Objective

The study of over the horizon HF radio communications is fascinating. It is also a lot of fun as we know from DXing, contesting, and general rag-chewing. However, at times HF communications becomes serious work. There are still parts of the United States and Canada, as well as other parts of the world, where HF radio is the only available form of long-distance communications. This is particularly true in remote and mountainous regions. In his excellent book “Propagation and Radio Science” Eric Nichols (KL7AJ) describes the difficulties of communicating in the vast interior of Alaska where people are widely scatter over long distances. HF communications, of course, becomes critical during natural disasters when the infrastructure we depend on is destroyed. The ability to quickly get an antenna up and begin operating using portable electrical power becomes essential. We practice the ability to do this every year during the June field day event. The problems appear to becoming worse. Severe weather, particularly hurricanes, tornadoes, torrential rain and snow, seem to be occurring more frequently and becoming more violent. Add to that ravaging wild fires burning over thousands of acres destroying everything in their path. In California we have the everpresent danger of large earthquakes. Following an earthquake, it is a very hollow feeling knowing that you cannot contact your family in other parts of the country to let them know that you are ok because all telephone, cell phone and internet service is out.

As amateur radio operators we have successfully dealt with less than ideal situations from the very beginning of amateur radio when we were exiled to the “worthless” frequency bands of 200 meters and down, today known as 160 thru 10 meters. Yet we became very successful at relaying messages across country and in the process discovered the exciting world of long distance short wave radio. During WWII, radio propagation conditions deteriorated throughout the war with solar cycle minimum occurring in 1944. Poor propagation conditions persisted through the last year of the war. Despite deteriorating conditions, radio operators learned how to deal with the situation and got their radio traffic through. They had to! At the time HF radio was the only means of long-distance communications between land-based stations (all telephone and telegraph lines in the war zone had been cut) as well as with ships at sea and aircraft.

Being really good at what we do depends in part on having a solid understanding of skywave communications. Not only is such knowledge critical during natural disasters, it also makes the fun

parts of our hobby (contesting, DXing, etc.) more interesting and successful. Understanding what is happening as our radio waves travel through the ionosphere from here to there is exhilarating.

At the core of the website is an in-depth book covering HF radio communications. The book is easy to read, understand, and apply to every day radio communications work. The sections of the book include:

- **Introduction**: Focusing on the early days of radio and the people who made it happen,

- **The Sun**: The Sun is the energy source that makes long distance HF radio communications possible. However, violent activity on the Sun can at times severely disrupt radio operations. Understanding the structure of the Sun and solar dynamics is important.

- **Solar-Terrestrial Interaction**: We are protected from the ravages of the solar winds by Earth's Magnetosphere, making possible life on Earth as we know it. The interaction between the solar winds and the magnetosphere produces geomagnetic and ionospheric storms that directly affect HF communications.

- **Earth's ionosphere**: The formation, structure, and dynamics of Earth's ionosphere explains the diurnal, seasonal, and long-term variations in HF communications.

- **Radio Wave Propagation**: The characteristics of radio wave propagation explains how radio waves travel through the ionosphere.

- **HF Radio Communications**: Finally, the chapters in this section cover the details of skywave communications including: the ionosphere's critical frequency, maximum usable frequency, skip distance, propagation modes, noise and signal fading, low and high latitude communication problems, and ionospheric storms.

The book also includes an appendix on the "Nature of Light". Light and radio waves are the same thing differing only in wavelength. A detailed study of light provides valuable insight into HF radio communications, including refraction of radio waves in the ionosphere. The "Related Topics" section of the book is just that, a series of articles covering some of the history and science underlying HF radio communications.

Supplementing the book are PowerPoint presentations which taken together constitutes a lecture series on HF Radio Communications. These are available under the website's "Presentation" tab.

Knowing the current solar and ionospheric weather conditions is important for daily radio operations, particularly during emergencies. The website's "Current Conditions" tab provides access to all of the solar and ionospheric weather information that affect HF communications including:

- Solar Activity,
- Critical Frequency,
- X-ray Flux,
- D-Layer Absorption
- Kp Index,
- Proton Flux,
- Dst Index,
- Current solar wind conditions
- Aurora forecast, and
- Solar Cycle Progression

The impact of these various parameters and indices on radio operations are described in the book and also in the PowerPoint presentations. Linking the book and presentations directly to current conditions allows you to actually see and experience what the book is talking about. This is dramatically illustrated by the intense ionospheric storm that occurred in May 2024 (see the article "Severe May 2024 Geomagnetic and Ionospheric Storms" found under the "Short Articles" tab).

An extensive set of tools useful in planning and executing radio operations are founded under the "Tools" tab. These tools include Maximum Usable Frequency charts, HAP charts, Hop Distance and Skip Distance charts, a sunrise/sunset calculator, a solar position calculator, LAT/LONG calculator and other HF communication tools. The tools are accompanied by brief explanations of how to use them with more extensive details provided in the book and presentations.

Under the "Short Articles" tab there are various interesting articles on radio communications, some of which are difficult to find. One of the articles is an excellent paper written by the Australian Government Bureau of Meteorology titled "Introduction to HF Radio Propagation". The paper is on the order of 10 pages or so.

The book "Propagation and Radio Science" written by Eric P. Nichols (KL7AJ) is an excellent introduction to HF propagation. In his book, Nichols provides an abundance of very useful HF operational information.

Leo F. McNamara's book "The Ionosphere: Communications, Surveillance, and Direction Finding" is an easily read summary of Kenneth Davies very technical book "Ionospheric Radio".

Clinton B. DeSoto's book "200 Meters & Down" provides an interesting account of amateur radio's early days.

It is hoped that you find this information and the website itself interesting, informative, and above all useful.

73,

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