PREFACE

The Auroral Electrojet (AE) index was originally introduced by Davis and Sugiura in 1966 as a measure of global electrojet activity in the auroral zone. The AE index is now widely used for researches in geomagnetism, aeronomy, and solar-terrestrial physics. After the initial development at the NASA/Goddard Space Flight Center the calculation of the index was first performed at the Geophysical Institute of the University of Alaska, which published hourly values of the index for the years 1957 to 1964. The production of 2.5 min values was then made at the Goddard Space Flight Center for the period from September 1964 to June 1968.

After these early publications the index was regularly issued by the World Data Center A for Solar-Terrestrial Physics (WDC-A for STP) in Boulder, Colorado, which published 2.5 min values for the years 1966 to 1974 and 1.0 min values for 1975 and the first 4 months of 1976.

When it became difficult for the WDC-A for STP to continue the production of the AE index, a question was raised if the index could be produced at the WDC-C2 for Geomagnetism, which is operated by the Data Analysis Center for Geomagnetism and Space Magnetism, Faculty of Science, Kyoto University. Responding to this request we decided to produce the index for the two years, 1978-1979, of the International Magnetospheric Study (IMS), and published 1.0 min values of the AE index for these years in the "WDC-C2 for Geomagnetism Data Book" N0.3-6.

Although the International Association of Geomagnetism and Aeronomy (IAGA) recommended the. continuation of the production of the AE index at the WDC-C2, the AE production could not be extended beyond IMS because of the constraints in manpower and computing capability. Increasing demands for the AE index, however, motivated us to resume its production, and we then published the Data Book N0.7 for the first half of 1980. After this publication, various possibilities of financial support for the production of the index were explored by the Subcommittee on Solar Terrestrial Physics of the Special Committee for International Cooperation, Science Council of Japan. Beginning with the Data Book N0.8, the production of the AE index has been continued at the Kyoto University, but the printing and distribution of the Data Book have been done by National Institute of Polar Research in Tokyo.

In order to reduce the digitization burdon in Kyoto, WDC-B for STP in Moscow and WDC-C2 for Geomagnetism in Kyoto began a cooperative digitization project for Russian analog data. At the same time there have been several projects to rescue the Russian observatories after the collapse of USSR. One of these efforts was the STEP project which enabled IZMIRAN to digitize Tixie data for 1990. Another effort is a cooperative work to support Arctic and Antarctic Reserch Institute (AARI) which operates the Russian AE stations with the help from the WDC panel, WDC-A for STP and WDC-C2 Kyoto. This effort has resulted in the installation of digital magnetometers In the Russian AE stations, and part of digital data has been provided since 1993. This effort has also resulted in the fast digitization of the data from the Russian AE stations by AARI.

As a result of the prompt derivation of the AE index, provisional AE index based on data from fewer stations are published in Prompt Reports of WDC-C2 for Geomagnetism, Kyoto for 1990, 1993, 1994. These provisional AE indices will be updated and will be published as the final AE index at later dates.

For 1991 and 1992, we obtained data from all 12 stations. However, the error check made is not as rigorous as it is usually made. Therefore we publish them as the provisional AE (12) in the Data Book series. Nevertheless the quality of this version seems quite high. Therefore a revised final version may not be published unless severe errors are detected.

Additional efforts are being made by INTERMAGNET. A transmitter was provided to the Tixie IKFIA station in 1990 by USGS and a way to send realtime data from Tixie through the Japanese Geostationaly Meteorological Satellite (GMS) to the WDC-C2 Kyoto was sought with help of the Communications Research Laboratory in Japan and the Japan Meteorological Agency. After long negotiations, a temporary radio license was obtained and realtime data were successfully sent from Tixie to the WDC-C2 Kyoto for 6 months from March 1996 till September 1996; at the middle of September 1996 the license expired. After that, we have not been able to obtain the permanent radio license from the Russian authority.

We are trying to install the same transmitter system in Cape Chelyuskin and Cape Wellen as at Tixie; both stations are in the service area of the GMS satellite. However, Cape Wellen was closed in 1996 because of the local power failure. The situation in Cape Wellen looks so bad, and WDC-C2 Kyoto and AARI are seeking a way to set up a new station near Pyebek between Tixie and Cape Wellen, but the situation in the Russian Arctic area is now not favorable at all.

AARI and WDC-C2 Kyoto also made a cooperative effort to transmit Dixon data via a local meteorological telex line, and a radio telemetry system was set up at Dixon in 1996. However, the organizational situations of the Russian government are

not preferable for providing the data through the system regularly to WDC-C2 Kyoto via AARI in Petersburg.

Development of INTERNET and cooperation of observatories directly or through INTERMAGNET enable us to collect near realtime data from many of the AE stations. Since January 1997, we have been deriving a Quick Look (QL) AE index with a delay of 2-3 days, and have been providing the plot of the QL AE index through WWW. Data are available from only 8 out of the 12 standard AE stations so far. Thus this QL index should be used with care. We are continuing effort to increase the number of stations for the QL AE index and to speed up the derivation of the provisional and final AE indices.

Auroral Electrojet (AE) Indices

for January - December 1992

(Provisional)

1. Derivation and Representation

The AE index is derived from geomagnetic variations in the horizontal component observed at selected (10-13) observatories along the auroral zone in the northern hemisphere. To normalize the data a base value for each station is first calculated for each month by averaging all the data from the station on the five international quietest days. This base value is subtracted from each value of one-minute data obtained at the station during that month. Then among the data from all the stations at each given time (UT), the largest and smallest values are selected. The AU and AL indices are respectively defined by the largest and the smallest values so selected. The symbols, AU and AL, derive from the fact that these values form the upper and lower envelopes of the superposed plots of all the data from these stations as functions of UT. The difference, AU minus AL, defines the AE index, and the mean value of the AU and AL, i.e. (AU+AL)/2, defines the AO index. The term "AE indices" is usually used to represent these four indices (AU, AL, AE and AO). The AU and AL indices are intended to express the strongest current intensity of the eastward and westward auroral electrojets, respectively. The AE index represents the overall activity of the electrojets, and the AO index provides a measure of the equivalent zonal current.

In this report we present daily plots and hourly values of the AE indices and "contributing station" plots giving additional information on the indices. The stations that actually give the AU and AL values are named the "contributing stations" of the AU and AL indices. The pair of the AU and AL contributing stations is referred to as "the contributing stations of the AE indices". The plot identifies these AE contributing stations, and also gives information on the data availability for each station.

2. Data Used

To obtain reliable AE indices it is desirable to use as many observatories as possible. However, there are two major difficulties: one is that the distribution of the observatories in operation is not uniform along the auroral zone, and the other is that the digitization of magnetograms is a laborious task.

For the derivation of the AE indices reported in this Data Book, we used twelve observatories listed in Table 1. The distribution of these observatories is shown in Figure 1. Of the twelve observatories seven are taking digital data in year 1992; these stations are referred to as digital stations below. Three of the digital stations, Fort Churchill, Poste-de-la-Baleine, and Yellowknife, give data in the X, Y, Z coordinate system. To make these data compatible with the other stations, we convert the X and Y components to the H component by $H = \sqrt{X^2 + Y^2}$. If either X or Y is missing, H is also treated as being missing. For the other three digital stations, Barrow, College, Narsarsuaq and Lerivogur, the original digital H component data are used. We used the Abisko data digitized from analog records at the station. For Dixon, Cape Chelyuskin, Tixie and Cape Wellen, we used the H values digitized at the Arctic and Antarctic Research Institute in Petersburg.

In the confused state of affairs during the reorganization of Russia, the observatory personnel responsible for the magnetic observation at Cape Chelyuskin left the station from the middle of July till the middle of November. The observatory personnel at Tixie also was absent from the observatory during the month of September. The magnetic observation at these

observatories for the periods indicated above is therefore truly lacking and will never be recovered, unfortunately.

We by-passed the correction process of re-digitization of analog magnetograms at Kyoto in this provisional version of the AE index unless the digital recording or digitized values appear clearly faulty; hence we call this version 'provisional'. However, the quality of the data for 1992 is quite high, and although this is a 'provisional' version, we believe that this provisional AE(12) for 1992 is reliable enough to be used for scientific analyses.

3. The Superposed Plot and the Plot of the Contributing Stations of the AE Indices

Figure 2a shows an example of the superposed plot of H traces from the AE stations for April 10, 1978. The upper envelope gives the AU index and the lower envelope, the AL index; Figures 2b and 2c show sample plots of the contributing stations in geomagnetic (2b) and geographic (2c) local time, for the same day as in Figure 2a. In these figures, the upper and lower plumes on a diagonal line for each station show the contribution of this station to the AU and AL indices, respectively. In Figure 2b, for example, the data from Dixon Island (DIK) give the AU index from 0000 to 0240 UT and again from 1330 to 1530 UT, and the AL index from 0640 to 0830 UT. It is seen that from 1100 to 1200 UT Leirvogur (LRV) offers no data. Since Leirvogur is a key station for the AL index for this time interval, the exact AL values may be lower than was calculated for this interval.

We use geomagnetic local time (MLT) for the ordinate of the plot of the contributing stations. MLT is defined by the difference between the geomagnetic longitude of the station and the geomagnetic longitude of the meridian opposite to the subsolar point; and MLT is a function of the geomagnetic longitude of the station, the Sun's declination, and universal time. Figures 3a, 3b, and 3c show the differences between geographic local time GLT and MLT of the stations used to derive the AE indices for winter, summer and equinox, respectively. In these figures GLT is represented for each station by a straight line which runs diagonally, and MLT is shown by the top of T shaped mark (or the bottom of inverted T). The length of the vertical line of T from the diagonal line is the difference between GLT and MLT. Note that for some stations the difference between GLT and MLT is as much as 2 hours.

4. Results

(Omitted)

5. Acknowledgements

The calculation of the provisional AE indices in this volume was made possible with the data provided directly to us by the AE stations or through the World Data Centers and the INTERMAGET GINs.

As we do not know the details of the operation of each observatory, it is not possible for us to acknowledge all the persons who have contributed to the preparation of data. Here we mention only those persons with whom we have directly corresponded.

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