Deliverable 2.5

Provision of a Web-interface for AE activity monitor and local indices database

Project acronym: *AFFECTS*
Project title: *Advanced Forecast For Ensuring Communications Through Space*
Grant Agreement number: *263506*
Coordinator: *Volker Bothmer*

Project co-funded by the European Commission, Seventh Framework Programme

Funding Scheme: *FP7-SPACE-2010-1*

Due date of deliverable:	August 31, 2011
Actual submission date:	August 23, 2011
Start date of the project:	March 1, 2011
Project duration:	3 years

Work package:	2. “Data, Calibration, Maintenance and Instrumentation”
Deliverable:	2.5
Lead beneficiary for this deliverable:	UoT
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Quality reviewer:	Volker Bothmer

Project co-funded by the European Commission within the Seventh Framework Programme (2007)		
Dissemination level		
PU	**Public**	**PU**
PP	**Restricted to other programme participants (including the Commission Services)**	
RE	**Restricted to a group specified by the consortium (including the Commission Services)**	
CO	**Confidential, only for members of the consortium (including the Commission Services)**	

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Issue record

Version	Date	Author(s)	Reason for modification	Status
1.0	31-08-2011	Chris Hall Norbert Jakowski	NA	Submitted to AFFECTS PI
1.0	31-08-2011	Chris Hall Norbert Jakowski	NA	Dissemination at AFFECTS Website
1.1	31/10/2011	Chris Hall Norbert Jakowski	Suggested Improvements by AFFECTS Team	completed
1.2	20/12/2011	Volker Bothmer	Quality Review and final comments	
1.3	31/07/2012	Volker Bothmer	Comments of technical reviewer	

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Collaborations beyond AFFECTS and Acknowledgements

The Ae index data for this deliverable are fetched from the World Data Centre, Kyoto, by their prior knowledge and approval.

Contents

1 Scope of the deliverable

The goal of deliverable report D2.5 is the provision of a Web-interface for monitoring Auroral Electrojet (AE) activity through local data and derived local geomagnetic indices provided by measurements from a chain of magnetometers ranging from the polar cap region to subauroral latitudes, and from the digital ionosonde operated near Tromsø. Provision of the data base to the community in NRT requires upgrades and maintenance of the magnetometer chain and of the Longyearbyen antenna.

The following sections describe how the auroral activity is locally monitored and how the data can be accessed online.

1.1 Auroral electrojet (AE) activity monitoring

Traditionally activity in the auroral oval is described by the Auroral Electrojet Index, AE, is designed to provide a global, quantitative measure of auroral zone magnetic activity produced by enhanced ionospheric currents flowing below and within the auroral oval. Ideally, it is the total range of deviation at an instant of time from quiet day values of the horizontal magnetic field (h) around the auroral oval. Defined and developed by Davis and Sugiura [1966], AE has been usefully employed both qualitatively and quantitatively as a correlative index in studies of substorm morphology, the behavior of communication satellites, radio propagation, radio scintillation, and the coupling between the interplanetary magnetic field and the earth's magnetosphere. For these varied uses, AE possesses advantages in terms of measuring space weather conditions at geographic/geomagnetic latitudes above about 60° in comparison with other geomagnetic indices (e.g., Dst):

1. it is derived on an instantaneous basis or from averages of variations computed over any selected interval;
2. it is a quantitative index which, in general, is directly related to the processes producing the observed magnetic variations;
3. its method of derivation is relatively simple, digital, and objective and is well suited to present computer processing techniques; and
4. it may be used to study either individual events of statistical aggregates.

   While fully validated AE values are available from:

   ftp://ftp.ngdc.noaa.gov/STP/GEOMAGNETIC_DATA/INDICES/AURORAL_ELECTROJET/

Provisional near real-time (NRT) results, viz. this deliverable are available at:

http://wdc.kugi.kyoto-u.ac.jp/ae_realtime/today/today.html

here a link is provided from the main AFFECTS portal:

http://swaciwebdevelop.dlr.de/geomagnetic-observations/

The NRT data are not available in a format other than graphical. The http-provided graphic can be downloaded using the public domain tool "wget":

http://gnuwin32.sourceforge.net/packages/wget.htm

Since AE index values are not available in NRT online, the AFFECTS project aims at providing NRT measurements of the auroral activity through local measurements from a chain of magnetometers ranging from the polar cap region to subauroral latitudes, and from the digital ionosonde operated near Tromsø as described in the next sections.

2 Local geomagnetic data base and ionosonde data

Solar wind variations, coronal mass ejections, solar flares and solar energetic particle events perturb the Earth's magnetic field (ref. AFFECTS WP1 D1.1) on large-scale, and locally cause ground induced currents leading subsequently to magnetic field variations that can be registered by magnetometers. Local three hour K indices take into account the local variations inherent in the magnetometer records. Based on the local K indices of more than a dozen world-wide distributed stations, a global planetary index Kp (Del. 2.4) is generated for 3 hour intervals each day, starting at 00 UT. The Kp index has been introduced by Julius Bartels at the Institute for Geophysics at University of Göttingen in 1934 to help determine the overall geomagnetic activity on Earth during 3 hour periods each day dating back to 1932. Specific details of Kp are given on dedicated websites; for example:

http://www-app3.gfz-potsdam.de/kp_index/index.html

The Kp-data are currently officially available and maintained from the World Data Center A for Solar-Terrestrial Physics at the Space Weather Prediction Center at 325 Broadway, Boulder, Colorado, USA, the AFFECTS project external US collaborator, at the FTP server: ftp://ftp.ngdc.noaa.gov/STP/GEOMAGNETIC_DATA/INDICES/KP_AP/ with monthly updates.

In a manner identical to the Kp index generation but for only one observational site, local k indices are also generated at higher latitudes, usually by local operators. **For AFFECTS we provide local k indices for a selection of sites from mid-latitude Europe to the Scandinavian sector polar cap.** For this deliverable the k-index sites are:

Location	Coordinates
Longyearbyen (auroral zone – high latitude)	78°N, 16°E
Tromsø (auroral zone)	70°N, 19°E
Dombås (sub-auroral zone)	62°N, 9°N
Brorfelde (mainland Europe)	56°N, 12°E

A shortcoming of the k index is that the dynamic range is itself a local characteristic. Therefore activity levels can be ascertained by comparing k-indices at the same location, but not

between locations in a quantitative fashion. We therefore provide alternative indices for the above locations wherein the values are in nT. These local activity indices are defined as absolute mean deviations of the current horizontal component of the geomagnetic field at the location relative to the previous day's mean value. All activity index values are updated hourly, while k index values *per definition* are 3 hourly. Values are published as soon as they are available on the AFFECTS servers specified herewith. **The scope of the high latitude magnetometer data is to provide physical measurements of space weather conditions at polar regions and their quantitative connection to dTEC convection**, e.g., as shown in Figure 1 and to help track equatorward movements of the auroral electrojets. Figure 2 shows the physical connection between the auroral electrojet latitude and the Kp-Index.

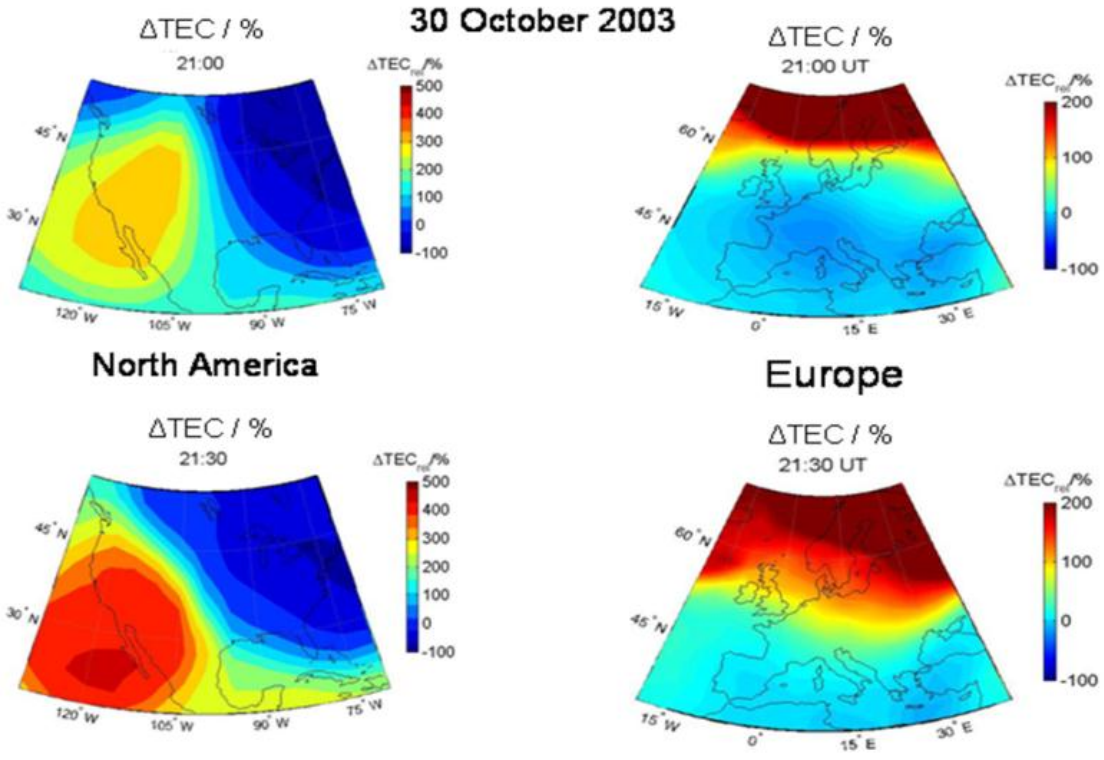

Figure 1. dTEC convection from polar to lower latitudes on October 30, 2003 as caused by the impact of a coronal mass ejection (Presentation by UGOE and DLR at the European Space Weather Week 6, DTEC measurements provided by DLR).

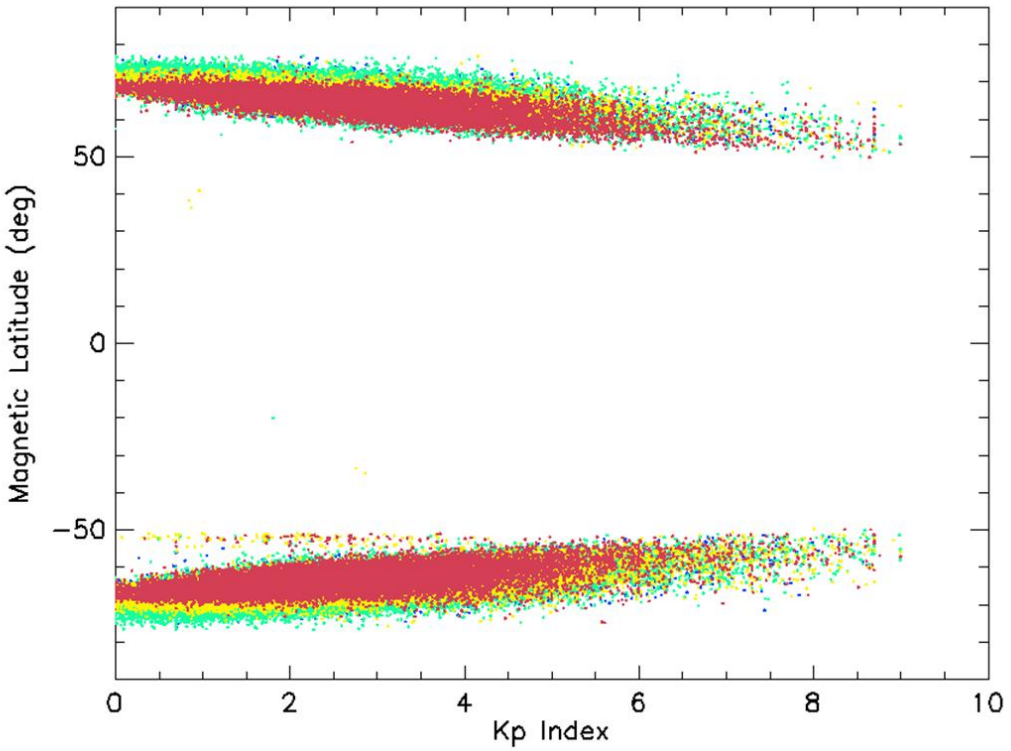

Figure 2. A statistical analysis of the sub-auroral electric field. In preparation for J. Geophys. Res. by Talaat et al., 2011 (VB: private communications).

Filenames on the server locations uniquely identify the data as described in the following table:

The activity index files consist of 4 lines of title information flowed by one line for each day of the month. Each of these data lines starts with the day-of-the month, month and year; these are followed by up to 24 values corresponding to hours of the day. Thus the value for "01" is the absolute mean deviation of measurements between 00UT and 01UT from mean of the preceding 24 hours for the horizontal component etc.

The k index files consist of 3 lines of title information followed by 7 lines of k index information corresponding to the current day (last line) and previous 6 days. Each line of data starts with the day-of-the month, month and year; these are followed by up to 8 values corresponding to 3-hour "k" intervals of the day (in UT). Missing values (typically in the pending intervals for the current day) are filled with "99".

UoT provides ionospheric data since 1935 – one of the three longest existing datasets in the world. Today's instrument, a collaboration with the UK, provides information on electron density in the atmosphere several times every hour.

filename	description
ActIx_PrevMonth_bfe6d.txt	Activity index (nT) for previous month for Brorfelde
ActIx_PrevMonth_dob1a.txt	Activity index (nT) for previous month for Dombås
ActIx_PrevMonth_lyr2a.txt	Activity index (nT) for previous month for Longyearbyen
ActIx_PrevMonth_tro2a.txt	Activity index (nT) for previous month for Tromsø
ActIx_ThisMonth_bfe6d.txt	Activity index (nT) for this month for Brorfelde
ActIx_ThisMonth_dob1a.txt	Activity index (nT) for this month for Dombås
ActIx_ThisMonth_lyr2a.txt	Activity index (nT) for this month for Longrearbyen
ActIx_ThisMonth_reo2a.txt	Activity index (nT) for this month for Tromsø
latest_k_bfe6d.txt	Latest k index for Brorfelde
latest_k_dob1a.txt	Latest k index for Dombås
latest_k_lyr2a.txt	Latest k index for Longyearbyen
latest_k_tro2a.txt	Latest k index for Tromsø
filename	description
ActIx_PrevMonth_bfe6d.txt	Activity index (nT) for previous month for Brorfelde
ActIx_PrevMonth_dob1a.txt	Activity index (nT) for previous month for Dombås
ActIx_PrevMonth_lyr2a.txt	Activity index (nT) for previous month for Longyearbyen
ActIx_PrevMonth_tro2a.txt	Activity index (nT) for previous month for Tromsø
ActIx_ThisMonth_bfe6d.txt	Activity index (nT) for this month for Brorfelde
ActIx_ThisMonth_dob1a.txt	Activity index (nT) for this month for Dombås
ActIx_ThisMonth_lyr2a.txt	Activity index (nT) for this month for Longrearbyen
ActIx_ThisMonth_reo2a.txt	Activity index (nT) for this month for Tromsø
latest_k_bfe6d.txt	Latest k index for Brorfelde
latest_k_dob1a.txt	Latest k index for Dombås
latest_k_lyr2a.txt	Latest k index for Longyearbyen
latest_k_tro2a.txt	Latest k index for Tromsø

3. Summary and online provision of the data

Online NRT access to the local geomagnetic and ionosonde data and data bases and descriptions of the products is provided for registered users through the SWACI system as defined in the AFFECTS DoW (Figure 3.2) through the following website:

http://swaciweb.dlr.de/affects/