



# **Kiruna Geophysical Data**



**Data Summary 16/10-12 (October-December 2016)**

**Swedish Institute of Space Physics**



# Kiruna Geophysical Data

Data Summary 16/10-12  
October – December 2016

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## INTRODUCTION

”Kiruna Geophysical Data” is a collection of results of ground-based more or less continuous measurements of upper atmosphere variables carried out at the Swedish Institute of Space Physics. Our objective with this data summary is to present current geophysical data, related to polar upper atmospheric conditions, to those who require it for their research work.

Coordinates of the Swedish Institute of Space Physics are:

| Geogr. |        | Geomagn. Dipole |         | Corr. Geomagn. |         |
|--------|--------|-----------------|---------|----------------|---------|
| Lat.   | Long.  | Lat.            | Long.   | Lat.           | Long.   |
| 67.8°N | 20.4°E | 65.2°N          | 116.0°E | 64.8°N         | 104.2°E |

The following ground-based measurements of upper atmospheric parameters have been conducted at the Swedish Institute of Space Physics in the period for which data is presented in this report.

| Geomagnetism |                                     | Optical<br>aurora    | Ionospheric<br>ionization                              |
|--------------|-------------------------------------|----------------------|--|
| 1.           | Geomagnetic<br>digital<br>recording | 1. All-sky<br>camera | 1. Riometer<br>30.0 MHz<br><br>2. Riometer<br>38.2 MHz |

In addition the Swedish Institute of Space Physics operates the Ionospheric Observatory at Lycksele (64.7°N, 18.8°E) where it conducts riometer and ionosonde measurements. The Geological Survey of Sweden (SGU) also operates a magnetometer there in collaboration with IRF. That data is not reported in this publication.

Universal time is used in all tables.

Ionosonde data obtained at the Swedish Institute of Space Physics in Kiruna have been published together with ionosonde data from Lycksele and Uppsala in a monthly report ”Ionospheric Data Sweden” between January 1990 and March 2000. Copies are available from the Swedish Institute of Space Physics.

Scaled ionosonde parameters from 1965 – 1998 are also available from [http://www.wdc.rl.ac.uk/wdcc1/ionosondes/data\\_archive.html](http://www.wdc.rl.ac.uk/wdcc1/ionosondes/data_archive.html)

The most recent data from all instruments are accessible via internet at <http://www.irf.se/Data>

For more information contact [urban.brandstrom@irf.se](mailto:urban.brandstrom@irf.se)

## GEOMAGNETIC DATA

### Magnetograms

The magnetograms reproduced here are plots of data recorded by a three component digital fluxgate magnetometer with a sampling frequency of 1 sample/second.

The scaling is indicated by the tick mark values on the plots. Note that for large disturbances the normal scaling has been reduced. The positive direction of the components are: X north, Y east and Z down, in geographic coordinates.

### K-indices

The K-indices give a measure of the amount of disturbance of the geomagnetic field.

A reading of maximum deflection has been made during each 3-hour interval (starting from 00 to 03 UT) of two components X and Y. The Sq + L variation has been compensated for. A detailed description of the determination of K-indices has been given by J. Bartels: The technique of scaling indices K and Q geomagnetic activity. IGY Annals 4, London 1957.

The following scale has been used:

| K-indices | Deflection in nT |          |      |
|-----------|------------------|----------|------|
| 0         | 0                | -        | 15   |
| 1         | 15               | -        | 30   |
| 2         | 30               | -        | 60   |
| 3         | 60               | -        | 120  |
| 4         | 120              | -        | 210  |
| 5         | 210              | -        | 360  |
| 6         | 360              | -        | 600  |
| 7         | 600              | -        | 990  |
| 8         | 990              | -        | 1500 |
| 9         | 1500             | and more |      |

## **ALL-SKY CAMERA DATA**

Digital all-sky camera images are typically recorded in jpeg format at a rate of one frame per minute. The filename of each image contains information about UTC and exposure time. Longer exposure times are used at regular intervals (typically eight minutes). Data might be recorded at higher frame rates during selected periods. More information and image data are available from: <http://www.irf.se/allsky>

Information about available records of all-sky camera data is presented as colour keograms. Keograms are time sequences of poleward to equatorward slices through the centre of all-sky images. The top of the image points poleward, the bottom equatorward. Time is on the horizontal axis (0:00-24:00 UTC). Each page contains keograms for seven days. White areas indicate missing data (e.g. daylight conditions).

## **IONOSPHERIC ABSORPTION DATA**

Ionospheric absorption at 30.0 MHz and 38.2 MHz is recorded by two La Jolla riometers. The riometer records of cosmic noise power are reproduced in this report. The zero power level is at bottom of each panel.

The absorption (in decibels) can be computed from the formula

$$A(\text{dB}) = 10 \log_{10} \frac{P_o}{P}$$

where  $P$  is the received cosmic noise power,  $P_o$  the cosmic noise power expected under ionospherically quiet conditions at the same sidereal time.



## GEOMAGNETIC K-INDICES, KIRUNA

October 2016

Lower limit of K=7 is 600 nT

Time in UT

| Day | 00  | - 03 | - 06 | - 09 | - 12 | - 15 | - 18 | - 21 | - 24 | Sum  |
|-----|-----|------|------|------|------|------|------|------|------|------|
| 1   | (5) | 4    | 3    | 3    | 3    | 3    | 6    | 6    |      | (33) |
| 2   | 5   | 3    | 3    | 3    | 4    | 3    | 6    | 5    |      | 32   |
| 3   | 3   | 3    | 3    | 2    | 3    | 4    | 5    | 6    |      | 29   |
| 4   | 6   | 6    | 3    | 5    | 4    | 3    | 6    | 6    |      | 39   |
| 5   | 5   | 5    | 3    | 2    | 3    | 2    | 3    | 4    |      | 27   |
| 6   | 3   | 2    | 1    | 1    | 2    | 4    | 4    | 2    |      | 19   |
| 7   | 4   | 1    | 1    | 1    | 2    | 2    | 4    | 2    |      | 17   |
| 8   | 4   | 2    | 2    | 2    | 2    | 1    | 2    | 3    |      | 18   |
| 9   | 2   | 1    | 1    | 1    | 2    | 1    | 4    | 3    |      | 15   |
| 10  | 4   | 2    | 2    | 2    | 2    | 4    | 6    | 2    |      | 24   |
| 11  | 1   | 0    | 1    | 1    | 1    | 0    | 1    | 2    |      | 7    |
| 12  | 1   | 1    | 1    | 2    | 1    | 1    | 2    | 3    |      | 12   |
| 13  | 2   | 2    | 4    | 5    | 5    | 7    | 7    | 6    |      | 38   |
| 14  | 7   | 6    | 4    | 2    | 2    | 2    | 1    | 2    |      | 26   |
| 15  | 3   | 2    | 2    | 2    | 2    | 4    | 3    | 5    |      | 23   |
| 16  | 4   | 2    | 2    | 3    | 3    | 3    | 7    | 6    |      | 30   |
| 17  | 5   | 4    | 3    | 4    | 2    | 5    | 6    | 5    |      | 34   |
| 18  | 4   | 4    | 3    | 3    | 2    | 2    | 2    | 5    |      | 25   |
| 19  | 3   | 1    | 2    | 2    | 2    | 1    | 2    | 1    |      | 14   |
| 20  | 1   | 0    | 1    | 1    | 1    | 0    | 2    | 1    |      | 7    |
| 21  | 0   | 0    | 1    | 0    | 1    | 0    | 0    | 1    |      | 3    |
| 22  | 1   | 0    | 1    | 1    | 1    | 1    | 3    | 4    |      | 12   |
| 23  | 1   | 1    | 1    | 2    | 1    | 4    | 4    | 6    |      | 20   |
| 24  | 5   | 3    | 2    | 3    | 4    | 5    | 4    | 6    |      | 32   |
| 25  | 7   | 4    | 3    | 5    | 6    | 7    | 6    | 7    |      | 45   |
| 26  | 6   | 6    | 5    | 4    | 5    | 7    | 7    | 6    |      | 46   |
| 27  | 6   | 5    | 4    | 4    | 5    | 7    | 6    | 5    |      | 42   |
| 28  | 4   | 3    | 3    | 4    | 5    | 4    | 7    | 5    |      | 35   |
| 29  | 7   | 7    | 5    | 3    | 5    | 3    | 6    | 5    |      | 41   |
| 30  | 6   | 5    | 4    | 3    | 5    | 4    | 6    | 4    |      | 37   |
| 31  | 4   | 2    | 2    | 4    | 2    | 3    | 3    | 2    |      | 22   |
| Sum | 119 | 87   | 76   | 80   | 88   | 97   | 131  | 126  |      |      |

## GEOMAGNETIC K-INDICES, KIRUNA

November 2016

Lower limit of K=7 is 600 nT

Time in UT

| Day | 00 - | 03 - | 06 - | 09 - | 12 - | 15 - | 18 - | 21 - | 24 | Sum  |
|-----|------|------|------|------|------|------|------|------|----|------|
| 1   | (3)  | 1    | 2    | 3    | 4    | 4    | 1    | 6    |    | (24) |
| 2   | 7    | 1    | 1    | 3    | 5    | 4    | 4    | 6    |    | 31   |
| 3   | 5    | 4    | 3    | 4    | 3    | 4    | 5    | 6    |    | 34   |
| 4   | 5    | 2    | 2    | 1    | 1    | 0    | 2    | 2    |    | 15   |
| 5   | 1    | 0    | 1    | 1    | 1    | 0    | 0    | 0    |    | 4    |
| 6   | 1    | 1    | 1    | 1    | 2    | 1    | 3    | 3    |    | 13   |
| 7   | 4    | 0    | 1    | 0    | 1    | 1    | 0    | 0    |    | 7    |
| 8   | 0    | 0    | 1    | 1    | 1    | 1    | 0    | 2    |    | 6    |
| 9   | 0    | 0    | 1    | 1    | 2    | 2    | 5    | 4    |    | 15   |
| 10  | 1    | 1    | 1    | 1    | 5    | 6    | 5    | 6    |    | 26   |
| 11  | 6    | 2    | 2    | 2    | 1    | 3    | 3    | 6    |    | 25   |
| 12  | 5    | 2    | 3    | 4    | 3    | 4    | 4    | 6    |    | 31   |
| 13  | 5    | 3    | 3    | 3    | 3    | 3    | 6    | 5    |    | 31   |
| 14  | 2    | 2    | 2    | 2    | 3    | 3    | 3    | 5    |    | 22   |
| 15  | 3    | 4    | 3    | 1    | 2    | 2    | 1    | 1    |    | 17   |
| 16  | 1    | 1    | 1    | 1    | 1    | 0    | 4    | 4    |    | 13   |
| 17  | 3    | 1    | 1    | 1    | 1    | 1    | 2    | 2    |    | 12   |
| 18  | 2    | 1    | 1    | 0    | 0    | 2    | 0    | 1    |    | 7    |
| 19  | 0    | 0    | 0    | 1    | 1    | 0    | 1    | 2    |    | 5    |
| 20  | 0    | 0    | 0    | 0    | 1    | 0    | 2    | 3    |    | 6    |
| 21  | 1    | 0    | 1    | 1    | 1    | 2    | 5    | 6    |    | 17   |
| 22  | 1    | 1    | 1    | 1    | 2    | 5    | 6    | 7    |    | 24   |
| 23  | 5    | 4    | 3    | 2    | 2    | 3    | 5    | 4    |    | 28   |
| 24  | 6    | 3    | 2    | 3    | 5    | 5    | 5    | 6    |    | 35   |
| 25  | 7    | 5    | 5    | 3    | 4    | 5    | 5    | 4    |    | 38   |
| 26  | 4    | 4    | 4    | 3    | 3    | 4    | 5    | 4    |    | 31   |
| 27  | 2    | 3    | 3    | 2    | 2    | 1    | 4    | 5    |    | 22   |
| 28  | 3    | 1    | 2    | 2    | 2    | 4    | 5    | 5    |    | 24   |
| 29  | 3    | 0    | 1    | 1    | 1    | 2    | 3    | 4    |    | 15   |
| 30  | 1    | 1    | 1    | 0    | 0    | 1    | 1    | 0    |    | 5    |
| Sum | 87   | 48   | 53   | 49   | 63   | 73   | 95   | 115  |    |      |



## GEOMAGNETIC K-INDICES, KIRUNA

December 2016

Lower limit of K=8 is 990 nT

Time in UT

| Day | 00 - | 03 - | 06 - | 09 - | 12 - | 15 - | 18 - | 21 - | 24 | Sum |
|-----|------|------|------|------|------|------|------|------|----|-----|
| 1   | (0)  | 1    | 1    | 0    | 1    | 0    | 0    | 0    |    | (3) |
| 2   | 0    | 1    | 1    | 1    | 1    | 1    | 3    | 2    |    | 10  |
| 3   | 0    | 0    | 0    | 0    | 0    | 0    | 2    | 0    |    | 2   |
| 4   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 1    |    | 1   |
| 5   | 3    | 1    | 0    | 0    | 0    | 2    | 2    | 1    |    | 9   |
| 6   | 0    | 1    | 1    | 1    | 5    | 2    | 4    | 5    |    | 19  |
| 7   | 0    | 1    | 2    | 1    | 3    | 4    | 5    | 5    |    | 21  |
| 8   | 6    | 4    | 3    | 2    | 4    | 5    | 8    | 6    |    | 38  |
| 9   | 5    | 2    | 3    | 2    | 3    | 3    | 6    | 7    |    | 31  |
| 10  | 5    | 5    | 3    | 3    | 4    | 3    | 4    | 4    |    | 31  |
| 11  | 5    | 4    | 2    | 3    | 3    | 4    | 5    | 3    |    | 29  |
| 12  | 3    | 2    | 1    | 1    | 1    | 1    | 1    | 3    |    | 13  |
| 13  | 2    | 1    | 1    | 1    | 1    | 0    | 2    | 2    |    | 10  |
| 14  | 1    | 1    | 1    | 2    | 1    | 0    | 2    | 0    |    | 8   |
| 15  | 0    | 0    | 0    | 1    | 0    | 0    | 1    | 0    |    | 2   |
| 16  | 0    | 1    | 0    | 0    | 0    | 0    | 1    | 2    |    | 4   |
| 17  | 0    | 0    | 0    | 1    | 1    | 2    | 3    | 6    |    | 13  |
| 18  | 5    | 2    | 2    | 2    | 2    | 1    | 2    | 3    |    | 19  |
| 19  | 2    | 1    | 1    | 1    | 1    | 2    | 4    | 2    |    | 14  |
| 20  | 1    | 1    | 1    | 1    | 2    | 3    | 0    | 5    |    | 14  |
| 21  | 5    | 1    | 1    | 3    | 5    | 7    | 7    | 6    |    | 35  |
| 22  | 6    | 5    | 4    | 3    | 3    | 3    | 5    | 6    |    | 35  |
| 23  | 4    | 4    | 4    | 4    | 3    | 4    | 6    | 5    |    | 34  |
| 24  | 4    | 3    | 3    | 3    | 3    | 4    | 5    | 4    |    | 29  |
| 25  | 4    | 4    | 2    | 4    | 4    | 6    | 6    | 4    |    | 34  |
| 26  | 6    | 4    | 3    | 4    | 4    | 5    | 3    | 6    |    | 35  |
| 27  | 5    | 3    | 2    | 2    | 2    | 1    | 3    | 4    |    | 22  |
| 28  | 3    | 1    | 1    | 0    | 1    | 2    | 1    | 2    |    | 11  |
| 29  | 2    | 1    | 0    | 1    | 2    | 3    | 1    | 1    |    | 11  |
| 30  | 1    | 1    | 1    | 0    | 1    | 0    | 2    | 2    |    | 8   |
| 31  | 1    | 1    | 1    | 1    | 5    | 4    | 5    | 4    |    | 22  |
| Sum | 79   | 57   | 45   | 48   | 66   | 72   | 99   | 101  |    |     |



# **ALL-SKY CAMERA KEOGRAMS**

October - December 2016

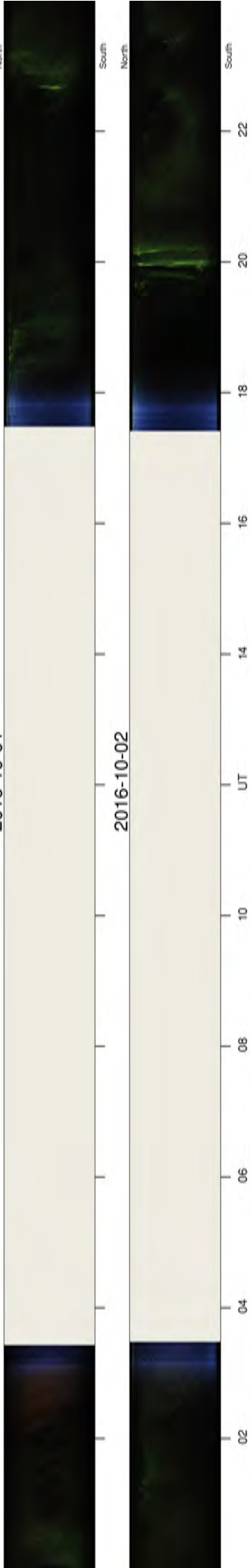
<http://www.irf.se/allsky/kgd>

Camera fault 2016-10-20–2016-10-22, 2016-11-22

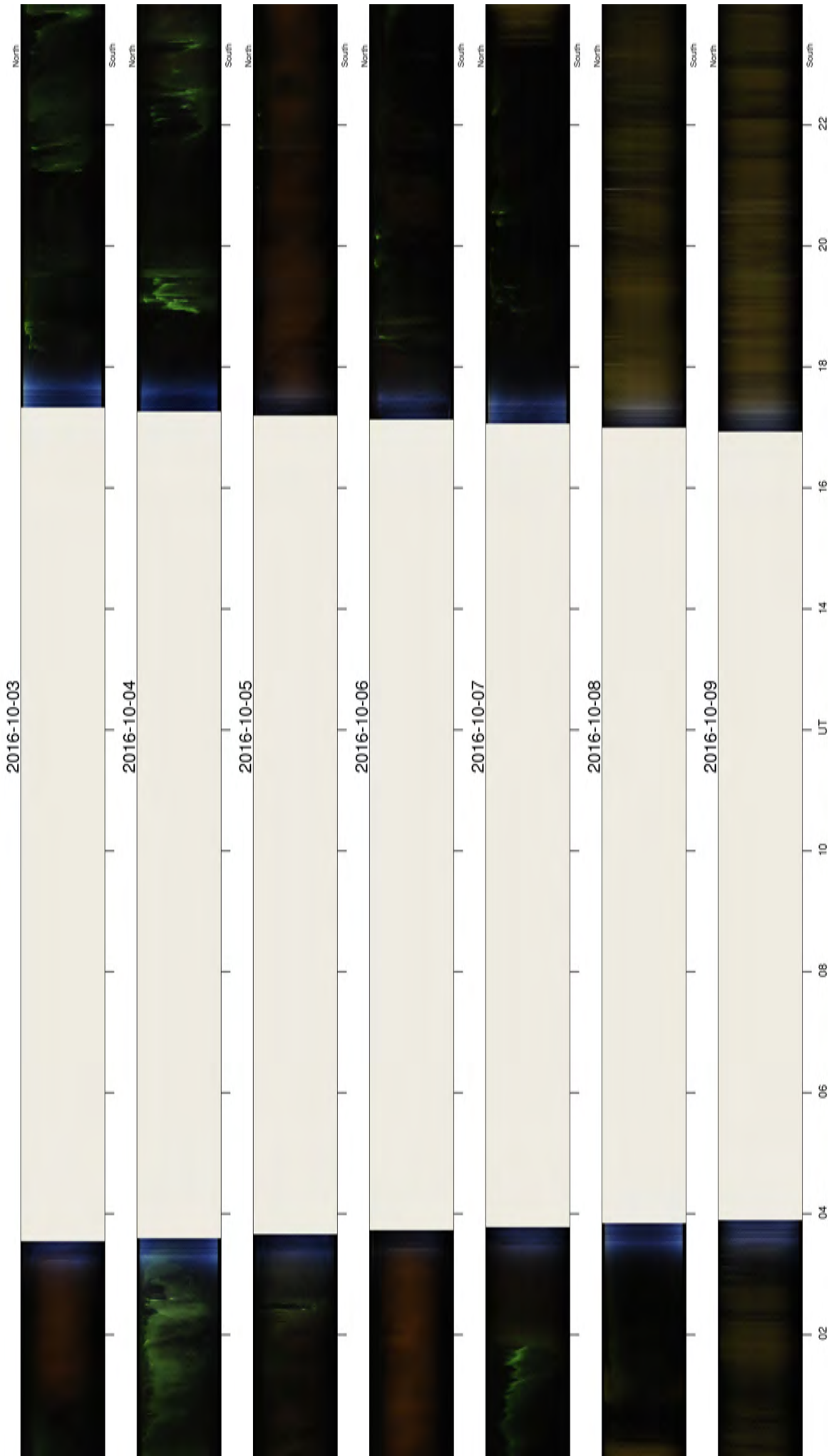


# Kiruna keogram

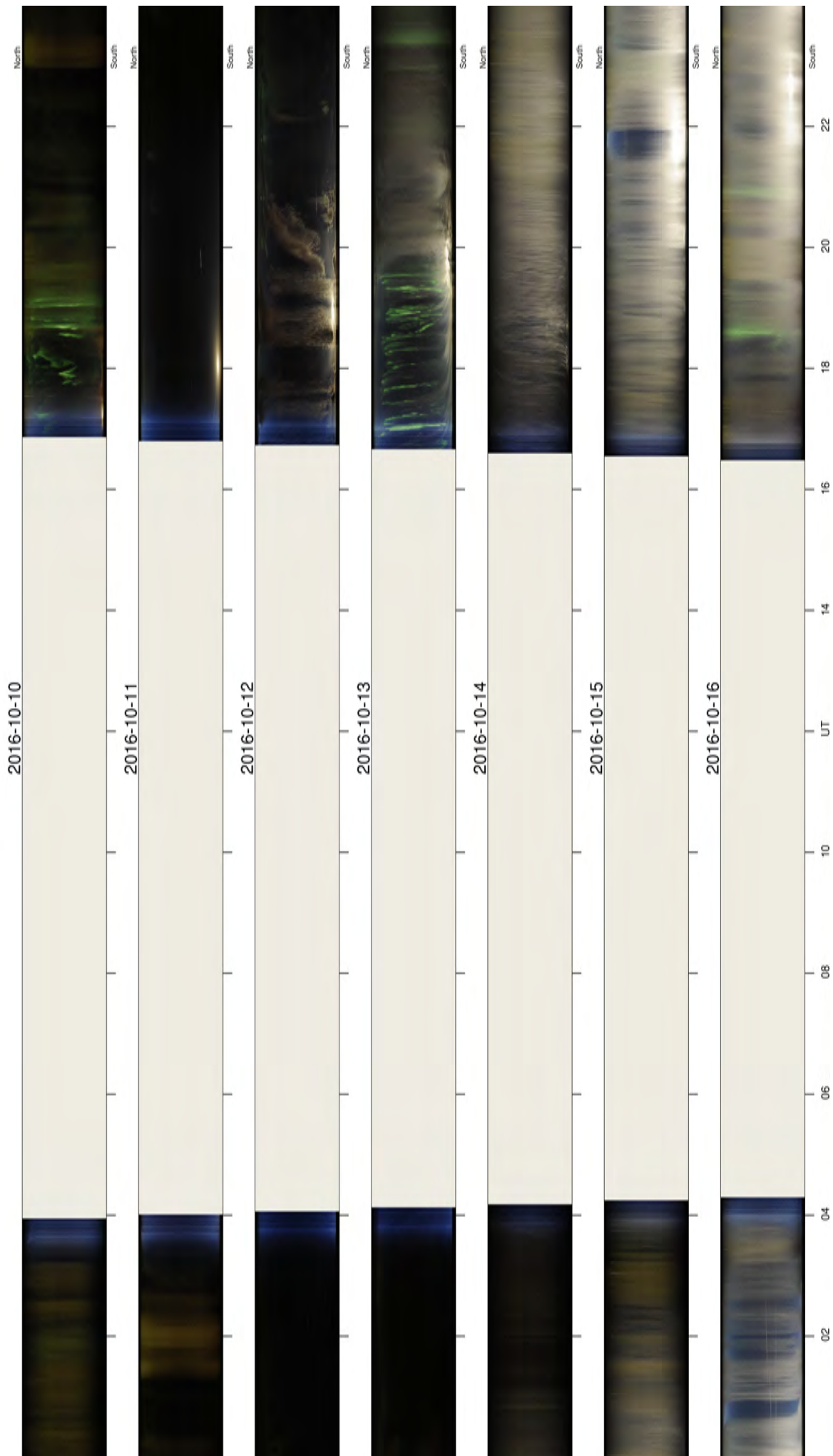
2016-10-01



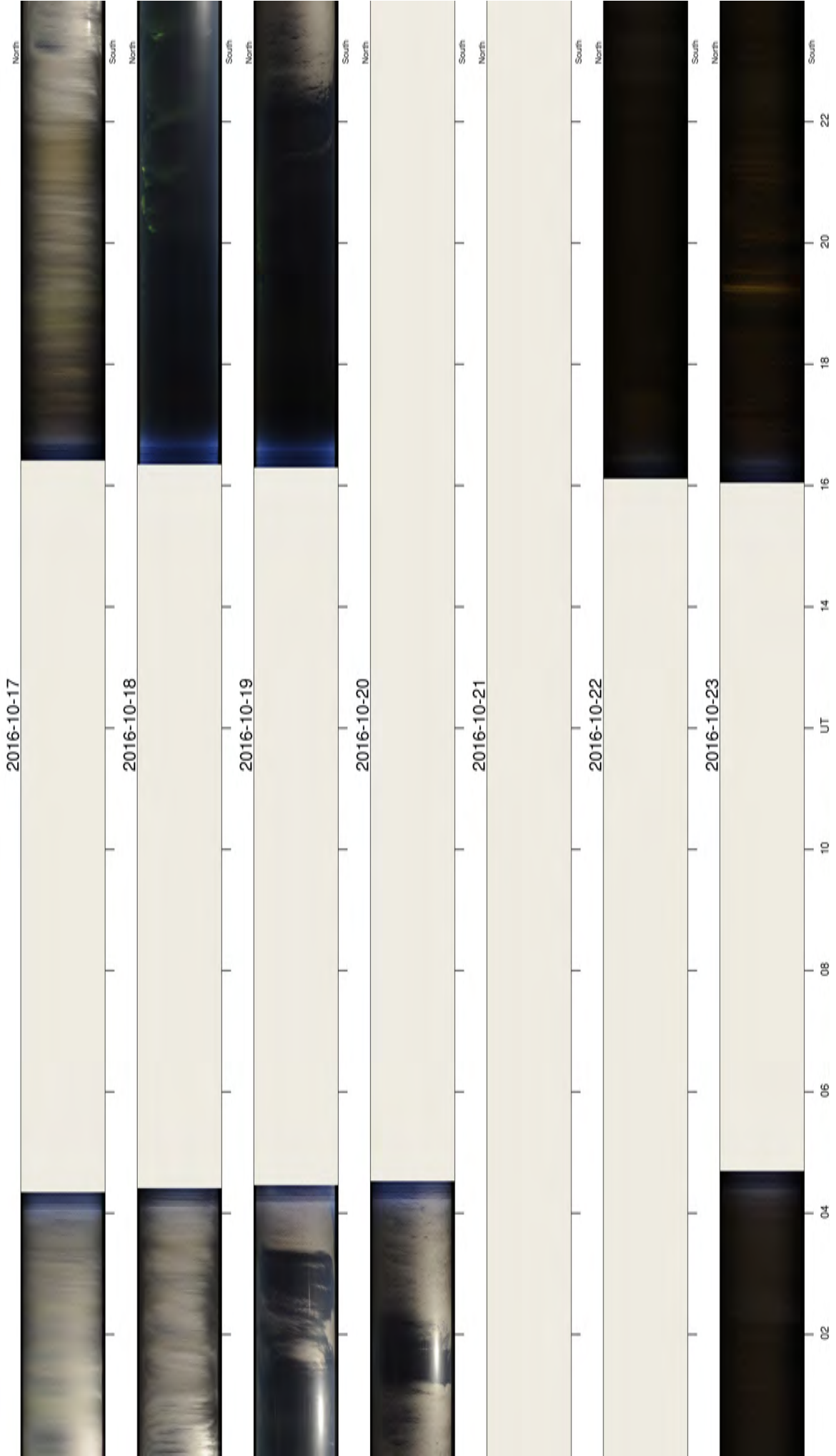
# Kiruna keogram



# Kiruna keogram

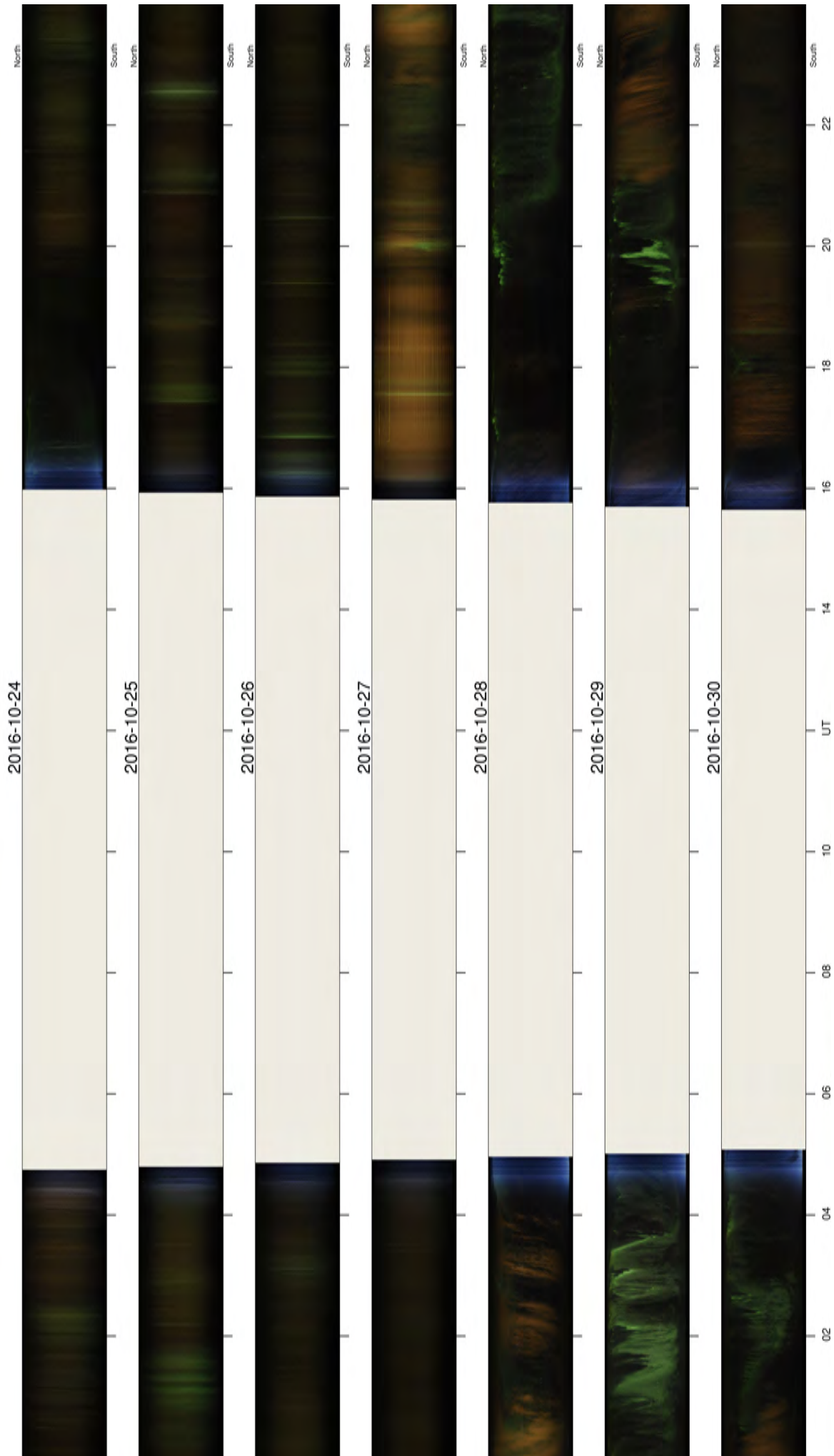


# Kiruna keogram

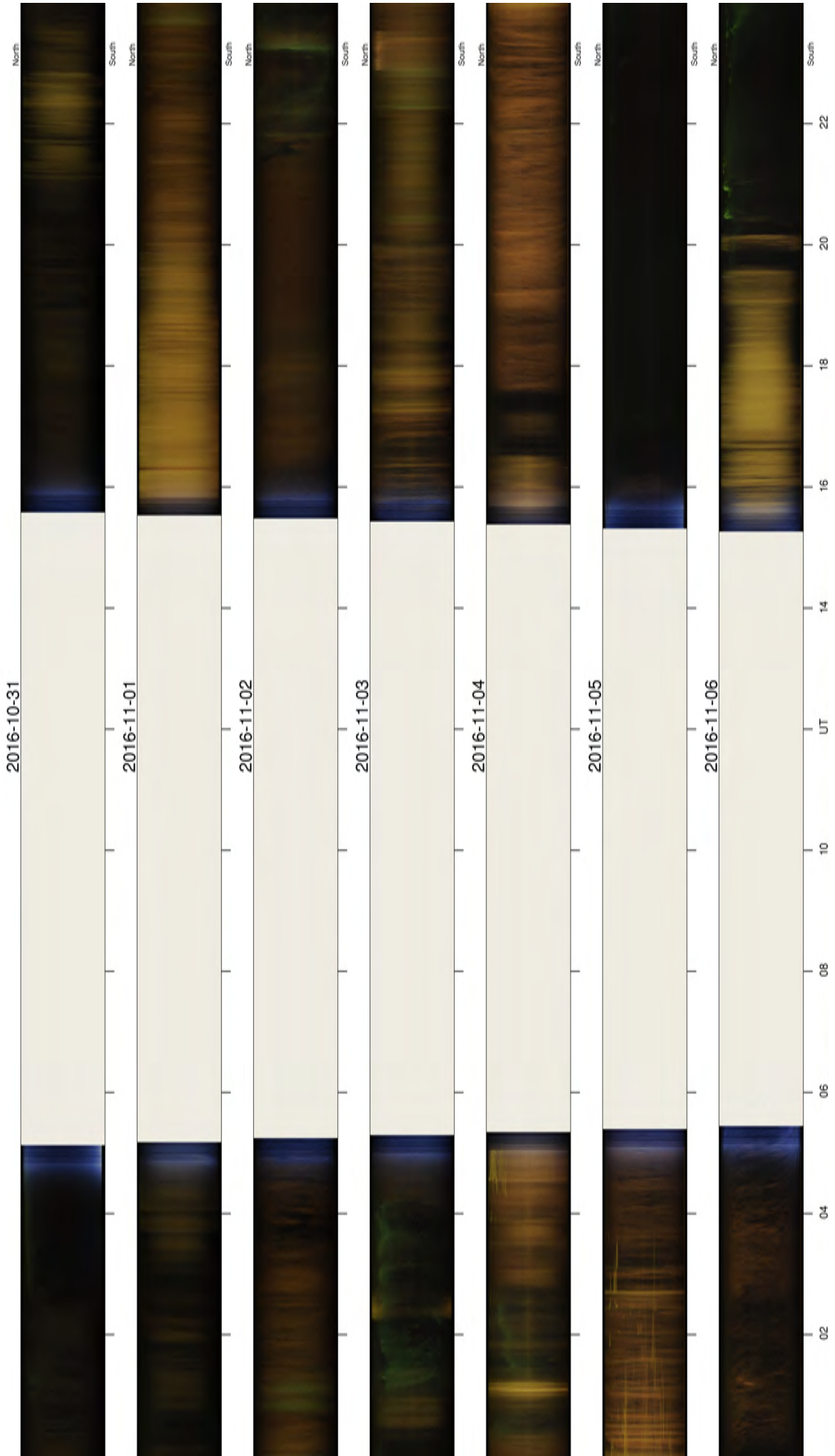




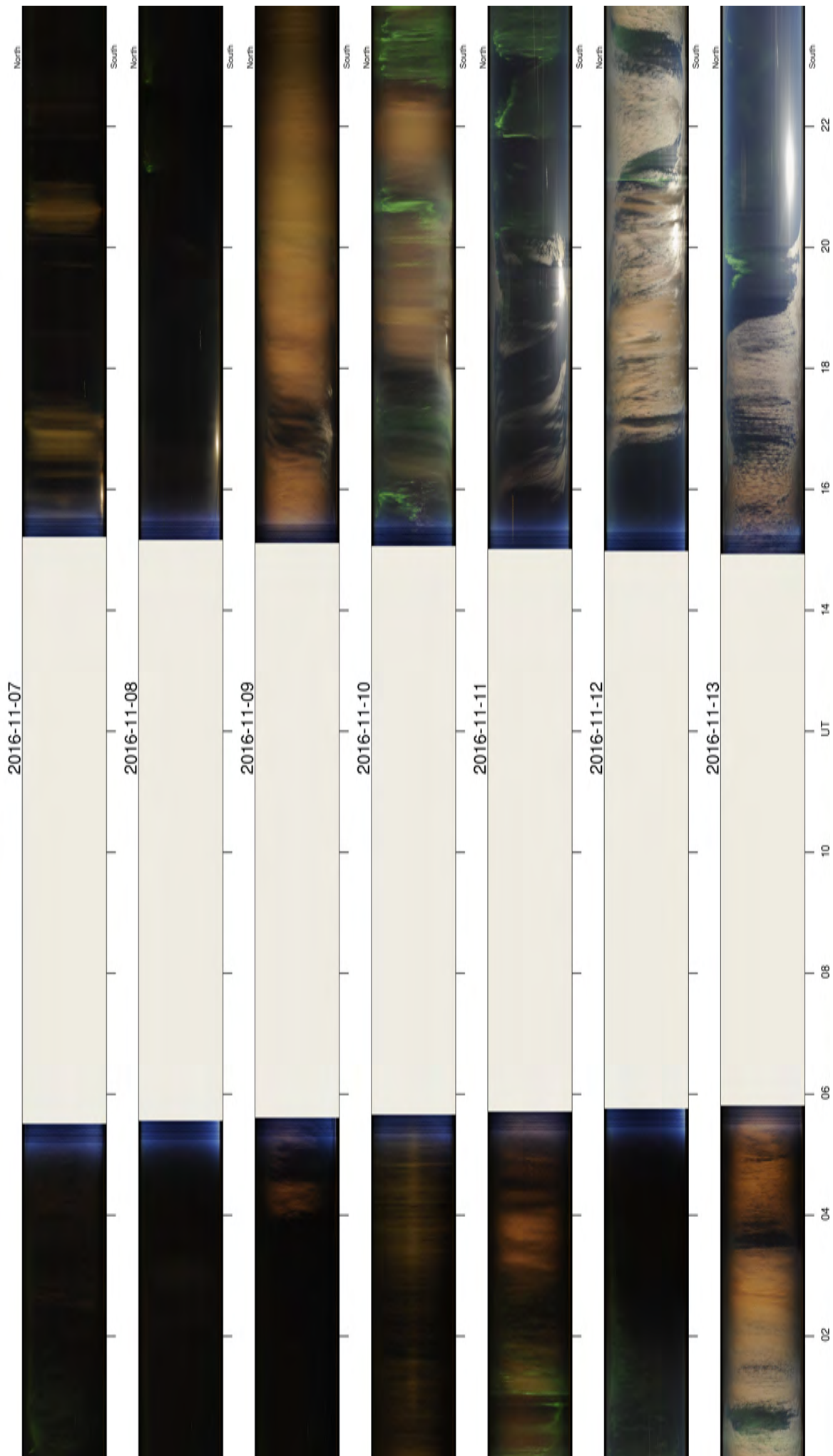
# Kiruna keogram



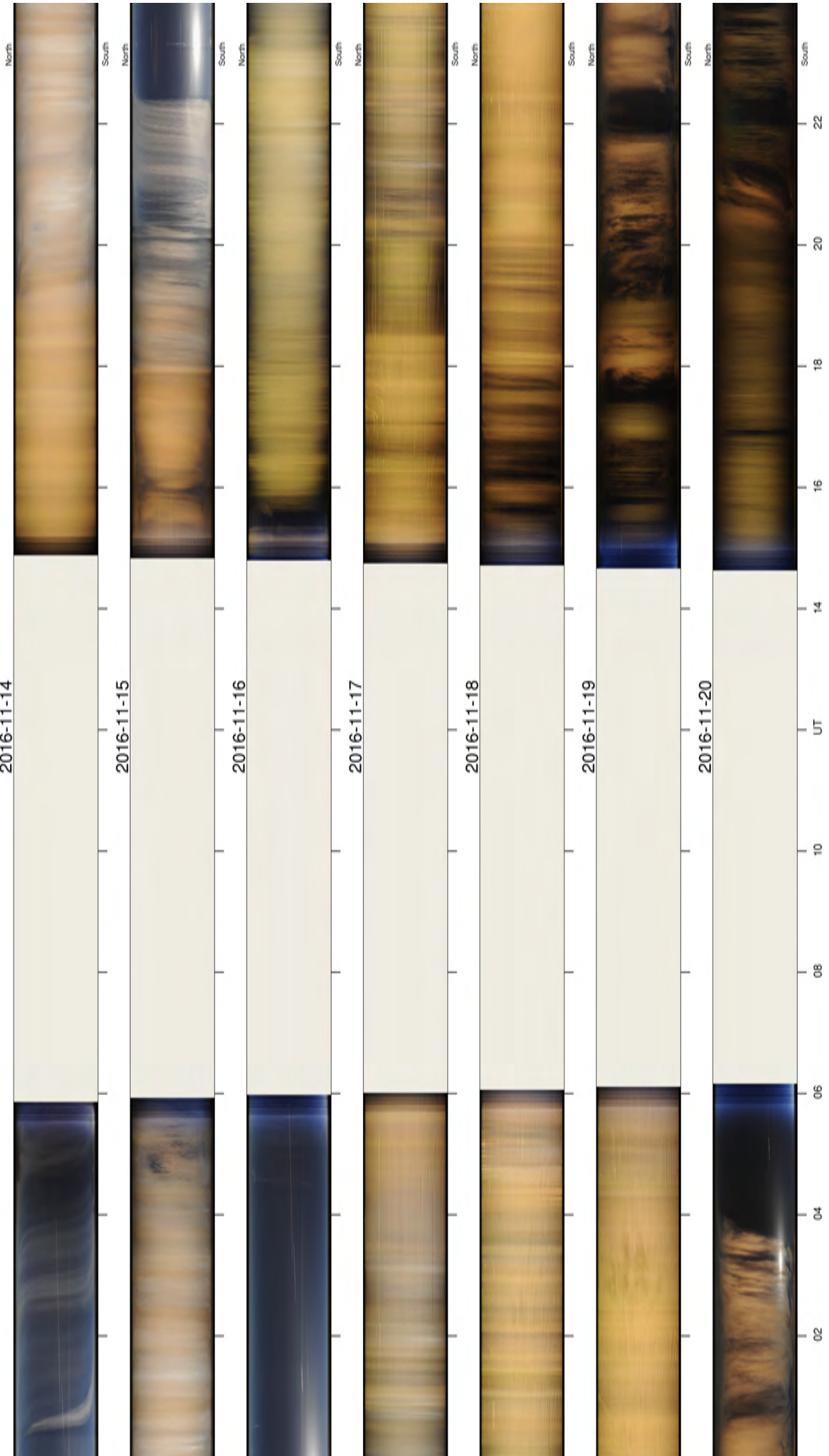
# Kiruna keogram



# Kiruna keogram

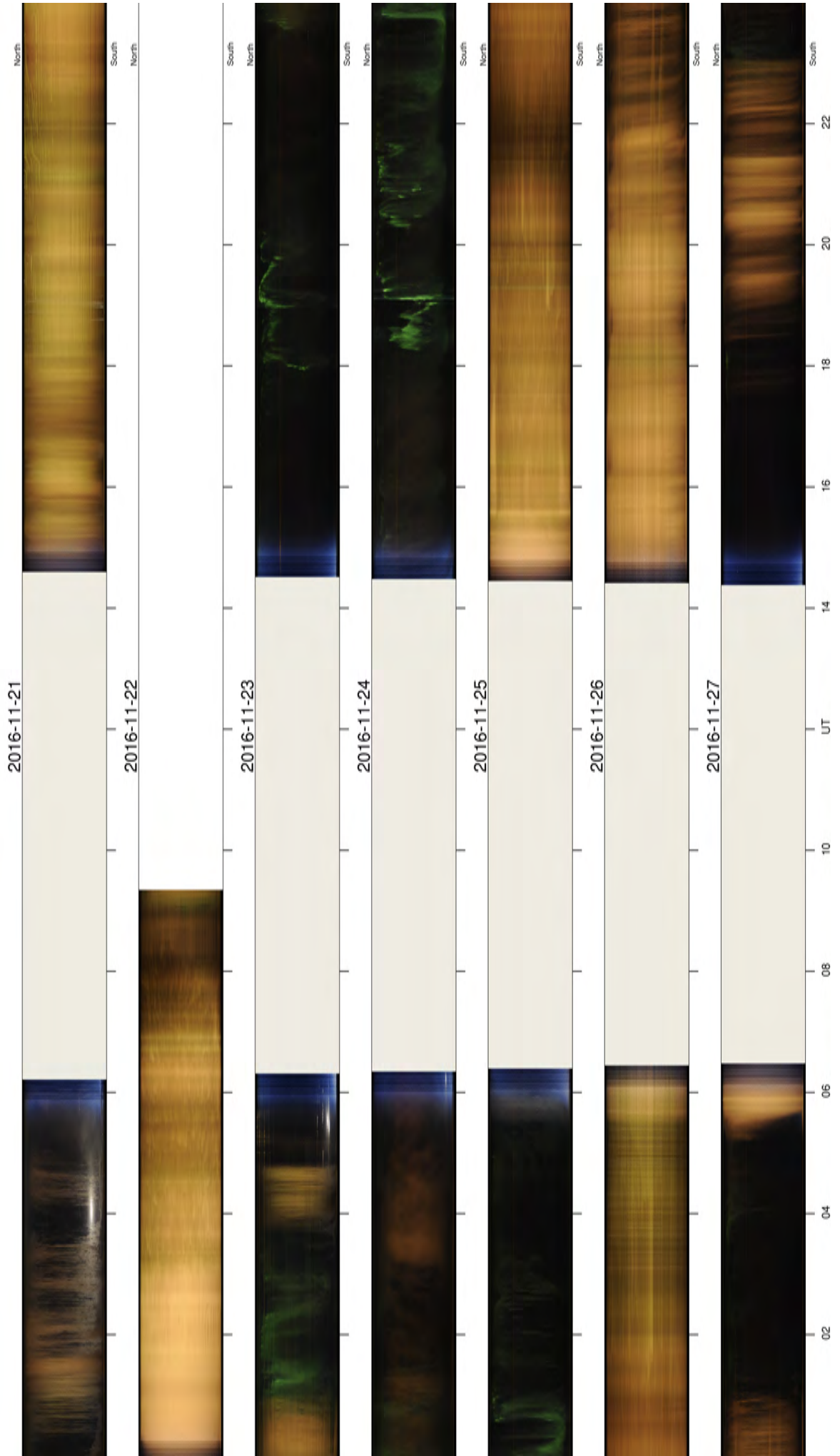


# Kiruna keogram

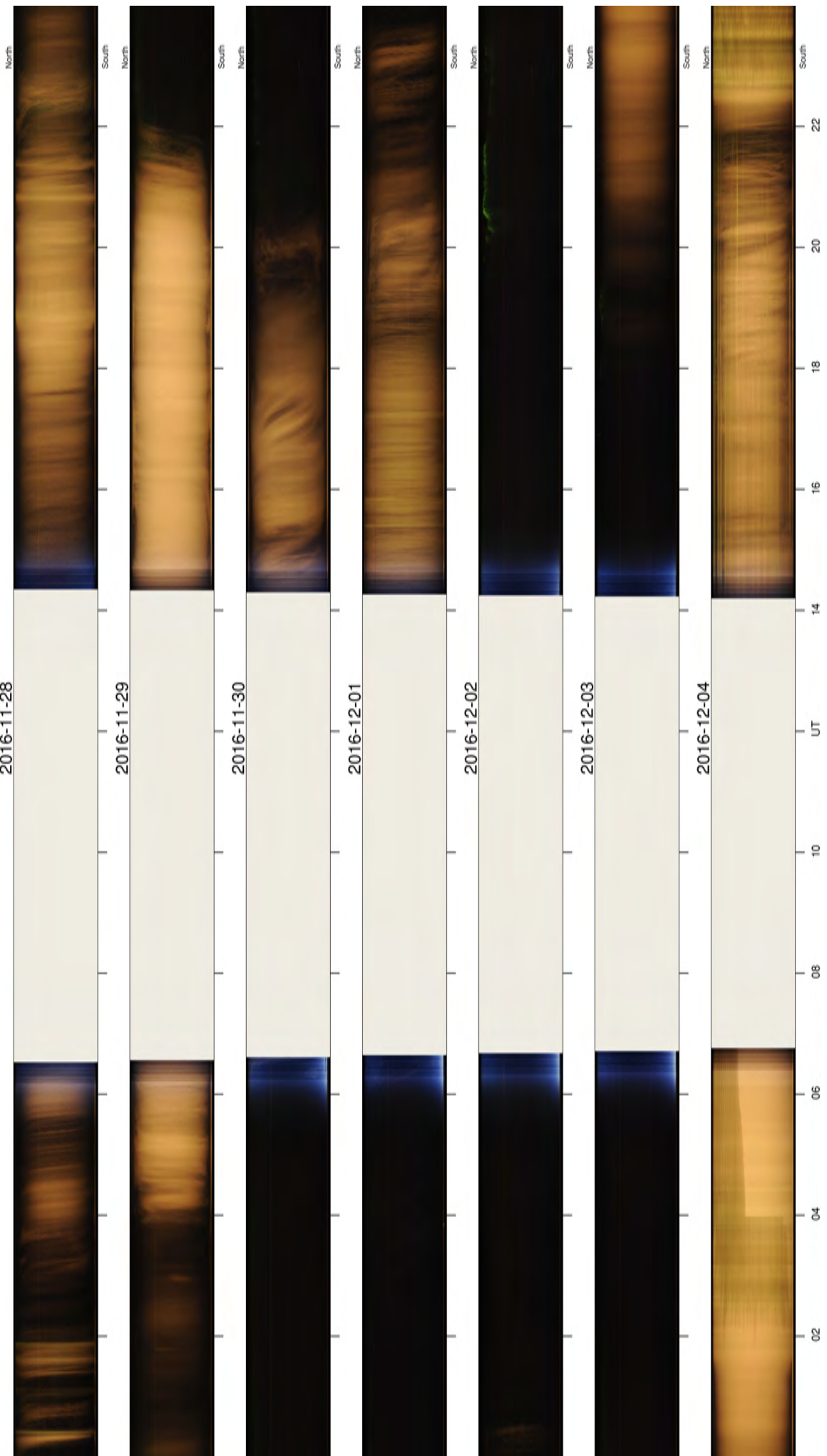




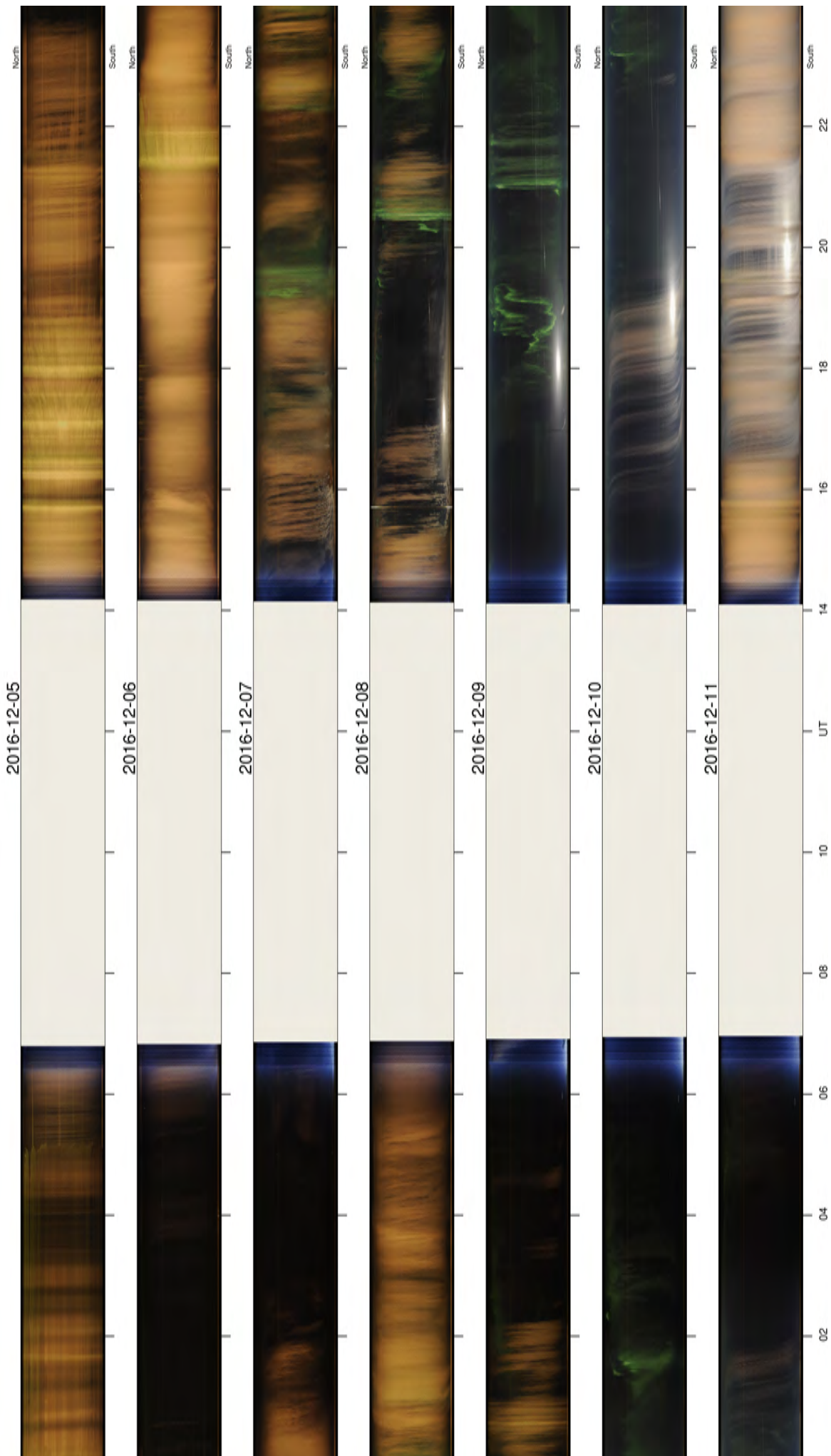
# Kiruna keogram



# Kiruna keogram

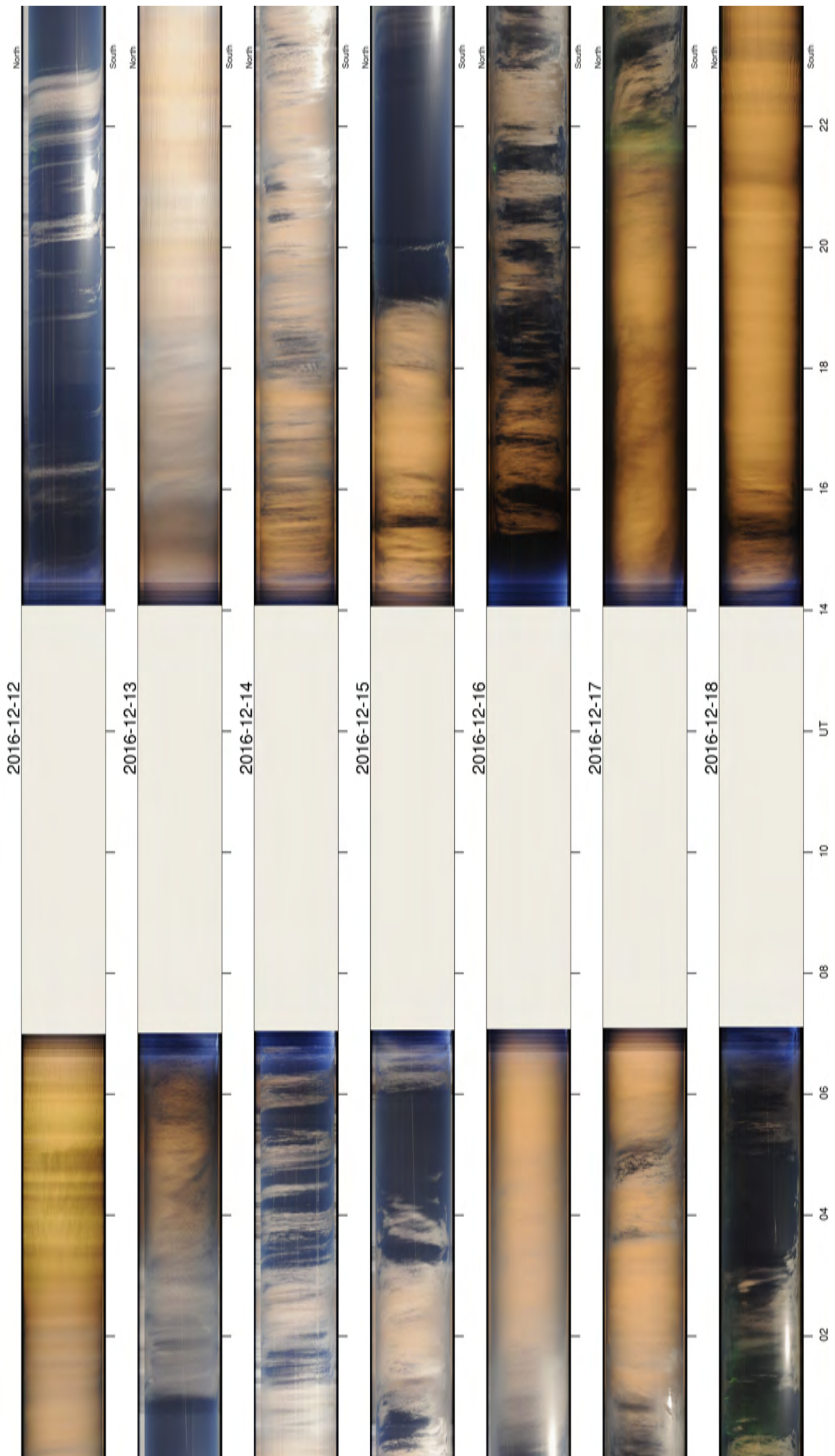


# Kiruna keogram



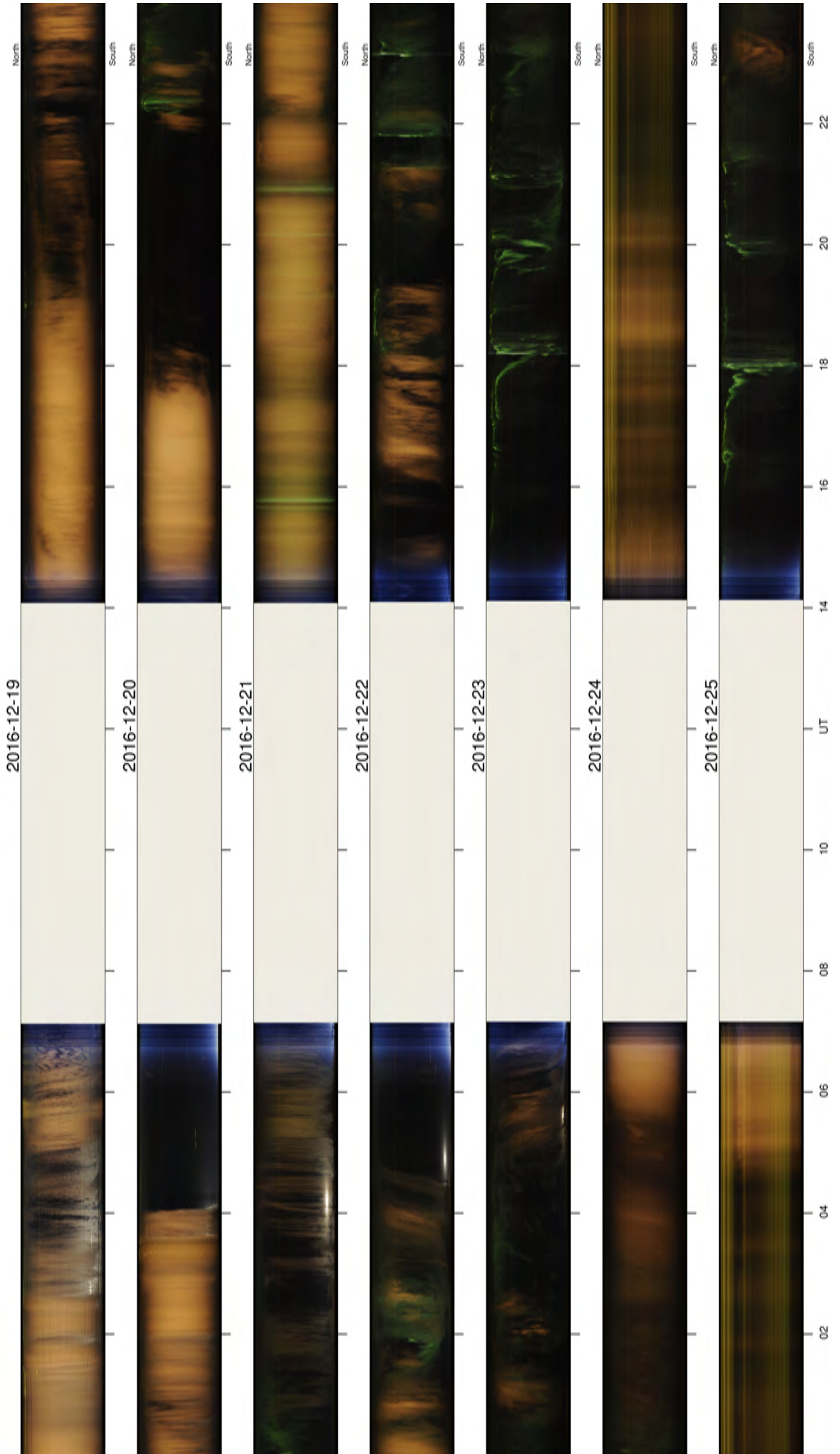


# Kiruna keogram

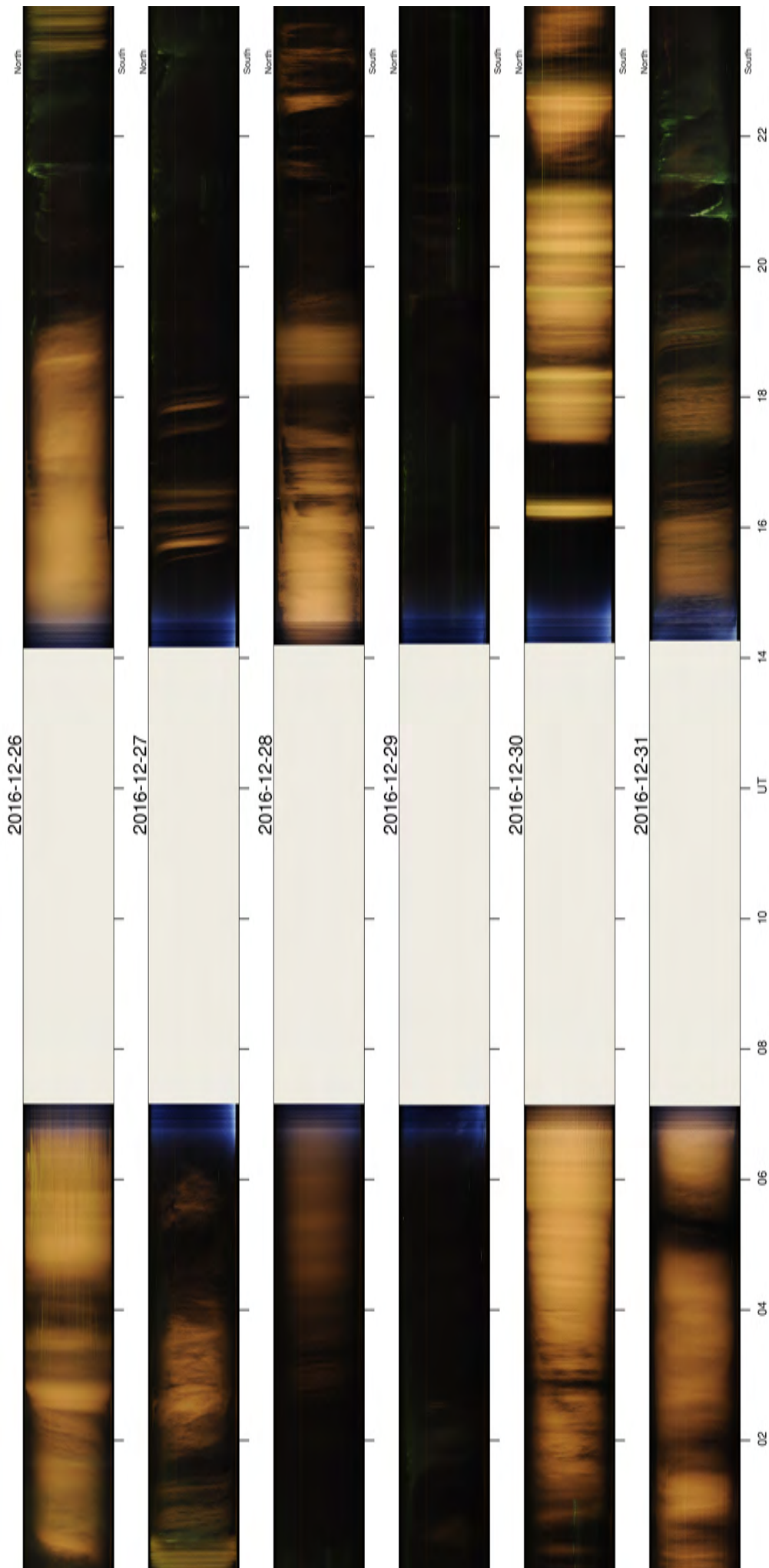




# Kiruna keogram



# Kiruna keogram



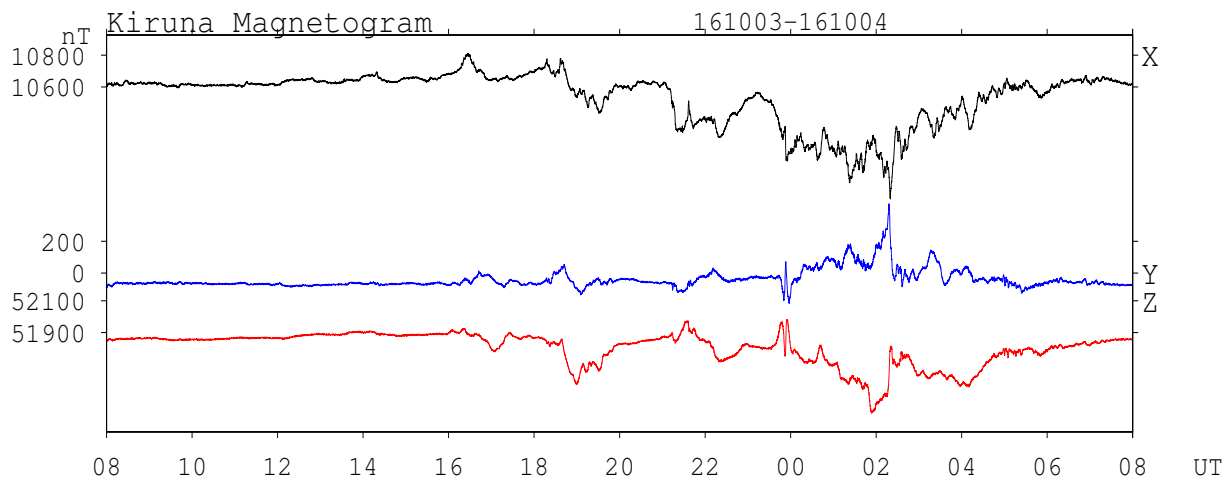
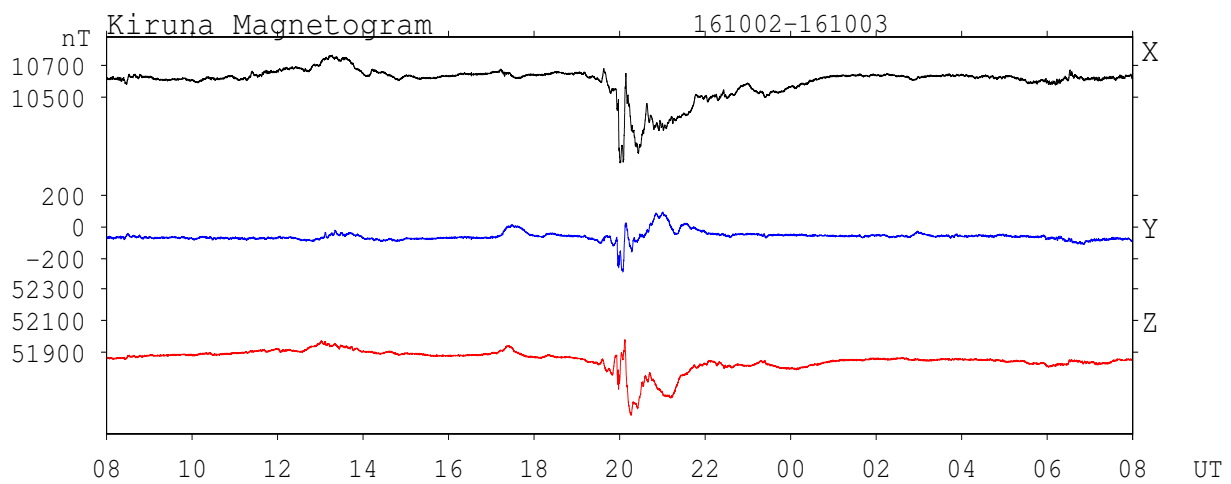
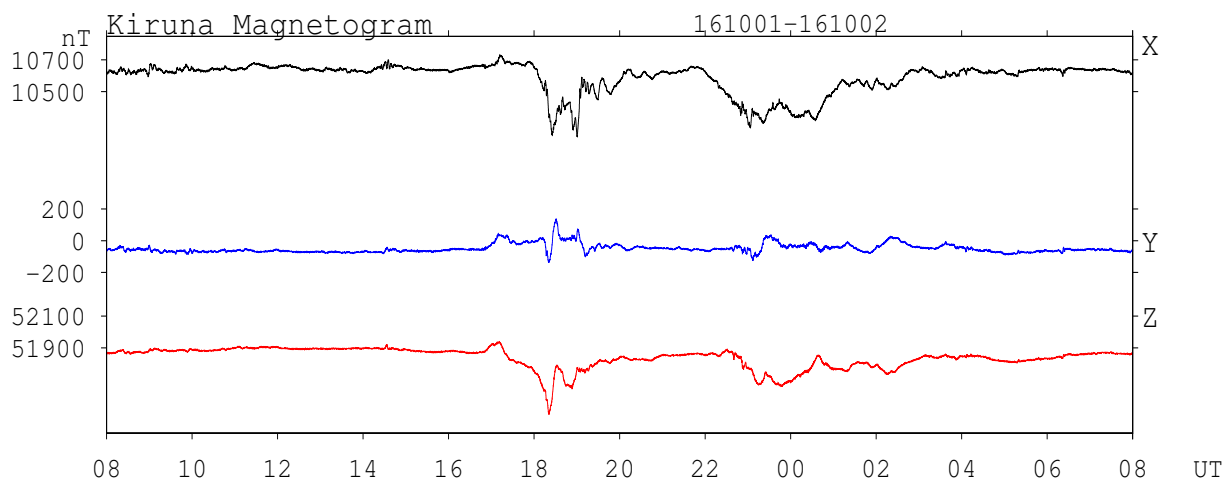
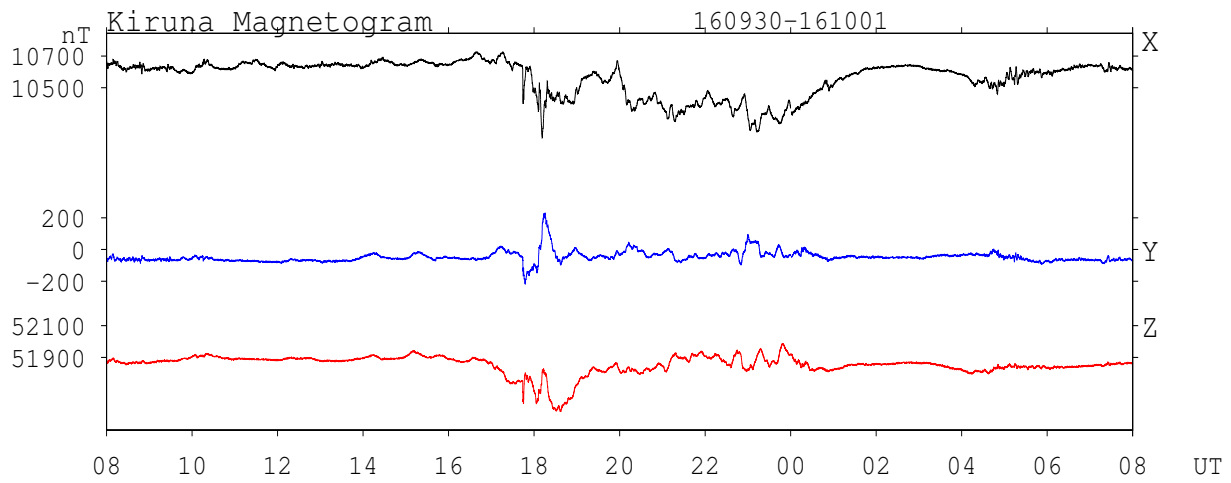
# **KIRUNA MAGNETOGRAM PLOTS**

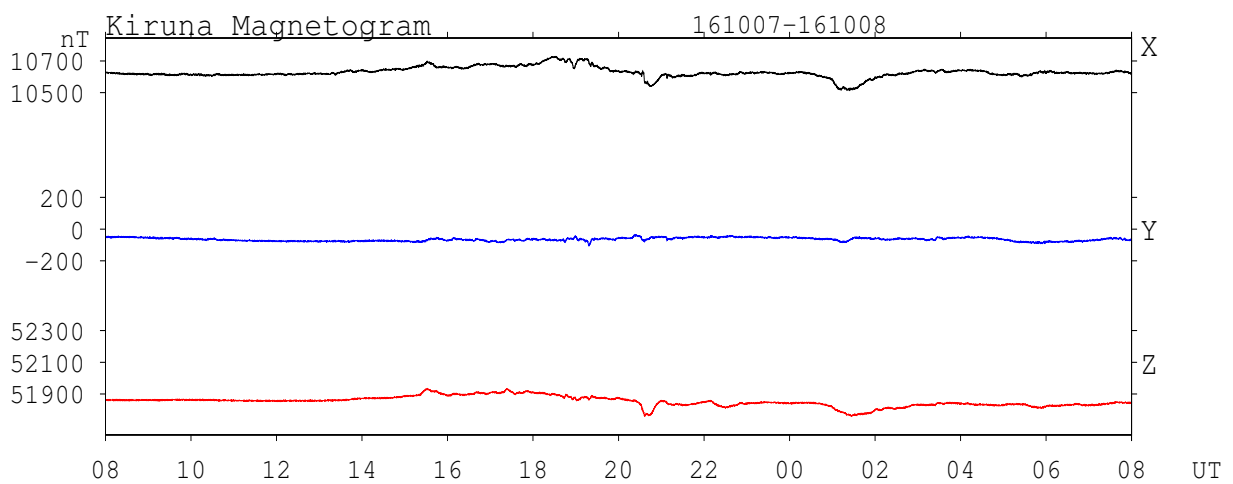
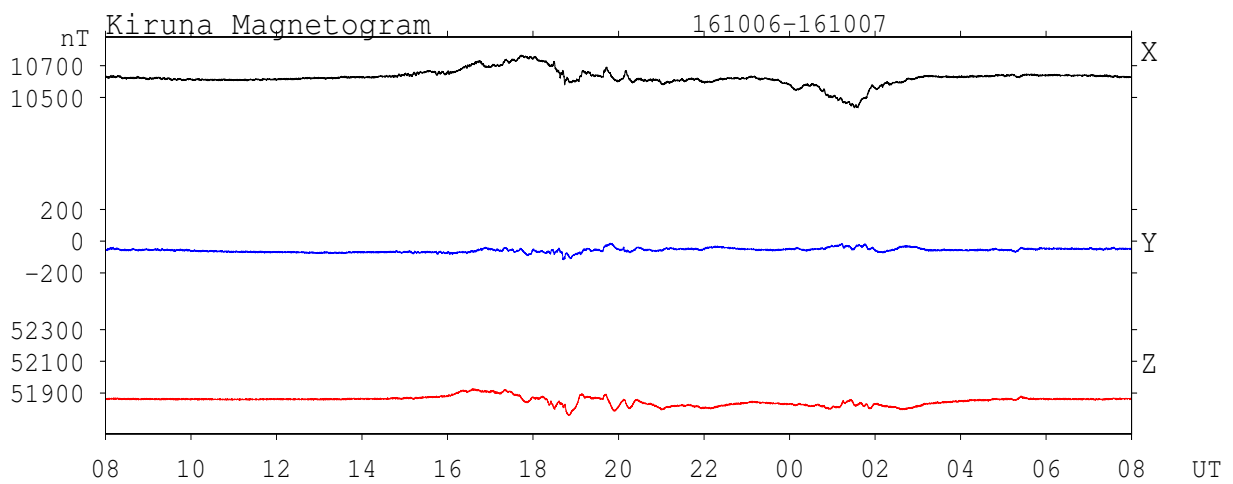
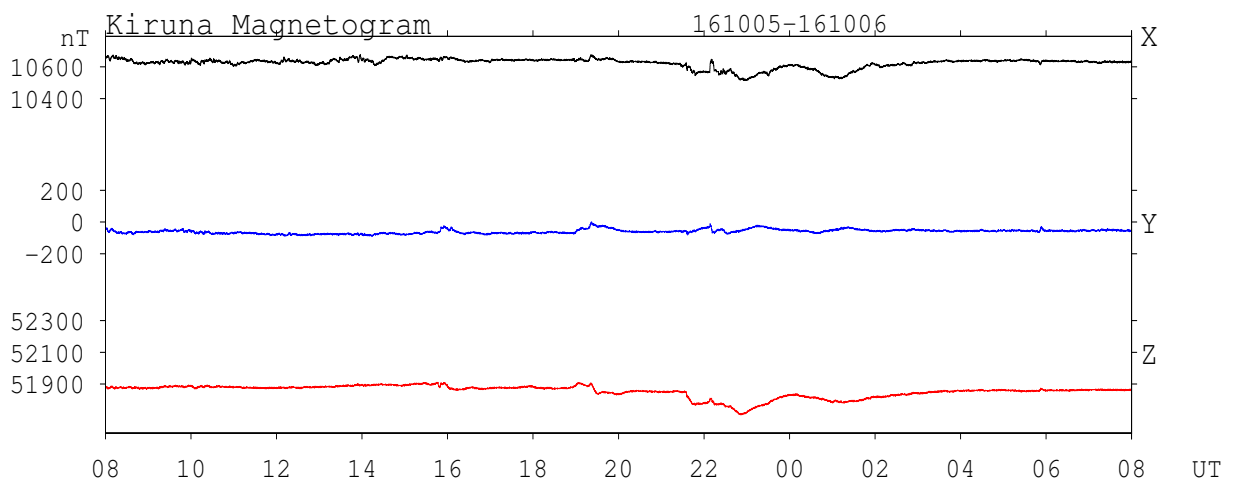
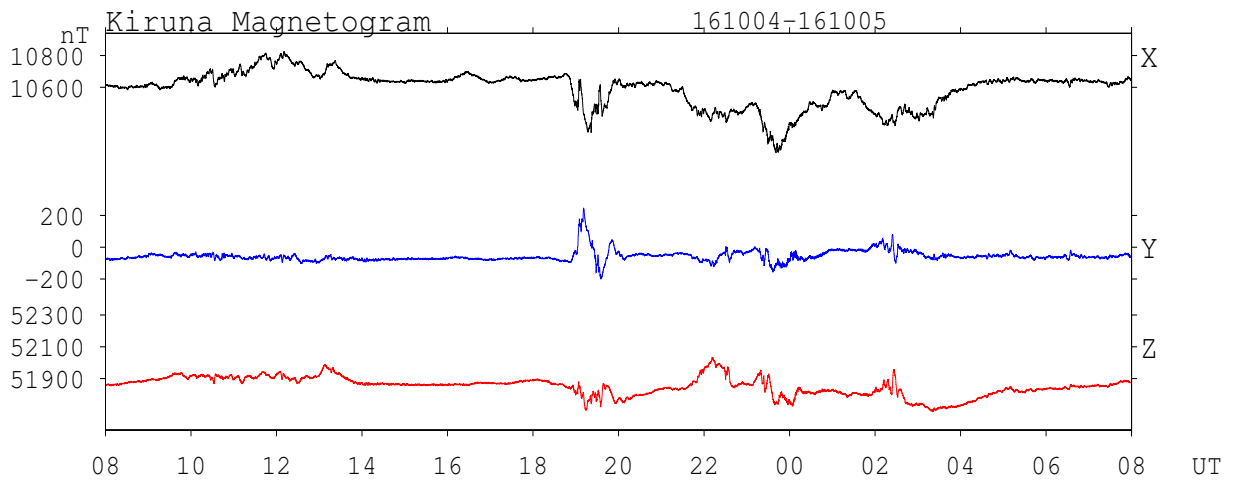
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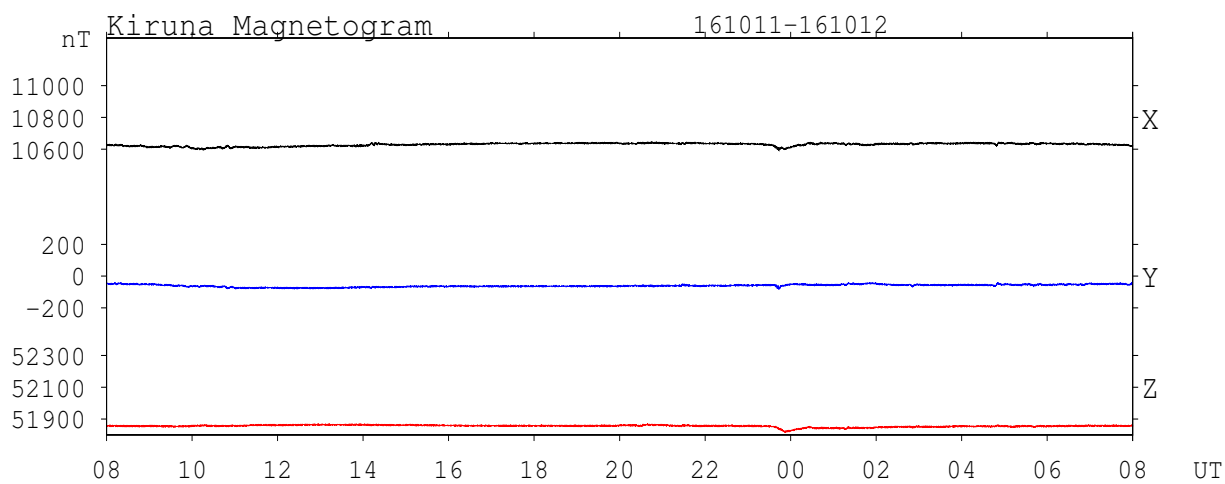
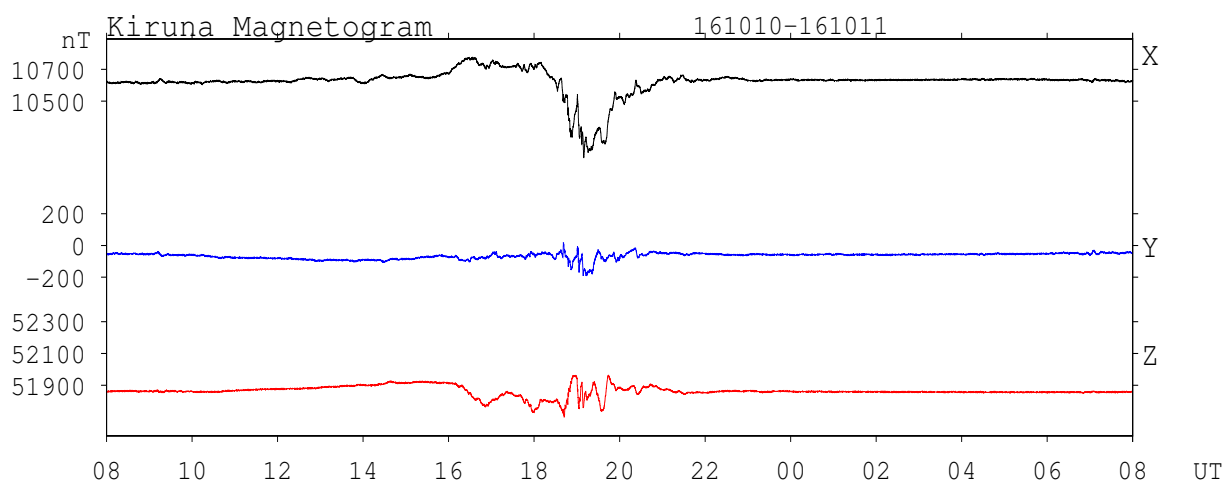
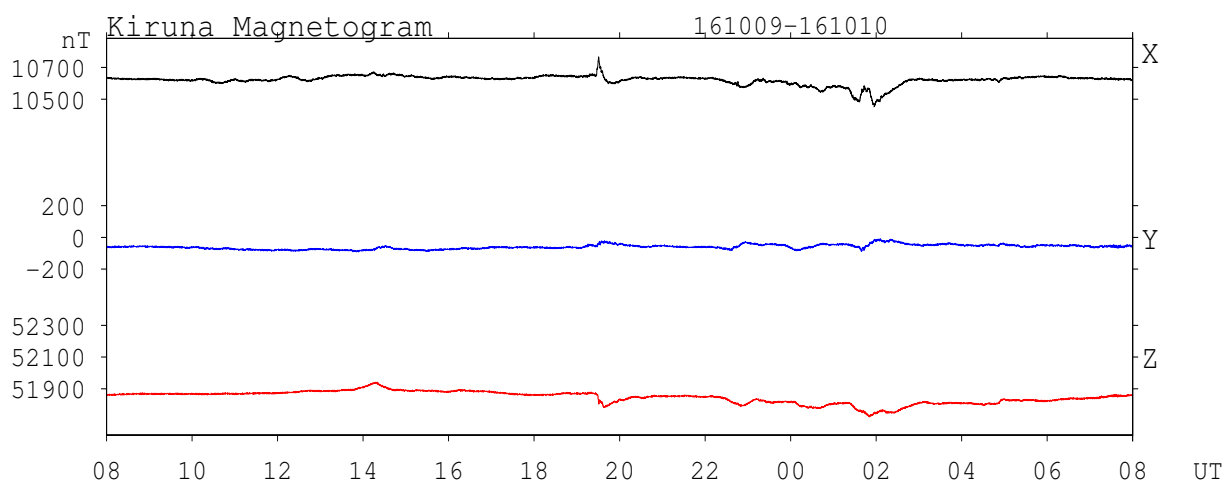
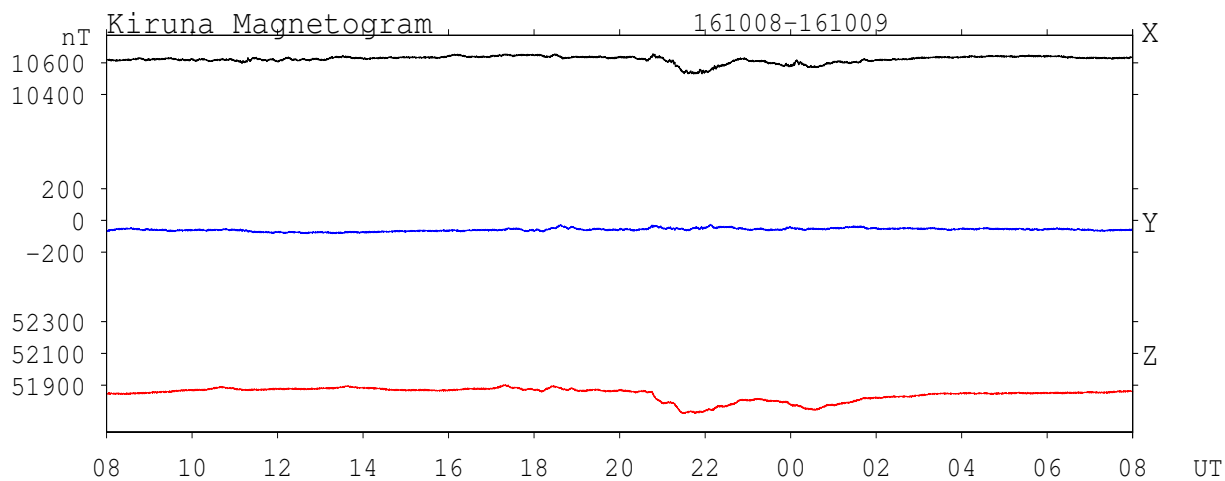
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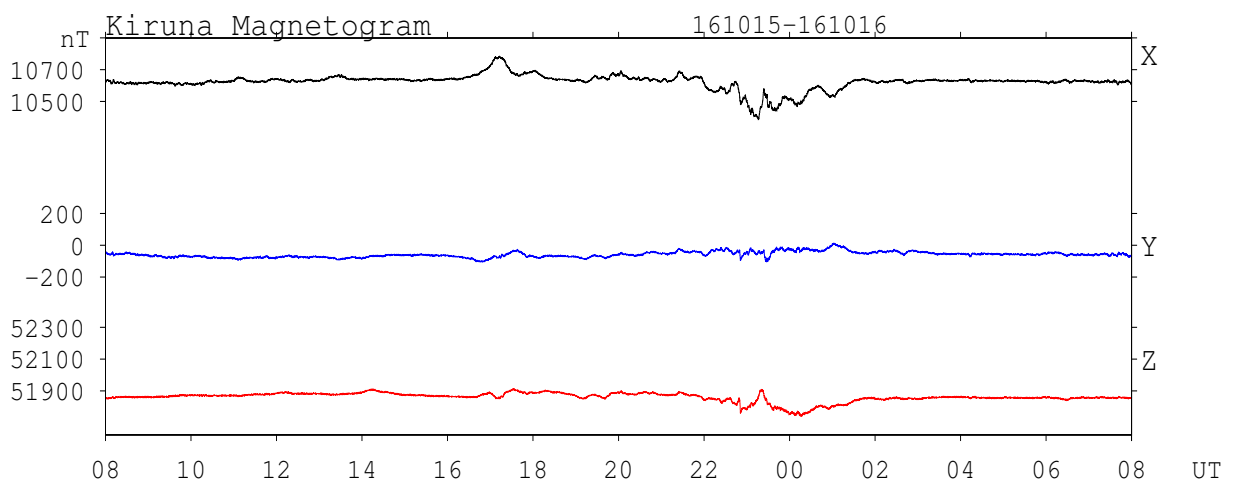
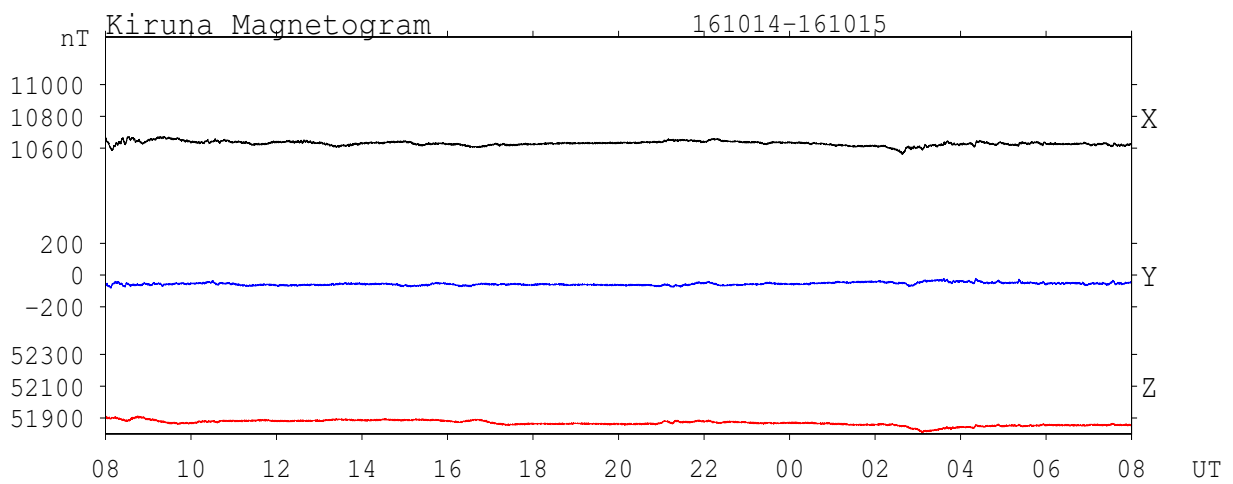
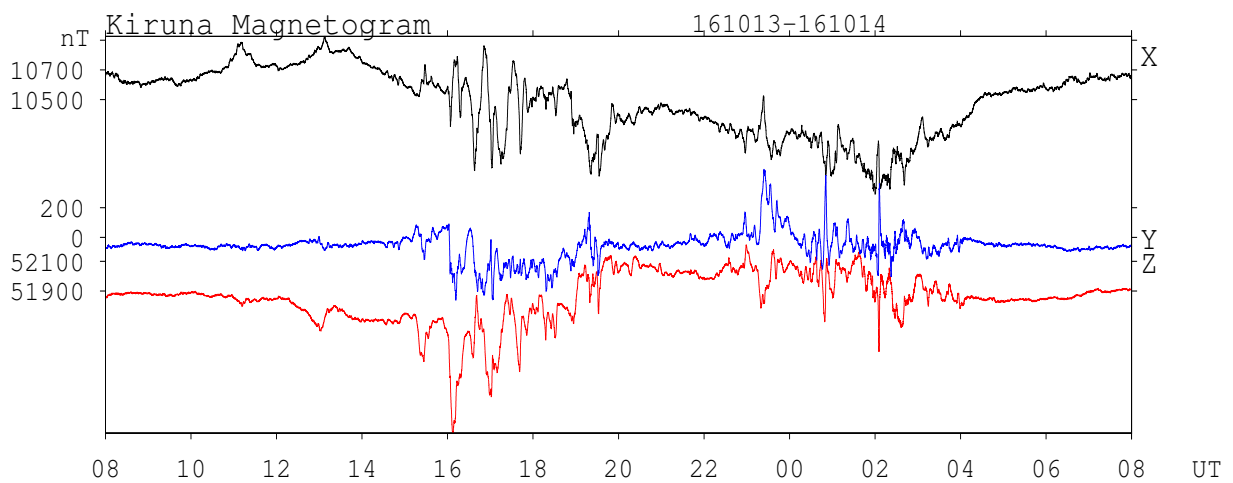
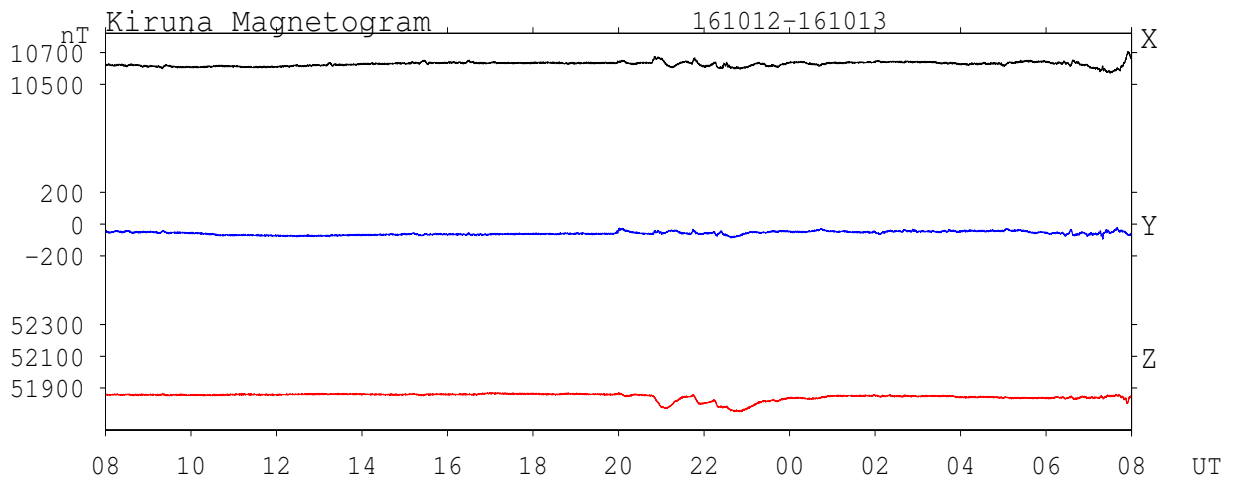
Note on scaling: Scaling for 161025 is 300 nT instead of 200 nT.



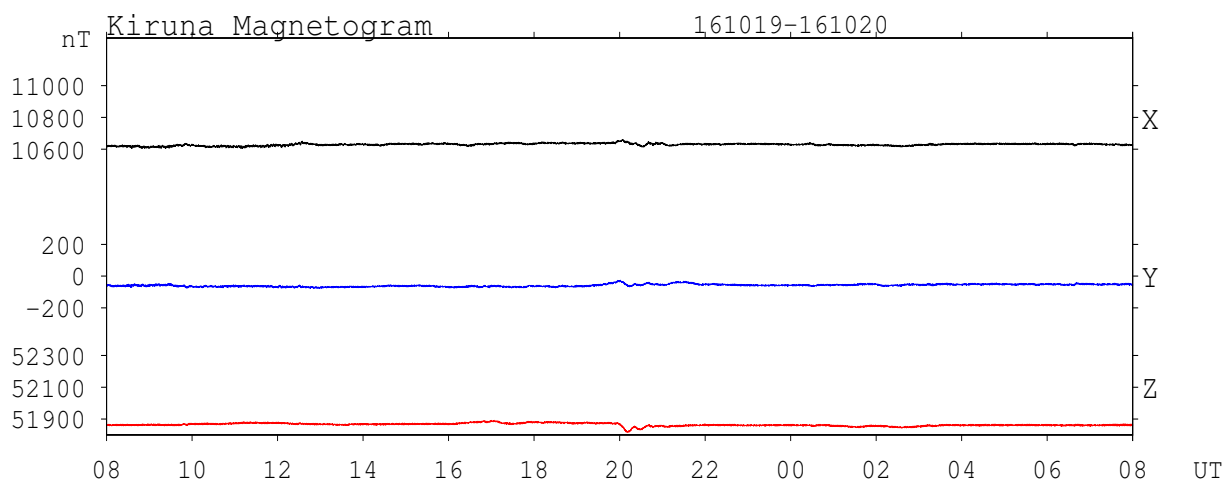
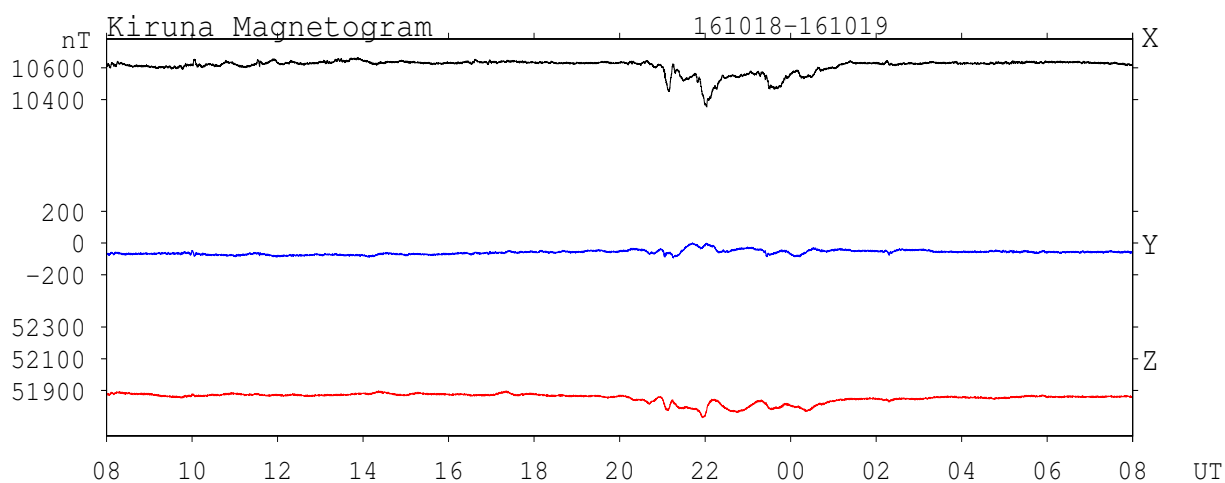
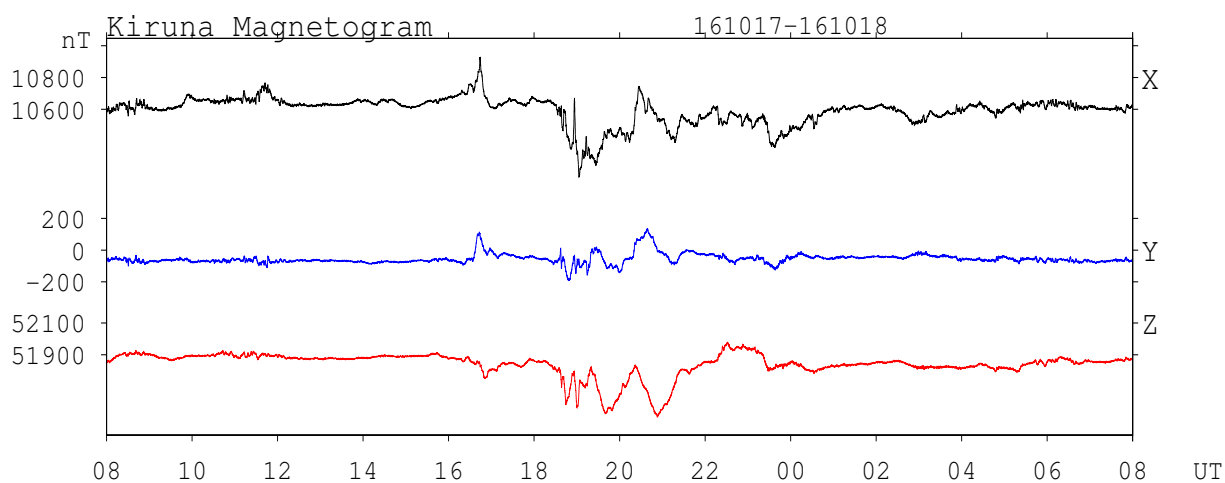
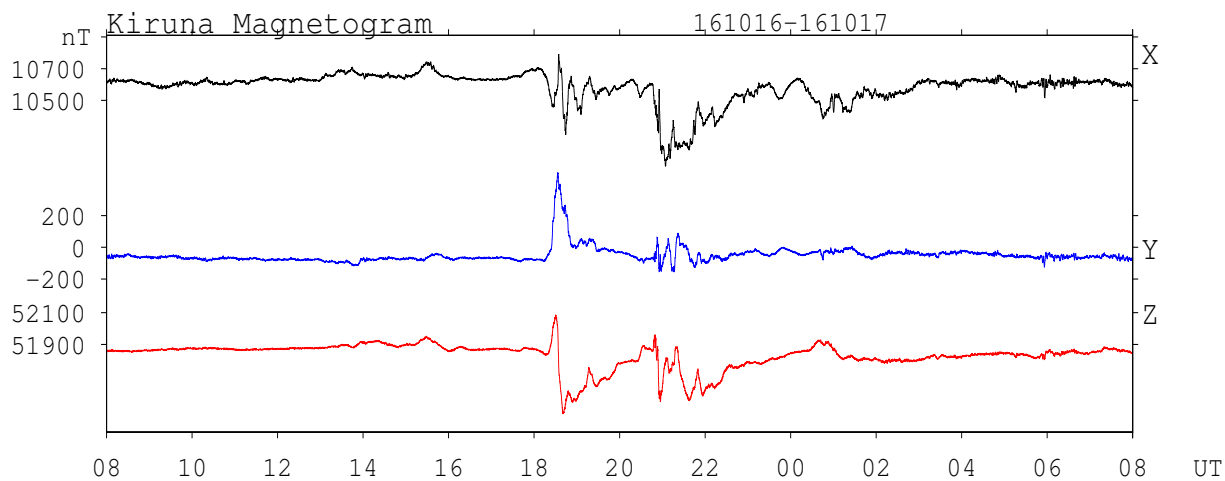


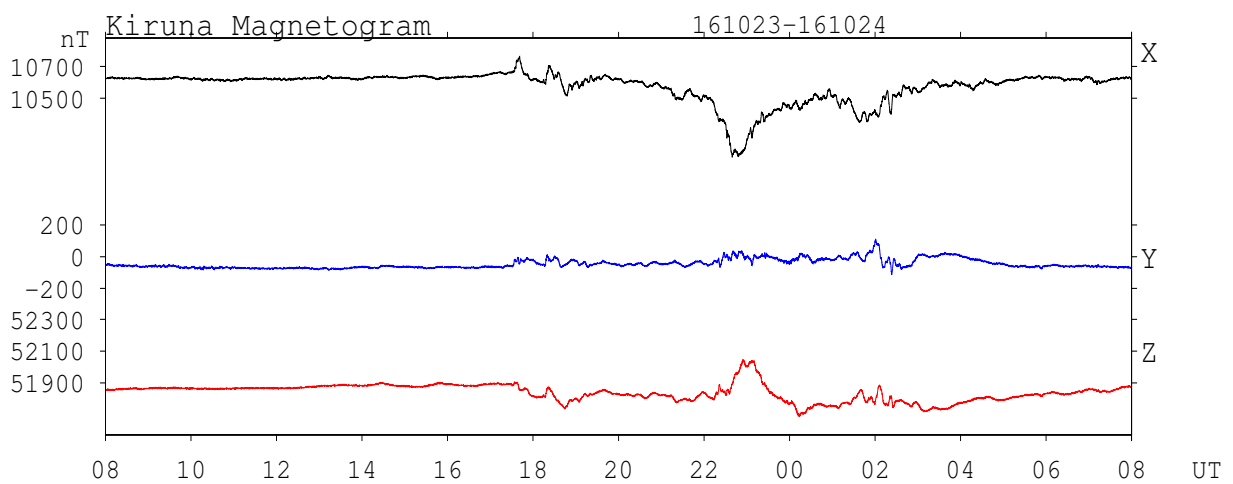
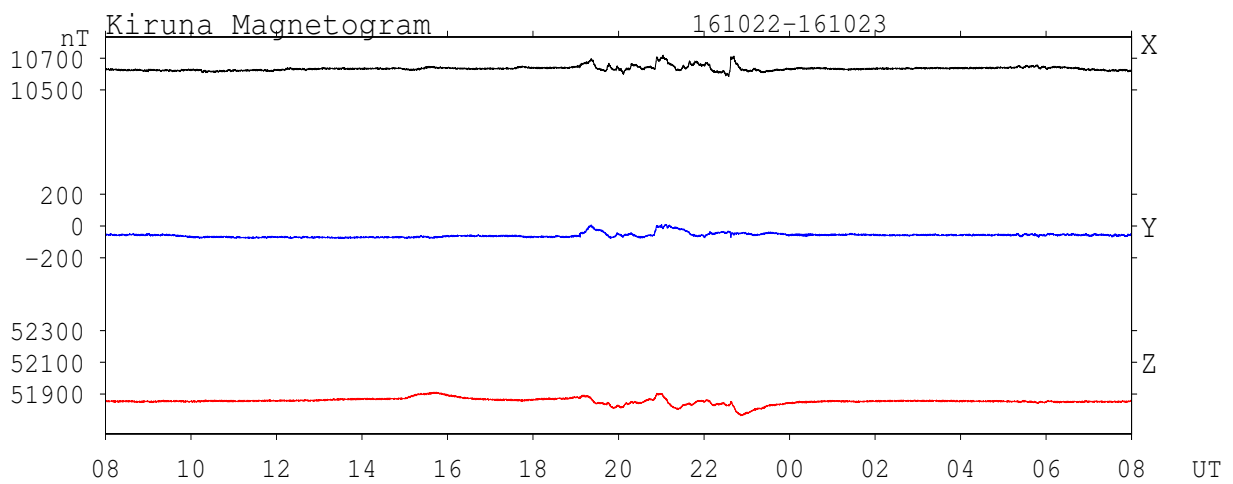
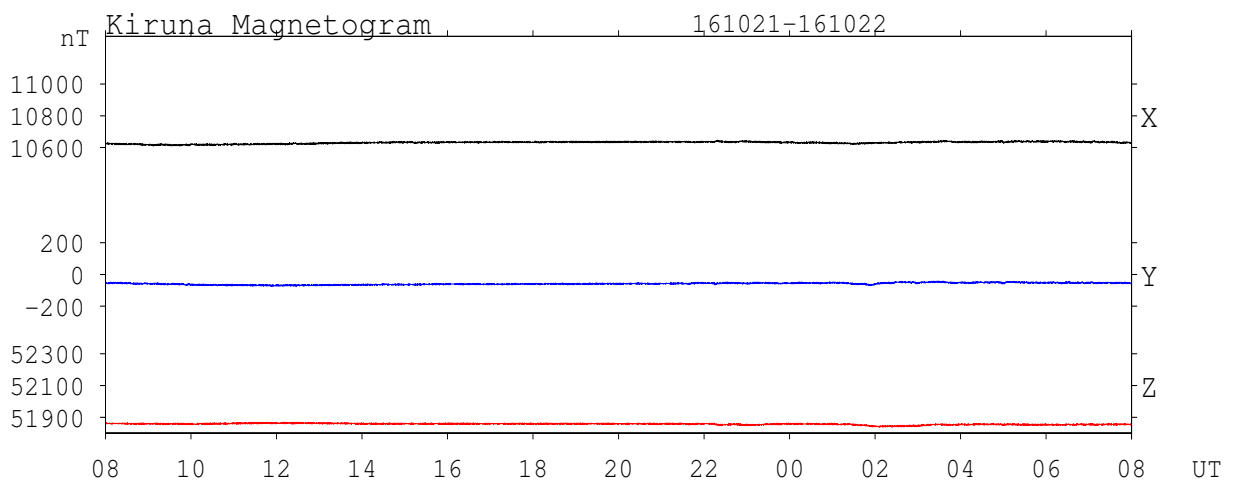
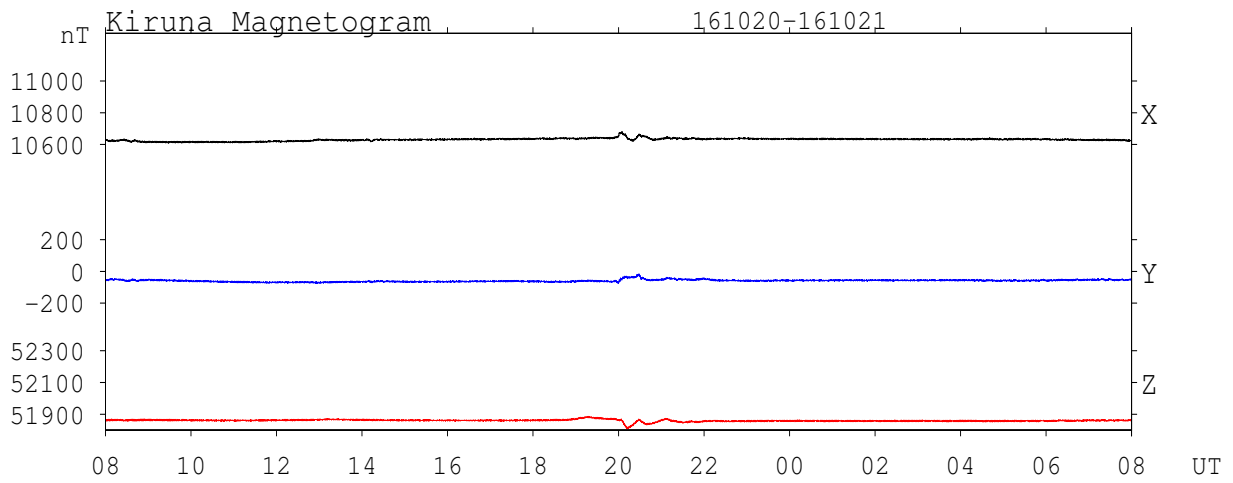


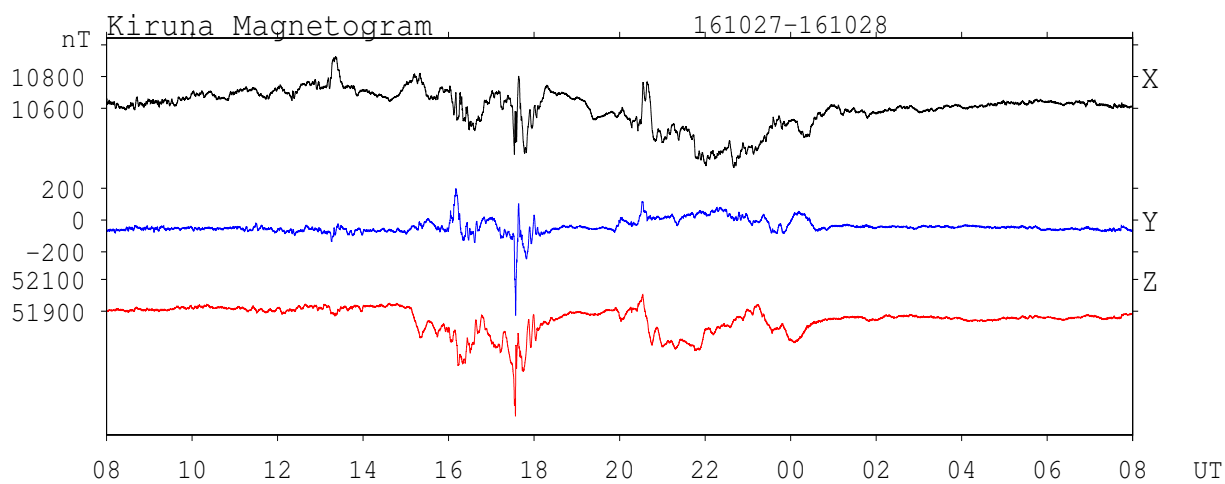
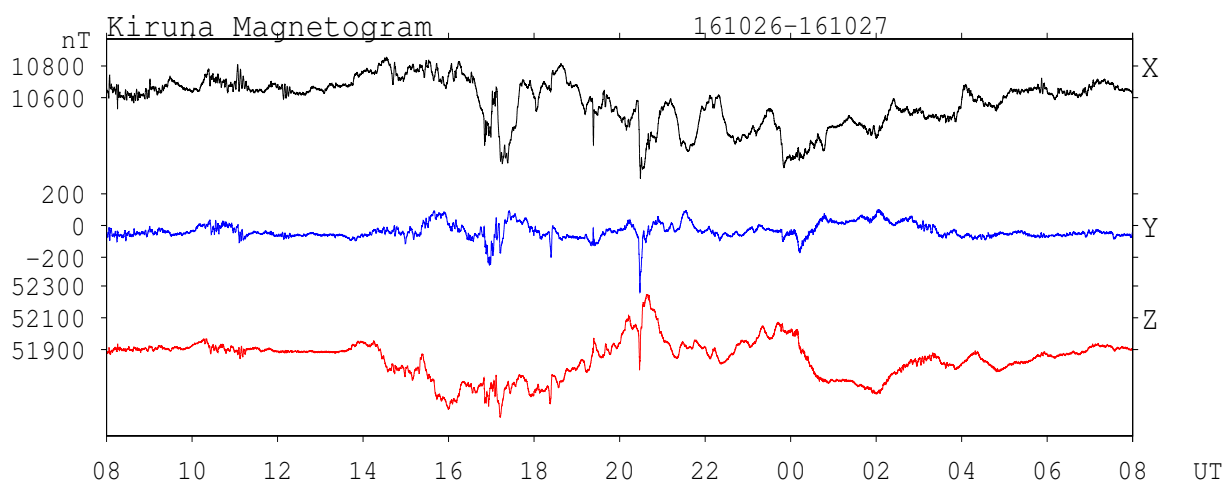
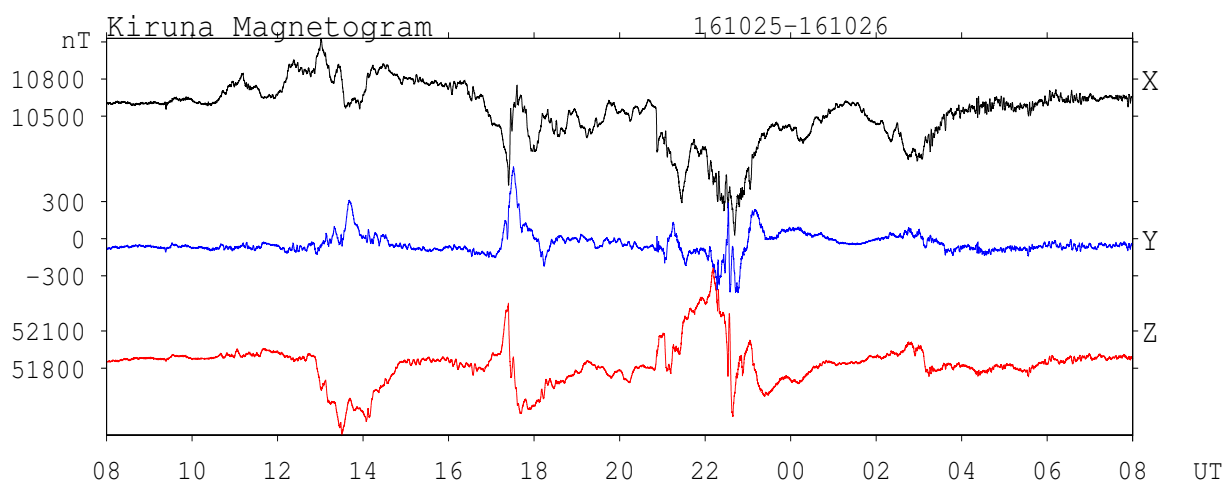
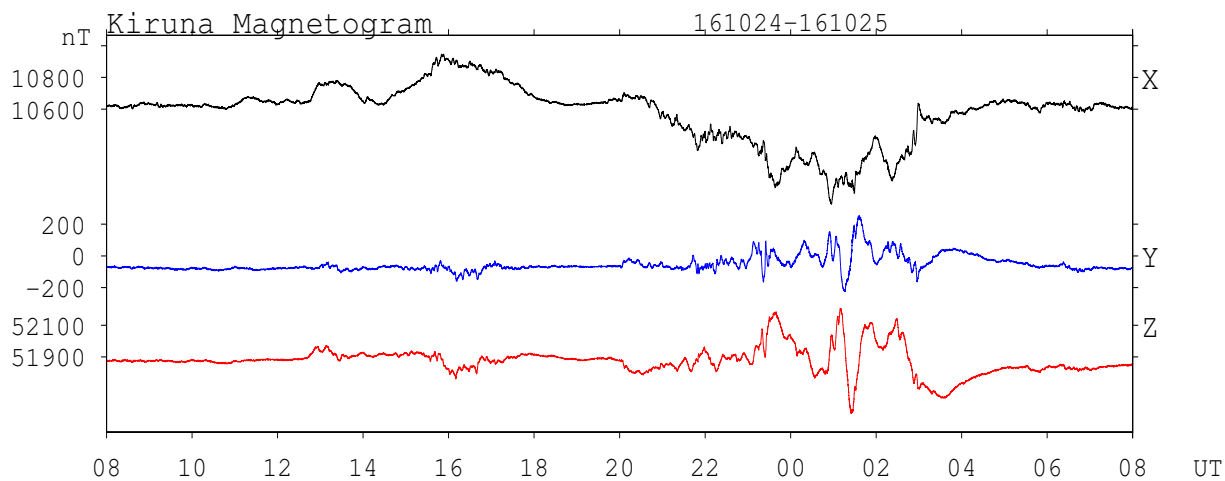


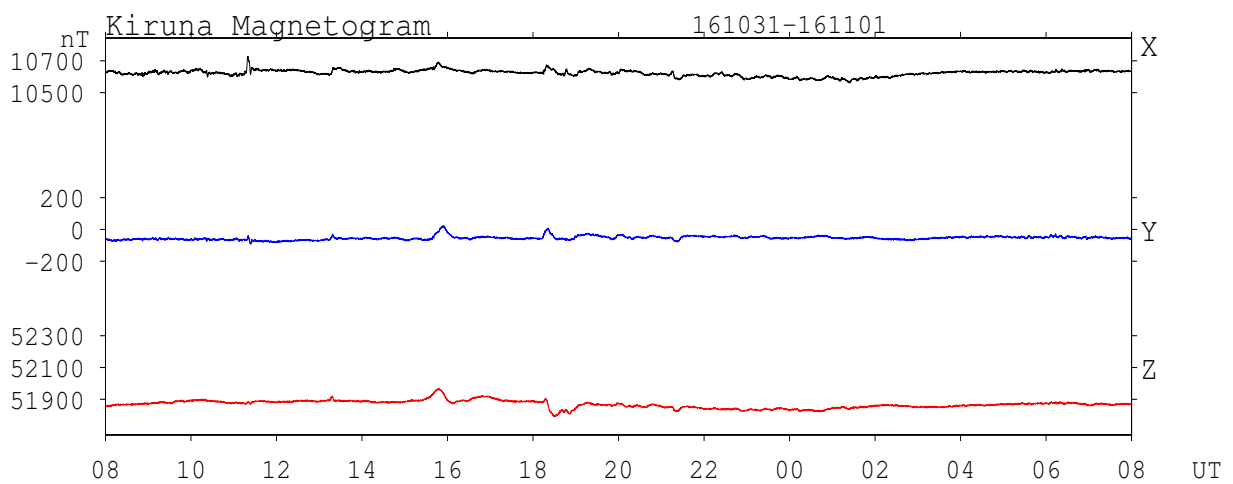
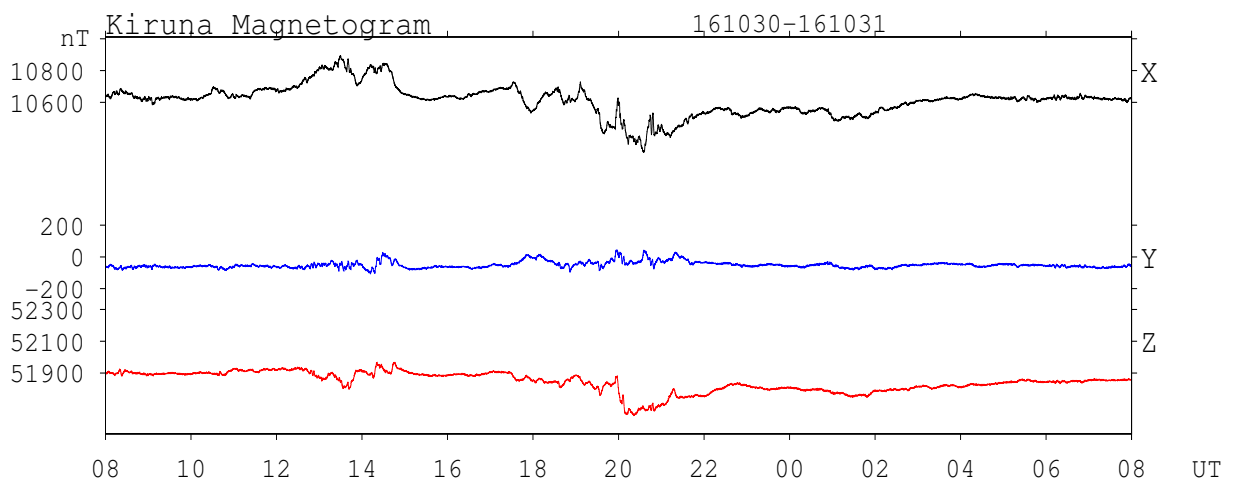
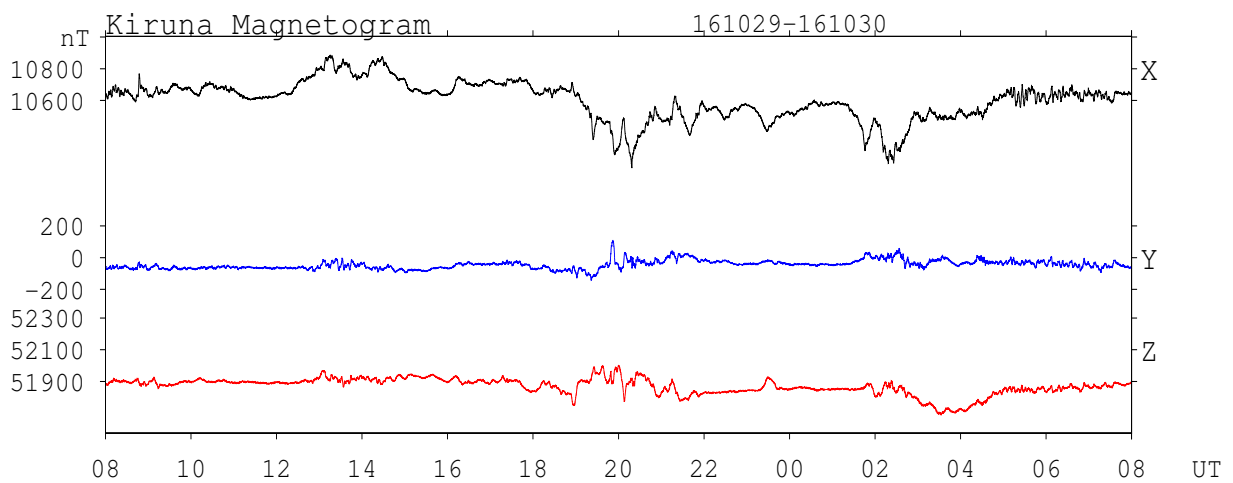
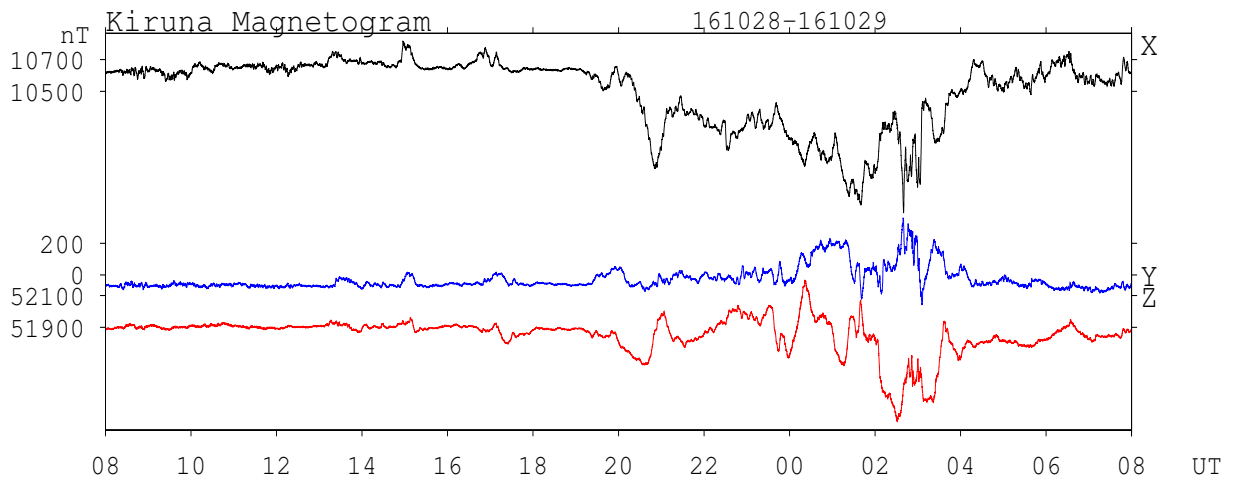


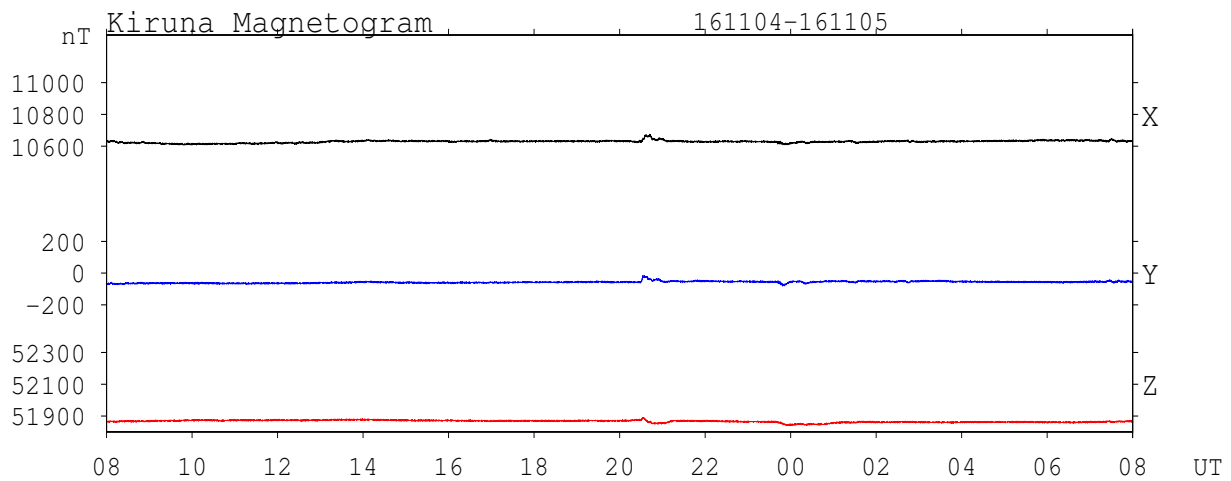
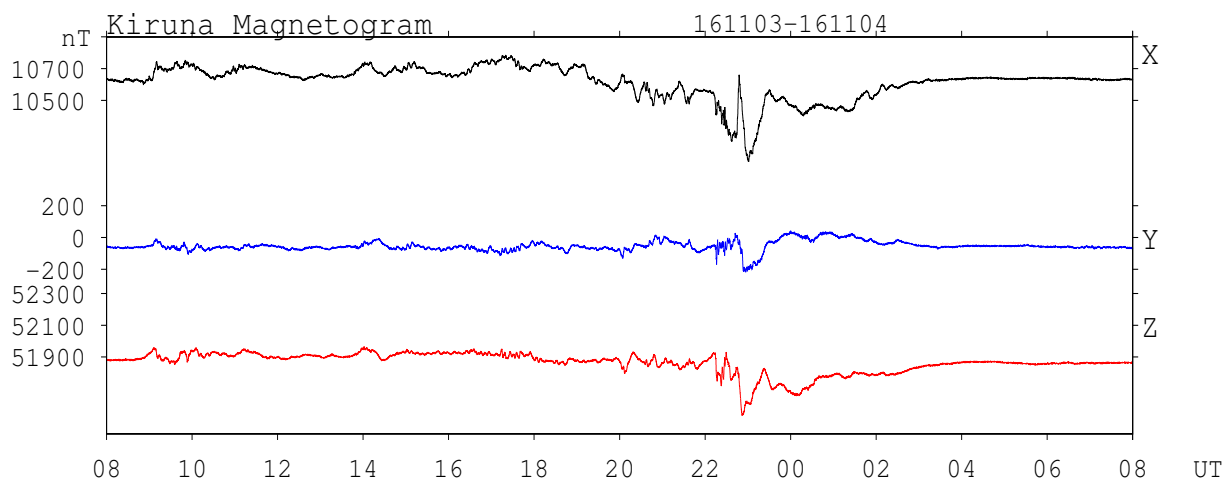
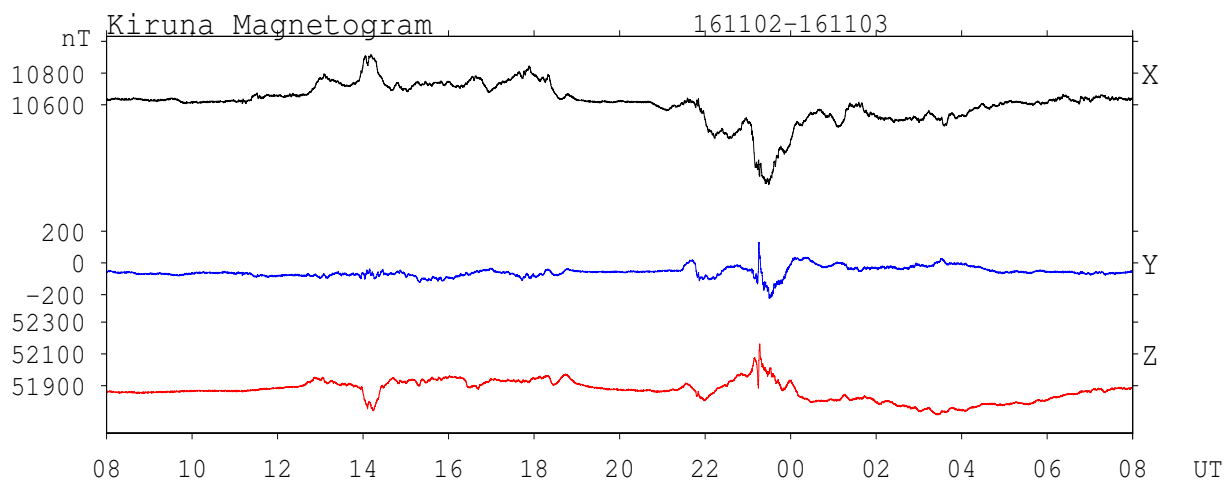
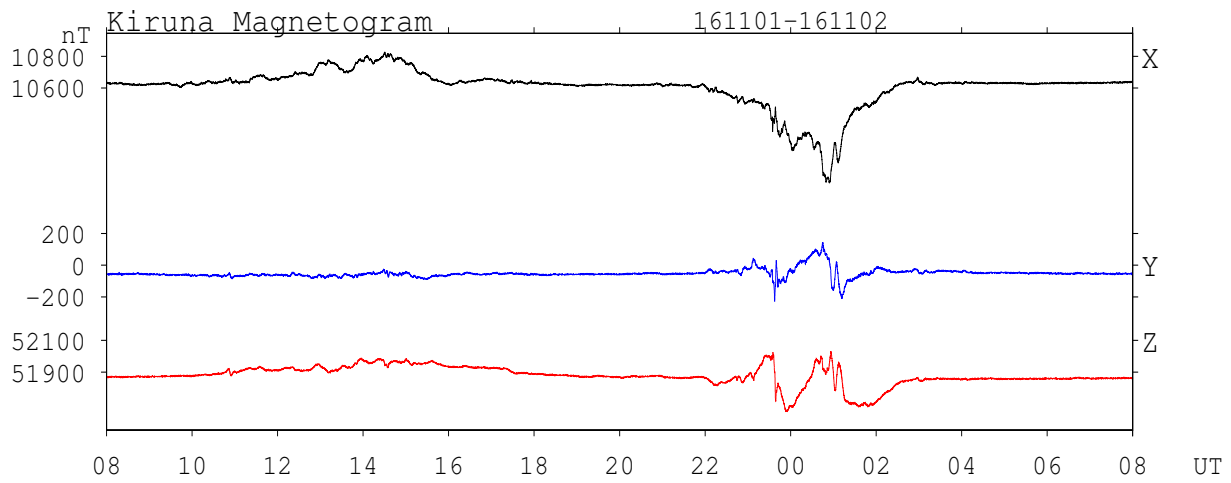


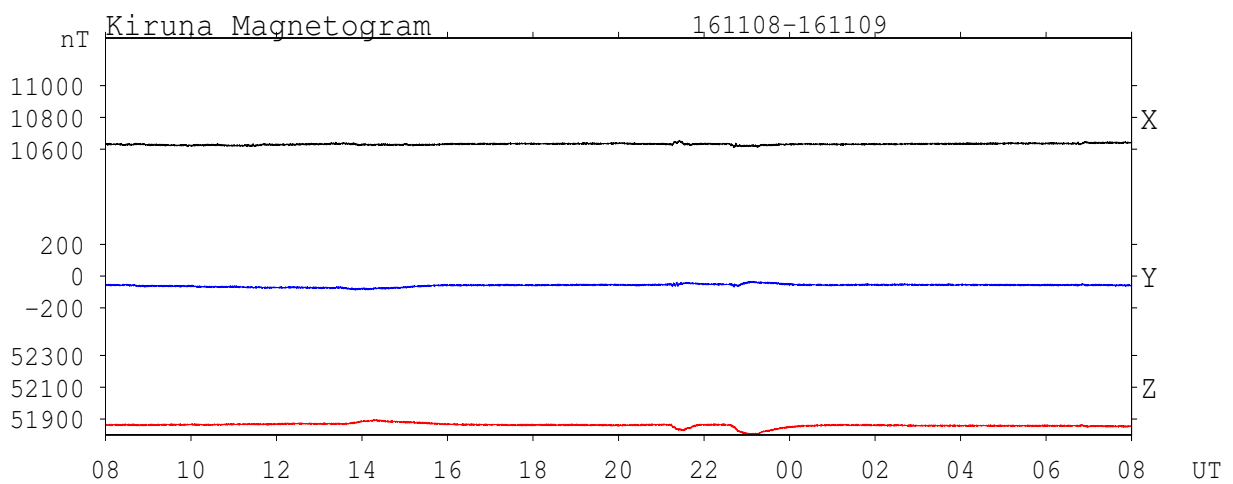
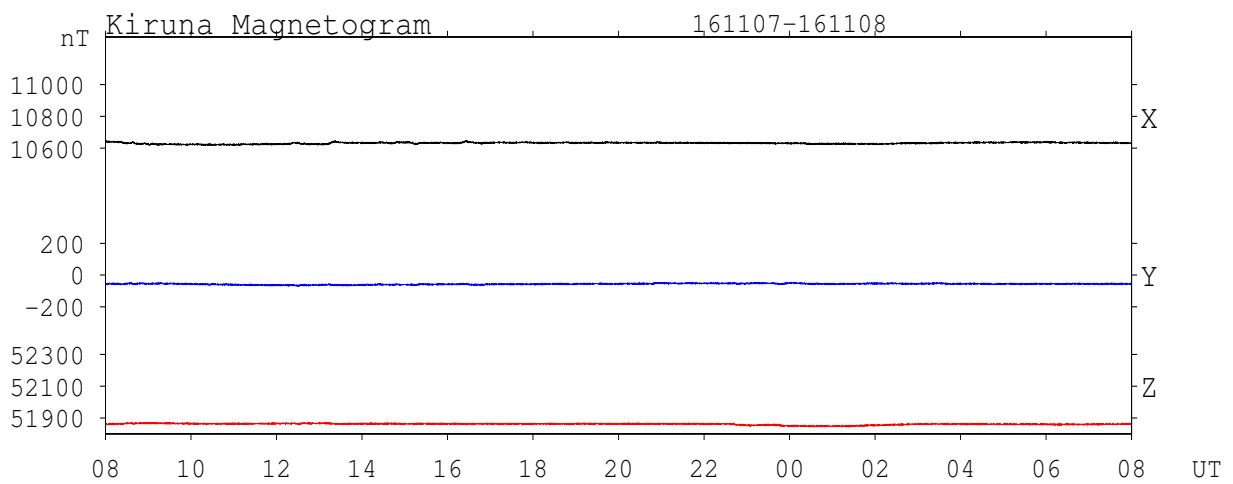
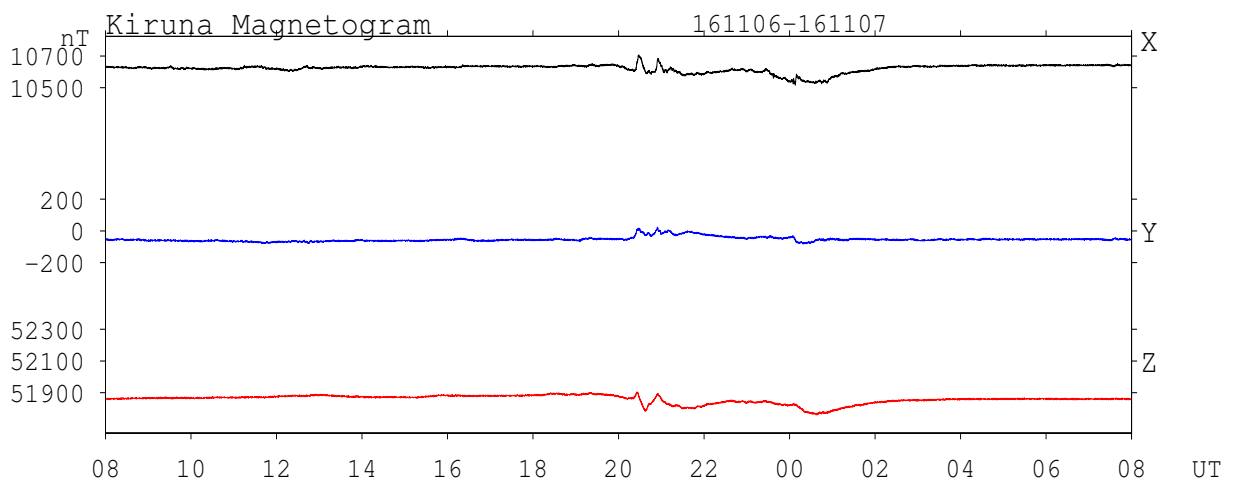
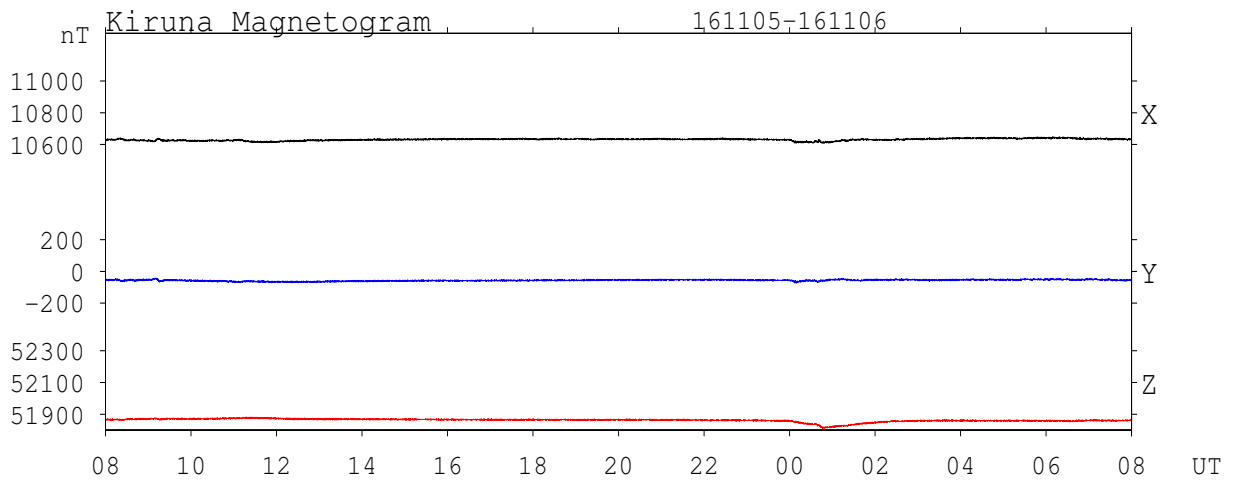


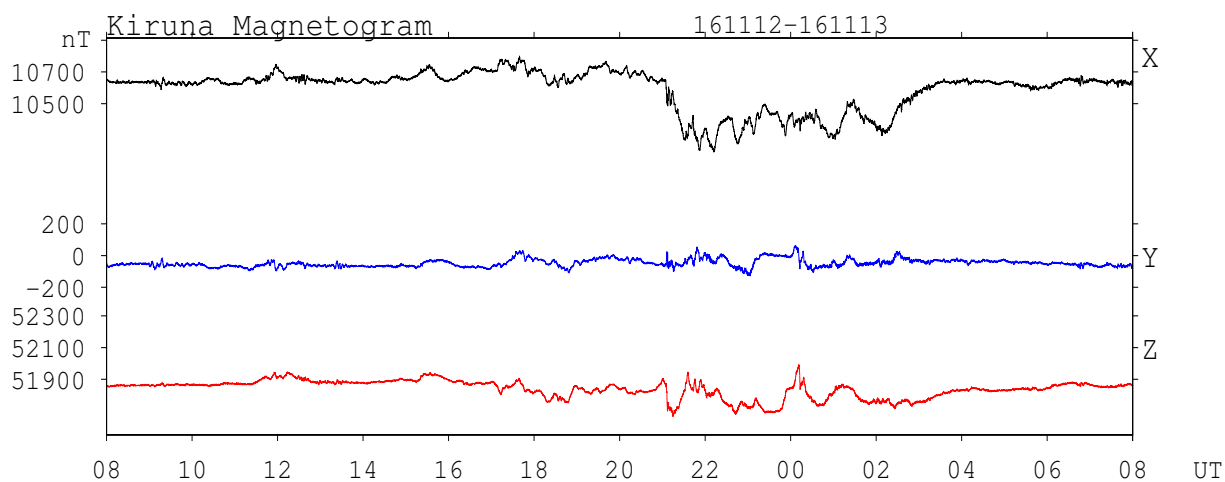
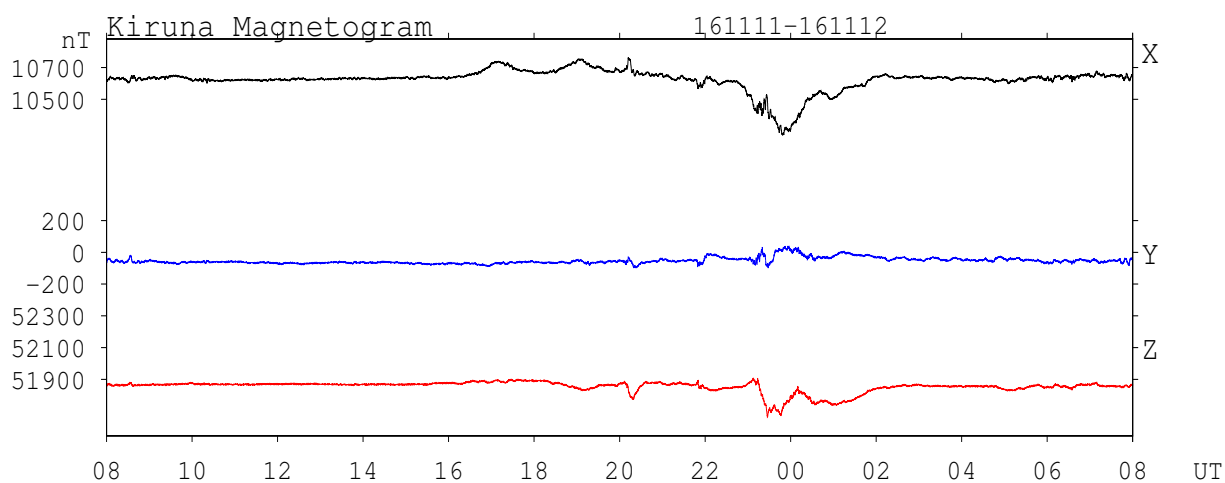
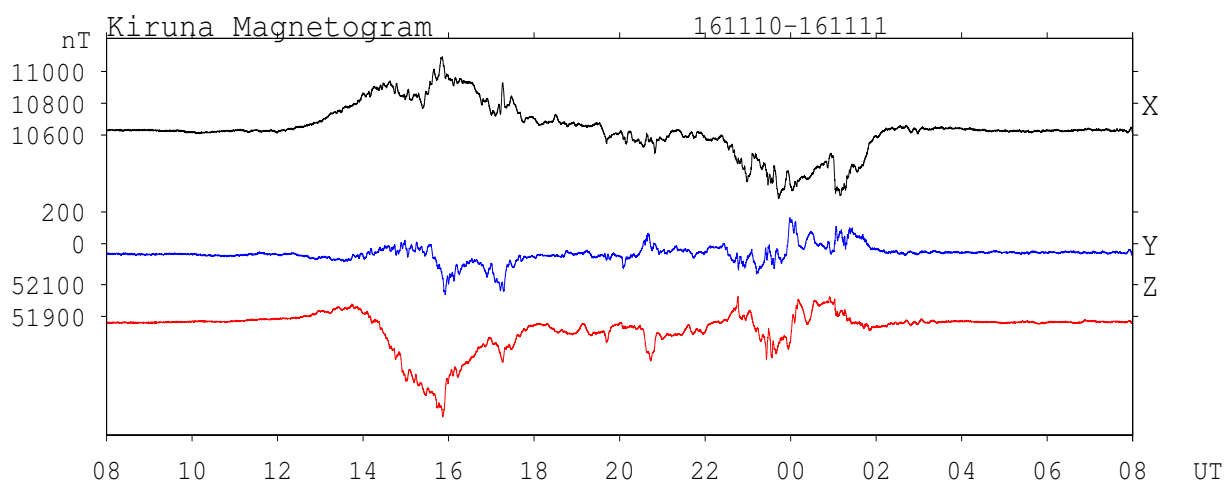
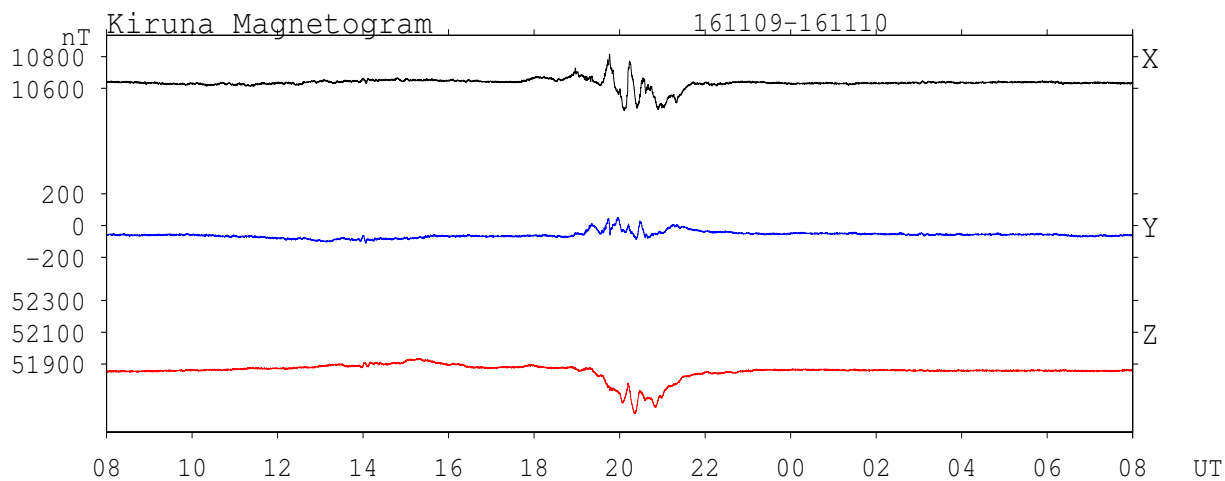


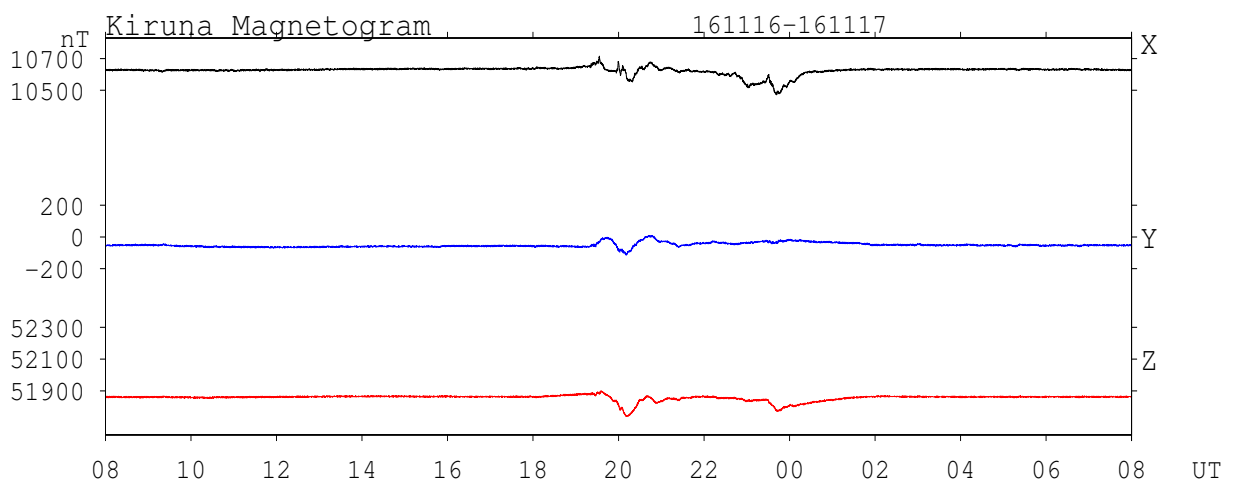
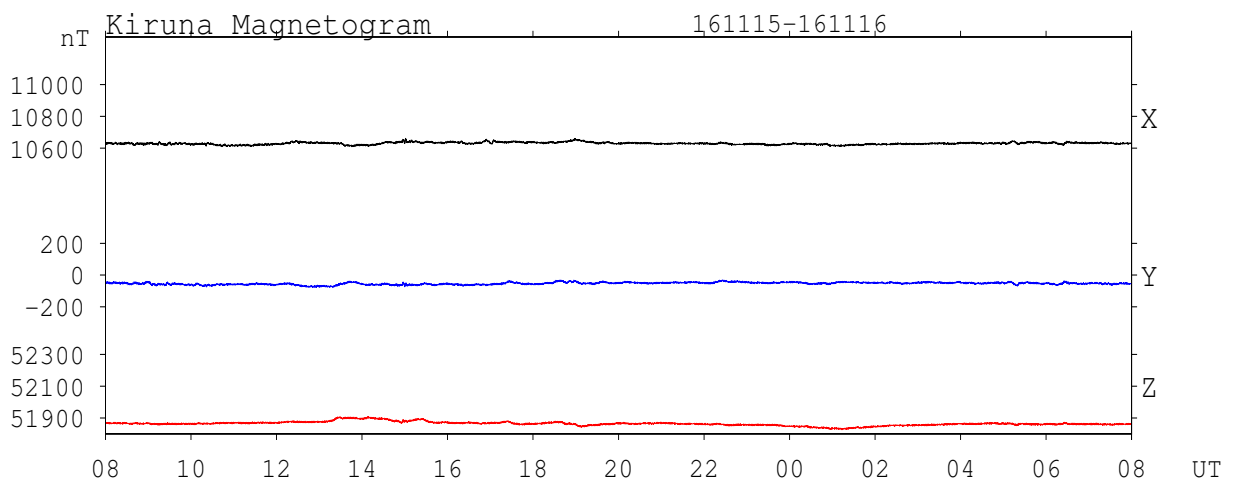
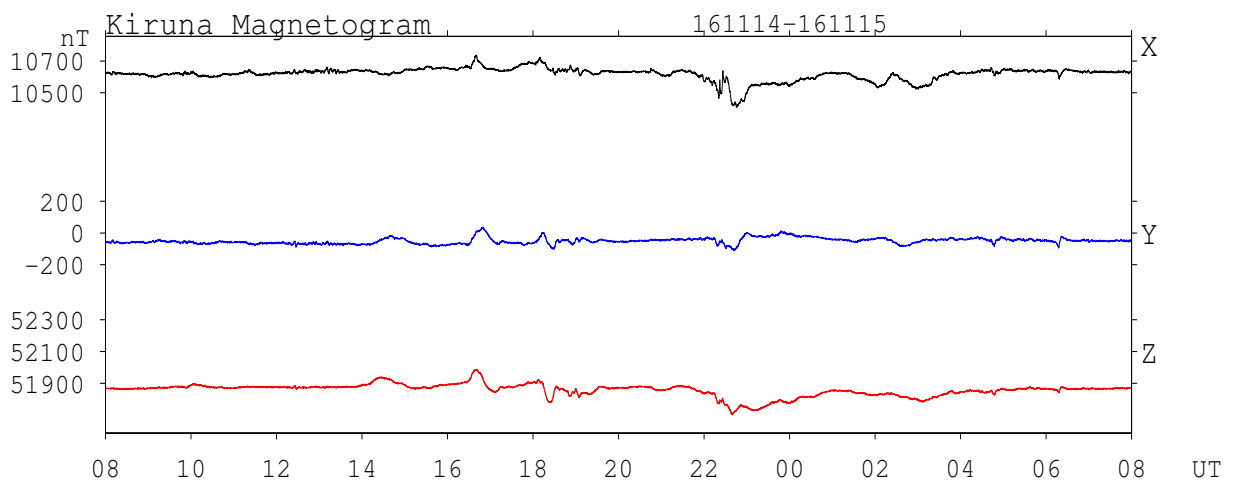
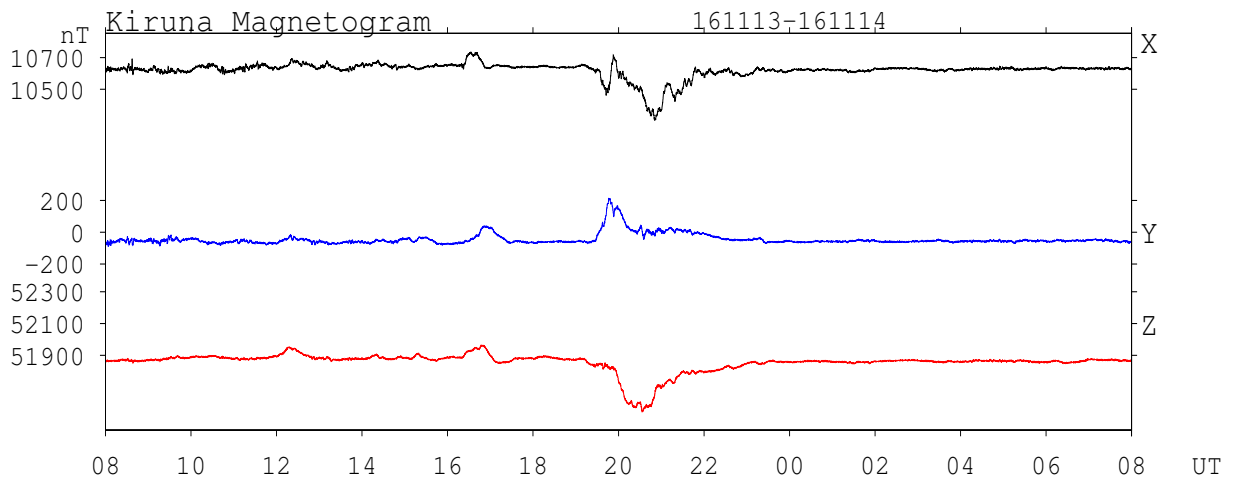




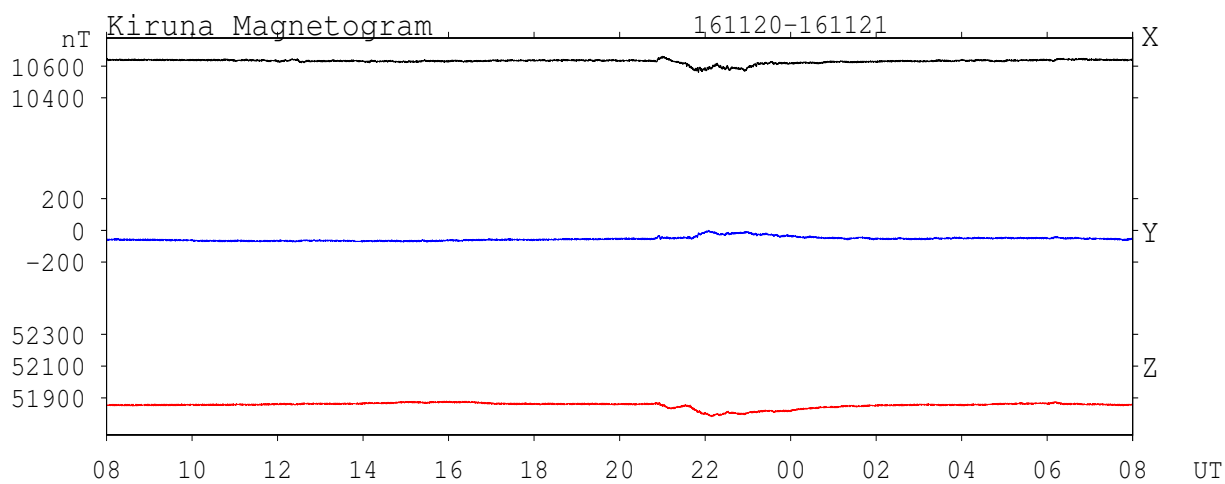
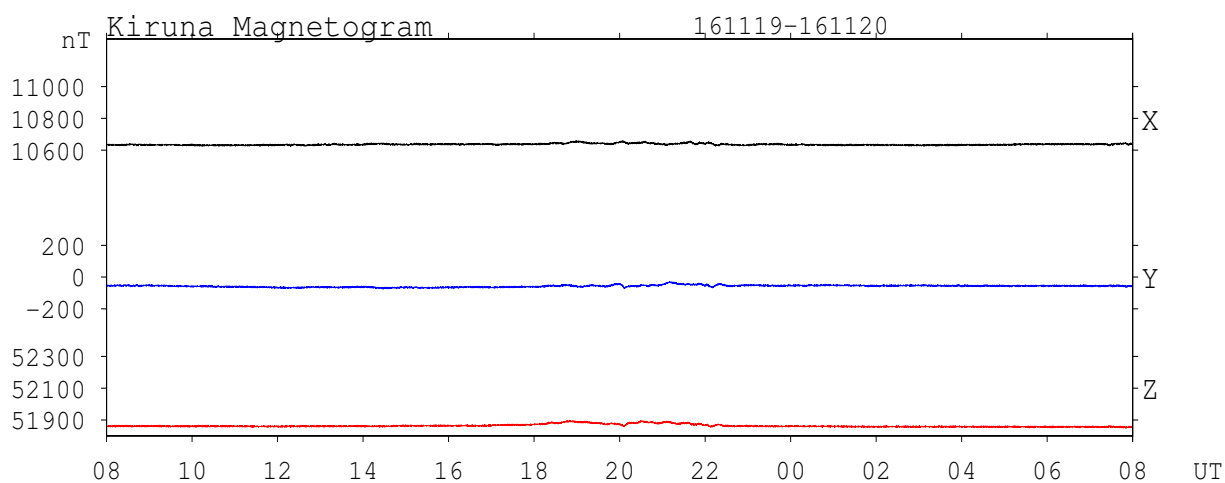
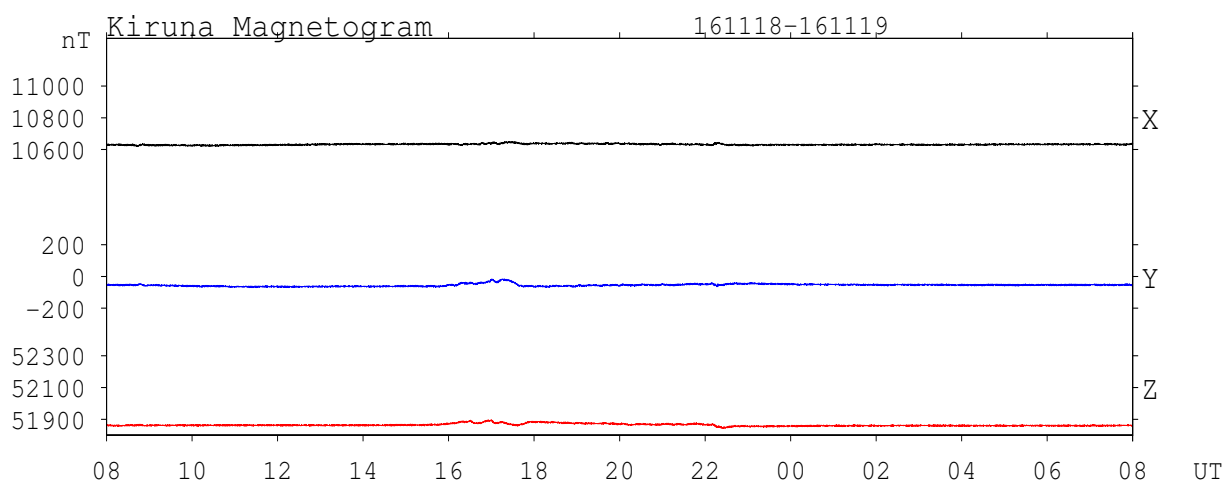
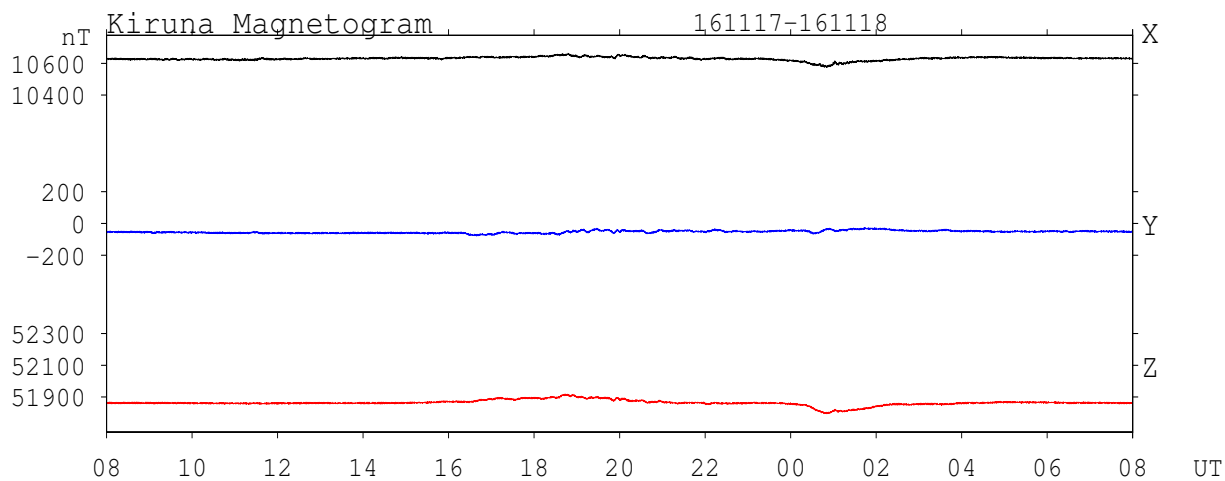


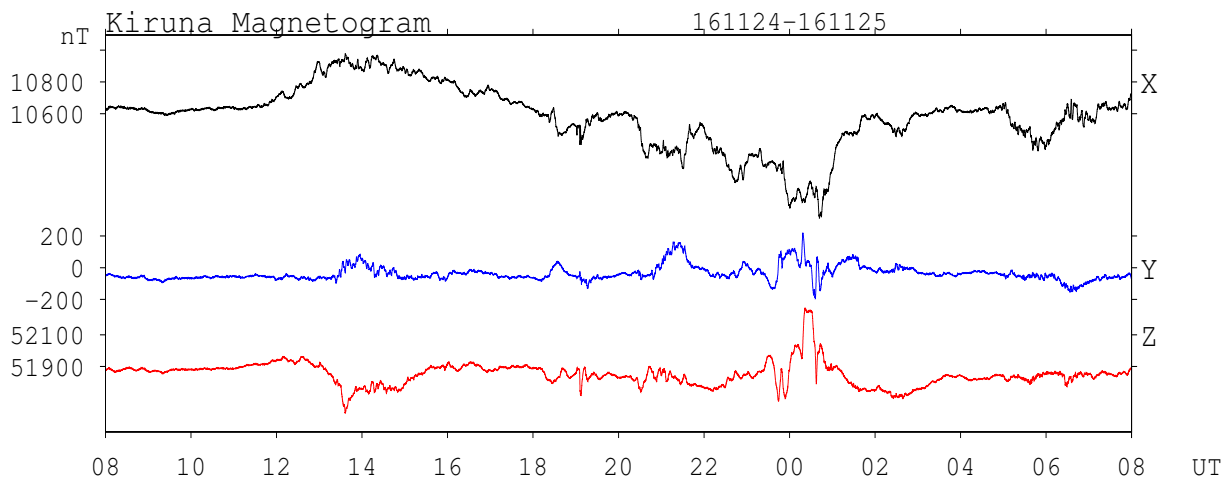
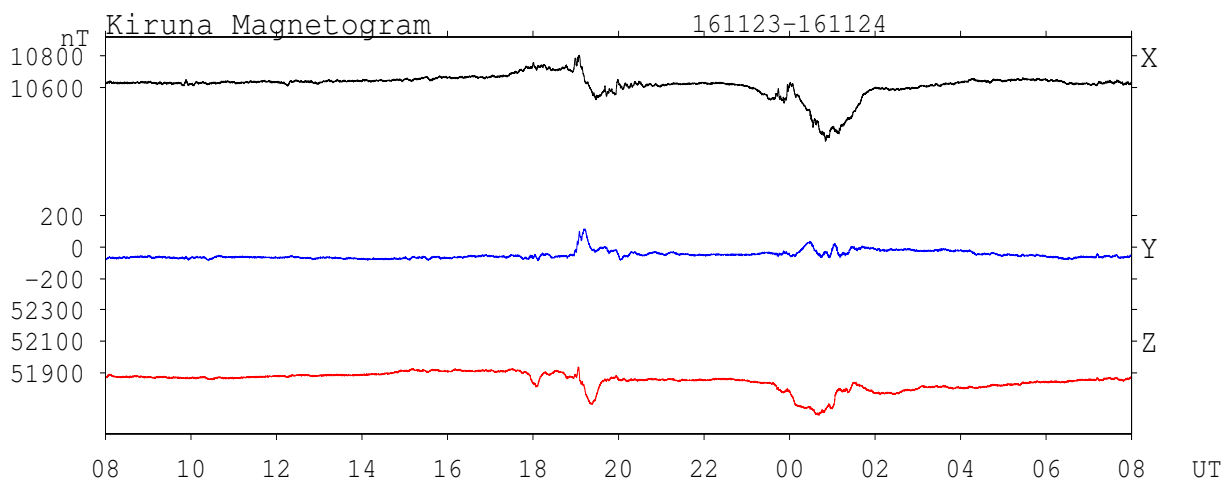
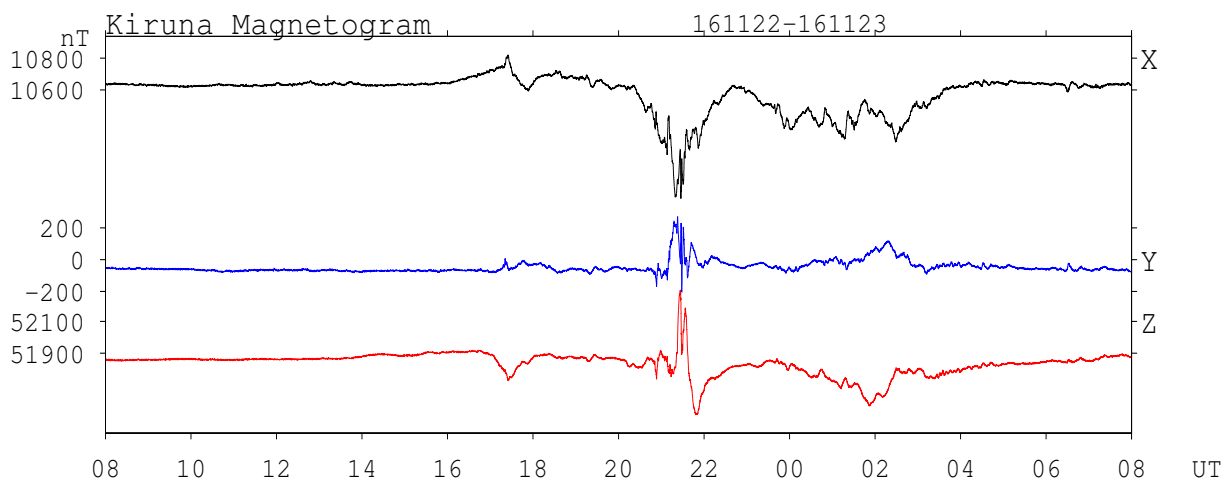
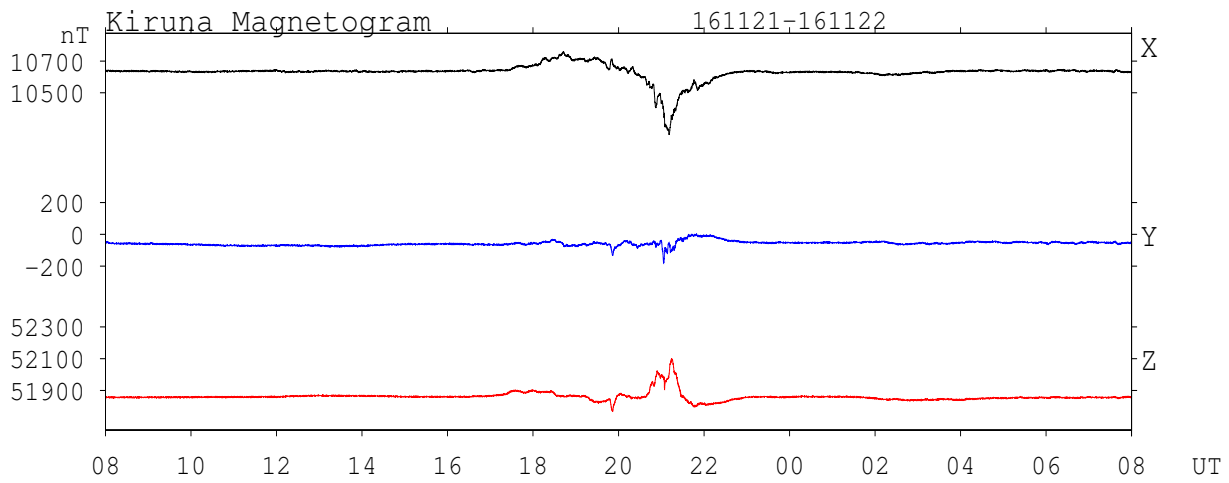


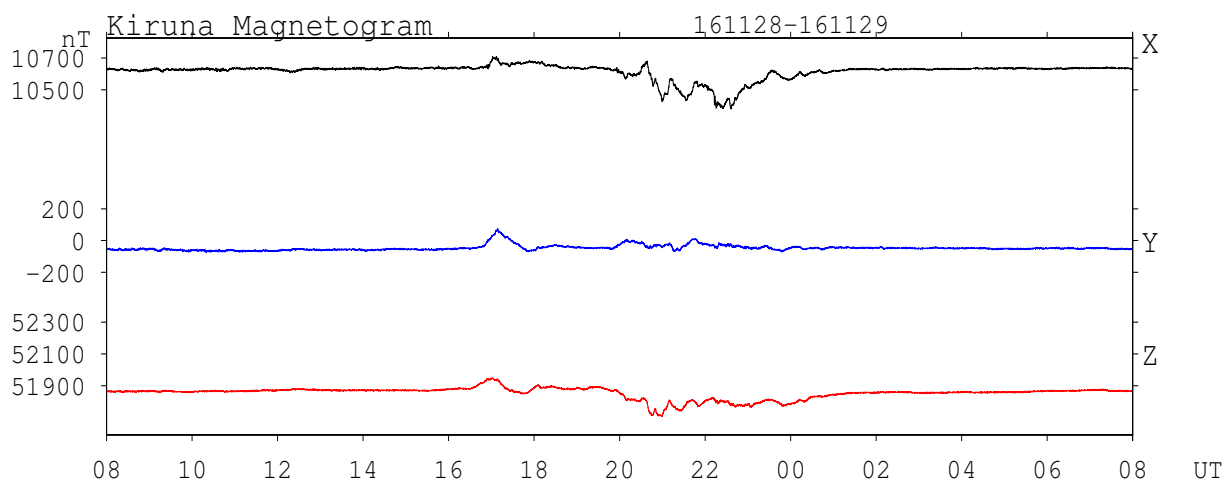
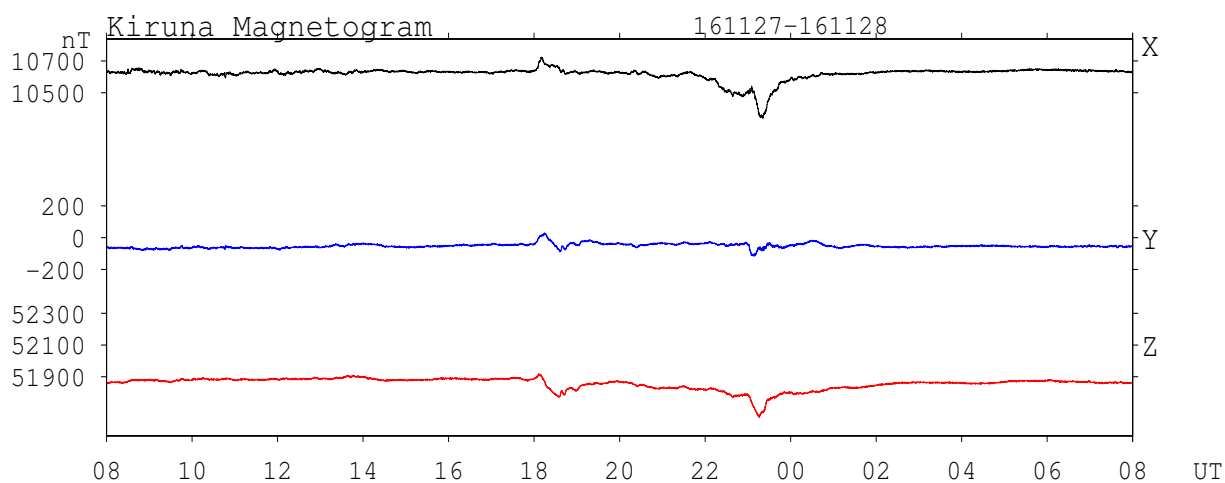
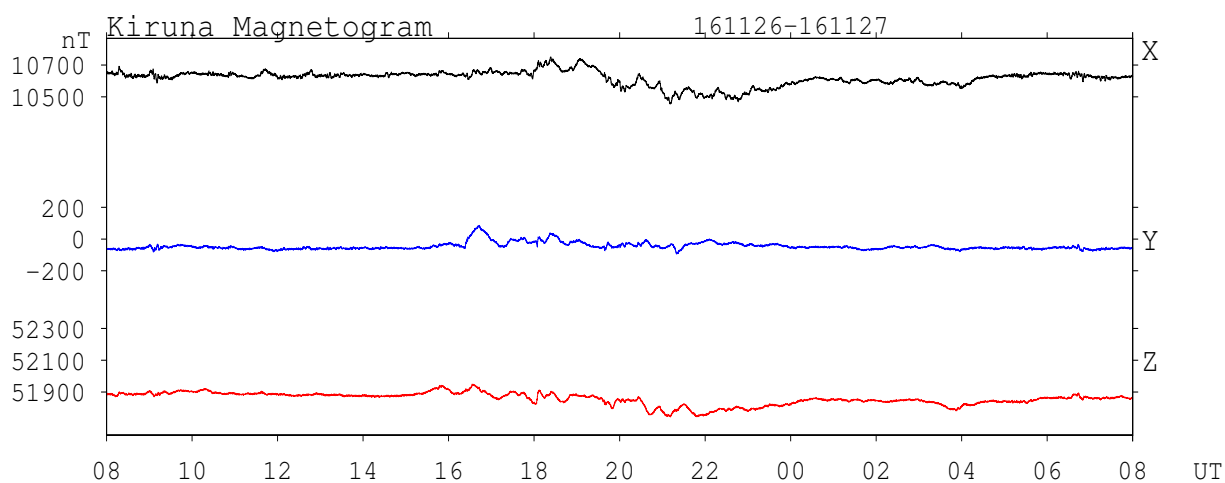
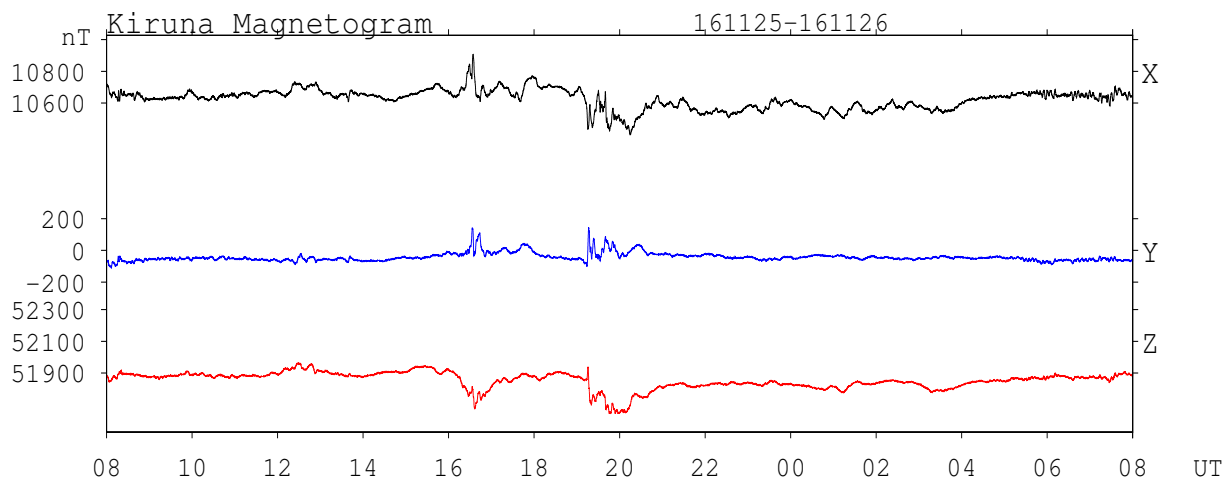


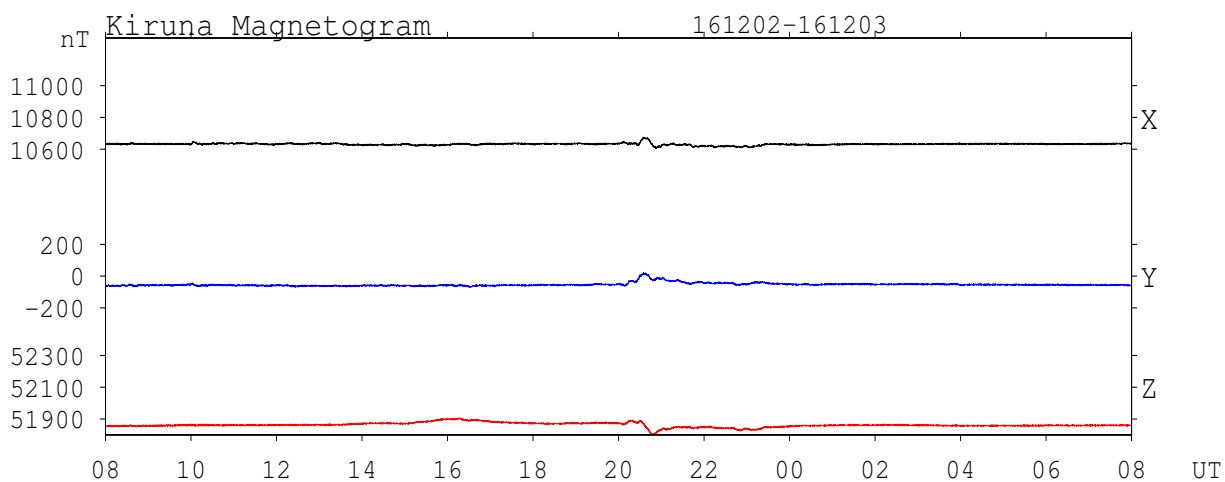
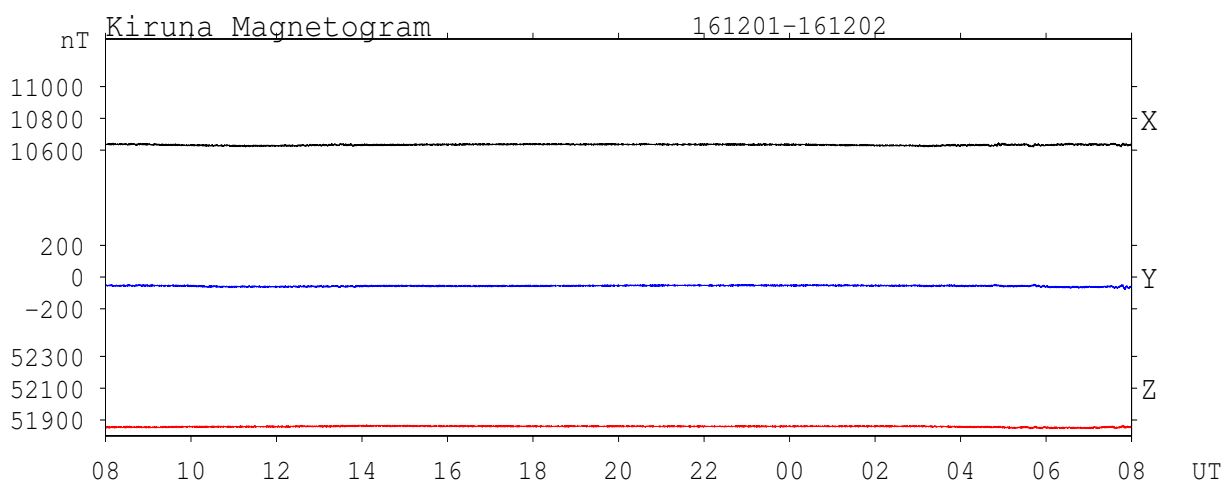
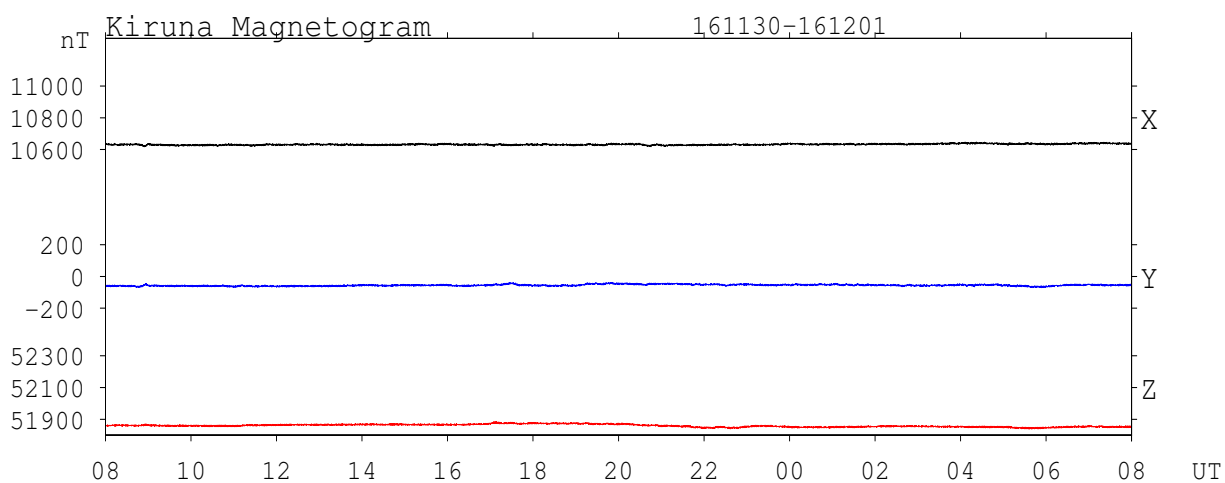
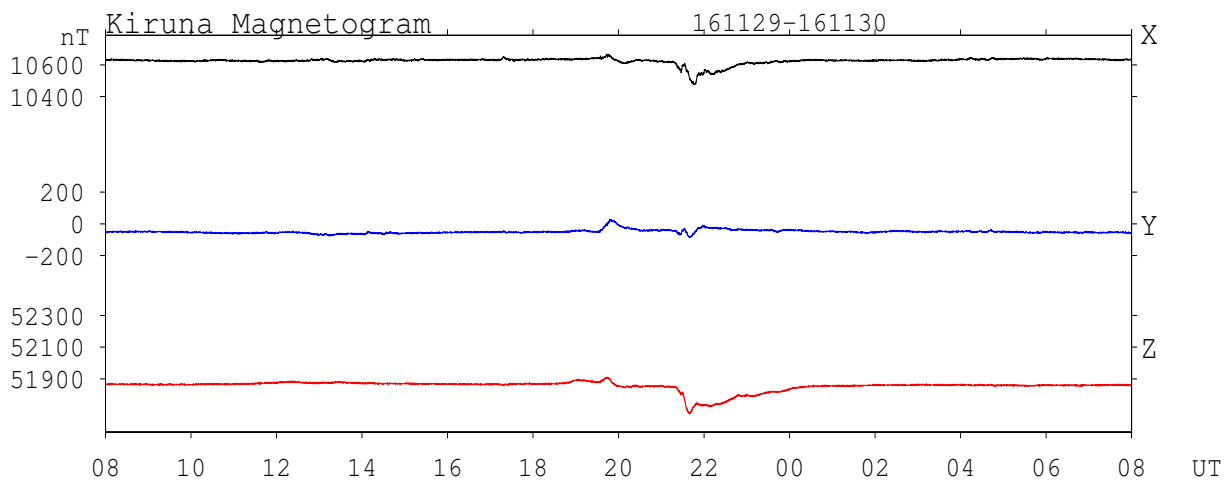


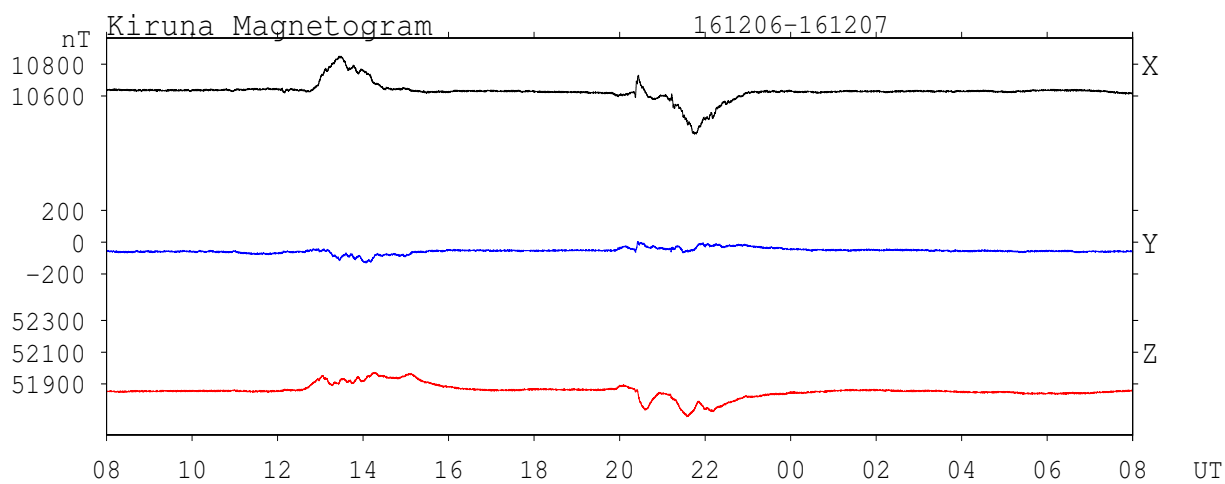
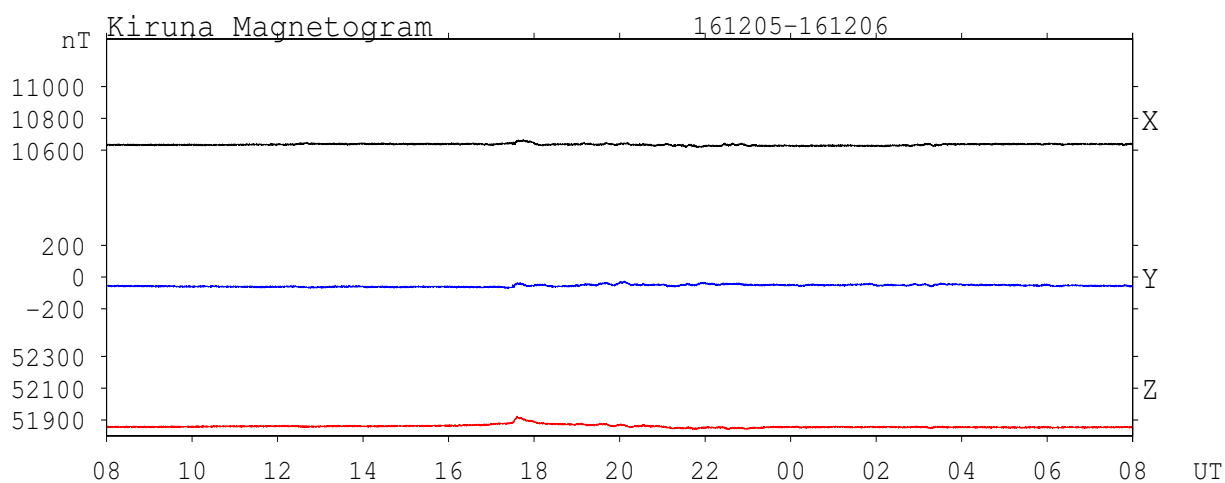
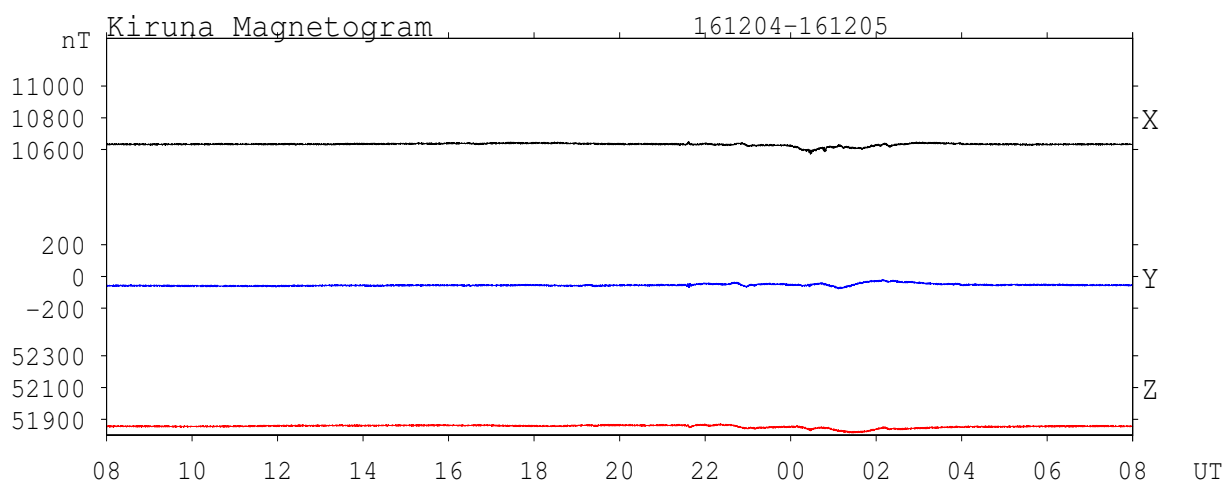
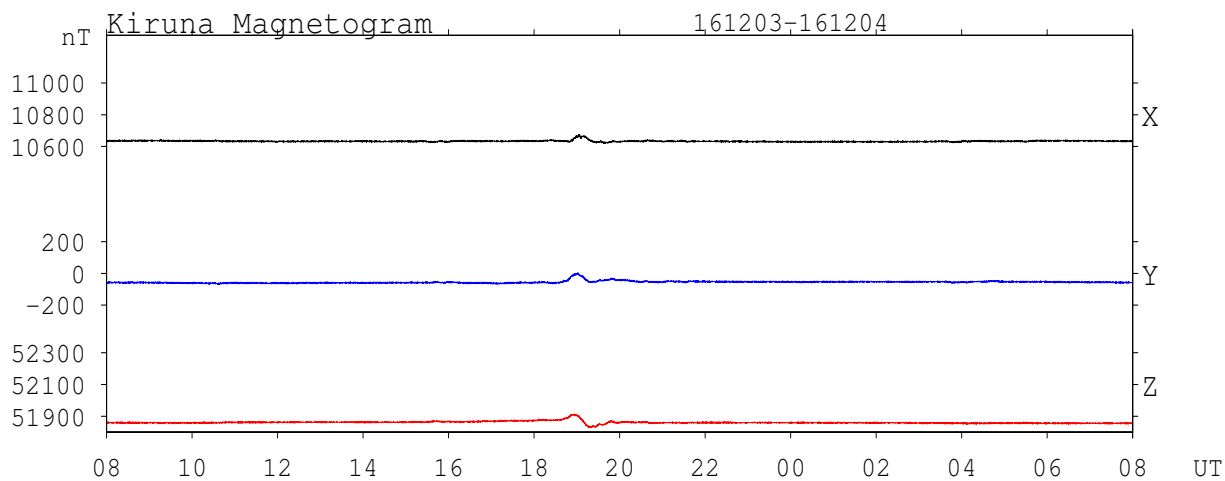


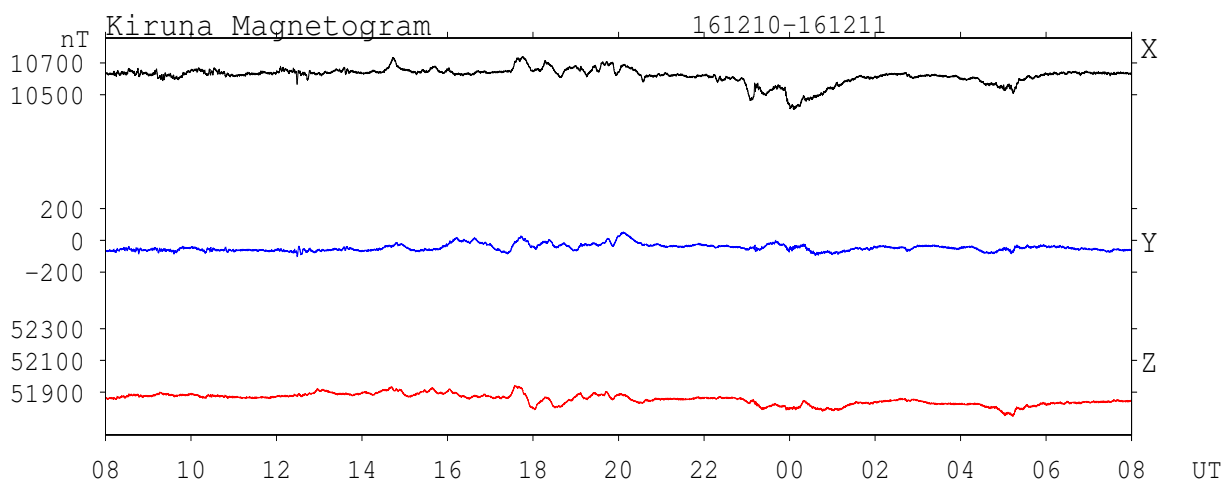
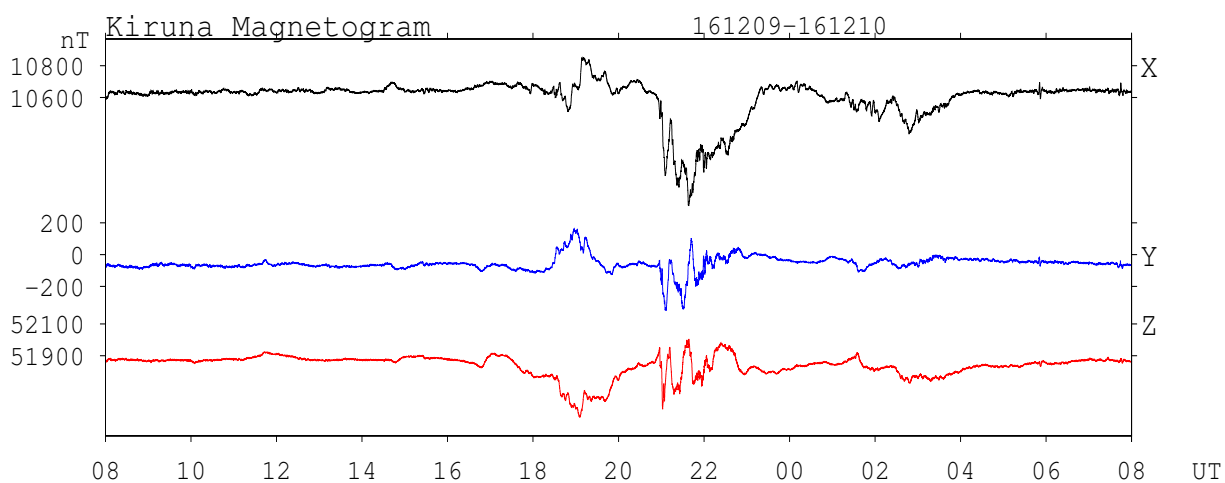
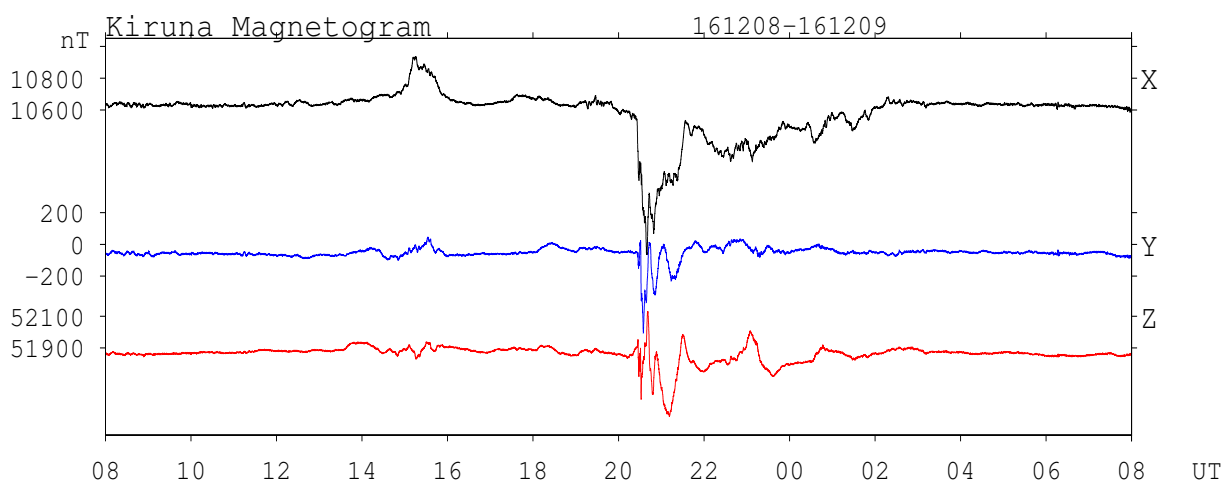
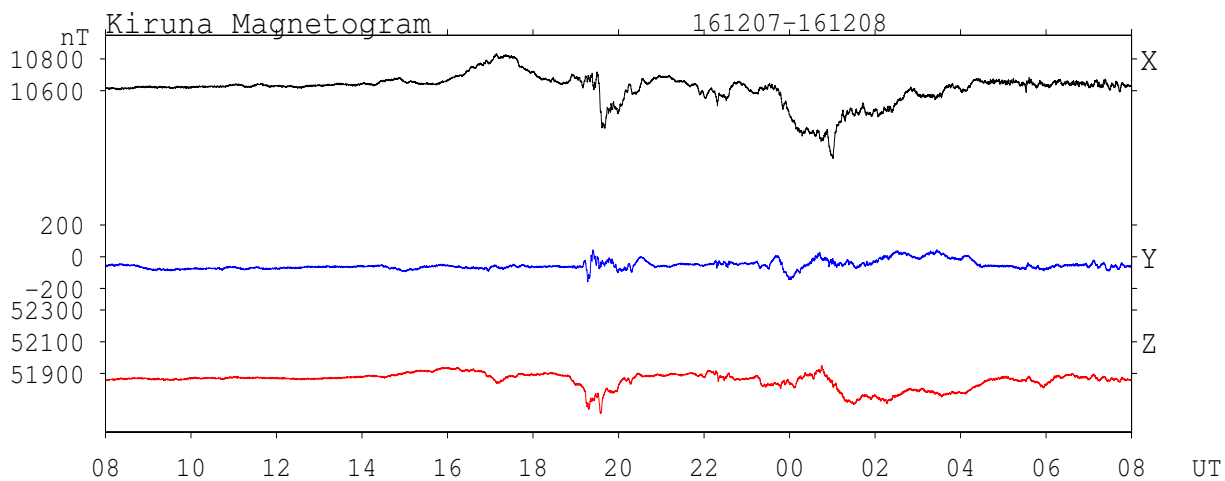


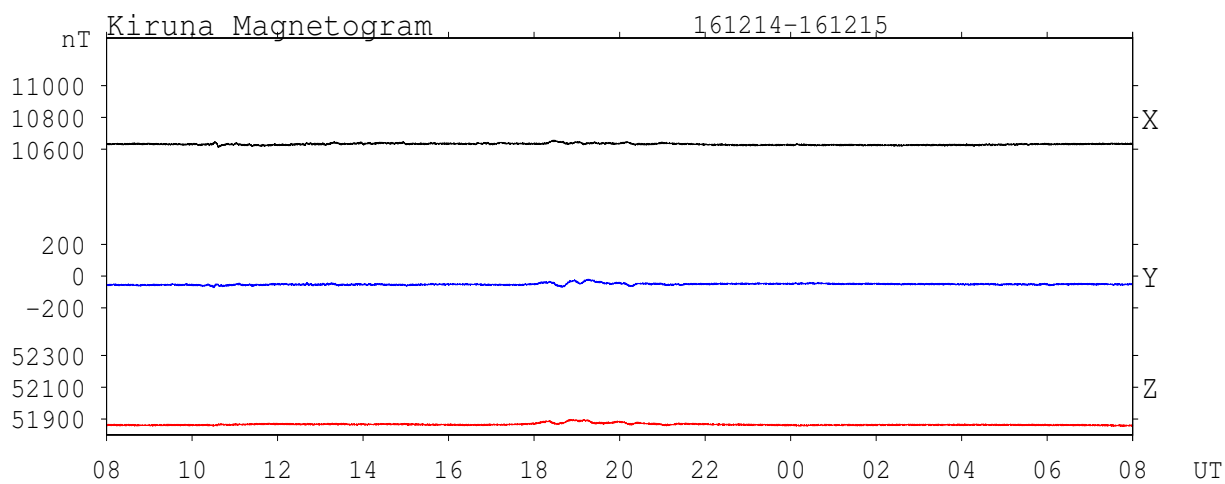
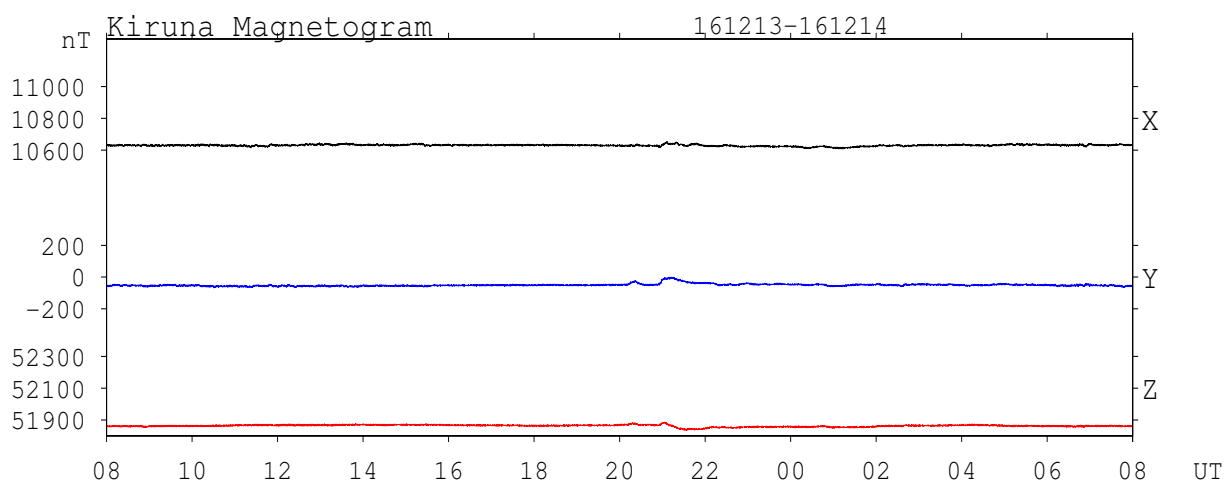
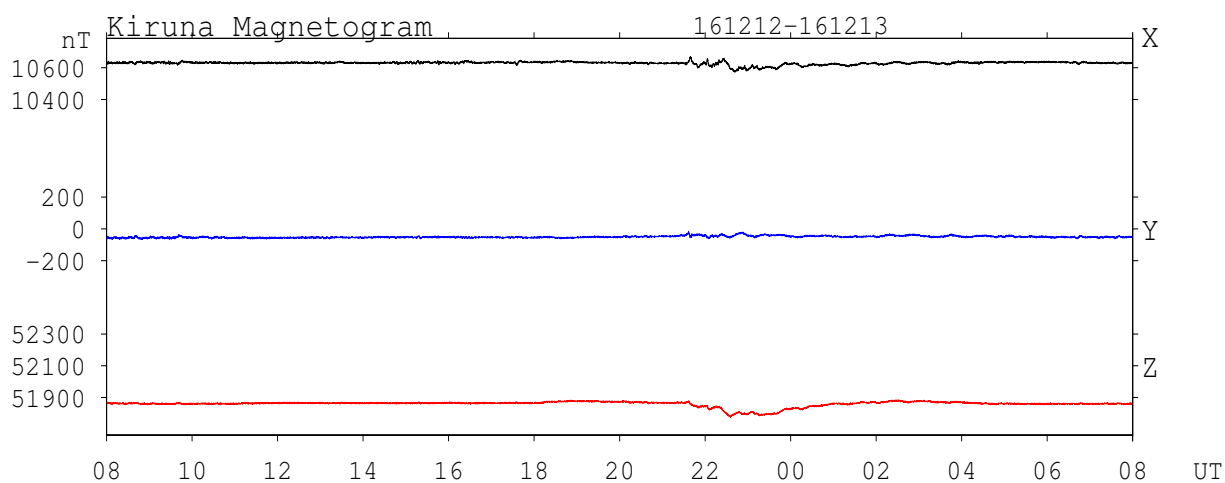
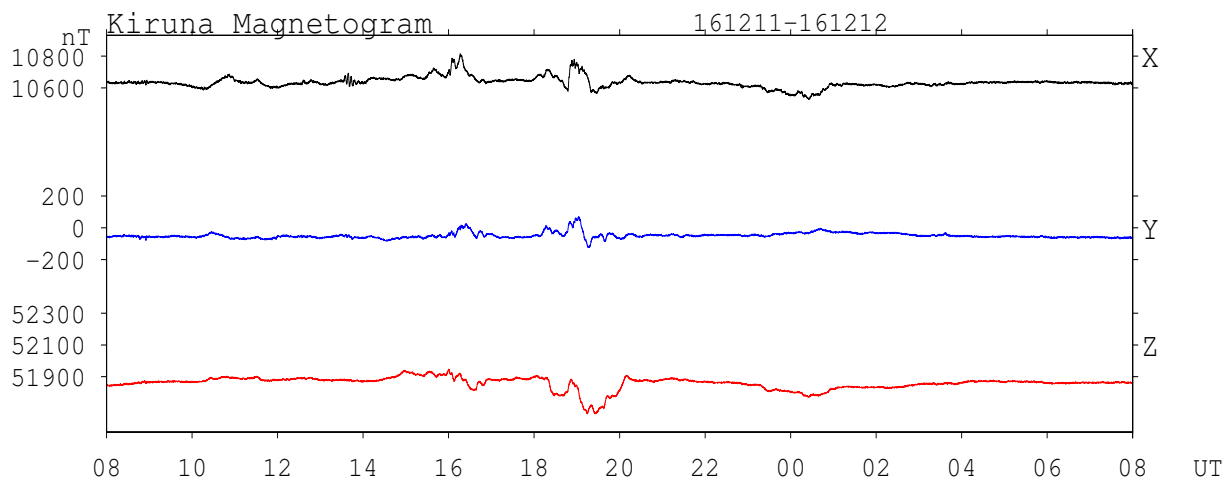


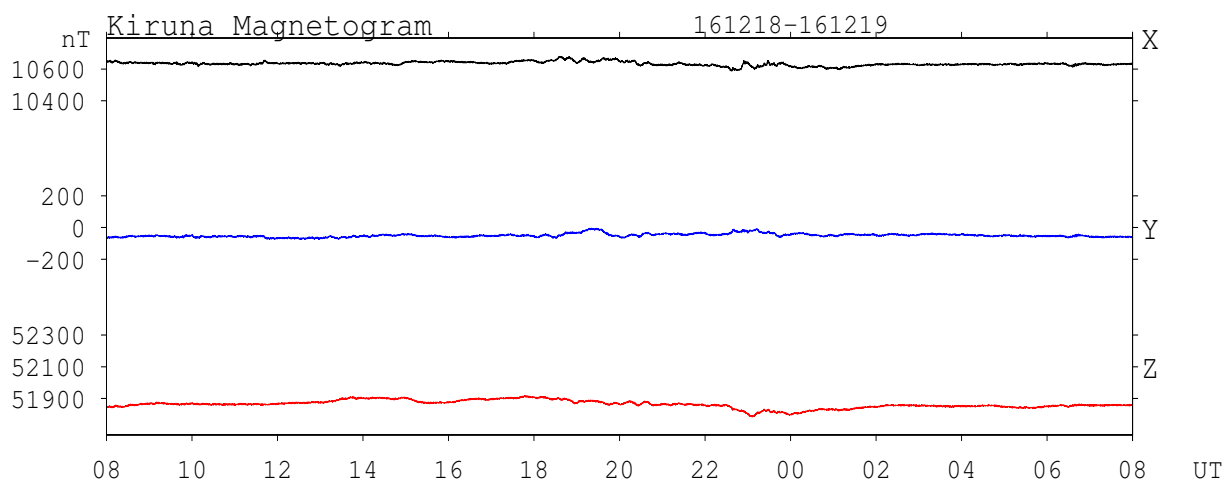
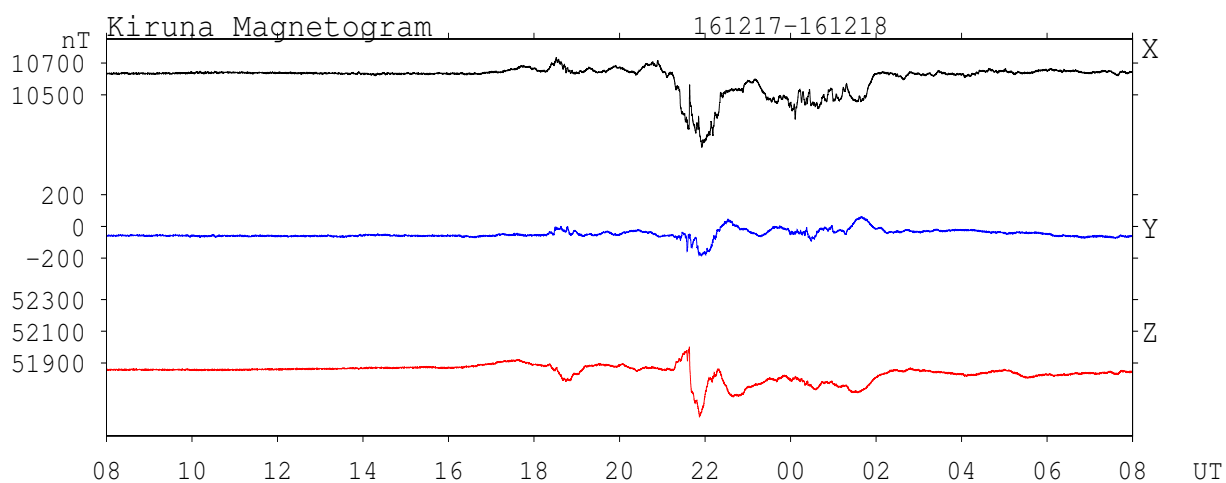
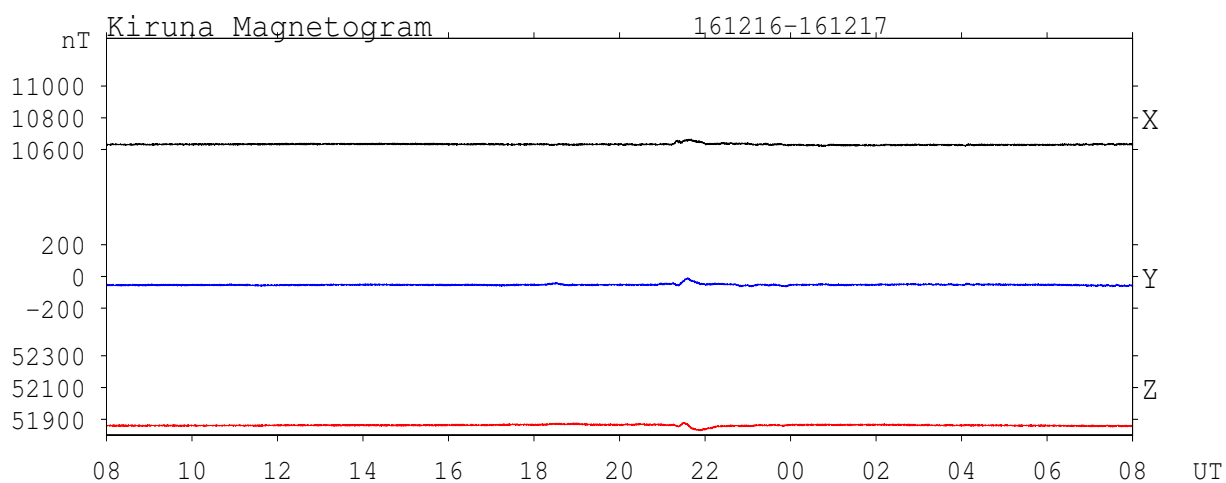
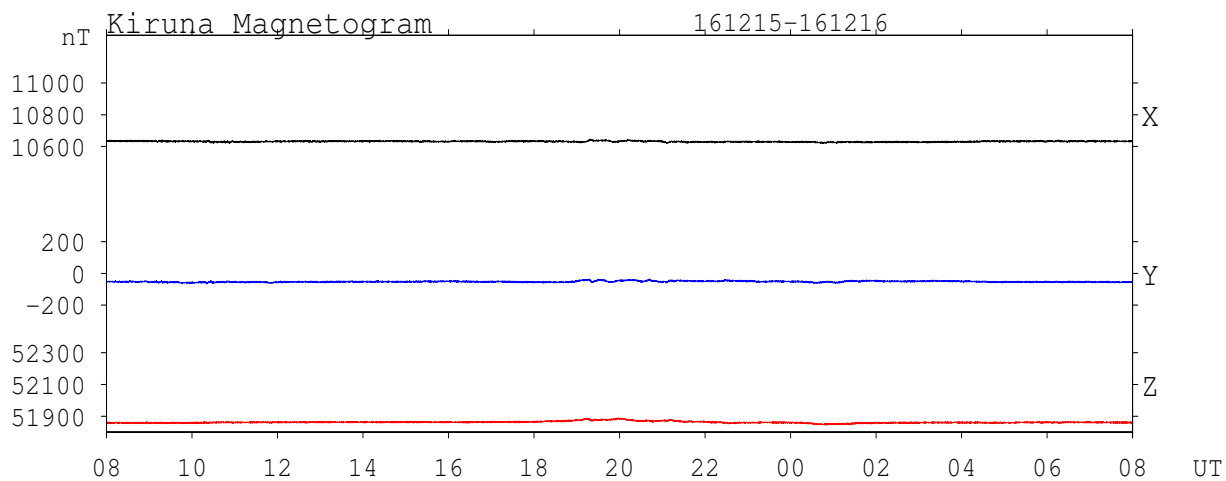




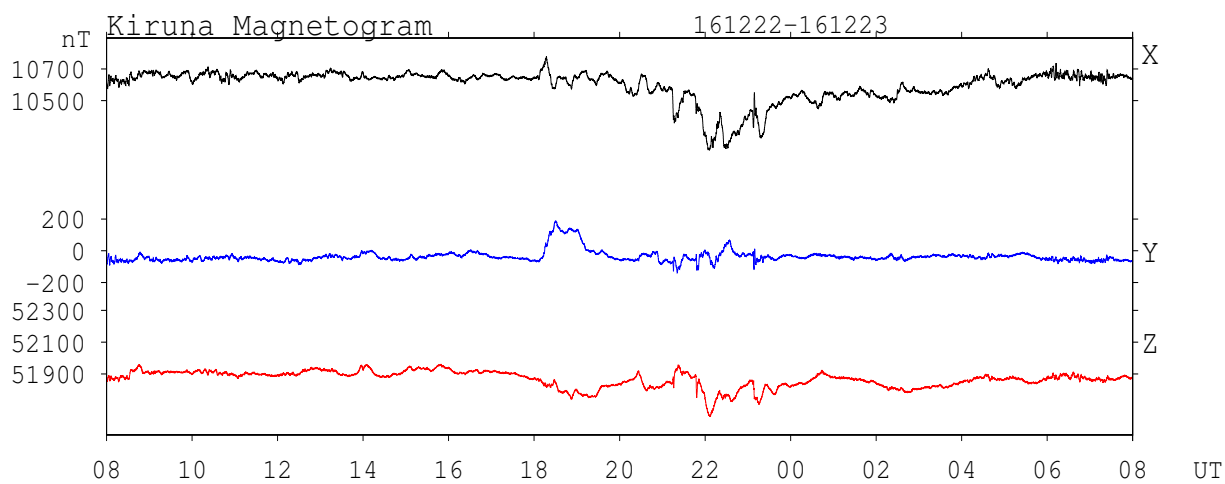
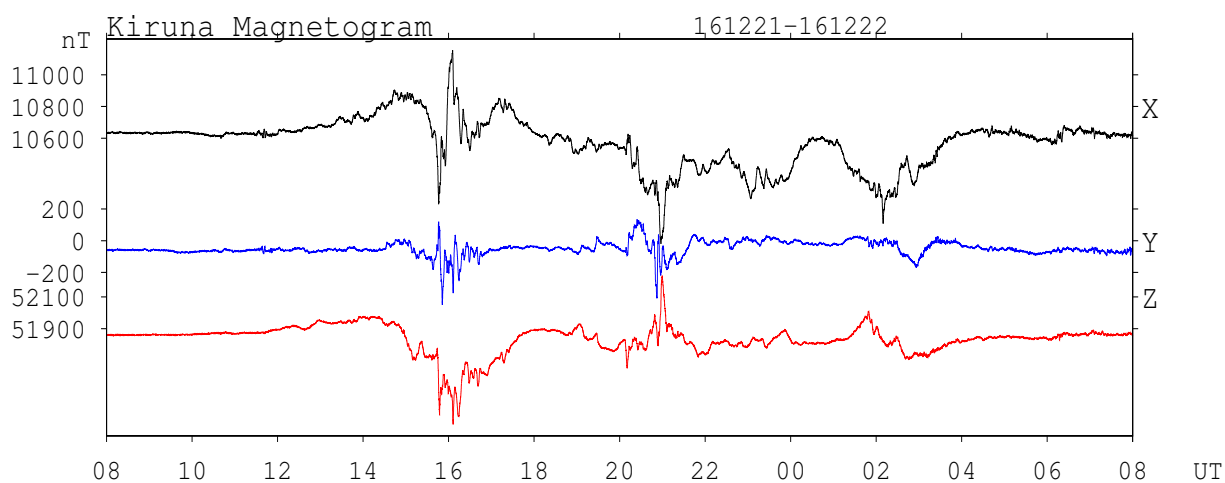
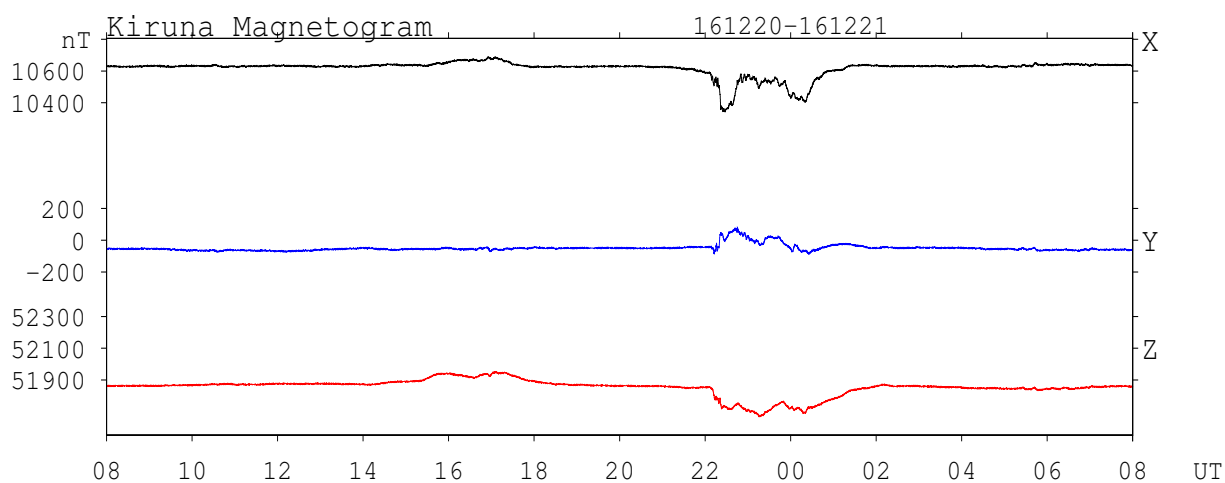
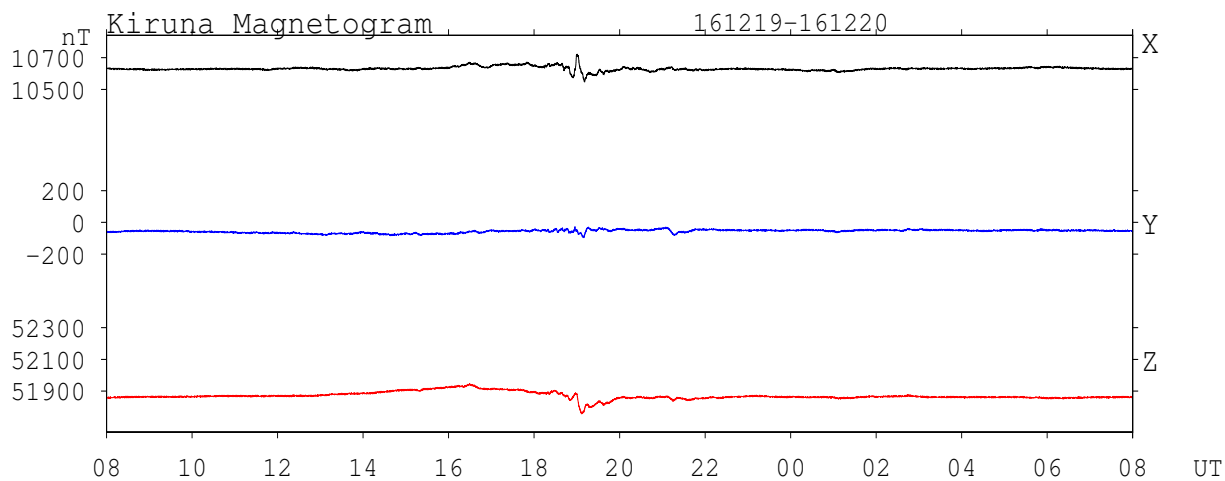


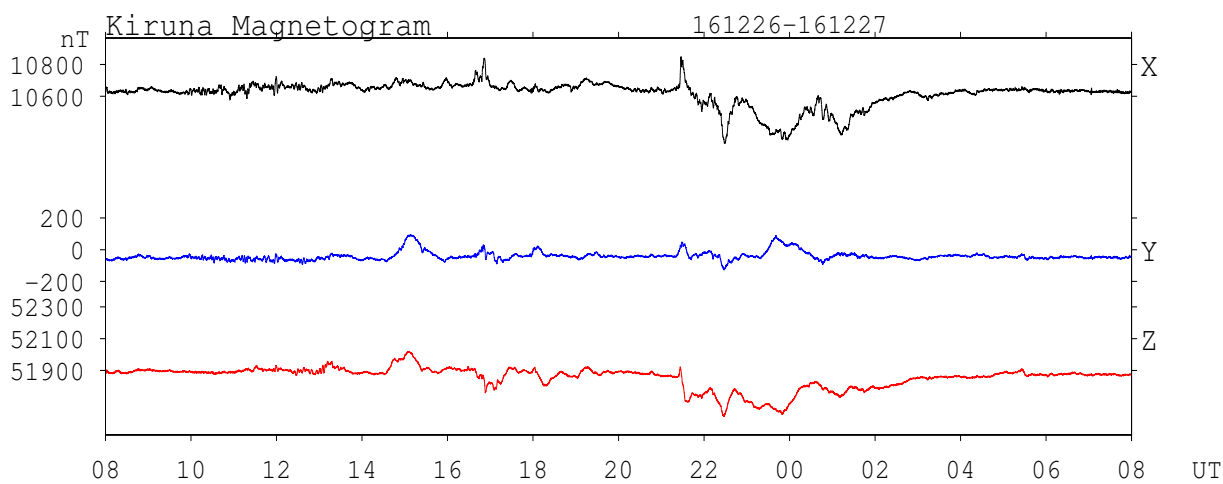
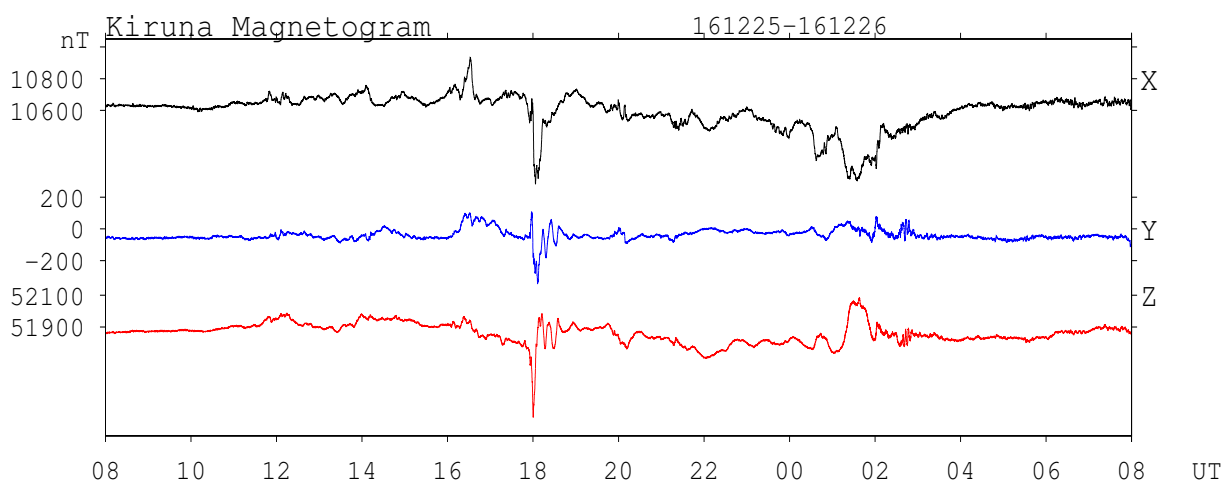
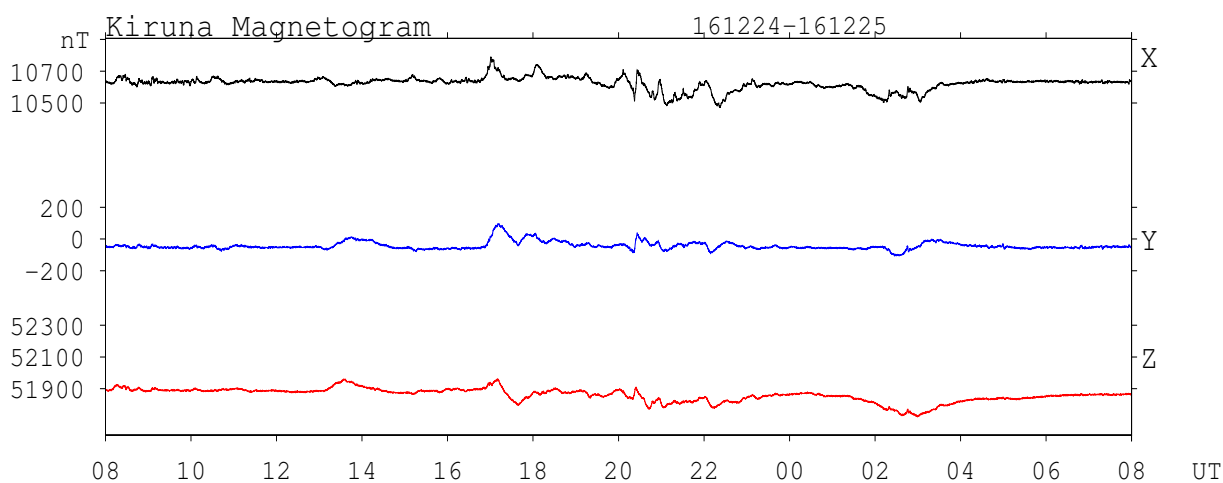
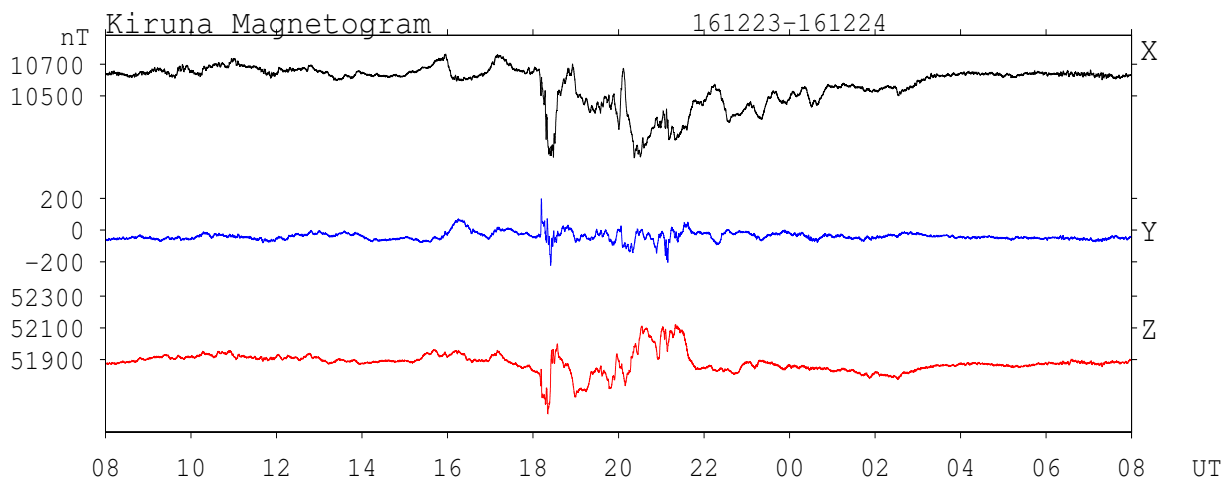


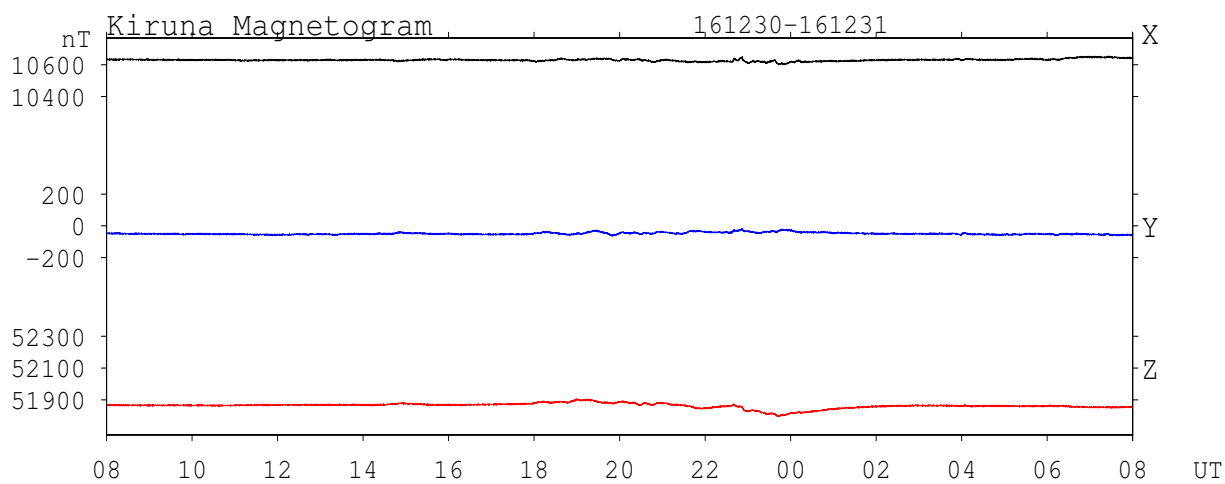
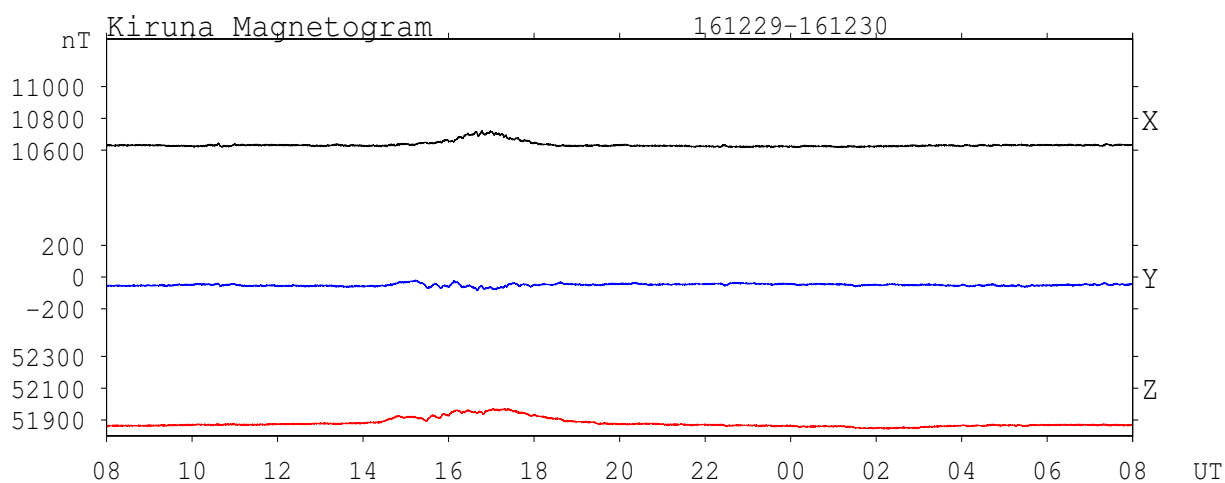
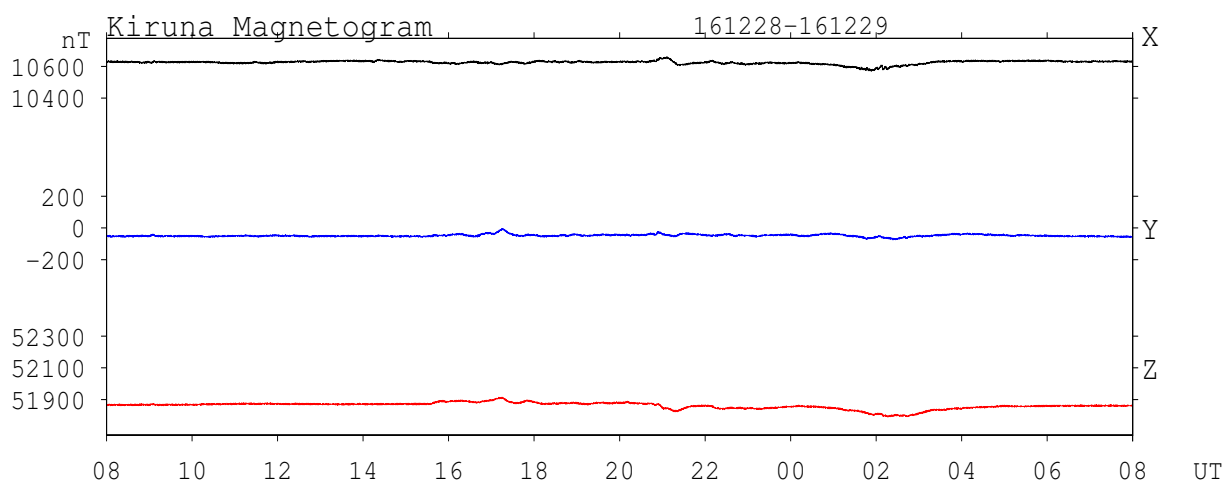
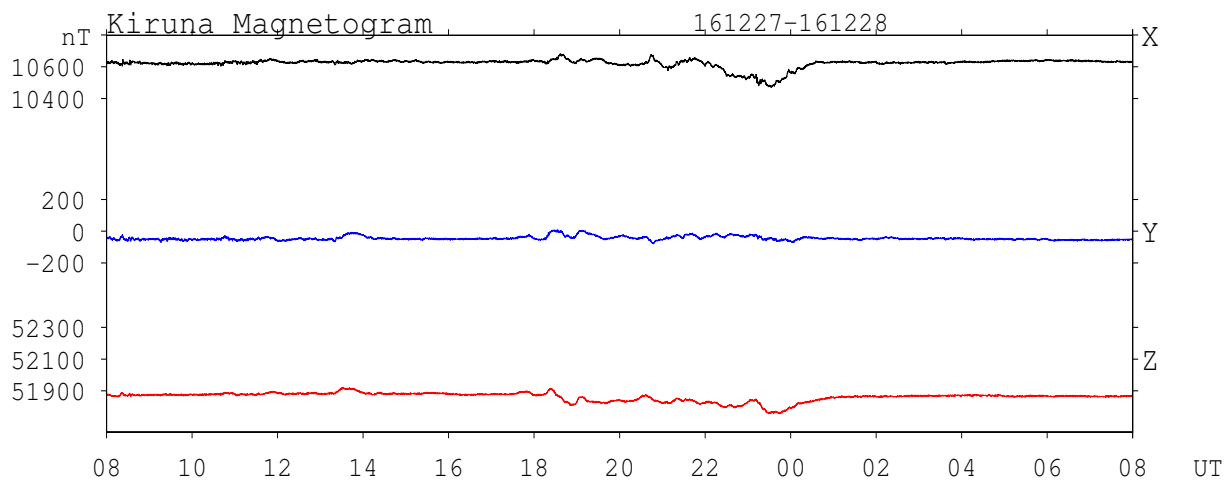


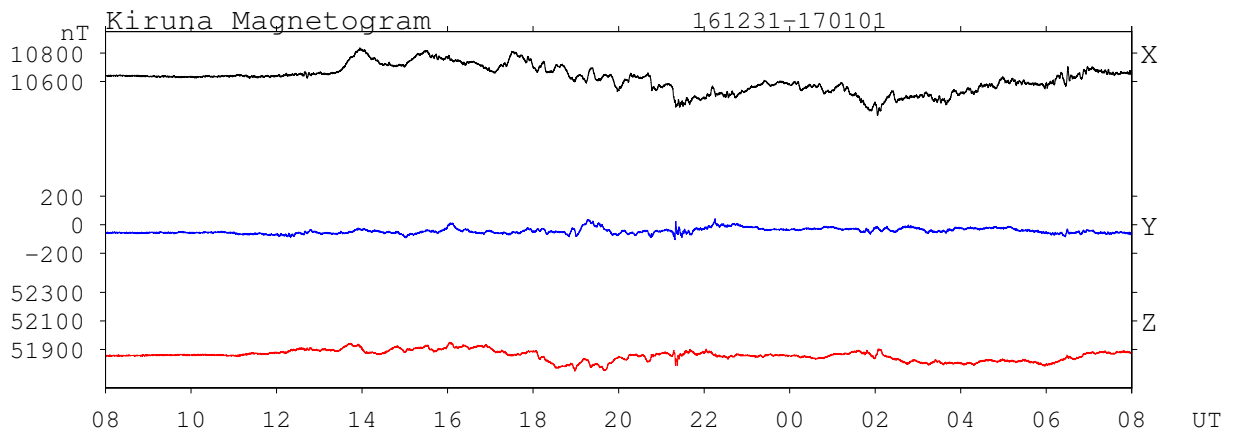












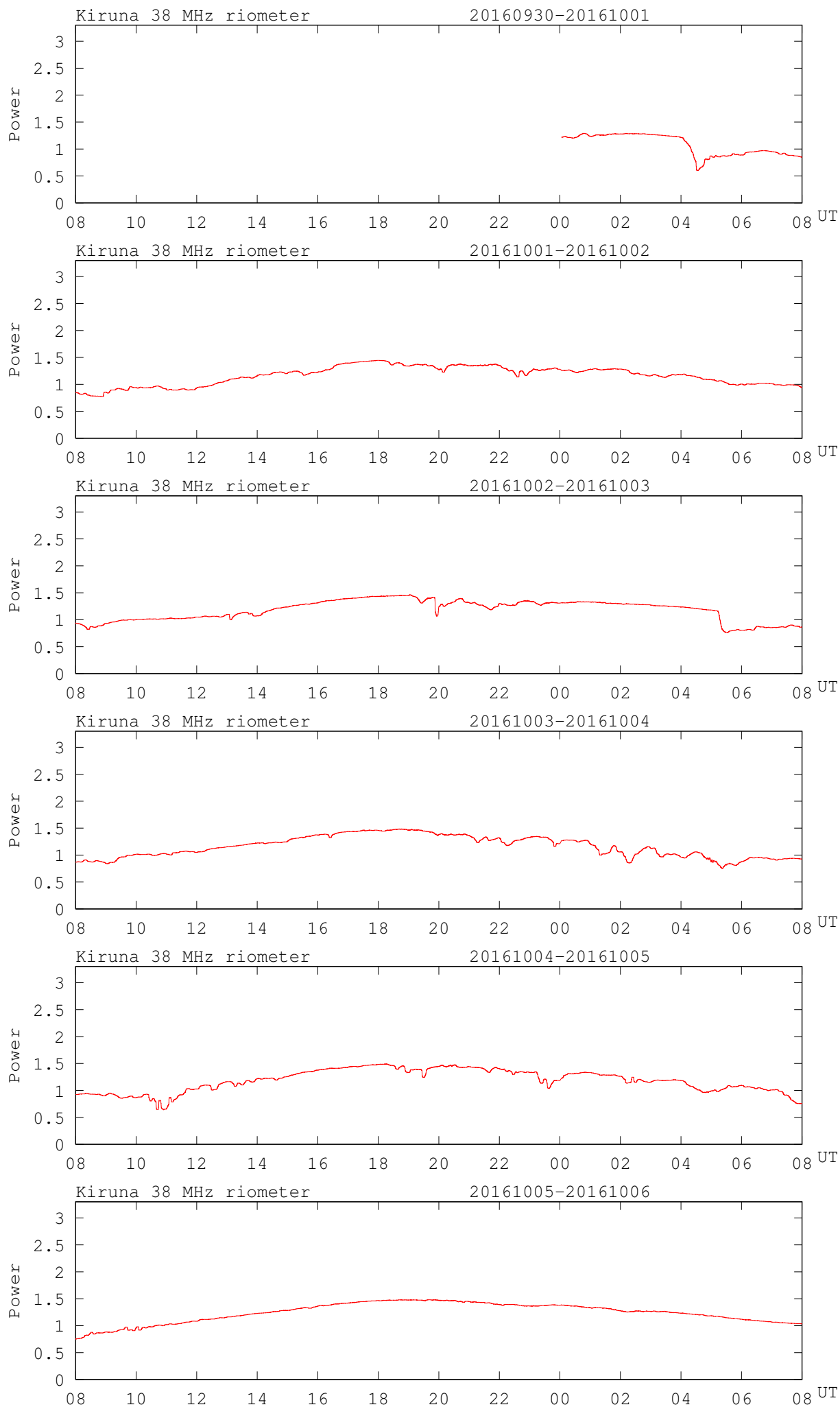
# **KIRUNA VERTICAL RIOMETER**

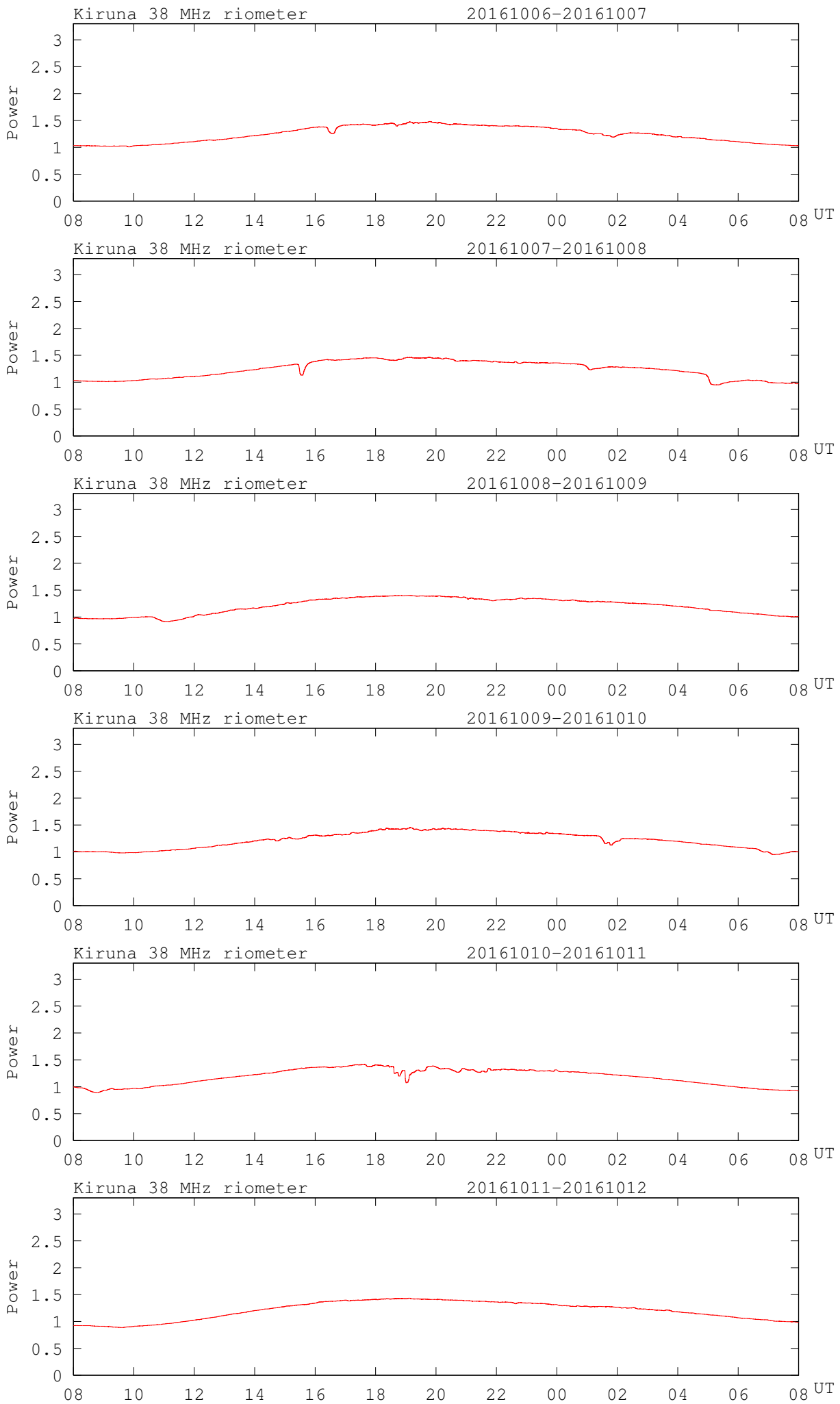
October - December 2016

<http://www.irf.se/~rio>

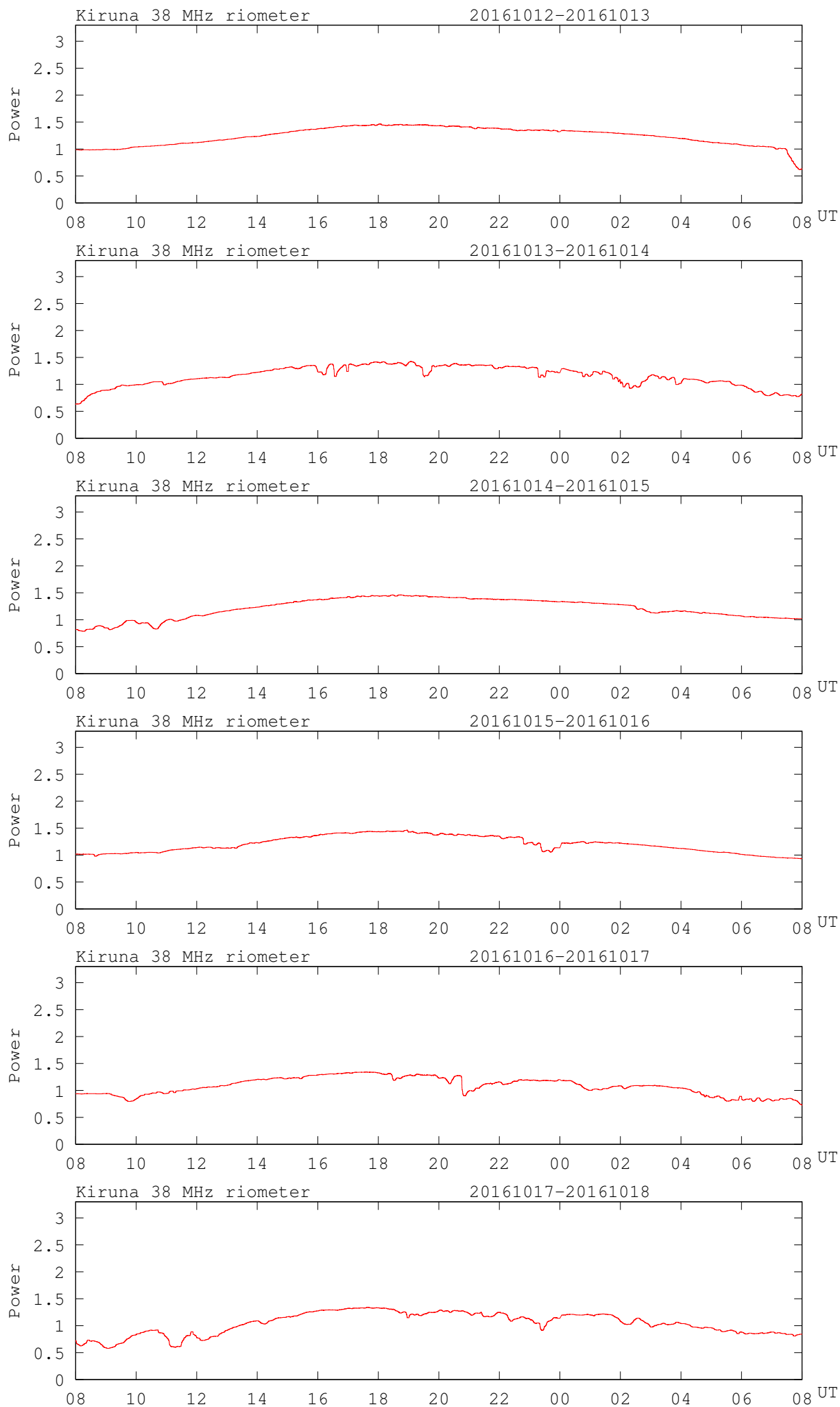
Note: Fast oscillations, for example on 2016-12-09 are due to a power interference.

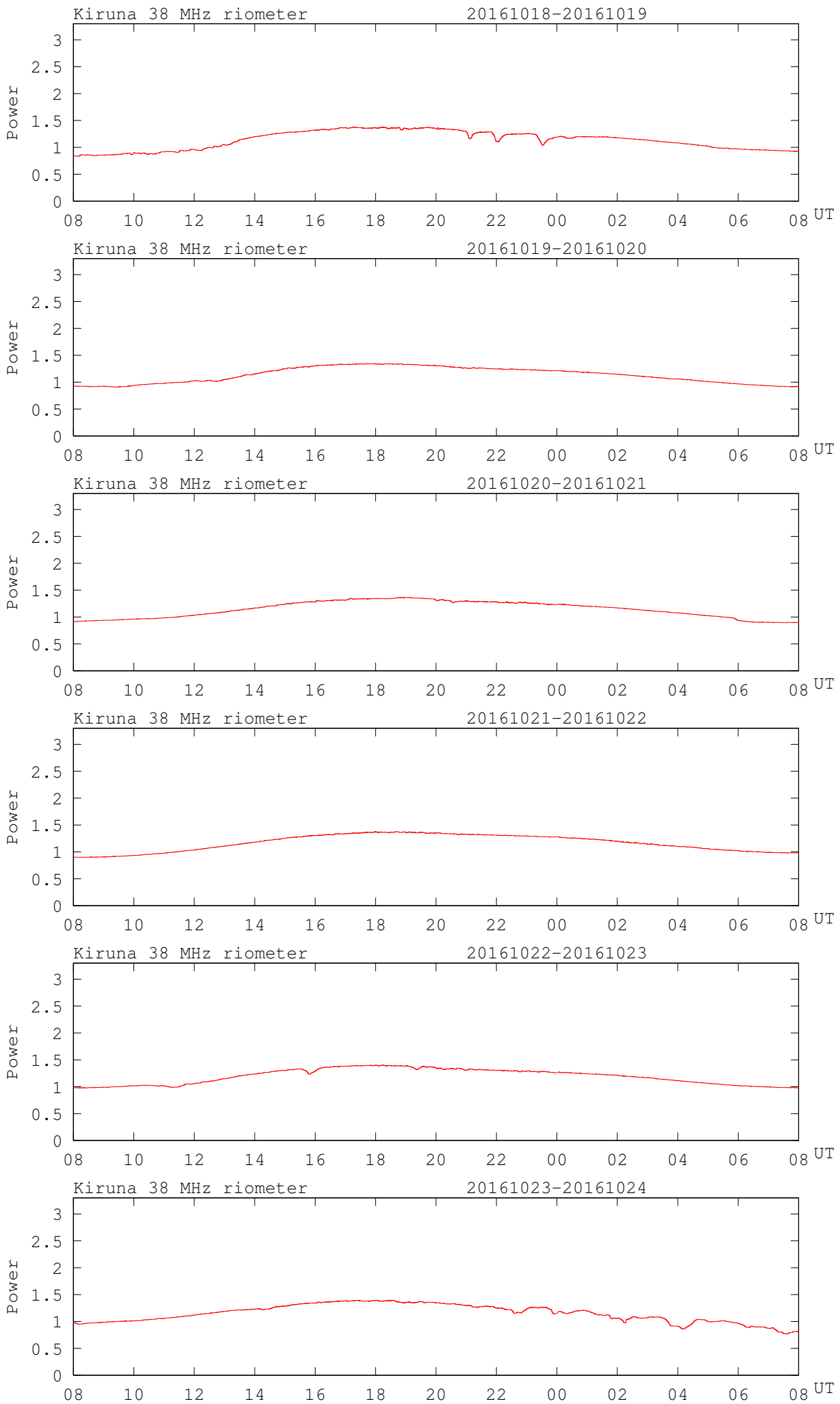


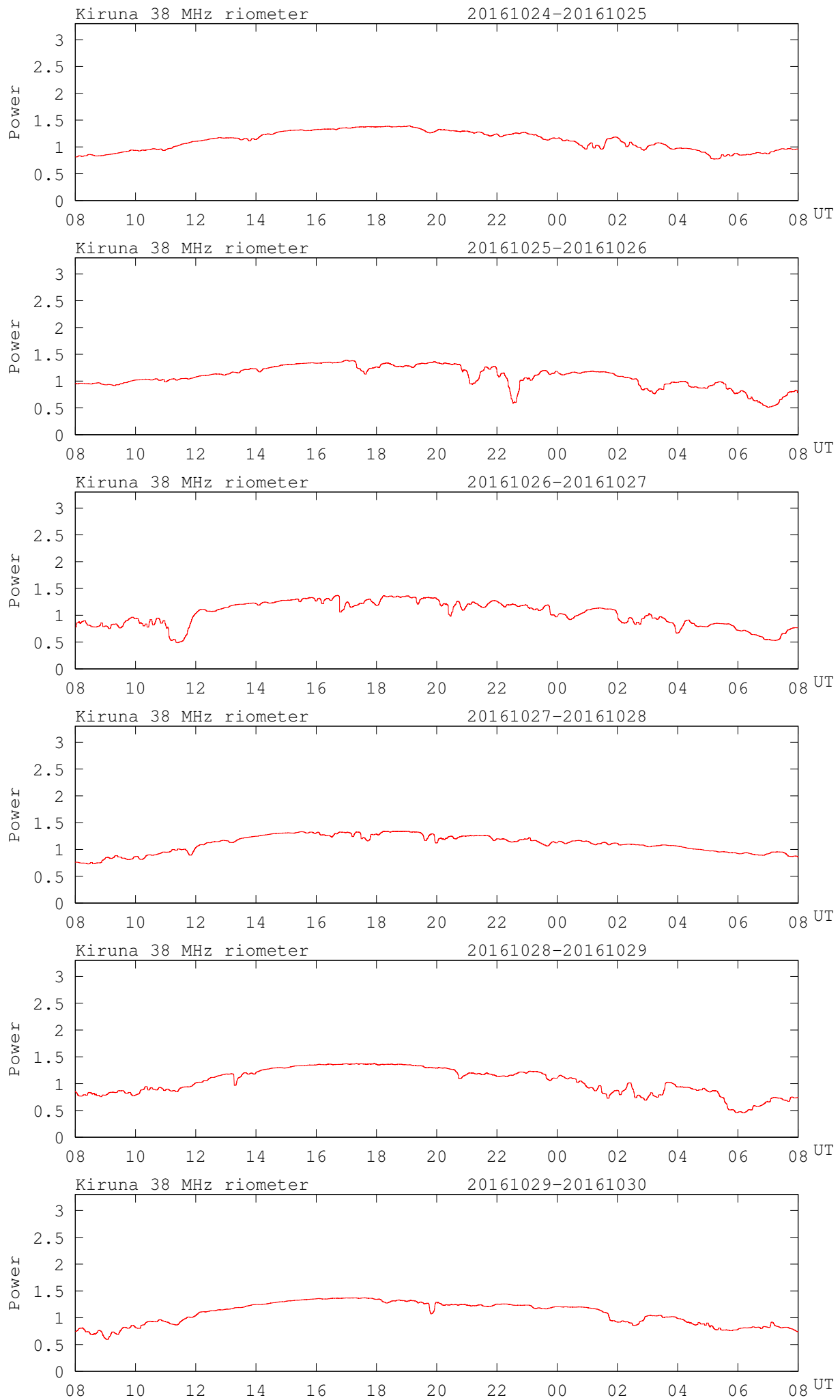


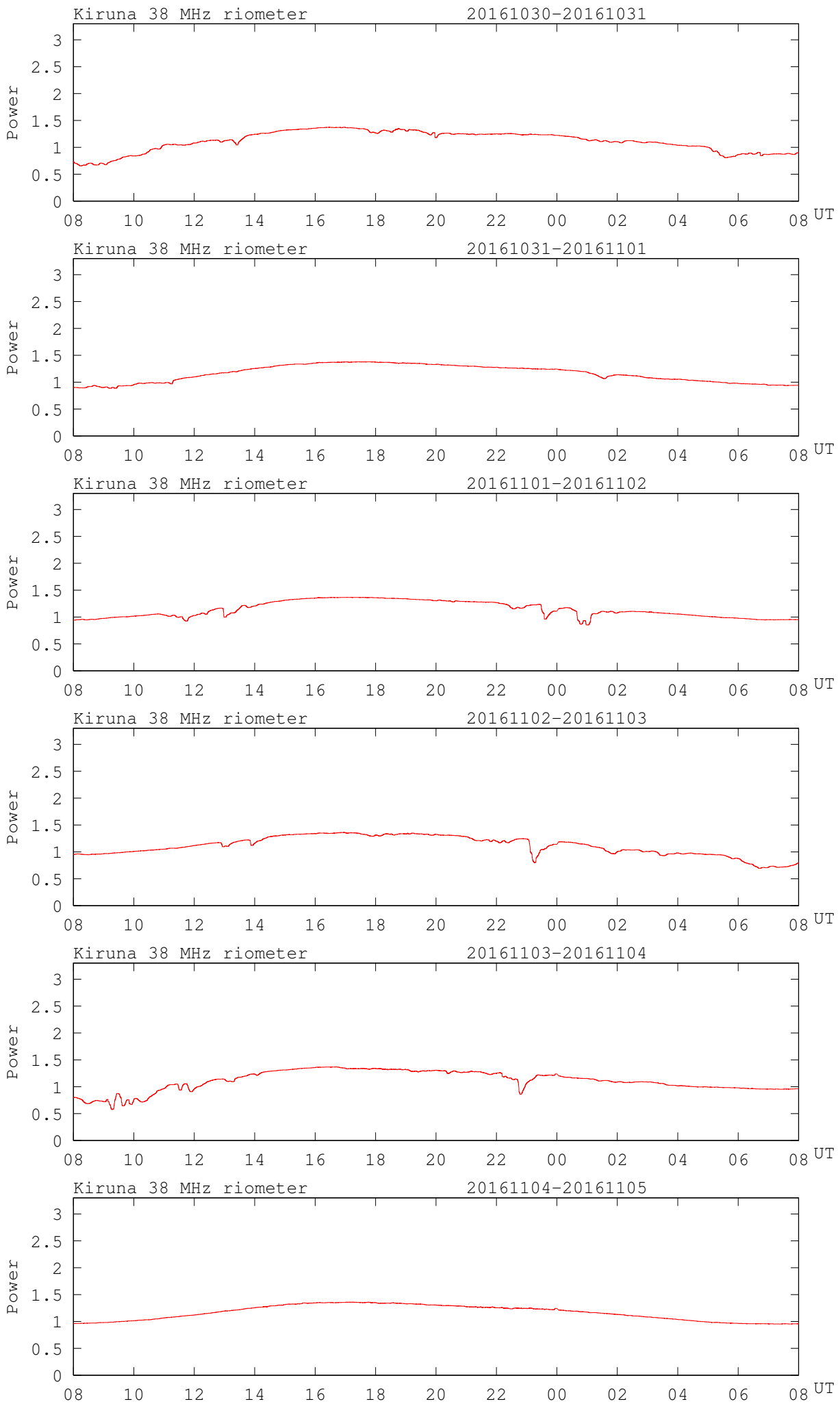


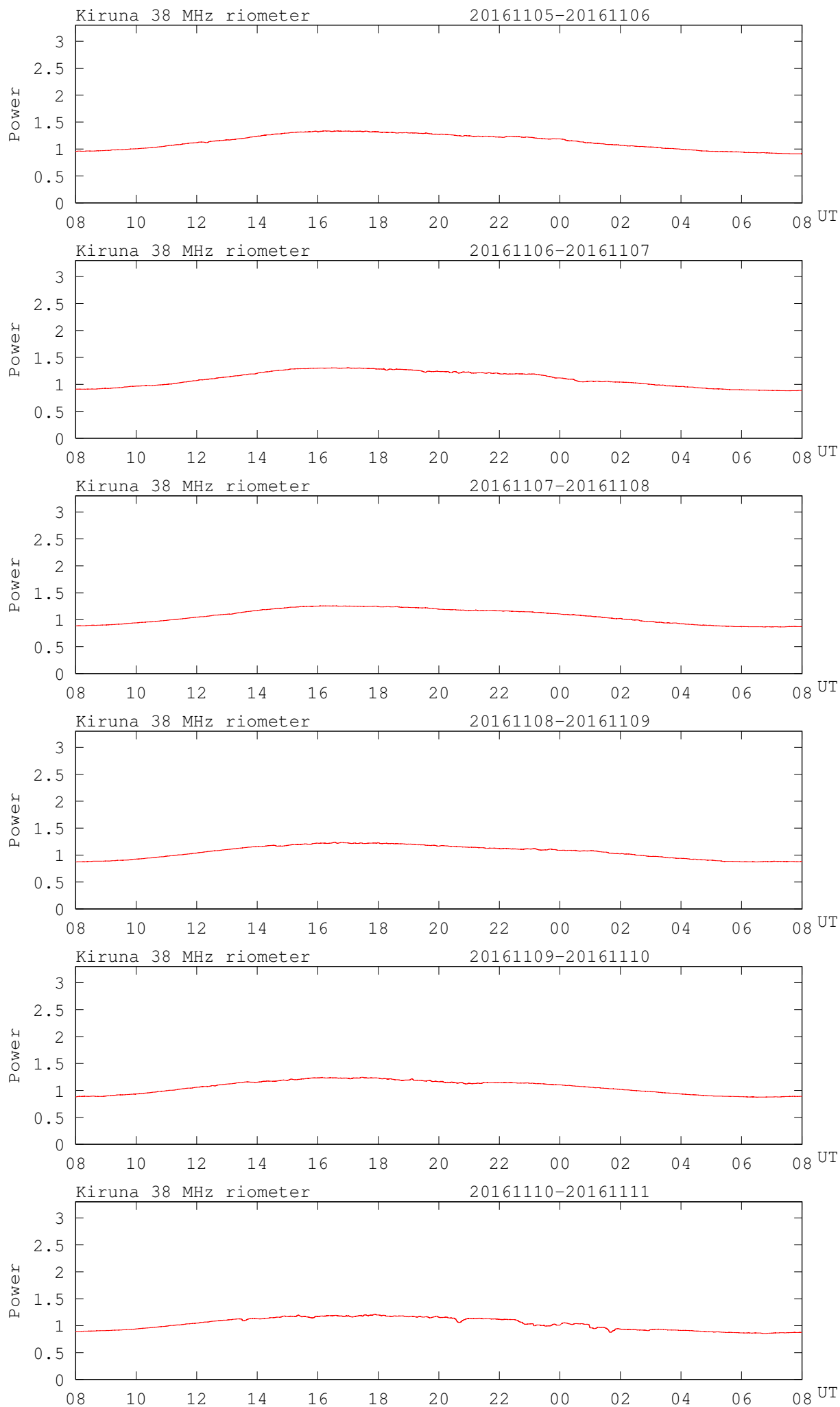


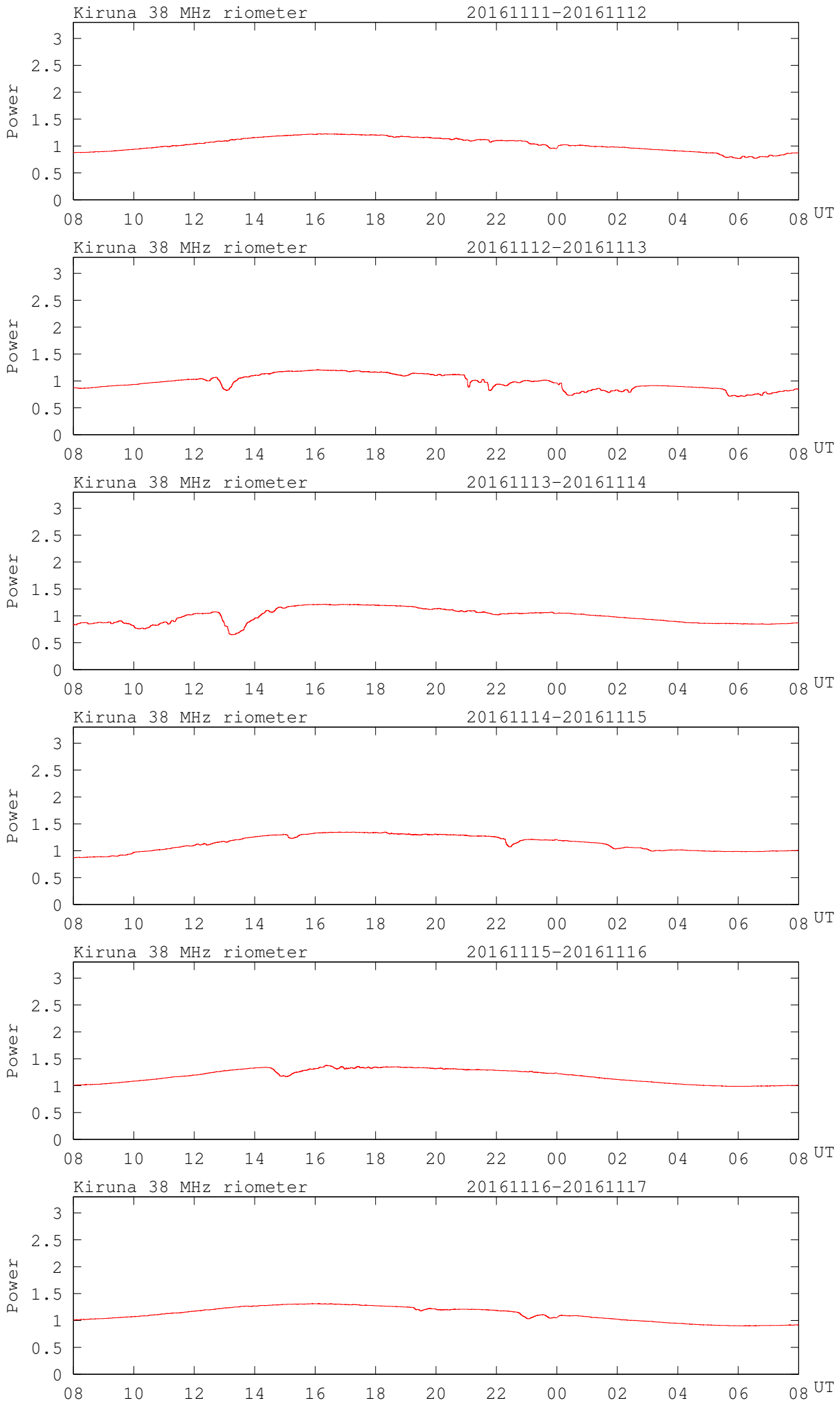


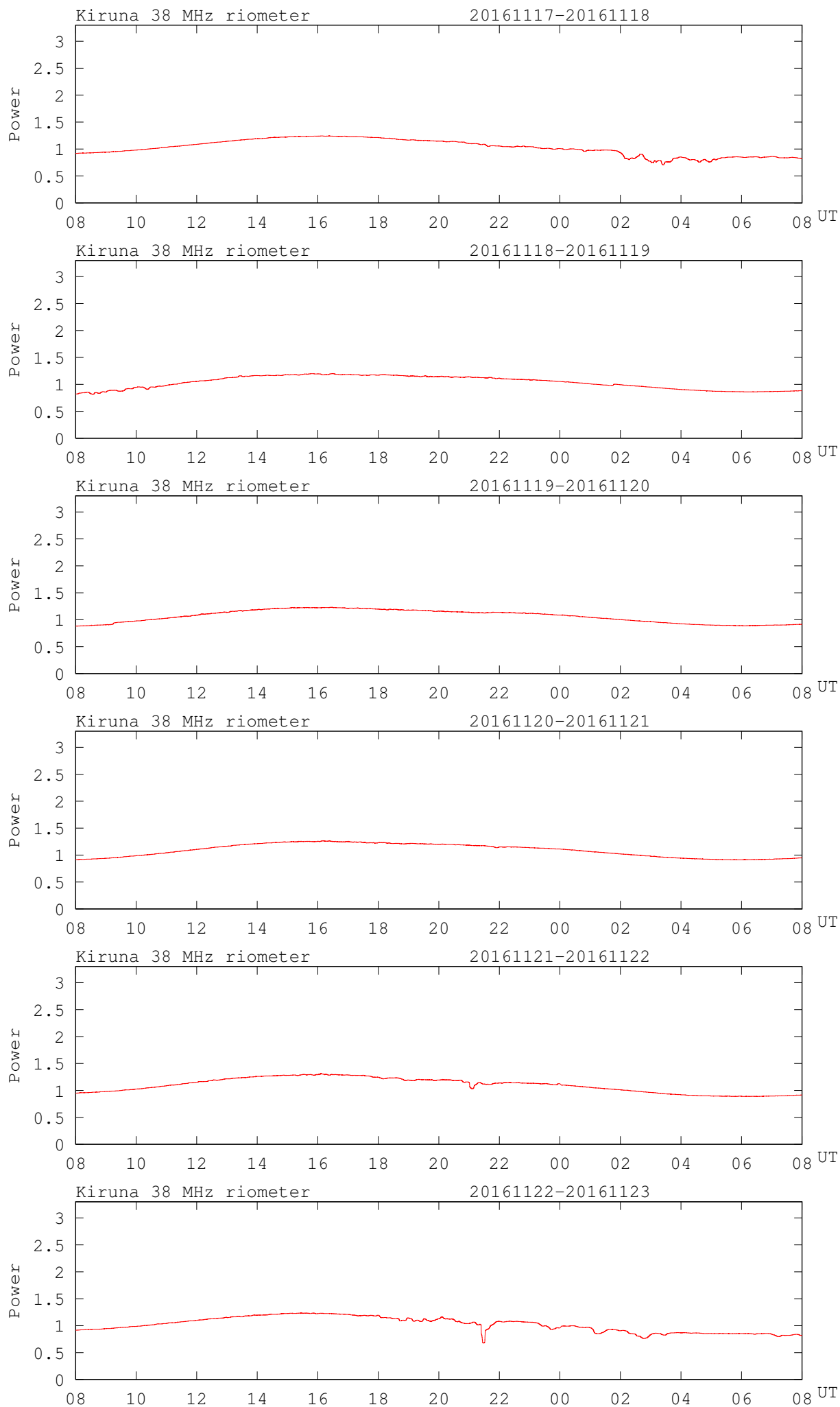


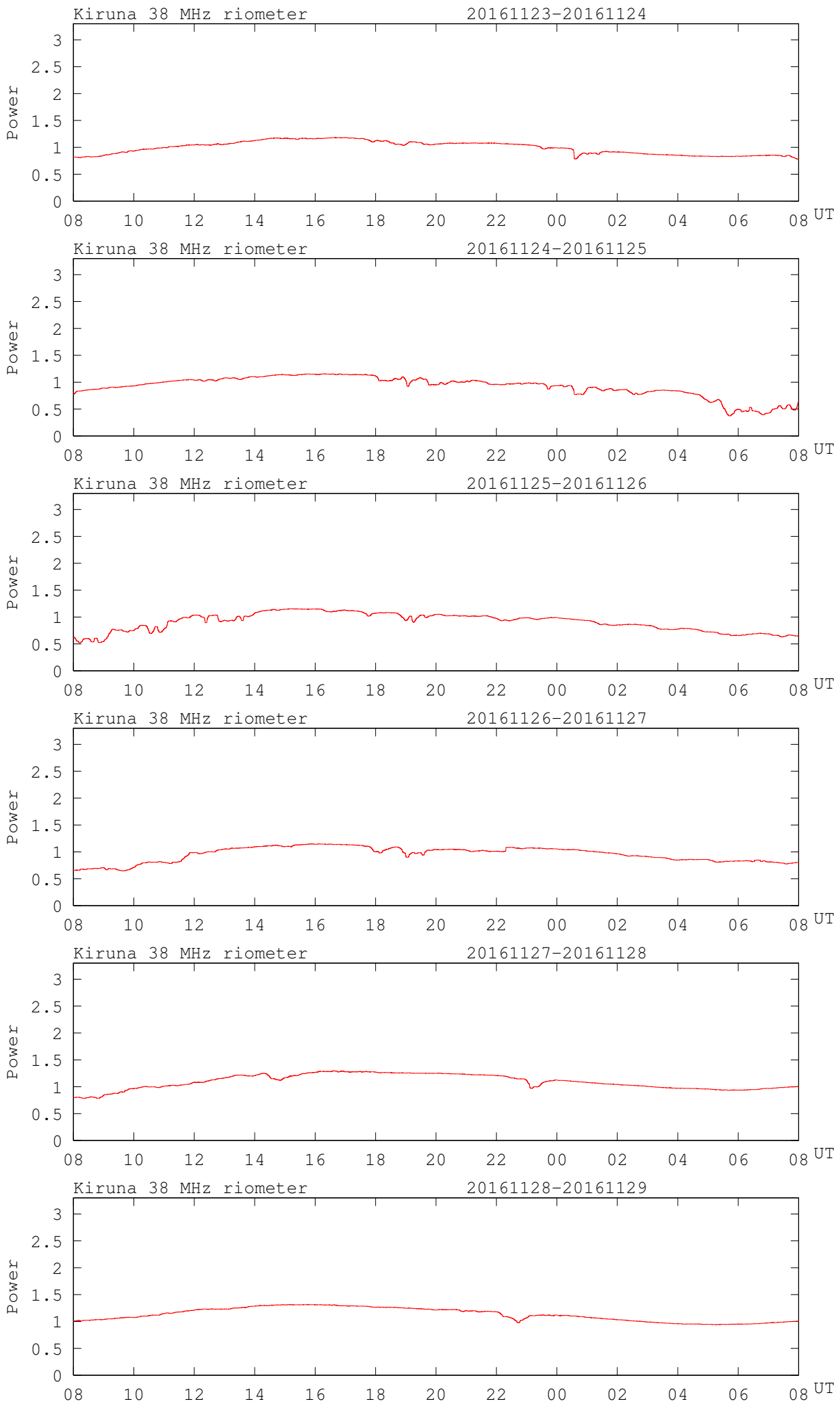




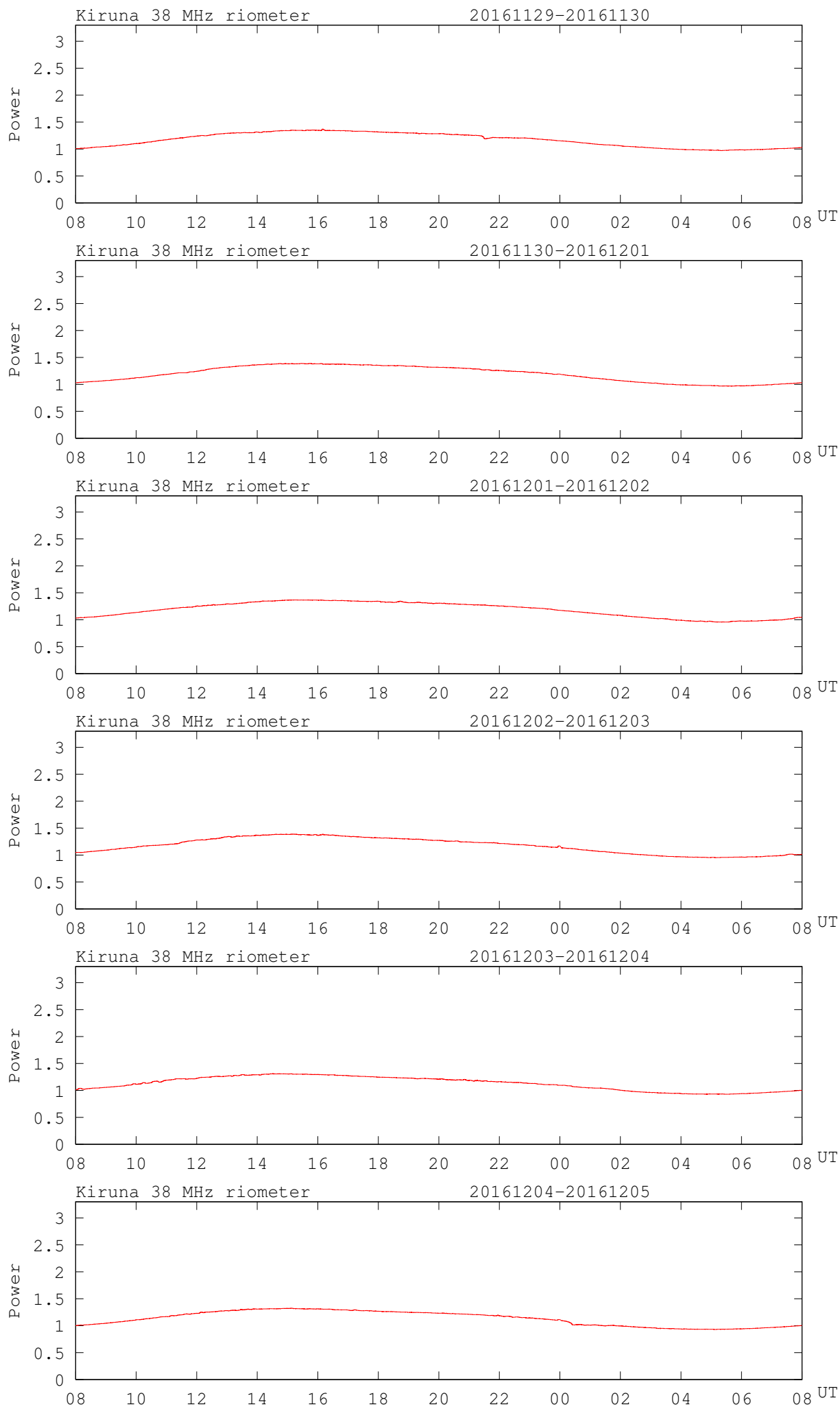


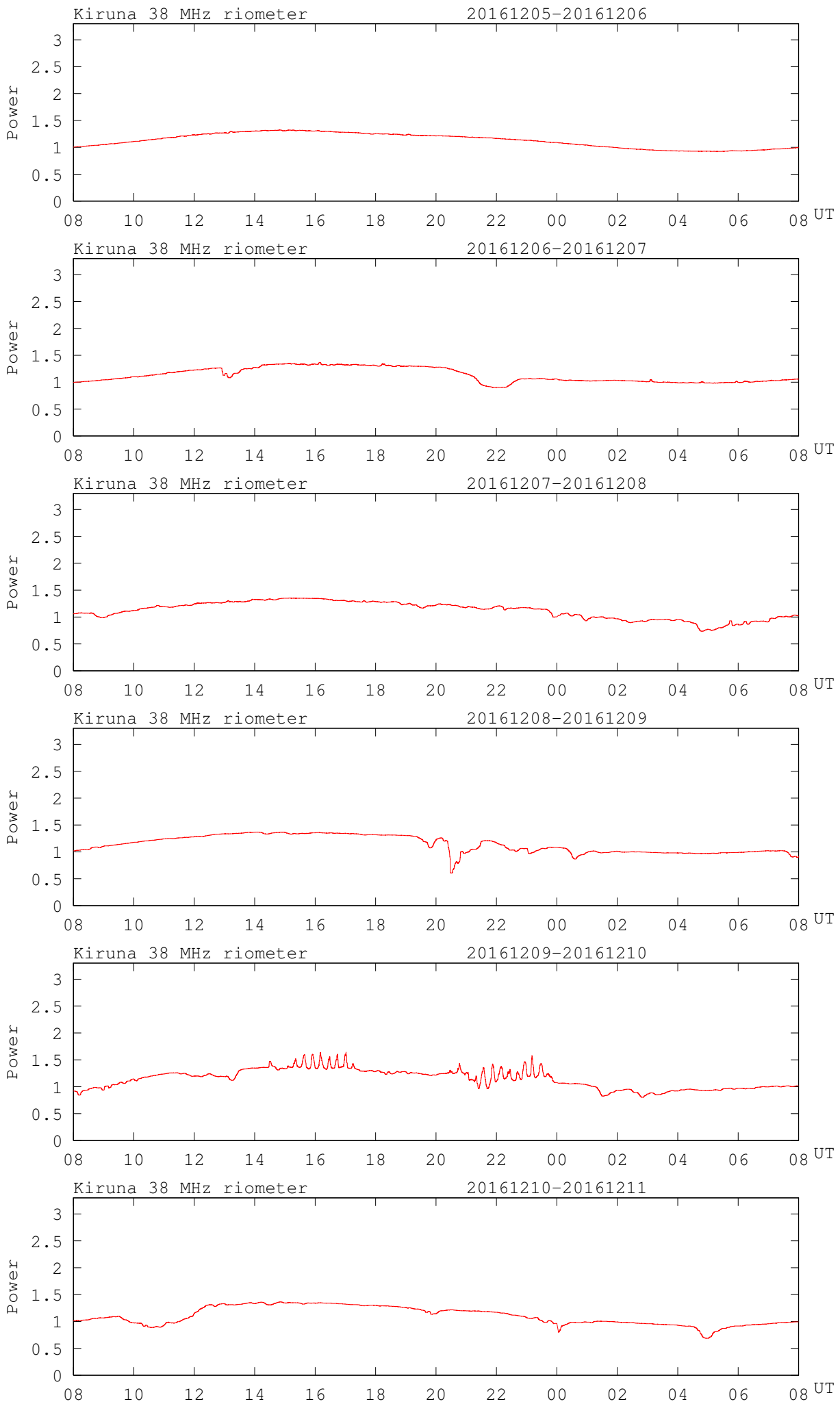


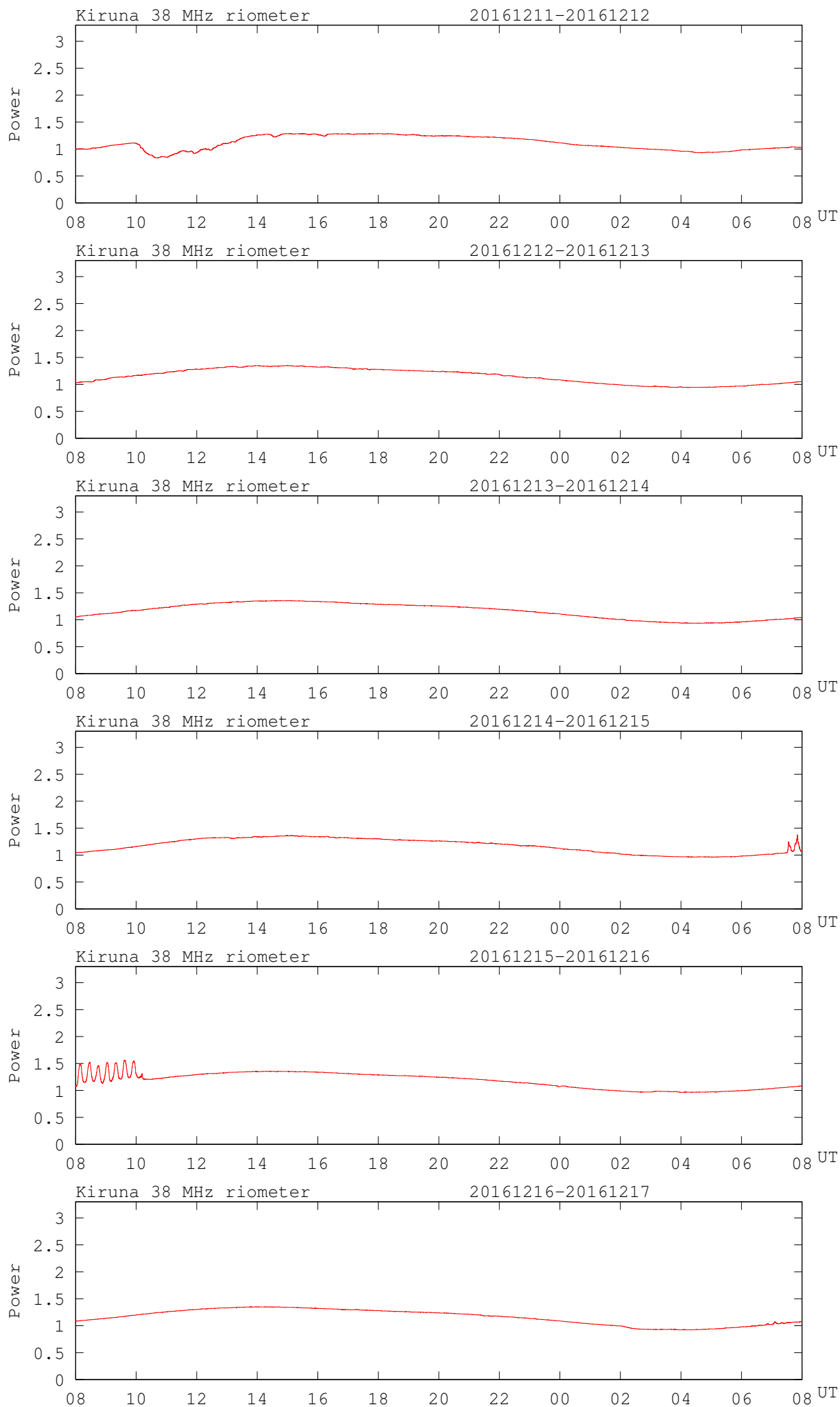


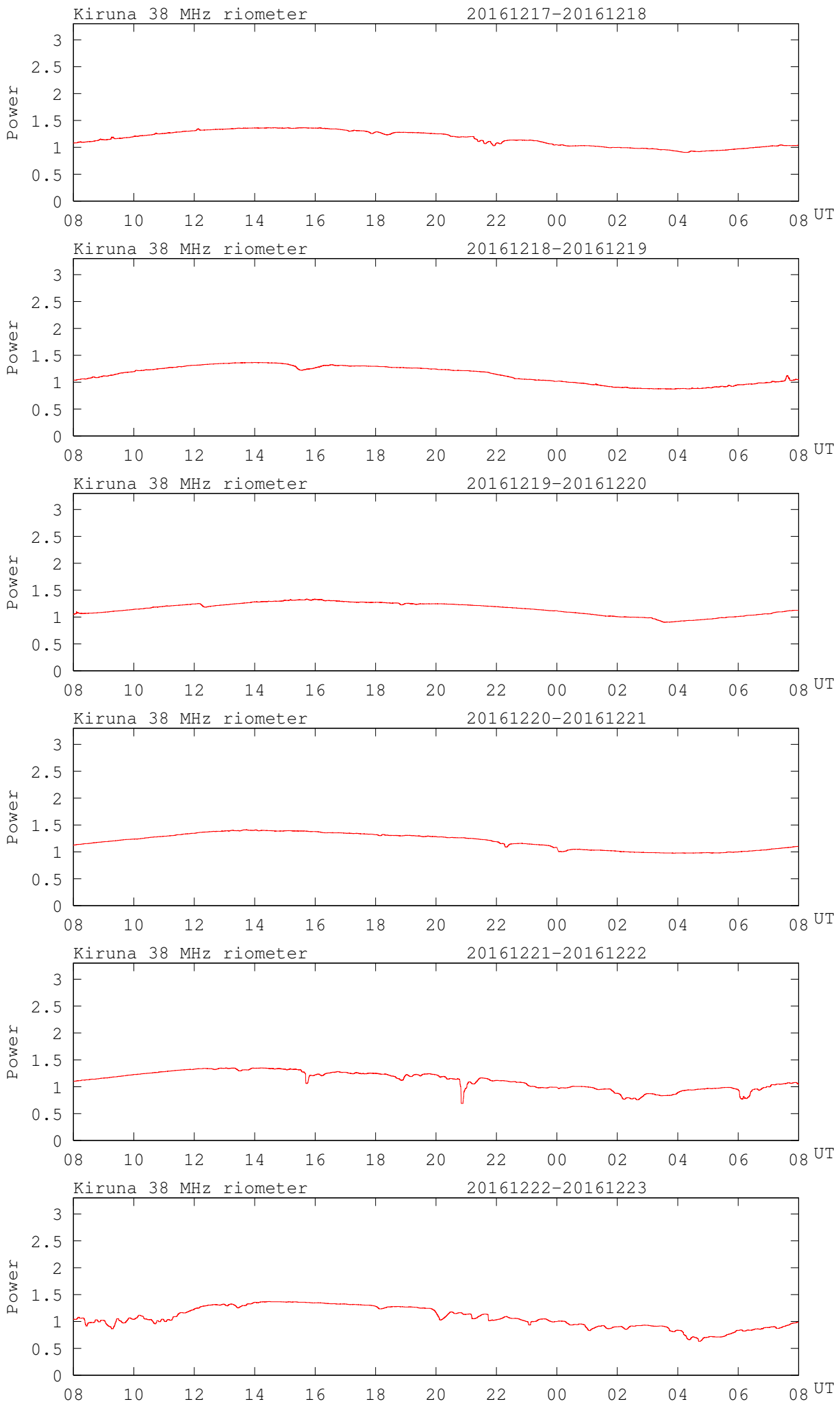


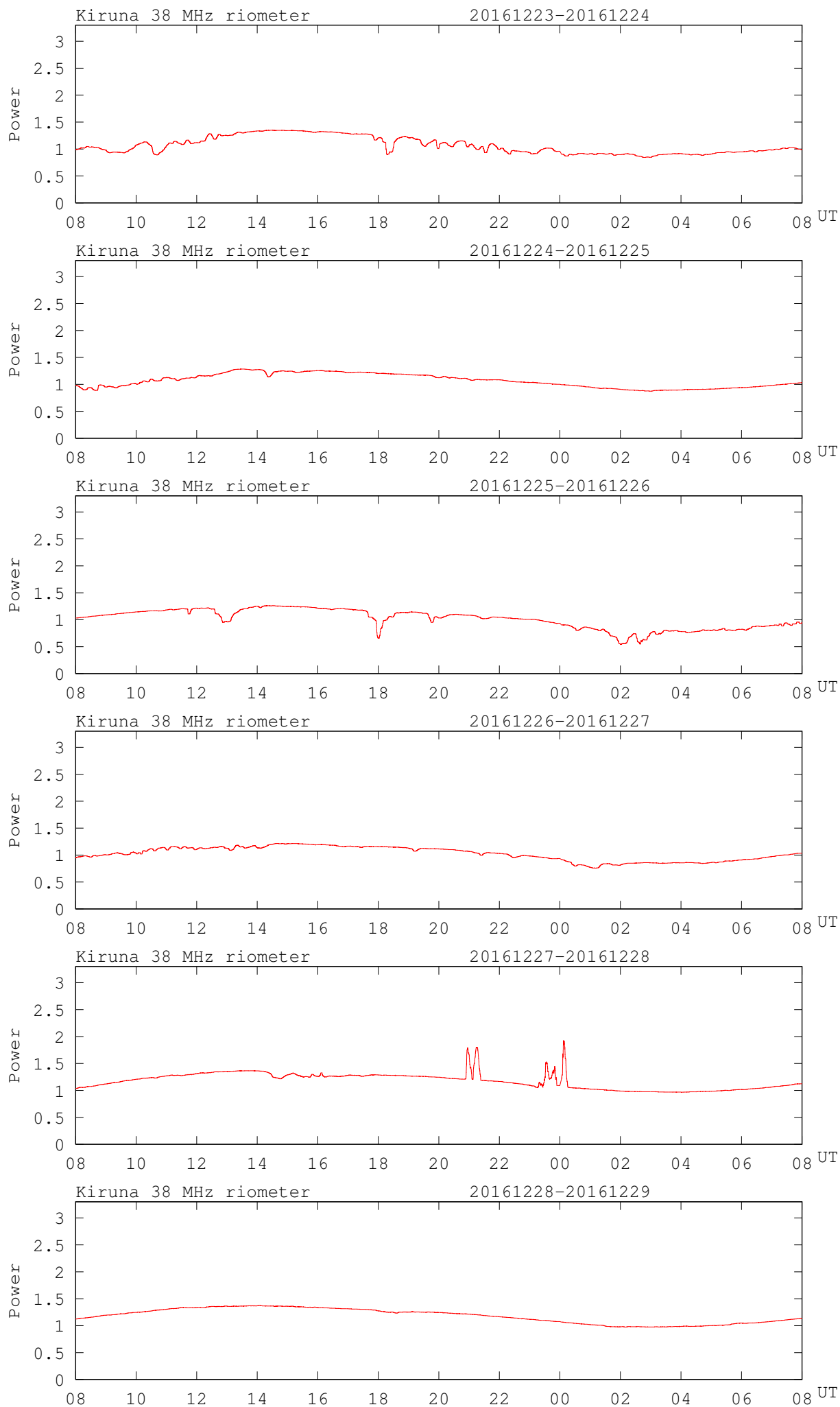


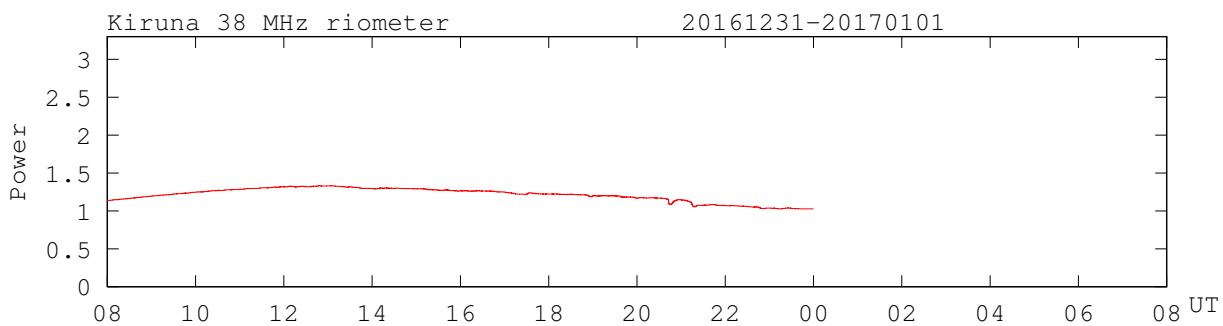
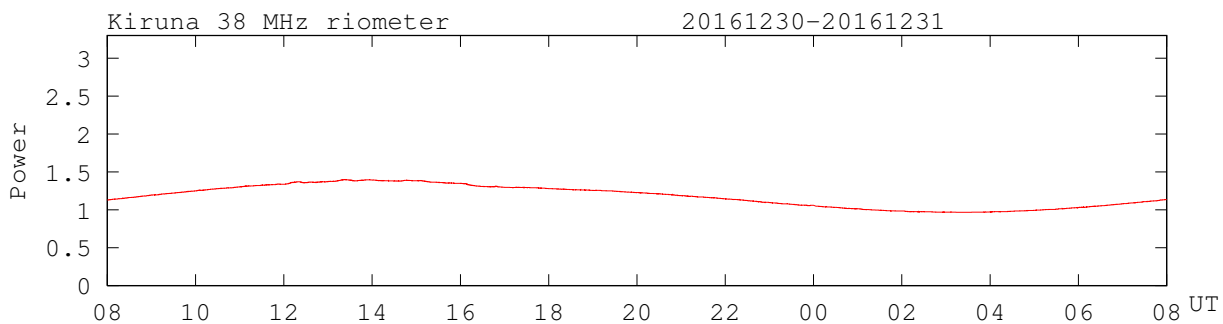
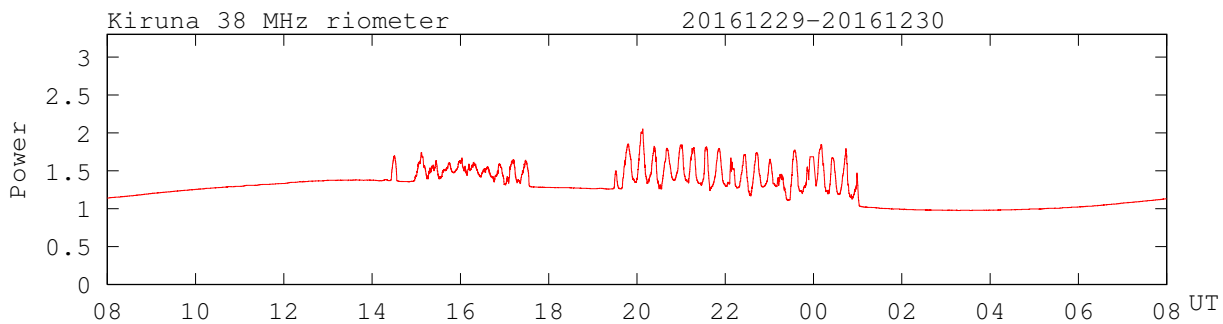
















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