White Paper

MW GROUNDWAVE MODELLING FOR MARITIME NETWORKS

September. 2021

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ATDI
ADVANCED SPECTRUM SOFTWARE

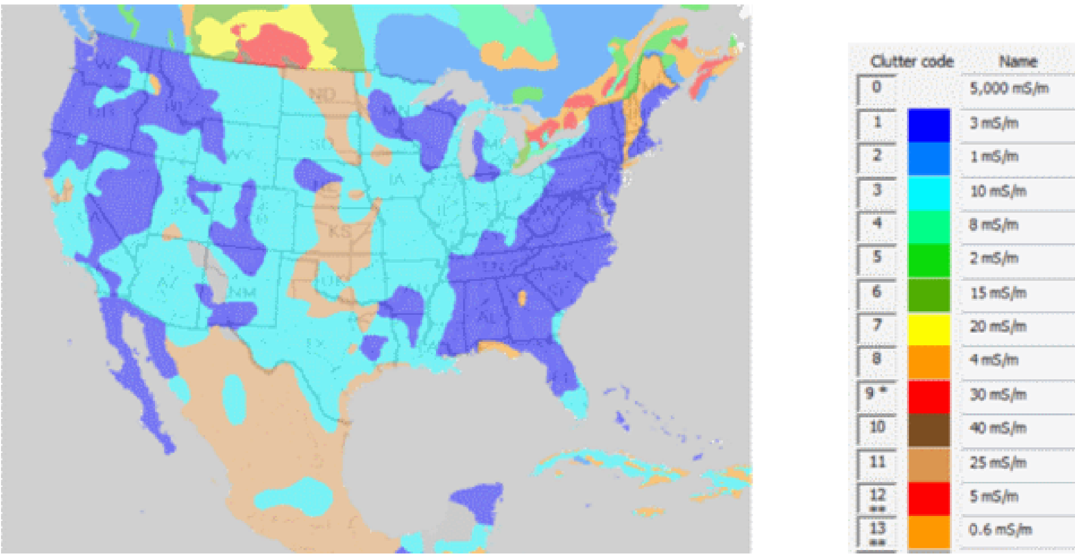
MW GROUNDWAVE MODELLING FOR MARITIME NETWORKS

This white paper introduces MF band propagation modelling (3 kHz – 30 MHz) for maritime networks using HTZ. For nearly three decades, ATDI has been at the forefront of software development for modelling anomalous radio wave propagation for the purposes of RF network design. This paper covers propagation phenomena such as ducting, troposcatter and their applications over terrain and water.

Over the past decade, ATDI has researched how to model the propagation characteristics of frequencies below the VHF band. Many applications use these frequencies including:

- Aeronautical navigational aids;
- Automatic link establishment for intelligence gathering; and
- Emergency communications for maritime networks.

ATDI has developed several features in HTZ for modelling various propagation issues below-VHF band for these applications. This document highlights how HTZ models maritime communications by focusing on modelling MF groundwave propagation from ship to shore along coastlines. Additionally, this paper will look at developments in the areas of cartographic map data preparation, integration of propagation standards and calibration information and custom reporting options in HTZ for modelling maritime networks.



Conductivity map of the United States from ITU IDWM sources

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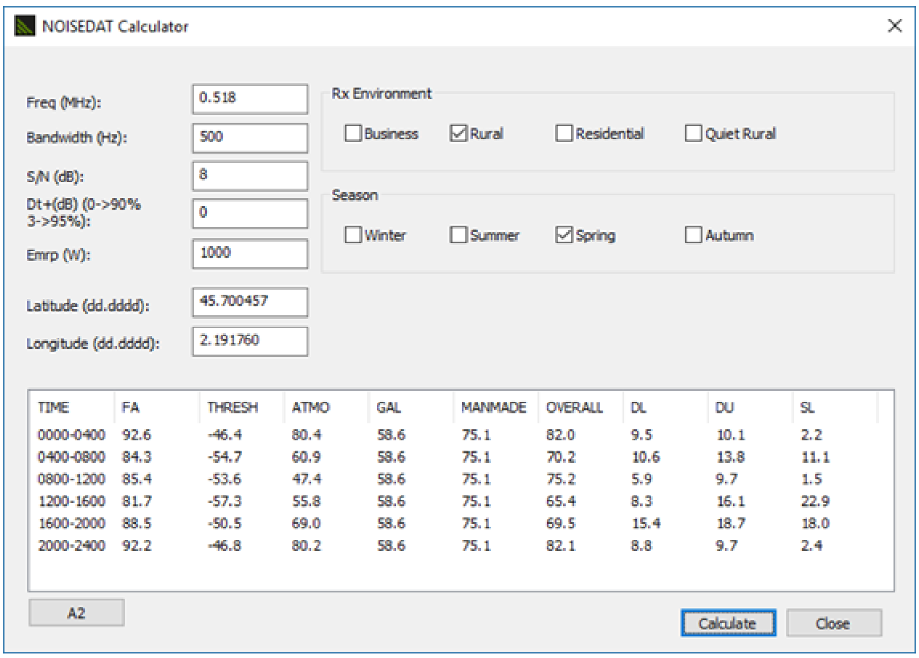
Preparation of a Conductivity/Permittivity Map from the ITU IDWM database

For MF propagation, terrain obstruction information provided by DTM is becoming less relevant. More significant are the electromagnetic properties of the terrain - in particular, the conductivity and permittivity of the ground.

This type of map is usually available from the national spectrum regulator. The "IDWM to Raster" feature of HTZ can convert these maps from IDWM sources into HTZ format. ATDI offers cartography services that convert map data for any country in the world using specific sources or the ITU Digital World Map (IDWM) database for conductivity and permittivity data. NB. this is the same source as for the conductivity map in the FCC 47 CFR 73.190.

This map data is supplied in HTZ's classic clutter layer format. Since clutter data servers as an overlay on the terrain model it can offer user-defined propagation characteristics (such as clutter class/code). This layer is well suited to use as a conductivity map layer.
The units of each region of conductivity are in milli-Siemens/meter (mS/m). The layers can be configured as labels of each clutter class/code to give the map distinction in the HTZ interface.
To properly model the radio wave propagation in MF signals, ATDI integrated the latest ITU recommendations into HTZ. Regulations ITU-R P.368-9 and ITU-R M.1467-1 are used to generate the field strength received predictions for each pixel on the map is based on the integration of the former model into HTZ's propagation engine.
The ITU-R P.368-9 model depends on the input of conductivity and permittivity data which is provided by the ITU maps outlined above. These values provide the ITU-R P.368 Groundwave model with the appropriate attenuation information to model MF propagation over land and sea, enabling HTZ to generate MF Groundwave coverage plots.

To ensure that the receive sensitivity of each radio network element is configured appropriately, (in respect to environmental conditions and time of year), HTZ has also integrated a NOISDAT calculator derived from ITU-R M.1467-1.



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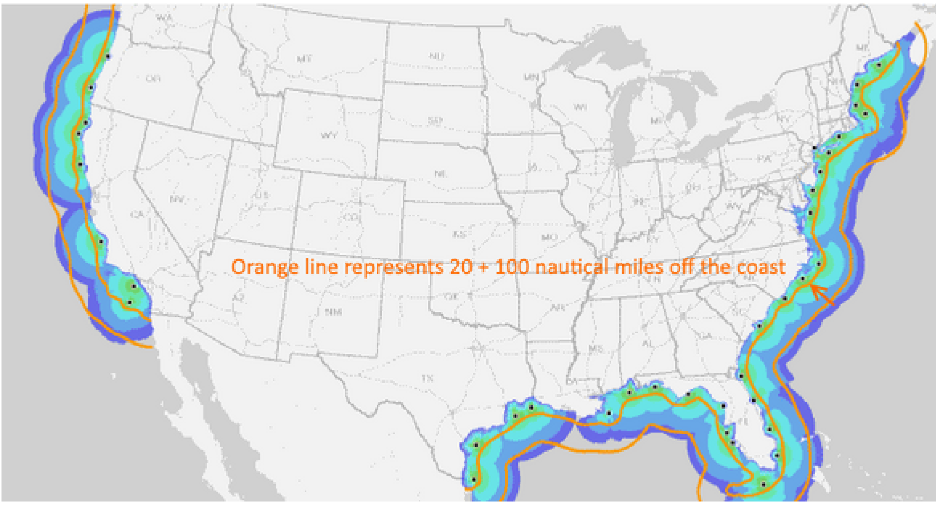
The NOISEDAT Calculator considers the operating frequency, bandwidth, signal-to-noise ratio, 90% fade margin and estimated radiated power. It also respects the receiver environment and variations in weather by season, to model the variability in Noise contribution to radio propagation in the MF band.

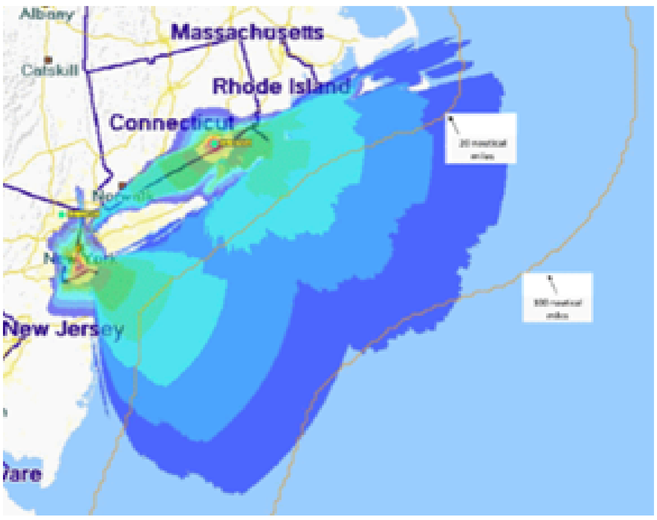
Essentially, the NOISEDAT calculator serves as a reference to model the expected noise rise and respective threshold degradation at a given site of interest.

HTZ also takes into account the A2 sea region to generate an output based on ITU-R M.1467-1 NOISEDAT calculation to give the predicted receive sensitivity in dBm and dB-V/m, as well as the range in nautical miles and kilometres. This information is used to calibrate HTZ’s propagation engine appropriately for the ship to shore (or reverse coverage) calculations.



Reporting options specific to modeling Maritime Networks

HTZ features a reporting function specific to modelling maritime communications, including the ability to generate nautical mile boundaries from the coastline or from the locations of the shore stations:



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Solutions

ATDI continues to refine its modelling processes for MF groundwave propagation in response to developing requirements from the spectrum authorities for coast guards and naval agencies all over the world.

ATDI has a long association with ITU and integrates ITU recommendations into its product line. The result is a leading organisation able to translate complex propagation phenomena into simple, intuitive graphics that can be understood by policymakers and stakeholders who use and manage a country's spectrum resources.