World Atlas of Ground Conductivity

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TO DO: WWV & References

Importance

It is important to know the conductivity (and permittivity!) of the soil around your HF station for two good reasons:

1. It allows to model power loss to the ground in the near-field of HF antennas —both vertical and horizontal—,
2. It allows to accurately calculate radiation patterns of HF antennas, taking into account ground reflections.

Measurement

In literature, a number of ways to measure ground conductivity and permittivity have been described. Most notably, Rudy Severns, N6LF wrote two excellent papers on the subject.

Nonetheless, it is not particularly inciting having to construct a measuring apparatus just for using it once or twice. Moreover, the area of land that most influences the radiation pattern is at about 10λ away from your antenna, and is therefore often not accessible for measurements. I am by no means discouraging ground conductivity measurements. However, in practice, most people —including myself— prefer spending time differently.

Ground conductivity atlas

Quite a while ago, the CCIR (now ITU-R) published Recommendation 832, containing a detailed world atlas of ground conductivities. The maps are for VLF and MF frequencies, though the MF maps still remain useful for the lower HF frequencies. One can easily be misled by the bookmarks in this PDF document. Be sure to scroll down at least to Figure 7 in this atlas to get to the MF maps; preceeding maps are for VLF! An example MF conductivity map of my home country Belgium is shown below.

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ground-conductivity-atlas.vlf&mf.pdf [3.9MB]

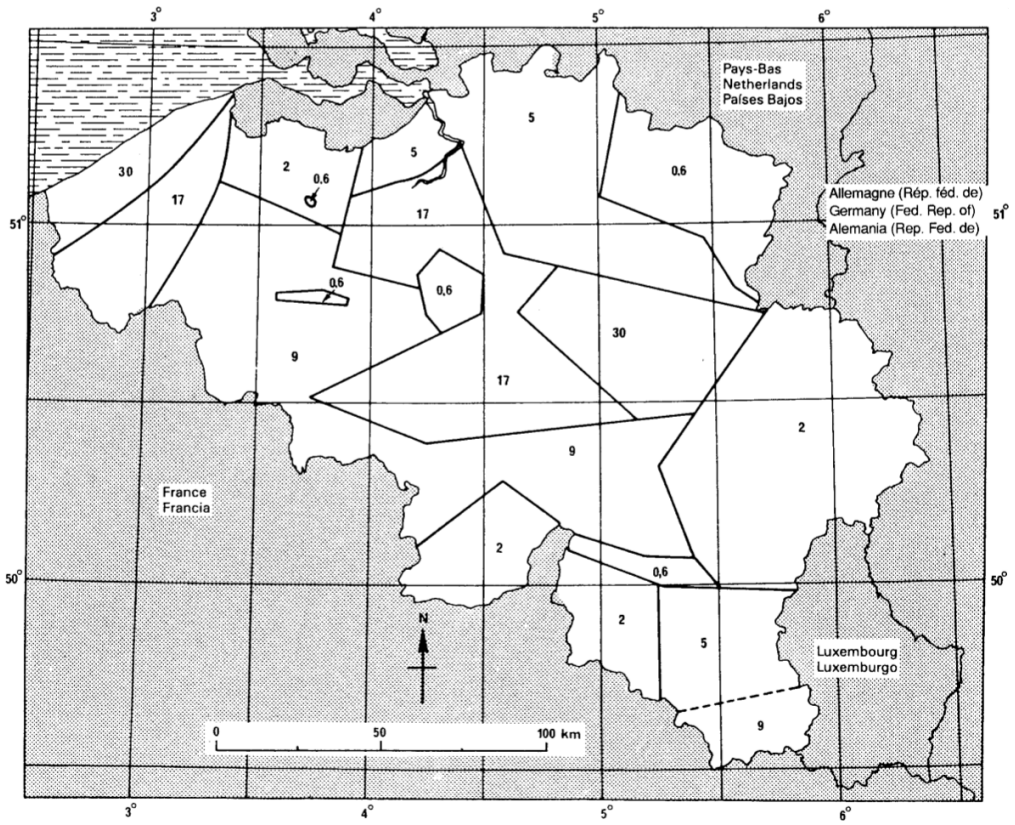

Figure 1: Belgian MF ground conductivity map in mS/m, standardised at 1MHz. *Source:* CCIR Rec. 832

Ground types

Table 1: Ground types as used by L. B. Cebik, W4RNL

soil description	ground quality	σ (S/m)	ε_r
cities, industrial areas	very poor	0.001	5
sandy, dry, flat, coastal	poor	0.002	10
rocky soil, steep hills, typically mountainous	poor	0.002	13
pastoral, medium hills, forestation, heavy clay soils	good/average	0.005	13
pastoral, low hills, rich soil	very good	0.0303	20
salt water	excellent	5.0	81

Table 2: Ground types as defined in 4nec2

soil description	σ (S/m)	ε_r
polar ice cap	0.0001	1
city industrial area	0.0001	3
polar ice	0.0003	3
city industrial; maximum attenuation	0.0004	3
arctic land	0.0005	3
sea ice	0.001	4
poor	0.001	5
city industrial; average attenuation	0.001	5
dry, sandy, coastal	0.001	10
fresh water	0.001	80
fresh water 10°C; @100 MHz	0.001	84
mountainous hills < 1000 m	0.002	5
fertile land	0.002	10
rocky, steep hills	0.002	15
moderate	0.003	4
medium hills and forest	0.004	13
average	0.005	13
highly moist ground	0.005	30
fresh water 20°C; @100 MHz	0.005	80
pastoral hills, rich soil	0.007	17
marshly land, densily wooded	0.0075	12
marshly, forested, flat	0.008	12
good	0.010	4
rich agric land, low hills	0.010	15
sea water 20°C; < 1 GHz	4.0	73
sea water 10°C; < 1 GHz	4.0	80
sea water	5.0	81

WWV

In the United States, call signs generally start with the letter "K" for stations located west of the Mississippi River, whereas stations east of the Mississippi generally have a call sign starting with the letter "W".[@Wikipedia.Call_sign]

References

1. http://www.antennasbyn6lf.com/measurement_of_soil_characteristics/
2. https://en.wikipedia.org/wiki/Near_and_far_field
3. https://en.wikipedia.org/wiki/Call_sign
4. http://tf.nist.gov/general/pdf/1434.pdf

This work is published at https://hamwaves.com/ground/en/.

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