Radiocommunication Study Groups

Received: xx June 2013

Subject: Questions ITU-R 202-3/3, ITU-R 225-5/3

ITU-R P.832-3 - WORLD ATLAS OF GROUND CONDUCTIVITIES

Document – XX / XX
XX June 2013
English only

Brazil (Federative Republic of)

IMPROVEMENTS TO BRAZILIAN GROUND CONDUCTIVITIES MAP

1 Introduction

Knowledge of soil characteristics in particular its electrical conductivity is essential to perform the propagation coverage prediction for telecommunication systems in VLF, MF and HF frequency bands.

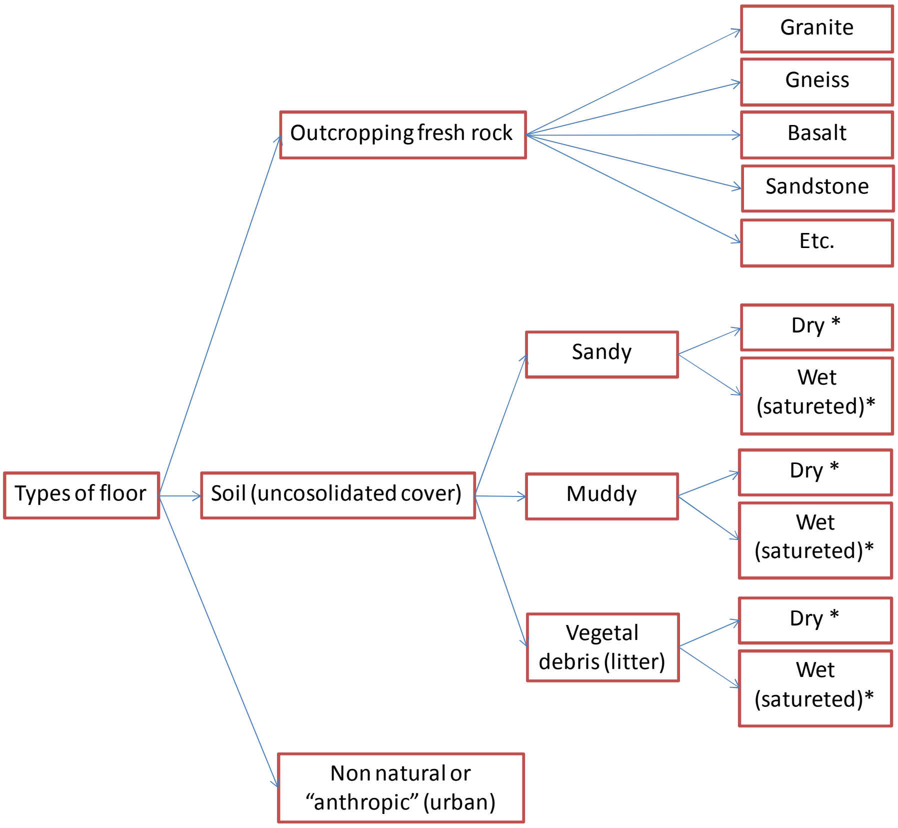
Existing conductivity maps, in some cases, have poor information about the land, which impairs the predictions of ground wave propagation.

2 Variations on soil electrical conductivities

Different natural settings affect ground electrical conductivity on terrain shallow section. The depth of penetration to where sub aerial electromagnetic propagation becomes critical depends upon the wavelength considered. In the case of medium waves (MW), for example, where wavelengths are in the order of magnitude of a few hundred meters (say 300 m), besides the soil layers itself some unaltered rock below and maybe some vegetated layer above may also affect the final “equivalent medium” conductivity, thus a rather “multi-layer” model applies. The vegetated superficial layer, actually comprising trees and vegetation as a whole, may be particularly important in areas such as Amazon Rainforest, where it can reach as much as 30 meters thick.

A simple scheme as the one below may be thought that comprises the main types of superficial covers that may have distinctive response in terms of electrical conductivity. For each one of the main classes (that’s is, massive or solid outcropping “fresh” rocks, soils and anthropic/non-natural floors) several factors may imply different conductivities, such as: humidity/ degree of water saturation (seasonably variable), texture, salinity of interstitial water, mineralogy (of solid particles, in the case of soils and of crystals and matrix in the case of rocks), height and density of live vegetation and thickness of leaves and other plants’ debris (“litter”). There is a diagram that illustrates these features in Figure 1.

Figure 1: Soil types.



* Seasonably variable.

3 Soil classification

EMBRAPA has put together a soil classification system for Brazil that comprises 14 different types, from which latosoils and argisoils are the most prevailing ones. The diversity of soils found in Rio de Janeiro state, where all of those classes are represented, makes it a suitable “field laboratory” for qualitative or even quantitative conductivity measurements. One exercise to be considered is to obtain significant in situ conductivity values in each one of these different soil provinces or classes in RJ state, and then use them as “calibration” values elsewhere in Brazil: assigning these values to the different soil occurrences on a 1:500.000 scale EMBRAPA’s soil map for Brazil would allow providing a conductivity map to be compared to the currently available one. Favorable aspects of obtaining those field measurements in RJ include the closeness to most of institutions and personnel involved in the Initiative, access and logistical easiness and the unique availability of a detailed 1:100.000 scale EMBRAPA’s soil map. Alternatively, conductivities could be measured in the lab from samples collected on the field, with the drawback of likely losses leading to the alteration of the in situ conditions.

4 New conductivity map

A striking feature of the currently available conductivity map of Brazil is the highly different sampling effort as comparing Southern-eastern and Northern-western regions. Ideally, the sampling grid should be more regular, and the sampling points should be oriented by the different soil classes (available on EMBRAPA soil maps) and, in the absence of unconsolidated covers, by the outcropping geological provinces or units (available on Brazilian Geological Map). Such an oriented sampling would honour the mostly expected shallow variations at an optimized, lower acquisition cost.

An issue emerges whether to consider a single measurement or a statistical average of several close measurements to compose one (x,y,z) data point to be gridded and contoured within the set of the several sampling points.

Nonetheless it's highly recommended to keep the repeatability of the several new measurements as high as possible during the whole campaign by using the same methodology, the same equipment, the same crew/ personnel and desirably conducting them during the same (either wet or dry) season of the year. By taking these guidelines, more robust and reliable results are to be obtained. Moreover, an updated Brazilian map is needed in the sense that changes such as those due to vegetation/ devegetation and urban/ anthropic interventions may have had significant impact on the previously available conductivity data through the last decades.

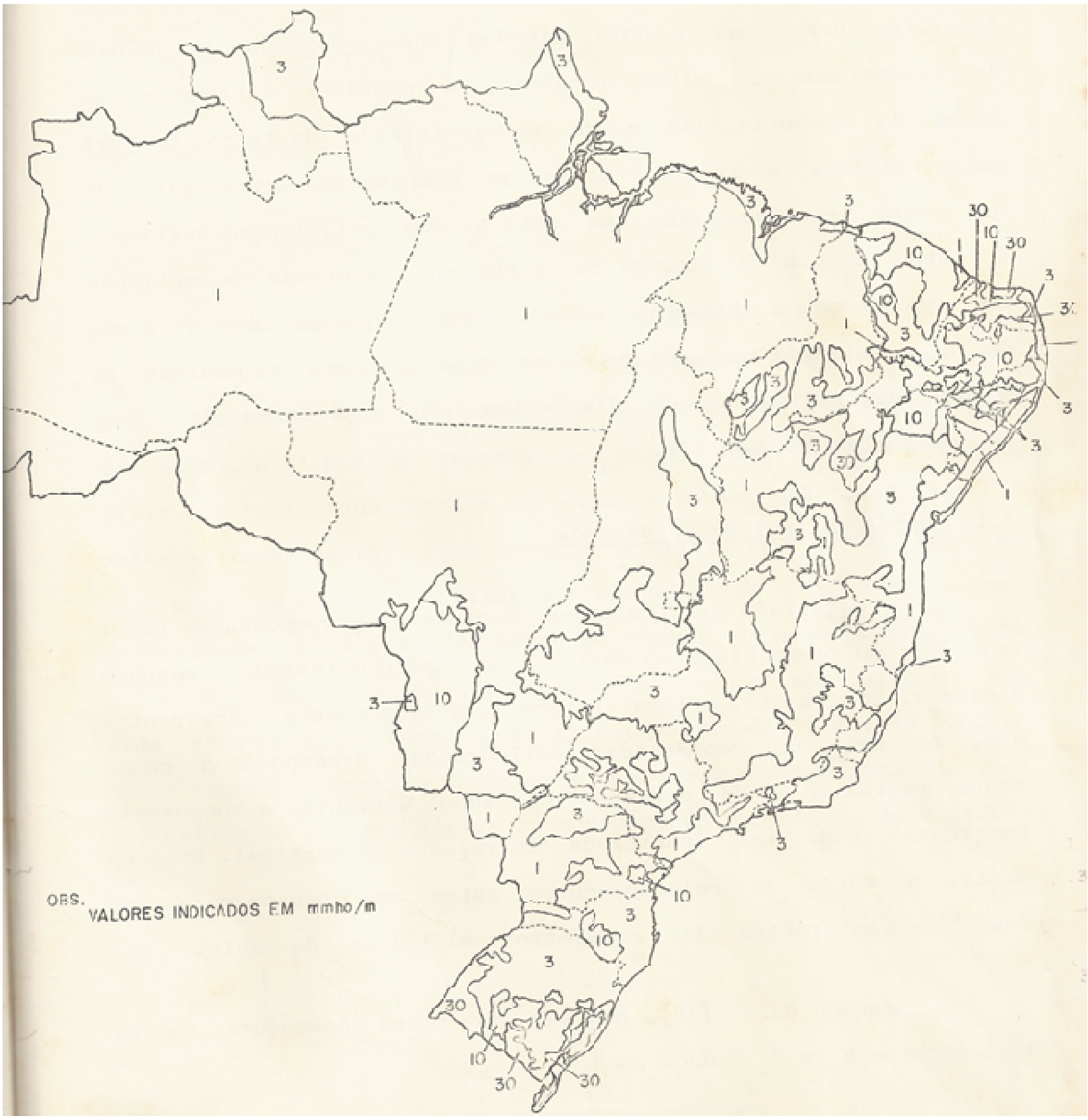
5 Contribution documents

The Iranian contribution to the last UIT meeting is based on a "logical" approach which utilizes a topographic map (moreover easy to be obtained) as a "first order approximation " or proxy to the soil development/ thickness and thus to the electrical conductivity: higher terrain gradients (slopes) are generally related to lower conductivity solid (massive) rocks, while lower and flatter slopes are generally related to thicker soil layers and thus, highly conductive materials. Apart from its practicality, this approach lacks fundamental issues: the same slope may be related to different types of soils, whose conductivities may vary to significant degree. Besides, it's rather non-dynamical in the sense wet soils may become dry soils and vice-versa depending on seasonal variations through the year (which are maybe minor in a country like Iran, but significant elsewhere, like in most of Brazil). Brazil has a large territory and a rich and diverse physical geography and geology which encompasses from older pre-cambrian rocks to younger sedimentary basins and unconsolidated covers, thus complex interactions and a relatively high degree of variation of shallow properties such as electrical conductivity are expected. This said, it could be stated that Iranian contribution wouldn't fully apply to Brazil and many countries with dissimilar natural characteristics.

6 Brazilian conductivity map

The figure 2 is a new conductivity map, proposed to be inserted in the Recommendation ITU-R P.832-3 - World atlas of ground conductivities.

Figure 2 – Brazilian conductivity map.



7 Conclusion

This document proposes a new approach to have the conductivity maps, based on geological information and measurements.

8 References

[1] Document 3J/140-E - Measurements of medium wave field strength in a dense urban area - 3 November 2010 - Brazil (Federative Republic of)

[2] Document 3L/14-E - Measurements of effective ground conductivity in Brazi - 12 June 2012 - Brazil (Federative Republic of)

[3] Document 3L/13-E - Relation between ground conductivity map and slope map - 12 June 2012 - Iran (Islamic Republic of)

[4] Recommendation ITU-R P.368-9, “Ground-wave propagation curves for frequencies between 10 kHz and 30 MHz”.

[5] Recommendation ITU-R P.832-2, “World atlas of ground conductivities”.