



# **KIRUNA GEOPHYSICAL DATA**

DATA SUMMARY 00/1-3  
JANUARY-MARCH 2000

Collected at  
SWEDISH INSTITUTE OF SPACE PHYSICS  
KIRUNA, SWEDEN



# **Kiruna Geophysical Data**

Data Summary 00/1-3  
January - March 2000

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Printed in Sweden  
Swedish Institute of Space Physics  
Kiruna 2001

ISSN 0453-9478

## TABLE OF CONTENTS

Introduction ..... page A1

### Legend

Geomagnetic data ..... A2  
All-sky camera data ..... A3  
Ionospheric absorption data ..... A3

### Tables of January - March 2000

Geomagnetic K-indices ..... B1  
All-sky camera ..... B4

### Reproductions for January - March 2000

Magnetogram plots: <http://www.irf.se/mag>  
Riometer recordings: <http://www.irf.se/~rio>

## 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 re-search 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 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>standard<br>recording | 1. All-sky<br>camera | 1. Ionosonde<br>0.5-16.0 MHz |
| 2. Storm<br>recording                   |                      | 2. Riometer<br>30.0 MHz      |
| 3. Geomagnetic<br>digital<br>recording  |                      | 3. Riometer<br>38.2 MHz      |

Ionosonde data obtained at the Swedish Institute of Space Physics in Kiruna is published together with ionosonde data from Lycksele and Uppsala in a monthly report "Ionospheric Data Sweden" which is available from the Swedish Institute of Space Physics.

The Ionospheric Observatory at Lycksele (64.7°N, 18.8°E) is also operated by the Swedish Institute of Space Physics. Mainly magnetic, riometer, photometer, all-sky camera and ionosonde measurements are conducted there.

The digital magnetic recordings are reproduced in this report instead of the normal magnetograms from January 1980.

Universal time is used in all tables.

The most recent magnetometer and riometer data are now accessible via internet at <http://www.irf.se>. For more information contact the editor ([victoria.barabash@irf.se](mailto:victoria.barabash@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

Information about available records of all-sky camera films has been presented on page B4. The photographic records are made on 16 mm colour film normally at a rate of one frame per min. Data is recorded at higher frame rates (up to six per min) during selected periods. The start and stop time of camera operation and an average over the hour of auroral intensity and weather conditions is included in the tables.

## Legend:

|    |                                                               |
|----|---------------------------------------------------------------|
| c  | Cloudy                                                        |
| a  | Aurora                                                        |
| r  | Red aurora                                                    |
| A  | Strong aurora                                                 |
| R  | Strong red aurora                                             |
| ac | Aurora and partly cloudy                                      |
| rc | Red aurora and partly cloudy                                  |
| Ac | Strong aurora and partly cloudy                               |
| Rc | Strong red aurora and partly cloudy                           |
| I  | No aurora, clear weather                                      |
| Ic | No aurora, partly cloudy                                      |
| +  | Camera fault                                                  |
| —  | Camera off (camera not running due to daylight, snow or rain) |

## 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

where  $P$  is the received cosmic noise power,  $P_0$  the cosmic noise power expected under ionospherically quiet conditions at the same sidereal time.

## B1

## GEOMAGNETIC K-INDICES, KIRUNA

January 2000

Lower limit of K=9 is 1500 nT

Time in UT

| Day   | 00 | - | 03 | - | 06 | - | 09 | - | 12 | - | 15 | - | 18 | - | 21 | - | 24 | K-sum |
|-------|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|-------|
| 1     | 6  |   | 6  |   | 4  |   | 4  |   | 3  |   | 3  |   | 7  |   | 6  |   | 39 |       |
| 2     | 6  |   | 4  |   | 3  |   | 4  |   | 4  |   | 4  |   | 5  |   | 5  |   | 35 |       |
| 3     | 6  |   | 3  |   | 3  |   | 3  |   | 3  |   | 3  |   | 4  |   | 2  |   | 27 |       |
| 4     | 3  |   | 2  |   | 2  |   | 3  |   | 3  |   | 3  |   | 4  |   | 6  |   | 26 |       |
| 5     | 5  |   | 5  |   | 3  |   | 3  |   | 2  |   | 5  |   | 6  |   | 7  |   | 36 |       |
| ----- |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |       |
| 6     | 4  |   | 3  |   | 2  |   | 3  |   | 5  |   | 6  |   | 6  |   | 5  |   | 34 |       |
| 7     | 4  |   | 3  |   | 2  |   | 2  |   | 2  |   | 2  |   | 5  |   | 5  |   | 25 |       |
| 8     | 2  |   | 0  |   | 1  |   | 1  |   | 1  |   | 3  |   | 0  |   | 0  |   | 8  |       |
| 9     | 1  |   | 1  |   | 0  |   | 0  |   | 0  |   | 0  |   | 0  |   | 3  |   | 5  |       |
| 10    | 2  |   | 2  |   | 1  |   | 1  |   | 0  |   | 2  |   | 5  |   | 5  |   | 18 |       |
| ----- |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |       |
| 11    | 3  |   | 2  |   | 1  |   | 2  |   | 4  |   | 6  |   | 6  |   | 7  |   | 31 |       |
| 12    | 5  |   | 4  |   | 3  |   | 2  |   | 1  |   | 2  |   | 4  |   | 3  |   | 24 |       |
| 13    | 2  |   | 2  |   | 3  |   | 2  |   | 2  |   | 2  |   | 1  |   | 4  |   | 18 |       |
| 14    | 5  |   | 2  |   | 2  |   | 1  |   | 1  |   | 2  |   | 4  |   | 2  |   | 19 |       |
| 15    | 2  |   | 1  |   | 1  |   | 1  |   | 1  |   | 0  |   | 2  |   | 3  |   | 11 |       |
| ----- |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |       |
| 16    | 2  |   | 1  |   | 1  |   | 1  |   | 1  |   | 2  |   | 3  |   | 4  |   | 15 |       |
| 17    | 3  |   | 1  |   | 0  |   | 1  |   | 0  |   | 0  |   | 2  |   | 1  |   | 8  |       |
| 18    | 0  |   | 1  |   | 1  |   | 1  |   | 1  |   | 1  |   | 1  |   | 1  |   | 7  |       |
| 19    | 1  |   | 0  |   | 1  |   | 1  |   | 0  |   | 1  |   | 3  |   | 5  |   | 12 |       |
| 20    | 3  |   | 2  |   | 1  |   | 2  |   | 2  |   | 3  |   | 6  |   | 3  |   | 22 |       |
| ----- |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |       |
| 21    | 0  |   | 1  |   | 1  |   | 1  |   | 0  |   | 0  |   | 0  |   | 1  |   | 4  |       |
| 22    | 2  |   | 1  |   | 2  |   | 2  |   | 4  |   | 4  |   | 7  |   | 7  |   | 29 |       |
| 23    | 8  |   | 7  |   | 2  |   | 4  |   | 4  |   | 4  |   | 0  |   | 2  |   | 31 |       |
| 24    | 2  |   | 3  |   | 4  |   | 3  |   | 2  |   | 3  |   | 4  |   | 6  |   | 27 |       |
| 25    | 3  |   | 3  |   | 2  |   | 1  |   | 1  |   | 3  |   | 4  |   | 4  |   | 21 |       |
| ----- |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |       |
| 26    | 3  |   | 4  |   | 2  |   | 1  |   | 1  |   | 1  |   | 3  |   | 6  |   | 21 |       |
| 27    | 6  |   | 2  |   | 1  |   | 1  |   | 2  |   | 3  |   | 5  |   | 6  |   | 26 |       |
| 28    | 6  |   | 6  |   | 4  |   | 4  |   | 5  |   | 4  |   | 4  |   | 6  |   | 39 |       |
| 29    | 6  |   | 5  |   | 5  |   | 4  |   | 4  |   | 6  |   | 5  |   | 7  |   | 42 |       |
| 30    | 5  |   | 3  |   | 4  |   | 2  |   | 3  |   | 3  |   | 6  |   | 5  |   | 31 |       |
| ----- |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |       |
| 31    | 5  |   | 3  |   | 3  |   | 2  |   | 2  |   | 2  |   | 3  |   | 4  |   | 24 |       |

## B2

## GEOMAGNETIC K-INDICES, KIRUNA

February 2000

Lower limit of K=9 is 1500 nT

Time in UT

| Day   | 00 | - 03 | - 06 | - 09 | - 12 | - 15 | - 18 | - 21 | - 24 | K-sum |
|-------|----|------|------|------|------|------|------|------|------|-------|
| 1     | 3  | (1)  | (2)  | 1    | 2    | 2    | 3    | 3    | (17) |       |
| 2     | 4  | 1    | 1    | 1    | 2    | 4    | 3    | 3    | 19   |       |
| 3     | 1  | 1    | 1    | 1    | 3    | 2    | 5    | 5    | 19   |       |
| 4     | 3  | 1    | 2    | 1    | 1    | 0    | 0    | 3    | 11   |       |
| 5     | 1  | 1    | 0    | 1    | 1    | 3    | 6    | 5    | 18   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 6     | 5  | 6    | 4    | 4    | 3    | 5    | 6    | 7    | 40   |       |
| 7     | 7  | 4    | 5    | 4    | 4    | 6    | 6    | 6    | 42   |       |
| 8     | 6  | 3    | 2    | 2    | 3    | 3    | 7    | 5    | 31   |       |
| 9     | 3  | 3    | 2    | 1    | 4    | 4    | 2    | 4    | 23   |       |
| 10    | 3  | 2    | 2    | 1    | 2    | 3    | 3    | 4    | 20   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 11    | 4  | 4    | 3    | 2    | 3    | 5    | 5    | 7    | 33   |       |
| 12    | 8  | 7    | 6    | 6    | 6    | 6    | 5    | 5    | 49   |       |
| 13    | 4  | 2    | 2    | 3    | 3    | 5    | 4    | 5    | 28   |       |
| 14    | 5  | 5    | 3    | 4    | 6    | 6    | 5    | 7    | 41   |       |
| 15    | 6  | 5    | 3    | 2    | 2    | 2    | 5    | 6    | 31   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 16    | 4  | 3    | 2    | 1    | 2    | 4    | 4    | 4    | 24   |       |
| 17    | 3  | 1    | 1    | 2    | 4    | 3    | 3    | 1    | 18   |       |
| 18    | 0  | 0    | 1    | 0    | 1    | 1    | 0    | 0    | 3    |       |
| 19    | 0  | 0    | 1    | 1    | 1    | 1    | 1    | 1    | 6    |       |
| 20    | 0  | 1    | 2    | 1    | 0    | 1    | 1    | 4    | 10   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 21    | 5  | 6    | 2    | 3    | 4    | 5    | 4    | 2    | 31   |       |
| 22    | 1  | 1    | 1    | 1    | 2    | 2    | 2    | 3    | 13   |       |
| 23    | 1  | 0    | 1    | 3    | 4    | 4    | 3    | 3    | 19   |       |
| 24    | 3  | 4    | 3    | 4    | 5    | 5    | 6    | 6    | 36   |       |
| 25    | 6  | 5    | 4    | 3    | 3    | 3    | 4    | 4    | 32   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 26    | 5  | 3    | 3    | 3    | 2    | 4    | 7    | 6    | 33   |       |
| 27    | 6  | 3    | 3    | 2    | 2    | 3    | 5    | 5    | 29   |       |
| 28    | 4  | 6    | 4    | 3    | 5    | 3    | 2    | 3    | 30   |       |
| 29    | 0  | 1    | 2    | 2    | 2    | 1    | 0    | 0    | 8    |       |



## B3

## GEOMAGNETIC K-INDICES, KIRUNA

March 2000

Lower limit of K=9 is 1500 nT

Time in UT

| Day   | 00 | - 03 | - 06 | - 09 | - 12 | - 15 | - 18 | - 21 | - 24 | K-sum |
|-------|----|------|------|------|------|------|------|------|------|-------|
| 1     | 2  | 2    | 3    | 3    | 5    | 5    | 7    | 6    | 33   |       |
| 2     | 6  | 5    | 2    | 2    | 1    | 1    | 0    | 2    | 19   |       |
| 3     | 1  | 1    | 1    | 2    | 2    | 2    | 4    | 3    | 16   |       |
| 4     | 0  | 0    | 1    | 2    | 2    | 2    | 0    | 1    | 8    |       |
| 5     | 0  | 1    | 2    | 2    | 2    | 3    | 4    | 5    | 19   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 6     | 3  | 1    | 2    | 3    | 2    | 4    | 5    | 5    | 25   |       |
| 7     | 5  | 5    | 3    | 2    | 4    | 5    | 4    | 5    | 33   |       |
| 8     | 5  | 3    | 2    | 2    | 4    | 5    | 5    | 4    | 30   |       |
| 9     | 5  | 1    | 1    | 2    | 2    | 1    | 1    | 2    | 15   |       |
| 10    | 2  | 0    | 1    | 3    | 4    | 4    | 5    | 5    | 24   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 11    | 5  | 5    | 2    | 2    | 5    | 4    | 4    | 4    | 31   |       |
| 12    | 4  | 4    | 4    | 3    | 3    | 4    | 4    | 5    | 31   |       |
| 13    | 5  | 2    | 1    | 1    | 1    | 0    | 3    | 3    | 16   |       |
| 14    | 4  | 1    | 1    | 1    | 2    | 3    | 4    | 5    | 21   |       |
| 15    | 3  | 1    | 0    | 2    | 1    | 1    | 1    | 0    | 9    |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 16    | 0  | 0    | 0    | 1    | 1    | 1    | 1    | 1    | 5    |       |
| 17    | 1  | 1    | 2    | 2    | 1    | 1    | 0    | 0    | 8    |       |
| 18    | 0  | 1    | 1    | 2    | 2    | 2    | 4    | 3    | 15   |       |
| 19    | 1  | 2    | 1    | 2    | 3    | 2    | 3    | 0    | 14   |       |
| 20    | 1  | 1    | 2    | 2    | 3    | 1    | 0    | 0    | 10   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 21    | 0  | 1    | 2    | 2    | 2    | 2    | 1    | 0    | 10   |       |
| 22    | 2  | 2    | 2    | 2    | 3    | 4    | 3    | 5    | 23   |       |
| 23    | 3  | 3    | 3    | 3    | 4    | 5    | 2    | 1    | 24   |       |
| 24    | 3  | 3    | 2    | 3    | 4    | 4    | 2    | 2    | 23   |       |
| 25    | 3  | 2    | 2    | 2    | 2    | 3    | 4    | 1    | 19   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 26    | 0  | 1    | 2    | 2    | 2    | 2    | 1    | 2    | 12   |       |
| 27    | 1  | 2    | 1    | 2    | 2    | 1    | 1    | 1    | 11   |       |
| 28    | 2  | 1    | 2    | 2    | 2    | 1    | 1    | 1    | 12   |       |
| 29    | 1  | 2    | 1    | 2    | 2    | 2    | 4    | 6    | 20   |       |
| 30    | 3  | 2    | 2    | 2    | 3    | 3    | 7    | 5    | 27   |       |
| ----- |    |      |      |      |      |      |      |      |      |       |
| 31    | 5  | 5    | 3    | 4    | 5    | 4    | 6    | 5    | 37   |       |





ALL-SKY CAMERA, KIRUNA  
March 2000

|        | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 01 | 02 | 03 | 04 | 05 | UT |
|--------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1-2    | -  | -  | -  | -  | -  | -  | ac | c  | -  | c  | c  | c  | -  | -  | c  | c  | c  |    |
| 2-3    | -  | -  | -  | -  | -  | c  | c  | c  | ac | ac | a  | a  | a  | +  | +  | +  | +  |    |
| 3-4    | -  | -  | -  | -  | -  | ac | ac | ac | c  | c  | c  | c  | c  | c  | ac | ac | -  |    |
| 4-5    | -  | -  | -  | -  | -  | c  | c  | Ic | a  | a  | ac | ac | I  | I  | I  | -  | -  |    |
| 5-6    | -  | -  | -  | -  | -  | a  | a  | a  | A  | A  | a  | ac | c  | c  | c  | -  | -  |    |
| 6-7    | -  | -  | -  | -  | -  | c  | ac | Ac | Ac | Ac | ac | ac | a  | a  | a  | -  | -  |    |
| 7-8    | -  | -  | -  | -  | -  | ac | ac | ac | Ac | ac | c  | c  | c  | c  | c  | -  | -  |    |
| 8-9    | -  | -  | -  | -  | -  | c  | c  | c  | c  | c  | ac | ac | ac | c  | -  | -  | -  |    |
| 9-10   | -  | -  | -  | -  | -  | Ic | Ic | Ic | ac | ac | ac | ac | Ic | Ic | Ic | -  | -  |    |
| 10-11  | -  | -  | -  | -  | -  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | -  | -  |
| 11-12  | -  | -  | -  | -  | -  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | -  | -  |
| 12-13  | -  | -  | -  | -  | -  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | -  | -  |
| 13-14  | -  | -  | -  | -  | -  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | -  | -  |
| 14-15  | -  | -  | -  | -  | -  | c  | c  | c  | c  | c  | c  | c  | c  | c  | Ic | Ic | -  | -  |
| 15-16  | -  | -  | -  | -  | -  | c  | c  | Ic | Ic | Ic | Ic | I  | I  | I  | I  | -  | -  |    |
| 16-17  | -  | -  | -  | -  | -  | I  | I  | I  | a  | a  | a  | I  | I  | I  | I  | -  | -  |    |
| 17-18  | -  | -  | -  | -  | -  | Ic | c  | c  | c  | c  | c  | c  | c  | c  | c  | -  | -  |    |
| 18-19  | -  | -  | -  | -  | -  | I  | Ic | Ic | Ic | Ic | c  | c  | c  | c  | c  | -  | -  |    |
| 19-20  | -  | -  | -  | -  | -  | Ic | Ic | c  | c  | c  | c  | c  | I  | I  | +  | -  | -  |    |
| 20-21  | -  | -  | -  | -  | -  | Ic | Ic | Ic | I  | I  | I  | I  | I  | I  | I  | -  | -  |    |
| 21-22  | -  | -  | -  | -  | -  | I  | a  | ac | a  | a  | a  | a  | I  | I  | I  | -  | -  |    |
| 22-23  | -  | -  | -  | -  | -  | c  | ac | ac | Rc | ac | ac | ac | ac | ac | c  | -  | -  |    |
| 23-24  | -  | -  | -  | -  | -  | a  | a  | a  | a  | a  | a  | a  | ac | a  | -  | -  | -  |    |
| 24-25  | -  | -  | -  | -  | -  | Ic | a  | a  | ac | c  | c  | c  | c  | c  | -  | -  | -  |    |
| 25-26  | -  | -  | -  | -  | -  | I  | I  | I  | Ic | Ic | I  | I  | I  | I  | -  | -  | -  |    |
| 26-27  | -  | -  | -  | -  | -  | Ic | Ic | ac | c  | ac | ac | a  | a  | +  | -  | -  | -  |    |
| 27-28  | -  | -  | -  | -  | -  | Ic | Ic | c  | c  | c  | c  | I  | I  | I  | -  | -  | -  |    |
| 28-29  | -  | -  | -  | -  | -  | c  | c  | c  | c  | c  | c  | c  | c  | c  | -  | -  | -  |    |
| 29-30  | -  | -  | -  | -  | -  | Ic | a  | a  | a  | a  | a  | a  | a  | a  | -  | -  | -  |    |
| 30-31  | -  | -  | -  | -  | -  | a  | ac | ac | ac | ac | ac | ac | c  | c  | -  | -  | -  |    |
| 31-1/4 | -  | -  | -  | -  | -  | c  | c  | ac | ac | Ac | ac | ac | ac | c  | -  | -  | -  |    |

# KIRUNA MAGNETOGRAM PLOTS

January - March 2000

<http://www.irf.se/mag>

# KIRUNA VERTICAL RIOMETER

January - March 2000

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

(No records during 000101 – 000119 due to riometer fault)