Program Kasm for calculation of geomagnetic activity K indices
User Manual (updated March 2011)

Program Kasm is designed for calculation of geomagnetic activity indices K on the basis of recorded geomagnetic field components, according to the ASm[1] method.

The program is a console application working both under Windows and Linux. There is possible to compile Kasm from sources. The first line of Kasm.ccp shows example of compilation under g++.

The Kasm accepts two formats of input data:

a) IAF (INTERMAGNET archive format) such as the Definitive data format in the INTERMAGNET DVD/CD-ROM,

b) IMFV1.22 text format.

The K-indices calculated with the use of program Kasm can be stored either in the IAF files or *.DKA text file, depending upon the parameters of program call.

The most important features of the program include the following:

i. a possibility of choosing whether the indices are to be calculated from the horizontal components X and Y or H and D.

ii. a possibility of storing the calculated indices onto text files as well as to the IAF files.

Moreover, while calling the program with adequate parameters one can obtain additional interesting information, such as:

- a post-script plot representing, for a given day, the filtration of daily variations S_R according to the ASm method

- information on differences between the indices calculated by the Kasm program and the indices contained in the input IAF files

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[1] **Remark:**
Adaptative Smoothing method was, as one of four methods of computer derivation of K-indices, accredited and recommended by the IAGA Working Group V-5 'Geophysical Indices', during the Vienna IUGG General Assembly, in 1991.
References: Nowożyński K., Ernst T. & Jankowski J., 1991: Adaptive smoothing method for computer derivation of K-indices. Geophys. J. Int., 104, 85-93.
Menvielle M., Papitashvili N., Hakkinen L. & Sucksdorff C., 1995. Computer production of K indices: review and comparison of methods. Geophys. J. Int., 123, 866-886.

The syntax of calling the program is the following:

Kasm OBS:ddmmmyyyy[:days] K9|0 H|0|xy out [path] [-0|-1|-2|-3] [-b] [-p] [-c] [-u] [-l]

| | separates permissible options of parameter
[] parameter is not obligatory
OBS 3 chars IAGA code, example: HLP
dd day of month (01..31), date of beginning
mmm month (JAN..DEC), date of beginning
yyyy year, date of beginning, example: 2001
days number of days, obligatory, example: 365

Note: parameter 'days' is not allowed in case of using switch -p

K9|0 K9 limit of K9-index in nT, examples: 450, 700

0 0 means that K9 incl. in 1-min IAF files is to be used

H|0|xy H annual value of H-component in nT, K-indices will be calculated from HD elements, examples: 18720, 8245

0 0 means that H included in 1-min IAF file is to be used; K-indices will be calculated from components H and D

xy K-indices will be calculated from components X and Y

out name of output text file, this name will be supplemented with extensions 'dka', 'K', 'plo', 'ps', 'log'

[path] directory with input data, example: d:\data\binary\, the last character must be '\'

[-0|-1|-2|-3] concerns only the situation when K-indices are calculated for one day

-0 K's will be calculated from one day

-1 K's calculated from preceding and current day

-2 K's calculated from current and subsequent day

-3 K's calculated from preceding, current and subsequent

] day

[-b] means that program expects 1-min IAF files(s)

[-p] program creates *.ps plot, this option works under condition that parameter 'days' is missing

[-c]   current K's are compared with previous K's included in 1-min IAF file(s), result of comparison is placed in out text file

[-u]   current K's generated are placed in 1-min IAF file(s)

[-l]   creates *.log file including additional information useful while testing the program

The use of the Kasm program is illustrated below on 5 examples of its typical applications. The examples concern Windows.

Example 1. The IAF XYZF (or XYZG or XYZ) files are supplemented with the K-indices calculated from components X and Y.

Example 2. The IAF HDZF files are supplemented with the K-indices calculated from components H and D.

Example 3. The K-indices are calculated from components H and D on the basis of IAF XYZF (or XYZG or XYZ) files containing previously calculated indices. A comparison of indices calculated by Kasm and those contained in IAF files.

Example 4. Calculation of the indices from the Intermagnet text files in the IMFV1.22 format.

Example 5. Creation of a post-script plot representing filtration of daily variations S_R according to the ASm method.

The description of each example contains the following sections:

INPUT   information about the input data in the current example,

OUTPUT   information on the data the user will get as a result of running the program,

COMMAND   the manner of calling the program,

NOTES   remarks on the current example.

EXAMPLE 1

INPUT:
a) The hard disk directory D:\IMAG\BIN contains 12 IAF files BEL99???.BIN
b) The IAF files contain, among other things, the following data:

word 6:	(orientation)	XYZF (or XYZG or XYZ)
word 8:	(D-conversion factor)	55130 (equivalent to H=18954 nT)
word 11:	(K9 limit in nT)	450

OUTPUT:

The user request that
   a) the IAF BEL99???.BIN files be supplemented with the K-indices calculated with the ASm method.
   b) text file BEL99K.DKA with the K-indices, similar to the files *.DKA from the INTERMAGNET DVD/CD-ROM, be created in the existing directory D:\IMAG\REPORT
   c) the indices be calculated on the basis of components X and Y, according to the limit K9=450 nT (i.e., according to the limit written in the IAF files).

COMMAND:
Kasm BEL:01JAN1999:365 0 xy D:\IMAG\REPORT\BEL99K D:\IMAG\BIN\ -b –u

NOTES:
   a) Parameter **0** (prior to parameter **xy**) means that the K9 limit value is to be read from the IAF files. If the user had given in the command line a specific value of K9 limit, for instance, 550 instead of 0, then the program would have calculated the indices with K9=550, because the data given in the command line are preferential to the data read from the IAF files. If the data in the command line differ from those read from the IAF files, the user will be notified about this fact.
   b) Parameter **xy** means that the K-indices are to be calculated from the X and Y components even if the IAF files had contained the HDZF components,
   c) Parameter **D:\IMAG\REPORT\BEL99K** means that a text file **BEL99K.DKA**, containing the K-indices, will be created in the directory **D:\IMAG\REPORT**. This file can be used, for instance, upon modification of the header part, as a file to be placed on the INTERMAGNET CD-ROM.
   d) Parameter **-b** means that the data for index calculation are placed in the IAF files; in the current example in the BEL99???.BIN files.
   e) Parameter **-u** means that calculated indices are to be written without warning (!) on the input IAF files BEL99???.BIN contained in directory **D:\IMAG\BIN**

f) Parameter with the path to IAF files (in our example **D:\IMAG\BIN**) must be obligatorily terminated with character \

g) For a more correct calculation of „boundary" K-indices for the periods:
1999-01-01 00-03 UT
1999-12-31 21-24 UT
files BEL98DEC.BIN and BEL00JAN.BIN are to be placed in the directory D:\IMAG\BIN.

EXAMPLE 2

INPUT:
a) The hard disk directory D:\IMAG\BIN contains 12 IAF files ESK99???.BIN
b) The IAF files contain, among other things, the following data:
   word 6: (orientation)   HDZF
   word 8: (D-conversion factor)   50485 (equivalent to H=173574 nT)
   word 11: (K9 limit in nT)   750

OUTPUT:
The user request that
a) the IAF ESK99???.BIN files be supplemented with the K-indices calculated with the ASm method
b) text file ESK99K.DKA containing the K-indices, similar to the files *.DKA from the INTERMAGNET CD-ROM, be created in the existing directory D:\IMAG\REPORT
c) the indices be calculated on the basis of components H and D, according to the limit K9=800 nT given in the command line (the value K9=750 written in IAF files is to be ignored).

COMMAND:
Kasm ESK:01JAN1999:365 800 0 D:\IMAG\REPORT\ESK99K
    D:\IMAG\BIN\ -b –u

NOTES:
a) Parameter **800** means that K9=800 nT from the command line and not 750 contained in the IAF files will be used for the calculation of K-indices. The program will calculate indices according to K9=800, since the data specified in the command line are preferential to the data read from the IAF files. If the data in the command line differ from those read from the IAF files, the user will be notified about this fact.
b) Parameter **0** (next to parameter **800**) means that the K-indices are to be calculated from components H and D, and the conversion of D-values into the changes expressed in nT will be made with the use of D-conversion factor contained in the IAF files.
c) Parameter **D:\IMAG\REPORT\ESK99K** means that a text file ESK99K.DKA containing the K-indices is to be created in the directory D:\IMAG\REPORT. This file can be, for instance, used, upon modification of the header part, as a file to be placed on INTERMAGNET CD-ROM.
d) Parameter **-b** means that the data for K-index calculation will be contained in the IAF files; in our example, in the files ESK99???.BIN

e) Parameter -**u** means that the calculated indices will be written without warning (!) on the input IAF files ESK99???.BIN contained in the directory D:\IMAG\BIN

f) Parameter with the path to IAF files (in our example **D:\IMAG\BIN**) must be obligatorily terminated with character \

g) For a more correct calculation of „boundary" K-indices for the periods:
1999-01-01 00-03 UT
1999-12-31 21-24 UT
files BEL98DEC.BIN and BEL00JAN.BIN are to be placed in the directory D:\IMAG\BIN.

EXAMPLE 3

INPUT:
  a) The hard disk directory D:\IMAG\BIN contains 12 IAF files BEL99???.BIN containing previously calculated K-indices.
  b) The IAF files contain, among other things, the following data:
word 6:	(orientation)	XYZF (or XYZG or XYZ)
word 8:	(D-conversion factor)	55130 (equivalent to H=18954 nT)
word 11:	(K9 limit in nT)	450

OUTPUT:
The user request that
  a) the K-indices be calculated according to the ASm method, but without storing them in the IAF files; instead, they should to be stored in the text file BELTEST.DKA
  b) a comparison of the currently calculated indices with those contained in the IAF files be made. The results of the comparison are to be placed in the text file BELTEST.DKA
  c) the indices be calculated according to the limit K9=500 nT (regardless of the K9 value contained in the IAF files).
  d) the K-indices are to be calculated from components H and D (in spite of the fact that the IAF files contain the components X, Y, Z, and F)

COMMAND:
Kasm BEL:01JAN1999:365 500 19000 D:\IMAG\REPORT\BELTEST
    D:\IMAG\BIN\ -b –c

NOTES:
a) Parameter **500** means that K9=500 nT from the command line and not the value 450 contained in the IAF files is to be used for the calculation of K-indices. The program will calculate indices according to K9=500, since the parameters specified in the command line are preferential to the data read from the IAF files. If the data in the command line differ from those read from the IAF files, the user will be notified about this fact.
b) Parameter **19000** means that the K-indices are to be calculated from components H and D, and the conversion of D-values into the changes expressed in nT are to be made with the use of D-conversion factor calculated on the basis of H=19000. The D-conversion factor value contained in the IAF files will be ignored, since the values in the command line are preferential to those read from the IAF files.

c) Parameter **D:\IMAG\BIN** determining the path to the IAF files must be obligatorily terminated with character \

d) Parameter **-b** informs that the data for index calculation are contained in the IAF files; in our example in the files BEL99???.BIN

e) Parameter **-c** means that a comparison will be made of the currently calculated indices with those contained in the IAF files. The results of this comparison are to be placed in the text file BELTEST.DKA in the directory **D:\IMAG\REPORT**. At the end of this file, a percentage of the numbers of cases showing differences, which may be used, e.g., for constructing a histogram, will be written.

f) For a more correct calculation of „boundary" K-indices for the periods:
1999-01-01   00-03 UT
1999-12-31   21-24 UT
files BEL98DEC.BIN and BEL00JAN.BIN are to be placed in the directory D:\IMAG\BIN.

EXAMPLE 4

INPUT:
a) The hard disk directory D:\IMAG\IMF contains 365 Intermagnet text files ?????99.BEL written in format IMFV1.22.
b) Files ?????99.BEL contain data on components X, Y, Z, and F.

OUTPUT:
a) The user requests that a text file BEL99K.DKA containing K-indices, similar to the *.DKA files from the INTERMAGNET CD-ROM, be created in the existing directory D:\IMAG\REPORT.
b) The indices are to be calculated on the basis of components X and Y, according to the limit K9=450 nT specified in the command line.

COMMAND:
Kasm BEL:01JAN1999:365 450 xy D:\IMAG\REPORT\BEL99K D:\IMAG\IMF

NOTES:
a) Parameter **450** in the command line means that the value K9=450 nT is to be used for the K-index calculation.
b) Parameter **xy** means that the K-indices are to be calculated from components X and Y, even if the text files IMFV1.22 contained components H, D, Z, and F.
c) Parameter **D:\IMAG\IMF** determining the path to the text files IMFV1.22 must be obligatorily terminated by character \.
d) Parameter **D:\IMAG\REPORT\BEL99K** means that a text file BEL99K.DKA containing K-indices will be created in directory D:\IMAG\REPORT. This file can be, for instance, used, upon modification of the header part, as a file to be placed on INTERMAGNET CD-ROM.
e) For a more correct calculation of „boundary" K-indices for the periods:
1999-01-01   00-03 UT
1999-12-31   21-24 UT
files DEC3198.BEL and JAN0100.BEL are to be placed in the directory D:\IMAG\IMF.

EXAMPLE 5

INPUT:
The hard disk directory D:\IMAG\BIN contains IAF file BEL99JUL.BIN. The file contains, among other things, the previously calculated K-indices.

OUTPUT:
a) The user wants to be able to assess in a visual manner the performance of the ASm filtration for data of July 8, 1999, and to obtain a comparison of currently calculated indices with those contained in the IAF file. The indices are to be calculated according to the limit K9=450 nT.
b) The K-indices are to be calculated from components H and D (in spite of the fact that the IAF files contain components X,Y,Z,F); the D-conversion factor is to be calculated with the use of H=19000 nT.
c) The user requests that – whenever possible – the data from adjacent day be also used for the index calculation.

COMMAND:
Kasm BEL:08JUL1999 450 19000 D:\IMAG\REPORT\BELTEST
D:\IMAG\BIN\ -3 –b -p

NOTES:
a) Parameter **450** means that K-indices are to be calculated with the use of the value K9=450 nT given in the command line. If K9-value from the command line and that read from the IAF file disagree, the user will be notified about this fact. In that case, the program will calculate indices according to K9=450, since the data specified in the command line are preferential to those read from the IAF file.
b) Parameter **19000** means that the K-indices are to be calculated from components H and D, and the conversion of component D into the changes expressed in nT is to be made with the use of the D-conversion factor calculated on the basis of H=19000 nT.
c) Parameter **D:\IMAG\BIN** determining the path to the IAF files must necessarily be terminated with character \
d) Parameter **-3** means that the K-indices are to be calculated, whenever possible, with the use of the data of the adjacent day too. The neglect of the data from the adjacent day (e.g., the use of parameter **-0**) would produce greater errors of determining the "boundary" indices, i.e., those for the time intervals 00-03 and 21-24.
e) Parameter **-b** informs that the data for the index calculation are in IAF files; in our example, in file BEL99JUL.BIN.
f) Parameter **-p** is in this case crucial, since it is responsible for the creation of postscript file named BELTEST.PS in the directory D:\IMAG\REPORT.

The plot in the file BELTEST.PS contains, among other things, the following;
- a plot illustrating the ASm filtration used in the program,
- the K-indices calculated for each component (H and D) separately,
- the currently calculated indices for each 3-hour interval and the indices contained in the IAF file.

To visualize the post-script plot one can use, for instance, a free program available from the internet address   http://www.cs.wisc.edu/~ghost/gsview/ .