

Ap in Real Time

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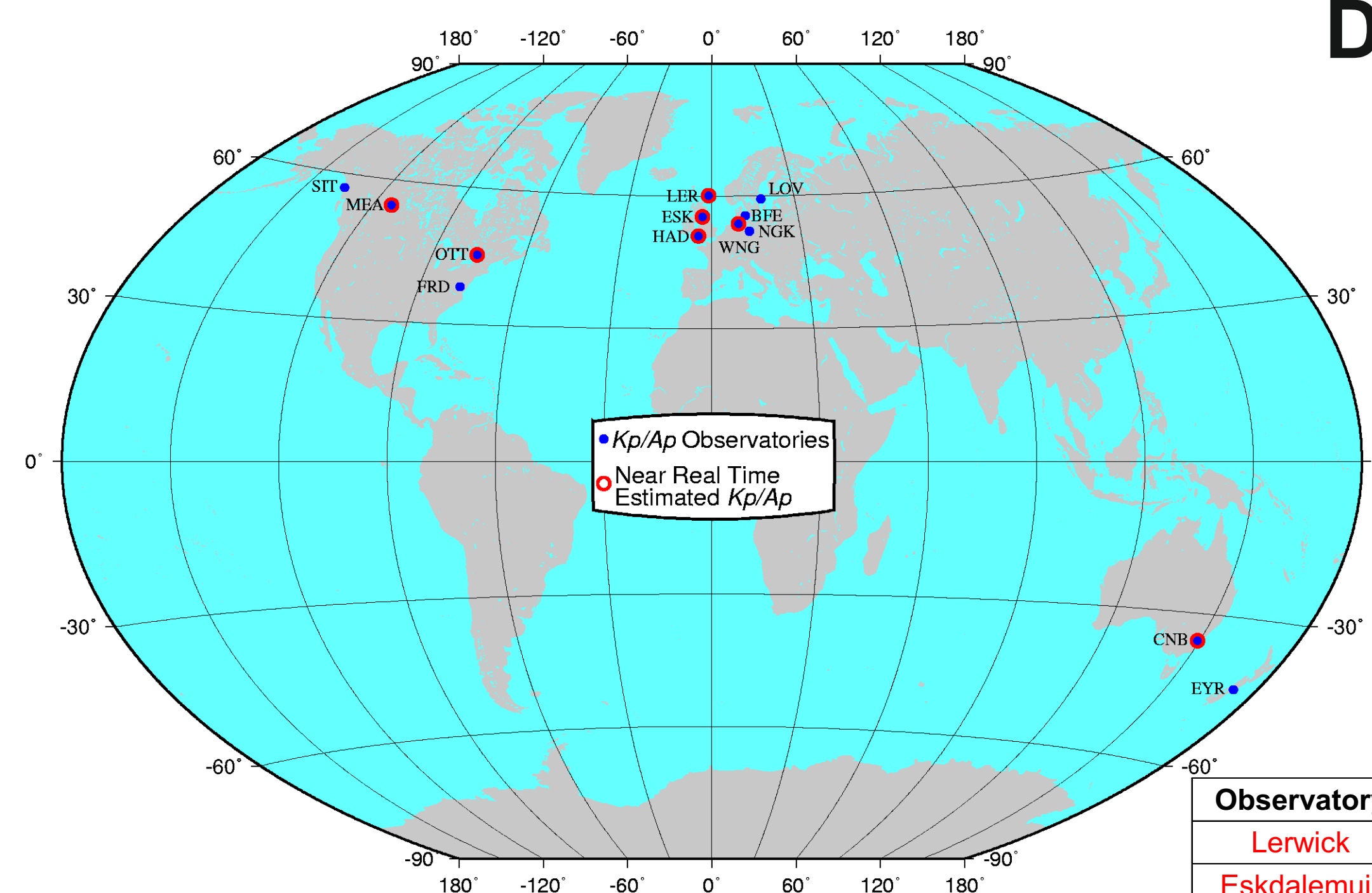
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NATURAL ENVIRONMENT RESEARCH COUNCIL

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The 3-hourly planetary indices K_p and ap and the daily planetary index, Ap , which are derived by GeoForschungsZentrum (GFZ), Potsdam, on behalf of the International Service of Geomagnetic Indices (ISGI), are made available twice per month. This time delay is inevitable because of the need for a high quality homogenous data set. However, the process may not be sufficiently responsive to the needs of the space weather community, in particular forecasters, where small discrepancies in the data are usually less important than their timely availability. An automated algorithm has been developed by the British Geological Survey (BGS) to derive real-time estimates of the ap and Ap indices, called ap_{est} and Ap_{est} respectively. These are available on-line at www.geomag.bgs.ac.uk/gifs/apindex.html. The derivation process of these indices is described and has been designed to match

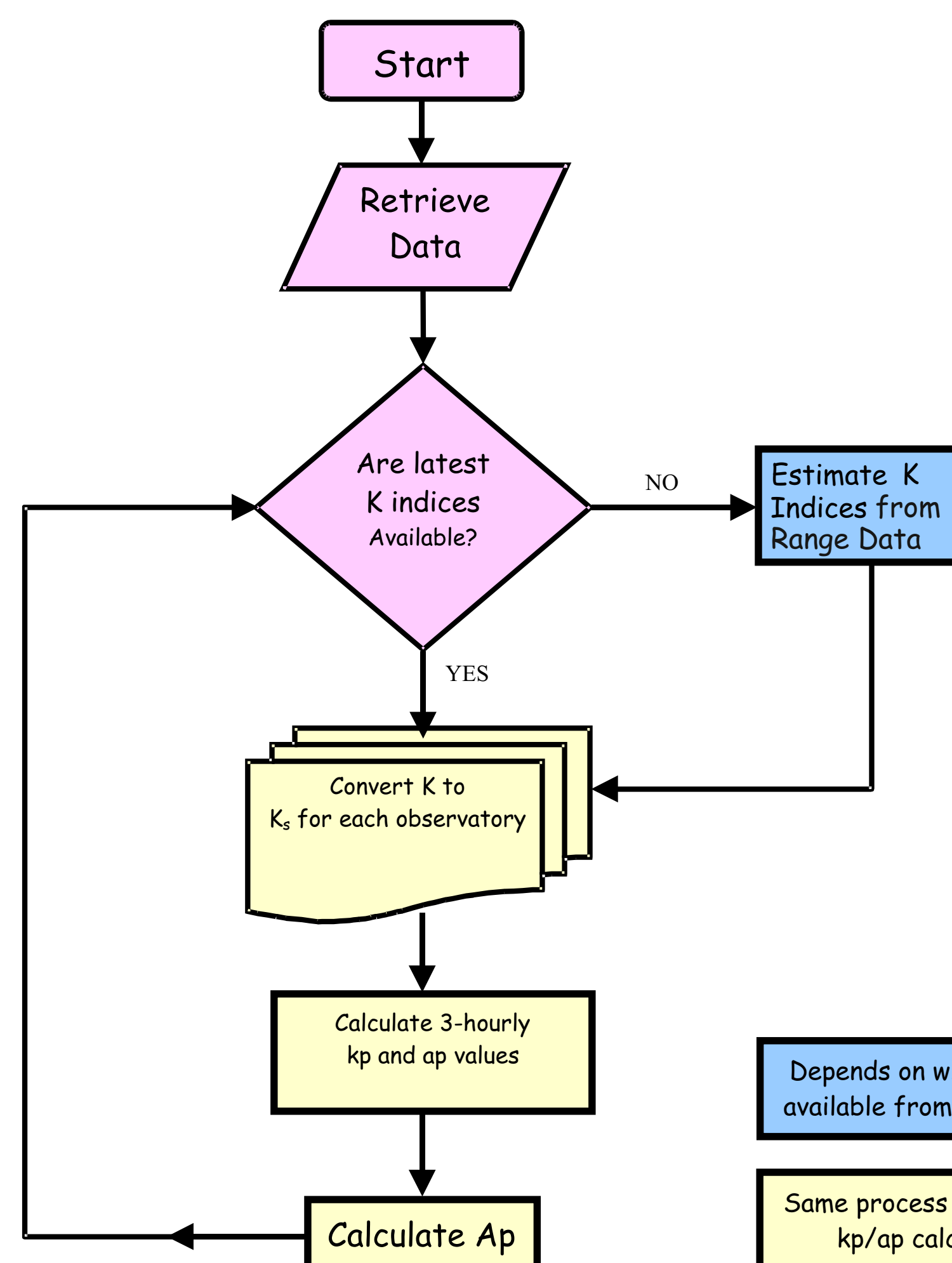
that of the definitive indices as closely as possible. A comparison between BGS ap_{est} , Ap_{est} and the corresponding definitive values is presented. Modifications to the derivation process are still on going and will take advantage of the advances made by the INTERMAGNET program in data delivery. Ultimately GFZ will assume responsibility for derivation and delivery of the real time indices, which could be considered quick-look or provisional values. Real time Ap and the related estimated K_p index may find use in various ESA space weather pilot projects, for example, in atmospheric drag models and in nowcasting and forecasting of the electron content of the ionosphere for satellite navigation purposes.



The map shows the global distribution of the magnetic observatories providing data. These are also listed in the table. The algorithm for ap_{est} and Ap_{est} derivation currently uses data from those listed in red. The aim is to include more of the definitive K_p observatories to improve the accuracy.

Observatory	Location
Lerwick	Scotland
Eskdalemuir	Scotland
Hartland	England
Wingst	Germany
Niemegk	Germany
Brorfelde	Denmark
Lovö	Sweden
Meanook	Canada
Ottawa	Canada
Fredericksburg	USA
Sitka	Alaska (USA)
Canberra	Australia
Eyrewell	New Zealand

Derivation of Ap_{est} and ap_{est}



Currently the required input data are collected automatically from various locations and by various means :

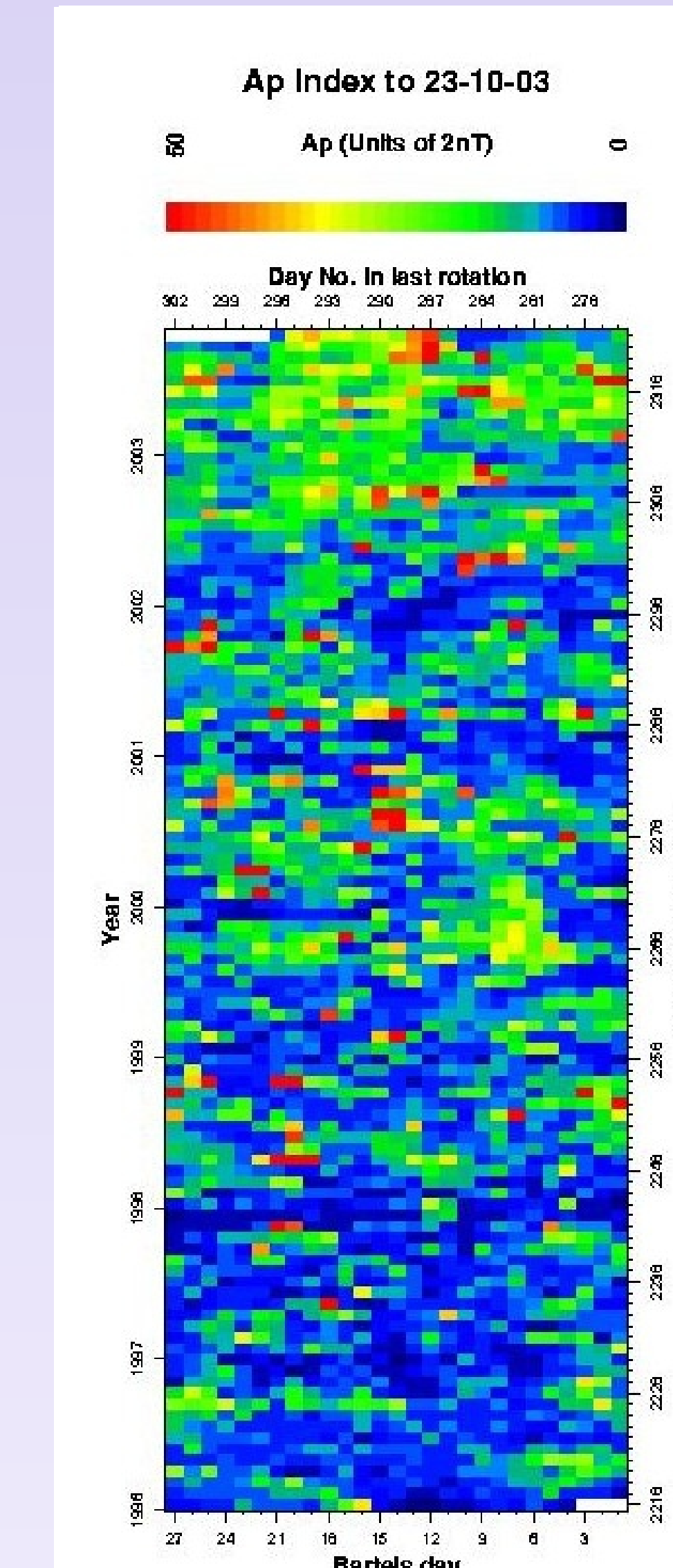
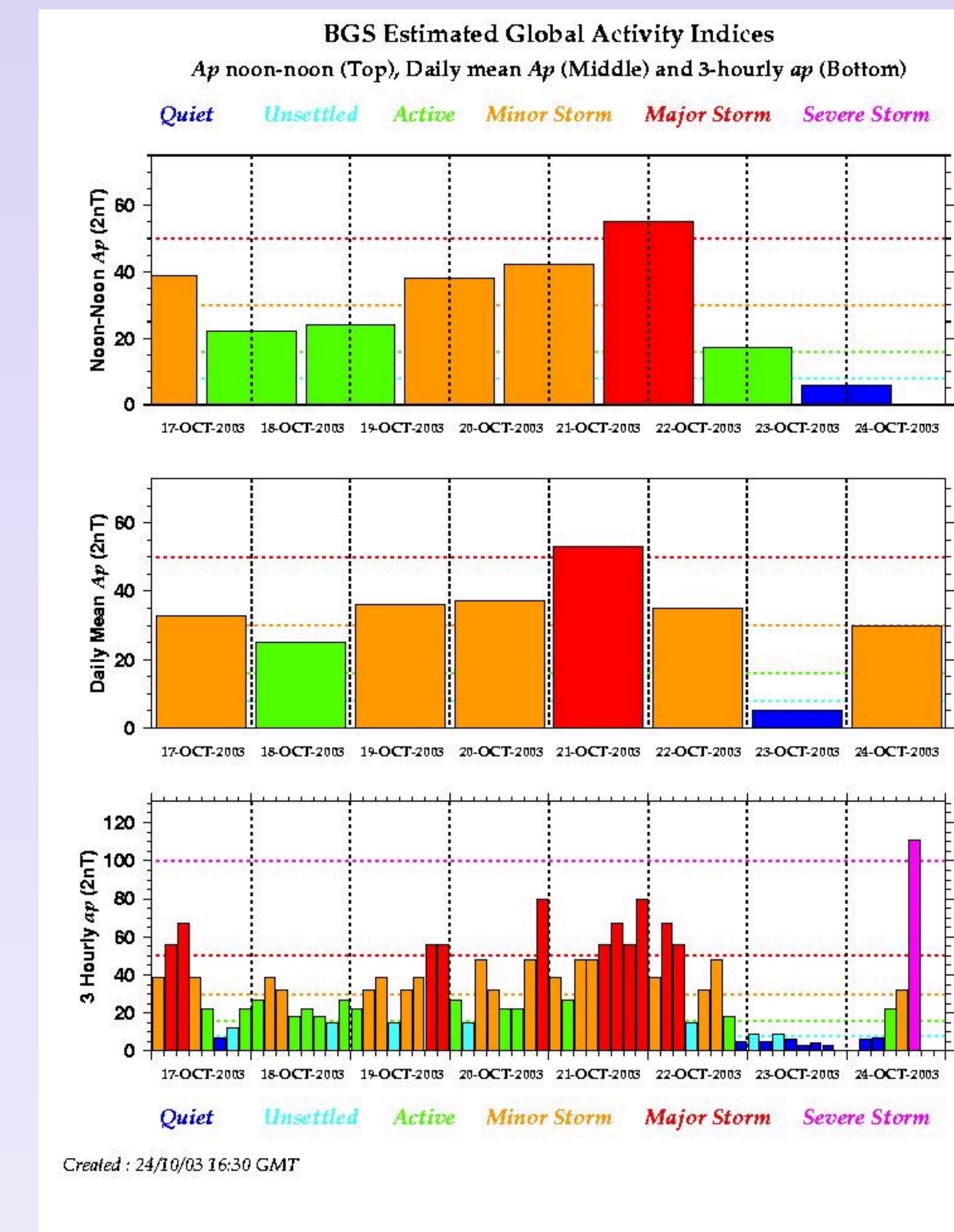
INTERMAGNET GIN;
Anonymous ftp site;
Daily emails of SIDC URSIGRAM bulletins and IPS reports

An individual algorithm has been developed for estimating the K indices from each observatory. These depend on the input data available and the method of data collection. As soon as the definitive K indices are available they are used to replace the estimated values in the calculations of K_p . The flow diagram summarises the real time production process.

Depends on what data are available from observatory

Same process as definitive kp/ap calculations

This is controlled by scripts running automatically every hour on a Unix Sun workstation



An example of the real time display available on-line is shown above. The web address is:

www.geomag.bgs.ac.uk/gifs/apindex.html

Derived from all the available K and estimated K indices in the network, the 3-hourly ap_{est} are up-dated every hour. 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. Noon-noon (local to UK time) Ap values are plotted in the top left panel to give a better representation of activity levels over the local night time. The values are also used to determine the accuracy of the most recently made predictions. The plot on the right shows Ap , colour coded and plotted by Bartels 27-day rotation, which can help forecasters by highlighting recurrent activity patterns.

Future Plans

1. Incorporate data from the remaining observatories

These are Niemegk, Brorfelde, Lovö, Fredericksburg, Sitka and Eyrewell. Although real time data availability is not necessarily possible for all of these at present, it should be possible for those observatories currently sending preliminary data to an INTERMAGNET Geomagnetic Information Node (GIN) in near real time.

2. Software upgrade

The software, originally written for personal use, has been developed over time to meet the growing requirements. However, a complete overhaul is now required to create a package that is both robust and portable, whilst remaining flexible enough to allow future improvements when more real time input data become available.

3. Transfer from BGS, Edinburgh to GFZ, Potsdam

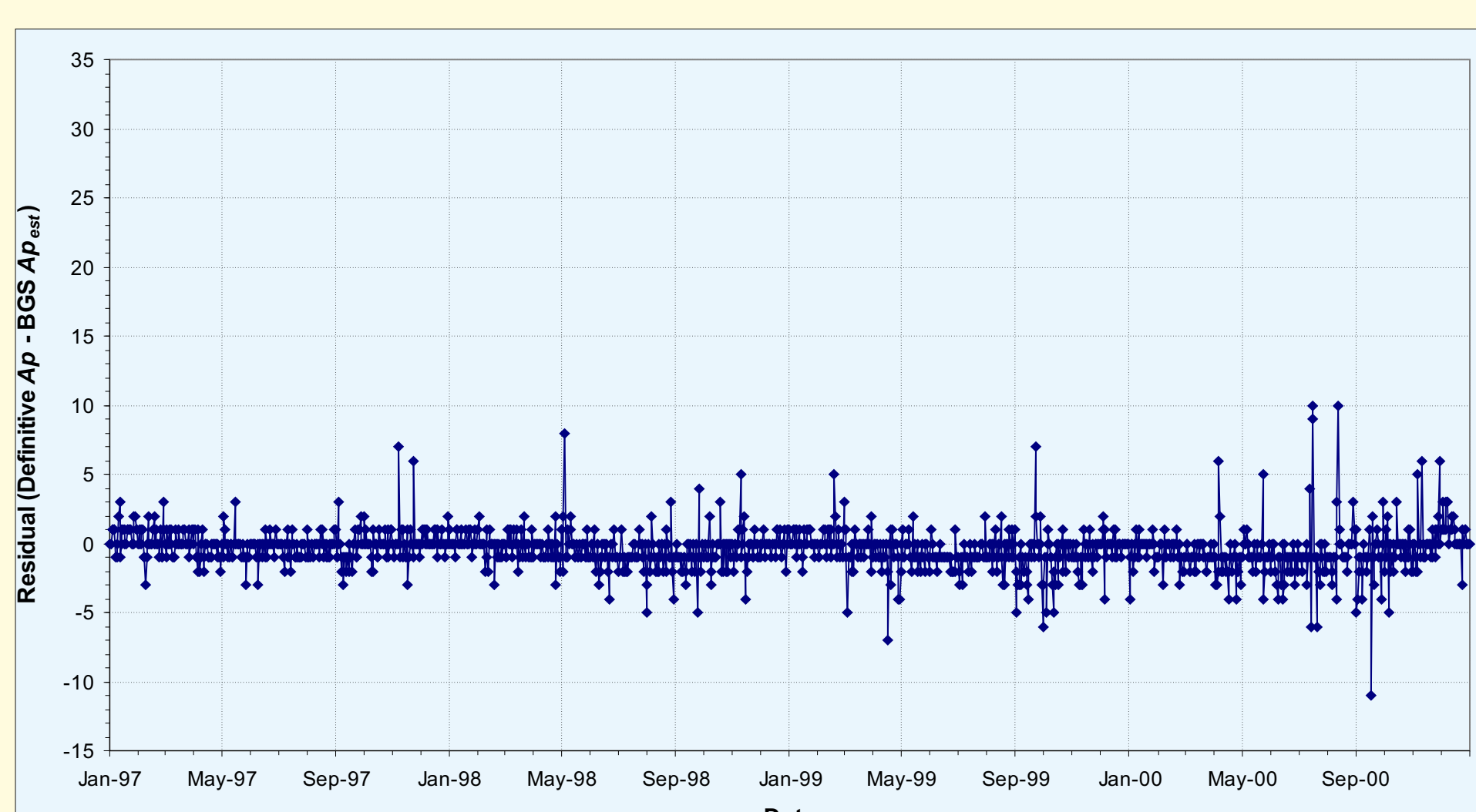
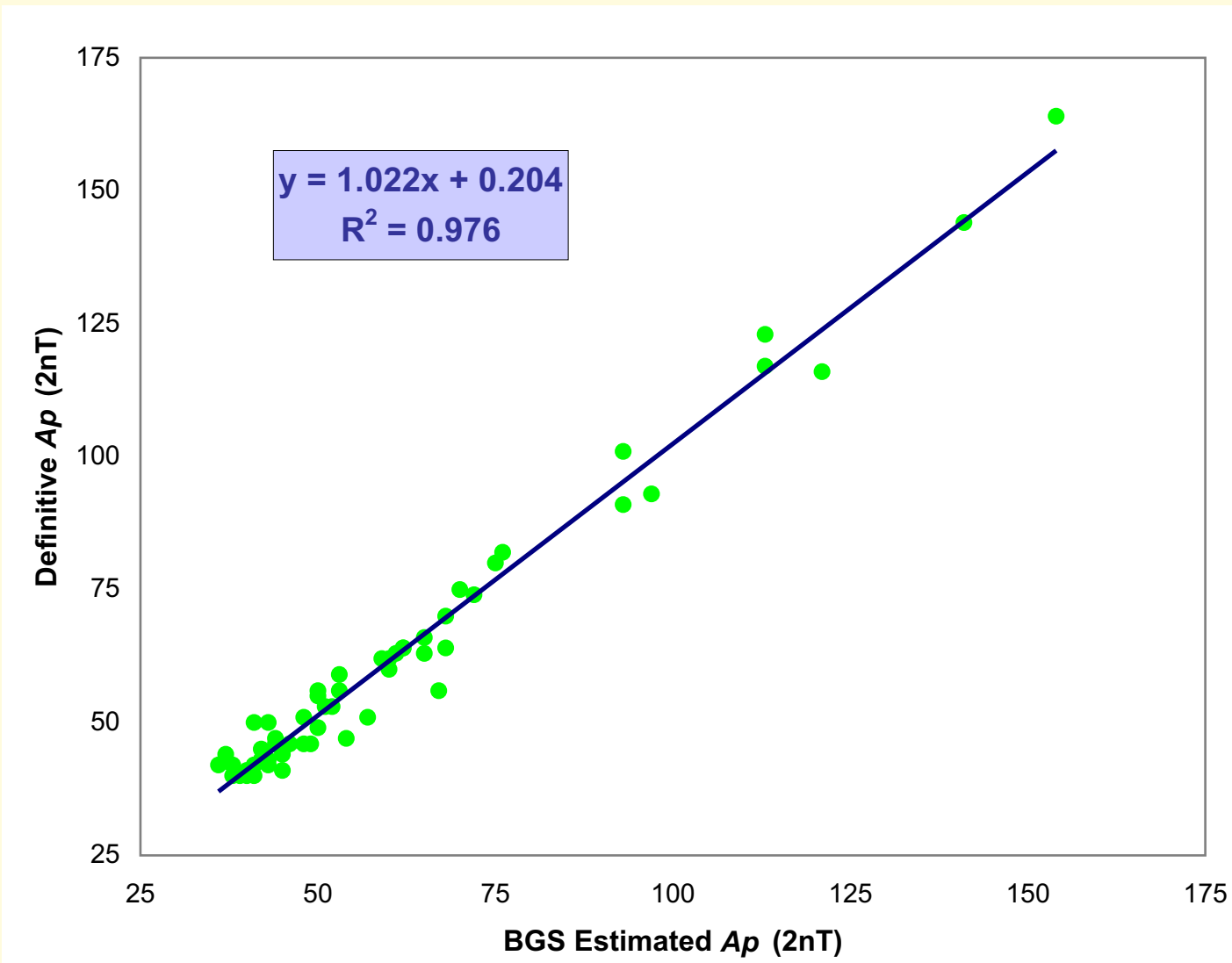
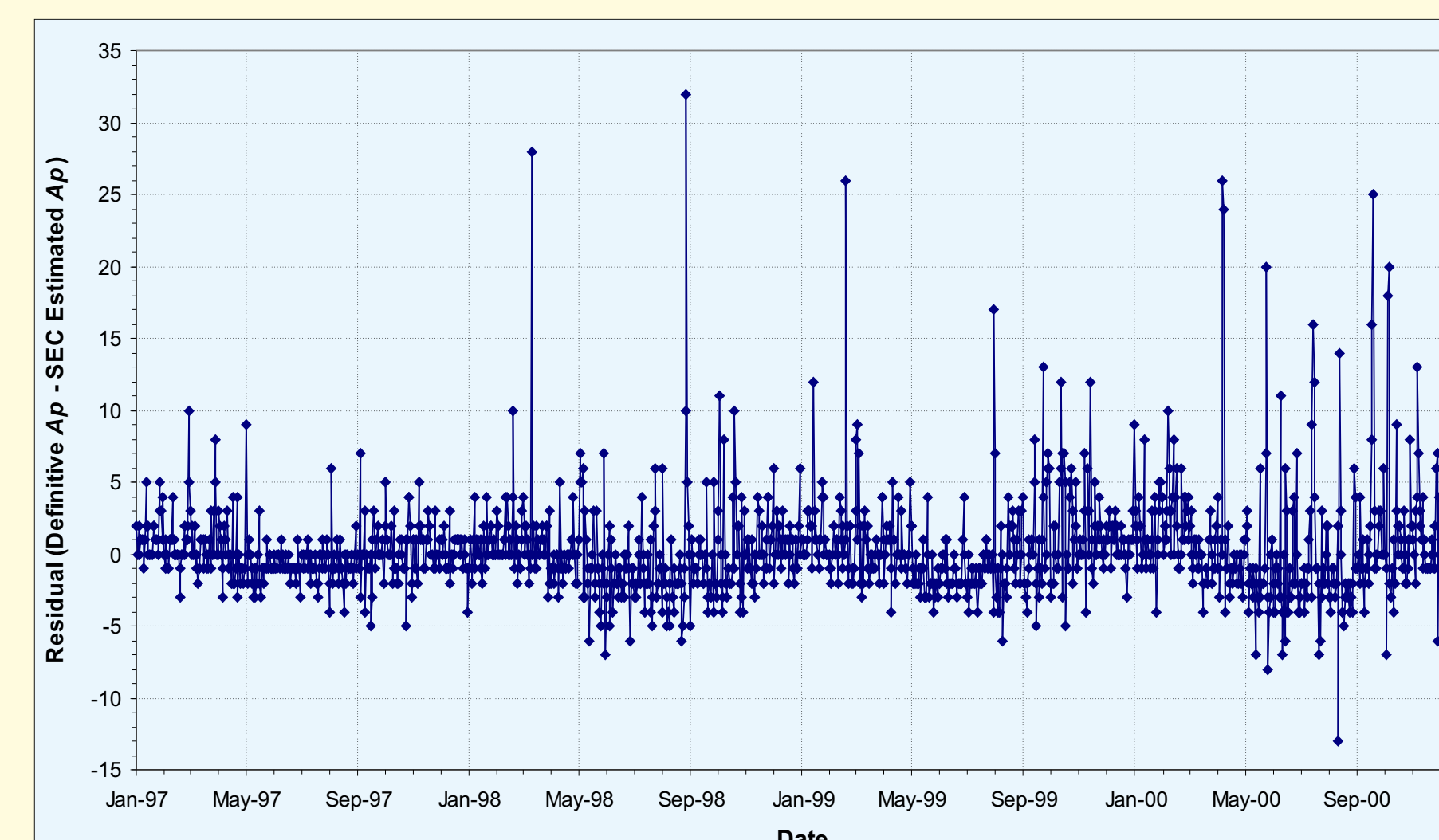
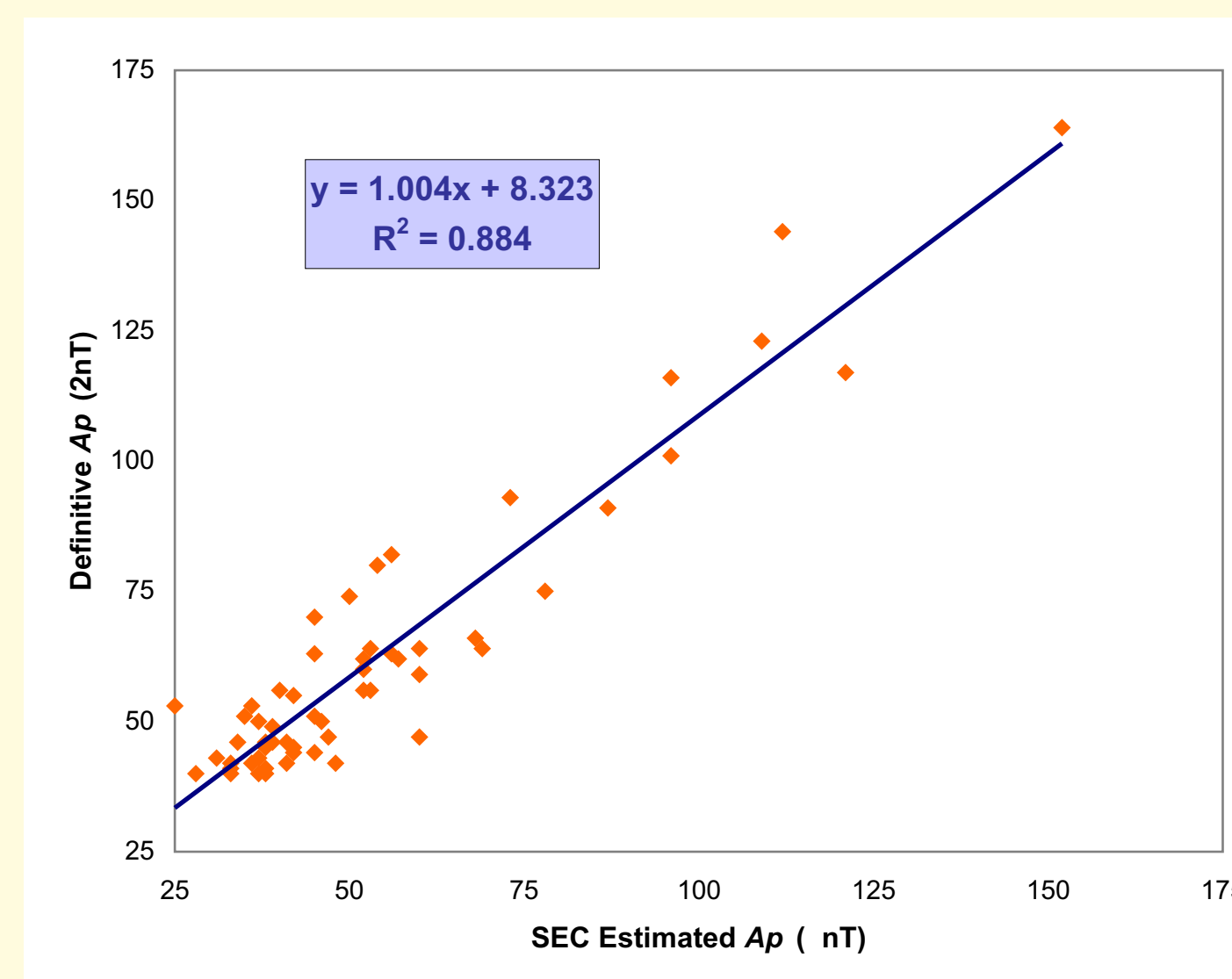
Several organisations are now making their own estimated indices, some of which are publicly available. There is some potential for confusion. As GFZ are the official IAGA appointed providers of K_p and Ap indices it would be sensible for the real time estimated values to also be derived and disseminated by GFZ.

4. Space Weather Services

These data and forecasts of future activity, based on these data, should find wide application within the ESA space weather pilot projects. For example, Ap is important in atmospheric drag modelling at ESOC and the related K_p index is important for nowcasting and forecasting of the electron content of the ionosphere for satellite navigation purposes. **BGS and GFZ would welcome comments on how to best integrate these data within SWENET.**

Daily Ap_{est} Accuracy

The real time Ap_{est} accuracy is considered with respect to the definitive Ap values published 2 weeks in arrears. The Space Environment Center (SEC) also issue estimated Ap in near real-time. An analysis has been carried out on the accuracy of both estimates by comparing each against definitive Ap for the period 1997 to 2000. In the regression analysis (top left and right) only values of definitive $Ap > 40$ 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. Our 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 our estimates. 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 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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