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Supplement of

**Brief Communication: An electrifying atmospheric river –
understanding the thunderstorm event in Santa Barbara
County during March 2019**

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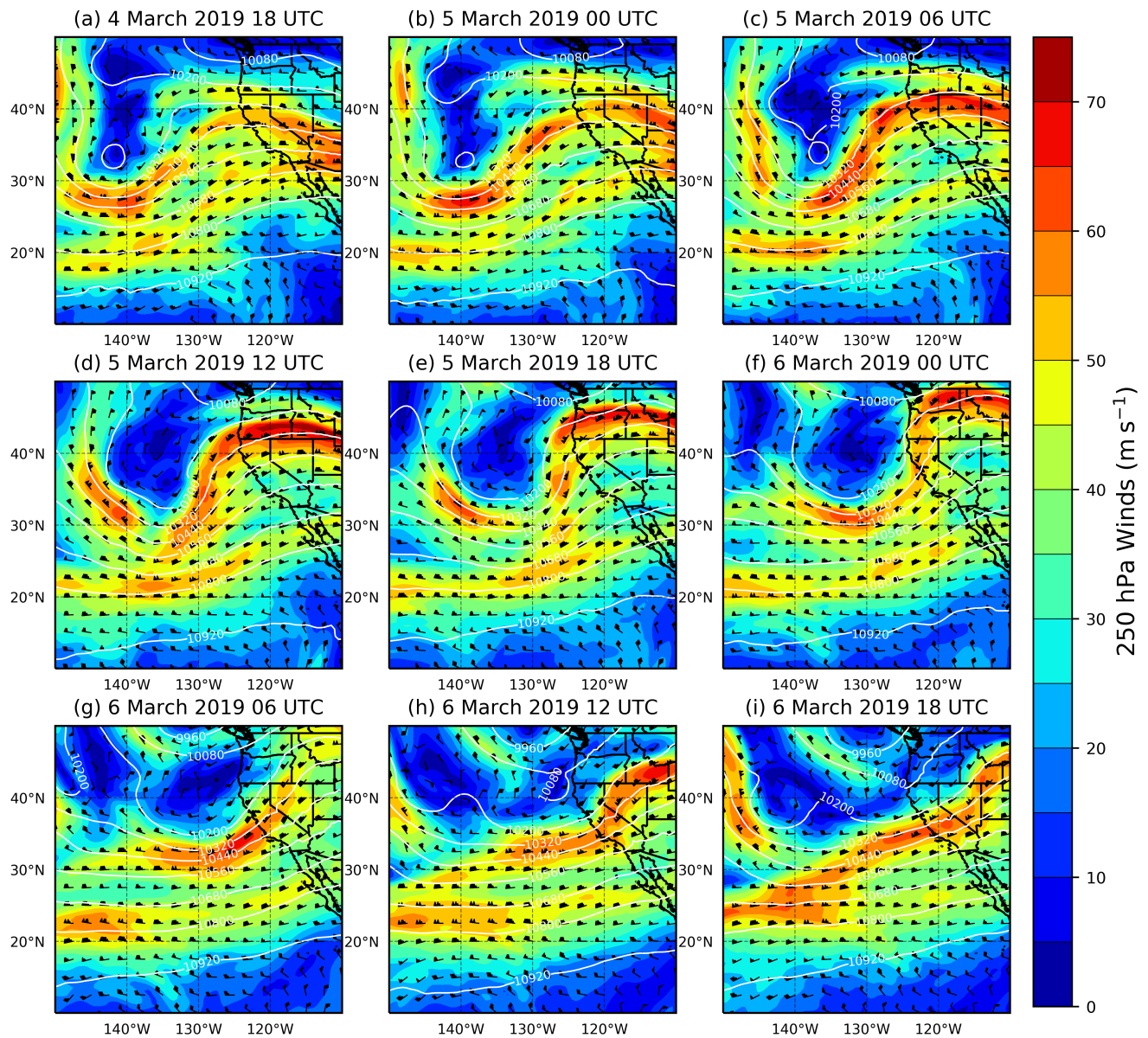


Figure S1. CFSv2 250 hPa winds (barbs, knots), 250 hPa wind magnitude (shaded; m s⁻¹) and 250 hPa geopotential height (white contours; m) at 6-hourly timesteps between 4 March 2019 18 UTC and 6 March 2019 18 UTC.

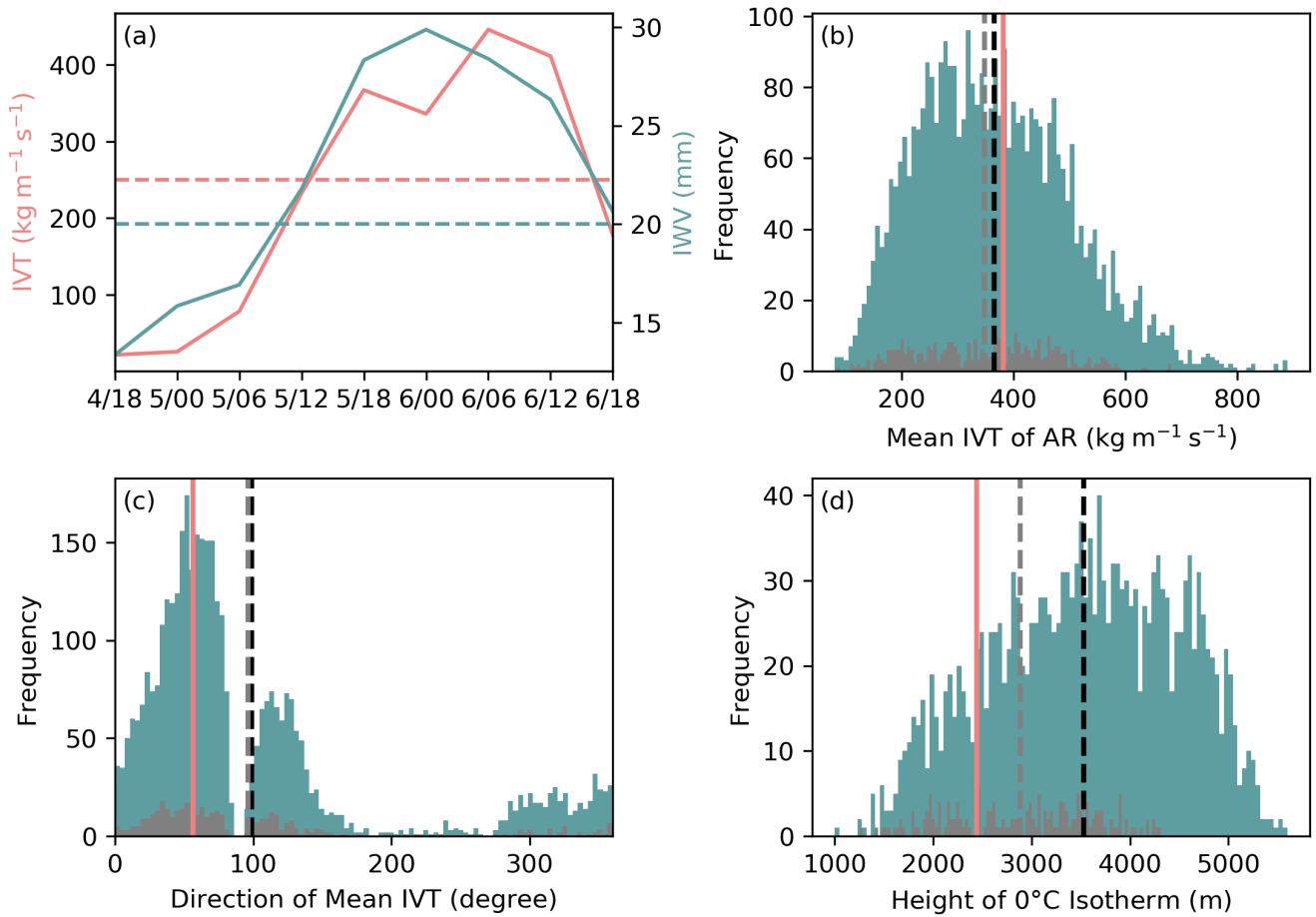


Figure S2. (a) CFSv2 IVT (red line; $\text{kg m}^{-1} \text{s}^{-1}$) and IWV (blue line; mm) at the grid cell closest to Santa Barbara (34.5°N, 119.5°W) at each 6-hour time step between 4 March 2019 18 UTC and 6 March 2019 18 UTC. The minimum thresholds for the location to be considered part of an AR event are indicated by the dotted lines. (b) Mean IVT of the AR objects that made landfall in Santa Barbara in all the months (blue lines) and only March (grey lines) between January 1980 and May 2019 based on the AR Catalog from Guan and Waliser (2015). The mean IVT for the AR Event on March 5 is shown by the red solid line. The means of the distributions are shown in the dotted line. (c) Same as (b) but for direction of mean IVT propagation (azimuth is 0° if IVT is directed to the north). (d) Same as (b) but for the height of the 0°C Isotherm (m) interpolated from MERRA2 temperature and geopotential height.

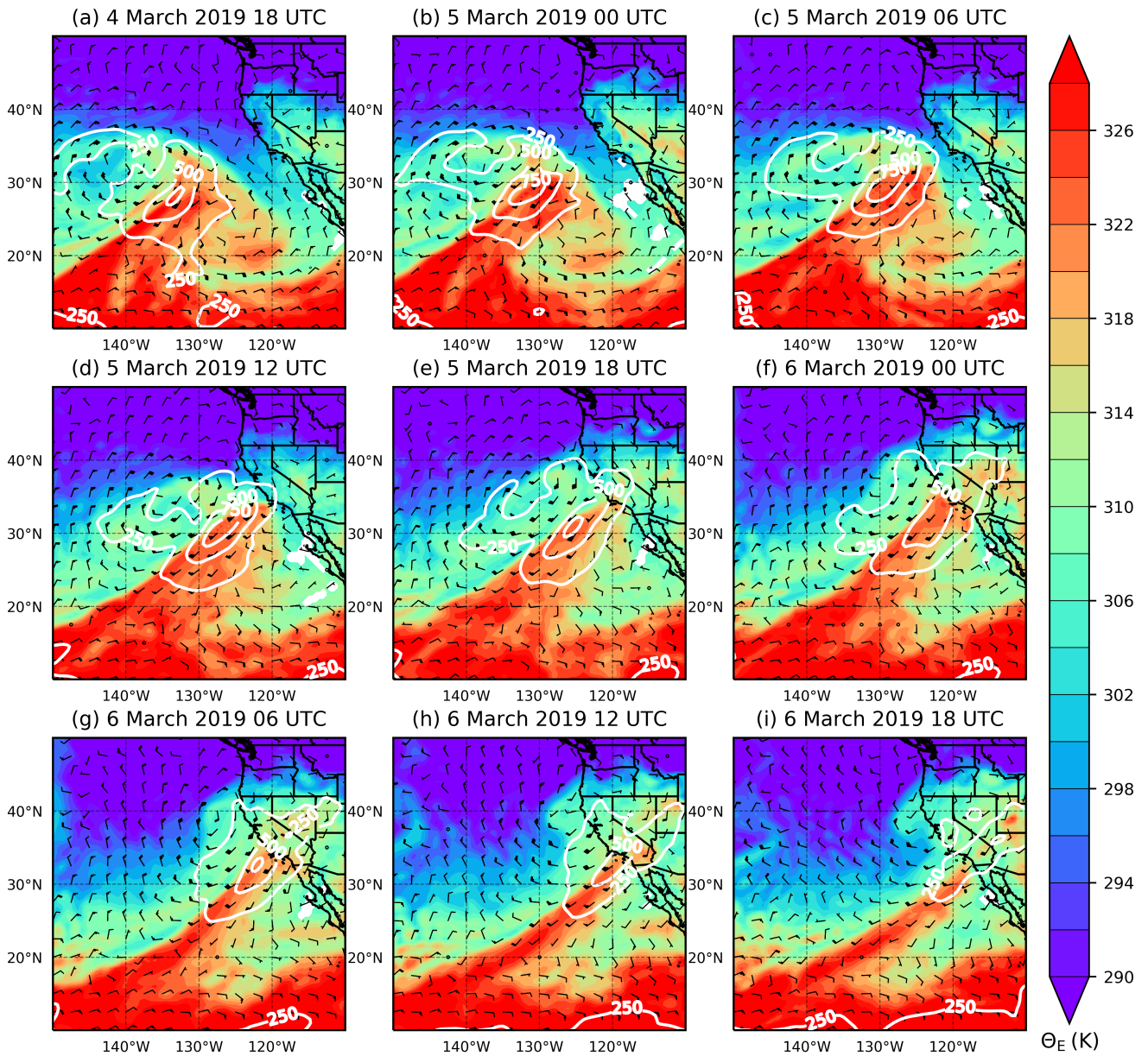


Figure S3. Figure S3. CFSv2 850 hPa Equivalent Potential Temperature (shaded; K), 850 hPa winds (barbs; knots), and IVT greater than $250 \text{ kg m}^{-1} \text{ s}^{-1}$ (white contours; every $250 \text{ kg m}^{-1} \text{ s}^{-1}$) for each 6-hour time step between 4 March 2019 18 UTC and 6 March 2019 18 UTC.

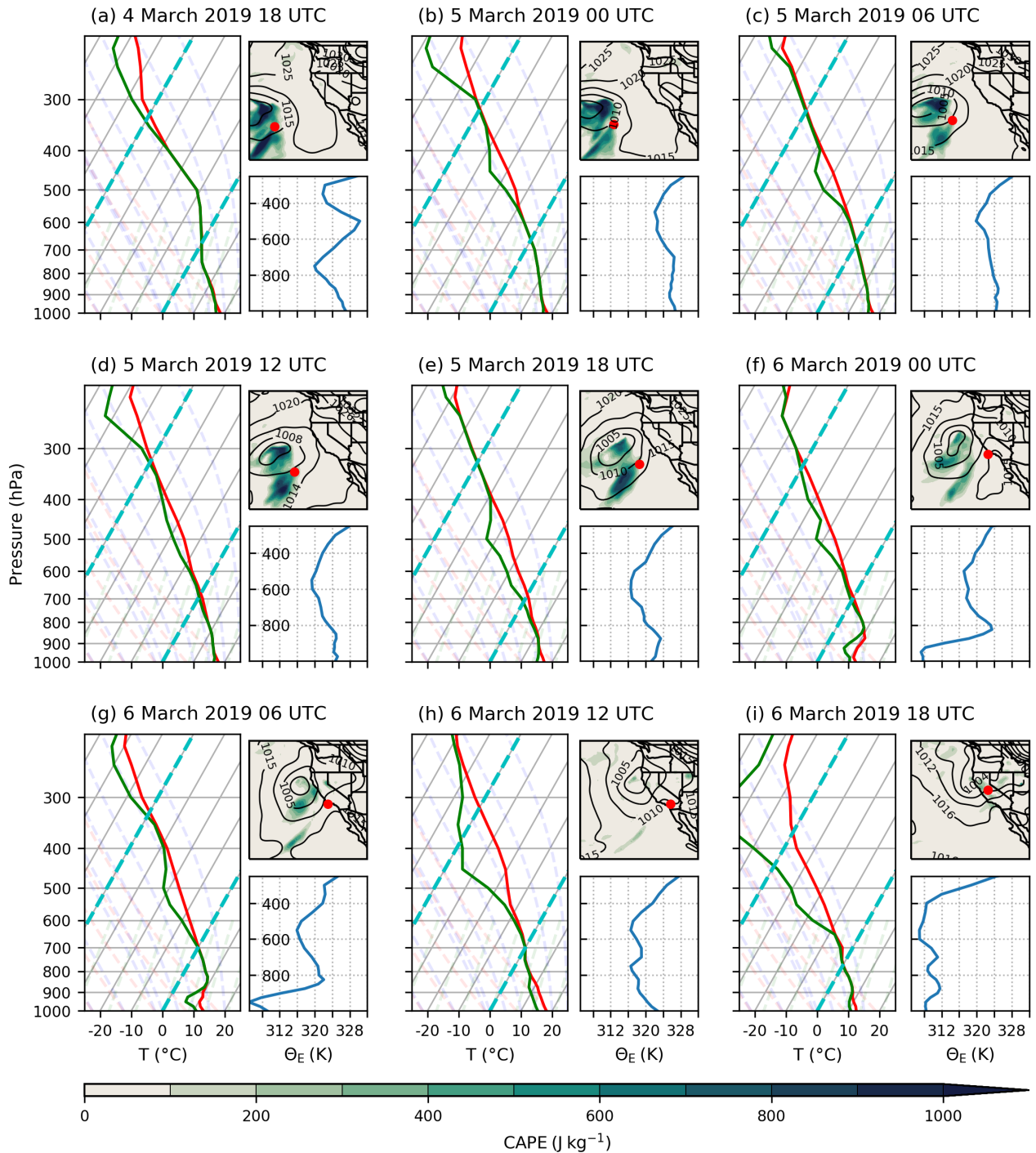


Figure S4. (left panel) Skew(t) - log(p) vertical profile of CFSv2 temperature (red line) and dew point (green line) at the grid cell with the highest flash density (per 6 hours); (right top panel) CFSv2 CAPE (shaded, J kg^{-1}) and MSLP (black dashed contours; hPa) with the location of the highest flash density indicated by the red dot; (right bottom panel) CFSv2 Equivalent Potential Temperature (blue line; K) at the grid cell with the highest flash density for each 6-hour time step between (a) 4 March 2019 18 UTC and (i) 6 March 2019 18 UTC.

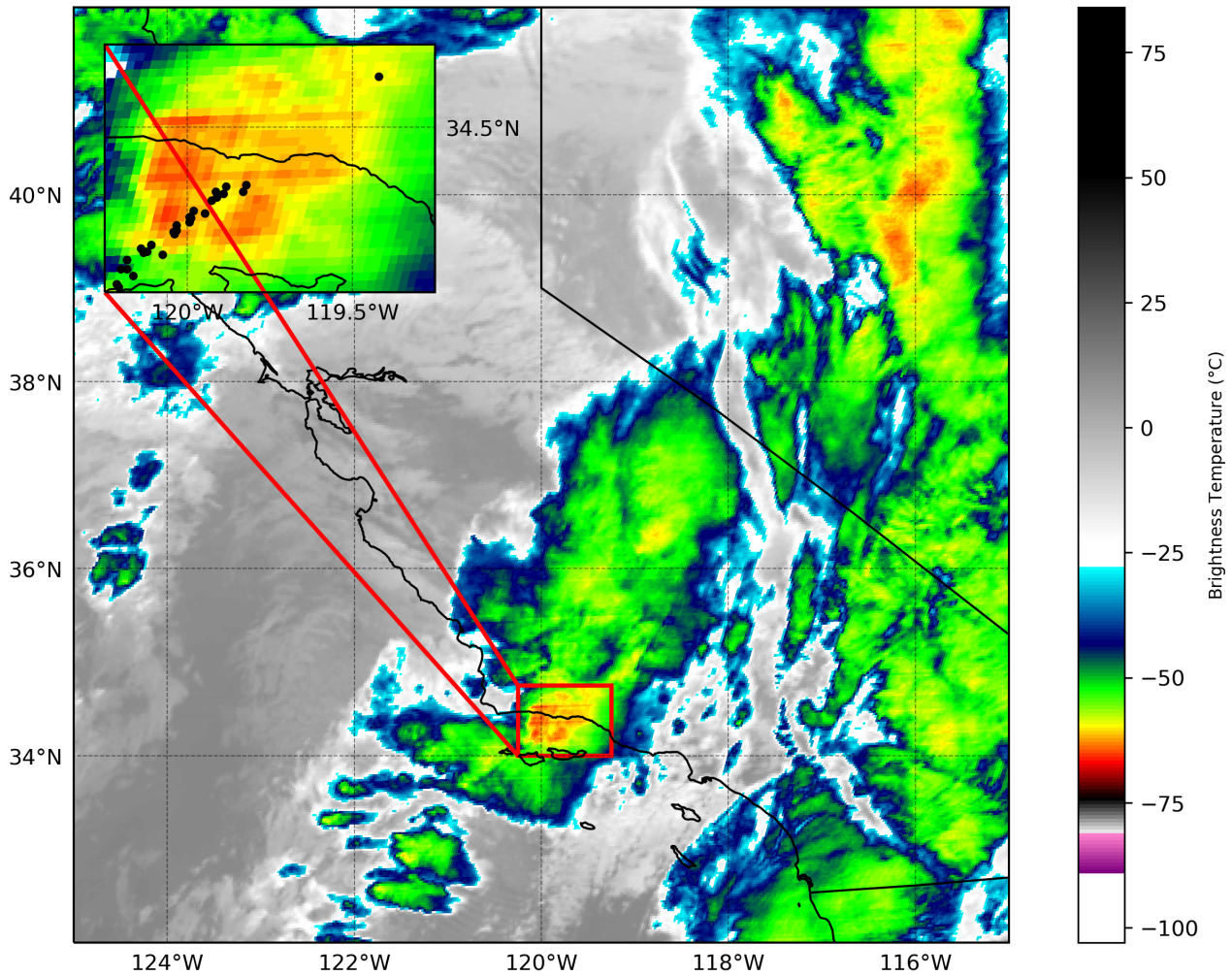


Figure S5. Infrared brightness temperatures (shaded, °C) derived from band 13 of the GOES17 ABI L2 Cloud and Moisture Imagery Brightness Temperature at 6 March 2019 4:24 UTC. Detailed infrared brightness temperatures around Santa Barbara (outlined in red) are shown in the top left area of the map. Locations of NOAA NEXRAD L3 Hail Signatures (black points) identified between 4:15 UTC and 4:45 UTC on 6 March 2019 are shown on the inset map.

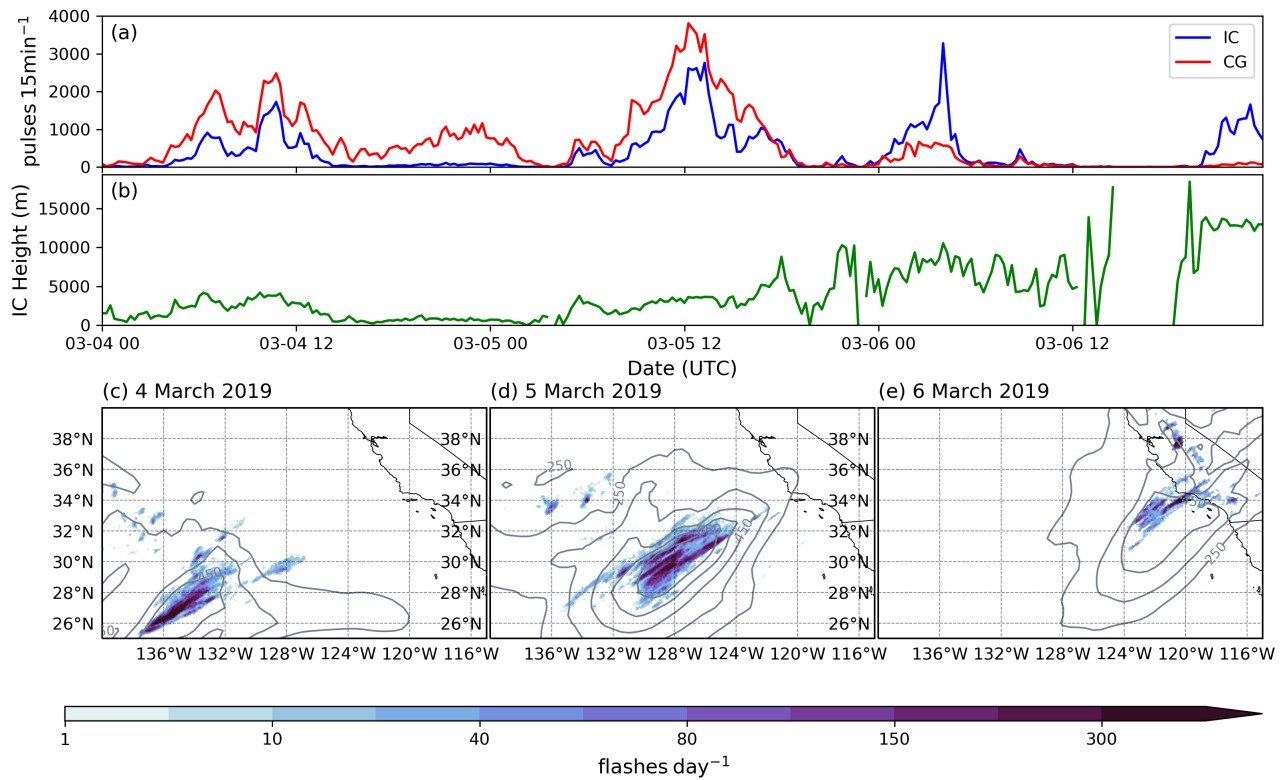


Figure S6. (a) ENGLN number of flashes per 15 minutes between 4 March 2019 0 UTC and 7 March 0 UTC for in-cloud (IC) flashes (blue line) and cloud-to-ground (CG) flashes (red line). (b) ENGLN average IC lightning flash height (green line; m) between 4 March 2019 0 UTC and 7 March 0 UTC. (c) ENGLN lightning flash count (shaded, flashes day⁻¹) interpolated to 0.1° and IVT greater than 250 kg m⁻¹ s⁻¹ (grey contours; every 100 kg m⁻¹ s⁻¹) for the 24-hour period of 4 March 2019. (d) Same as (c), but for the 24-hour period of 5 March 2019. (e) Same as (c), but for the 24-hour period of 6 March 2019.

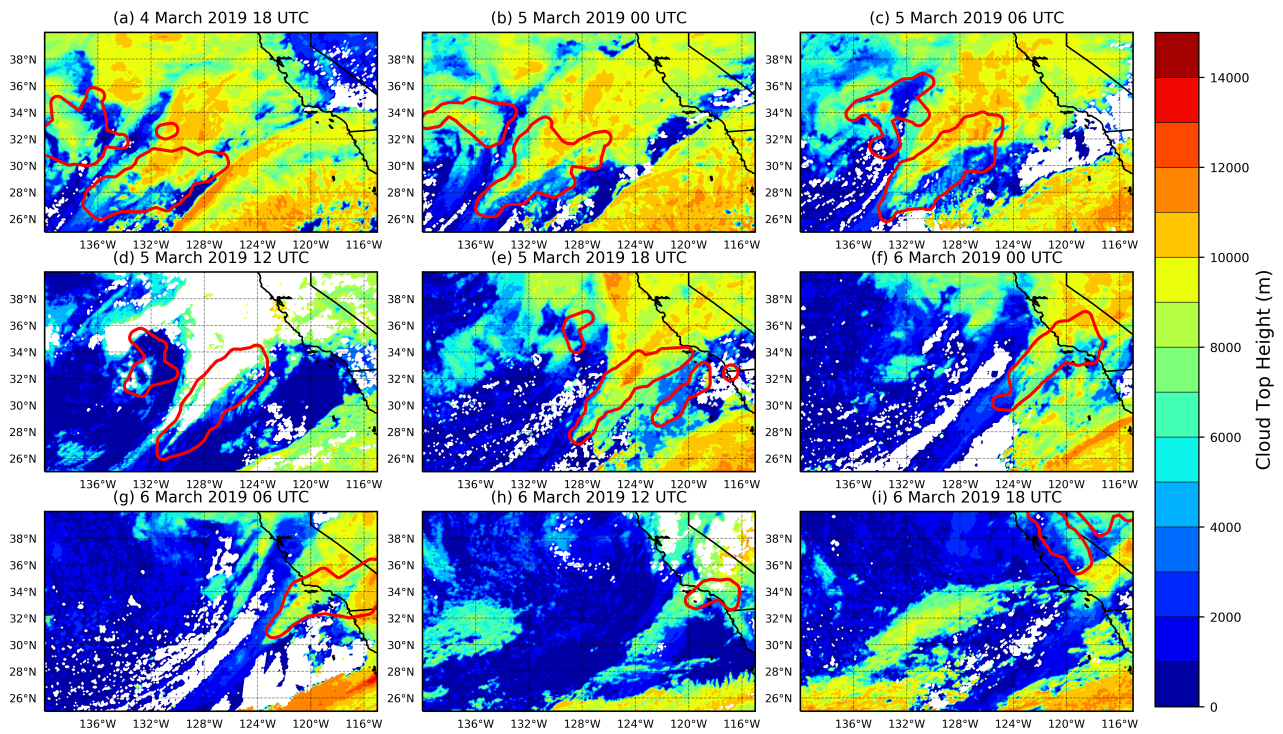


Figure S7. GOES ABI L2 ACHC cloud top height (shaded; m) and the location of the majority of lightning flash points (red polygon) at each 6-hour time step between 4 March 2019 18 UTC and 6 March 2019 18 UTC.

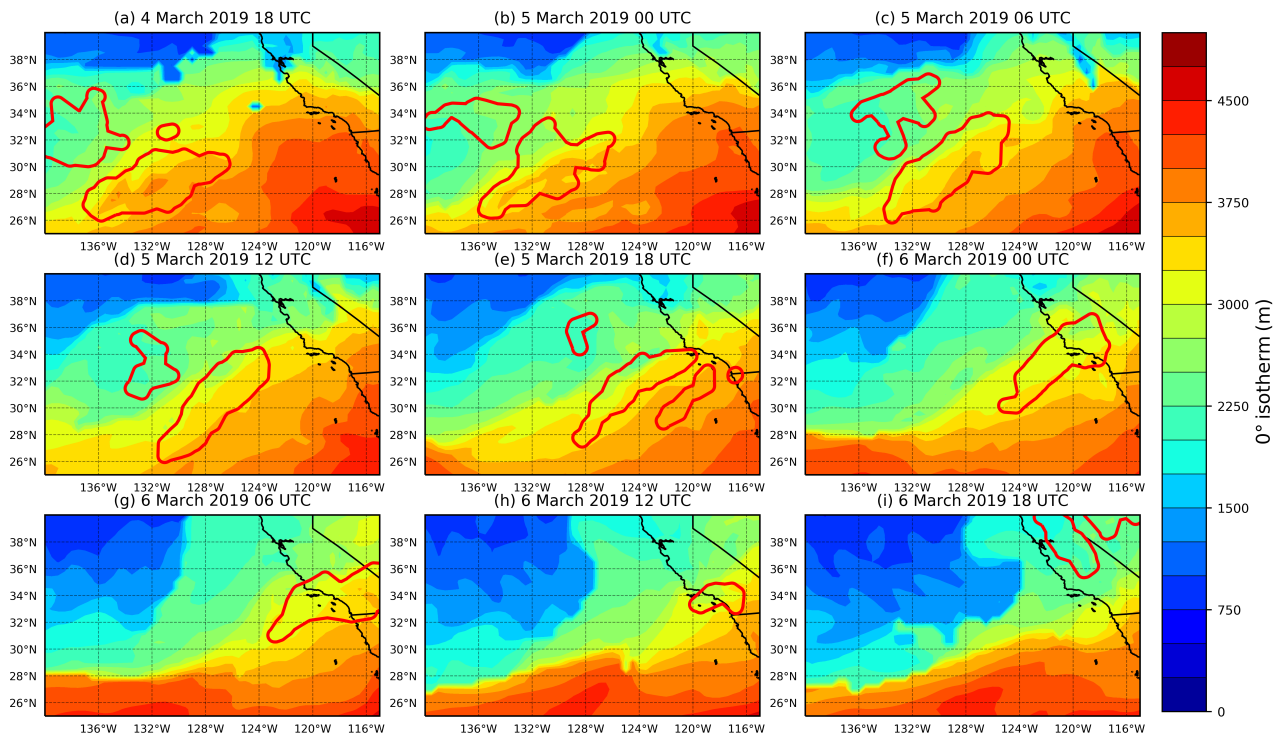


Figure S8. CFSv2 height of 0°C isotherm (shaded; m) and the location of the majority of lightning flash points (red polygon) at each 6-hour time step between 4 March 2019 18 UTC and 6 March 2019 18 UTC.