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1 Introduction

1.1 Overview

The primary purpose of the Kp Forecast system is to provide AFWA the capability to predict Kp. Kp is a 3-hour index that is commonly used to characterize the global planetary geomagnetic disturbances caused by the solar wind over a 3-hour period. (The K indices are generally used to indicate the solar wind effects on the earth’s magnetic field; the subscript "p" means “planetary” and designates a global magnetic activity index.) The official Kp index is derived using data acquired at the selected 13 ground-based magnetic observatories which lie between 46 and 63 degrees north and south geomagnetic latitude: Lerwick (UK), Eskdalemuir (UK), Hartland (UK), Ottawa (Canada), Fredericksburg (USA), Meannook (Canada), Sitka (USA), Eyrewell (New Zealand), Canberra (Australia), Lovo (Sweden), Rude Skov (Denmark), Wingst (Germany), and Witteveen (The Netherlands). Based mainly on the horizontal components of the magnetic field measured by these stations, the Kp index discriminates conservatively between the true magnetic field perturbations and the quiet-day variations.

The value of Kp ranges in 28 steps from 0 to 9, indicating very quiet to very disturbed level respectively, with fractional parts expressed in thirds of a unit. The scale is quasi-logarithmic and the integer values are sub-divided into thirds commonly expressed with symbols + and -, e.g. 0, -1, 1, 1+, 2-, 2, ...9. For many applications, it is often easier to express the fractional values explicitly without using the + and - symbols. For example, Kp values of 3+ = 3.3 = 3 and 1/3, and 5- = 4.7 = 4 and 2/3, etc.

Many models for the near-Earth space environment need Kp to predict various parameters such as atmospheric density, ionospheric conductivities, auroral particle precipitation boundaries, ionospheric and magnetospheric electric field etc. Unfortunately, Kp indices are published with significant time delay. The purpose of the Forecasting Kp project is to provide a predicted Kp using inputs from the ACE satellite.

The Forecasting Kp application consists of a series of scripts and programs that download data from the NOAA Space Weather site, process the data into fifteen minute averages, input the data into a neural network, and create images of the forecasted Kp. The user can then view this information via a web browser.

1.2 Statement of purpose

The purpose of this document is to outline the resources necessary to install, run, and evaluate the Forecasting Kp software system.
2 Product Support Resources

2.1 Facilities

The Forecasting Kp software has been adapted for the AFWA facilities. No resources other than those listed in the following subsections will be required from these facilities.

2.2 Hardware

The Forecasting Kp software runs on the Sun Solaris platform. For installation and operation of the software, access to a Sun platform, approximately 2 MB of disk space, and a 4mm DAT tape drive are required. This platform shall be connected to the Internet to allow access to the NOAA Space Weather website.

2.3 Software

The Forecasting Kp system consists of two major components developed under the Sun Solaris platform. The first is the prediction engine, which is implemented in Java and comes with all necessary libraries. It can be run on any system that has Java installed. The second component (which need not be run on the same machine) is a set of shell scripts and perl scripts that periodically obtain new data from the NOAA archive, process that data, and generate new plots for the web page display. This component requires the following utilities to be installed: /bin/bash, cron, perl (vs. 5.005_2 or higher), GNU gcc compiler (version 2.95.2 or higher), and a web server.

2.4 Data

NOAA provides the data for the Forecasting Kp software system on a publicly accessible ftp server, at http://sec.noaa.gov. Our scripts download the new data as it becomes available. Connectivity must exist to the Internet to enable this operation.

2.5 Personnel

2.5.1 Personnel required for installation

The installation process is expected to take less than 2 business days. We request that the UNIX system administrator be responsible for the installation process. During this time, access to the individual(s) that will be evaluating the software will be required. The APL Transition Team will be available during this period, via email or telephone, to answer questions or troubleshoot.
2.5.2 Personnel required for evaluation

We recommend that one person be assigned to the evaluation at a level of effort conducive to the desired level of intensity of evaluation. This person should be competent to evaluate the output of the software.

2.6 Error Handling

Currently, the error reporting mechanisms in the software are written to the screen as well as an error log.

3 Recommended Procedures for Operation

The software as delivered is designed to run without human intervention or automatically via a cron job.

4 Training

Person(s) at AFWA conducting the installation and evaluation will be able to contact the UPOS Transition Team by telephone or email to ask questions.

5 Anticipated Areas of Change

Additional software changes can be made through the UPOS Transition Team corrective action process via the UPOS web page. A general-purpose email account has been established to accept project-related feedback. This email link is available under the feedback section of the UPOS web page. The URL for the UPOS web page is: http://sd-www.jhuapl.edu/UPOS.

6 Evaluation and Transition

The software is being delivered to AFWA for the purpose of evaluation. We will make resources available to support the evaluations conducted at AFWA. Additional requirements, documentation and training may be negotiated as a result of the evaluation.
7 Related Documentation


## Appendix A
### Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>ACE</td>
<td>Advanced Composition Explorer</td>
</tr>
<tr>
<td>AFWA</td>
<td>Air Force Weather Agency</td>
</tr>
<tr>
<td>APL</td>
<td>Applied Physics Laboratory of Johns Hopkins University</td>
</tr>
<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange</td>
</tr>
<tr>
<td>Bx</td>
<td>X component of the Interplanetary Magnetic Field</td>
</tr>
<tr>
<td>By</td>
<td>Y component of the Interplanetary Magnetic Field</td>
</tr>
<tr>
<td>Bz</td>
<td>Z component of the Interplanetary Magnetic Field</td>
</tr>
<tr>
<td>GIF</td>
<td>Graphic Interchange Format</td>
</tr>
<tr>
<td>HTML</td>
<td>Hypertext Markup Language</td>
</tr>
<tr>
<td>IMF</td>
<td>Interplanetary Magnetic Field</td>
</tr>
<tr>
<td>JHU</td>
<td>Johns Hopkins University</td>
</tr>
<tr>
<td>Kp</td>
<td>Geomagnetic index that indicates the global geomagnetic disturbances</td>
</tr>
<tr>
<td>MAG</td>
<td>Magnetometer (ACE Instrument)</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>SWEPAM</td>
<td>Solar Wind Electron, Proton, and Alpha Monitor (ACE Instrument)</td>
</tr>
<tr>
<td>UPOS</td>
<td>University Partnering for Operational Support</td>
</tr>
<tr>
<td>USAF</td>
<td>United States Air Force</td>
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