Supporting Information

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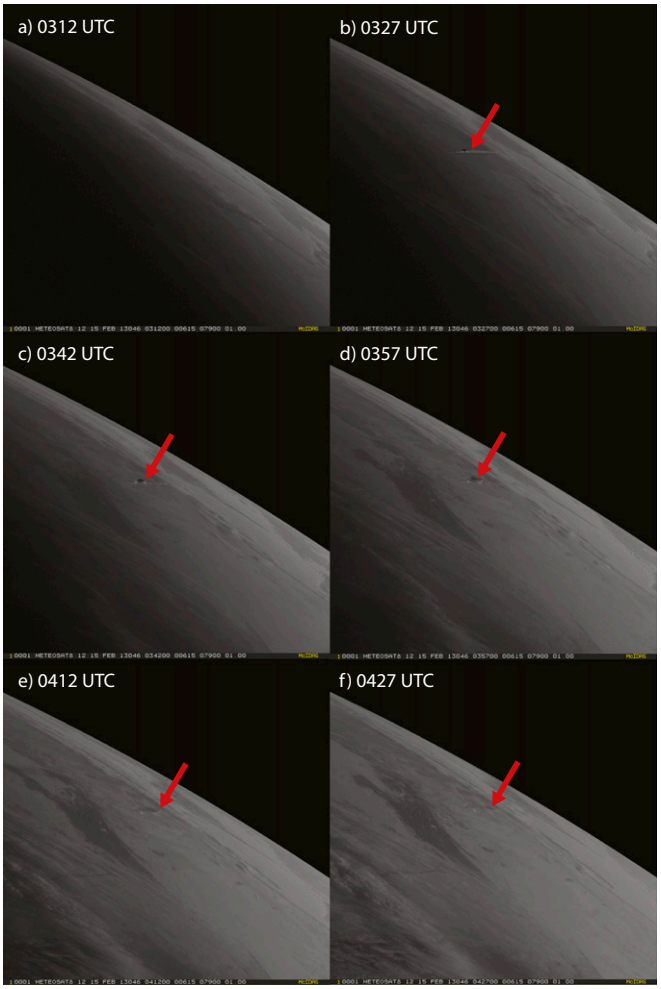

Fig. S1. Meteosat-8 (4.2°E) sequence of visible-band imagery showing the Chelyabinsk meteor trail formation and its evolution at 15-min intervals. The first image of the sequence (*A*) was collected before impact, and the remaining images of the sequence (*B*–*F*) show the formation and drift of the trail. These data have been remapped to a 9.5° E reference location, providing additional eastern coverage.

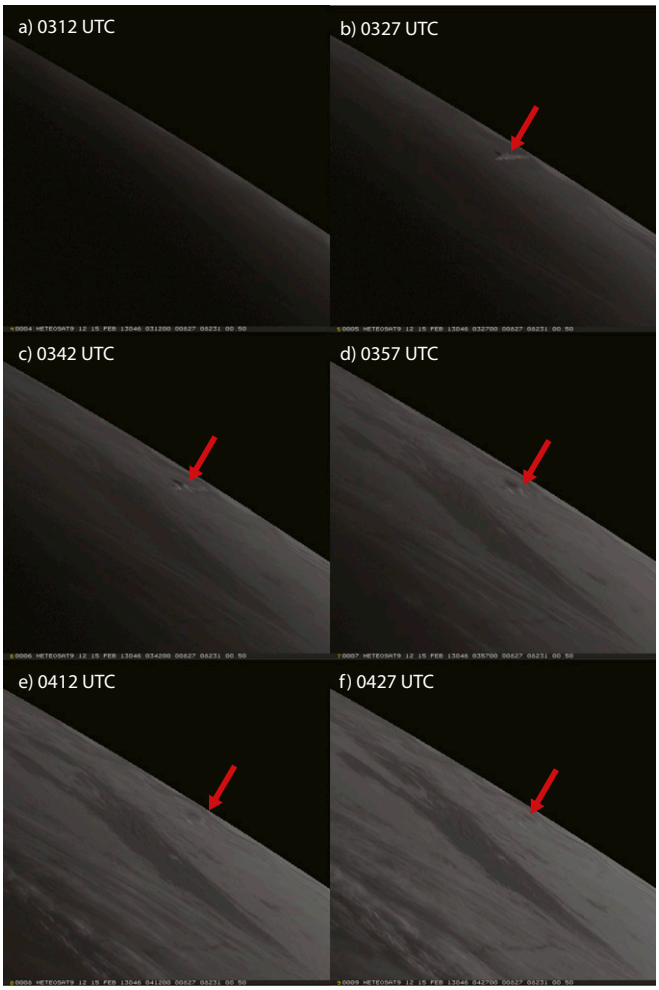

Fig. S2. As in Fig. S1, but as viewed from Meteosat-9 (9.5°E), showing imagery just prior to impact (*A*) and subsequent imagery (*B*–*F*) showing formation and drift of the meteor trail. Unlike the Meteosat-8 imagery, this image was remapped to a 0° longitude reference location. This explains why the edge of imagery coverage is slightly west of Meteosat-8, despite Meteosat-9's subpoint being 5° farther to the east.

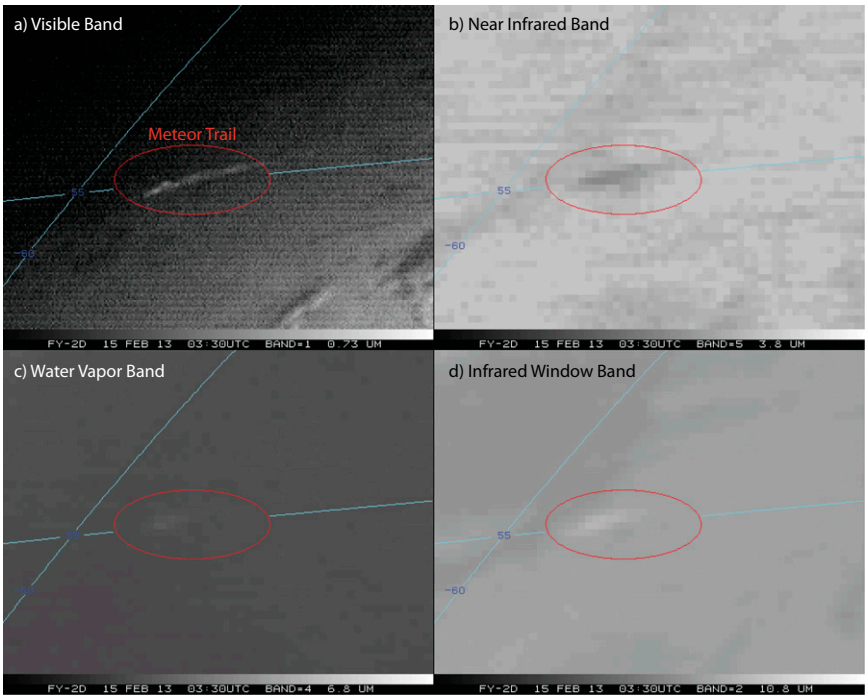

Fig. S3. Feng-Yun 2D (86.5°E) multispectral imagery of the Chelyabinsk meteor trail 0330 UTC collection time (0332 UTC actual scan time, or roughly 12 min after trail formation). The visible (0.73 μm), near-infrared (3.8 μm), "water vapor" (6.8 μm), and far-infrared (11.0 μm) bands are shown in (*A*–*D*), respectively. The signature of the meteor trail is present in each of the bands. For the infrared bands, a darker color corresponds to a warmer brightness temperature.

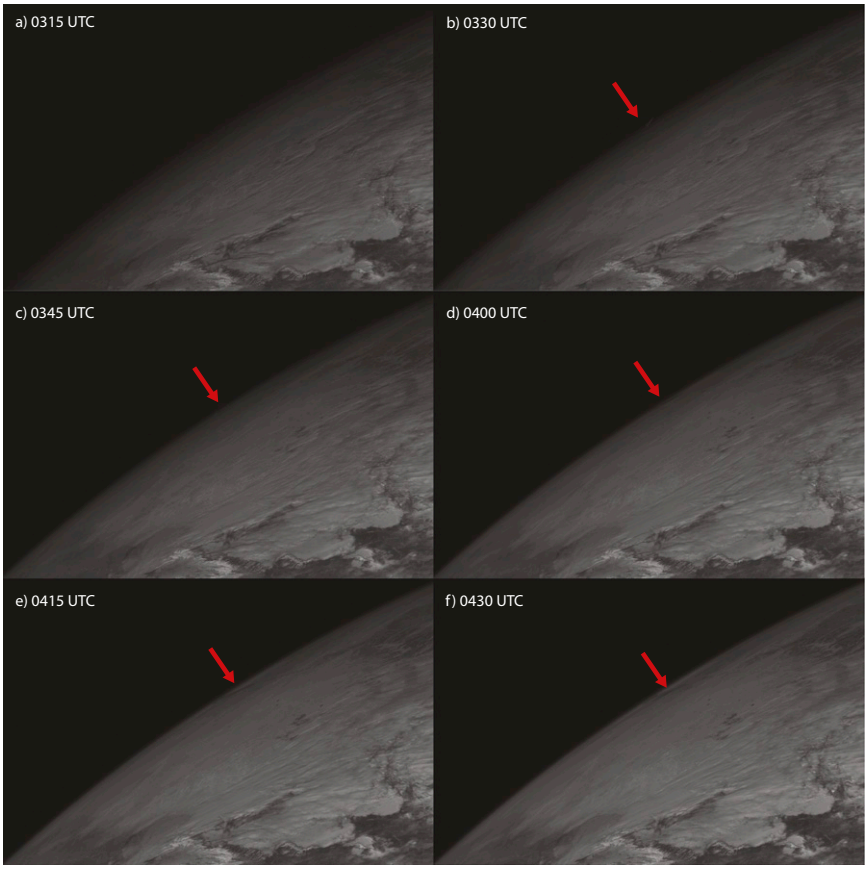

Fig. S4. As in Fig. S1, but as viewed from the Communication, Ocean, and Meteorological Satellite (COMS; Korean Meteorological Administration), showing imagery just prior to impact (*A*) and subsequent imagery (*B*–*F*) of formation and drift of the meteor trail. From this satellite's vantage point at 128.2°E, the meteor trail nearly blends in completely with the limb of the earth.

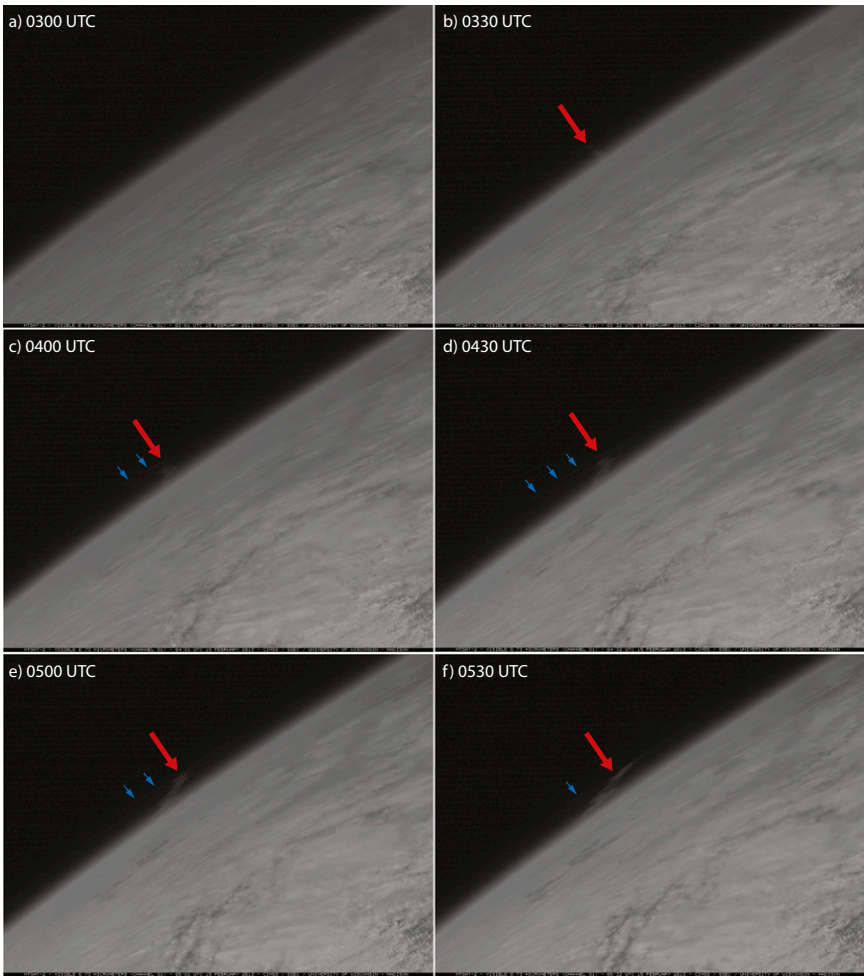

Fig. S5. As in Fig. S1, but as viewed from Multifunctional Transport Satellite (140°E), showing imagery from just before impact (*A*) and subsequent imagery (*B*–*F*) showing formation and drift of the meteor trail. From this satellite's unique vantage point, the trail is observed well above the Earth's limb and provides good contrast against the darkness of space. Blue arrows denote faint portions of the initial meteor trail which were being advected rapidly to the east/southeast by strong upper-level winds.

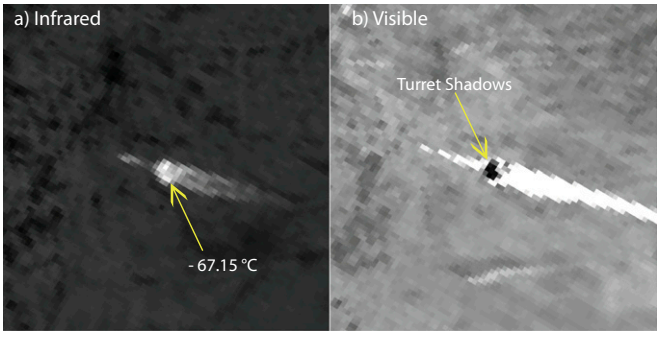

Fig. S6. Defense Meteorological Satellite Program (DMSP) constellation F-16 satellite and its Operational Linescan System (OLS) sensor (*A*) infrared (11.0 μm) and corresponding (*B*) visible (0.6 μm) imagery zoomed in on the Chelyabinsk meteor trail, collected on 15 February 2013 at 0324:40 UTC. The scale of this scene is 200 km on a side. The −67.15 °C infrared brightness temperature of the optically thick "turret" feature (*Fig. 2*, *Inset*) places this feature in the lower stratosphere, consistent with geometric calculations.

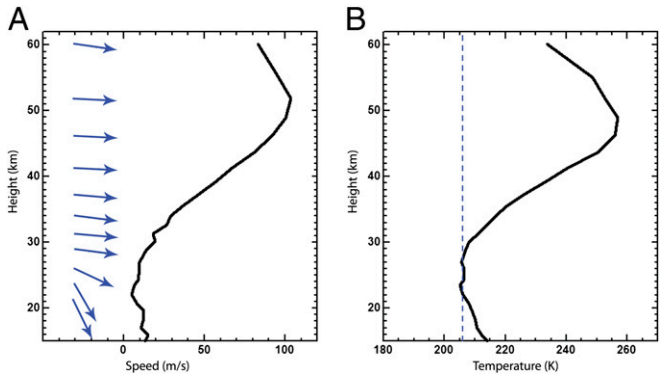

Fig. S7. Profiles of (*A*) wind direction (arrows; up = north, right = east) and speed, and (*B*) temperature between 15 and 60 km from European Centre for Medium-range Weather Forecast model fields, valid on 15 February 2013 at 0300 UTC for the closest model grid point (0.5° grid resolution; 55°N, 61°E) to the Chelyabinsk meteor event. The dashed blue line on the temperature plot corresponds to the DMSP F-16 OLS-measured turret temperature of –67.15 °C (= 206 K; Fig. S6).