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Earth Observation Based-Flood Monitoring in the Senegal River Valley and Estuary

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The Senegal River basin is located in West Africa and occupies an area of roughly 300,000 km². The entire basin, including the upstream catchments is drained by the 1700 km long Senegal River and its tributaries. Hundreds of thousands of people live along the Senegal river which rises in the Fouta-Djalou mountains of Guinea and flows north towards the edge of the Sahara desert before swinging west to empty into the Atlantic Ocean.

The relevance of the study has been accentuated during flooding period in 1999, when the greatest river flow in 30 years was reported. Because of exceptionally high rainfall in Fouta-Djalou in the rainy season of 1999, peak flow at Bakel reached 4440 m³ /s. 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.

In the Senegal River valley and estuary, poor and socially disadvantaged groups are usually the most vulnerable and affected by floods. These disasters, in turn, are a source of transient hardship and distress and a factor contributing to persistent poverty. For example, the floods that swept through Senegal between January, 9 - 11 2002 led to the loss of 28 lives, with over 100 000 other affected. A damage assessment revealed that an estimated 105 471 head of livestock had perished and 13 993 homes here demolished. As much as 581 ha of crops were washed away. Approximately 1537 tons of rice was also destroyed. Further downstream, Saint-Louis, the former capital of Senegal, experienced large damages due to inundation of areas built up during the dryer years in the 80's.

Flood impacts have been severe during these last year because of the high levels of vulnerability and low levels of resilience of the population, the lack of adequate physical protection infrastructure and changing flooding patterns

due to environmental change and the impact of the dam's structures. Thus, to attenuate the impact of the natural disasters on the poor populations, it is important to undertake in-depth studies on the relation between disaster and poverty. Our project tries to tackle this question in the Senegal River basin by using space technology to map the floods extension and thus to identify area and populations which are touched or which are in danger. Remote Sensing, DTM and GIS seem to be powerful tools for combining important information for a better comprehension of the floods and the characterization of surface qualities in the estuary. The establishment of this project provided a beginning of coordinated approach to a flood mitigation strategy for the Senegal estuary and lower valley. Since 1999, the local scientist community and local authorities try to made good progress in addressing the existing flood threats in the area.

By a multi-temporal approach, we established the qualitative and quantitative impact of floods on the various geographical objects, a detailed cartography of land use during the flooded period in 1999. The constitution of a tool of decision-making aid makes possible to have information relating to the limits reached by the flood, the surface of flooded surfaces and to detect the more exposed zones (the most reached) in order to establish a hierarchical map according to the percentage of exposure to the risk of the geographical objects touched by the floods (populations), road infrastructures and tracks, medical and social infrastructures, perimeters of cultures (agriculture), etc.

This study meet a double aim: on the one hand to better include/understand the dynamic of the floods in the estuary, on the other hand to produce documents for early alarm in direction to the authorities and to place at their disposal tools of decision making. Its purpose was to provide a preliminary approach that can be used as a demonstration of the capabilities, applications and advantages of satellite images, and as a guide for future investigations. Remote Sensing technology has its special superiority and potentiality for flood monitoring and assessment, so it has been applied for this purpose in this study, especially for the disaster resulting from floods.