

**Auroral Morphological Changes to the Formation of Auroral Spiral
during the Late Substorm Recovery Phase:
Polar UVI and Ground All-Sky Observations**

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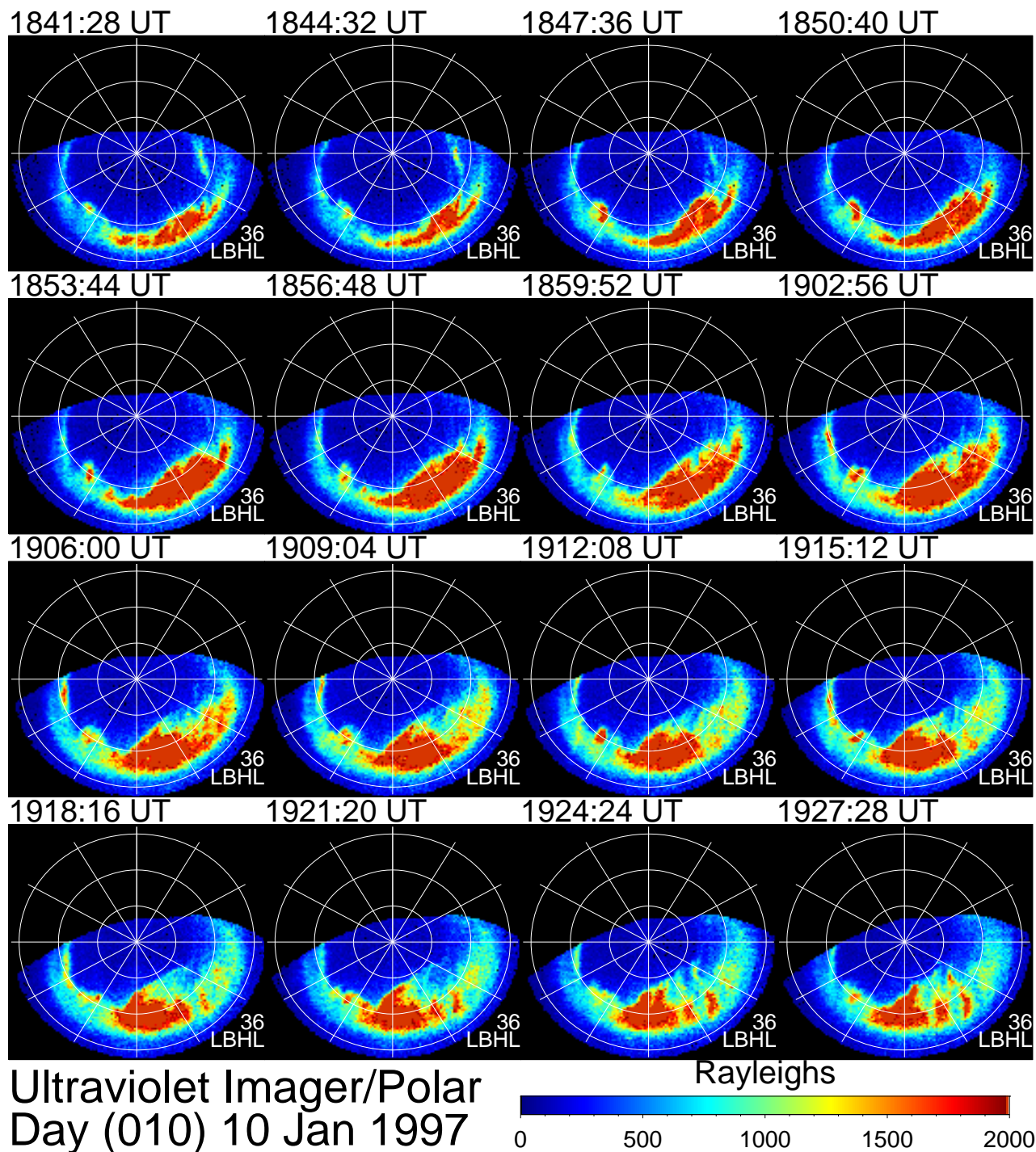
Figures S1, S2, and S3

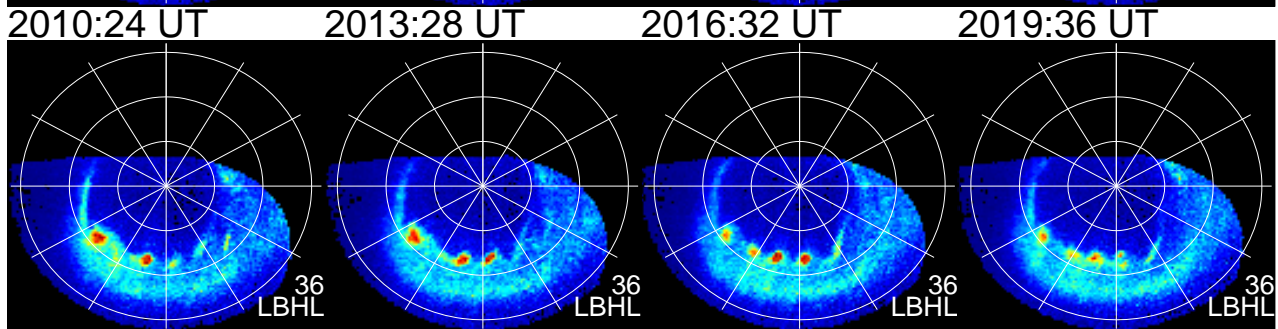
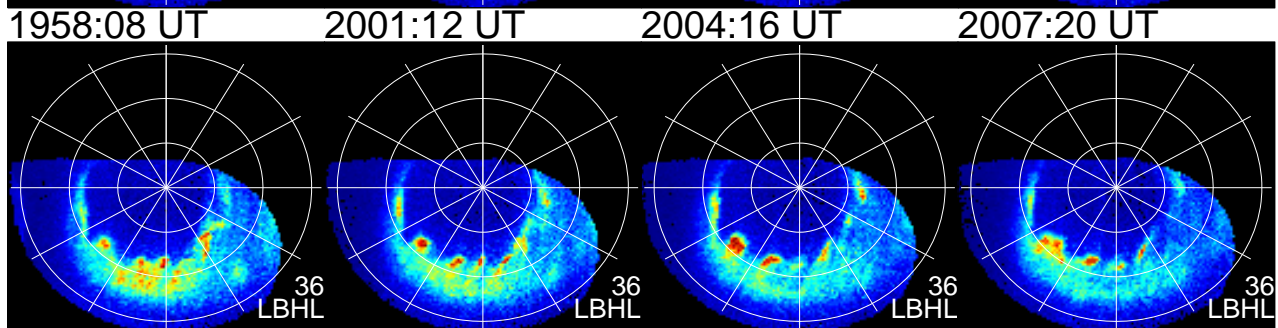
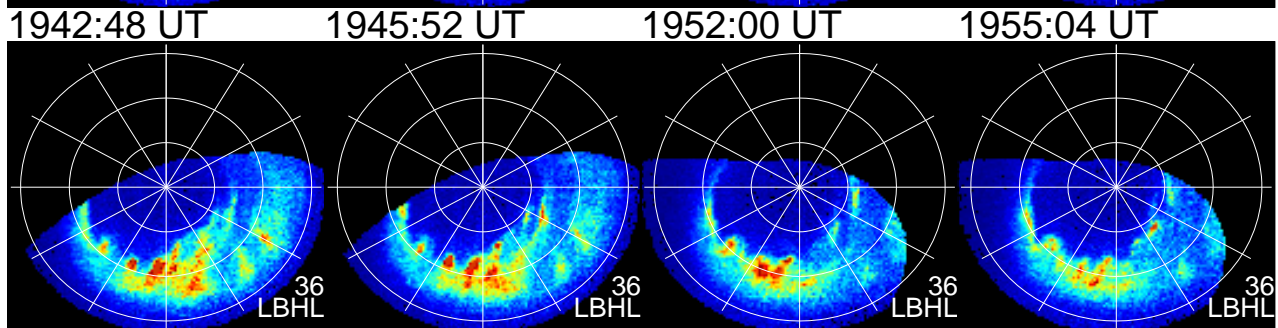
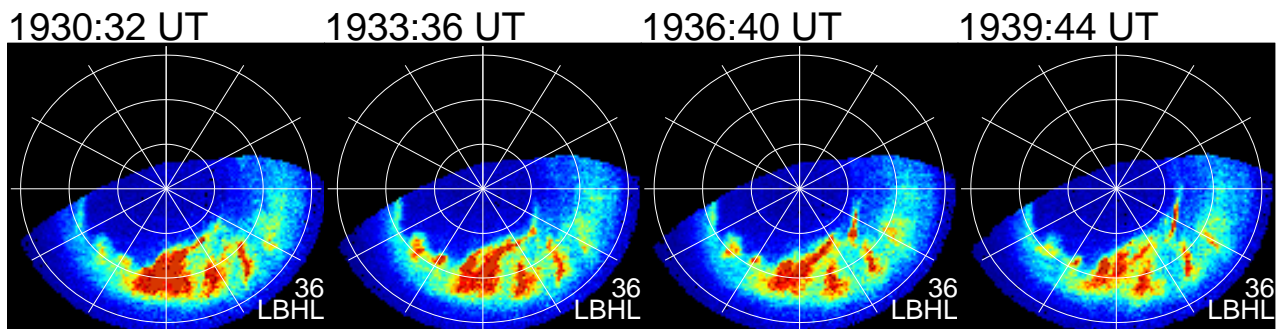
Movie S1

Introduction

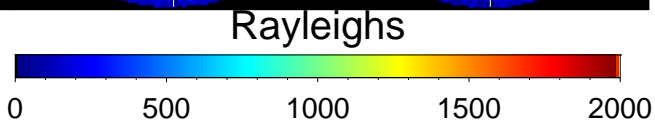
Time-series of Polar ultraviolet imager (UVI) data of Lyman-Birge-Hopfield long (LBHL) emission with an integration time of 36.8 s is shown to examine the global auroral morphological changes before and during the formation of the aurora spiral from 19:59 UT to 21:23 UT on January 10, 1997. The UVI data are shown in two different coordinates: altitude adjusted corrected geomagnetic (AACGM) (Figure S1) and geographic coordinates (Figure S2) from 18:41:28 UT to 21:57:44 UT. The all-sky camera (ASC) images in geographic coordinates are also shown to help discuss the spiral position and motion relative to the ASC's field of view (Figure S3). All UVI data were obtained from the Northern Hemisphere. Here, we also show a movie of consecutive images obtained from ASC installed at the Longyearbyen station for 2 h from 20:00 UT to 22:00 UT, when the auroral spiral interval is covered (Movie S1).

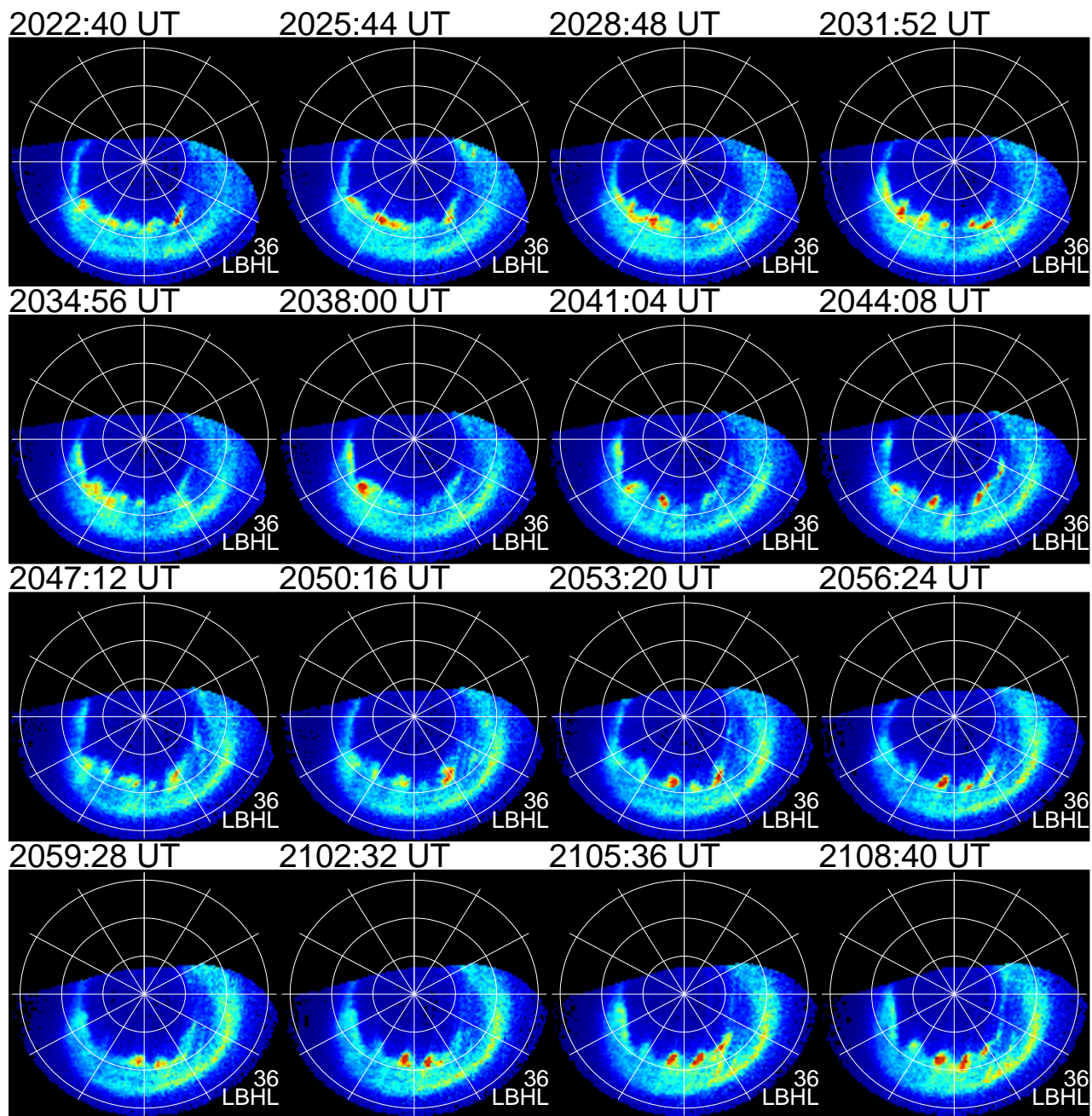
Figure S1





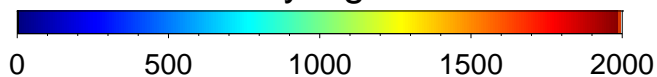
Ultraviolet Imager/Polar
Day (010) 10 Jan 1997

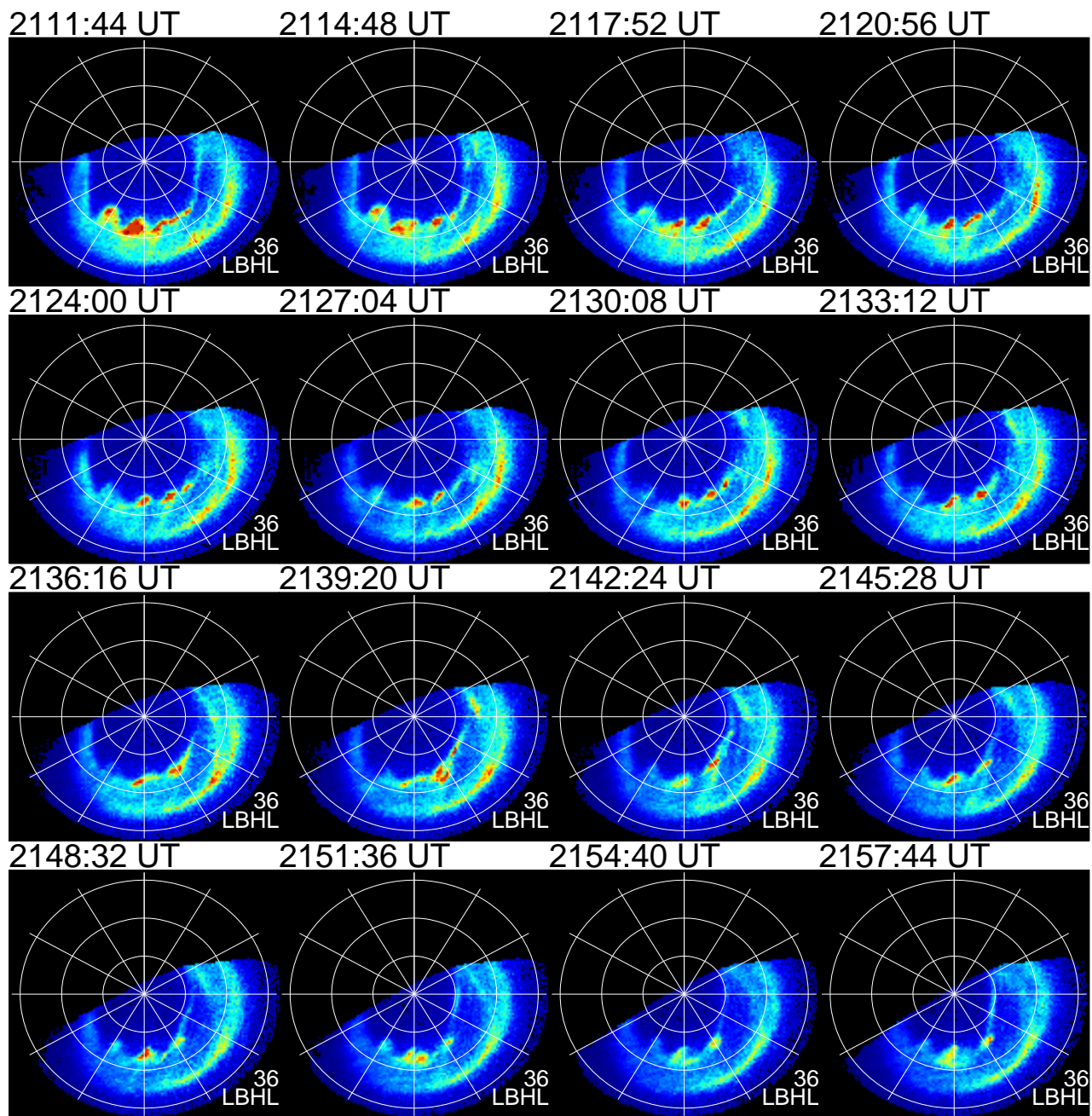




Ultraviolet Imager/Polar
Day (010) 10 Jan 1997

Rayleighs





Ultraviolet Imager/Polar
Day (010) 10 Jan 1997

Rayleighs

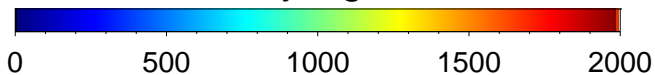
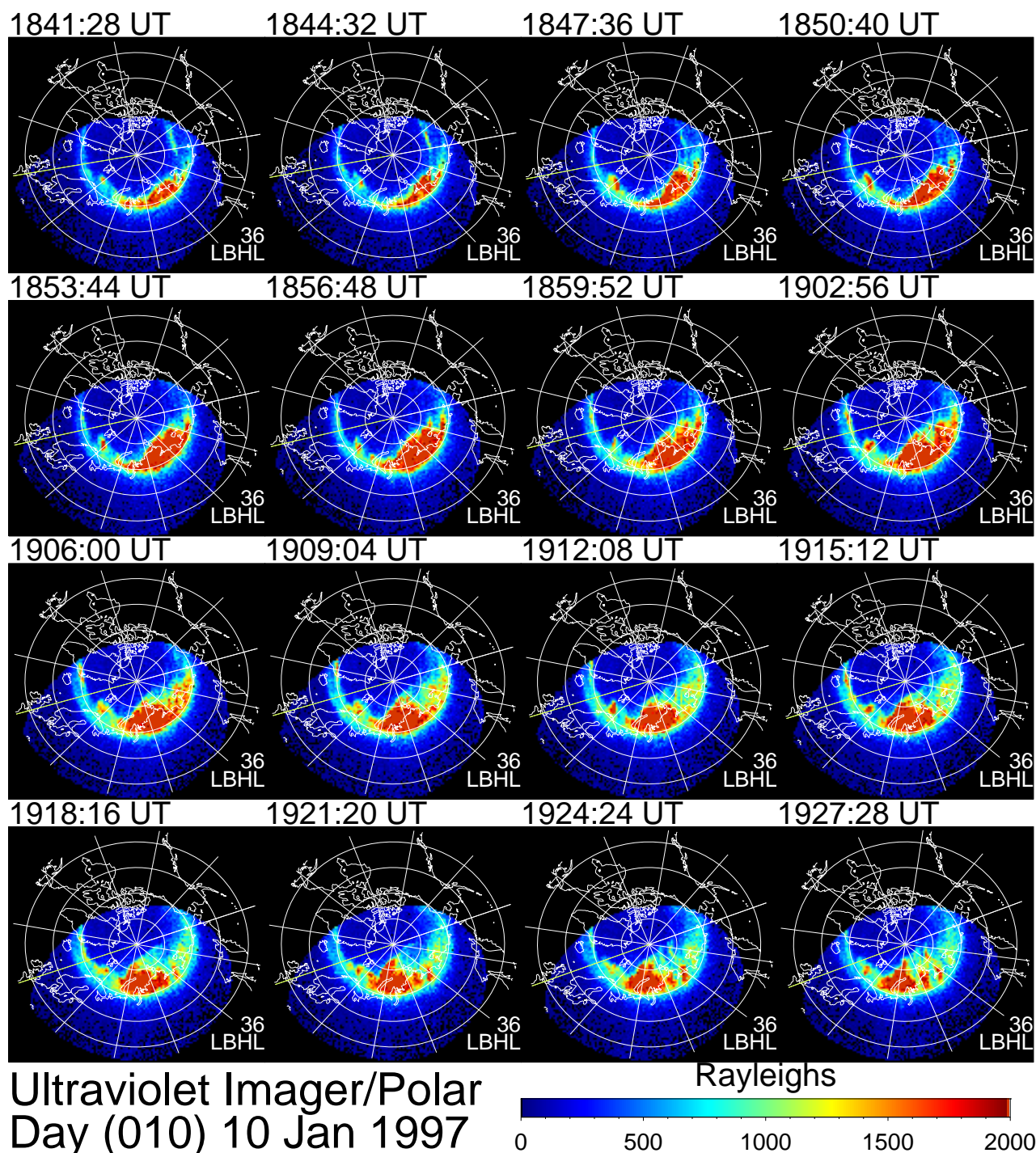
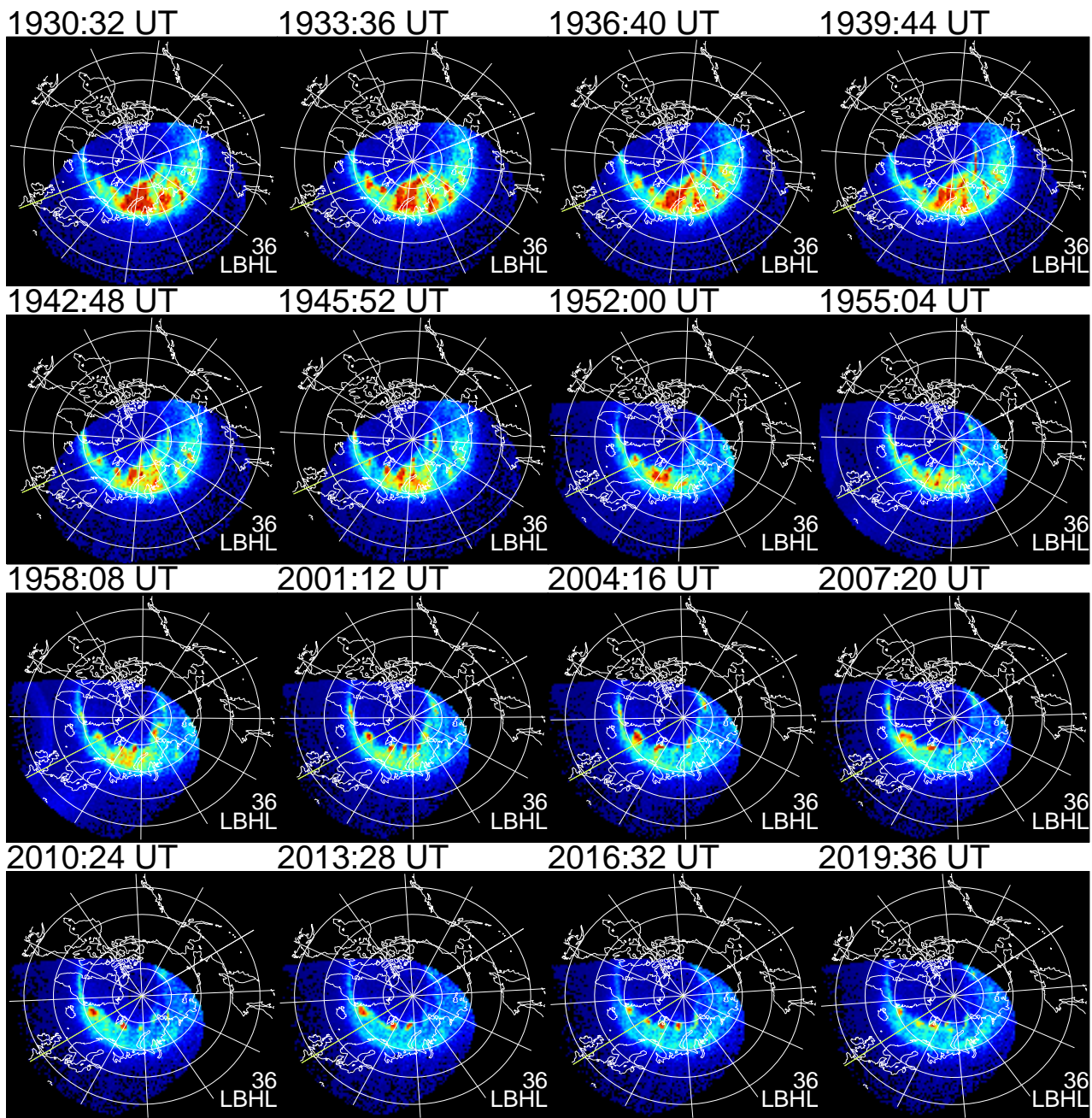


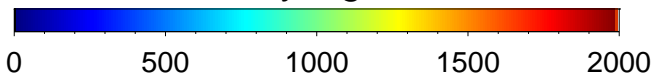
Figure S2

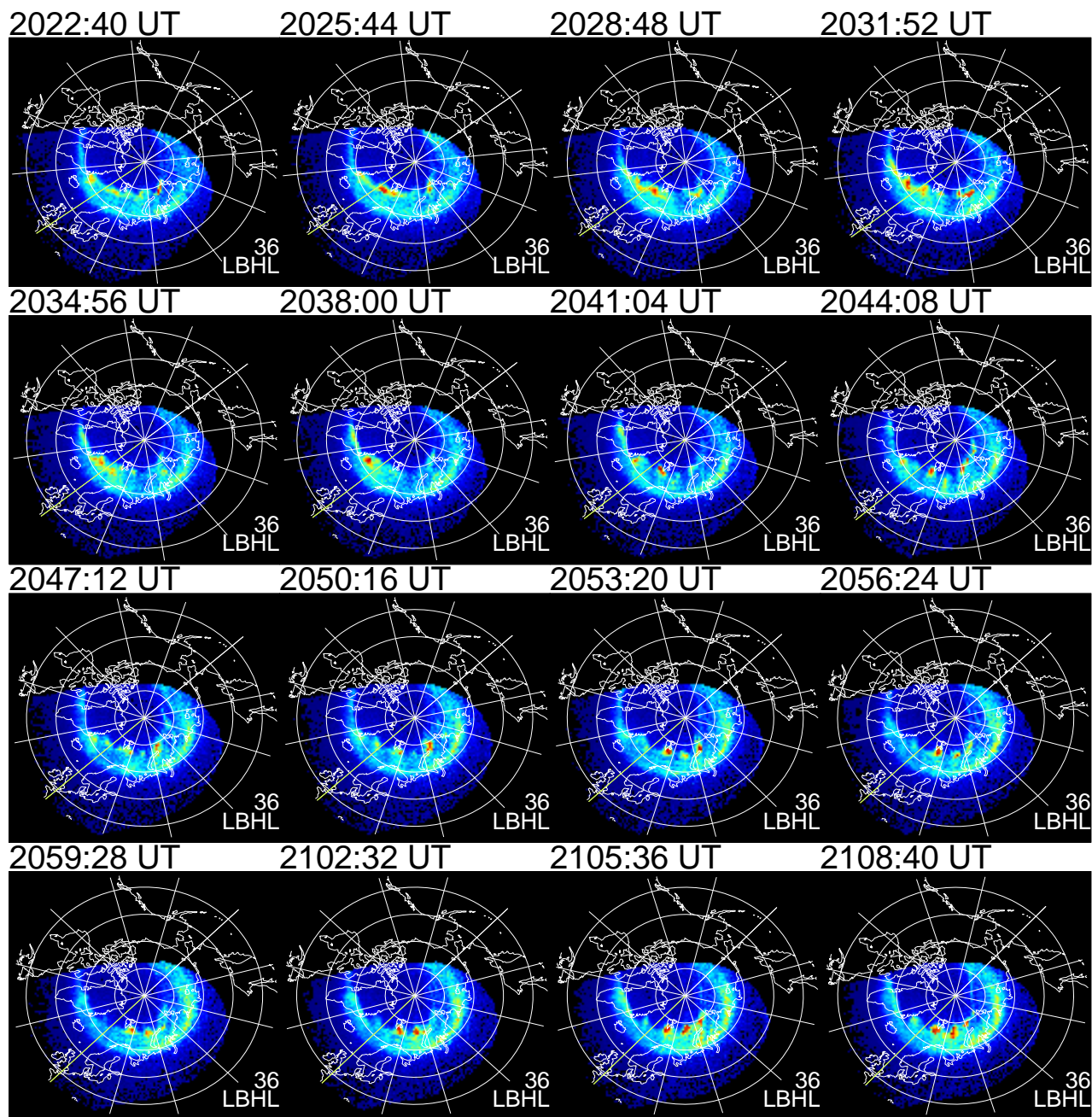




Ultraviolet Imager/Polar
Day (010) 10 Jan 1997

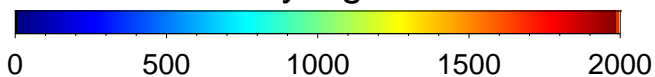
Rayleighs

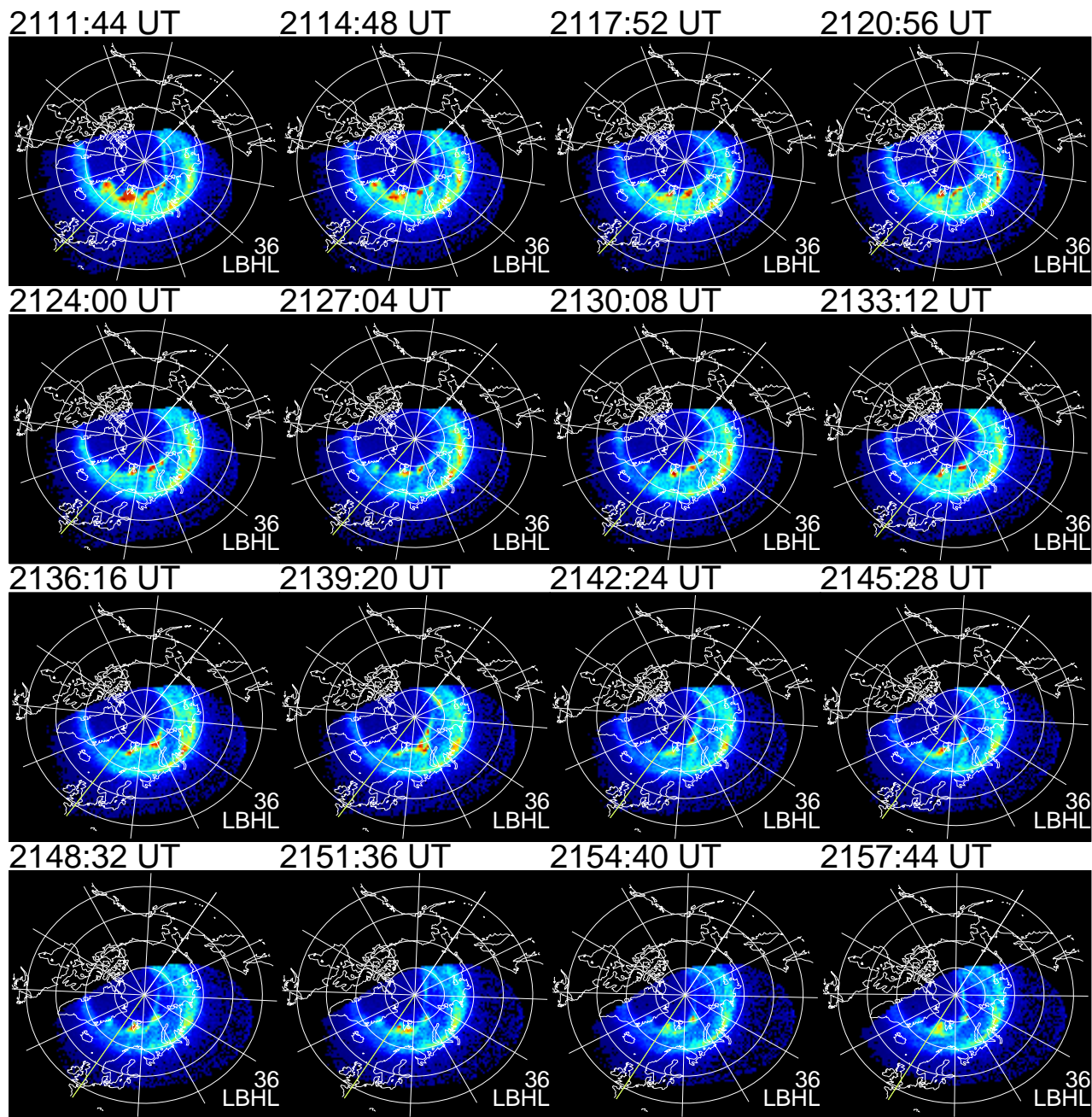




Ultraviolet Imager/Polar
Day (010) 10 Jan 1997

Rayleighs





Ultraviolet Imager/Polar
Day (010) 10 Jan 1997

Rayleighs

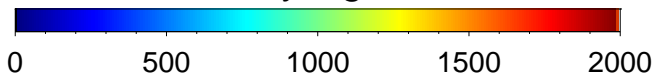
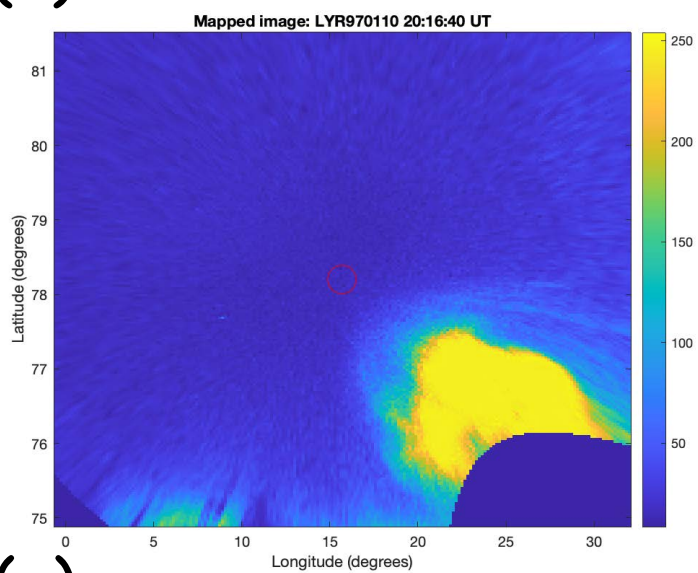
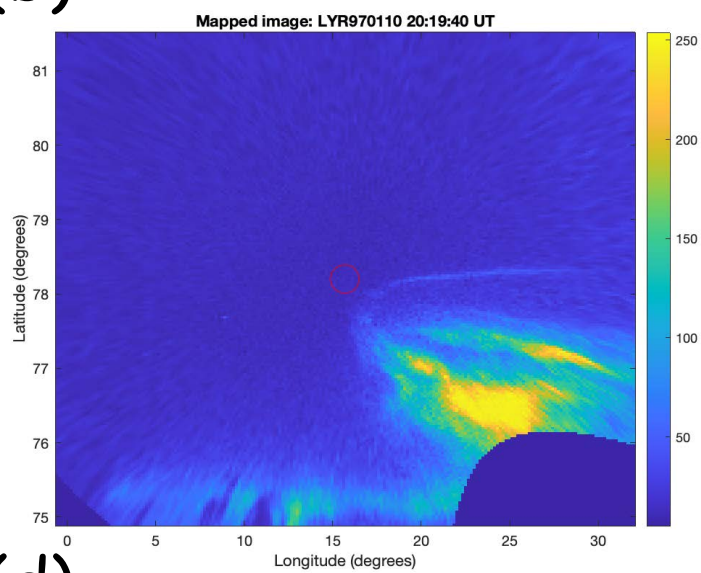


Figure S3

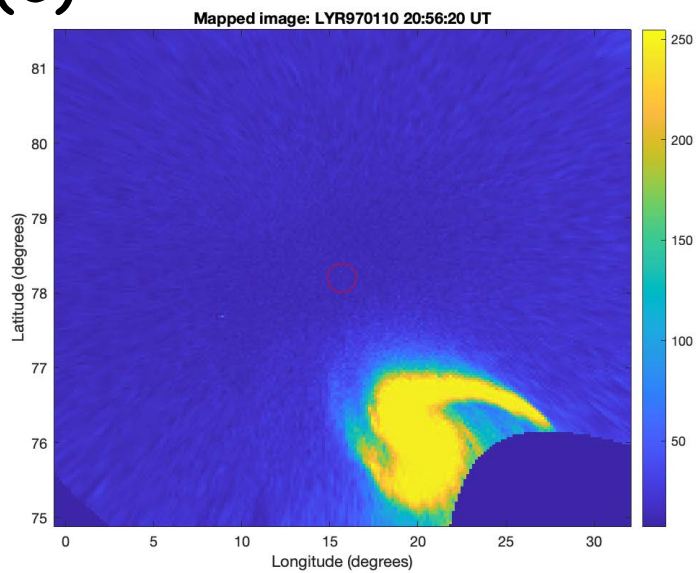
(a)



(b)



(c)



(d)

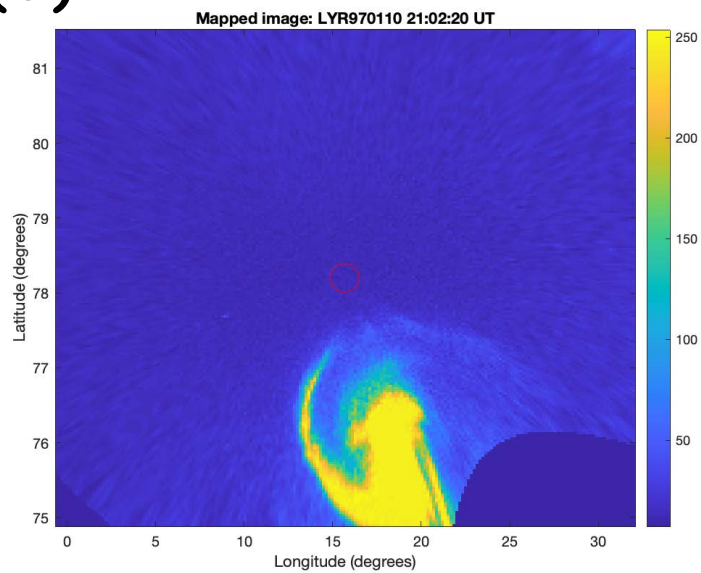


Figure S1. Time-series snapshots of Polar ultraviolet imager (UVI) of Lyman-Birge-Hopfield long (LBHL) emission with an integration time of 36.8 s in altitude adjusted corrected geomagnetic (AACGM) coordinates are shown for 3 h 16 min from 18:41:28 UT to 21:57:44 UT. The white circles are drawn every 10° from 60° to 80° magnetic latitude (MLat). Each panel is oriented such that the top, right, bottom and left sides correspond to noon (12h MLT (magnetic local time)), dawn (6h MLT), midnight (24h MLT), and dusk (18h MLT), respectively. The white lines are drawn every 2 h MLT. The color code is assigned according to the luminosity in units of Rayleigh.

Figure S2. Time-series of Polar UVI snapshots in geographic coordinates with coast lines for the same time interval as Figure S1 are shown in the same format as Figure S1.

Figure S3. The all-sky camera (ASC) data plots in geographic coordinates for four times are shown. Panels (a) – (d) show the plots for 20:16:40 UT, 20:19:40 UT, 20:56:20 UT, and 21:02:20 UT. The red circle in each panel indicates the location of the Longyearbyen station. In these plots, we assumed that the auroral emission height was 110 km. Vertical and horizontal axes give the geographical latitude and longitude in units of degree (°). The color code is assigned according to the auroral luminosity in units of Rayleigh.

Movie S1. Movie of consecutive images of the aurora spiral for 2 h from 20:00 UT to 22:00 UT on January 10, 1997, obtained from the all-sky camera (ASC) installed at Longyearbyen on Svalbard island is shown. The ASC covers a circular area with a diameter of about 600 km at an altitude of 110 km, with a field of view of 140°. Because the number of pixels corresponding to a 140° field of view is 440×440, the average spatial resolution of the image is about 1.4 km/pixel. The temporal resolution of the ASC's images is 20 s. The top, right, bottom, and left correspond to north, east, south, and west, respectively.