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 completely 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 brought on by atmospheric rivers, 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. Of course, in California we have the everpresent danger of large earthquakes. Following an earthquake, it is a very hollow feeling knowing that you can not 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. 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 ionospheric 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 and marveling at what is happening as our radio waves travel through the ionosphere from here to there is exhilarating.

There are a number of outstanding graduate level text books on HF radio communications, Kenneth Davies book “Ionospheric Radio” being one of the best. These books, however, are not light reading.

The objective of this website is to provide an in-depth book on HF radio communications that is easy to read, understand, and apply to every day radio communications work. Supplementing the book, the website provides access to solar, space weather, and ionospheric current conditions that hopefully make the book come alive. You can actually see and experience what the book is talking about. In addition, the website includes interesting short articles, some of which are difficult to find, as well as including useful communication tools, slide presentations and videos.

The book is divided into 5 sections.

The first section “Early Days of Radio” begins with the discovery and early understanding of electricity, development of the telegraph, evolution of the telegraph into the spark-gap wireless, and finally development of the radio, ushering in the electronic age. The section examines some of the radio equipment, antennas, and politics that drove early radio communications leading to short wave radio, discovery of the ionosphere, and an understanding of HF radio propagation.

The second section covers the Sun including the structure of the Sun, the solar cycle, the violent active Sun, and the solar wind all of which are not only responsible for creating Earth’s ionosphere, but severely disrupting it as well. It is the Sun that drives the ionosphere and our ability to communicate through it.

Section 3 covers “Solar Terrestrial Interaction”, including the disruptions in Earth’s magnetic field and atmosphere caused by the Sun’s electromagnetic radiation, high energy particles, and solar wind. It is important to note that Earth’s magnetic field makes life on Earth possible. Without our magnetic field Earth would become a barren desolate planet as happened long ago to Mars when Mars lost its magnetic field. This section also discusses geomagnetic storms which have the potential for producing hundreds of billions of dollars in damage to our technological infrastructure. It is this serious threat that has led to Space Weather becoming a new field of study and fleets of spacecraft being deployed to study and monitor the Sun’s activity.

The fourth section covers Earth’s ionosphere including Earth’s atmosphere, development and characteristics of the ionosphere, the very interesting equatorial ionosphere, and the violent polar region ionosphere. It is the ionosphere that makes possible HF over the horizon radio communications. The constantly changing ionosphere directly affects how successful HF skywave communications is.

Section 5 “HF Radio Communications” focuses on radio wave propagation through the ionosphere, critical frequency, D-layer absorption, maximum usable frequency, frequency of optimum transmission, skip distance, HAP charts, maximum usable angle, propagation modes, and communication problems including fading and ionospheric storms.

The book also includes an extensive 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 last part of the book is titled “Related Topics”. It is just that, a series of articles covering some of the history and science underlying HF radio communications.

The “Presentation” tab of the website provides PowerPoint presentations on selected chapters of the book, including several presentations on antennas.

The “Tools” tab includes HAP charts, skip distance charts, a sunrise/sunset calculator, a solar position calculator, and other tools helpful in selecting suitable frequencies and operating modes.

Finally, the “Current Conditions” tab provides access to all of the current space weather conditions which affect HF communications including critical frequency, x-ray flux, D-Level absorption, Kp index, etc.

The book outlined above is quite large. The main body of the book, plus the appendix, plus the related topics is over a thousand pages.

Under the “Short Articles” tab there 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 web site itself interesting, informative, and above all useful.

73,

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