Supplementary Information: Measurement report: In situ observations of deep convection without lightning during the tropical cyclone Florence 2018.

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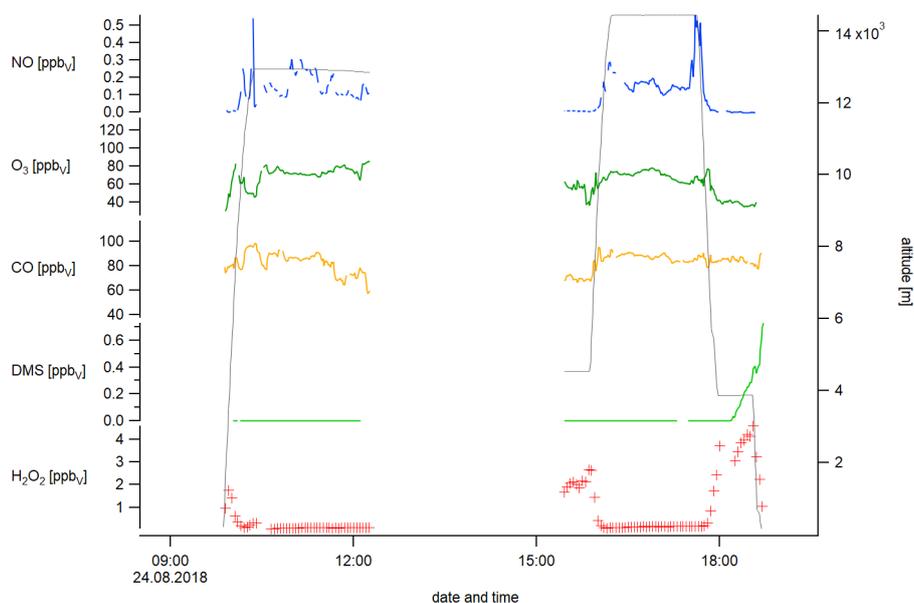


Figure S1. Overview of the temporal development of trace gases during flight MF10 on August 24, 2018.

(a) MF10   (b) MF12

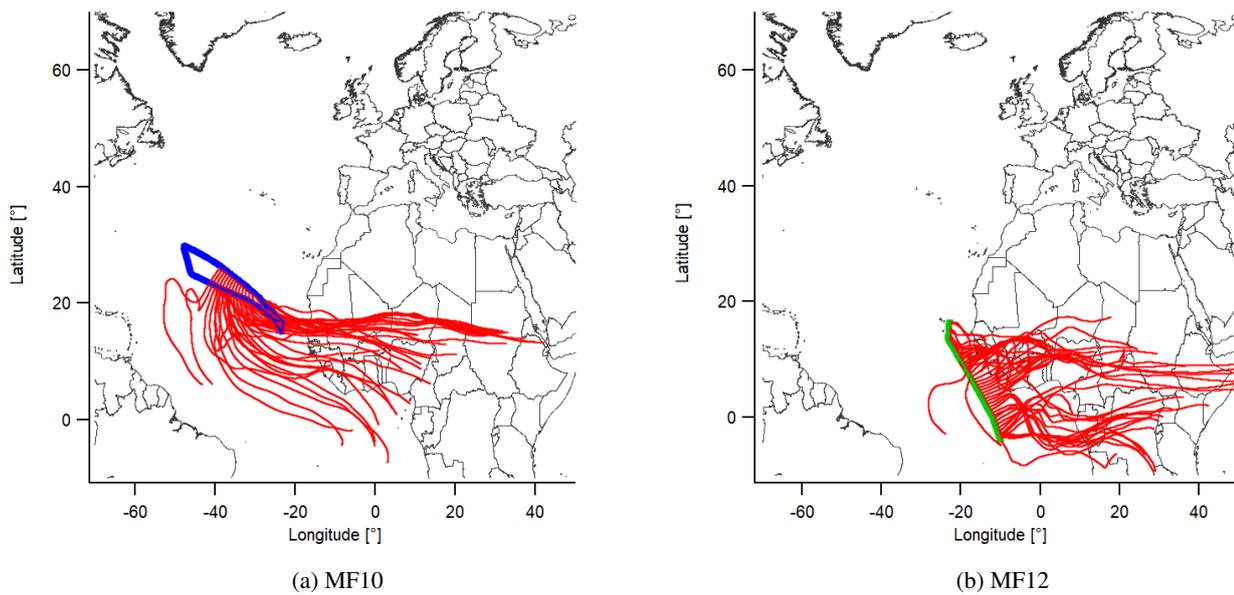



Figure S2. Overview of backward trajectories for MF10 and MF12 which originated from over the African continent where lightning is frequent.

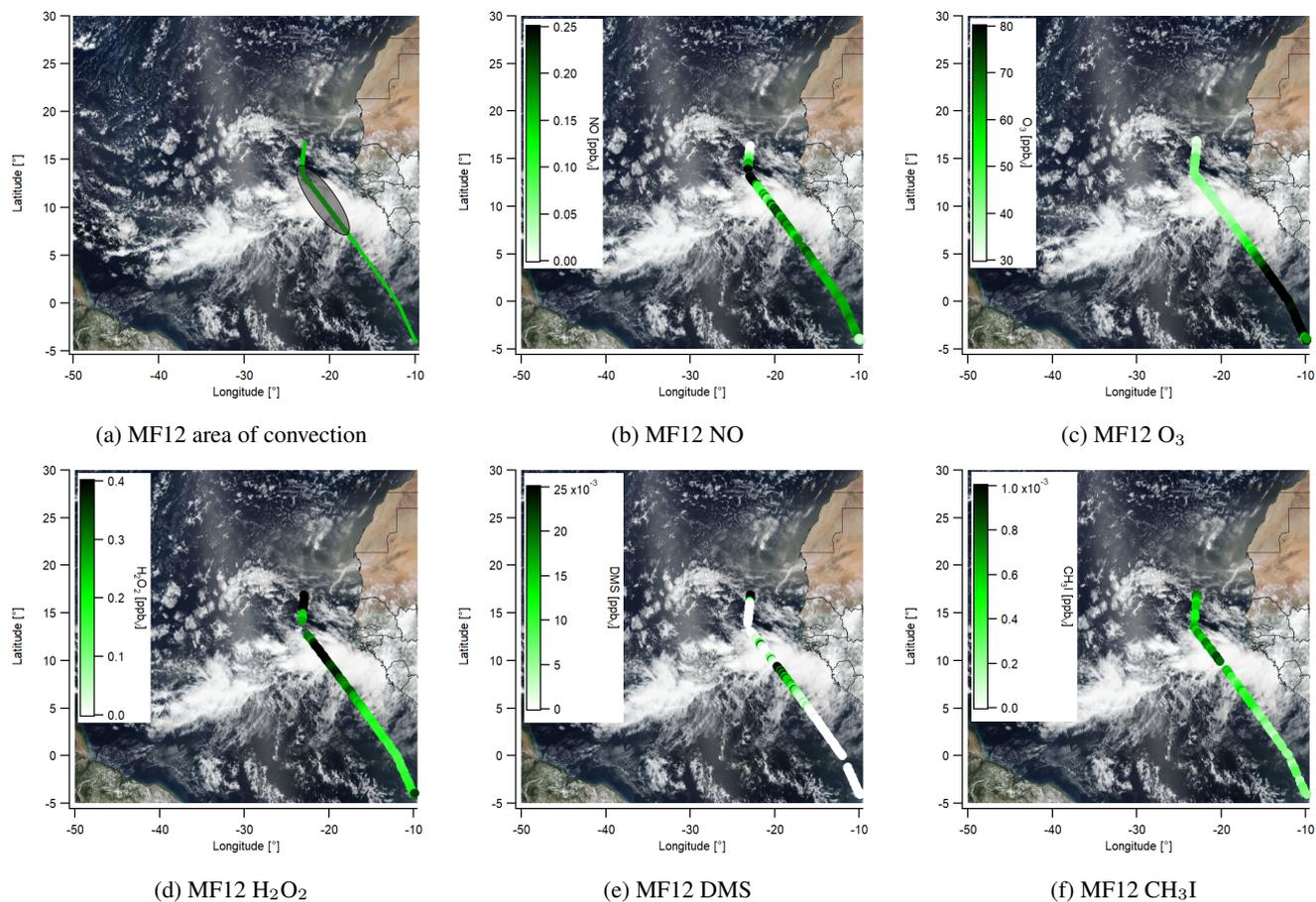



Figure S3. Overview of trace gas concentrations on the flight track of MF12 on August 29. Out- and inbound flights for MF12 were stacked. Here we show the outbound flight as an example. In the area where we observed deep convection O_3 was reduced and H_2O_2, DMS and CH_3I were elevated. NO was elevated due to lightning. CO is not shown here due to the influence of biomass burning as described in the main text. Background satellite images were obtained from the NASA Worldview application.

(a) MF14 area of convection   (b) MF14 NO   (c) MF14 O_3

(d) MF14 CO   (e) MF14 H_2O_2 (f) MF14 DMS

(g) MF14 CH_3I

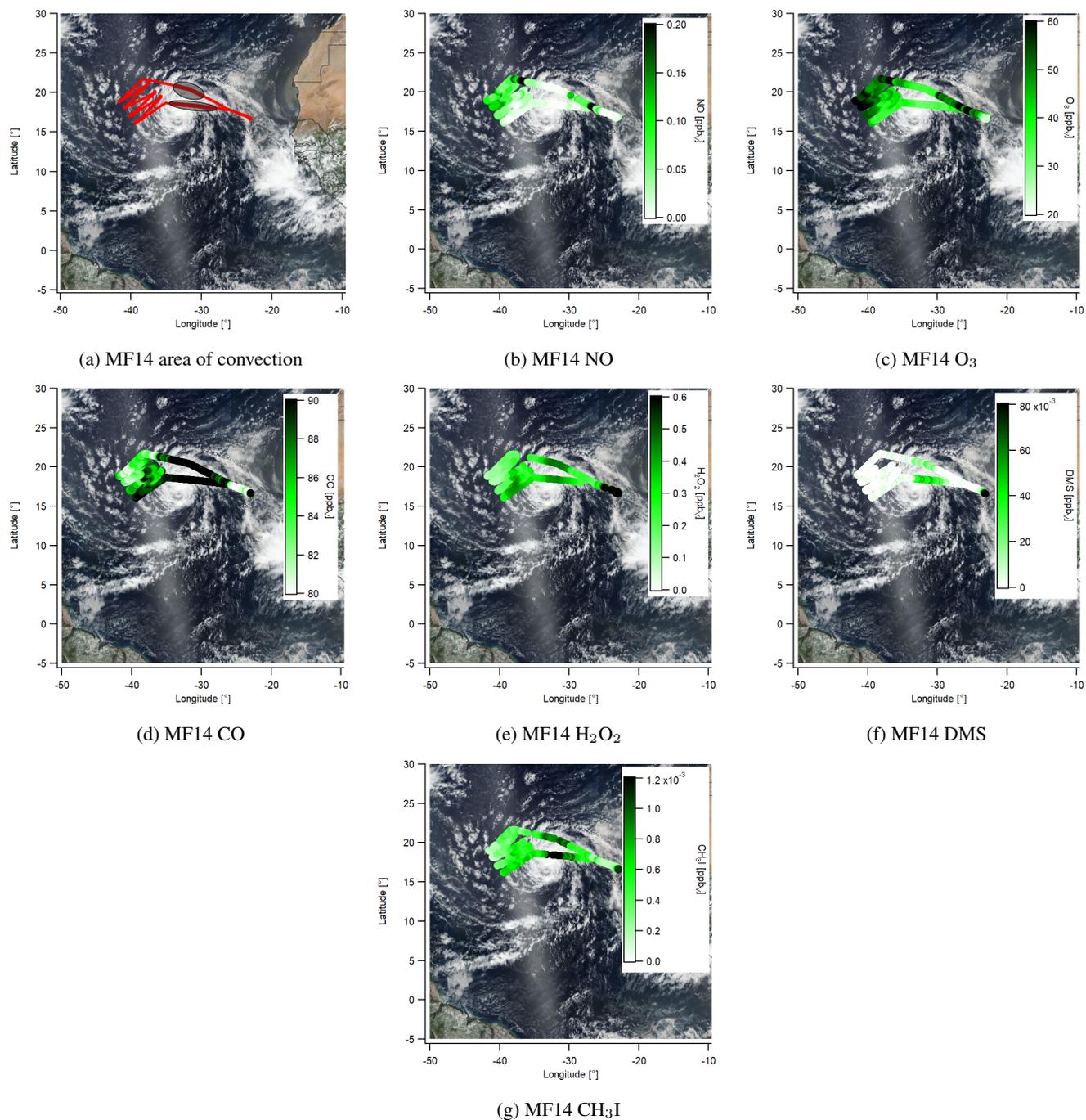



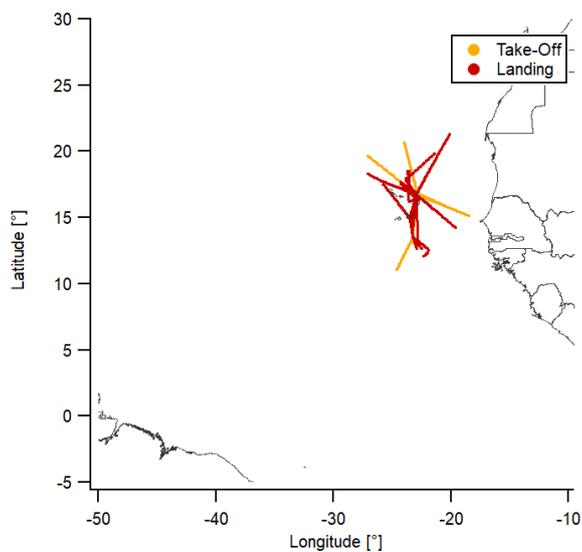
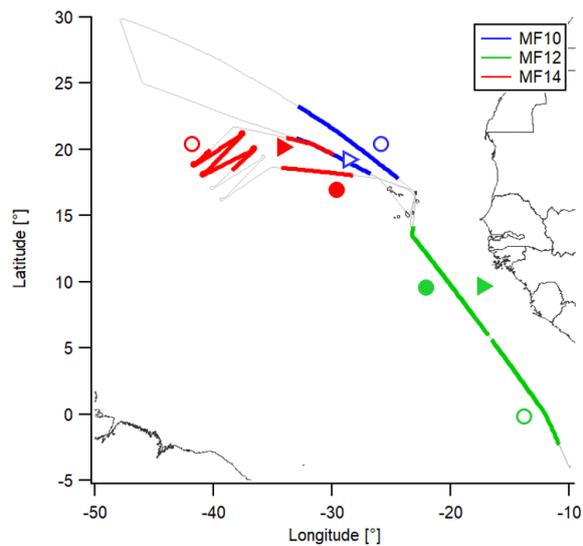
Figure S4. Overview of trace gas concentrations on the flight track of MF14 on September 2. In the area where we observed deep convection O_3 and NO were reduced while CO, H_2O_2, DMS and CH_3I were elevated. Background satellite images were obtained from the NASA Worldview application.

(a) take-offs and landings

(b) legend

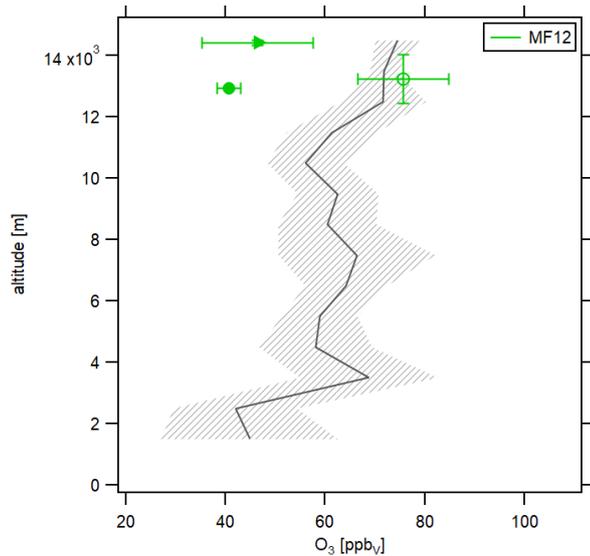
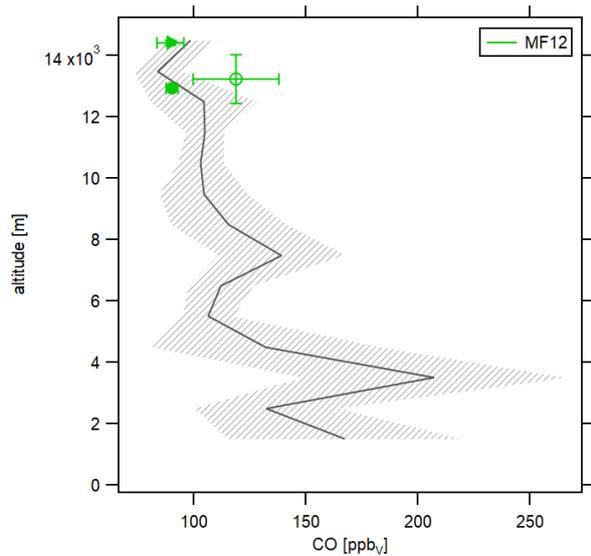
Figure S5. (a) Overview of all take-offs (orange) and landings (red) considered for the background profiles and (b) overview of symbols for the vertical profiles shown in Figure 4 and S7 (b).

(a) O₃

(b) CO

Figure S6. Southern hemisphere (< 5 °N) background profiles for O₃ and CO including MF12 average concentrations (as shown in Figure 4) for comparison.

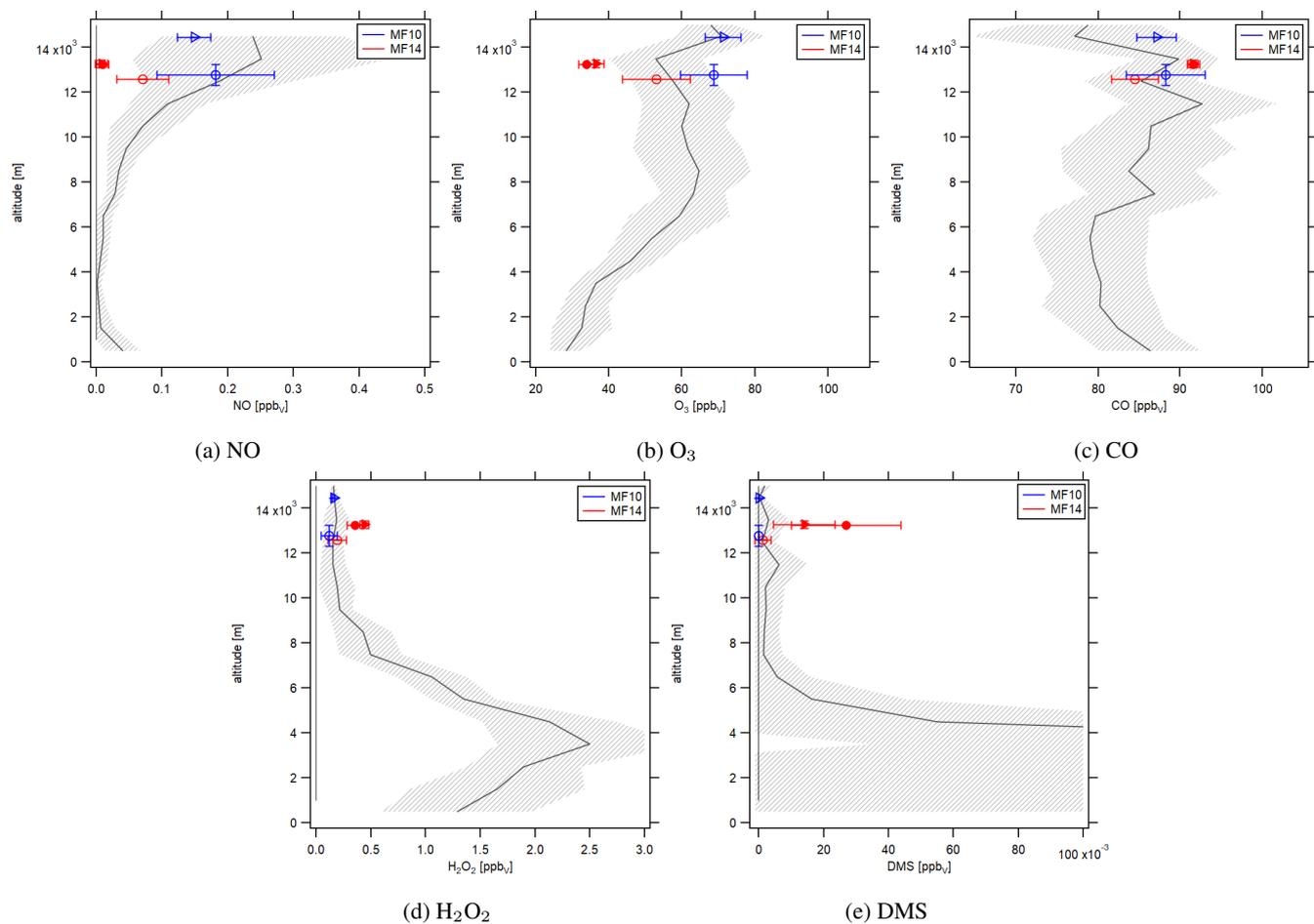
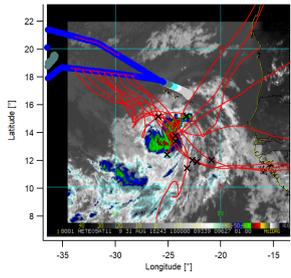



Figure S7. Vertical profiles of background trace gas concentrations during CAFE Africa around Cape Verde (gray) and average trace gas concentrations for convective (filled symbols) and non-convective (open symbols) areas during MF10 (blue) and MF14 (red). Data on CH_3I are not available for MF10 due to instrumental malfunction.

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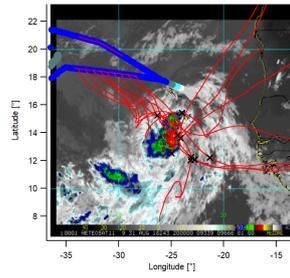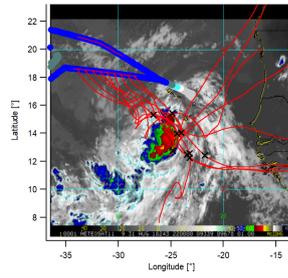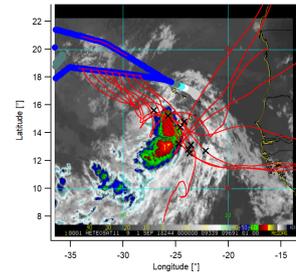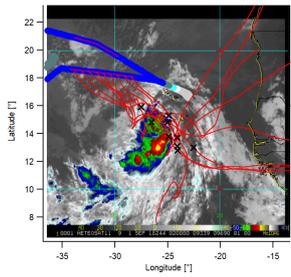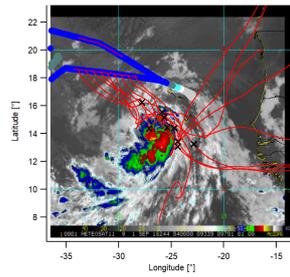
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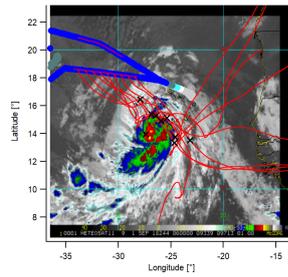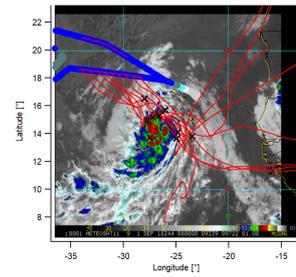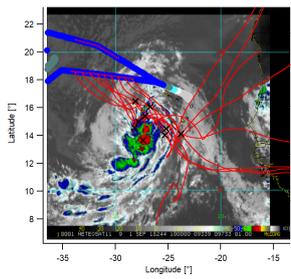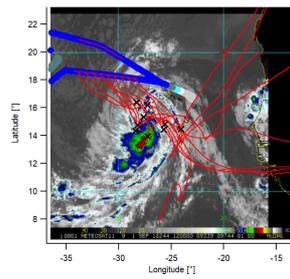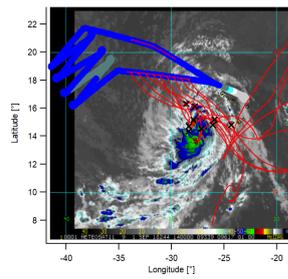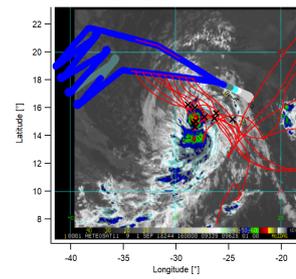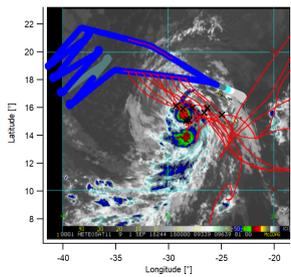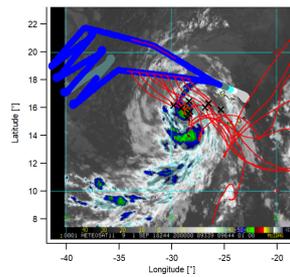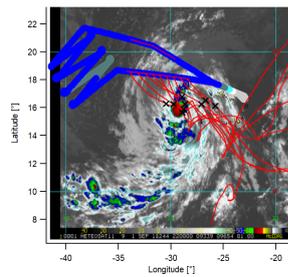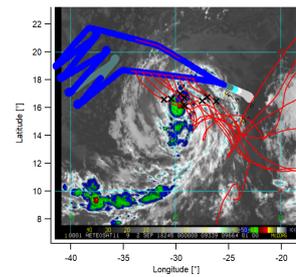
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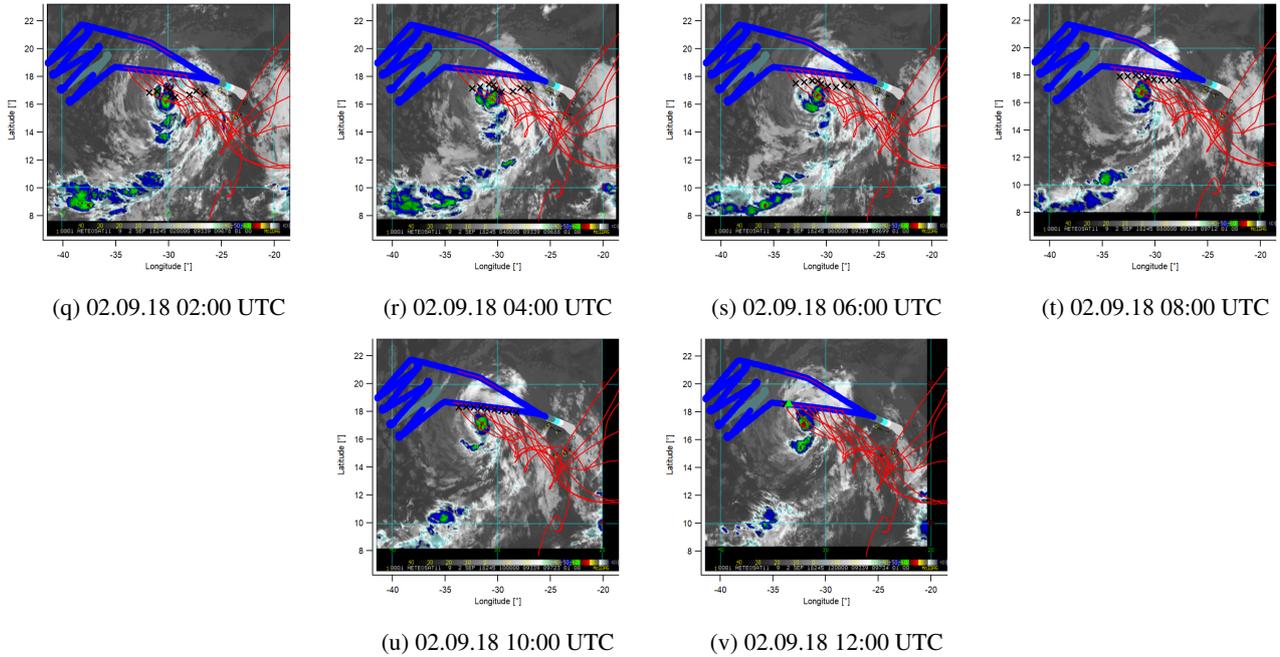
Figure S8. Color enhanced infrared images with flight track and backward trajectories for MF14 from 31.08. 18:00 UTC to 02.09.18 12:00 UTC in 2 h intervals. Black crosses mark the location of each calculated "air parcel" on its backward trajectory at the time of the satellite image. Red lines are the backward trajectories for the air parcels for which we observed convection on the outbound flight. The green triangle marks the current position of the research aircraft. Background satellite IR images were obtained from the TC-Realtime web page maintained by the Cooperative Institute for Research in the Atmosphere, Colorado State University, and NOAA's Center for Satellite Research, Fort Collins Colorado.

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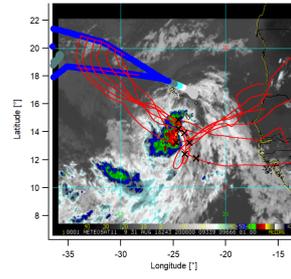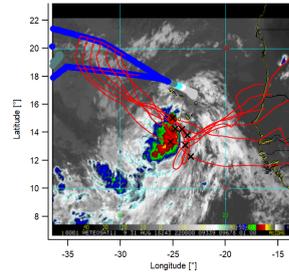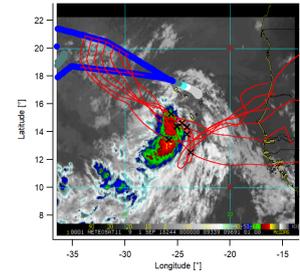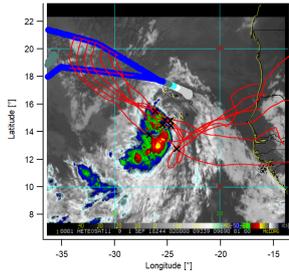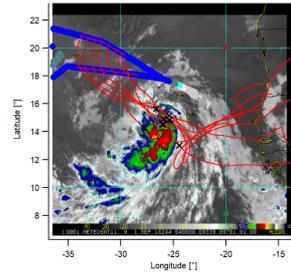
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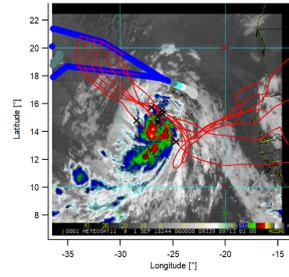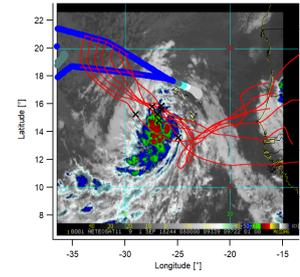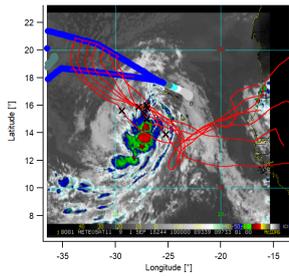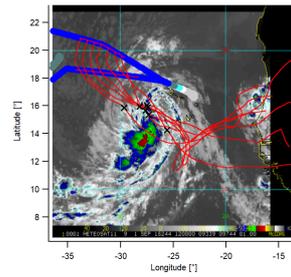
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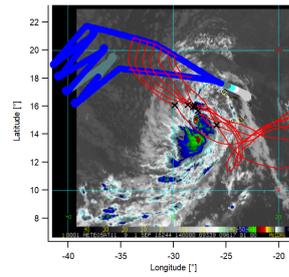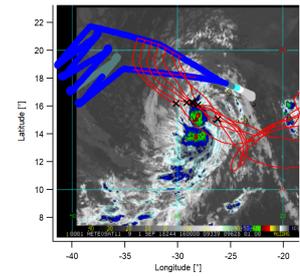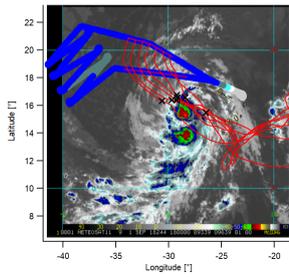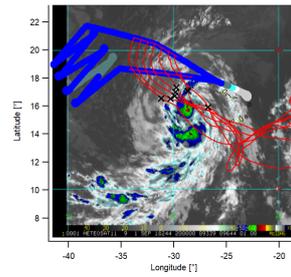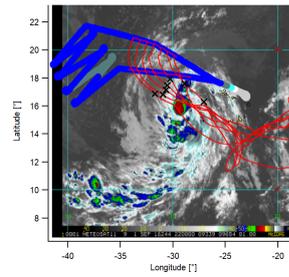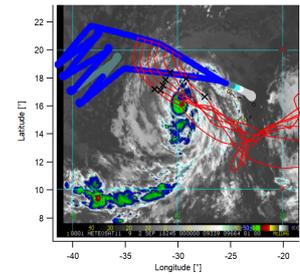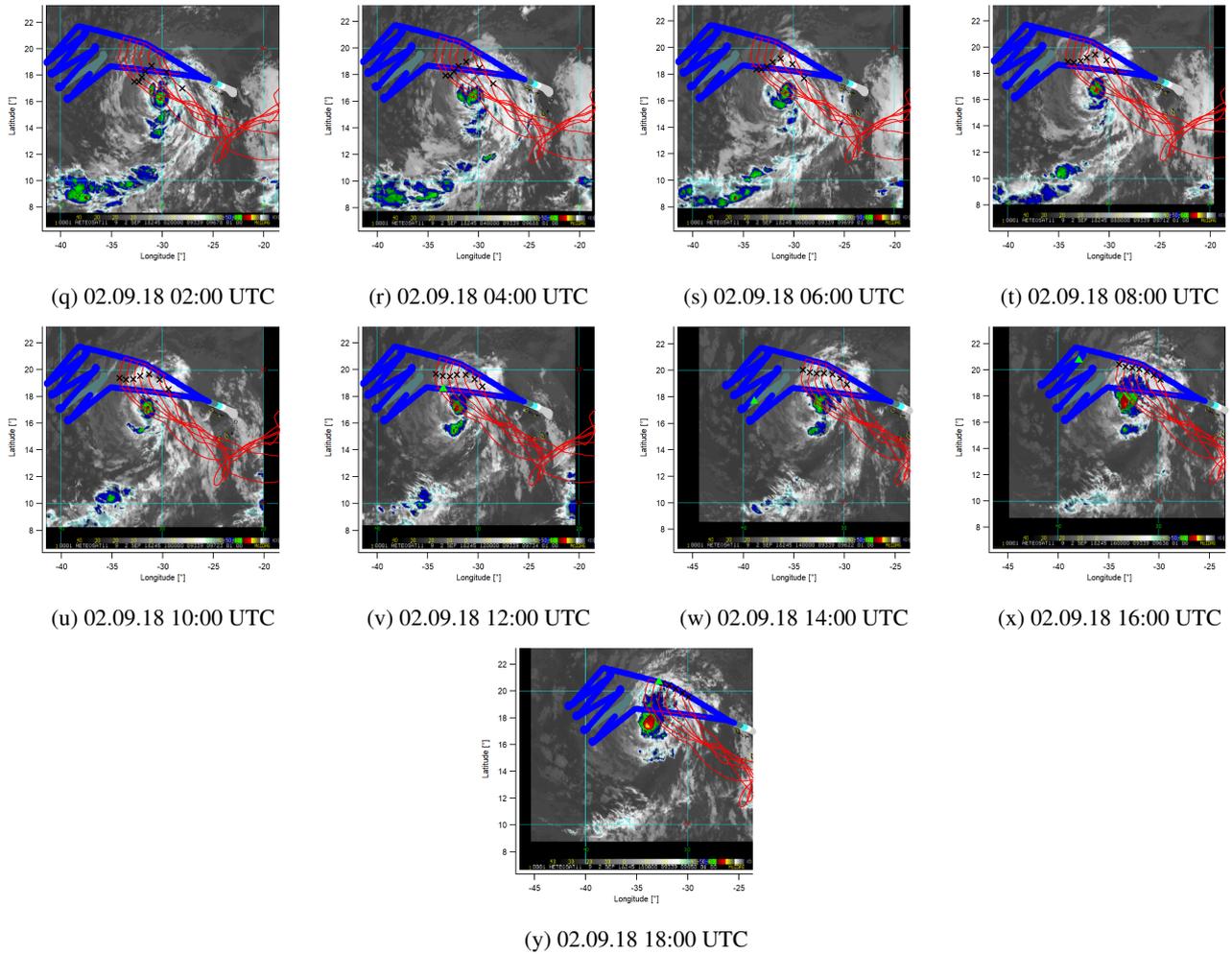
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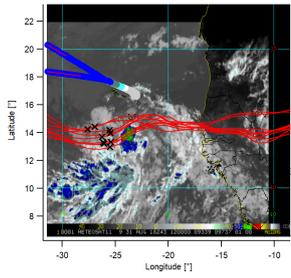
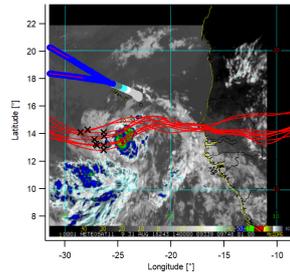
Figure S9. Color enhanced infrared images with flight track and backward trajectories for MF14 from 31.08. 18:00 UTC to 02.09.18 18:00 UTC in 2 h intervals. Black crosses mark the location of each calculated "air parcel" on its backward trajectory at the time of the satellite image. Red lines are the backward trajectories for the air parcels for which we observed convection on the inbound flight. The green triangle marks the current position research aircraft. Background satellite IR images were obtained from the TC-Realtime web page maintained by the Cooperative Institute for Research in the Atmosphere, Colorado State University, and NOAA's Center for Satellite Research, Fort Collins Colorado.

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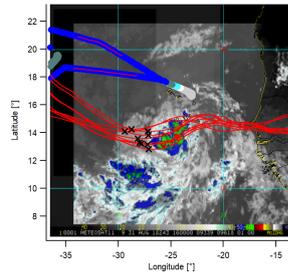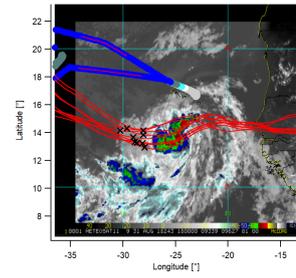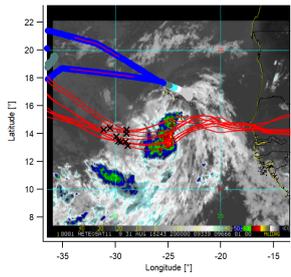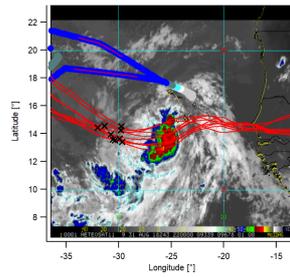
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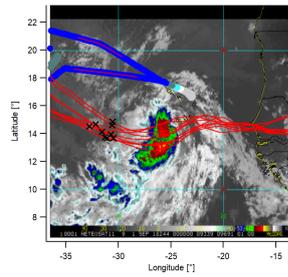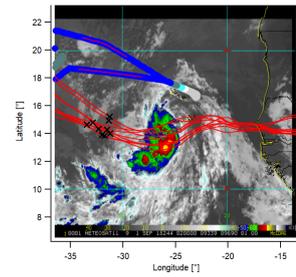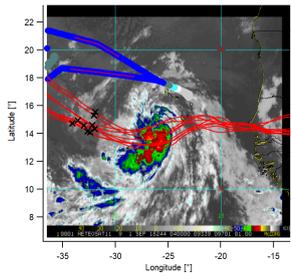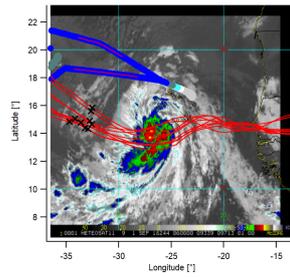
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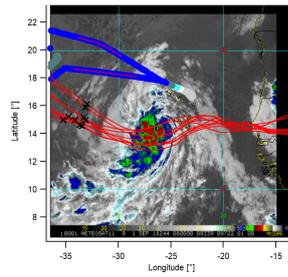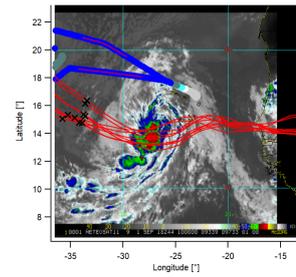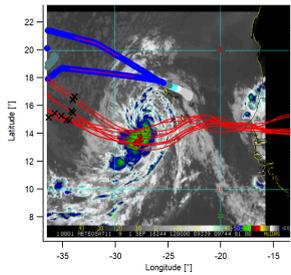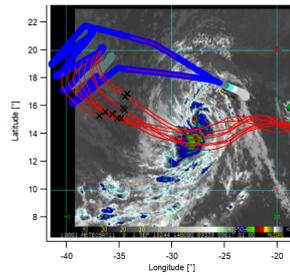
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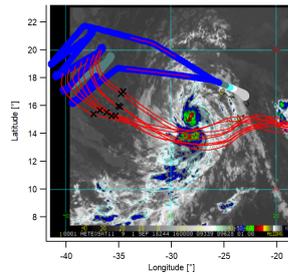
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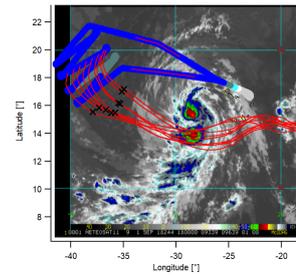
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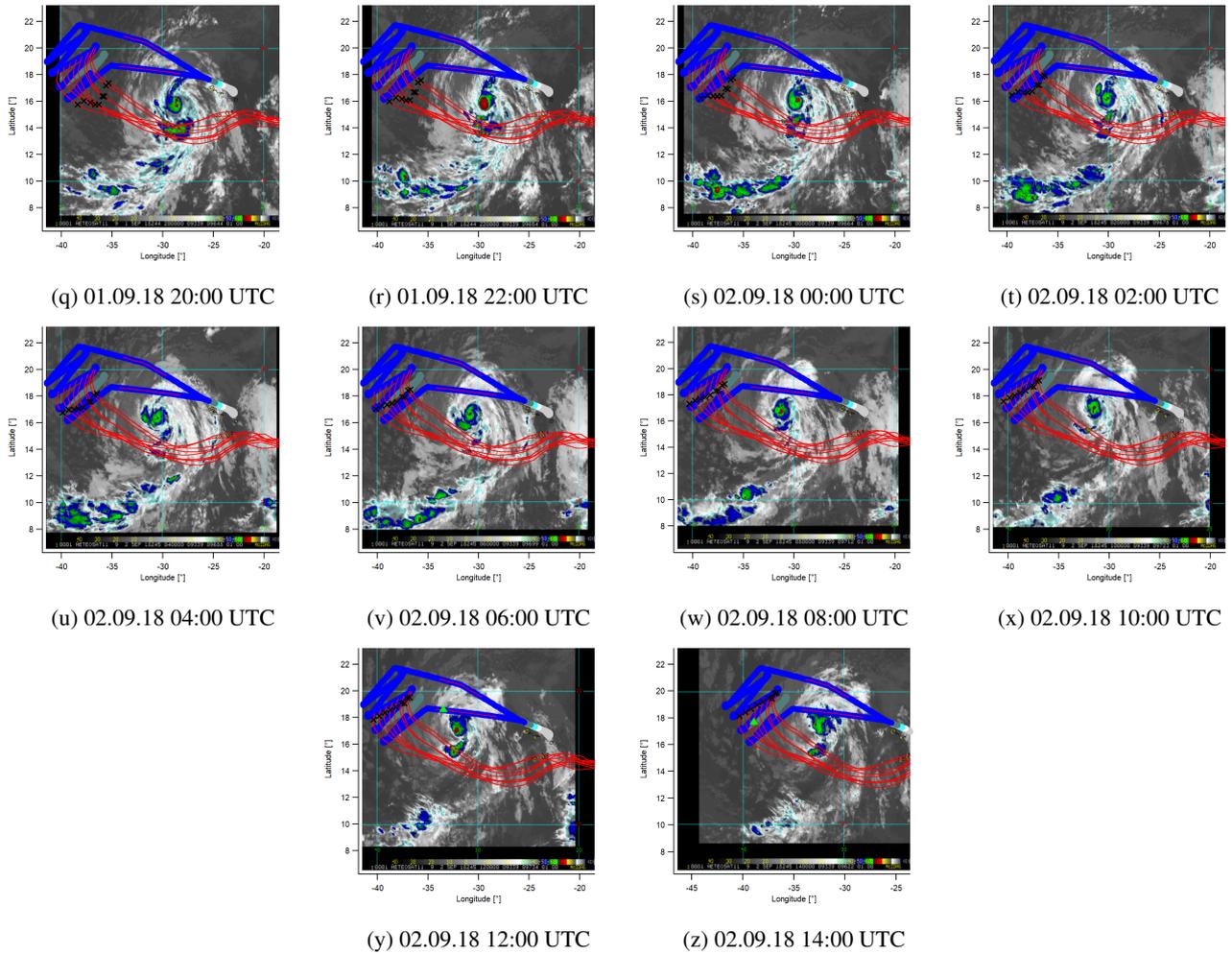
Figure S10. Color enhanced infrared images with flight track and backward trajectories for MF14 from 31.08. 18:00 UTC to 02.09.18 14:00 UTC in 2 h intervals. Black crosses mark the location of each calculated "air parcel" on its backward trajectory at the time of the satellite image. Red lines are the backward trajectories for air parcels for which we did not observe convection. The green triangle marks the current position of the research aircraft. Background satellite IR images were obtained from the TC-Realtime web page maintained by the Cooperative Institute for Research in the Atmosphere, Colorado State University, and NOAA's Center for Satellite Research, Fort Collins Colorado.