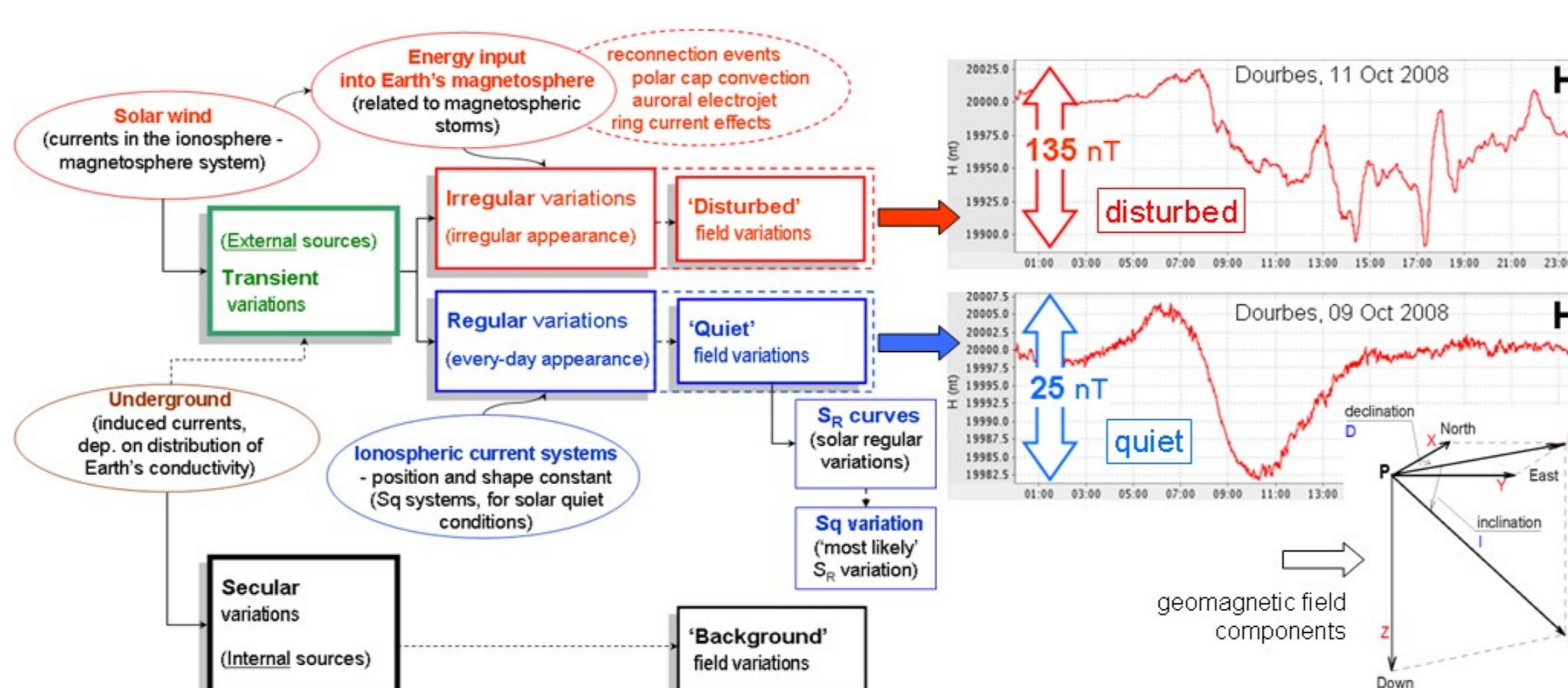# On the local operational geomagnetic index K calculation

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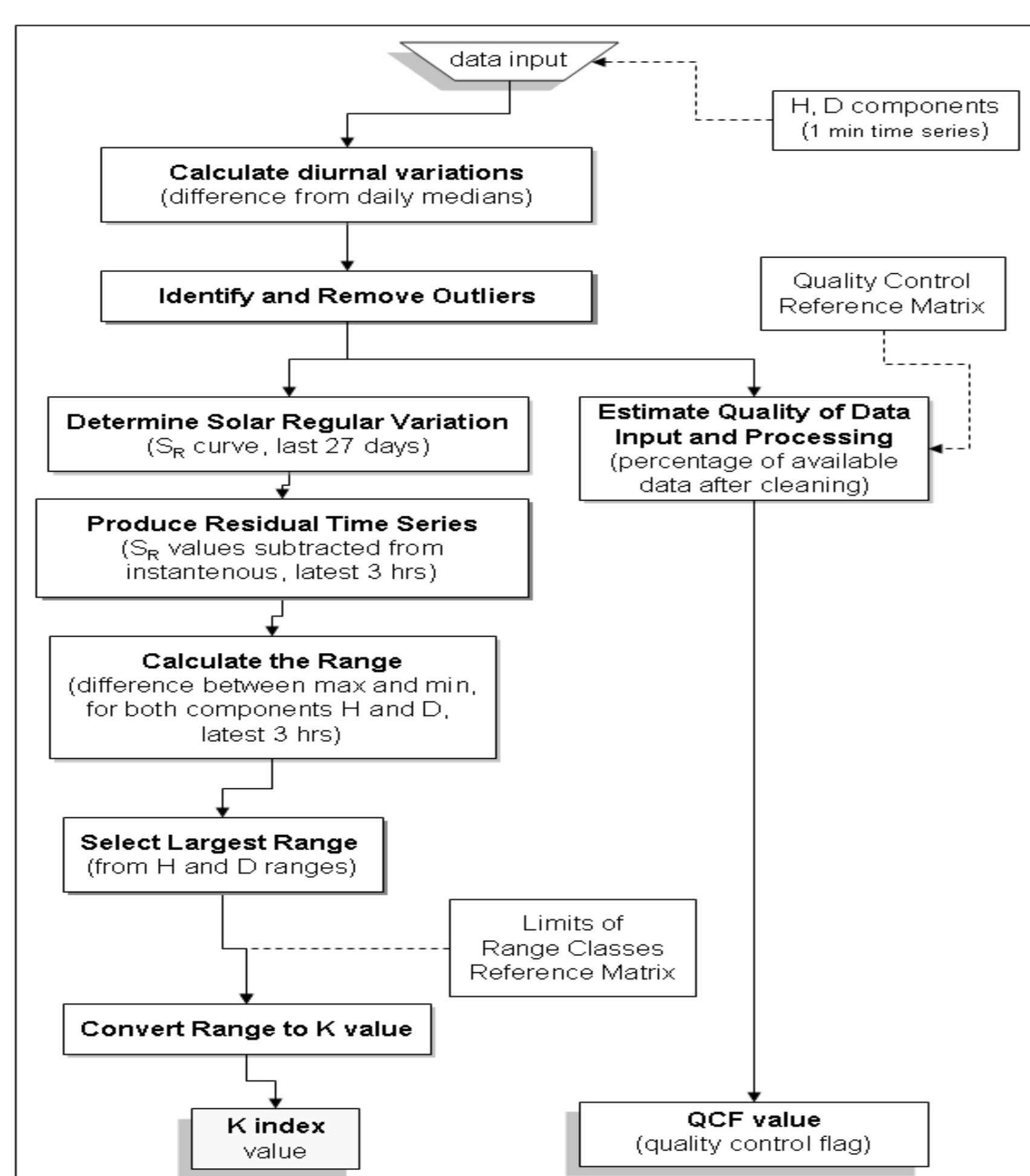
Motivation

There is an ongoing demand for services that can provide real-time assessment of the (global and local) geomagnetic activity being of importance to exploration geophysics, radio communications and precise position/navigation practices, space weather research and modelling, etc.

Background

The geomagnetic field experiences pronounced variations that are the sum of the secular variations (internal sources) and the transient variations (external sources, e.g. solar wind). The K index is a code (in integers, 0 to 9) accounting for the morphological characteristics of the transient irregular variations and is designed to characterise the geomagnetic activity at a certain location. It is derived from the larger of the two ranges measured in the field's horizontal components over a 3-hour interval after subtracting the daily solar regular (Sr) variations.
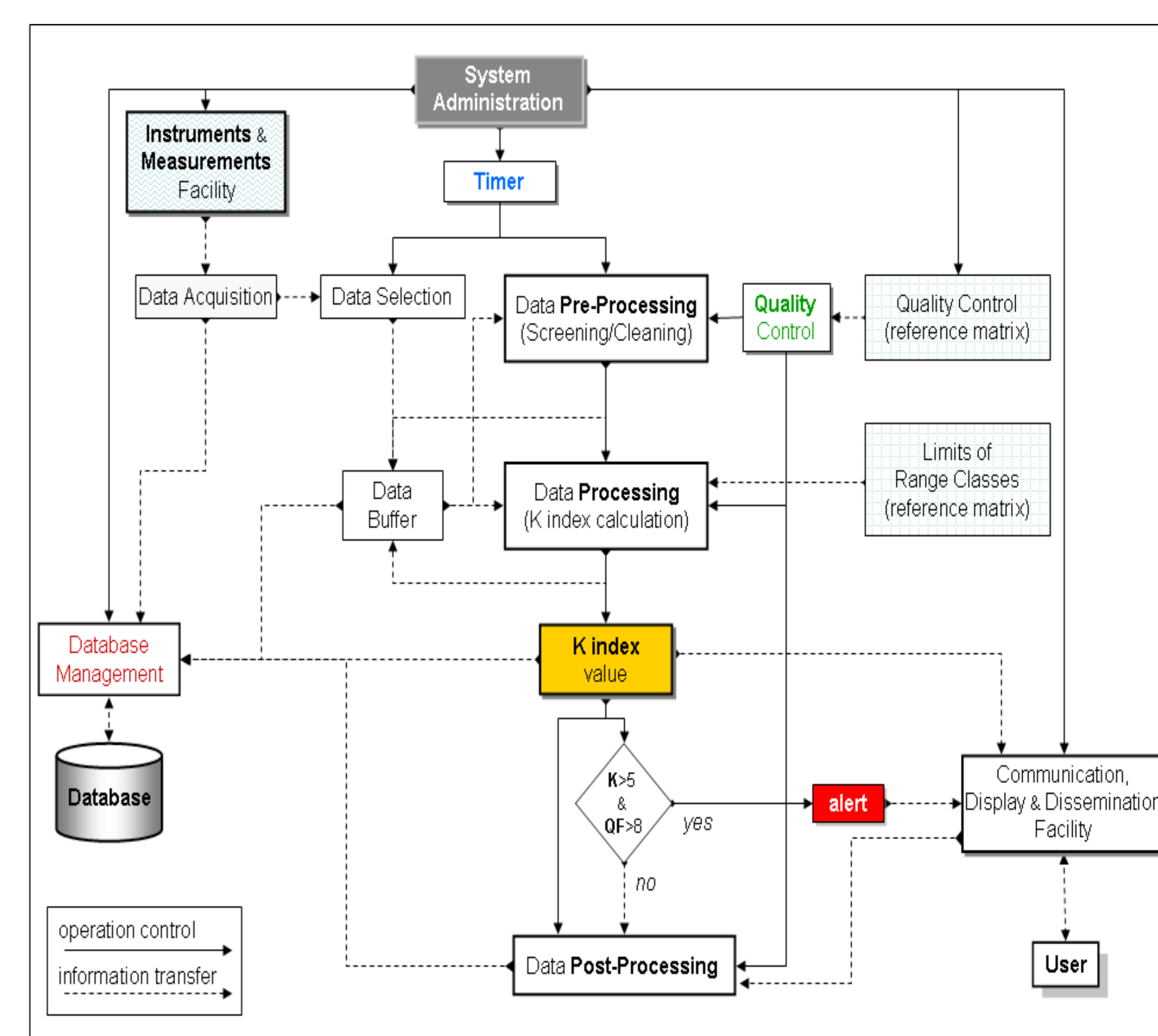
Nowcast Algorithm

K-LOGIC

The K nowcast system is based on a fully automated computer procedure for real-time digital magnetogram data acquisition, screening the dataset and removing the outliers, establishing the solar regular (Sr) variation of the geomagnetic field, calculating the K index, and issuing an alert if storm-level activity is indicated.

This is a time-controlled (rather than event-driven) system delivering as regular output (time resolution set to 1 hour) the K value, the estimated quality flag, and eventually, an alert.
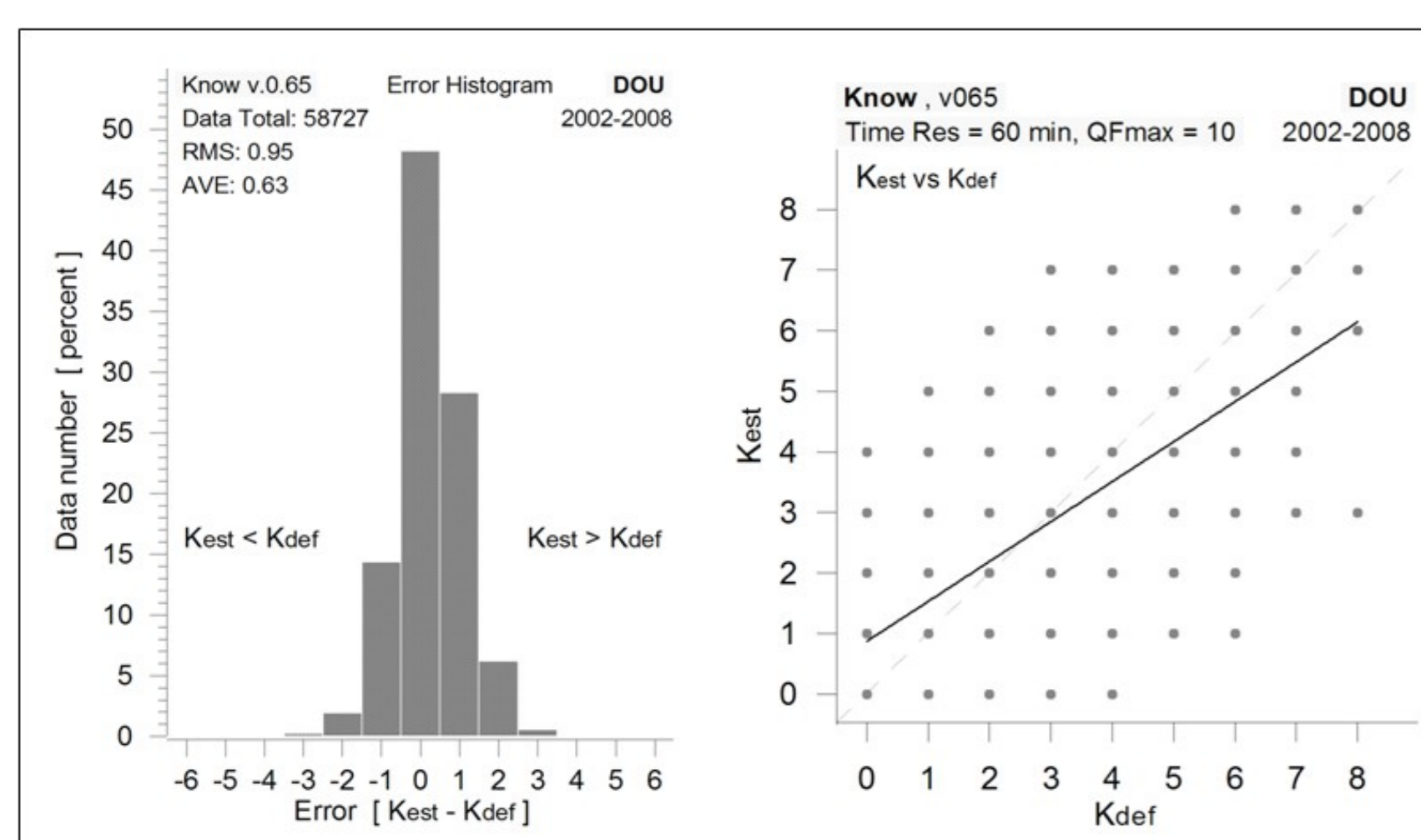
The regular field variation is determined from the hourly medians of the horizontal components' values obtained during the recent magnetically-quiet days.
These Sr values are subtracted from the corresponding instantaneous measurement values (in the latest 3 hours) to determine the components' ranges (maximum value minus minimum value).
Finally, the larger of the two horizontal components' ranges is used to determine the K value referring to the limits-of-range-classes table for the particular observatory.
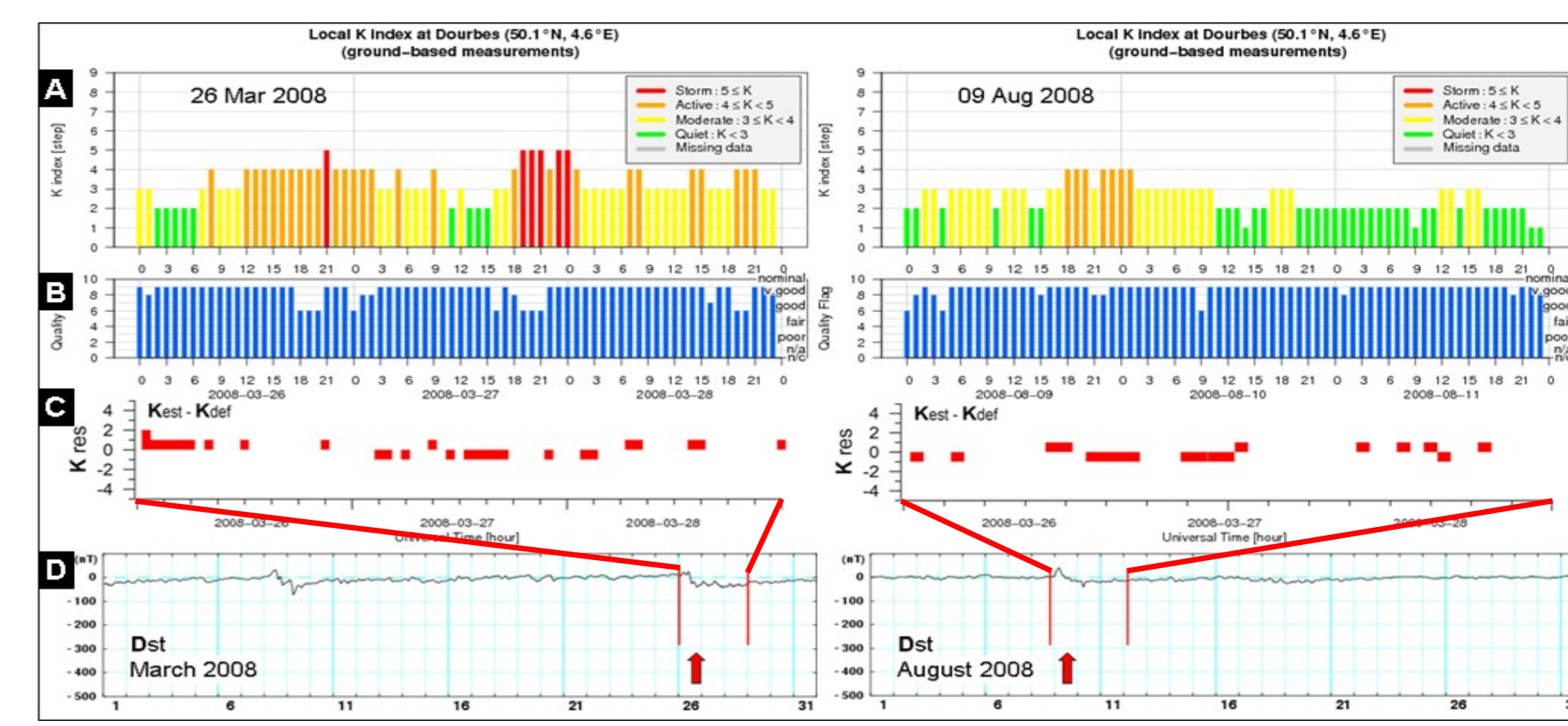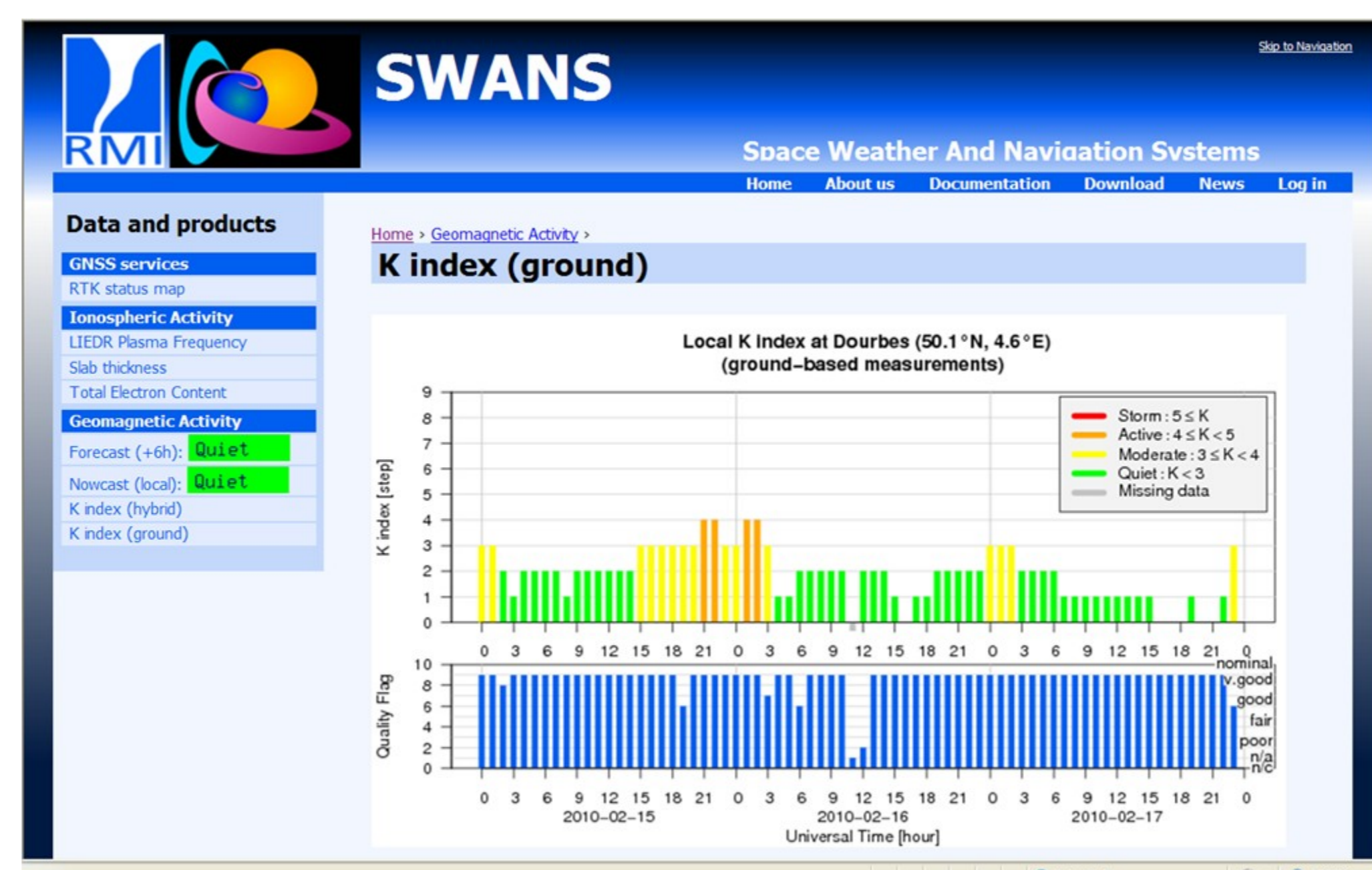
Operational System

Evaluation

A very important feature of the K nowcast system is the strict control of data input and processing, allowing for an immediate assessment of the quality of output. The key concept of the implemented quality control (QC) procedure is based on the fact that a complete and sound dataset provides the ideal platform for reliable, closest-to-definitive index production. In this sense, any gap or outlier in the dataset can erode the quality of the produced output. The QC matrix takes into account both, the total length of data gaps (shorter or no gaps – the better) and the time elapsed from the latest gaps/outliers (more distant in the past – the better).

Interoperability Test

Service

A statistical comparison between nowcast and definitive K index values was performed using data from years 2002 through 2008.

Almost 50% of the nowcast yields the correct K value and more than 90% of the total nowcast is within 1 KU difference from the correct, definitive value.

The average residual error is estimated at about 0.63 and the RMS error is about 0.95 over the whole period.

In general, the nowcast tends to overestimate the low geomagnetic activity values, and oppositely, to underestimate the high end of the geomagnetic activity.

The above-described control is of crucial importance for the nowcast system operation since it helps minimising the existing possibility of missing an event or issuing a false alert. Therefore, a quality control flag (QCF) is assigned to each K nowcast value produced. The K value should be used for alerts only if quality is high.

The K-LOGIC system's operability, accuracy and precision have been tested with instantaneous measurements from the recent years.

The system is now operational at the RMI Geophysical Centre in Dourbes (50.1N, 4.6E), Belgium.

http://swans.meteo.be/geomagnetism

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