

**The cartography of the Amazonian coast by remote sensing (PROCLAM project):
methodological context and limitations**

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Abstract. PROCLAM project proposes to realize a linear cartography of the littoral located between the Amazon (Brazil) and Maroni (French Guiana). This cartography rests on an assembly of more than 60 satellite images (SPOT and ENVISAT). The space coherence of this cover will depend on a several methodological limitations which will have to be solved. It will be a question in particular of limiting the geographical positioning distortions at the end of the assembly line and of smoothing the radiometric differences. Lastly, acquisitions of the images should be ideally carried out at the time of identical tidal conditions.

Keywords : remote sensing, image assembling, linear cartography, image processing, littoral, Amazon.

1. Introduction

PROCLAM program (PROjet de Cartographie des Littoraux AMazoniens) proposes to carry out a cartography of the coastal landscapes under Amazonian influence, between the Amazon mouth, Brazil and Maroni mouth, French Guiana. This program, financed on European funds (INTERREG) gathers French (IRD, UAG) and Brazilian (IEPA, UFPA) partners. The project rests on an initial mosaic of more than 60 SPOT and ENVISAT images which acquisition already poses a several methodological questions presented in this article.

2. Geographical context

The littoral located between the Amazon (Brazil) and Orinoco (Venezuela) is dominated by a muddy context and the coastal dynamic is one of highest in the world. The morphodynamic process of this coast is directly under the influence of the sedimentary provisions coming from the mouth of the Amazon, distant of only 400 kilometers of the Oyapock river (French Guiana). The Amazonian mud, plated at the coast under the double influence of the north-Brazil current and of a moderate trade wind swell (Lefebvre et al, 2004), circulates along the coast in the shape of individualized mud banks. On the mud bank, colonization by the mangrove is massive. At the contrary, in the inter-bank situation, the mud dismantling by the swell causes a fast erosion of the coastline. In French Guiana, this dynamics poses serious problems of country planning, for the urban and balneal installations (Cayenne), the harbour access (Kourou) and the agricultural polders (Mana) (Dolique, 2004). Therefore, a better knowledge of the coastal environment from a complete linear cartography is necessary.

3. PROCLAM project

PROCLAM project aims at developing an Amazonian coastal cartography (ecosystems, human occupation, vulnerability) for optimizing the management of these environments. The methodology, based on techniques of satellite remote sensing, will be established jointly by French and Brazilian scientific teams. A first mosaic of natural colors images will be carried out, starting from about sixty SPOT 5 images with a 5 meters resolution, between the Amazon and Maroni. We will study the possibility of carrying out one second cover at the end of the project on a purely comparative basis. We will complete the initial cover by ENVISAT radar acquisitions. In the long term, this mosaic will be continued to the mouth of Orinoco. The data acquisition process will be done via the SEAS reception station located in Cayenne. The final cartography will be produced to the 1: 250.000 scale. Eight priority zones of interest will be the subject of a more detailed cartography (SPOT 5 P+XS with a 2,5 meters resolution) integrated within a geographical information system (GIS) into four principal layers (background picture in natural colors, ecosystemic classifications, anthropogenic borrows, environment vulnerability by indices realization), for a cartographic produce at a 1: 50.000 scale.

Transfer of results towards the managers, decision makers and users of the littoral will be realized in the form of a bilingual scientific book (French and Brazilian) on the remote sensing applications of the Amazonian coastal ecosystems study, as well as a methodological guide for the use of geographical information for coastal management.

4. Methodological questions

The realization of a linear mosaic covering 1600 kilometers, using a satellite images assembly presents several geometrical, temporal and radiometric problems.

The orthorectification of the images requires a significant number of fixed and reliable setting points. However, on certain areas, Amapa in particular, the number of locations points is limited and the maps references are not all perfectly usable. At the end of the assembly line, the induced error of positioning is likely to be important (higher than 50 meters).

In order to have a perfect space continuity of the intertidal zone, necessary to the cartography of the mud banks, all acquisitions will have to be carried out with a low tide level. However, dates and hours of the images acquisition will not be controlled. Consequently, we are likely to be confronted with inconsistencies of space linearity to the land – sea interface.

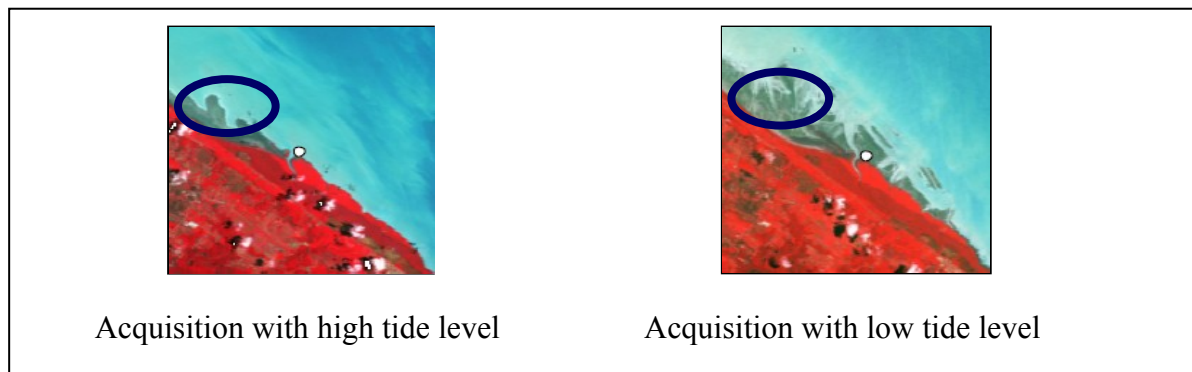


Figure 1 : Difference in intertidal zone recognition between high and low tides.

The cloud cover is another problem to deal with during SPOT 5 acquisition. Amazonian basin and Guyanas plateau are well known, like the majority of intertropical areas, to be very cloudy. Thus, data acquisition needs to be optimised during the dry season (from July to November), and some operations of data fusion will be used to resolve the problem of cloud masking with optical imagery.

Radiometric corrections from SPOT 5 images will be realised in order to have a homogeneous dataset. These corrections are necessary to resolve the differences of conditions during the data acquisition (angle, meteorology...).

The assembly of the 60 SPOT 5 scenes will represent an important step to the map production. Different methods will be tested with several softwares in order to compare and choose the best results. Radiometric and geometric corrections are fundamentals to produce an homogeneous mosaic of images.

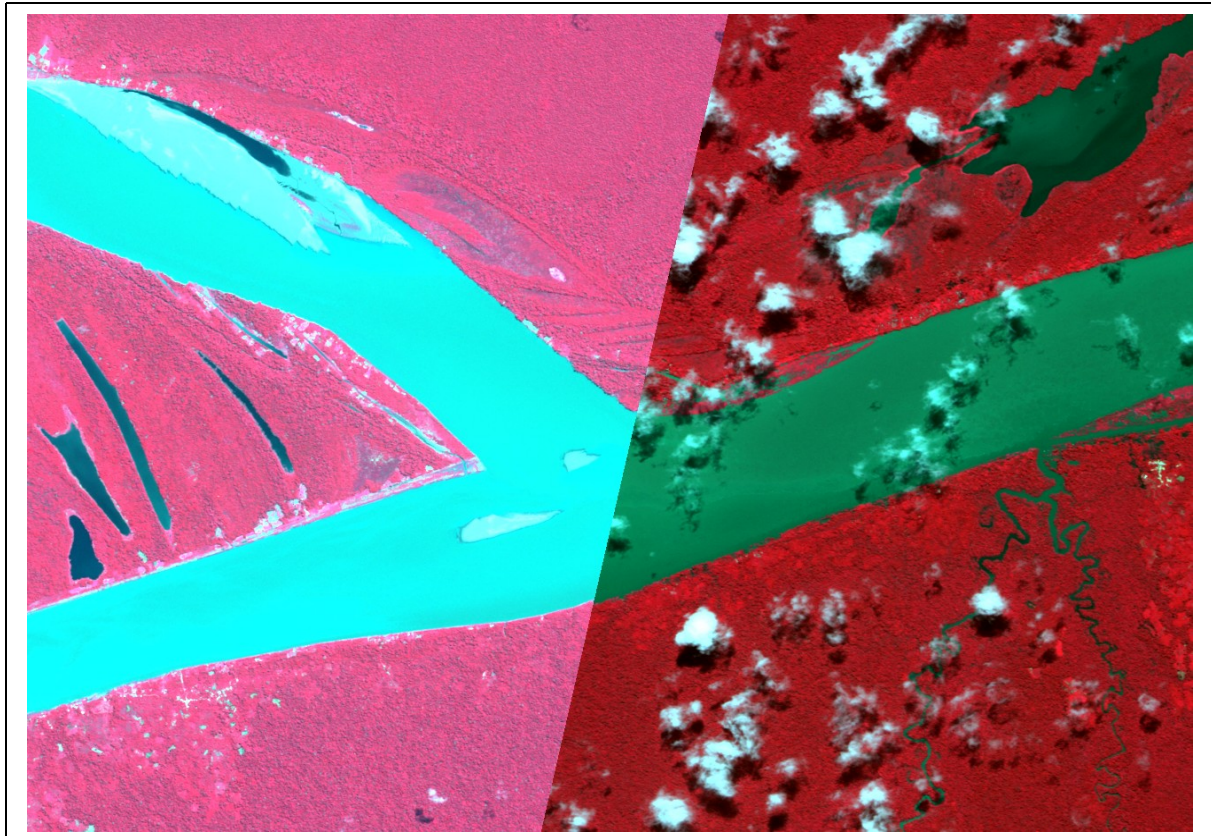


Figure 2 : Radiometric variations which disturb the space continuity, obtained after the assembly of two SPOT images acquired on different dates (IRD, US ESPACE).

5. Conclusion

The assembly of a great number of satellite images in order to carry out a linear cartography on a long distance (1600 kilometers) poses several methodological interrogations. Development of tools for geometric and radiometric corrections will be necessary to obtain a coherent cartographic result.

6. References

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