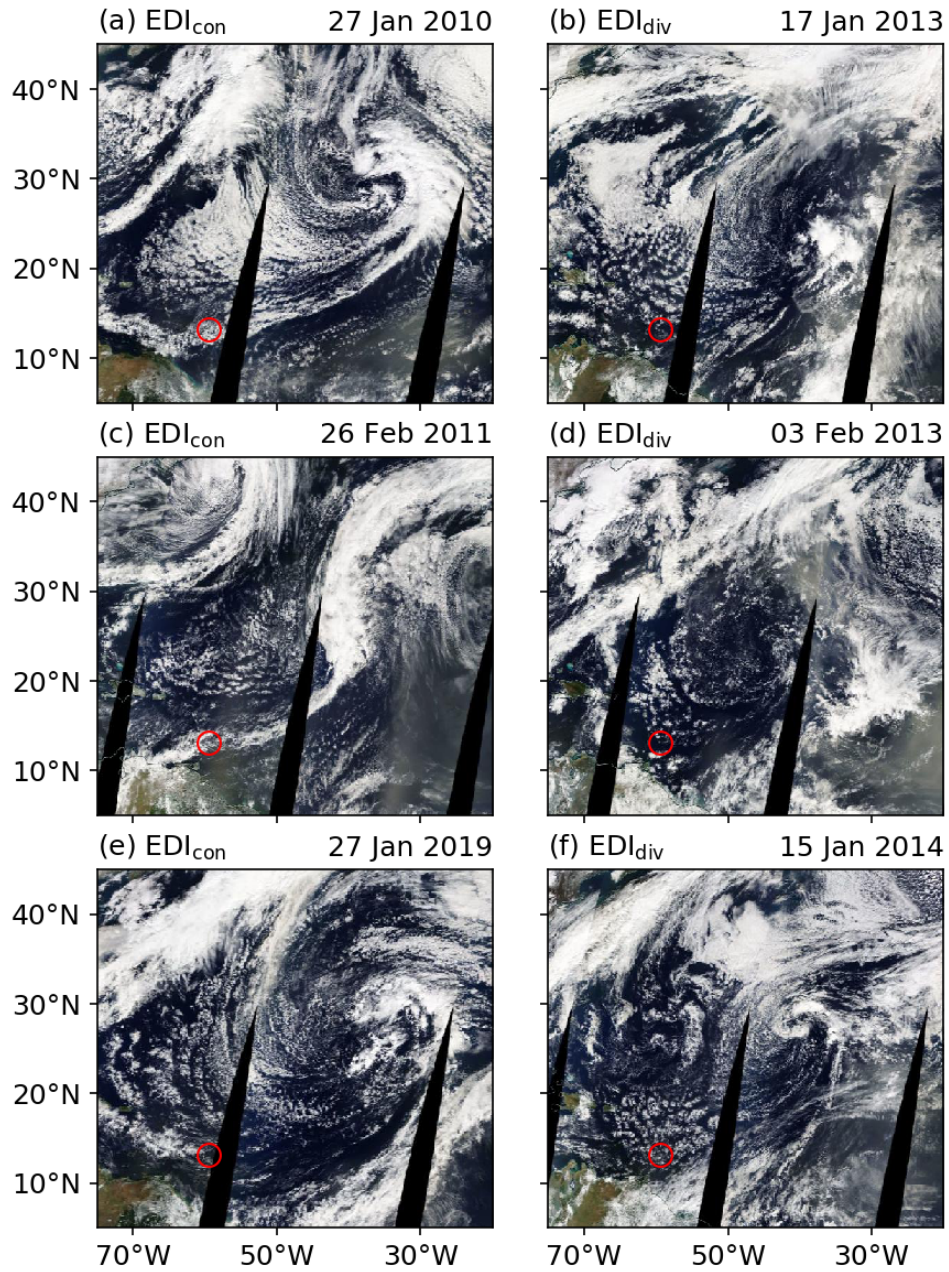


Figure S2.1: MODIS Terra satellite images at about 14:30 UTC on (a,c,e) EDI_{con} and (b,d,f) EDI_{div} days in the domain 5–45° N, 20–75° W, with the location of Barbados (red circle).

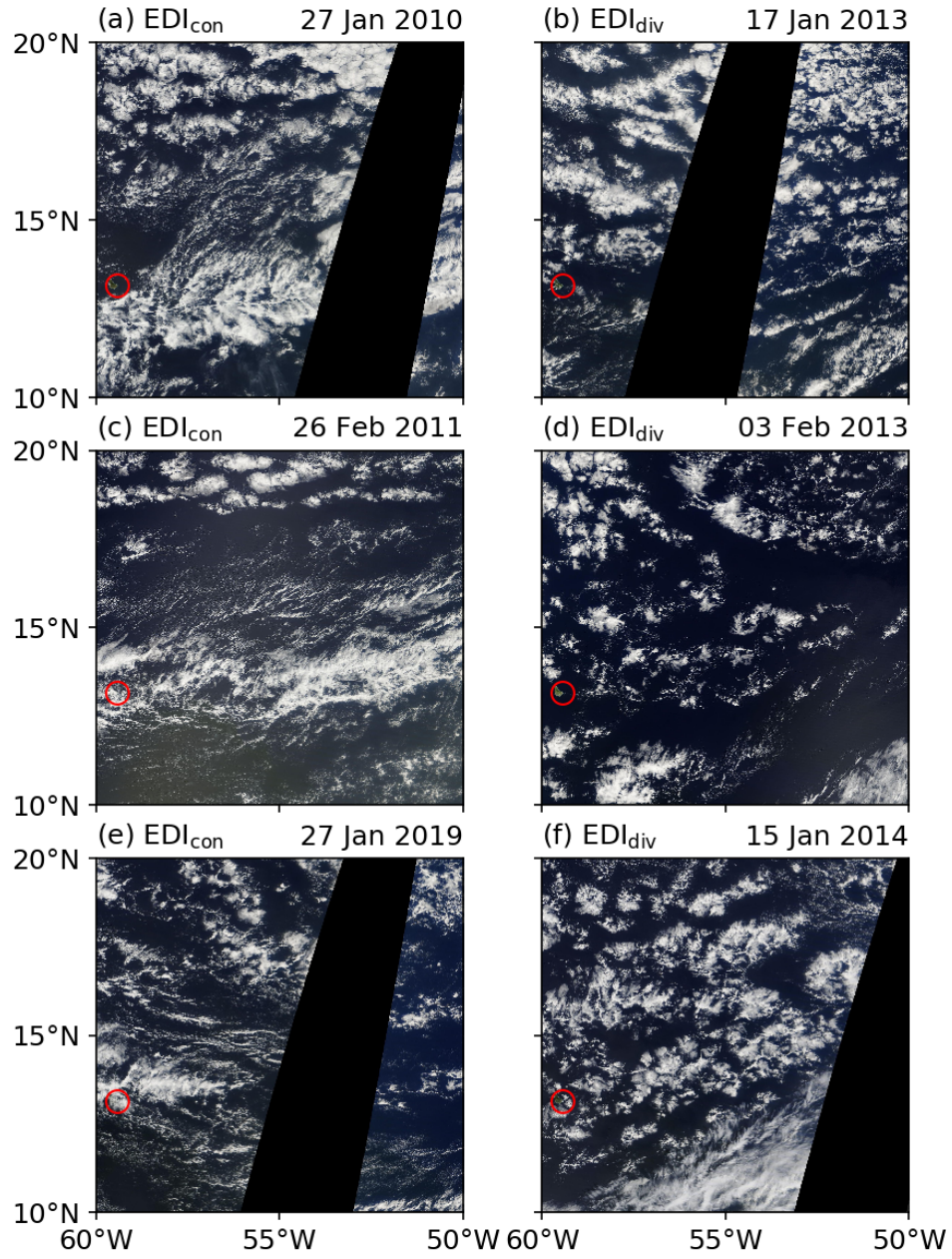


Figure S2.2: Similar to Fig. S2.1 but in the domain 10-20° N, 50-60° W.

Strength of upper-level forcing: 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.

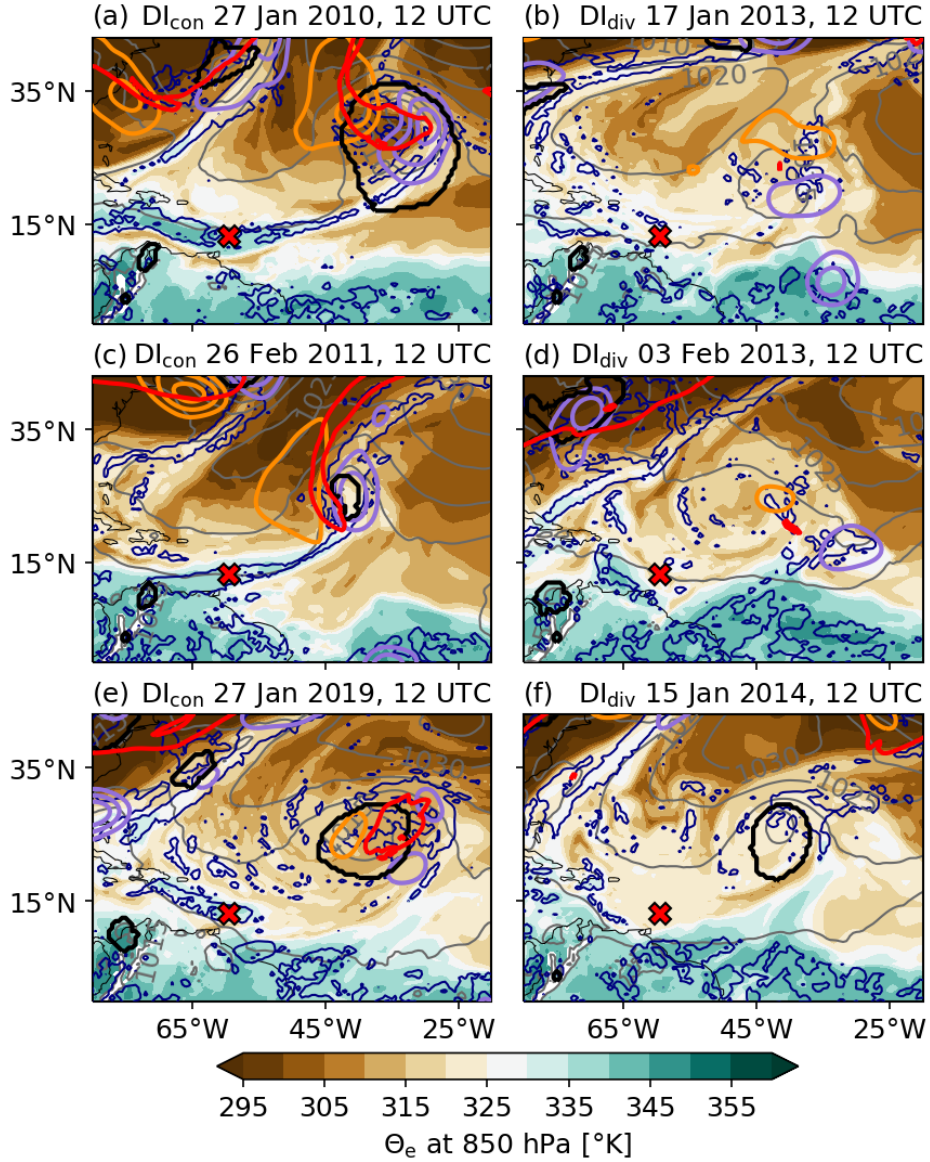


Figure S2.3: Synoptic situation over the North Atlantic on (a,c,e) EDI_{con} and (b,d,f) EDI_{div} days (identical dates as in Fig. S2.1 and S2.2). Shown are equivalent potential temperature at 850 hPa (shading), sea level pressure (gray; 5 hPa intervals), cyclone masks (black), precipitation (blue; 0.1 mm), upward and downward winds at 500 hPa (purple and orange, respectively; ± 0.2 , ± 0.4 , $\pm 0.6 \text{ Pa s}^{-1}$), 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. Data: ERA5.

Interaction between EDI and trailing cold front: The EDI air parcels arriving on 22 January 2020 (EDI_{con}; Fig. S2.4-S2.5) overtake the front by diving into the boundary layer in the cold sector behind the cold front and arriving in Barbados on the front's warm side. On 15 January 2014 (EDI_{div}; Fig. S2.6-S2.7) the EDI air parcels remain behind the cold front, continuously descending towards Barbados and arriving together with the cold sector.

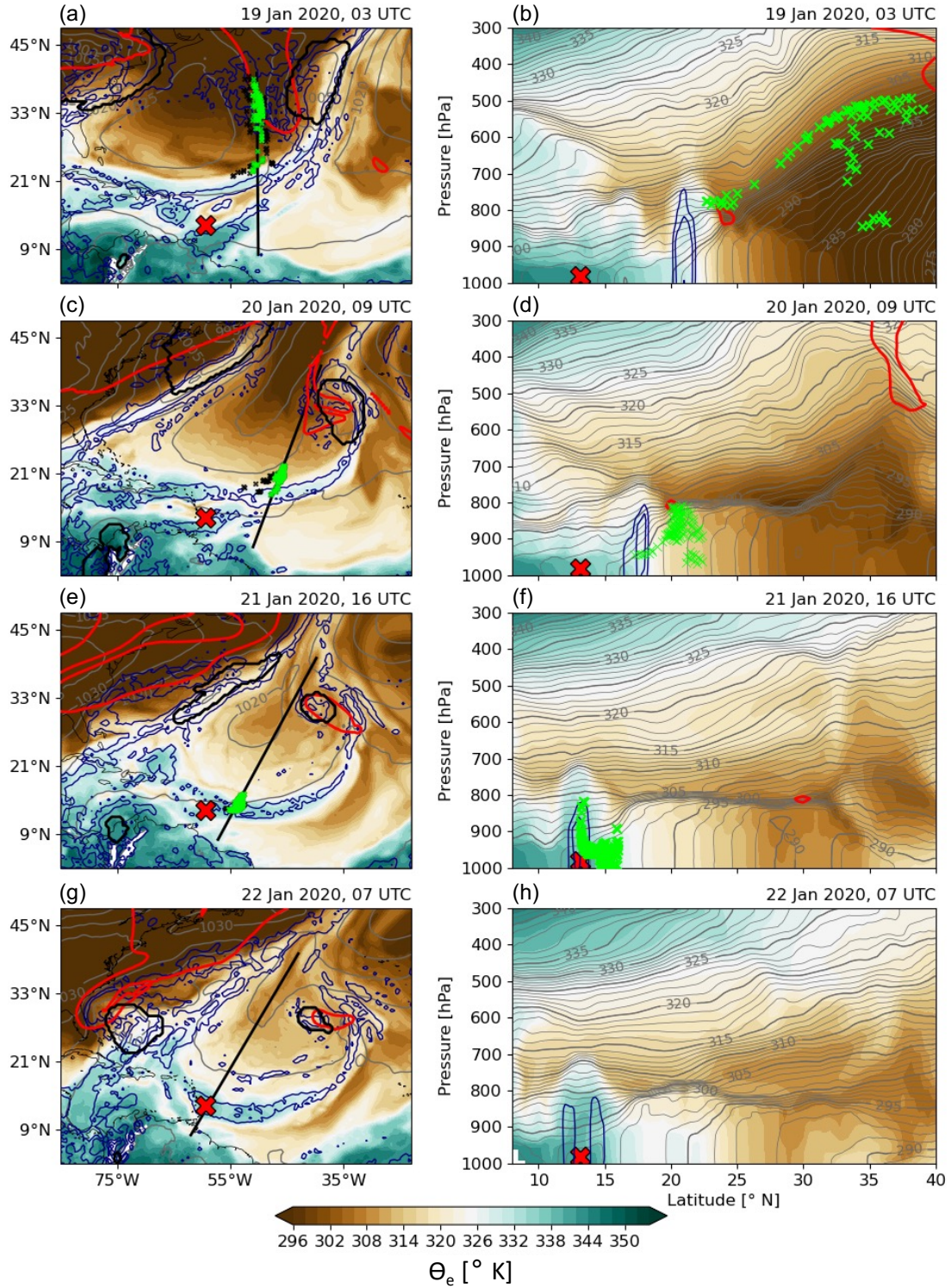


Figure S2.4: Synoptic situation over the North Atlantic and the position of backward trajectories from the BCO started in the layer 1000-650 hPa on 22 January 2020 (09-15 UTC, every 1 h) which descend at least 400 hPa (48 h)⁻¹ (a,b) at 03 UTC on 19 January, (c,d) at 09 UTC on 20 January, (e,f) at 16 UTC on 21 January, and (g,h) at 07 UTC on 22 January 2020. Shown are (a,c,e,g) equivalent potential temperature at 850 hPa (shading), precipitation (blue; 0.1 mm), sea level pressure (gray; 5 hPa intervals), cyclone masks (black), 2 pvu at 320 K (red), the location of the BCO (red thick cross), the vertical cross section (black line; note that it is different for every time step) displayed to the right, and the location of the air parcels (thin crosses in green if not more than 1° longitude from cross section away, otherwise in black); (b,d,f,h) equivalent potential temperature (shading), potential temperature (gray; 1°K intervals), rain water (blue; 5, 10, 20 mg kg⁻¹), and 2 pvu (red). Data: ERA5.

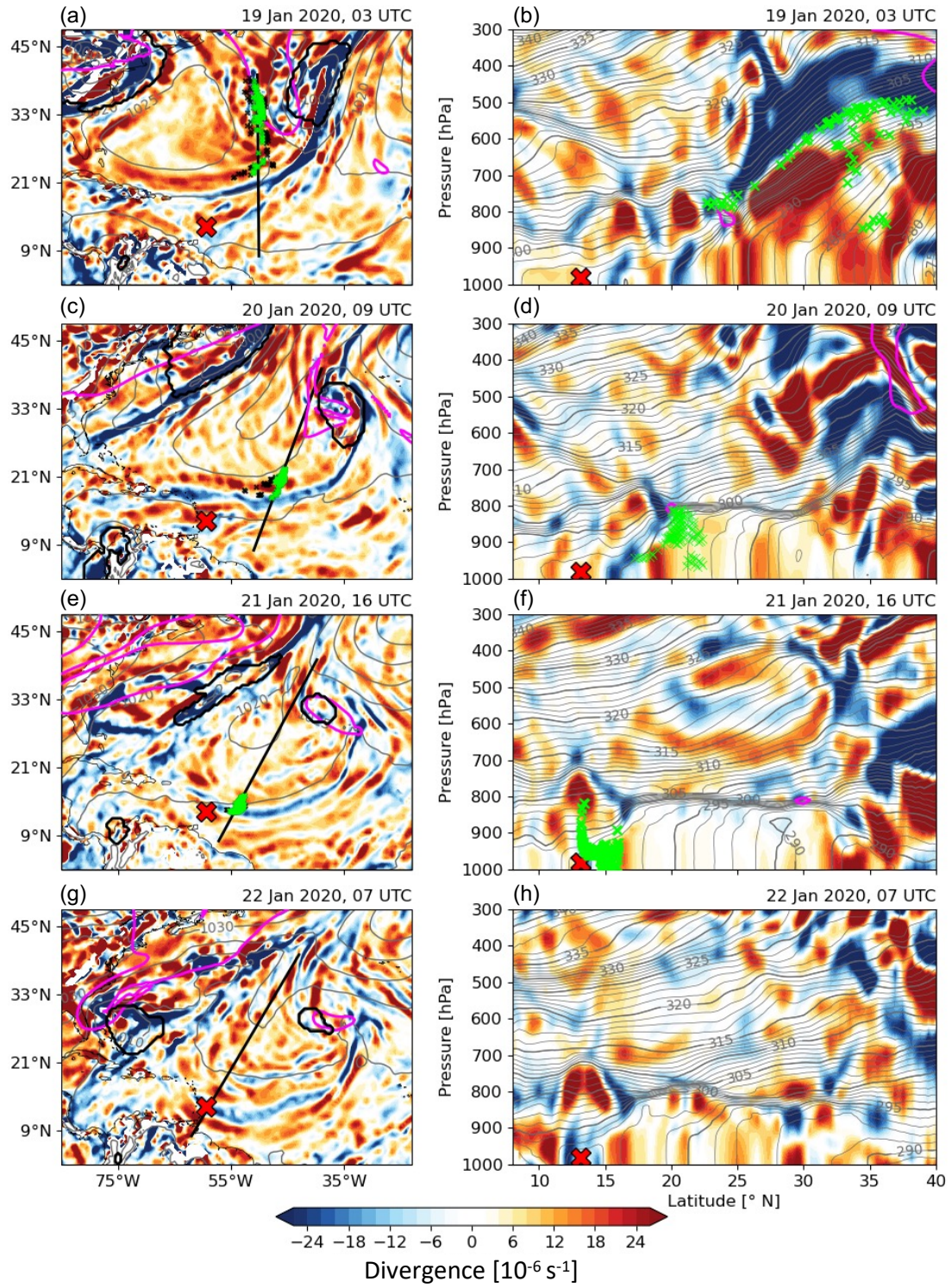


Figure S2.5: Similar to Fig.S2.4, but the shading shows divergence (a,c,e,g) at 950 hPa or (b,d,f,h) along the vertical cross section and 2 pvu as pink contour.

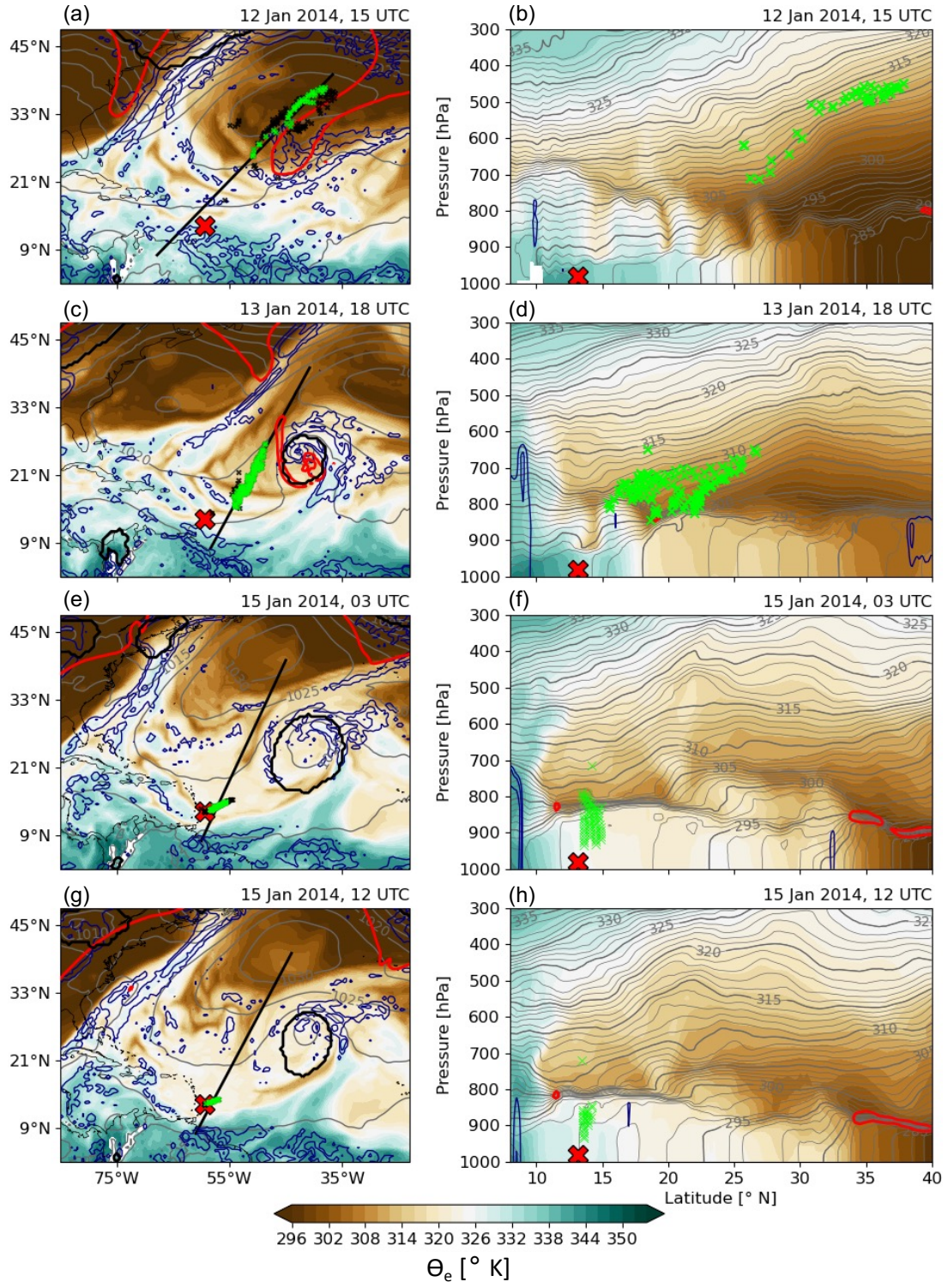


Figure S2.6: Similar to Fig.S2.4, but for the trajectories arriving on 15 January 2014 (00-24 UTC, every 3h).

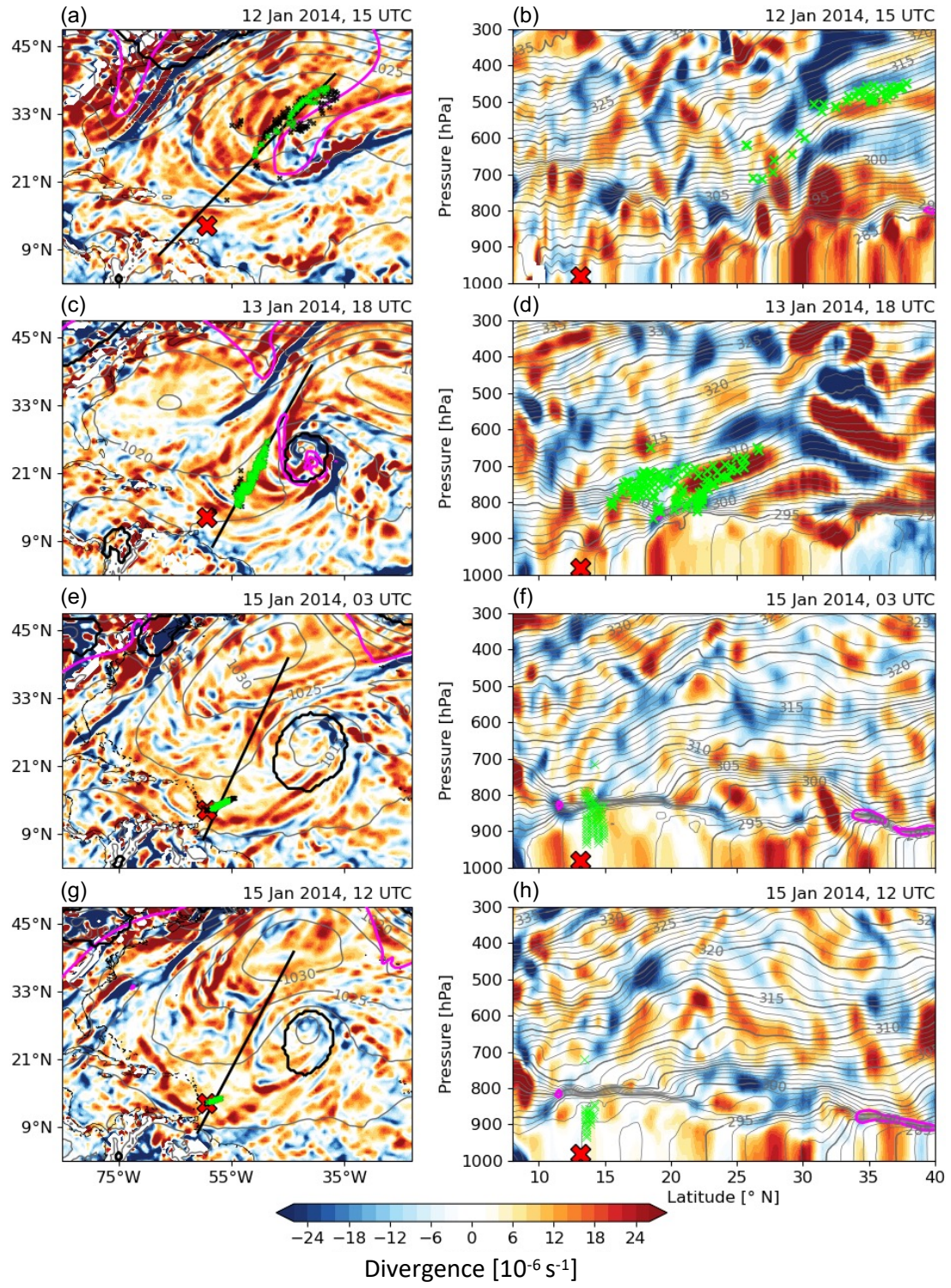


Figure S2.7: Similar to Fig. S2.5, but for the trajectories arriving on 15 January 2014.

Net cloud radiative effect (CRE) related to EDIs: Fig. S2.8 shows the density distribution of CRE for the EDI days in comparison to the remaining days (nonEDI) of the quasi-climatological period.

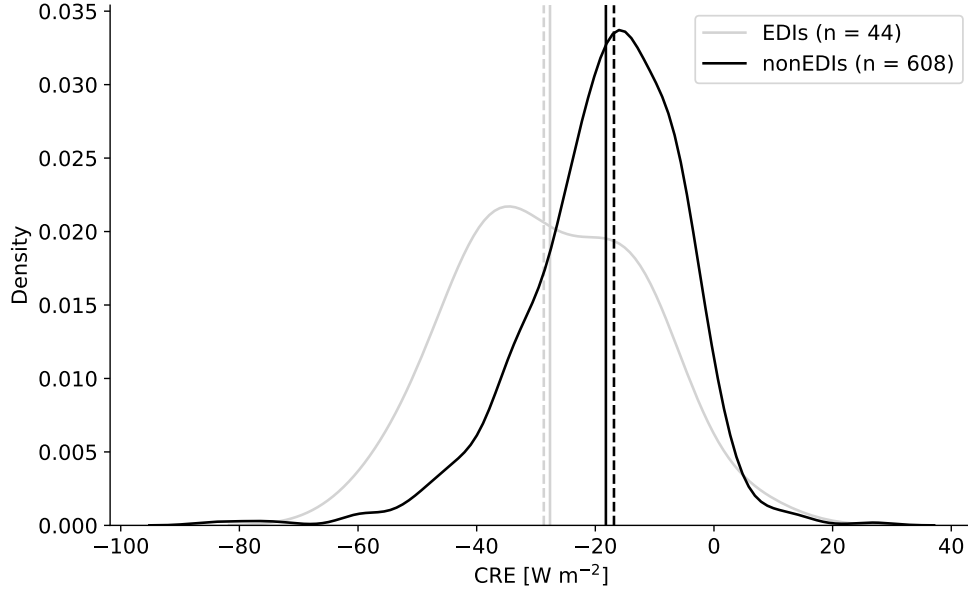


Figure S2.8: Density distribution of the CRE for the 44 EDI (lightgray) and the 608 nonEDI (black) days from the quasi-climatological period. The mean (continuous vertical line) and the median (dashed vertical line) are shown for the two data samples. The two data samples do not come from the same distribution according to the Kolmogorov-Smirnov test. Data: ERA5.

Information about Supplement 3 and 4: Supplement 3 and 4 are movies showing 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 , $\pm 0.6 \text{ Pa s}^{-1}$), and 2 pvu at 320 K (red). The red cross marks the location of Barbados. A Gaussian filter was applied to surface evaporation and vertical winds for better readability. Data: ERA5. The files are:

- Supplement3_trajectories_1000-650hPa_2020-01-22.mp4
- Supplement4_trajectories_650-300hPa_2020-02-14.mp4