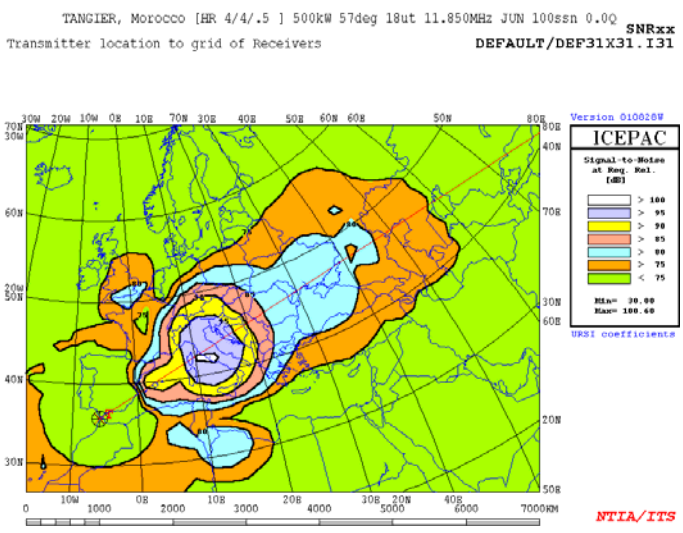
Propagation Models

Institute for Telecommunication Sciences (ITS)

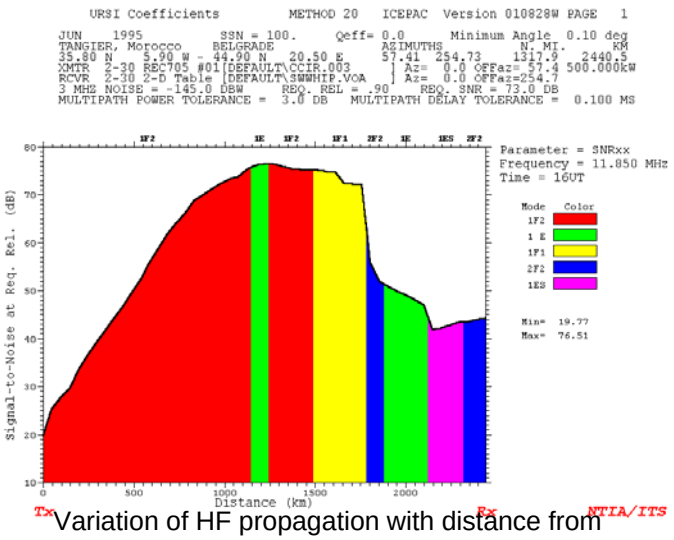
- HF Propagation software provides implementations of ICEPAC, VOACAP, and REC533 models
- Area coverage, point-to-point, and signal-to-interference calculations.
- Windows (95, 98, NT, 2000, XP) compatible program with GUI interface.
- Available free via the internet at http://elbert.its.bldrdoc.gov/hf.html

HF – NTIA/ITS offers HF Propagation software: ICEPAC and VOACAP (direct descendants of the Ionospheric Communications Analysis and Prediction Program - IONCAP - 1983). VOACAP was modified by the Voice of America (VOA) to meet the needs of the HF broadcaster community. ICEPAC (Ionospheric Communications Enhanced Profile Analysis and Circuit prediction program) was developed by adding the Ionospheric Conductivity and Electron Density (ICED) profile model to IONCAP. ICED is a statistical model of the large-scale features of the northern hemispheric ionosphere and contains distinct algorithms for the sub-auroral trough, auroral zone, and polar cap. NTIA/ITS also offers a software implementation of the International Telecommunication Union's (ITU) Recommendation ITU-R P.533 (REC533). This software was developed specifically for the planning of the HF bands allocated to the broadcasting service (Geneva 1987, WARC HFBC-87).



Sample screen from the ICEPAC HF Propagation program.

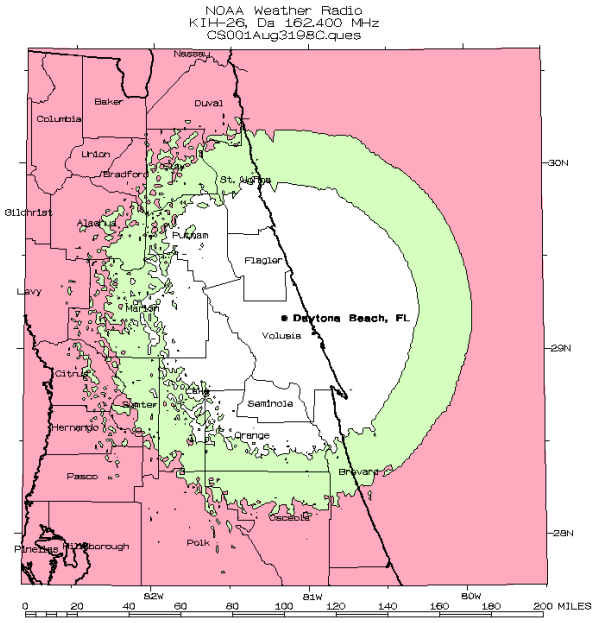
The software allows a user to display and print color or black-and-white plots of any output parameter from any of the propagation models. Additionally, a powerful combine function allows area coverage maps to be mathematically combined to produce maps that represent the worst or best case scenarios for many combinations of Month/SSN/Frequencies/Hours/Transmitters.



Variation of HF propagation with distance from transmitter.

VHF-UHF – NTIA/ITS offers VHF-UHF Propagation software: ITM and IF-77 (developed at ITS in 1960's-1980's to predict the propagation of radio waves in the VHF and UHF bands). ITM (the Irregular Terrain Model or Longley-Rice Model) is intended for tropospheric circuits with both terminals below 2 km height above ground in the frequency range 20-20,000 MHz and distances ranging from 1-2,000 km. IF-77 (or the Gierhart-Johnson Model) is intended for circuits with at least one terminal at a greater elevation above ground in the frequency range 100-20,000 MHz.

ITM has both area (i.e., path-general) and point-to-point (i.e., path-specific) modes. In the point-to-point mode, the user must provide details of the terrain profile along the circuit that are estimated using empirical medians in the area mode. In either mode, the reference attenuation relative to free space is computed based on path distance and either the line-of-sight range, the diffraction range, or the troposcatter range. General inputs for both modes are the distance between the two terminals, the antennas' structural heights above ground, the wave number, the terrain irregularity parameter, the minimum monthly mean surface refractivity, the effective earth's curvature, the surface transfer impedance of the ground and the radio climate. For the area mode, the only additional input is the siting criteria at the location of each terminal. For the point-to-point mode, the additional inputs are the effective antenna heights above the effective reflecting plane, the distances from each terminal to its radio horizon and the elevation angles of these horizons at the height of each antenna. Outputs include the reference attenuation relative to free space and values of that attenuation for time, location and situation variabilities. These variabilities are applied in several different combinations to obtain confidence and reliability according to the type of application (i.e., single message, individual, mobile or broadcast).



Example of TA Services output using ITM to calculate radio propagation coverage.

IF-77 is applicable to many air-air, air-ground, air-satellite and ground-satellite circuits. Irregular terrain and propagation beyond the line-of-sight range are included in the model. The terrain feature (single knife edge) is keyed to the lower terminal and the radio horizon for the upper terminal is taken as either the terminal horizon obstacle or the smooth earth radio horizon when the horizon obstacle is negated by the earth's bulge. In addition, the model accounts for average raybending, long-term power fading, surface reflections inclusive of a divergence factor, troposcatter, atmospheric absorption, ionospheric scintillation, rain attenuation and sea state. Outputs include transmission loss, available power, power density, and desired-to-undesired signal ratio. Only time variability is considered in this model.

General Information – The source codes (or Windows® executables) and examples are available on the NTIA/ITS website, http://www.its.bldrdoc.gov. Users requiring terrain data will find instructions on the NTIA/ITS website for obtaining the GLOBE 1.0 (30" resolution terrain database) online from the National Geophysical Data Center (NGDC).

Contact: Paul McKenna
303-497-3474
pmckenna@its.bldrdoc.gov

Institute for Telecommunication Sciences
325 Broadway, Boulder, Colorado 80305
http://www.its.bldrdoc.gov, **303-497-5216**

The Institute for Telecommunication Sciences (ITS), located in Boulder, Colorado, is the research and engineering arm of the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce. ITS receives direct support from the Department of Commerce and is sponsored by other government agencies and U.S. industry. ITS performs telecommunications research and provides technical engineering support on a reimbursable basis. ITS also has cooperative research agreements with private companies.

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