(10 m of resolution), with themultispectral SPOT images of October 23, 1999 and of October 31, 2002 (20 m of resolution). This permits to obtain an image richer simultaneously in spatial and spectral information (Figure 4). The fusion is most certainly an important manipulation to realize in the case of such a study, but we realise that the panchromatic image brings noise on the Spot XS image and this information is very difficult to analyse in the classification process.

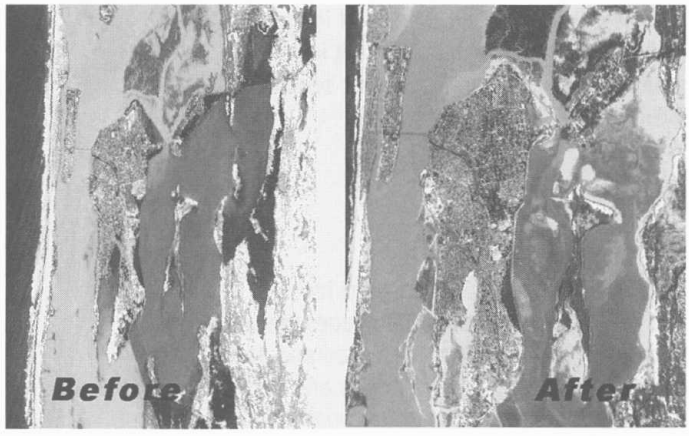

Figure 4: Fusion process between SPOT image (23/10/1999 and 16/01/2001)

The Classification process

The first unsupervised classification process is a method of reiterated classification and this process does not lean on any exterior data. The pixels are regrouped according to the method of minimum distance. The K-Means unsupervised classification method has given satisfied results. It is based on the calculation of classes to obtain a result distributed regularly in the data space, then iteratively regroups the pixels according to the class the more near using the method of minimum distance. From the great classes obtained in a coarse way, we refined the classification with the method of supervised classification (Figure 5).

A standard supervised maximum likelihood classification was carried out using the ENVI image processing system. A total of five spectrally different classes are identified corresponding to spectral variability in the image. Differences on water reflectance are caused by turbidity and water depth and presence of varying amounts of green vegetation. Training and test areas were defined using field observations and delimitation carried out from a visual interpretation of SPOT images.

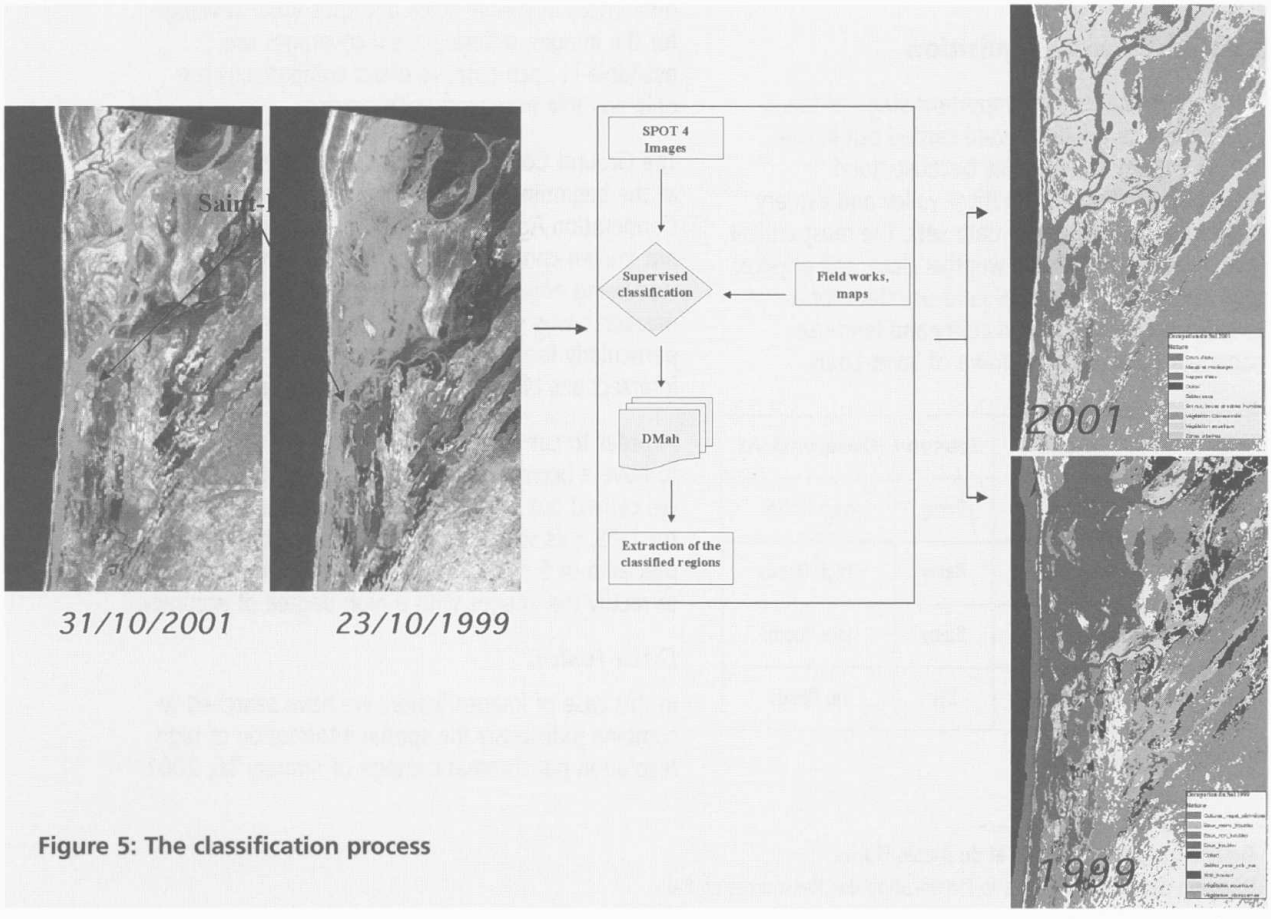

Figure 5: The classification process

MAPPING FLOOD EXTENSION AROUND THE CITY OF ST LOUIS

The relevance of the study has been accentuated by extensive flooding in 1999, when the greatest river flow in 30 years was reported. Because of exceptionally high rainfall in Fouta-Djalon in the rainy season of 1999, peak flow at Bakel reached 4440 m^3/s (IRD—Institut de Recherche pour le Développement, 2001). The result was the destruction of many villages and irrigation infrastructure. Substantial parts of low lying Saint-Louis by the Atlantic Ocean was struck by flooding. Man-made factors contributed to the seriousness of the event. Dikes constructed along the river channel to protect populations hindered or delayed up-stream flooding of the wide river valley, exacerbating problems downstream (Figure 6).

Figure 6: A view of flooded area in Saint-Louis in October 1999

Cartography of flooded area in October 1999

The cartography of flooded surfaces permitted to isolate the different regions reached by the flood in October 1999. It is a multi-temporal approach which consists in comparing the level of water surfaces between the flooded period and the normal period. The characteristics of the 2 multispectral SPOT images used are presented in the table below.

We took as reference the 2001 image, because it has the same seasonal and temporal characteristics that the 1999s image, except only that it was acquired in a normal period with out floods. Figure 7 shows satellite imagery of the lower estuary around the city of Saint-Louis during the flood period in October 1999 (left) and during the normal period in 2001 (right).

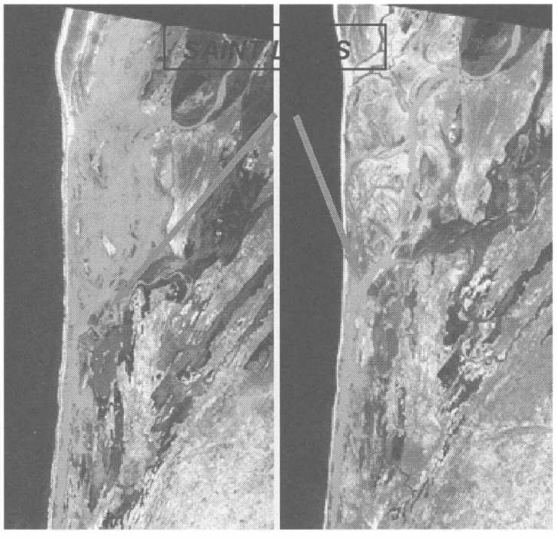

Figure 7a: Satellite Imagery of Senegal River Lower Estuary, Flood conditions in October 1999 (left) and no flood conditions in October 2001 (right)

Date	Mode	Season	Observations
23 10 1999	XS 4	Rainy	High flood
31 10 2001	XS 4	Rainy	not flood

Table 2. Characteristics of multispectral SPOT images