

ESTEC Noordwijk, 3rd-5th November 2003

BAE SYSTEMS

Space Weather Applications Pilot Project Service Development Activity

Daily Ionospheric Forecasting Service

Nigel.Wheadon@baesystems.com
Tel: +44 (0)1245 242143




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Why do we need a forecast ? An HF sky-wave user's perspective



- Operating the circuits requires a frequency schedule
- Planned several months in advance
 - Uses internationally recognised HF sky-wave propagation prediction program
 - Frequencies assigned based on analysis
 - Additional assignments provided to cover ionospheric storms
- However which frequency does the user select today?
 - Normal daily variations
 - Predictions of storm periods & ionospheric disturbances

User Profiles:

- Highly mobile users (short range - few km)
 - Hand-held, man-pack, vehicle or platform mounted
- Fixed to mobile (short to medium range - few 100s km)
 - Search & Rescue (NVI mode)
- Fixed to fixed & mobile (medium to long range - 500km to world-wide)
 - Long range (Beyond Line Of Sight) comms to aircraft
 - Long-haul world-wide point-to-point circuits

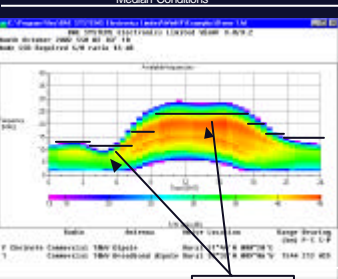
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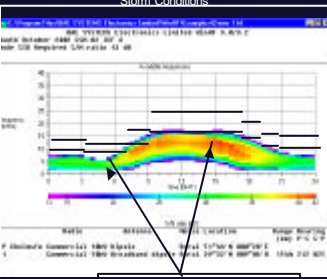
Example - HF sky-wave circuit prediction

Median Conditions



Channel Assignment

Storm Conditions



Modified Channel Assignment

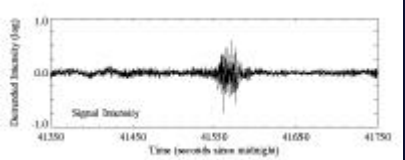
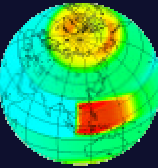
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Why do we need a forecast ? A SATCOM user's perspective

- A radio signal traversing the ionosphere will be modified by irregularities in the electron density.

- Peak Activity
 - Equatorial latitudes
 - Post sunset until midnight
 - Auroral latitudes
 - Post mid-night and early morning

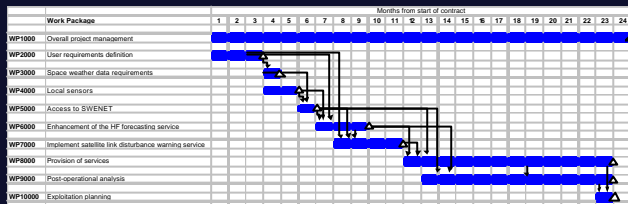
SATCOMs outages into Sierra Leone (UK Mil Skynet IV)
GPS receivers lose lock

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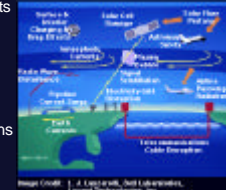
Pilot Project - DIFS

- to implement a new service for the provision of space weather forecasting for HF users
- to develop and implement a new service for SATCOM communicators
- by making full use of the information available via ESA SDA support infrastructure and other solar, geophysical and ionospheric data sources.
- the Services will be fully automated and distribution will be via email and www
- The outputs will be various study reports and the provision of services for HF and SATCOMs users.



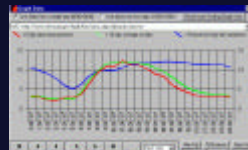
User Requirements

- Aim - capture user requirements for HF & SATCOM forecasts
- Requirements
 - HF users (MoD)
 - Support to operations (peace-keeping, exercise, ...)
 - Global & regional forecasts
 - Timely forecasts - move to 6 hourly to support operations
 - web-based service; email also
 - No one-size fits all with MoD
 - SATCOMs
 - Derived requirements from several discussions (SATCOMs)
 - Equatorial night-time
 - Continuing to monitor situation
 - Discussion of proposed content and format
 - Expect trial SATCOM forecast service will show benefits



Space Weather Data Requirements

- Aim
 - Capture SPW data requirements to fulfil user requirements
- Requirements
 - Identify data
 - Focus of availability of real-time data (>24 hrs is generally past its sell by date)
 - Easy to process e.g. indices, estimated daily values,...
 - Listed current & additional data sources:
 - near real-time ionospheric data over Eu & World-wide (RAL-Prompt Ionospheric Database, SEC, ESA mirror site, SWENET)
 - near real-time solar & planetary data (SIDC -Planetary A index, k indices, Wingst, Sunspot number groups, daily solar flux, absorption, Sudden Ionospheric Disturbance reports)
 - Data processing issues
 - Format - data providers use different formats
 - Raw data difficult to handle
 - Models
 - In-house & published forecasting algorithms
 - Global Ionospheric Scintillation Model (IEEA)



Access to SWENET (SDA Support Infrastructure)

- Aims
 - To develop interfaces to access data from SWENET (SDA Support Infrastructure)
 - To develop interfaces to post data to SWENET
 - FORMAT (URSIGRAM / SEC...)
 - Keyword, data in 5 character groups
 - foF2 data in SEC FTP format
- Work Programme
 - Access to data sets (mirror SEC)
 - Standard interfaces (FTP, HTTP, email datasets,...) ?
 - Availability of data (near real-time ; <24hrs, <6hrs)
 - Posting of forecasts



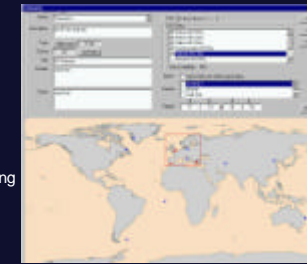
Local Sensor Data

- Aims
 - Enhance local sensor support to the forecasting service
- Work Programme
 - provide data to DIFS for use in forecasts
 - Re-locate a magnetometer probe
 - currently above ground in poor/noisy location
 - bury to provide
 - » more stable temperature environment
 - » reduced noise and magnetic interference
 - generate pseudo 3hrly indices
 - scan recordings for SID events (provisional - uncalibrated)
 - HF receiver
 - Received Signal quality
 - Scans for daylight SWF

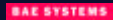


Enhancements to HF Service

- Aims
 - Provision of a service providing multiple ionospheric forecasts
 - global; regional
 - frequent (6hrly; 24hrly)
- Work Programme
 - Design & development of service
 - multiple forecast capability
 - Report: Past summaries & forecasts
 - user interface
 - data import facilities, templates & parsing
 - enhanced web data retrieval
 - Forecast generation
 - implementation of forecasting algorithms
 - dissemination to users

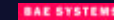
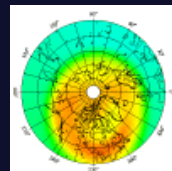


DIFS - Creating a new forecast



SATCOM Disturbance Warning

- Aims
 - Provision of a global SATCOM disturbance Warning Forecast
- Work Programme
 - Design of the SATCOM service
 - Advice & information to present to users
 - Complexity of reporting
 - Development of service
 - user interface
 - data parsing (check data is reasonable)
 - data import facilities & functions (data templates)
 - Use of existing scintillation models to support forecasting
 - Forecast generation
 - implementation of forecasting algorithms



Service Provision (2004)

- Aims
 - Service delivery (commencing 1st April 2004)
 - Global & Regional forecasts
 - Increased frequency
 - Post operational analysis
 - Validation & verification of prediction accuracy
 - Feedback from users
 - Potential enhancements & improvements
 - Exploitation planning
 - Extend customer base
 - Tailored to customer base

Summary...

- Aims
 - Enhanced ionospheric forecast service
 - Implement new SATCOM service
 - Validation & Verification
- Progress
 - User Requirements - completed
 - Data requirements - completed
 - Local sensor data - Work In Progress
 - Access to SWENET data - Work In Progress
 - Enhance HF service /SATCOM service - Work In Progress
 - Service provision, validation/verification & exploitation - April 2004
- Conclusion
 - Progress in-line with plan to achieve goals

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