Experimental D Region Absorption Prediction, Release 2 (DRAP2)

Product Description Document (PDD)

Part I – Mission Connection.

a. Product/Service Description

The D-Region[1] Absorption Prediction, Release 2 (D-RAP2) product provides a suite of graphic and text information about the global High Frequency (HF) radio propagation conditions related to the state of the ionosphere's D-region. D-RAP2 will be web based (http://www.swpc.noaa.gov/drap) and is an enhancement of the current D Region Absorption Prediction product (http://www.swpc.noaa.gov/dregion/index.html). D-RAP2 fills a void that exists in the current product by providing absorption information due to energetic proton precipitation at high latitudes. The web site provides:

- A main page containing a global map of the highest HF frequencies affected by a 1dB attenuation, estimated recovery times, and links to subordinate pages.
- Subordinate pages containing: north and south polar maps of the highest frequencies affected by a 10dB attenuation, ASCII tabular values of total absorption at 10 MHz, and an ASCII message indicating warning and recovery times.
- DRAP2 is updated every minute (see below for regional update latency)

SWPC data and products are designed to provide accurate and real-time space weather information for the safety and benefit of our customers.

b. Purpose/Intended Use

The current D-region absorption product only addresses HF absorption due to solar X-ray flares, which affect only low and middle latitudes on the sunlit side of Earth, in spite of the fact that the entire globe is graphically depicted. Solar X-ray flares ionize the D-region, dramatically increasing local electron density, and hence the total electromagnetic (EM) absorption. Due to geometric effects, D-region ionization is greatest at the sub-solar point, where the sun is directly overhead. The amount of ionization and absorption falls with distance away from the sub-solar point, reaching zero at the day/night terminator. The night side of the Earth is unaffected and the polar regions are minimally affected.

The aviation industry relies primarily on HF for communications in remote areas, which include large portions of polar routes. The current D-RAP product can mislead users into believing that HF communication over the poles is unaffected by space weather. Solar radiation storms that

[1] While the term 'D-region' is used for this product, the formal appropriate spelling of this term was determined to be 'D region' according to the Federal Standard 1037C, *Telecommunications: Glossary of Telecommunications Terms* (1996).

sometimes follow large solar eruptions can result in significant and extended degradation of HF communications at high latitudes. D-RAP2 will identify HF degradation at all latitudes.

This global product should be used to gain regional and global situational awareness regarding HF communication degradation and the estimated time to return to normal HF communications.

c. Audience

The D-region product is a critical model in the Space Weather Prediction Center's (SWPC) Space Weather for Aviation Service Providers webpage and many different airline groups have requested this important improvement. ARINC Inc., the company responsible for air traffic message communications, displays the current D-region model continuously in their operations centers. NavCanada has air traffic responsibility for all polar flights in Canadian air space (which extends to the Pole). They will use this product for route selection and management, emergency response, and other critical decision making processes at the control centers. Major airline dispatch offices will use this tool for route decision making. Amateur radio (HAM) operators will rely on this product to identify High Frequency (HF) problems, especially important during emergency response periods.

Additional customers cover a wide range of organizations including the NCEP/SWPC Space Weather Forecast Office, the NCEP Aviation Weather Center (for redistribution), DoD users of HF communications, and Antarctic scientific research stations.

d. Presentation Format

The enhanced D-Region Absorption Prediction consists of web based real-time graphical data displays and text summaries. The web based graphics and text formats were chosen to be largely consistent with the current D-region product, with specific additions for the polar regions.

e. Feedback Method

We are always seeking to improve our services based on user feedback. Comments regarding the D-RAP2 product should be sent to the feedback email address on the main graphics webpage. Feedback also will be solicited from users at the annual Space Weather Workshop meeting and other user meetings. Finally, a web survey will be requested.

Comments may also be provided to:

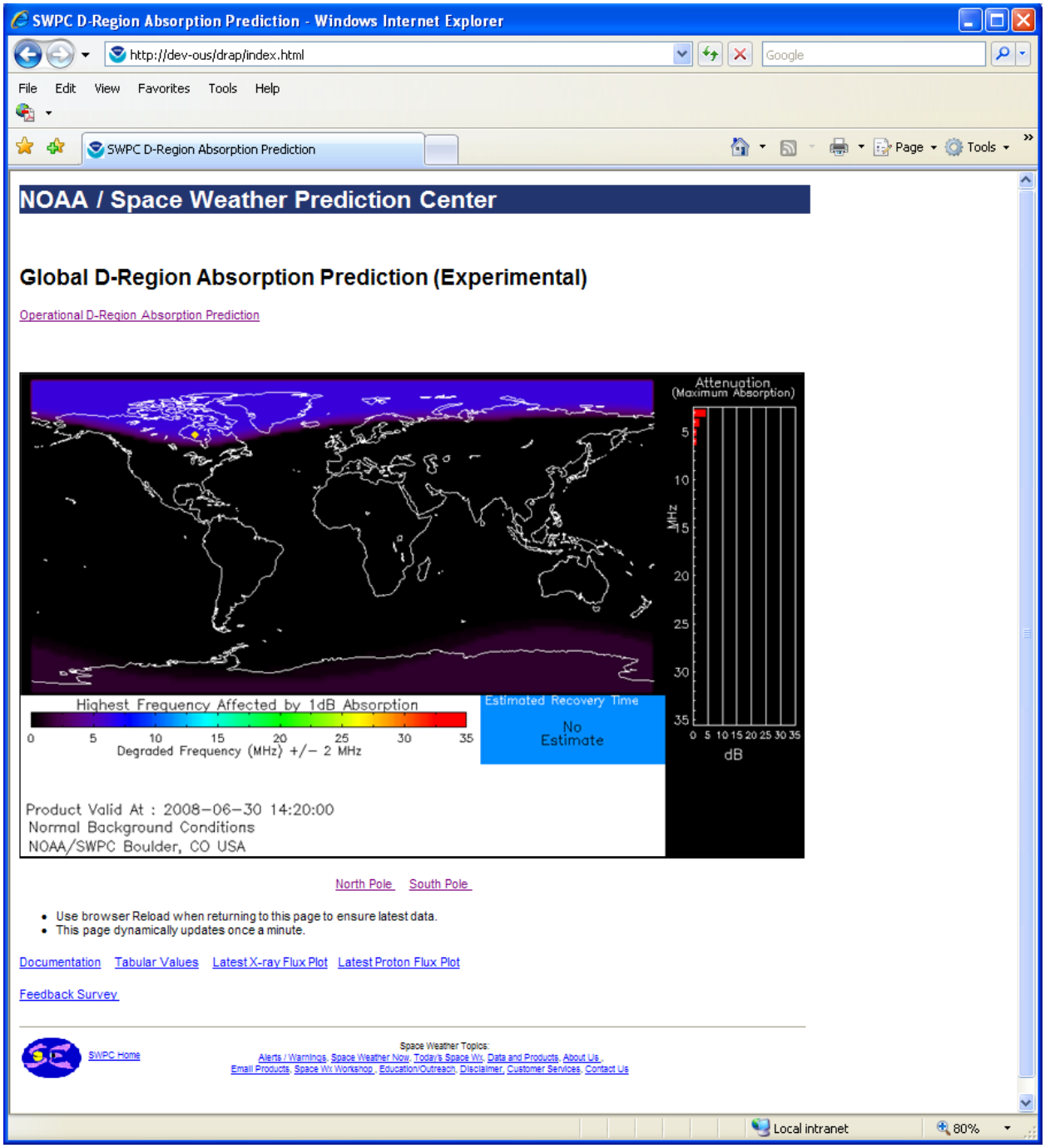
Mr. Joe Kunches
Space Weather Prediction Center
325 Broadway W/NP9
Boulder, CO 80305
USA
303-497-5275
Joseph.Kunches@noaa.gov

The dates of the comment period shall be from 1 July 2008 to 30 June 2009. Note that the comment period is the maximum length. This is due to the fact that the sun is near the minimum of its 11-year activity cycle and X-ray and proton events leading to HF degradation are relatively rare at this time.

Part II – Technical Description

a. Format and Science Basis

The D-region of the ionosphere is critically important to the propagation of HF radio signals. The lowest available frequency for HF users is directly related to the electron density in the D-region. Due to space weather effects, the electron density can vary dramatically over time scales as short as a few minutes. The D-RAP2 model uses empirically determined relationships to compute HF absorption and the highest affected frequencies, directly from space weather input parameters. D-RAP2 results are presented to users as a suite of graphical and text displays via the internet (http://www.swpc.noaa.gov/drap). The results are viewable in any standard web browser for the broadest possible accessibility. The graphical and text formats allow for quick user assessment of HF absorption conditions.


SWPC D-Region Absorption Prediction - Windows Internet Explorer
http://dev-ous/drap/index.html
File Edit View Favorites Tools Help
SWPC D-Region Absorption Prediction
NOAA / Space Weather Prediction Center
Global D-Region Absorption Prediction (Experimental)
Operational D-Region Absorption Prediction
Attenuation
(Maximum Absorption)
MHz
dB
Highest Frequency Affected by 1dB Absorption
Degraded Frequency (MHz) +/- 2 MHz
Estimated Recovery Time
No Estimate
Product Valid At : 2008-06-30 14:20:00
Normal Background Conditions
NOAA/SWPC Boulder, CO USA
North Pole
South Pole
Use browser Reload when returning to this page to ensure latest data.
This page dynamically updates once a minute.
Documentation
Tabular Values
Latest X-ray Flux Plot
Latest Proton Flux Plot
Feedback Survey
SWPC Home
Space Weather Topics:
Alerts / Warnings, Space Weather Now, Today's Space Wx, Data and Products, About Us,
Email Products, Space Wx Workshop, Education/Outreach, Disclaimer, Customer Services, Contact Us
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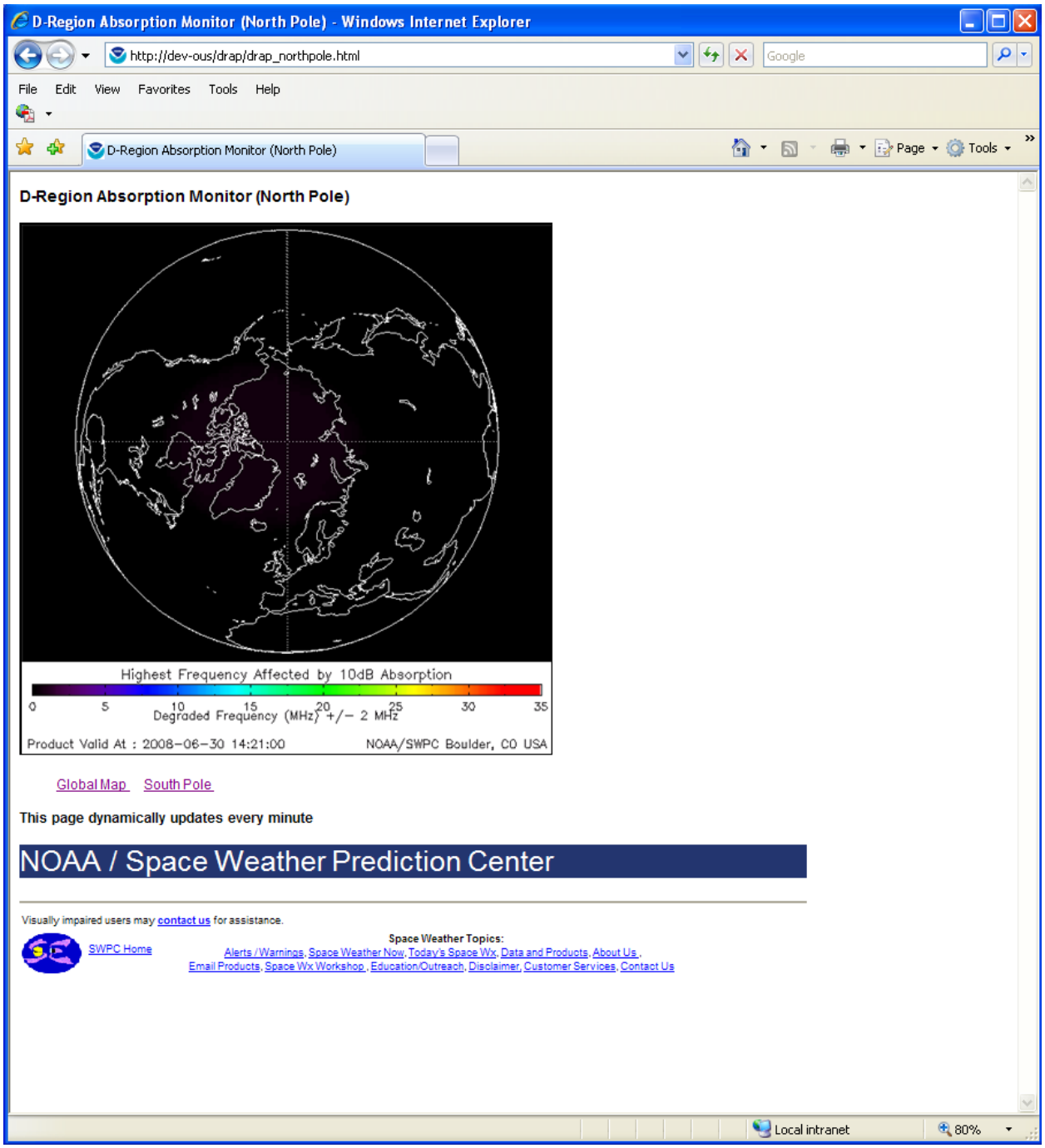

b. Availability

The D-RAP2 product will be updated once a minute, which is the cadence of the most frequently available input to the model.

c. Additional information – Include any other pertinent technical detail, such as:

(1) The product was created by a team at NOAA's Space Weather Prediction Center. The project scientist is:

Dr. Mihail Codrescu
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325 Broadway W/NP9
Boulder, CO 80305
USA
303-497-6763
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(2) Near real-time inputs to D-RAPs are derived from GOES satellite instruments and ground-based magnetometers:

- GOES XRS long wave channel 1-minute average data
- GOES EPS integral proton flux 5-minute average data (new for D-RAP2)
- The planetary geomagnetic activity index Kp 15-minute data (new for D-RAP2)

Additional static or slowly changing model inputs include:

- L-values derived from the IGRF main field geomagnetic model updated monthly (not updated during comment period) (new for D-RAP2)

(3) A standard web browser and Internet connectivity are needed to view D-RAP2 displays.

(4) References:

Davies, K., *Ionospheric Radio*. Peregrinus Ltd., London, UK. 1990.

Fuller-Rowell, T., *D Region Absorption Prediction Documentation*, (online at: http://www.swpc.noaa.gov/dregion/dregionDoc.html)

Sauer, H. H. and D. C. Wilkinson, *Modeling Ionospheric HF/VHF Radio-Wave Absorption due to Solar energetic Proton Events*, Space Weather…in publication, 2008.

Stills, M., B. Jones, J. Kunches, *CPTEWG Space Weather Sub-Group: defining Aviation Industry User Requirements*, Cross Plar TransEast ATM Providers' Working Group, AA System Operations Control Centre, Dallas, Texas, April 1-3, 2008

Stonehocker, G.H., *Advanced Telecommunication Forecasting Technique*, in Ionospheric Forecasting, AGARD CONF. Proc. No. 49, Advisory Group for Aerospace Research and Development, NATO; Agy, V. (Ed), p27-1, 1970.

Space Environmental Forecaster Operations Manual, page 4.3.1, 55th Space Weather Squadron, Falcon AFB, USAF, 21 October 1997.