

# **Supporting Information for ”Realism of Lagrangian large eddy simulations: Tracking a pocket of open cells under a biomass burning aerosol layer”**

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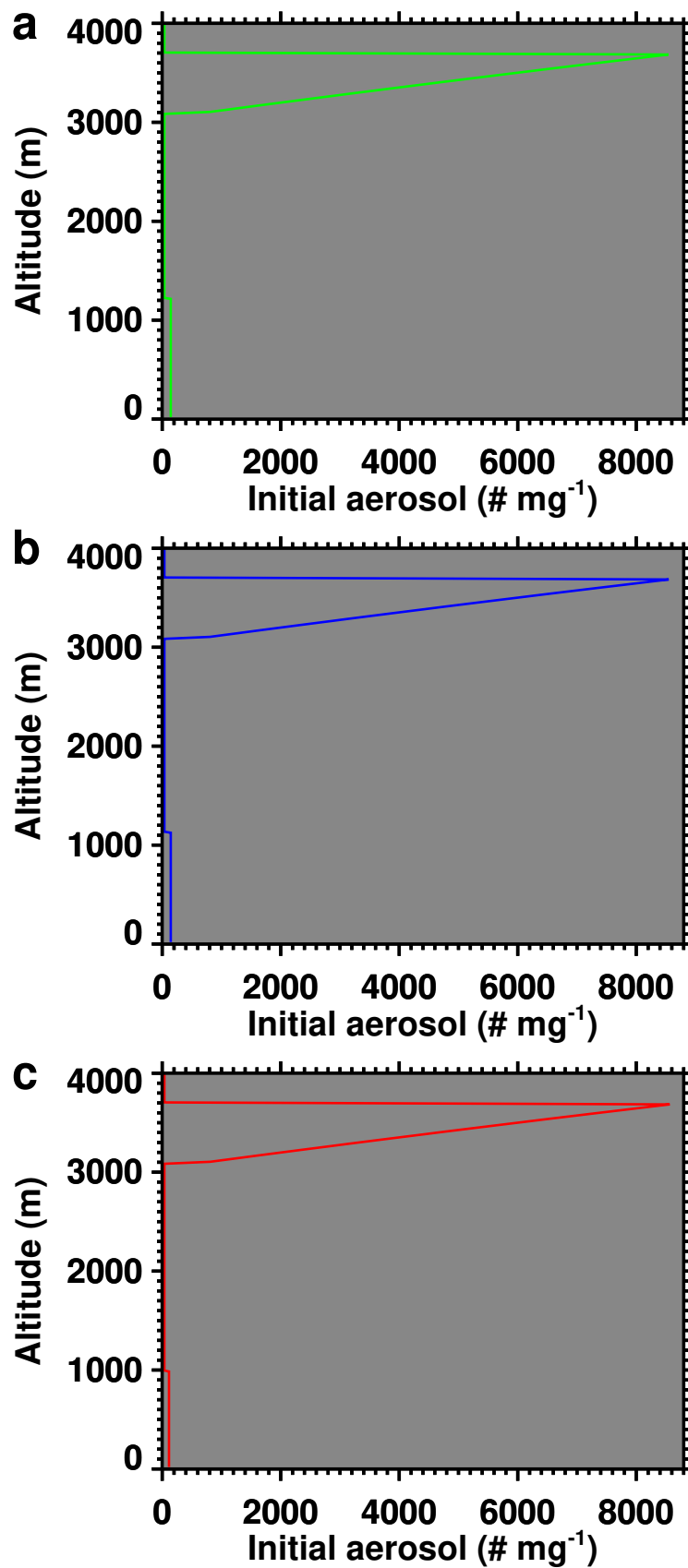
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## **Contents of this file**

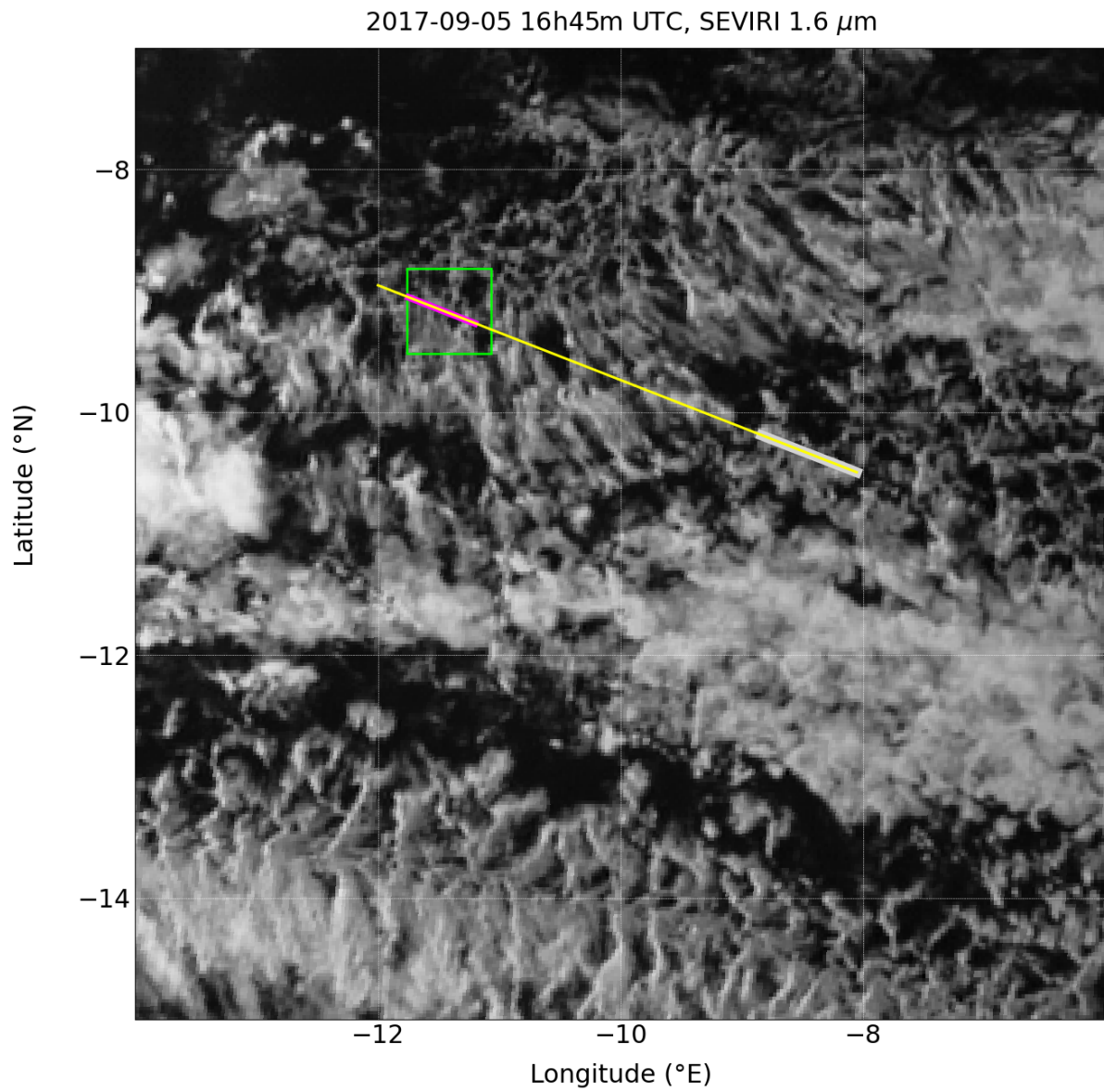
1. Supplemental Figures S1 to S12

## **Additional Supporting Information (Files uploaded separately)**

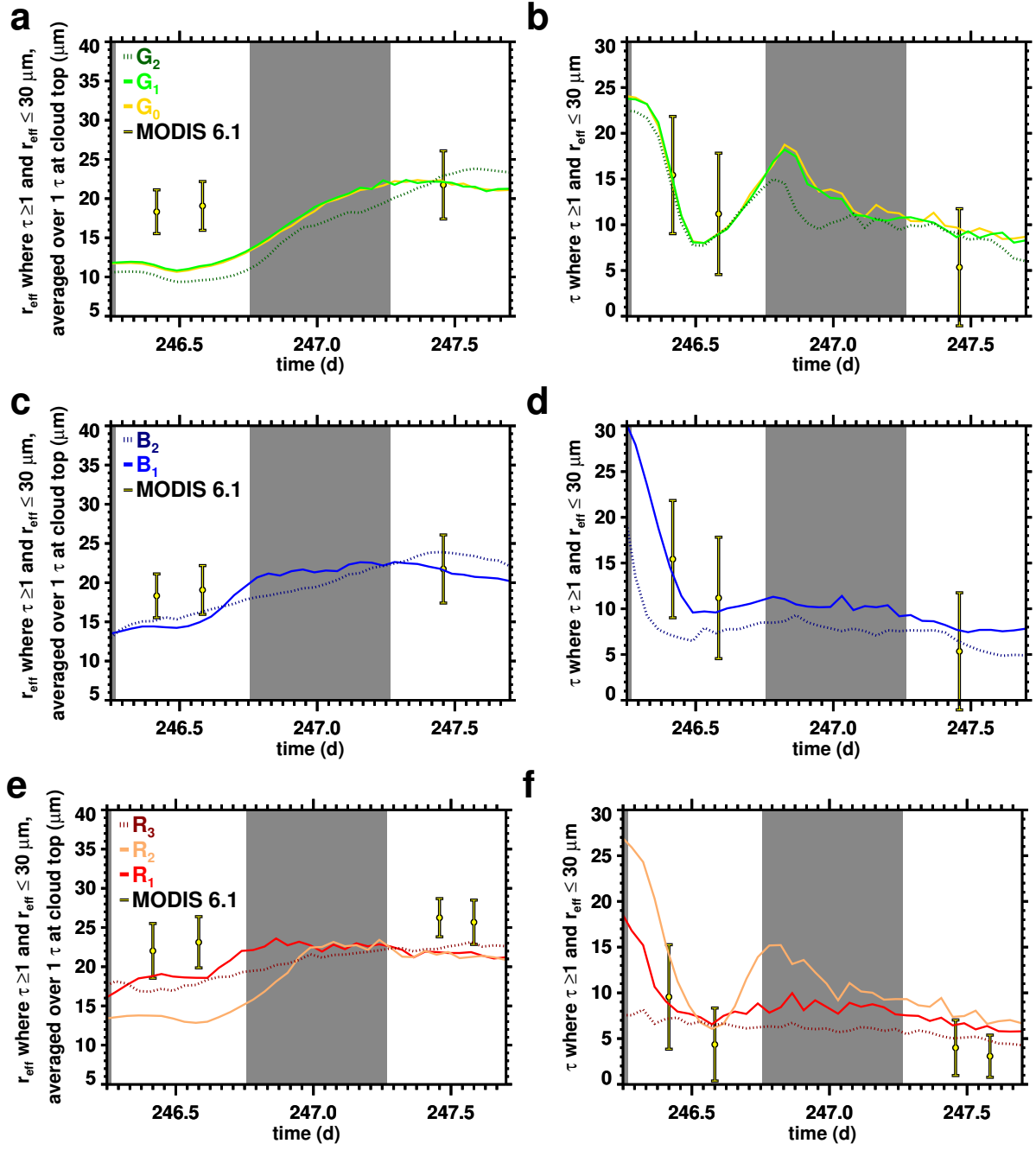
1. Animation A1, showing the cloud evolution seen by satellite and in the simulations



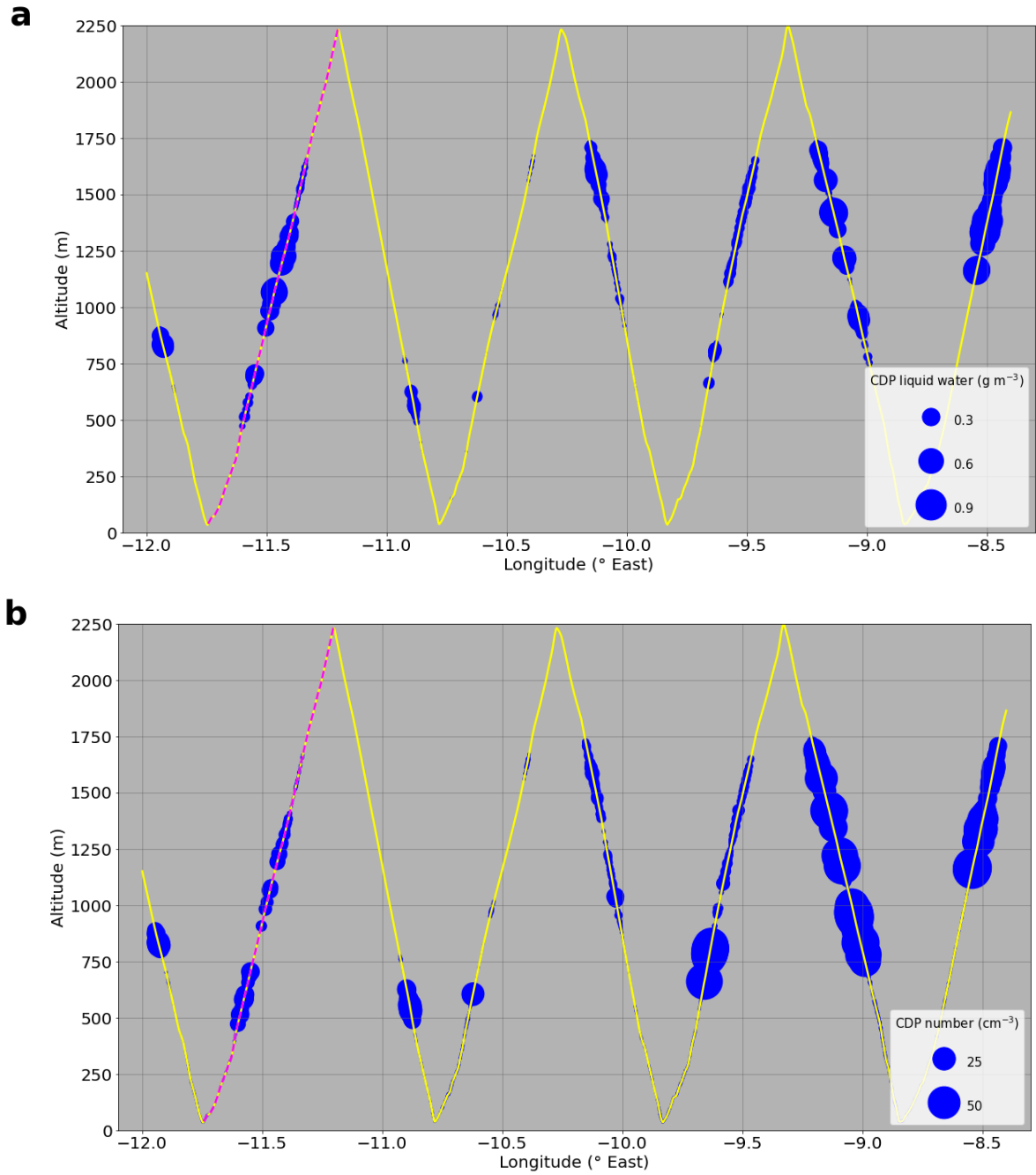
**Figure S1.** Aerosol number at the outset of the simulations on 3 September 2017, 14:45:00 UTC (fractional day of year  $d = 245.61458$ ) on the (a) green, (b) blue, and (c) red trajectories.



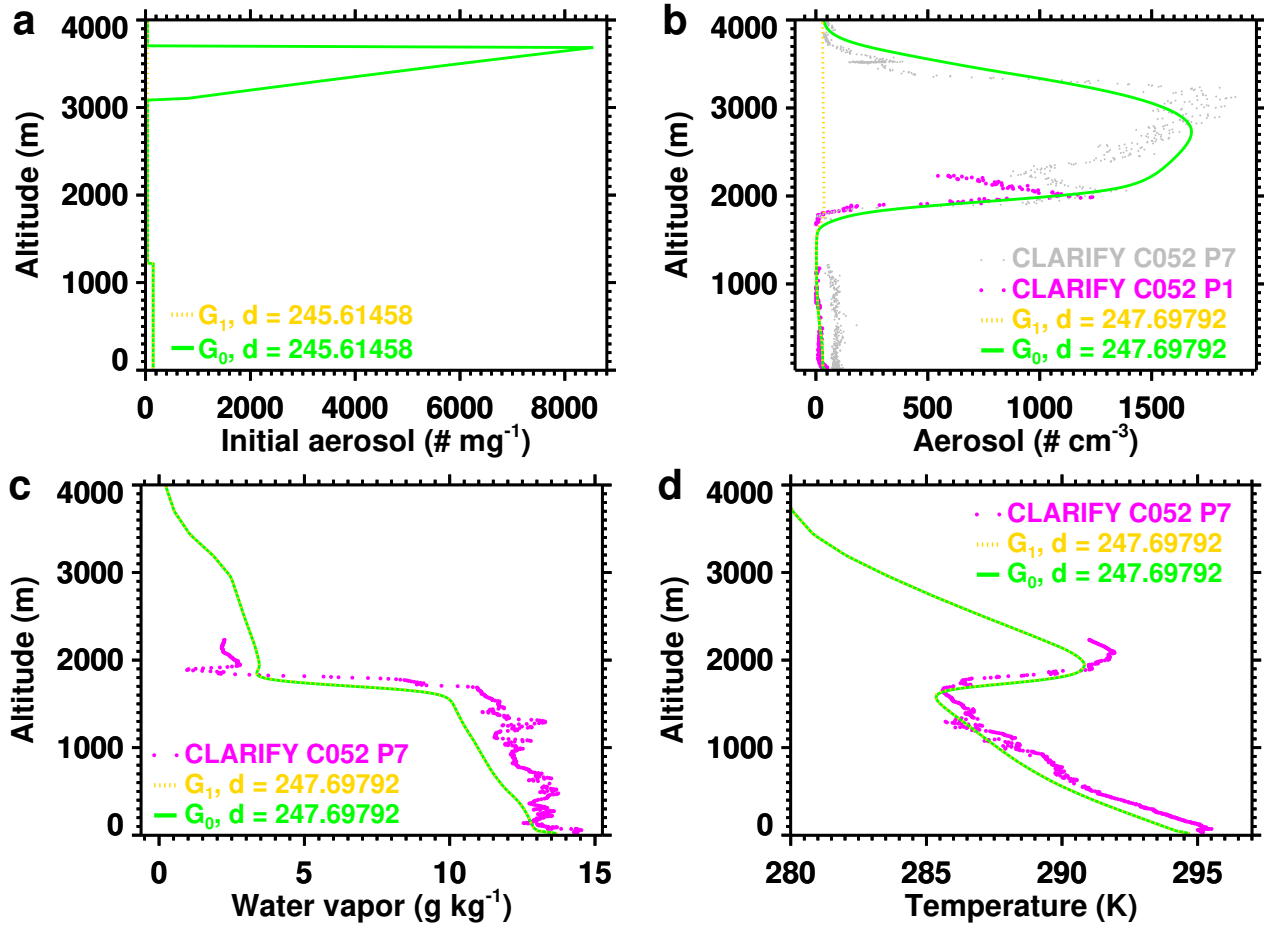
**Figure S2.** Meteosat Second Generation (MSG) Spinning Enhanced Visible and Infrared Imager (SEVIRI) imagery, with domain of simulation  $G_1$ , to scale, at 16:45:00 UTC. The trajectory of the simulation intersects with the path of CLARIFY flight C052 at this time. Magenta indicates flight C052 profile P7 (16:27:49–16:36:33 UTC). Yellow indicates the C052 flight profiles P1–P7 (5 September 2017, 15h44m10s–16h39m41s UTC). Light gray indicates the profile P1, which provided biomass burning aerosol concentrations in the free troposphere. See also Abel et al. (2020).



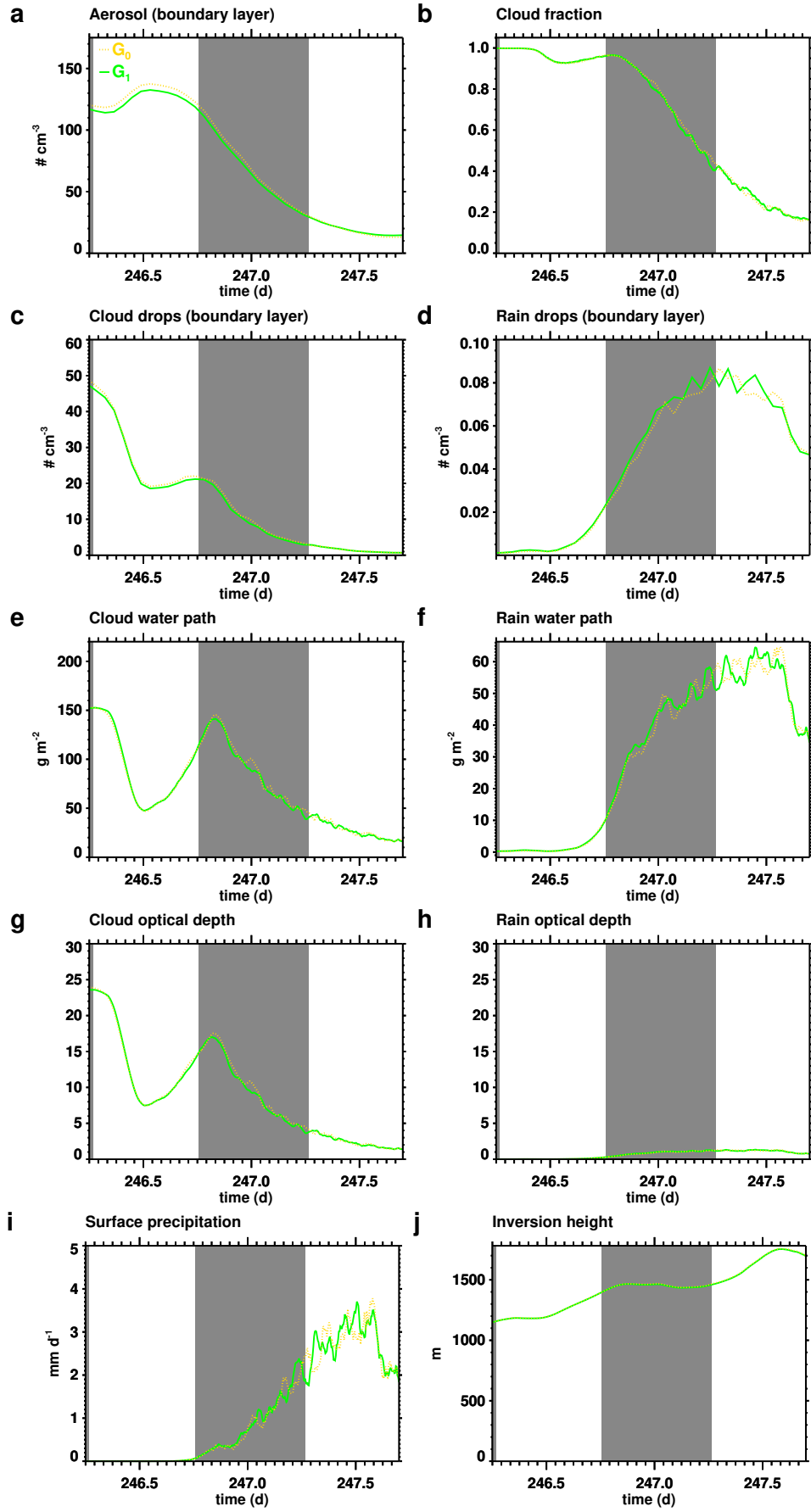
**Figure S3.** Cloud effective radius ( $r_{\text{eff}}$ ) and optical depth ( $\tau$ ) in the simulations along the green (a, b), blue (c, d), and red (e, f) trajectory. MODIS retrievals at the trajectory locations are shown in yellow/black. MODIS samples data from locations with  $r_{\text{eff}} \leq 30 \mu\text{m}$ . The simulated  $r_{\text{eff}}$  and  $\tau$  were sampled over locations where  $\tau \geq 1$  and where  $r_{\text{eff}} \leq 30 \mu\text{m}$ . Gray shading indicates nighttime. The simulations are listed in Table 1 of the main text.



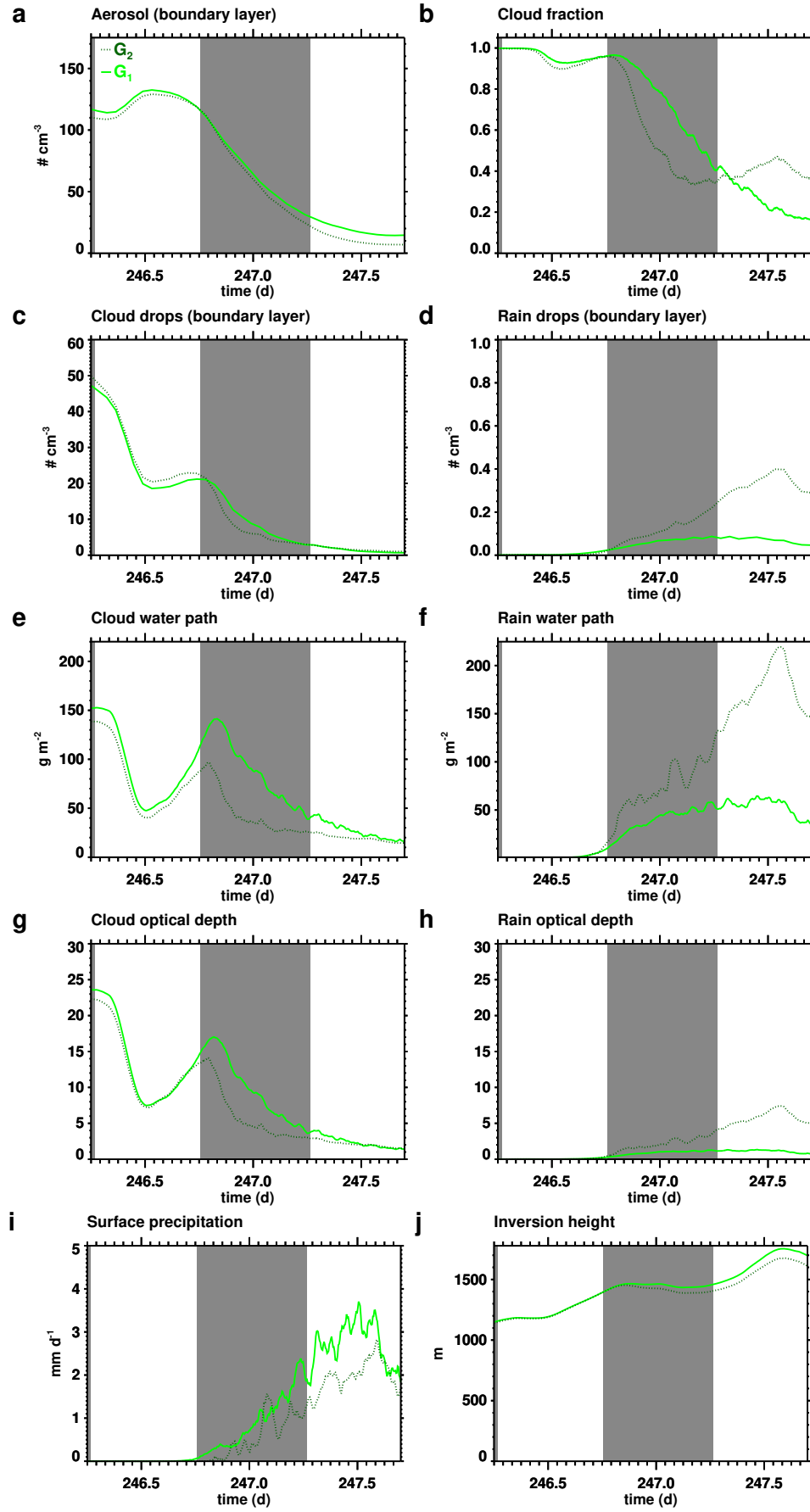
**Figure S4.** Cloud liquid water (a) and cloud drop number (b) collected by the CDP instrument along the segment of the CLARIFY flight C052 shown in Fig. S3. Magenta indicates the C052 profile P7 (16:27:49–16:36:33 UTC). Yellow indicates the C052 flight profiles P1–P7 (5 September 2017, 15h44m10s–16h39m41s UTC). See Abel et al. (2020) for details.



**Figure S5.** Vertical profiles in simulation  $G_0$  (green), with a biomass burning layer in the free troposphere, and simulation  $G_1$  (yellow), without a biomass burning layer. (a) Aerosol number mixing ratio at the outset of the simulations on 3 September 2017, 14:45:00 UTC (fractional day of year  $d = 245.61458$ ). (b) aerosol number concentration, (c) water vapor mixing ratio, and (d) temperature on 5 September 2017, 16h45m00s UTC (fractional day of year  $d = 247.69792$ ), and in-situ measurements from CLARIFY flight C052. CLARIFY C052 profile P7 (5 September 2017, 16:27:49–16:36:33 UTC, magenta) is located at the intercept of the simulation trajectory and the CLARIFY C052 flight path. CLARIFY flight C052 profile P1 (5 September 2017, 15h25m18s–15h50m53s, gray) is located upstream along the flight path. The location of the simulation domain, the CLARIFY flight C052 path and its profile P1 and P7 are shown in Fig. S2.

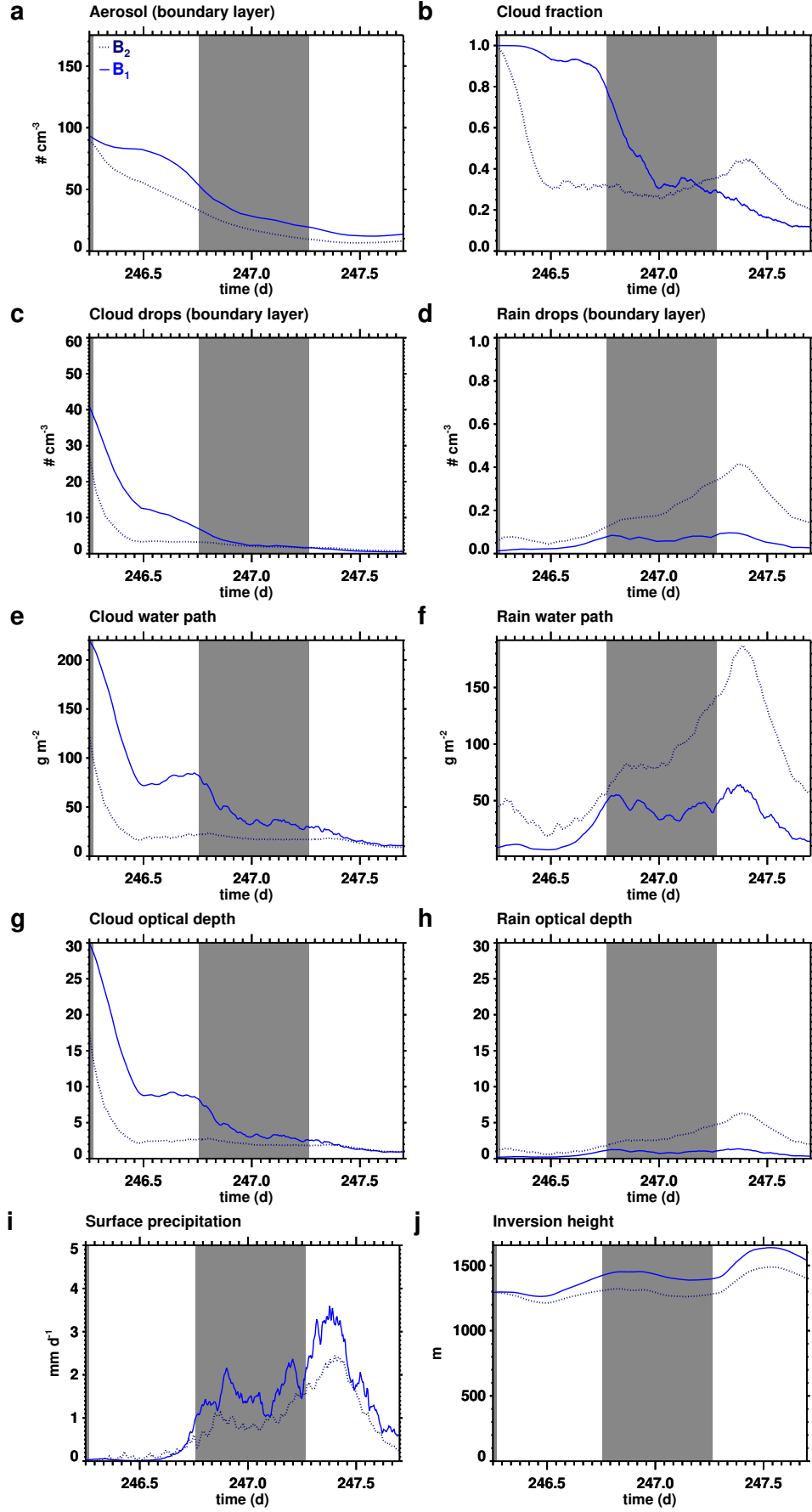


**Figure S6.** Time series in simulation  $G_0$  (yellow, without a biomass burning layer above the inversion) and simulation  $G_1$  (green, with a biomass burning layer above the inversion). Gray shading indicates nighttime.

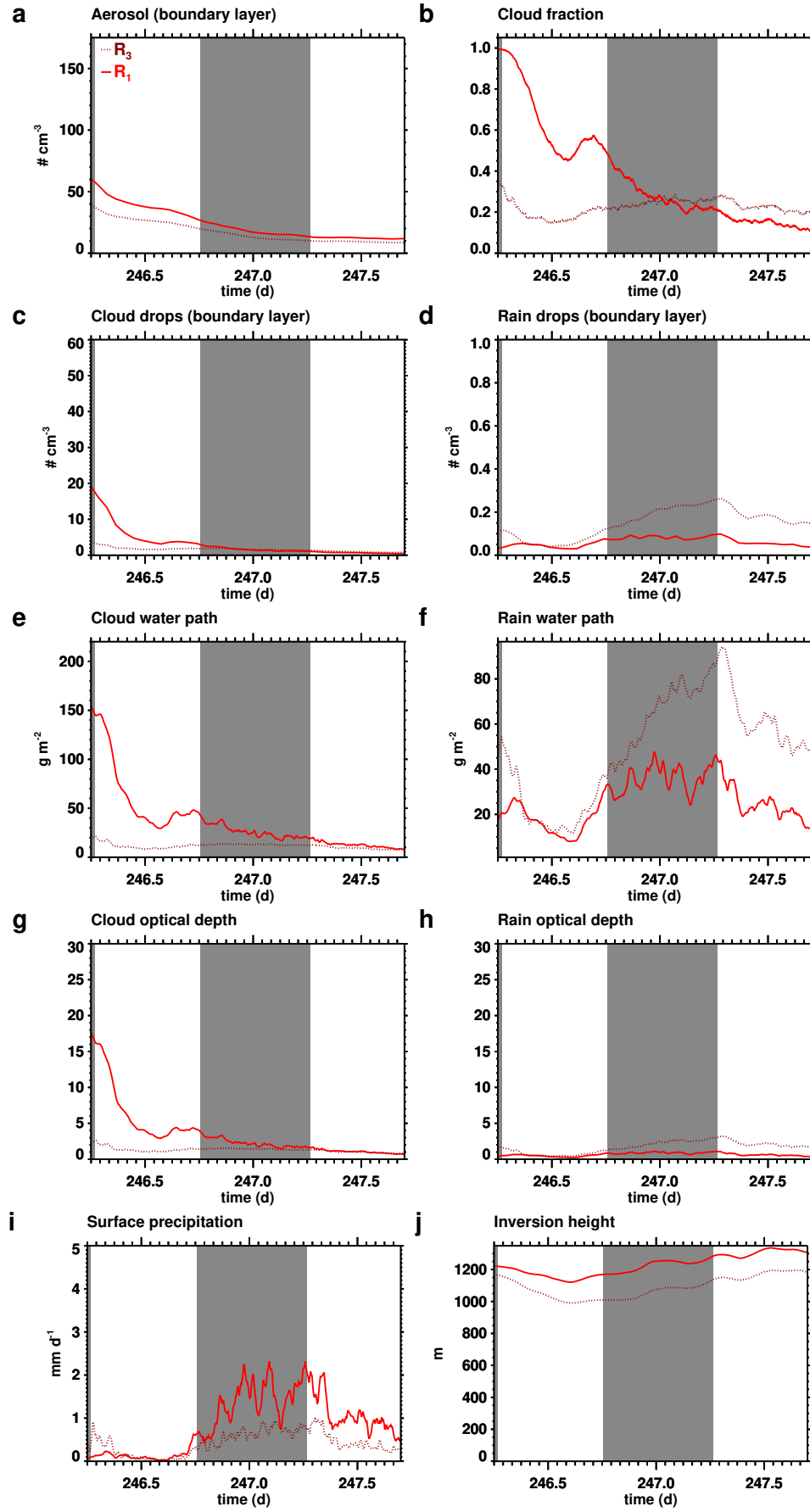


**Figure S7.** Time series in simulation G<sub>1</sub> using bin cloud microphysics (green) and simulation G<sub>2</sub> using bulk cloud microphysics (dark green). Gray shading indicates nighttime.

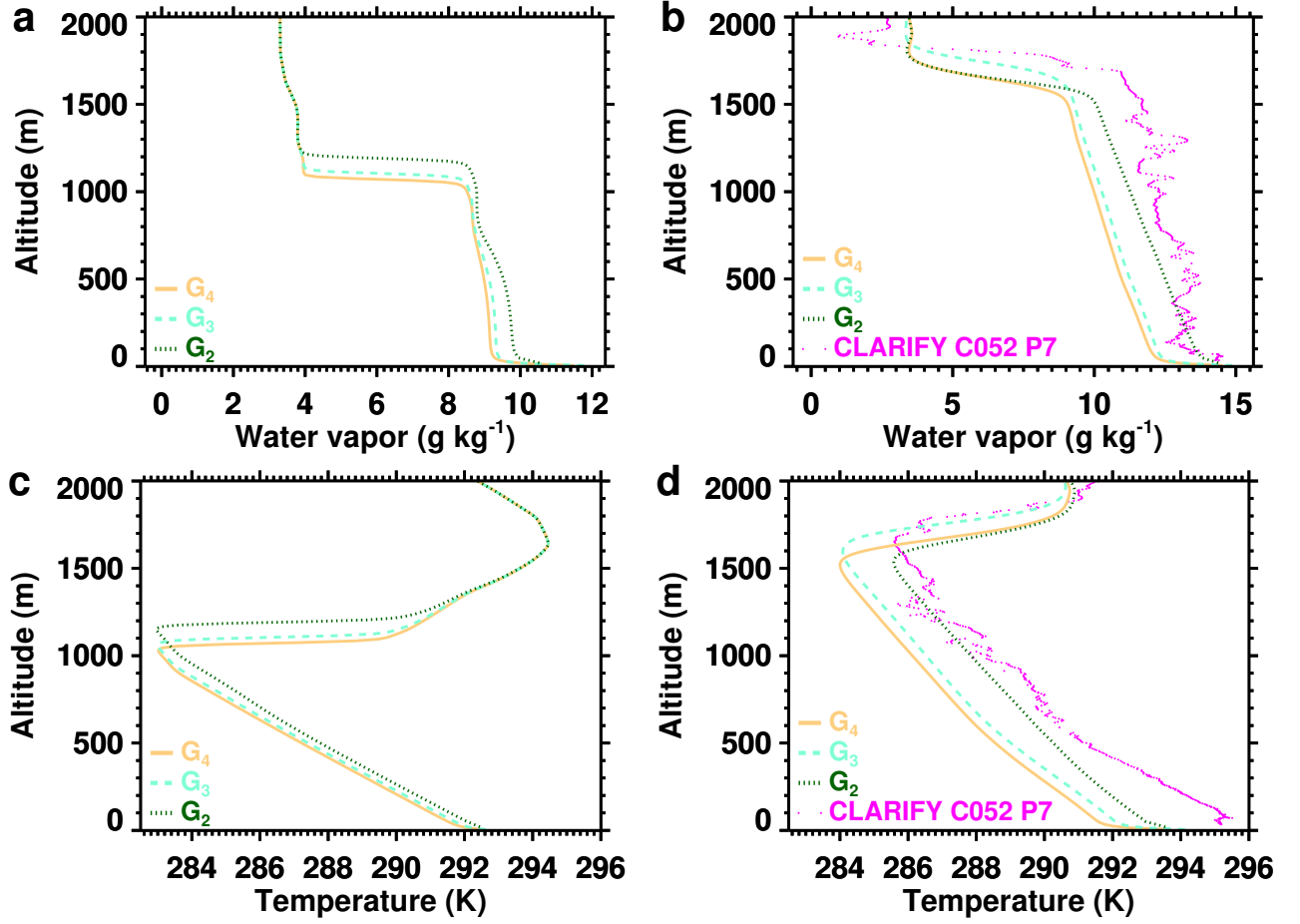




**Figure S8.** Time series in simulation B<sub>1</sub> using bin cloud microphysics (blue) and simulation B<sub>3</sub> using bulk cloud microphysics (dark blue). Gray shading indicates nighttime.



**Figure S9.** Time series in simulation R<sub>1</sub> using bin cloud microphysics (red) and simulation R<sub>2</sub> using bulk cloud microphysics (dark red). Gray shading indicates nighttime.



**Figure S10.** Domain mean profiles of water vapor (a, b) and temperature (c, d) in simulation  $G_2$  (dark green, dotted),  $G_3$  (aquamarine, dashed), and  $G_4$  (beige, solid), on (a, c) 4 September 2017, 12h00m00s UTC ( $d = 246.50000$ ) and (b, d) 5 September 2017, 16h45m00s UTC ( $d = 247.69800$ ), at the intercept of the simulation trajectory with the path of CLARIFY flight C052, with observations from the location of the intercept (CLARIFY flight C052 profile P7, 5 September 2017, 16:27:49–16:36:33 UTC, magenta).

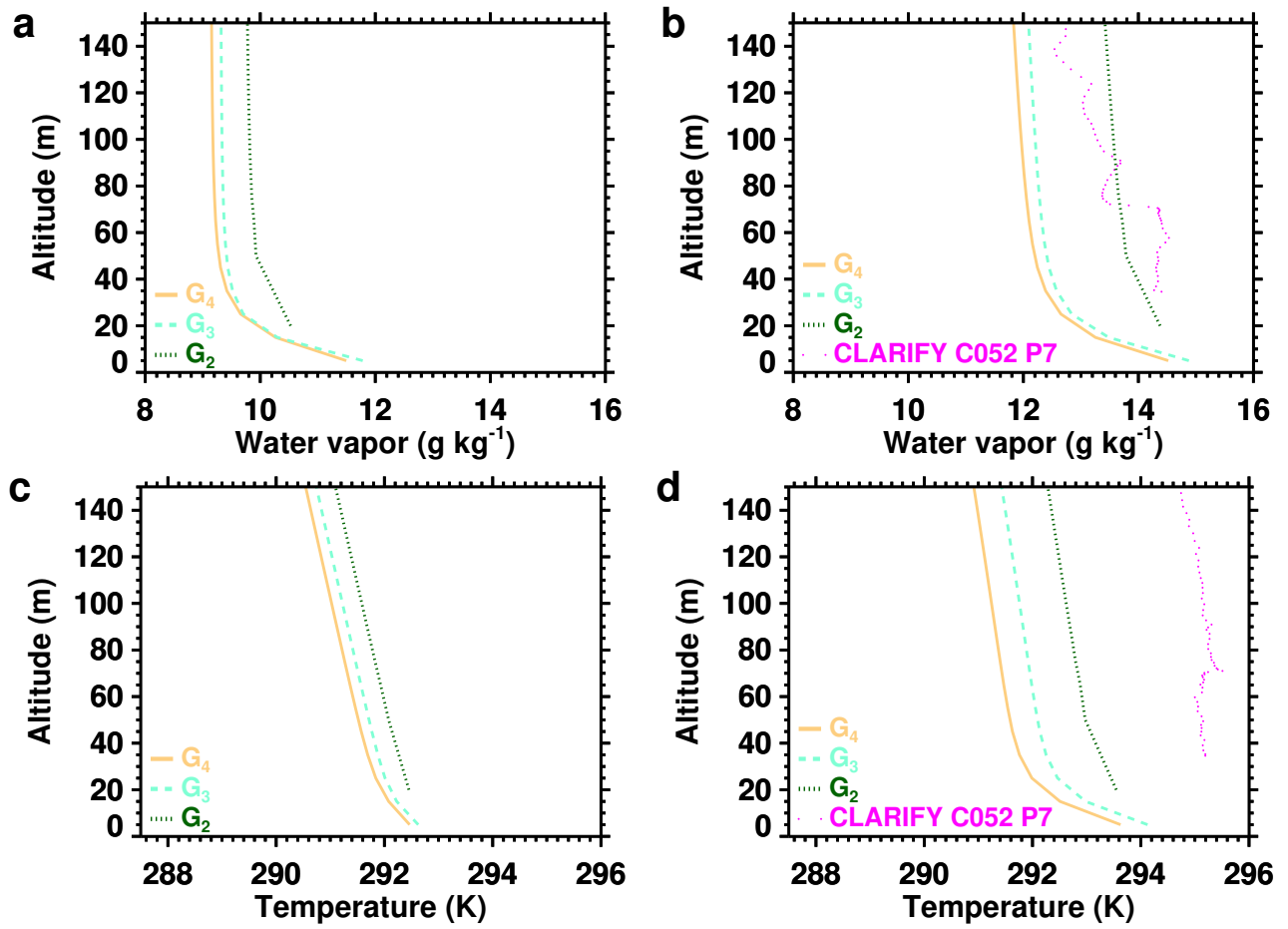
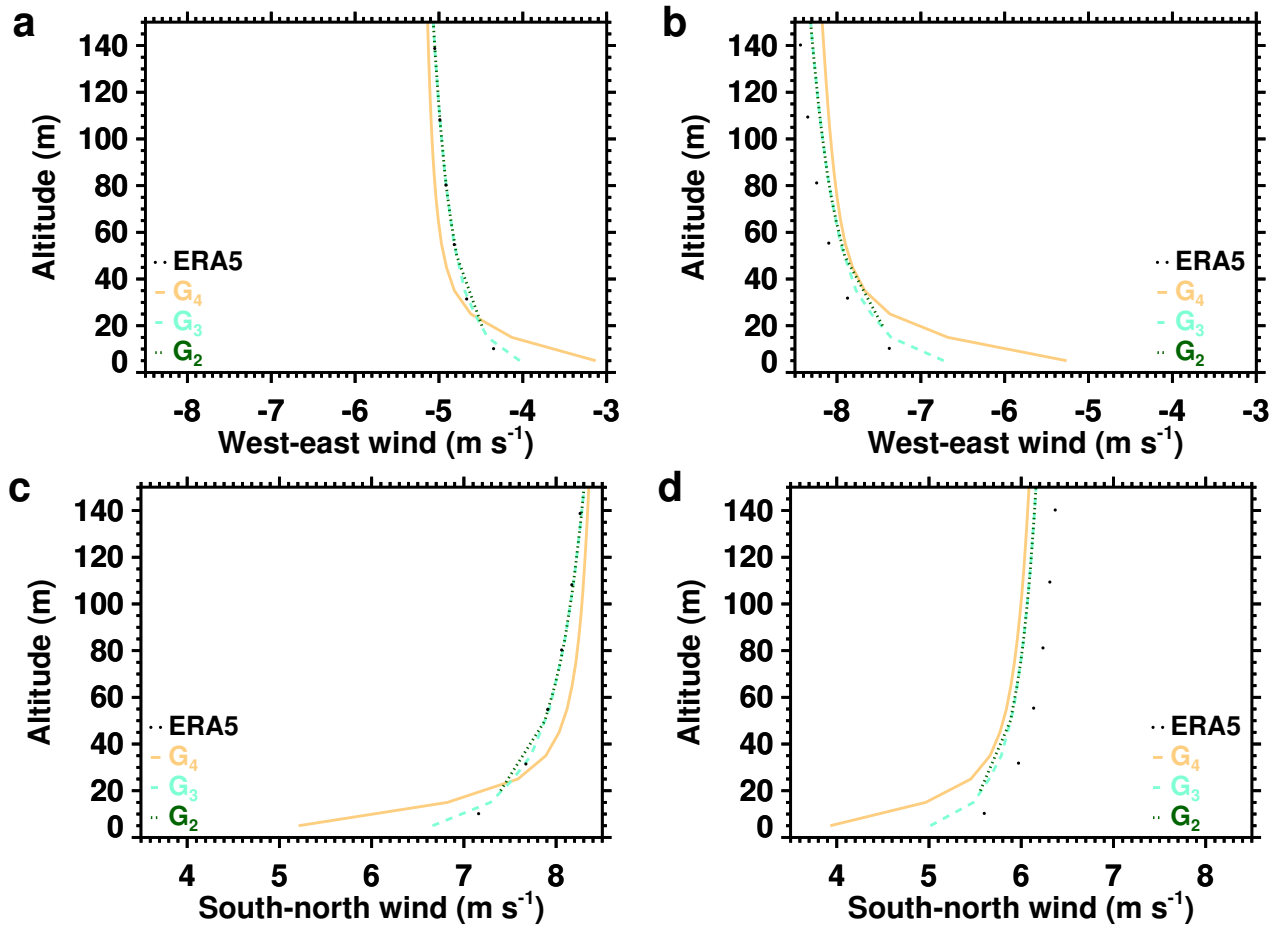


Figure S11. Same as Fig. S10, focusing on the altitude range 0–150 m.



**Figure S12.** Domain mean profiles of west-east (a, b) and south-north (c, d) wind speed in simulation  $G_2$  (dark green, dotted),  $G_3$  (aquamarine, dashed), and  $G_4$  (beige, solid), on (a, c) 4 September 2017, 12h00m00s UTC ( $d = 246.50000$ ) and (b, d) 5 September 2017, 16h45m00s UTC ( $d = 247.69800$ ) with ERA5 values at the ERA5 model levels (black dots).