REAL TIME MONITORING OF GLOBAL MAGNETIC ACTIVITY- THE AP_{est} INDEX

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Real and near real time global geomagnetic activity indices play an important role in Space Weather projects. Knowledge of the most recent activity levels and the current level is a very useful tool in forecasting. The well established and much used 3-hourly planetary index (*ap*) and the daily planetary index (*Ap*), which are provided by the International Service of Geomagnetic Indices (ISGI) of the International Association of Geomagnetism and Aeronomy (IAGA), are directly related to the 3-hourly *Kp* index. By using a network of mid-latitude magnetic observatories for their production, these indices were designed to measure the irregular disturbances of the geomagnetic field caused by solar particle radiation. The definitive *Ap* values are made available twice per month as soon after the 15th and the last day of the month as possible. A time delay is inevitable because of the need for a high quality homogenous data set. However the process is not sufficiently responsive to the needs of the space weather community, where small discrepancies in the data are less important than their timely availability. Estimates of the *ap* and *Ap* indices, called ap_{est} and Ap_{est} respectively, are routinely derived and continuously updated by the British Geological Survey (BGS) and are available on-line in real time. This paper describes the derivation process of these indices, which has been designed to match that of the definitive indices as closely as possible. In order to do this estimates are derived using data from as many of the official *Kp* magnetic observatories as possible. The data are collected from various locations making use of INTERMAGNET data as far as possible. Estimates of the local 3-hourly *K*-indices are made for each observatory, the derivation for which depends on the type of data available. These are then used to calculate ap_{est} and Ap_{est}, by using the same method as that for the definitive indices. A review of how well Ap_{est} corresponds to definitive *Ap* with respect to the time of availability on-line is presented. Similar estimated planetary indices (3-hourly *Kp* and daily *Ap*) are available in near real time from the Space Environment Center (SEC). These estimates are derived using data from magnetic observatories in North America. Comparisons have been carried out to show the benefits of having a wider global coverage, when attempting to produce a global index.

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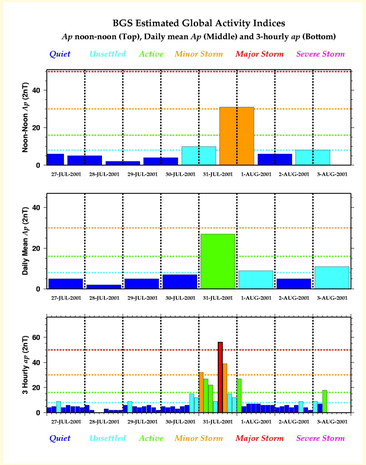
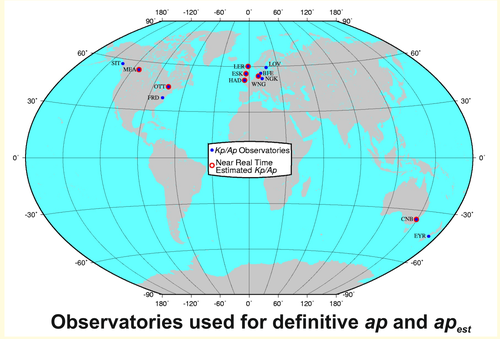
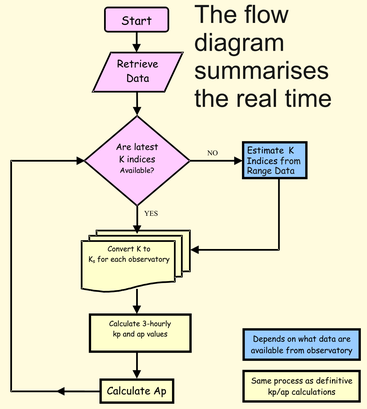
An example of the real time display available on-line is shown here. Derived from all the available *K* and estimated *K* indices in the network, the 3-hourly ap_{est} are up-dated hourly. Ap_{est} for today is determined from all available ap_{est}. These real time values are a valuable aid to BGS staff when forecasting geomagnetic activity levels in the short-term. The values are also used to determine the accuracy of the most recently made predictions.





Observatories used for definitive *ap* and ap_{est}

The map shows the global distribution of the magnetic observatories providing data. The aim is to use data from as many of the definitive *Kp* observatories as possible.



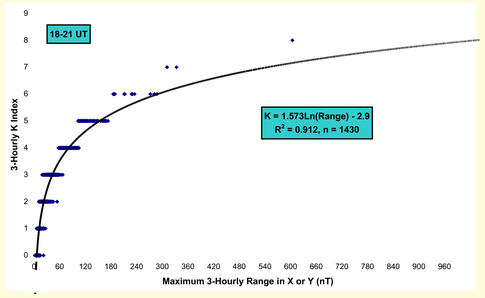
The flow diagram summarises the real time

Index available from www.geomag.bgs.ac.uk

Future Improvements to Ap_{est}

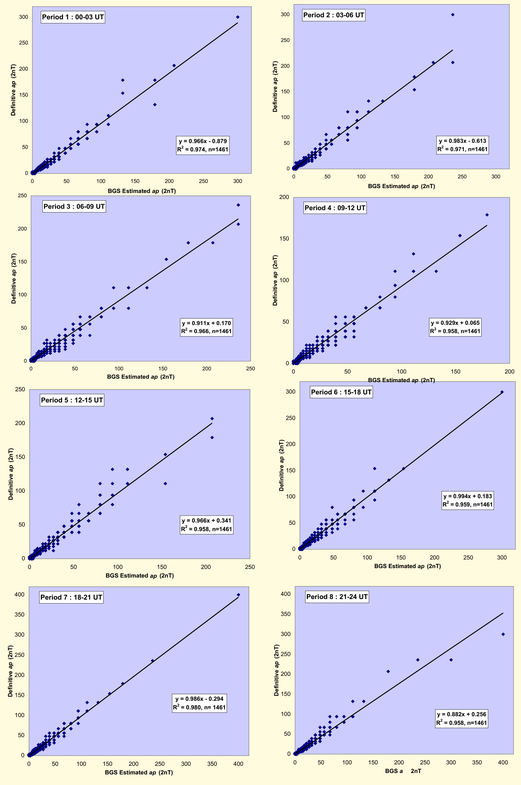
The two most important considerations for Ap_{est} to be of use in space weather studies are its timeliness and its accuracy. Possible changes are: (i) matching the method of *K* derivation used at each observatory; and (ii) inclusion of more of the observatories that are used in the definitive *Ap* calculations.

Estimating *K* Indices



Using data from 1997 to 2000, a logarithmic regression curve was derived for each 3-hour period for each observatory to give the *K* value from the maximum horizontal range. The above plot is one example. When the range is less than the normal lower bound for *K*=4 the *K* value is derived from the range using the observed statistical relationship. For *K*=4 to 9 the normal lower bound for the range for each index value is used. This not only avoids the clear misfit shown in the plot when *K*>5, but mimics the normal derivation process of ignoring Sq diurnal variation when the geomagnetic field is active. The accuracy of final ap_{est} values not only depends on which observatories are used, but also on the availability of their *K* indices. When definitive *K*s are unavailable the accuracy of this *K* estimation method is the limiting factor.

3-Hour ap_{est} accuracy

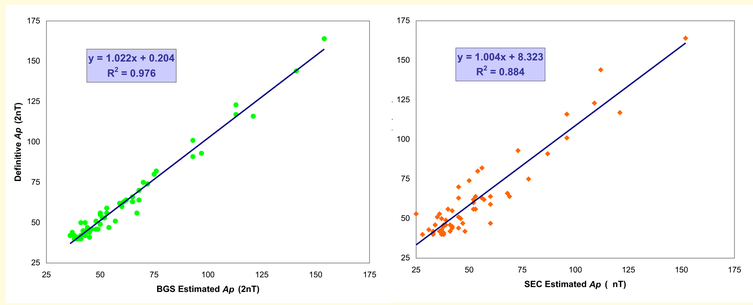


3-hour ap_{est}, which is available the following day, compared with definitive *ap* during the years 1997 to 2000.

The plots show that in all UT periods the ap_{est} values are well correlated with definitive *ap*. Some correlations are slightly poorer than others, which is related to the longitudinal coverage of observatories used not exactly matching that of those used for derivation of definitive *ap*.

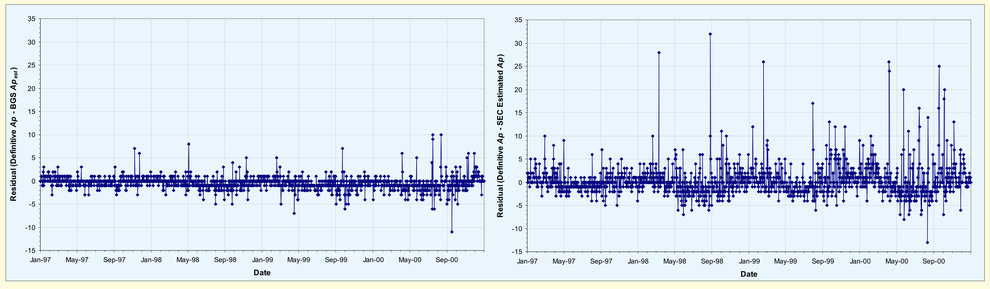
Daily Ap_{est} Accuracy

For many years the Space Environment Center (SEC) have issued estimated *Ap* in near real-time. An analysis has been carried out on the accuracy of the two estimates by comparing each against definitive *Ap* for the period 1997 to 2000. In the regression analysis (below left and right) only values of *Ap* >=40 are shown. The residual analysis (bottom left and right) shows all values during the 4 years. The SEC *Ap* are the values that were made available by 02:45 UT.



The BGS estimates have been derived retrospectively using the data that is most likely to have been available at this same time. This implies that these results are not conclusive. The SEC values were true real-time and any real-time data retrieval/processing problems that may have occurred are not included in the derivation of the BGS values. The BGS Ap_{est} is continually updated as new input data become available. Thus the match to definitive *Ap* is even closer later in the day.

The BGS residuals show no clear bias or periodicity. The same comparison for the SEC values highlights a small annual variation in the residuals. This result is most likely related to the restricted longitudinal coverage of the observatories used.



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