MAPPING AND GEOPOSITIONING METHODS IN ICE-FREE AREAS – ANTARCTICA

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Adriano Luís Schünemann[1,*], Filipe de Carvalho Victoria[1], Margeli Pereira de Albuquerque[1], Luiz Fernando Würdig Roesch[1], Antônio Batista Pereira[1]

[1]Universidade Federal do Pampa – UNIPAMPA, Campus São Gabriel, Av. Antônio Trilha, 1847, CEP 97300-000, São Gabriel, RS, Brazil

*e-mail: als@unipampa.edu.br

Abstract: *Mapping is an activity which can register the occurrence of phenomenons related to land cover. There are several methods of map registry. In Antarctic areas, the mapping gives importance to registry of the land cover of plants in ice-free areas. The maps are tools to understand the dynamics of plants in those areas. The Global Navigation Satellite System (GNSS) is an important tool to reach this objective, such as the plotting of georeference points in any place in the world including Antarctic locations. This study aims to contribute to the research of mapping in ice-free areas making a comparison with map builds for Hennequin Point and Keller Peninsula at King George Island, Antarctica. The study was carried out using GNSS L1/L2 and L1 receivers to record points in ice-free areas with plant coverage and post processing using specific software. The post processed data were exported to CAD software. With the points plotted, they were connected using polylines to draw the vegetation patches. The maps obtained were overlapped to identify the growth or retraction between the patches. The resulting maps are presented. The results show differences between the patches sampled during different polar years. Probably, these divergences are due to the different methodologies used to obtain the points in these areas. To better understand these variations, we need to produce more maps of the same place, obtained with the same methodologies or compare them using Satellite Images with high spatial resolution.*

Keywords: vegetation patches, GNSS, coordinates transpose

Introduction

Mapping is an application of the cartographic process over data collection or information to obtain a graphic presentation for several phenomenons in the landscape (IBGE, 1999). For this activity tools such Remote Sensing, Photogrammetrie, Photo Interpretation, GNSS and Geographical Information System (GIS) (Rocha, 2007), were used. A range of systems such GPS (Global Positioning System) and GLONASS (*Global'naya Navigatsionnaya Sputnikowaya Sistema*) (Leick, 2004) contributed to improve mapping in areas with difficult access. The systems permit obtaining the coordinates of the user in real time in any place in the World. The paper by Rudolph (1963) was one of the first studies that contained a schematic map of plant community (PC) distribution in the region of Halley Station, Victoria Land, Antarctica. Ochyra & Furmańczyk (1982) used the application of Remote Sensing by multispectral photography for determining the distribution of PC near the Arctowski Station, King George Island. The resulting map was not georeferenced. Pereira & Putzke (1994) used techniques of mapping to describe the floristic composition of Stinker Point, Elephant Island, Antarctica. The study was based on identification and mapping of the PC. The survey of the coastal ice-free area was undertaken by helicopter and identified the floristic composition (Pereira & Putzke, 1994). The referred mapping was carried out through empiric observation and registered in a base map of that place. The GPS facilitated the making of points in these areas, since there is no need for the surveyor to measure distances, directions and altitudes to obtain the coordinates for the points of study. This is the principle of Topographic survey (McCormac, 2007) which demands several repetitions to complete. Pereira *et al.* (2007) carried out a study using

GPS to reference the points in an aerial photographic survey to draw up a map with the distribution of the PC at King George Island, Antarctica.

Materials and Methods

Our study was conducted comparing two maps of two locations at Antarctic (Keller Peninsula – 62° 03' 00", 62° 06' 00" S and 58° 27' 00", 58° 21' 00" W; Hennequin Point – 62° 05' 00", 62° 09' 00" S and 58° 25' 00", 58° 16' 00" W) both located at King George Island. At Keller Peninsula (KP), the study was conducted during the austral summer of 2002/2003 (Pereira *et al.*, 2007) where some points were georeferenced using GPS for the aerial photographic survey. Based on the photographic survey the map with the distribution of the PC was drawn up. The second map, obtained through a survey making the contour of the PC, during the austral summer of 2009/2010 (Victoria et al, private communication), using a GPS L1 receiver able to obtain centimeter precisions while the data had to be post processed with the Astech Solutions® software. The two maps where overlapped and presented in Figure 1. At Hennequin Point (HP) the study was conducted during the austral summer of 2004/2005 (Victoria et al, unpublished) using the same GPS receiver used to obtain the last map KP. For the austral summer of 2010/2011 a GPS L1/L2 receiver to make the contour of the PC was used. The two maps were superposed and presented in the Figure 2.

Results

The results of the overlapped maps of Keller Peninsula were presented at the Figure 1. The contour of the vegetation patches, obtained at austral summer of 2002/2003 year were presented without hatch colors. The vegetation patches, obtained in austral summer of 2009/2010 year were

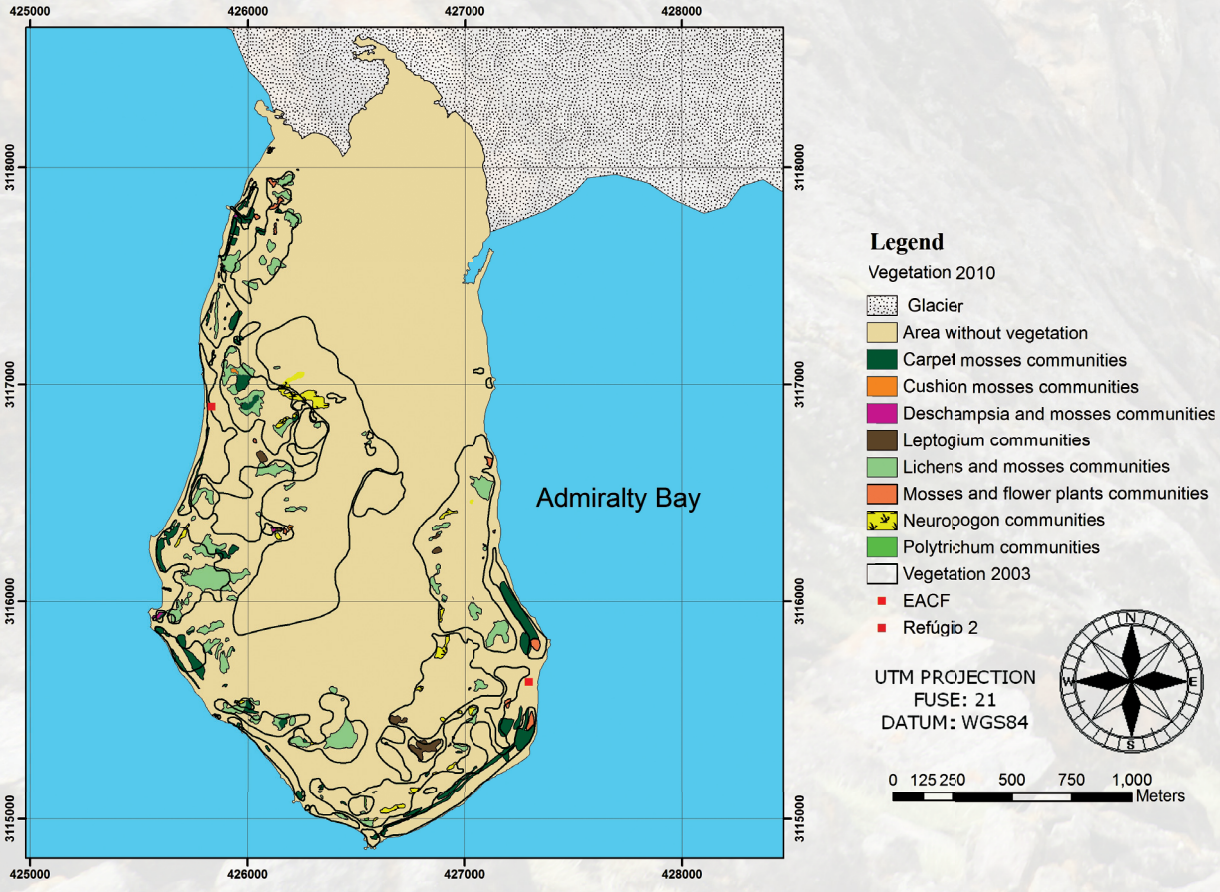

Figure 1. Overlapped maps of Keller Peninsula.

presented with different hatch colors. Each color represents a plant community as indicated in the subtitles of the Figures. The superposition of maps obtained can be undertaken through two different methods. By the differences between patch positions, patch areas and patch shapes revealed. On average the patch areas were bigger in the summer of 2002/2003 than in the summer of 2009/2010, when the patch shapes show up totally different. But we can see that on average the patches of vegetation in 2010 appear in the same place as the patches of vegetation in 2003.

The map obtained by overlaying of Hennequin Point was presented in the Figure 2. The contour of the PC patches, obtained in austral summer 2004/2005 year was presented with red lines. The PC patches, obtained in austral summer 2010/2011 year are presented in a green hatch color. Figure 2, presents a superposition of maps made with the same methodology, but using different GPS receivers. The two maps were designed with points obtained using the Stop and Go method which is able to obtain centimeter precision. We can see differences between the two maps. In the quadrant located at the longitude 428.000, 429.000E and latitudes 3.113.500, 3112.500N, there are 3 patches of PC 2005 which are not superposed with the PC 2011. In the same quadrant, they are almost 6 PC of 2011 which are not superposed with the PC 2005.

Discussion

The overlap of PC can indicate that both represent the same communities. The absence of patches in a map and a presence in another can indicate that the vegetation 2003 was retracted from 2003 to 2010. This paradigm can be explained with the difference of obtaining the two maps. The construction of the contour of patches over a photographic image can generalize a big area like a plant community which can have other patches from another PC in it. To obtain the 2010 vegetation, it was necessary to make a survey walking around all the patches. Each patch had several points, which connected to form the shape. To do this walk is very important that the surveyor has the care to measure points at their limits between the vegetations and other themes. The limits are not sharply contoured and it is possible for there to be some limit confusion. There is a tendency to translate the paradigm to encircle the patches. To solve this problem, it is necessary that the surveyor has training to identify superficially which species is presented at each location of the study. The identification of the transition between presence or absence of plants.

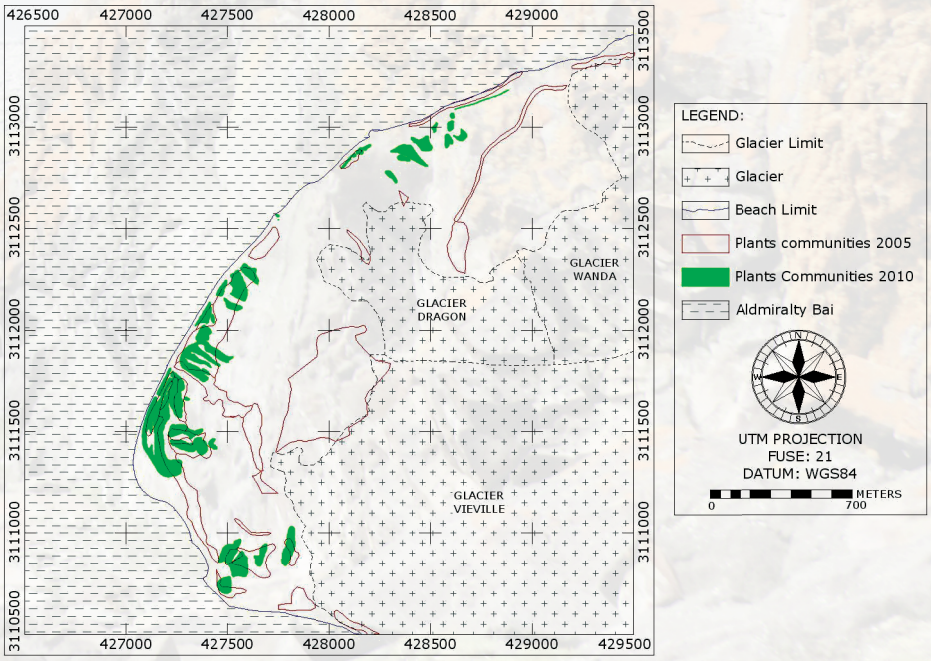

Figure 2. Overlapped maps of Hennequin Point.

Figure 2 can suggest that the 6 patches have grown over the last 6 years or the patches were covered with snow in 2004/2005 austral summer, implying that they were not found by the surveyor. We have some patches superposed with the same shape. Due to the fact that they are not in the same position can be explained by a cartographic problem. The latter problem occurs frequently in other areas of the map.

Conclusions

Regarding the survey methods we need to study more and collect more data for further comparisons. We can use Satellite Images with high spatial resolution to compare places in temporal evaluation. Probably the methods using photography and satellite images georeferenced can generalize the patches. Surveys made from Stop and Go methods need more experience on the part of the surveyor and the limits between the schemes cannot be precisely delineated. Differences of on average 2 or 3 meters can be considered insignificant. The GPS L1 or L1/L2 receivers show the highest precision to build the patches.

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